MetroWest

Portishead Branch Line (MetroWest Phase 1)

TR040011
Applicant: North Somerset District Council

8.7 Level Crossing Risk Assessment Report – Ashton Junction

The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009, regulation 5(2)(q)
Planning Act 2008

Author: Network Rail
Date: November 2019

Document Purpose

This technical document was produced by Network Rail as part of the Governance for Railway Investment Projects stage 3 option selection design and technical assessment, in accordance with Network Rail document formatting requirements.

The document assesses the impact of the DCO Scheme proposals on the existing Ashton Junction Highway Level Crossing.

Document Appendices

Appendix 'Ashton Junction Level Crossing Risk Assessment 13th November 2017 Sotera Risk Solutions Limited' was produced by Network Rail for the BASRE project in 2017, rather than for the DCO Scheme (MetroWest Phase 1). The content of this Appendix includes assessment of the DCO Scheme proposals based on the detail available at the time in late 2017 and some aspects of the proposals have subsequently been superseded. This did not have a material impact of the subsequent assessment undertaken and reported on by Network Rail in the main document in December 2018.

Appendix 'MetroWest Phase 1 Appendix N of the Transport Assessment – forms part of the Transport Assessment (Doc 6.25, Environmental Statement, Volume 4, Technical Appendices, Appendix 16.1: Transport Assessment – Appendix N, Ashton Vale Road)

Level Crossing Risk Assessment Report

Ashton Junction MCB CCTV

ver4.2, December 2018

Ashton Junction MCB CCTV viewed from Ashton Vale Road. Beyond the crossing is the junction of Ashton Vale Road and Ashton Gate Underpass/Winterstoke Road with Ashton Gate Stadium in the background

Issued by Network Rail Western Route, December 2018

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CONTENTS

INTRODUCTION

Background

1 Currently, the Portishead Branch (POD) is a lightly-used freight line extending between Parson Street Junction and Portbury Dock. Freight operators have paths granted for up to 25 movements per day, but on average only two or three trains run in any 24 hour period and these are generally outside the times of peak road traffic.

2 The only public road level crossing over the POD is where Ashton Vale Road, an all-purpose highway, crosses the railway. The level crossing, named Ashton Junction, requires the use of a manually-controlled CCTV type and it occurs close to the road junctions of Ashton Vale Road and Ashton Underpass/Winterstoke Road. As Ashton Vale Road is the only means of access for a large commercial estate, the level crossing presents an impediment to traffic flowing to and from from that estate.

3 At present levels of rail use the level crossing presents a minimal interruption to the flow of traffic as barrier downtimes are relatively infrequent and of short duration. However, the proposal to increase rail traffic will significantly increase the number of occasions that barriers are down throughout the day.

Reason for this risk assessment

4 It is proposed to introduce an hourly passenger service on the POD branch in addition to the current level of freight paths under the Metro West Phase 1 scheme.

5 This risk assessment will consider the impact of these changes to Ashton Junction MCB CCTV level crossing.

DESCRIPTION OF THE SITE

Crossing details

6 Ashton Junction is a Manually Controlled Barrier with CCTV supervision (MCB-CCTV) type of level crossing. Equipment of standard design is provided, including two pairs of lifting barriers which completely close off the highway when lowered, audible warning for pedestrians, flashing red traffic signals and approach traffic signage.

7 The line of route is the Portishead Branch (POD) in the Western route and the mileage of Ashton Junction MCB CCTV is 121m 17c.

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8 The POD is a single-track branch line except for a short section (approximately 34 chains) of double track close to Parson Street Junction. Permissible train speed is limited to 30 mph. There is also a 3 mile disused section of the POD not currently in Network Rail’s ownership which is to be brought back into ownership and operation as part of Metro West Phase 1.

9 The Ordnance Survey Grid Reference for the crossing is ST567713 and the postcode is BS3 2HR.

10 The local authority is Bristol City Council.

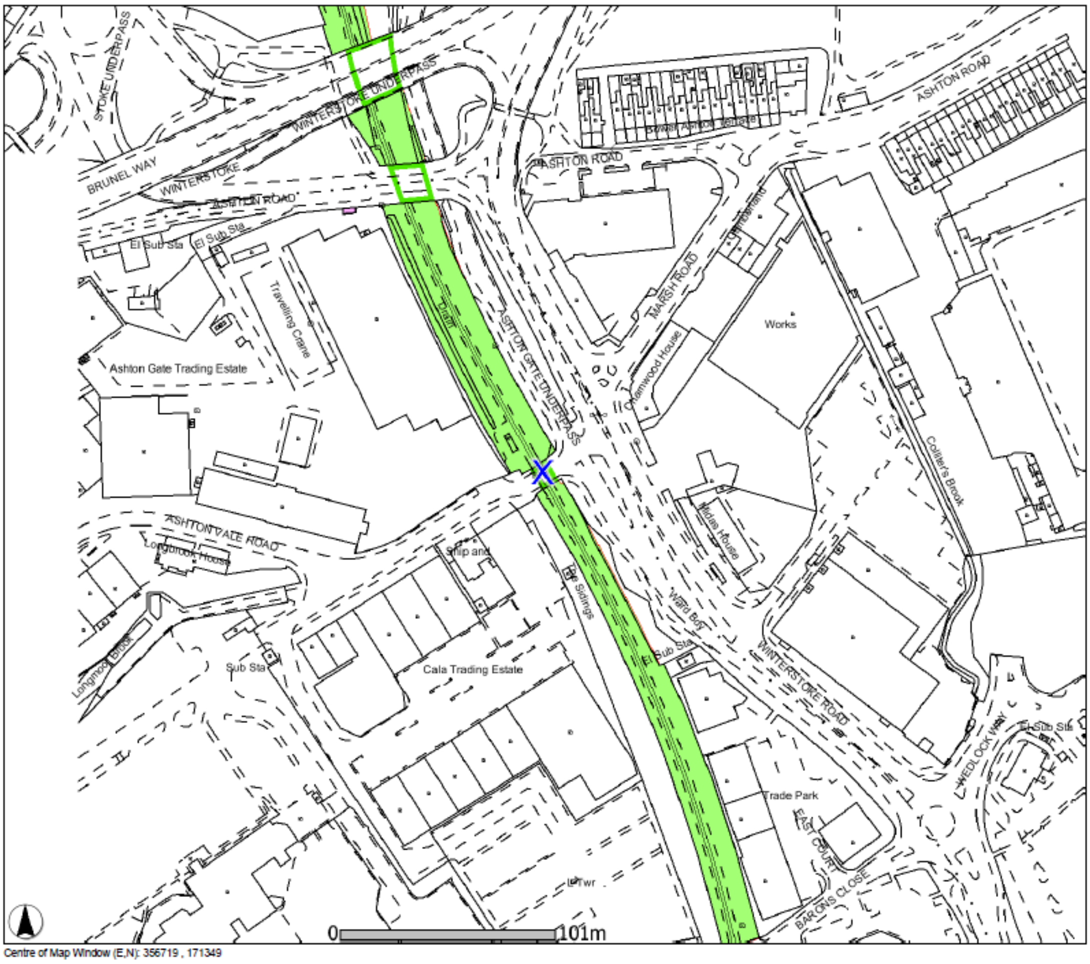
11 The crossing is controlled by the Temple Meads duty signaller based at the Thames Valley Signalling Centre located at Didcot.

12 The POD is not electrified.

Ashton Junction MCB CCTV viewed from Winterstoke Road.

The crossing's environment

Aerial photograph of the Ashton Gate area of Bristol



Map of Ashton Gate area showing Ashton Junction MCB CCTV level crossing (as the blue cross)

13 For road traffic, Ashton Junction MCB CCTV is approached from the west along Ashton Vale Road only. From the east the level crossing is close to the complicated junction of Ashton Vale Road and Ashton Gate Underpass (northbound single lane)/Winterstoke Road (two-way road).

14 Ashton Vale Road is a two-way public road maintained by Bristol City Council.

15 There are no distinguishable gradients on Ashton Vale Road, and the plated speed limit on the highway up to and over the crossing is 30 m.p.h.

16 The junction of Ashton Vale Road and Ashton Gate Underpass/Winterstoke Road occurs only 20m from the eastern edge of the level crossing. Within 200m to the west of the crossing there are several entrances to busy commercial premises and to the immediate west of the crossing is a construction site compound.

17 The road approaches are typical of a heavily-used urban carriageway.

18 As an MCB type, Ashton Junction level crossing has road traffic light signals (commonly known as wigwags) which are used to control road traffic and to convey the 'Stop' instruction to road users, together with a pair of barriers on each side that completely fence the railway when lowered. As such, MCB provides the highest form of level crossing protection. The adjacent road junction also has road traffic lights (red, amber, green). The traffic lights (red, amber, green) controlling traffic entering the road junction from Ashton Vale Road via the level crossing are located on different sides of the crossing as well as different sides of the road. The lights controlling traffic entering from Ashton Gate Underpass are set in a filter lane and are both in front of a road user before the user reaches the wigwags.

19 There is a new flyover accommodating a highway crossing the POD on Winterstoke Road. This has been constructed for the Metro Bus scheme. It is confirmed that this interface does not have any impact on the current or proposed railway scheme and any associated works to Ashton Vale Road Level Crossing, as the design of the flyover is curved to clear the railway by 7.2 metres, preventing any gauging or level crossing visibility restrictions. Additionally the flyover assists with reducing congestion between Winterstoke Road and the Cumberland Basin.

A photo of the new structure is shown below:

Local properties, businesses and amenities

20 Ashton Gate is a busy, urban district and Ashton Vale Road serves a large, mixed commercial estate. In fact Ashton Vale Road is the only means of entry and exit to and from the estate for vehicles.

21 There are approximately 40 companies trading within the estate including a large car auction, a coach hire company, a steel fabricator, a timber supplier, plumbing suppliers, and a catering supplier.

22 The pre-eminent attraction in the area close to the crossing is Bristol City FC's Ashton Gate Stadium.

Rail approach and usage

23 The train count, as used in the latest 'live' risk assessment carried out on 6th June 2018, was as follows; Passenger trains - nil (0), Freight trains – two (2). This is a notable drop from the freight traffic that has operated in the 15 years or so since the crossing was reconstructed and the POD was reopened.

The latest 24hr, nine-day road traffic census commissioned by Network Rail and used for the June 2018 was carried out at the crossing by Sotera 26th August and 3rd September 2017. Average weekday road vehicle count over that period was 3,120. The census was extended to cover 12:00 – 24:00 on 25th August, a matchday at Ashton Gate stadium. This was input to ALCRM as a 2nd census alongside the main one.

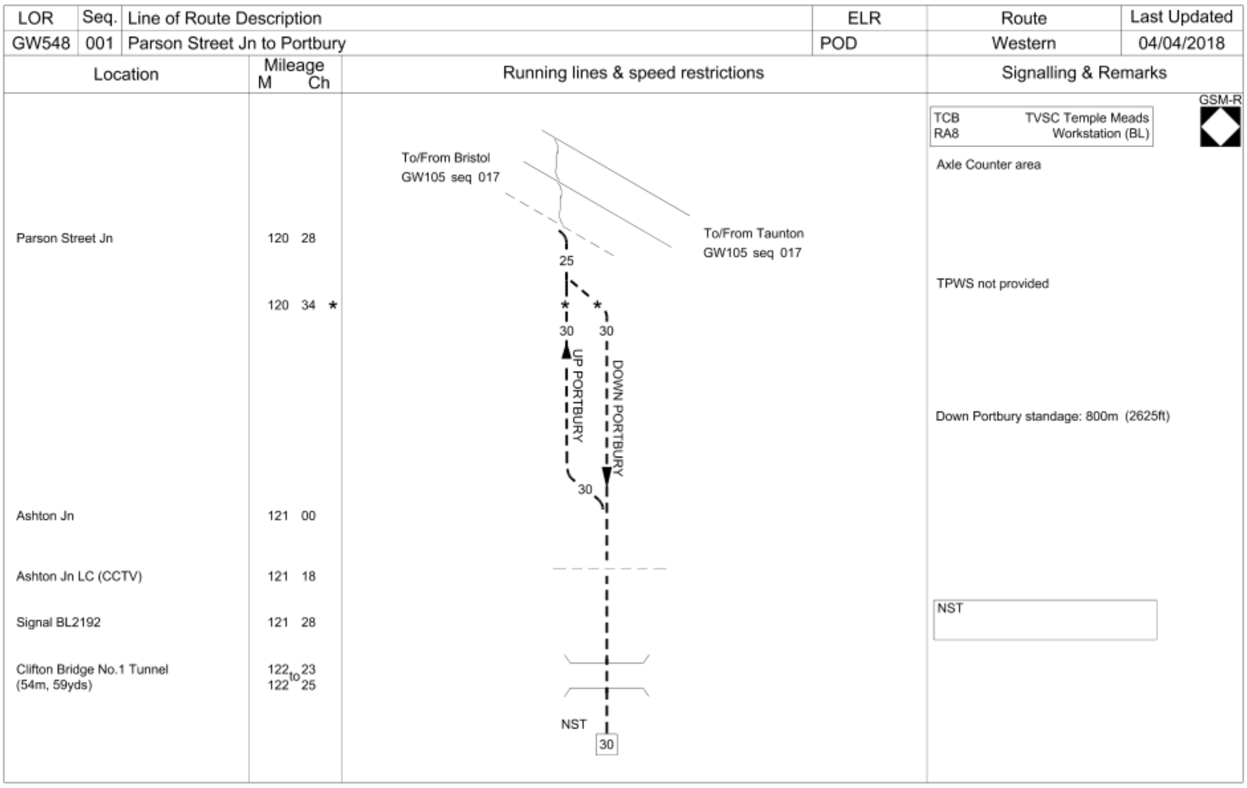
More recently, a traffic census commissioned by the West of England Councils took place between 15th and 28th March 2018. The results of this count did not include a sufficient breakdown of vehicle types used for ALCRM input, so this census has not been modelled. The daily average total counted (3,358 vehicles) was similar and while the quantified risk scoring in ALCRM is slightly different it has no bearing on the risk judgements or the optioneering.

24 As a dead-end branch line, the POD is not used as a diversionary route.

Future Development

25 MetroWest introduces an hourly passenger service in each direction along the POD under the MetroWest programme. For level crossing risk 'optioneering' purposes, Network Rail assumes that two passenger trains will operate over the crossing per hour during the time the line is open with a total of up to 50 trains per day, plus up to 25 freight trains per day operating at some point in the foreseeable future, making a 'worst-case' total of 75 trains.

26 The increase in rail traffic will have a significant impact on the barrier down-times. On average there will be three to four activations in every hour. Each activation requires the barriers to be lowered for typically 120-180 seconds. This represents the total road closure sequence from the amber wigwag signals shewing to the barriers rising behind each train.



Extract from the Sectional Appendix, Parson St. Jn to Clifton Bridge No. 1 Tunnel

Reported incidents at the crossing since 2012

Incident date	Fatalities	Collisions	Barrier strikes	Near misses	Other
11/01/2012	N/A	N/A	Car struck barriers	N/A	N/A
09/11/2012	N/A	N/A	N/A	N/A	Signaller observed children bending barriers
20/03/2013	N/A	N/A	Van jumped the lights and clipped barrier	N/A	N/A
10/07/2013	N/A	N/A	Car transporter struck barrier	N/A	N/A
14/08/2013	N/A	N/A	Vehicle struck a boom resulting in superficial damage	N/A	N/A
02/11/2016	N/A	N/A	Lorry hit and damaged the barriers	N/A	N/A

27 The recent history of incidents at the crossing (above) indicates that vehicles striking the barriers is the most frequent incident-type. There were five incidents of barrier strikes by vehicles (1 x car, 1x van, 1x ‘vehicle’, 2 x HGV) between 2012 and 2017 though the information available does not indicate whether any of those vehicles then entered the protected area of the crossing, except for the incident where the van jumped the lights.

28 However, it should be noted that even though five incidents of barrier strikes in such a busy environment seems a low number, an average of one barrier strike per year, the barriers are only lowered sporadically a handful of times per day and the times that the barriers are lowered tend to be mostly during off-peak and night-time road traffic flows.

29 If the barriers are to be lowered 20 times, or more, per day as a result of the MetroWest initiative, with a significant number of lowerings during times of peak road traffic flows, then it is reasonable to suggest that the number of deliberate misuse incidents will also increase.

OPTION ASSESSMENT

Blocking-back and other residual risks

30 Ashton Junction level crossing is situated adjacent to a busy signalised road junction off of the A3029 into the Ashton Vale industrial estate. A potentially critical result of this is ‘blocking back’, whereby road traffic queues foul the railway and impede prompt lowering of the barriers when required. While arguably not a great safety issue in terms of collision/ injury risk, given the protection characteristics of full-barrier controlled crossings, blocking-back increases signaller taskload with the need to watch the monitor very closely and prepare to pause barrier travel in order to avoid barriers striking objects or people. The more significant risk with blocking-back at this type of crossing is to train performance, caused by late clearance of the protecting signals resulting from anything that might impede the closure sequence, at worst prolonged delays of hours or even days if deliberate misuse causes damage to barrier or other equipment.

31. Blocking-back had been a known problem before the POD was mothballed in the mid-1980s, at which time the crossing was controlled from a signalbox adjacent to it. Under the project to reopen the POD in 2001, Railtrack and Bristol CC cooperated to design special controls which interlink the road junction traffic signals with the crossing sequence. The interlinking aims to mitigate blocking-back by placing a ‘priority call’ in the road junction traffic light controls such that when the signaller initates the crossing sequence road users get a clear exit out of Ashton Vale Road and are prevented from turning left into Ashton Vale Road. This allows any queues at the junction with Winterstoke Road to disperse and clear the crossing. Only very few crossings in the country have interlinked lights.

32. A known but less-frequent contributor to blocking-back is when vehicles queueing to exit the Ashton Vale estate obstruct entrances to nearby commercial premises

thereby impeding the flow of vehicles entering the estate and forcing vehicles further back in the queue to stop on the crossing. This contributes to the risk profile of the level crossing. In recognition of the significant increase in crossing closures under MetroWest, the highway minor works proposed by the project are expected to mitigate these risks.

33 Exiting from the commercial estate a user encounters normal road traffic lights in addition to the level crossing-specific road traffic lights (wigwags). When the wigwags show flashing red lights the normal traffic lights show (non-flashing) red. However, when the normal traffic lights change to green it is not obvious to a user that the wigwags cannot show red and the user may be trying to look for an indication from the wigwags at the same time. The view of road traffic lights is further complicated by the visually cluttered view from both sides of the crossing, but from the Ashton Vale Road towards Winterstoke Road direction in particular.

Census count used for assessments

34 A summary of figures from recent road traffic census counts are shown below:

	A	**B**	**C**	**D**
	24hr census March 2018	**24hr census Aug/ Sept 2017**	**12hr census match-day Aug 2017**	**24hr census 14th Sept 2015**
Cars	*	1940	1617	2500
Vans / Small Lorries	*	816	301	500
Buses	*	8	31	0
HGV	*	325	185	489
Pedal / Motor Cycles	*	164	104	180
Pedestrians	550	769	2161	300
Horses / Riders	0	0	0	0
Animals on the hoof	0	0	0	0
Tractors / Farm Vehicles	0	3	0	0
TOTAL vehs	**3655**	**3256**	**2134 #**	**3969**

Recent road traffic census counts over Ashton Junction Level Crossing

** - not broken down by vehicle type*
 # - ALCRM calculated this to be equivalent to 2378 vehs over 24hrs

35 The existing ALCRM 'live' (routine) risk assessment in place for the crossing was undertaken on 6 June 2018. For the purposes of modelling a base on which to run various options for this risk assessment report, the June 2018 live assessment has been run with 'B' above as the main census applying for 93% of the year (non-matchdays) alongside 'C' applying for 7% of the year as a 2nd census. The live assessment has not been run using the more recent March 2018 figures (Census 'A') as they lack a breakdown by ALCRM vehicle type, however for risk calculation purposes the figures are sufficiently consistent with previous censuses and Network Rail is satisfied that the risk scores are robust.

ALCRM risk score outputs

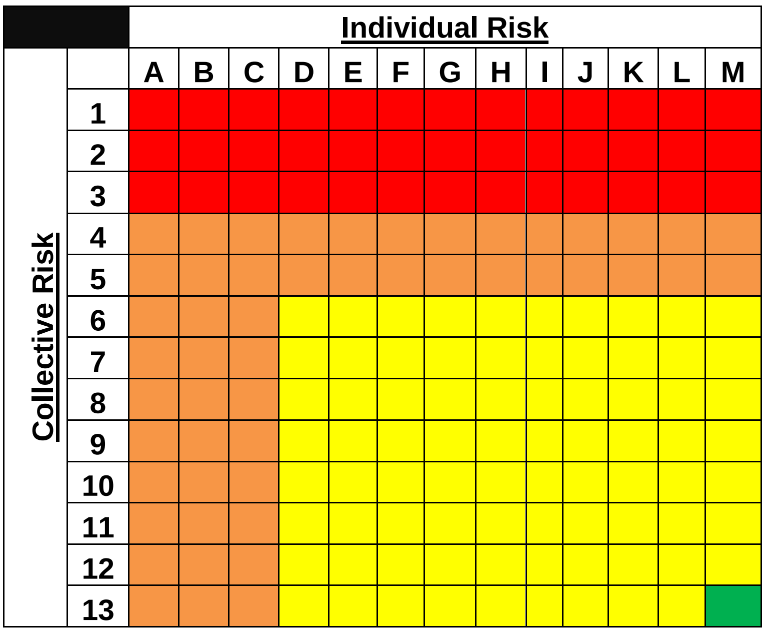
36 ALCRM results take the form of two main quantitative risk outputs; the Safety Risk Score and the Fatalities and Weighted Injuries index (FWI).

The Risk Score measures Individual and Collective Risks - when compared with other crossings nationally - and allocates a Risk Score categorised as Very Low, Low, Moderate or High. This is illustrated in the matrix below.

ALCRM ranks Individual Risk results as a letter between A and M, (with A being very high risk and M being very low risk).

The Collective Risk is ranked as a number between 1 and 13 (with 1 being very high risk and 13 being very low risk).

The Fatalities and Weighted Injuries index indicates the probability of a fatality or serious injury occurring at a crossing every year. The lower the FWI figure the lower the probability that a fatality or serious injury will occur every year.



The ALCRM Risk Matrix

37 With the risk results ALCRM highlights 'key risk drivers' which have influenced the scoring. The aim of this is to assist decision-makers in understanding what might be behind a score but also in prioritising possible risk control measures. At present, Ashton Junction's ALCRM KRDs are:

Infrequent trains: the tendency for regular users to be complacent where they very rarely (possibly never) encounter the crossing when activated; the higher tendency to be paying insufficient attention and/ or driving too fast to stop short if the crossing activates.

Large numbers of HGVs: a high proportion of such vehicles increases potential for train derailment after collision.

Both of the above KRDs are no surprise given the site conditions.

ALCRM options

38 ALCRM can not only quantify the current risks of the crossing within a 'live' assessment, but can also model proposals for change. Each proposal (or variation on each proposal) is known as an option. A wide range of options can be tested, from changing the crossing's protection type, train speeds/ quantum, upgrades to road or rail approaches/ environment, type and quantum of road traffic etc.

'Optioneering' is a routine exercise that Network rail carries out, using ALCRM to help inform management choices for level crossing risk reduction.

39 Five options have been considered for the Optioneering Exercise relating to Ashton Gate Level Crossing, which are classed as Options 1-5 for ease of identification.

Option 1 is the current 'live' risk assessment dated 6th June 2018, described above and used as the base.

The risk score for the current risk assessment but including match-day figures as a second census at 7%, is J6 [Moderate]. The individual risk is low and the collective risk is moderate.

This is not surprising given the high road traffic usage; the controlled full-barrier crossing is the highest available protection type; and the current very low number of trains per day.

The FWI is 0.000494207, which places Ashton Junction 25th out of Network Rail Western Route's 50 full-barrier crossings in terms of overall risk level.

Option 2 uses same traffic censuses as Option 1 but with Rail traffic quantum increased to 50 passenger tpd under MetroWest plus an assumed worst-case 25 freight tpd (total 75 tpd) and without adding any alternative access across the railway for pedestrians. ALCRM assessed these inputs as having a 'signifcantly lower than average' potential for deliberate misuse compared with other crossings of this type and that assumption stays unaltered in this option.

Compared with Option 1 ALCRM risk score rises from J5 to H4, although remains in the Moderate category. FWI rises to 0.002279378, which as expected is a significant increase on Option 1 and moves Ashton Junction up from 25th to 10th highest risk among Western Route's 50 full-barrier crossings. Pedestrian collective risk is 0.001787913.

ALCRM key risk driver = 'Large numbers of HGVs' remains and, as expected, 'Infrequent trains' is no longer an issue for this or Options 3 and 4.

Option 3 is the same as Option 2 but with the ALCRM-generated deliberate misuse default overidden to higher-than-average to reflect the frequency of activations and road users' (especially matchday pedestrians) unwillingness to wait. Option 3 ALCRM score stays at H4 [Moderate] but overall FWI rises to 0.00262793 which is 9th highest in Western Route's 50 full-barrier crossings. Pedestrian collective risk compared to Option 2 rises to 0.002134744.

Option 4 models the Rail and road traffic levels of Options 2 and 3 but assumes provision of alternative pedestrian access (ramps or steps) at or near the site, with low matchday pedestrian numbers due to Police presence at the crossing to guide pedestrians to use the proposed new access. For this option, the deliberate misuse default was changed back to 'significantly lower than average'.

Risk score remains H4 [Moderate], FWI drops back down to 0.002279378 while pedestrian collective risk returns to 0.001787913.

Option 5 assumes that Ashton Vale Road is stopped up and an alternative road access for the estate is built that enables the crossing to be abolished (with or without pedestrian/ cycle ramps at or near the site of the crossing). This has not been further considered due to the disproportionate costs (£ tens of millions) when compared to the benefit.

40 A summary of the options is shown in the table below:

Option	ALCRM Risk Score	FWI score	FWI change compared with June 2018 (base)	Remarks
1) **Base**: 'live' risk assessment (June 2018); freight-only rail traffic with Aug/ Sept 2017 full census incl match-day	J6 (Orange / Moderate)	0.000494207 (Equivalent to 0.5 fatalities per 10000 years)	N/A	N/A
2) Base censuses; with Rail traffic increase for MetroWest; without pedestrian alternative access (ramps); ALCRM default 'significantly lower than average' abuse	H4 (Orange / Moderate)	0.002279378 (Equivalent to 2.2 fatalities per 10000 years).	361% increase	Cost-neutral for LC; nil expenditure on ramps.
3) Base censuses; with Rail traffic increase for MetroWest, without pedestrian alternative access and without matchday police presence = override to 'significantly higher than average' abuse	H4 (Orange / Moderate)	0.00262793 (Equivalent to 2.6 fatalities per 10000 years).	432% increase	Cost-neutral for LC; nil expenditure on ramps. High abuse element reflects absence of enforcement measures on matchdays.
4) Base censuses; Rail traffic increase for MetroWest with pedestrian alternative access and matchday Police presence = 'significantly lower than average' abuse	H4 (Orange / Moderate)	0.002279378 (Equivalent to 2.2 fatalities per 10000 years).	361% increase	Cost circa £1.5M on ramps; cost-neutral for LC. Matchday policing assumed still to be necessary
5) LC closure by constructing alternative highway access for Ashton Vale estate	M13 (Green / Very Low)	zero	100% decrease	Network Rail's first preference, but cost would be disproportionate to the benefit.

Risk narrative

41 Given that increasing rail and/ or road traffic inevitably increases the risk profile at any level crossing affected, it is no surprise that MetroWest triggers a significant risk increase at Ashton Junction. To put the increase in national context, MetroWest would push Ashton Junction's risk level from 287^{th} to 218^{th} in the 'league table' of 431 MCB-CCTV crossings. There is other contextual information in the detailed BASRE Risk Assessment appended to this report.

42 The best option for Network Rail is to eliminate the risk altogether by permanent closure of Ashton Junction crossing by one means or another. Under Network Rail and Office of Rail & Road policy to eliminate level crossing risk with every 'reasonable opportunity', MetroWest could be deemed that opportunity given the significant risk increase it will cause. However, stopping up Ashton Vale Road can only be achieved by first constructing an alternative access road and the cost of this work (assumed to be over £10M) would be grossly disproportionate to the benefit.

43 The most important change to the crossing brought about by MetroWest, in terms of potential impact on road user behaviour, is the rise in activations from broadly twice per day to twice per hour. At present the crossing very rarely activates during peak road traffic periods, although there have been years since recommissioning in its current form in 2001 when freight trains have run during these times. MetroWest brings the most frequent train service for several decades over this crossing, so it is fair to assume that the vast majority of regular users who will encounter crossing activations there in the future do not currently encounter them at all. Close proximity to the crossing of commercial premises and the busy signalised junction with Winterstoke Road are reflected in existing crossing equipment and signage, designed to mitigate blocking-back. Further highway measures are proposed to be implemented by MetroWest project. The highway traffic impact of the increased activation of the level crossing as a result of the re-introduction of passenger train services is set out in Appendix N of the MetroWest Phase 1 Transport Assessment.

44 Implementing MetroWest will be the first time since the crossing was constructed in its present form in 2001 that blocking-back control measures will be regularly put to the test throughout the day. Frequent blocking-back and deliberate misuse potentially worsen train performance through delayed clearance of protecting signals, and in extreme cases equipment damage and subsequent repair lead to protracted train delays. It is recommended that Network Rail and Bristol City Council monitor efficacy of these measures regularly post-MetroWest 1 introduction, and be prepared to consider further controls if necessary. Public reputation of the new MetroWest service offering could be at risk if the crossing was to become a source of train delays.

45 Turning to the proposed pedestrian access ramp running from the northwest corner of the crossing up onto Ashton Road, the optioneering illustrates ALCRM's limitations in quantifying the effect of this kind of control measure in influencing user behaviour and therefore the crossing-related risk, especially at full-barrier type crossings. ALCRM is not fully capable of modelling how a proposed pedestrian access ramp would mitigate the effects of normal and occasional match-day traffic (with Police crowd control diverting pedestrians onto the pedestrian access ramp) and therefore cannot be used meaningfully to quantify the safety benefit. However, for the purposes of this exercise the ALCRM modelling has assumed that police officers are deployed 100% of pedestrians on matchdays are guided onto the ramp. As the ALCRM optioneering results show, the difference in pedestrian FWI with the ramp compared to without is small.

46 Police deployment on matchdays is likely to entail supervising both the highway at Winterstoke Road and the level crossing, which might not prove practical. Without Police supervision, the ramp may not be attractive to fans arriving at the stadium from Ashton Vale Road, given the additional 300 metres walking distance. Furthermore, on leaving the stadium after the match, it is unlikely that many fans would use the ramp, given its location on the opposite side of the railway, and the additional walking distance, without being directed by Police to do so. The effectiveness of the ramp to reduce the risk profile of the level crossing has been assessed in more detail in the Ashton Junction Level Crossing Risk Assessment, for the Bristol Area Signalling Renewal & Enhancement (BASRE) project, and is appended to this report.

47 The duration of each closure sequence, from yellow light showing to arrival of the train, is a main factor affecting road user behaviour/ compliance. Information from the BASRE project suggests that closures in the order of 120-150sec can be expected at Ashton Junction given train speed and the location of strike-in points. This is within typical closure timing ranges for this type of crossing. Auto-raise is provided, so that barriers consistently rise immediately after each train passes clear without needing the signaller to operate a manual raise control.

48 It could be argued that road closure timings in the order of 2-3min are unlikely to trigger high levels of deliberate misuse incidents, and that even matchday supporters can reasonably be expected to wait for such a relatively short time. The 'next best option' for reducing risk at the crossing, viz constructing a pedestrian access ramp, might therefore give a weak case for implementing, given the estimated cost of £1.5M vs the very modest additional benefits and may not offer value for money.

49 None of the options consider the effect that any change would have on road traffic volumes or flows. ALCRM is an exclusively level crossing risk assessment tool and it is not capable of informing about possible knock-on effects for public highways.

RECOMMENDATIONS AND CONCLUSIONS

50 As a MCB-CCTV, Ashton Junction level crossing on Ashton Vale Road is at the highest level of protection possible for any type of level crossing.

51 The introduction of the new MetroWest passenger train timetable will inevitably have an adverse effect on the risk profile of the existing level crossing.

52 Closing the level crossing permanently would have required an alternative vehicular highway entering and exiting the commercial estate from a different direction than Ashton Vale Road. However, this proposal was not found to be achievable without a very significant additional expenditure and compulsory acquisition of land. There appears to be little or no prospect of closing the level crossing in the foreseeable future.

53 Without considering any possible mitigation for the increase in risk, the introduction of hourly MetroWest passenger services to add to the available freight paths will increase the FWI figure by more than four times. However, putting this in context, Ashton Junction's risk profile would still remain modest compared with the population of MCB-CCTVs.

54 From a purely level crossing safety viewpoint the achievable risk reduction from constructing a pedestrian access ramp is small. There are possibly broader economic/ societal benefits to consider, but these fall outside the scope of this Report. There appear to be clear train performance benefits in policing matchdays, whether or not the pedestrian ramps are built.

55 Network Rail and the WoE Councils should jointly review the effectiveness of the mitigations after MetroWest service starts and if necessary consider implementing further measures.

56 Taking the existing and proposed highway mitigations into account, risks at Ashton Junction crossing are controlled to as low as reasonably practicable.

APPENDICES

Appendix 1: Ashton Junction Level Crossing Risk Assessment – 13th November 2017 Sotera Risk Solutions Limited

Appendix 2: MetroWest Phase 1 Appendix N of the Transport Assessment – August 2018

Risk Assessment for Ashton Junction Level Crossing

Doc: W1069E-SRK-REP-SSD-000001-P01

Rev: Issue 01

Date: 13th November 2017

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REVISIONS

Revision No	Prepared by	Checked by	Issue date	Comments
P01	David Harris	Peter Dray	24/10/17	Draft Issued for review

CONTENTS

ACRONYMS AND ABBREVIATIONS

Acronym	Description	Comments
ABCL	Automatic Barrier Level Crossing, Locally-monitored	
AHB	Automatic Half-Barrier (level crossing)	
ALARP	As Low As Reasonably Practicable	
ALCRM	The All Level Crossing Risk Model	A tool for assessing the risk at particular level crossings.
ARS	Automatic Route Setting	
BAP	Biodiversity Action Plan	
BASRE	Bristol Area Signalling Renewal and Enhancement	
BPM	Barrier Protection Management	A solution for auto-lower crossings that delays barrier lowering should there be a road vehicle underneath a barrier.
BSSR	Bristol South Signalling Re-control	
CBA	Cost Benefit Analysis	A numerical comparison of the monetised advantages and disadvantages of undertaking a particular course of action.
COD	Complementary Obstacle Detector	
CCTV	Closed Circuit Television	
EA	Equality Act 2010	
ELR	Engineering Line Reference	
ERTMS	European Rail Traffic Management System	A system of train control that allows for automatic train protection and cab based signalling.
ETCS	European Train Control System	
FWI	Fatalities and Weighted Injuries	A measure of safety performance where the predicted rate of fatalities and minor and minor injuries are combined into an overall measure of risk.
HGV	Heavy Goods Vehicle	
LCDT	Network Rail Level Crossing Development Team	
LCM	Level Crossing Manager	
LED	Light Emitting Diode	
MCB-CCTV	Manually-Controlled Barrier Level Crossing with CCTV	

Acronym	Description	Comments
MCB-OD	Controlled Barrier Level Crossing with Obstacle Detection	
MCG	Manually-Controlled Gate Level Crossing	
MSL	Miniature Stop Light	Red / green warning light to indicate whether or not it is safe to cross.
NPV	Net Present Value	
ORCC	Operations Risk Control Coordinator	
ORR	Office of Rail and Road	
PHI	Priority Habitat Inventory	
POD	Primary Obstacle Detector	
PROW	Public Right of Way	
RAM	Route Asset Manager	
ROC	Regional Operations Centre	
RLSE	Red light static enforcement cameras	
RSSB	Rail Safety and Standards Board	
RTA	Road Traffic Accident	
RTL	Road Traffic Light	
SAC	Special Area of Conservation	
S&SRA	Suitable and Sufficient Risk Assessment	
SEU	Signalling Equivalent Unit	A measure of signalling cost
SICA	Signal Infrastructure Condition Assessment	An indication of when the crossing would require renewal
SFAIRP	So Far As Is Reasonably Practicable	
SMIS	Safety Management Information System	The database used by the UK rail industry for reporting accidents and near misses
SPAD	Signal Passed at Danger	
SRM	Safety Risk Model	The rail risk model managed on behalf of the industry by RSSB
SSSI	Sites of Special Scientific Interest	
TMO	Trainman Operated crossing	
TMOB	Trainman Operated Barrier crossing	
TOC	Train Operating Company	

Acronym	Description	Comments
TPV	Train Pedestrian Value	A measure of used based on pedestrian usage and train frequency
TVSC	Thames Valley Signalling Centre	
VAS	Vehicle Activated Sign	A sign that illuminates in the event of blocking back ahead, reminding drivers to keep the crossing clear
VpF	Value of Preventing a Fatality	A value used to express safety risk in financial terms
WMSR	Western Mainline Signalling Renewals	
YN, YO, ZN, ZO	Denotes the corner of the crossing.	Y is closest to the Up line; Z the Down line; N is the nearside (for traffic); O the offside.

REFERENCE DOCUMENTS

The following documents have been used to support the production of this report:

Ref	Document Name	Number
1.	Level Crossings: A guide for managers, designers and operators (ORR)	Railway Safety Publication 7 December 2011
2.	Internal Guidance On Cost Benefit Analysis (CBA) In Support Of Safety-related Investment Decisions	ORR, April 2015
3.	Census Report for Ashton Junction Level Crossing (RSK)	Ashton Vale Junction__Report_General_Survey__22092017-1327, September 2017
4.	2019 Timetable: Crossrail DTT (Iteration 5) : Bristol Parkway – Cogload Jn (SX) (Note: this timetable is for two trains per hour per direction so does not reflected the latest MetroWest proposals)	
5.	Bristol Area Signalling Renewal and Enhancement Project: Fringe Specification Stage 4 Ashton Junction NST-R To TVSC CIXL9 VIXL20	SSL/PR045/SIG/SPE/00010 Issue 1.2 24 May 2017
6.	Ashton Gate Level Crossing CCTV MCB Controlled by Bristol PSB	9165-420 Version D
7.	Ashton Junction Level Crossing MCB-CCTV Ground Plan MetroWest Phase 1	W1097B-ARP-DRG-ECV-000505 Revision A02 13/12/16
8.	Ashton Junction Level Crossing Lighting Assessment Report	SSL/PR045/PRJ/LET/215 16th October 2014
9.	Thames Valley Signalling Centre Western Mainline Signalling Renewal Parson Street Junction Area Scheme Plan 5 of 10	11-GW-010/05 Version A3
10.	Thames Valley Signalling Centre Metrowest Phase 1 Portishead/Portbury Dock Line Option 2	BMW/140569/01 Version 0.1
11.	Primary Signalling Infrastructure Condition Assessment Ashton Junction MCB (CCTV) Level Crossing	PSICA Ashton Junction MCB (CCTV) Issue 01 January 2010
12.	LOR WMSR – Bristol Area Signalling Renewal & Enhancements: GRIP Stage 4 Approval In Principle Workload Report	CCD/1181/REP/001/13 Version 2.0 8th January 2013
13.	Bristol Area Signalling Enhancements GRIP 4: Predictive Workload Assessment	CCD/1537/REP/003/17 Version 2.0 28th February 2017
14.	MetroWest Phase 1	

	Pill Station and Ashton Vale Industrial Estate alternative access micro-consultations report	
15.	Network Strategy and Capacity Planning: Capability & Capacity Analysis MetroWest Phase One Portishead Service	Version 1.0 16/06/2017

1 INTRODUCTION

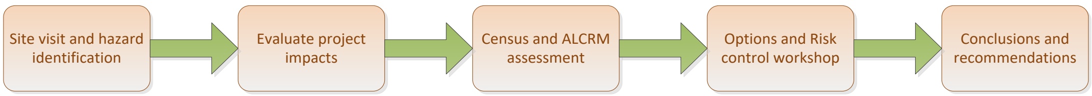
1.1 Background

In 2012 Sotera carried out suitable and sufficient risk assessment of level crossings within the scope of five signalling renewals projects within the wider WMSR scheme. This included the BASRE project that is tasked with renewal of signalling infrastructure in the Bristol area and recontrol to TVSC. The project is predominantly a relock and recontrol project, with limited enhancements most of which are renewals.

It has recently been identified by BASRE that Ashton Junction level crossing, which is within the scope of Stage 4 of the BASRE project, was not included within Sotera's scope of works so no risk assessment had been undertaken.

As a result of this, Sotera has now been tasked by Network Rail to undertake suitable and sufficient risk assessment of the level crossing to understand the risks associated with the recontrol.

Sotera's risk assessment process is structured as below:



The assessment takes cognisance of the impact on the crossing by the MetroWest Phase 1 project, which will reinstate passenger train services between Bristol and Portishead. This will introduce a regular passenger train service over the crossing from 2019. The assessment does not however specifically assess the MetroWest proposals for resignalling and level crossing ground plan modifications, the exact plans and full rationale for which are not known.

1.2 Approach to risk assessment

In order to carry out the risk assessments, Sotera has:

- Reviewed available information pertinent to the level crossing (including, SMIS event data, and input data to the All Level Crossings Risk Model (ALCRM)).
- Analysed national level crossing risk information to compare the main level crossing type options.
- Carried out a nine and a half day traffic census at the crossing to establish the current level of usage by vehicles and pedestrians, and associated issues including blocking back of traffic over the crossing.
- Specified and reviewed assessments of the crossing type options using the ALCRM, based upon the up-to-date traffic census.

- Undertaken a site visit to the crossing to assess its current operation, to determine the existing controls, identify local hazards, to measure distances key to the risk assessment and make a photographic record of any issues. David Harris and Peter Dray (Sotera) carried out the site visit on 22nd August 2017.

- Carried out an initial options assessment which considered the available crossing type options from a safety, cost and feasibility perspective.

- Facilitated a workshop with stakeholders from Network Rail where existing risks and closure and renewal options were discussed with the aim of selecting one or more options to be pursued by the project.

- Prepared this suitable and sufficient risk assessment report. The format of this is quite different from the other such reports Sotera produced for WMSR; this reflects the current good practice for suitable and sufficient risk assessment which has developed significantly since the 2012 work.

2 DESCRIPTION OF THE SITE AND THE EXISTING LEVEL CROSSING

2.1 Current level crossing details

Ashton Junction level crossing is currently a four barrier MCB-CCTV level crossing.

The level crossing is located on Ashton Vale Road, in the Ashton Gate area of Bristol. The crossing has four half-width road barriers and four level crossing RTLs. The RTLs are of LED type, however do not have extended hoods to reduce sun impact. The crossing is close to a complex road junction and there are road traffic lights which control the movement of traffic over the junction; the level crossing is situated within the traffic light controlled area and therefore the road traffic lights are linked to the level crossing sequence such that the road traffic lights are set to red before the normal crossing sequence commences.

At the time of the site visit a MetroBus flyover was under construction on the east side of the level crossing, between the level crossing and the road junction. Because of this work, the left sliproad towards the crossing from Winterstoke Road to the east was closed and there was an entrance into a site office and compound close to the crossing on the west side. There was also a temporary traffic light between the crossing and the junction on Winterstoke Road (on the off-side of the road only) in order to provide the pedestrian crossing facility as the normal pedestrian light was out of use.

There are footways marked on both sides of the crossing.

The line through the crossing is not electrified. Street lighting is provided on both sides of the crossing.

Figure 1 shows the configuration of the crossing, viewed from the west of the crossing (the Down side). The level crossing details are summarised in *Table 1*.

Figure 1 **Current crossing arrangement**

Table 1 **Current Level Crossing Details**

Level crossing name	Ashton Junction
Level crossing type	CCTV
ELR and mileage	POD 121m 18ch
Status	Public road
Number of running lines	1
Permissible speed over crossing (Up)	30mph
Permissible speed over crossing (Down)	30mph
OS grid reference	ST567713
Postcode	BS3 2LF
Road name and type	Ashton Vale Road - minor road
Local Authority	Bristol County Council
Supervising signal box	Bristol SB (B)
Electrification and type	No

2.2 Environment

The crossing is situated in the Ashton Gate area of Bristol. The Ashton Gate underpass and the A3029, Winterstoke Road, are to the east of the crossing; there are business premises, some residences and Ashton Gate Stadium, home of Bristol City Football Club, on the east side of the A3029. There are business and retail premises on the west side of the crossing, including a car auction business and parking for football match days. There is a local cycleway along the A3029, Winterstoke Road, east of the crossing, and along the A370, Ashton Road, north of the crossing.

Usage of the crossing is discussed in *Section 2.4*.

A map of the location is shown in *Figure 2*, and a satellite view of the location is shown in *Figure 3*.

Figure 4 provides the relevant extract from the sectional appendix covering the crossing.

Figure 2 Map showing an overview of the location of the crossing

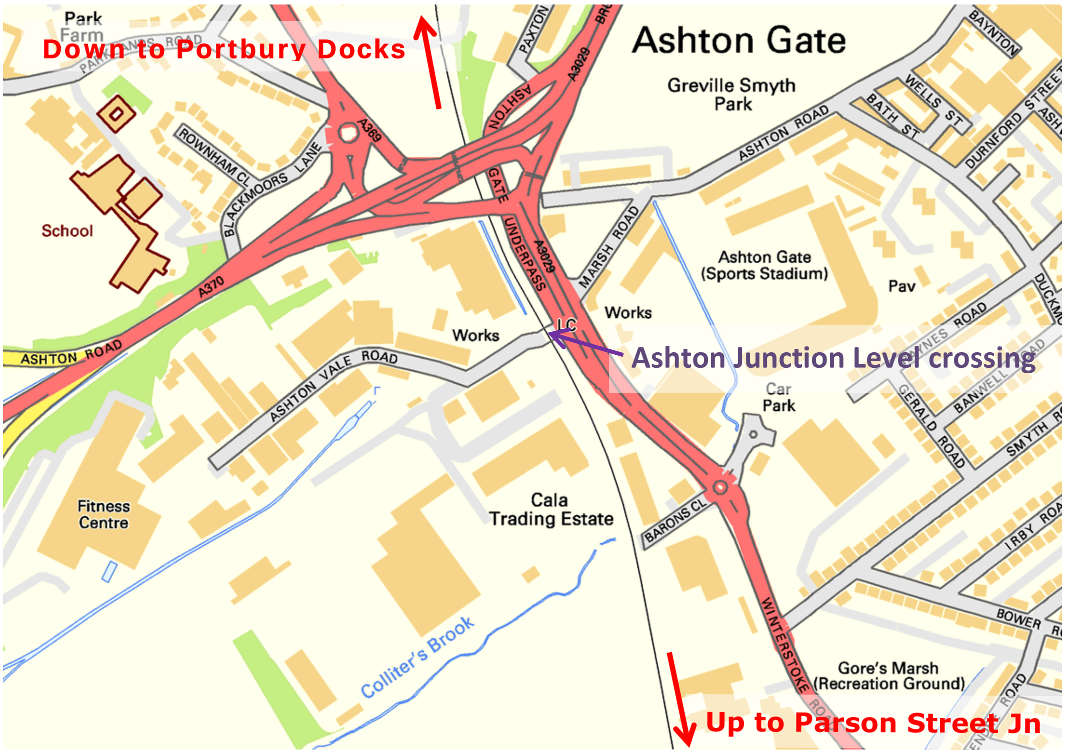
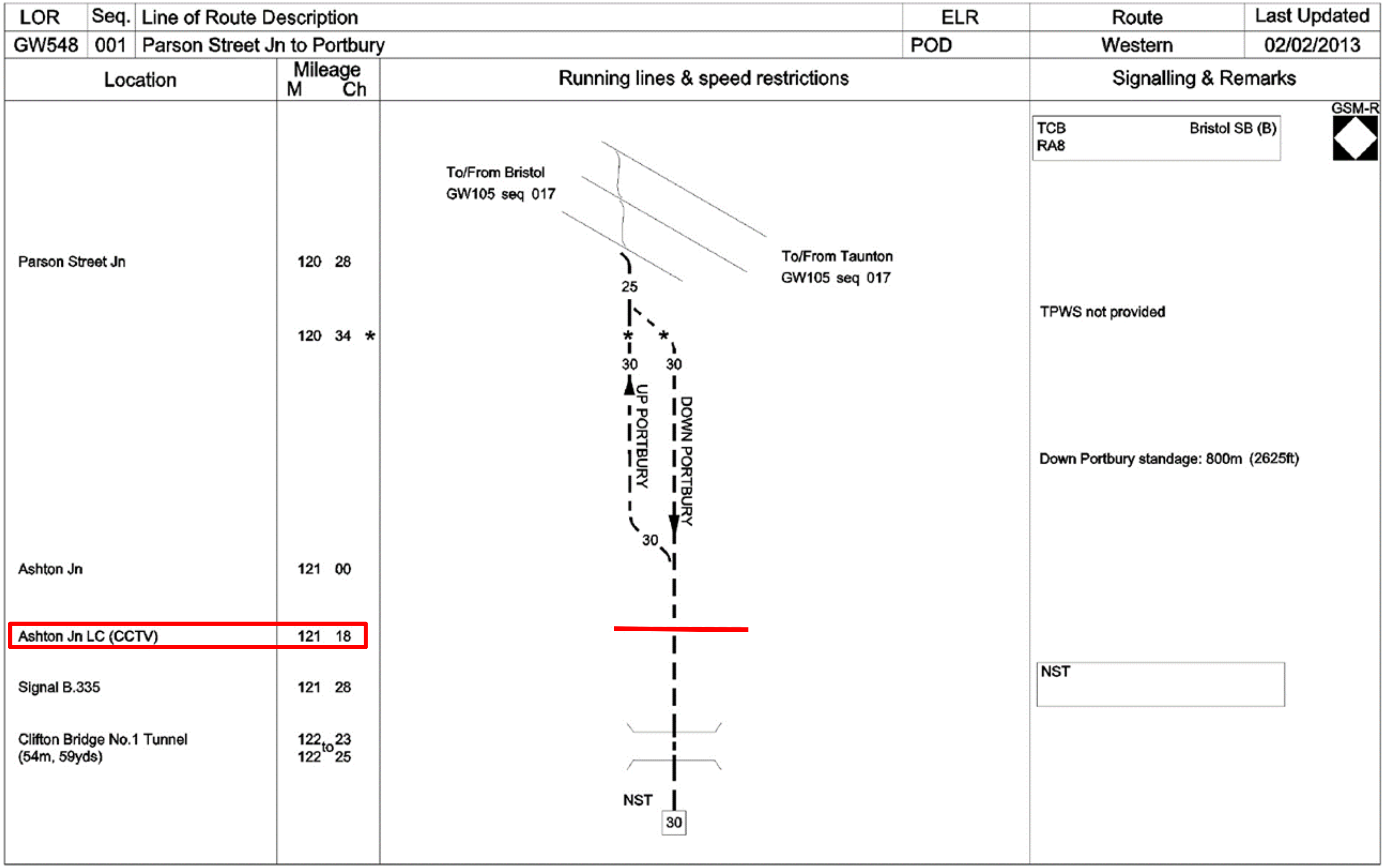


Figure 3 **Satellite Map of the location of the crossing**

Figure 4 Extract from the sectional appendix



LOR	Seq.	Line of Route Description	ELR	Route	Last Updated
GW548	001	Parson Street Jn to Portbury	POD	Western	02/02/2013

Location	Mileage M Ch	Running lines & speed restrictions	Signalling & Remarks
		To/From Bristol GW105 seq 017 To/From Taunton GW105 seq 017	TCB Bristol SB (B) RA8 GSM-R
Parson Street Jn	120 28	25	
	120 34 *	* 30 * 30	TPWS not provided
		UP PORTBURY DOWN PORTBURY	Down Portbury standage: 800m (2625ft)
Ashton Jn	121 00	30	
Ashton Jn LC (CCTV)	121 18		
Signal B.335	121 28		NST
Clifton Bridge No.1 Tunnel (54m, 59yds)	122 23 to 122 25		
		NST 30	

Environmentally significant sites are shown in *Figure 5*. Greville Smyth Park (200m north east of the crossing) is a Woodpasture and Parkland priority habitat. There is also a Woodpasture and Parkland priority habitat at Ashton Court (420m northwest), and a Registered Garden. Ashton Court SSSI begins 840m northwest of the crossing.

The Lower Lodge of Ashton court is Grade II listed (420m northwest of the crossing), and there are several other Grade II listed buildings in the area, further from the crossing.

Figure 5 Environmentally significant sites

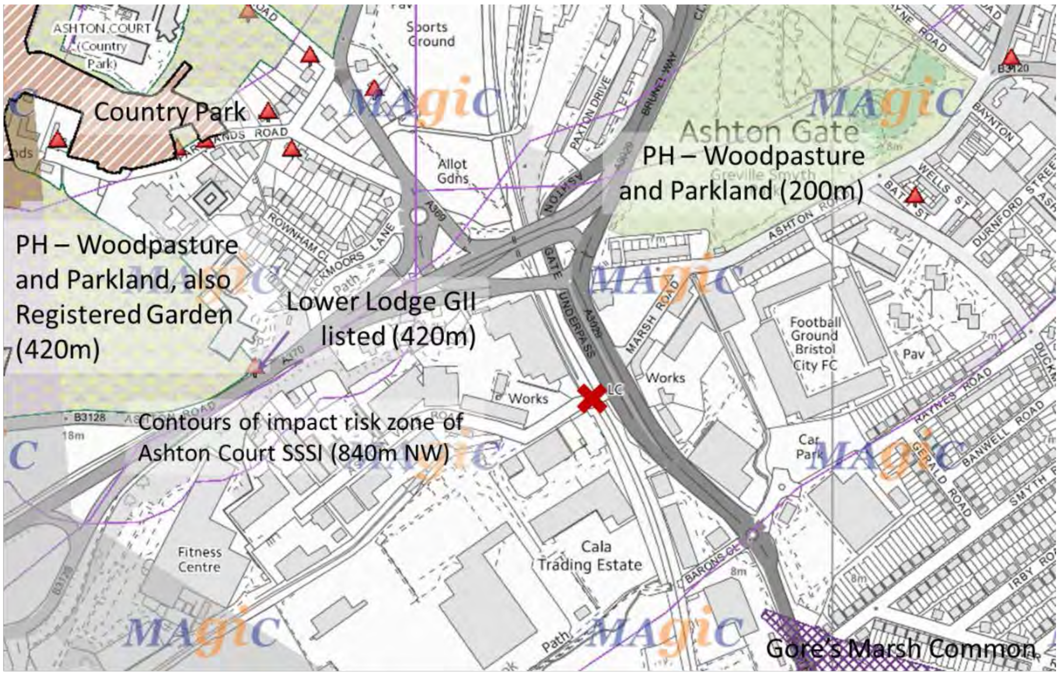


Table 2 Summary of local environs

Rural / urban	Urban
Main usage	Access to car auction, business and retail premises. Parking by football fans on match days
Local environs	Business and retail parks, football stadium
Station access	No
Number of tracks	1
Environmentally sensitive areas	Ashton Court SSSI 84m NW Woodpasture and Parkland priority habitat NE and NW
Heritage sites / listed buildings	Several Grade II listed buildings, nearest is the Lower Lodge of Ashton Court, 420m NW.

2.3 Road and footpath approaches

Footpath Approaches

There are footways delineated over the crossing on both sides, and there is pavement along the road for the footways to meet on either side of the crossing.

The footways, shown in *Figure 6* and *Figure 7,* are quite level with no identified trip hazards other than materials associated with the construction work (*Figure 8*) and very slightly uneven paving at the east end of the south footway.

At the west end the south footway leads to the entrance to a site area used by the MetroBus flyover construction team (*Figure 9)*.

The footway on the north side is 175cm wide, narrowed slightly by a fence post at the ZN corner. The footway on the south side is 200cm wide. The footways are 6m long.

The footways are not provided with white lines or tactile paving at the ends.

On the east side, between the crossing and the road junction, there is tactile paving and road studs marking a pedestrian pelican crossing route across the road (*Figure 8*). This is controlled by the junction traffic light sequence. A temporary traffic light is provided on the off-side of the road for this while the construction work is undertaken; this is linked into the junction traffic light sequence.

Figure 6 **Footway over the crossing – north side**

Figure 7 **Footway over the crossing – south side**

Figure 8 **East end of south footway – shows pedestrian crossing point and associated temporary traffic light**

Figure 9 **Entrance to parking area at west end of south footway**

Road approach to the crossing from the south

The distant, intermediate and close road approaches from the south are shown in *Figure 12* to *Figure 15*.

The road approach from the south along Winterstoke Road has a 30mph speed limit. A plan of the key features is shown in *Figure 10,* these are discussed below:

1. The road is flat on the approach. It splits into two lanes 80m south of the junction (*Figure 14*). The right hand lane continues as the A3029 Winterstoke Road, straight on over the junction with Ashton Vale Road to a junction with Ashton Road north of the crossing. The left hand lane becomes the Ashton Gate underpass; after the junction with Ashton Vale Road this passes underneath Ashton Road and the A370 and then curves to the east to form a slip road onto the A370 eastbound.

2. Prior to the construction work there was a separate turning lane for vehicles going left onto Ashton Vale Road. This is currently out of use, however it is assumed that this lane will be reinstated when construction of the MetroBus overpass is finished.

3. The junction of Ashton Vale Road with the Ashton Gate underpass is 10m east of the crossing, and the junction of Ashton Vale Road with the A3029 Winterstoke Road is 24m east of the crossing. There are road traffic signals at the junctions, and both have yellow boxes provided.

4. The crossing RTLs are visible at 20m from the crossing on the approach, and are orientated for the close approach i.e. the approach beyond the road traffic lights for the junction. The road traffic lights for the junction are visible from the roundabout 220m south of the junction.

5. The crossing is surfaced with concrete panels and has a relatively flat profile (*Figure 18*), although there is a loose panel and some damage to the sill beam on the east side (*Figure 19*). Yellow box markings are provided over the crossing. The road part of the crossing is approximately 6.5m wide.

Figure 10 Key features on southern approach to the crossing

Figure 11 View approaching crossing from the south - distant

Figure 12 **View approaching crossing from the south - intermediate**

Figure 13 **View approaching crossing from the south – intermediate 2**

Figure 14 View approaching crossing from the south - close

Figure 15 Junction east of crossing

Figure 16 **Temporary road traffic signals**

Figure 17 **Crossing surface**

Figure 18 Damaged sill – up side

Road approach to the crossing from the north

The road approach from the north has no right turn at the junction with Ashton Vale Road, therefore no vehicle will approach the crossing from this direction (unless manoeuvring illegally). The central reservation/traffic island is shaped to make a right turn more difficult.

Figure 19 View of junction from the north

Road approach to the crossing from the west

The distant, intermediate and close road approaches along Ashton Vale Road from the west are shown in *Figure 22* to *Figure 25*.

The road approach from the west has a 30mph speed limit. The key features of the approach are:

1. The road is flat on the approach.
2. There is a road junction 90m west of the crossing.
3. Vehicles tend to park on the pavement on the right hand side on the approach.
4. There is an entrance to a car sales business on the right 40m west of the crossing.
5. There is an entrance to a business (Babcock) car park on the left 9m west of the crossing. There is keep clear road marking on the road in front of this entrance, however it is extremely worn.
6. There is an entrance to a construction parking area on the right by the white line of the crossing.
7. The crossing RTLs and the road traffic lights for the junction are visible at 100m from the crossing on the approach.

A plan of these key features is shown in *Figure 21*.

Figure 20 Key features on western approach to the crossing

Figure 21 **View approaching crossing from the west - distant**

Figure 22 **View approaching crossing from the west - intermediate**

Figure 23 **View approaching crossing from the west – intermediate 2**

Figure 24 **View approaching crossing from the west - close**

Figure 25 **Junction west of crossing**

Figure 26 **Parking on pavement**

Figure 27 **Entrances on right on approach**

Figure 28 **Entrance on left on approach**

2.4 Crossing usage

A nine-day traffic census was carried out at the crossing between 26th August and 3rd September 2017, between the hours 00:00 – 24:00. This was extended for half a day to 25th August 12:00 – 24:00 in order to coincide with a football match at Ashton Gate stadium.

The following table provides a summary of the results obtained.

Train frequency	Busiest day	5
	Average weekday	4
	Saturday	3
	Sunday	2
Road vehicle frequency	Busiest day	3,912
	Average weekday	3,120
Pedestrian, cyclist and equestrian frequency	Busiest day	1,057 for a regular day 2905 in half day of football match
	Average week day	769
Current TPV and pedestrian category	TPV	284
	Pedestrian category	B
	Footway width required to comply with ORR guidance	1.8m
Future TPV and pedestrian category if trains increased to 4 per hour	TPV	618
	Pedestrian category	A
	Footway width required to comply with ORR guidance	2.0m
Observations of crossing during RTL sequence	Vehicles crossing on amber	0
	Vehicles crossing on red	0
	Pedestrians or cyclists crossing on amber	0
	Pedestrians or cyclists crossing on red	0

In terms of usage by vulnerable groups, there were nine observations of wheelchair users using the crossing, and one observation of an impaired person using the crossing. Most of these were on the football match day. There were also eight observations of unaccompanied children using the crossing.

The observed train, vehicle and pedestrian usage is presented in *Table 4.* The breakdown of usage by pedestrian user groups is presented in *Table 5*.

The hourly distribution of usage per weekday is shown graphically in *Figure 30*; the most notable finding of this is that there is a significant spike in pedestrian use on football evenings between 17:00-19:00, and between 21:00-22.00.

Table 3 Traffic survey observed usage

Census Ashton Junction			Totals per day										
			Vehicles							Pedal cyclists and pedestrians			
Day		No. trains per day	Cars	Vans / small lorries	HGVs	Buses	Tractors	Motor cycles	Total	Pedal cycles	Herded animals and horses	Pedestrians	Total
Friday	25-Aug-17	3	1,617	301	185	31	0	27	2,161	76	0	2,905	2,981
Saturday	26-Aug-17	3	288	151	37	0	0	0	476	14	0	42	56
Sunday	27-Aug-17	0	147	14	6	0	0	1	168	9	0	5	14
Monday	28-Aug-17	2	705	56	8	0	0	4	773	15	0	45	60
Tuesday	29-Aug-17	5	1,963	659	524	10	9	23	3,188	164	0	687	851
Wednesday	30-Aug-17	4	1,967	1,024	99	0	0	20	3,110	126	0	535	661
Thursday	31-Aug-17	4	2,219	529	579	17	12	26	3,382	108	0	643	751
Friday	01-Sep-17	4	1,611	1,052	98	4	0	33	2,798	152	0	660	812
Saturday	02-Sep-17	0	331	131	133	0	0	15	610	13	0	82	95
Sunday	03-Sep-17	2	531	39	1	0	0	0	571	3	0	893	896
Highest (excl. 25th)		5	2,219	1052	579	17	12	33	3,912	164	0	893	1,057
7 day average		3	1,302	498	200	4	3	16	2,023	84	0	440	524
Weekday average (excl. Bank Hol.)		4	1,940	816	325	8	5	26	3,120	138	0	631	769

Table 4 **Traffic survey observed pedestrian usage**

Pedestrian census		Totals per day					
Ashton Junction							
Day		Adult & Accompanied Child	Unaccompanied Child	Impaired	Wheelchair	Railway Personnel	Total
Friday	25-Aug-17	2897	0	1	7	0	2,905
Saturday	26-Aug-17	41	0	0	0	1	42
Sunday	27-Aug-17	5	0	0	0	0	5
Monday	28-Aug-17	43	0	0	0	2	45
Tuesday	29-Aug-17	680	7	0	0	0	687
Wednesday	30-Aug-17	425	0	0	0	110	535
Thursday	31-Aug-17	642	1	0	0	0	643
Friday	01-Sep-17	308	0	0	0	352	660
Saturday	02-Sep-17	82	0	0	0	0	82
Sunday	03-Sep-17	877	0	0	2	14	893
Highest		877	7	0	2	352	893
7 day average		372	1	0	0	67	440
Weekday average (excl. Bank Hol.)		514	2	0	0	116	631

TPV	284
Pedestrian category	B
Min footway width (m)	1.8
TPV if 4 trains within each hour	618
Pedestrian category	A
Min footway width (m)	2

Figure 29 **Hourly distribution of vehicle usage on weekdays**

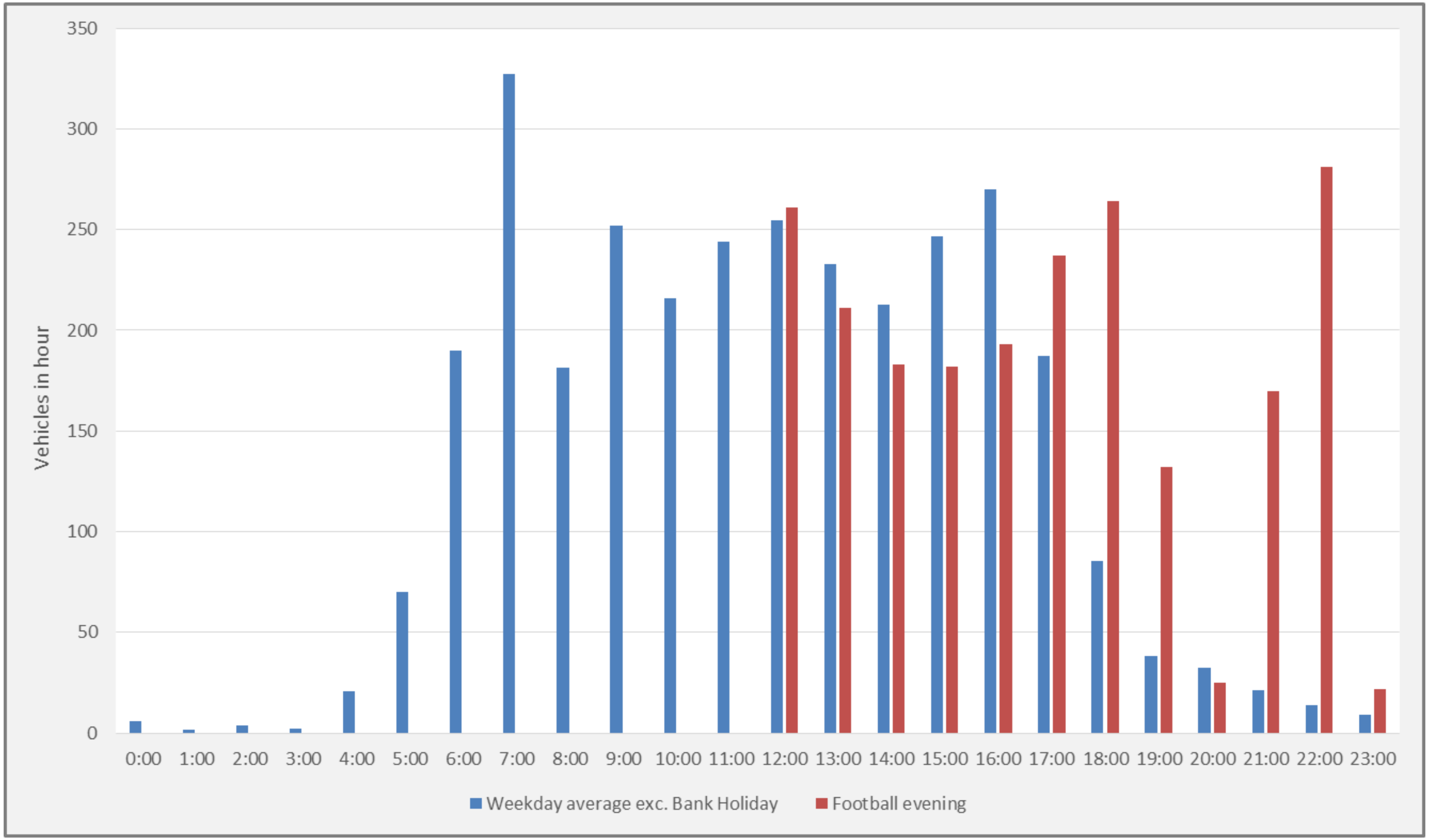
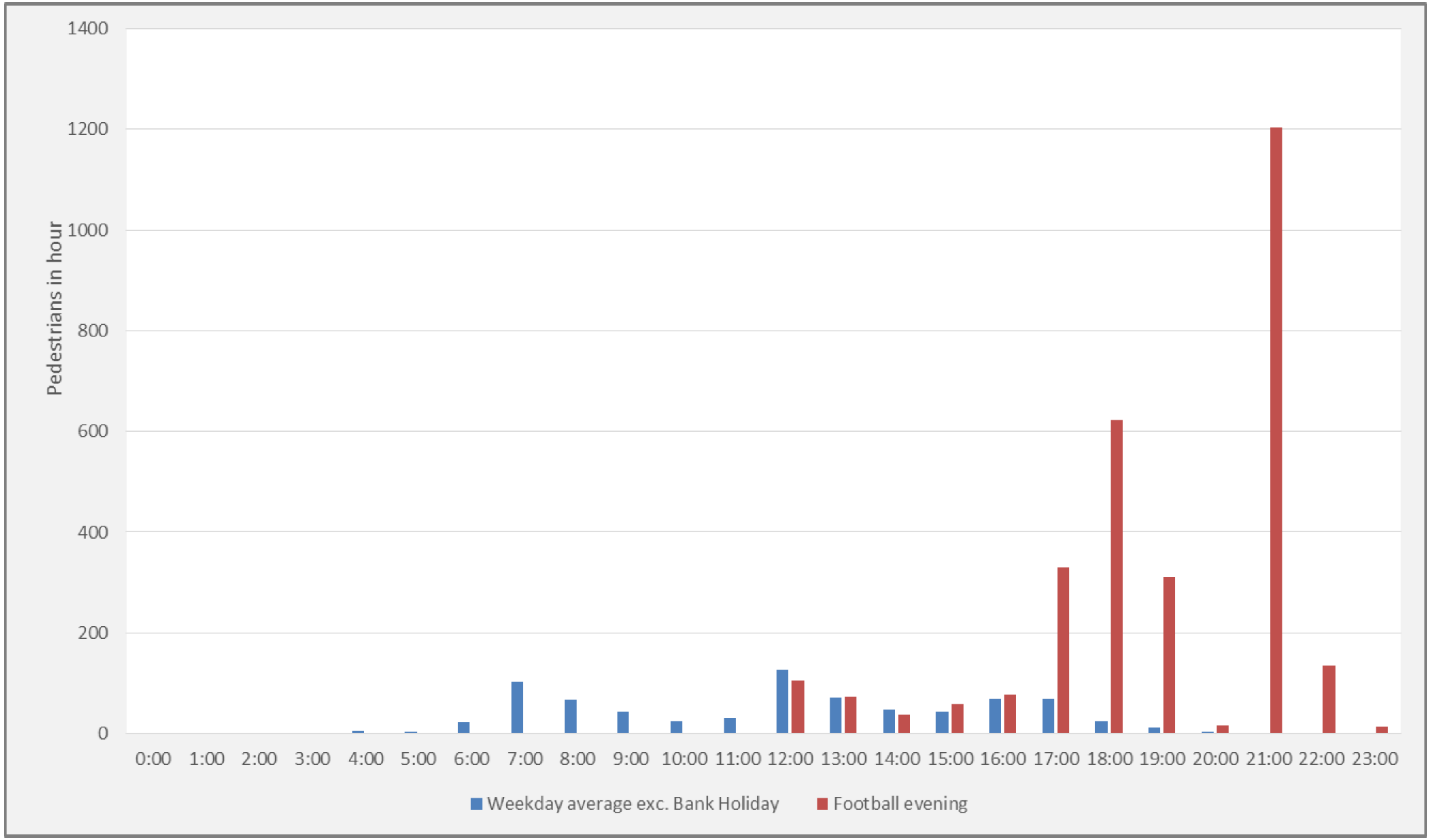


Figure 30 **Hourly distribution of pedestrian usage on weekdays**



During the census, there were no observations of vehicles crossing on amber signals, or on red signals. There were however a small number of observations of vehicles crossing the road traffic lights for the junction on red as well as a road traffic collision involving vehicles at the road traffic lights just to the west of the crossing.

The most noteworthy incidents identified during the census are described in *Table 5*. This excludes those associated with blocking back as these are described more fully in *Section 2.5*. In addition to this there were also multiple occasions when large numbers of pedestrians blocked traffic when crossing roads or walking along roads on the football match day.

Table 5 Noteworthy incidents from the census

Day		Time	Direction	Incident
Friday	25/08/2017	12:06	Eastbound	Car waiting on Ashton Vale Road facing East waiting at the level crossing turns around before the crossing, reversing onto the hatchings on the West exit of the crossing.
		16:45	Eastbound	Small van pulls out of Babcock car park and drives around a vehicle that is stopped at the red road traffic light before the crossing and partially onto the crossing before stopping and reversing off the crossing. When the traffic lights change to green the van waits while the other vehicle at the lights moves off (temporarily blocking another vehicle heading westbound) then the vehicle behind these moves forward towards the crossing partially on the pavement and is hit by the van which as it pulls to the left. The vehicle behind these pulls around them and stops on the crossing for an extended period as the road traffic lights have changed to red.
		18:26	Westbound	After a barrier down time (ending at 18:26:18), a coach waiting to go West across the level crossing moves slowly to avoid pedestrians oncoming before becoming stationary on the level crossing. The coach is stationary across the lines for approximately 15 seconds appearing to chat to a pedestrian before continuing.
		18:39	Eastbound	A coach travelling West across the level crossing does so slowly to fit through a small gap left between parked vehicles on the South side of Ashton Vale Road (West of the crossing) and a van waiting at the level crossing to travel East. To allow extra space for the oncoming coach, the van pulls forwards past the red traffic light and to the far side of the road to give the coach more space, but by doing so moves onto the rails on the crossing. The van remains stationary here for approximately 10 seconds before the traffic light turns green where it continues onto the A3029.
		16:15	Eastbound	Car goes through red traffic light before crossing then waits after the crossing before joining A3209
		17:16	Eastbound	Car approaching level crossing from the West doesn't stop for the traffic light until it is over the crossing. It becomes stationary here and remains on the rails for approximately 70 seconds before continuing onto the A3029.
		19:15	Eastbound	Car goes through red traffic light before crossing then waits after the crossing before joining A3209
		22:07	-	Police officer stands on level crossing to direct traffic
		22:19	Eastbound	Police van stops on or near the crossing to pick up police officers

Day		Time	Direction	Incident
Tuesday	29/07/2017	13:29	Eastbound	Car goes through red traffic light before crossing then waits after the crossing before joining A3209
		13:46	Westbound	Car travelling North on A3029 turns left onto Ashton Vale Road through a red traffic light and continues across the level crossing
		14:01	Eastbound	Car/van travelling East on Ashton Vale Road does not stop for a red traffic light and continues over the crossing onto A3029 without stopping
		17:54	Eastbound	Car exits carpark on the South side of Ashton Vale Road (West of crossing) and continues around the vehicles waiting at the traffic light over the crossing - has to temporarily wait to join traffic on A3029
Wednesday	30/07/2017	05:38	Eastbound	Car travelling East on Ashton Vale Road does not stop for a red traffic light and continue over the crossing - has to stop the other side of the crossing and join traffic on the A3029 when possible.
		10:08	Eastbound	Car travelling East on Ashton Vale Road does not stop for a red traffic light and continue over the crossing and disrupts vehicles travelling North on A3029 - has to stop the other side of the crossing and join traffic on the A3029 when possible.
Sunday	03/09/2017	00:01	Eastbound	Car approaching level crossing from the West doesn't stop for the traffic light until it is over the crossing. It becomes stationary here and remains on the rails for approximately 25 seconds before continuing onto the A3029.
		05:13	Eastbound	Car travelling East on Ashton Vale Road does not stop for a red traffic light and continue over the crossing slowly - has to stop the other side of the crossing and join traffic on the A3029 when possible.

2.5 Blocking back

A blocking back census was completed for the crossing.

The census observed a number of possible causes of blocking back closer to the crossing, in particular:

- Parked vehicles just to the west of the crossing limiting the road width, in particular for large vehicles such as coaches and car transporters which then required extensive manoeuvring past the vehicles, especially when vehicles are stopped at the road traffic light eastbound. This was most problematic on the football match day when the crossing was very busy and used by football coaches as well as car transporters.
- After the end of the football match the roads around the crossing and junction to the east were blocked at times by large numbers of pedestrians, in particular on or crossing Ashton Gate Underpass.
- Traffic queues north of the crossing on the Ashton Gate Underpass, presumably from the junction with the A370.
- Large vehicles manoeuvring into the entrance just to the southwest of the crossing.
- Vehicles blocked when turning right into Babcock by traffic stopped at the road traffic light just to the west of the crossing.
- Vehicles stopping at the junction to the east of the crossing due to confusion or indecision regarding which turn to take.

In all, there were thirty-two observations of blocking back in the eastbound direction, and eighteen in the westbound direction as summarised in *Table 6*. *Table 7* provides an analysis of blocking back incident duration and compares the results obtained with the criteria [2] for requiring BPM to be fitted to mitigate blocking back should an MCB-OD be provided[1]. This assessment indicates that if the crossing were upgraded to an MCB-OD, BPM would be required. *Table 8* provides a short summary of each incident.

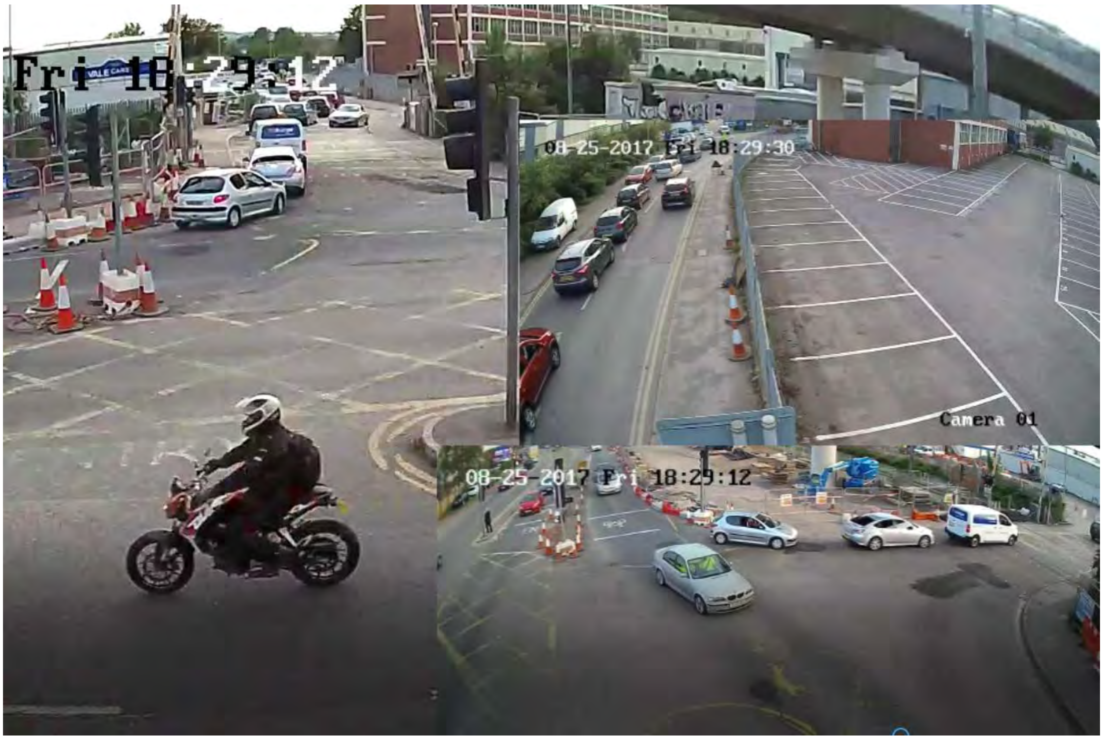
[1] From Ref. 2: *"Provision of BPM shall only be considered necessary for the MCB-OD if Red1, Red2 or Red3 severity blocking back occur during the 9 day census (Red2 or Red 3 zone for greater than 10 seconds, Red1 zone for greater than 28 seconds)"*

The majority of the events fell in the *Amber 1* or *Amber 2* categories, however two were of long duration - an *Amber 2* event of 2 minutes 5s westbound, and an *Amber 1* event of 1 minute 5s eastbound were noted on Day 0 (Friday). There were nine instances of a *Red* event in the eastbound direction – including a *Red 1* event of 23s duration on Day 7 (Friday). There were ten instances of a *Red* event in the westbound direction – including a *Red 1* event of 29s duration on Day 0 (Friday), and a *Red 3* event of 3 minutes 55s duration, also on Day 0 (Friday). The more significant incidents are described more fully below.

Football match day (Day 0) blocking back

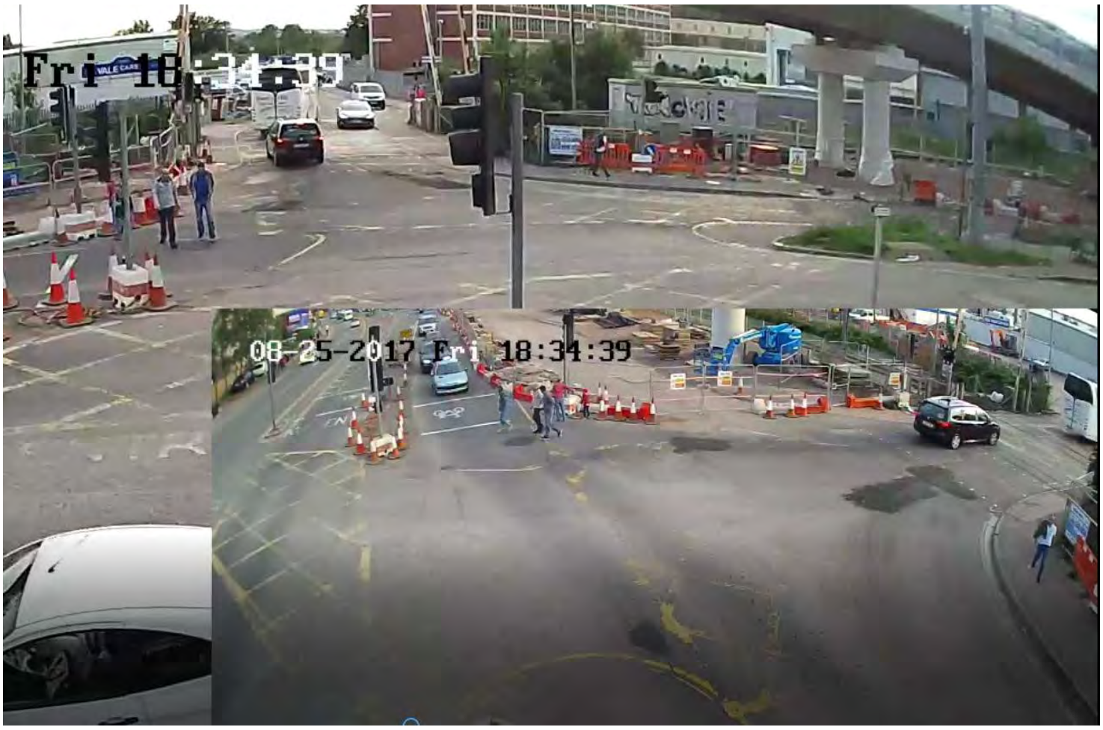
Between 18:27 and 18:29 there was queuing along Ashton Vale Road westbound, caused by cars that stopped at the junction 90m west of the crossing asking for directions (most likely to car parking areas). This resulted in prolonged amber blocking back and ultimately a 17s *Red 1* incident; see Figure 31 for a screen capture from this.

Figure 31 Screen capture from 17s Red 1 incident at 18:29



An incident at 18:34 caused *Red 1* blocking back westbound for 29s and *Amber 2* blocking back for 125s. In this case a coach was blocked by a parked vehicle just past the crossing and the car behind stopped under the level crossing entrance barrier (see *Figure 33* for a screen capture from this incident).

Figure 32 **Screen capture from the 29s Red 1 blocking back incident at 18:34 on Day 0**



A few minutes later, at 18:38, there was a similar *Red 1* incident of much shorter duration (3s) that was caused by a car transporter struggling to pass the parked vehicle just to the west of the crossing (*Figure 33*).

Figure 33 **Screen capture from 3s Red 1 blocking back incident at 18:38 on Day 0**

A very long, 3m 55s, *Red 1* incident which started at 21:41 was by far the most serious observed during the census. In this incident a car transporter turned west into Ashton Vale Road, but was blocked by a parked car just to the west of the crossing, coupled with eastbound traffic stopped at the road traffic light just to the west of the crossing and a large number of pedestrians, some of whom were in the road. The car transporter and a following car were both stopped on the crossing. A screen capture from this incident is shown in *Figure 34*.

Figure 34 **Screen capture from the 235s Red 3 blocking back incident at 21:41 on Day 0**

Even after 3m 55s when the car transporter was able to move sufficiently to clear the crossing, another car behind stopped under the entrance barrier causing a 26s *Red 1* incident.

As the above incident occurred, at two separate times after the traffic lights changed there was coincident blocking back in the other direction, caused by pedestrians blocking the road. At these times the crossing was completely gridlocked in both directions. Screen captures showing this are presented in *Figure 32 and Figure 33*. Each of these eastbound blocking back incidents were categorised as *Red 1* for 12s.

Figure 35 **Screen capture from the 235s Red 3 blocking back incident showing Red 3 blocking back in both directions (21:43)**

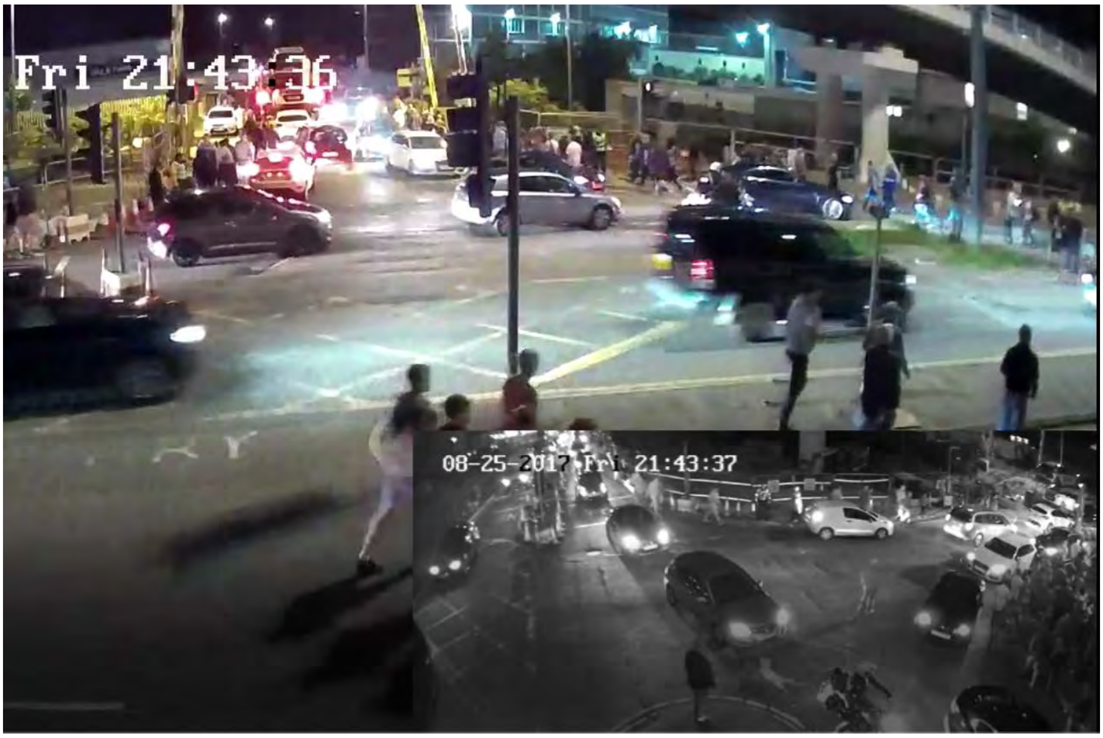
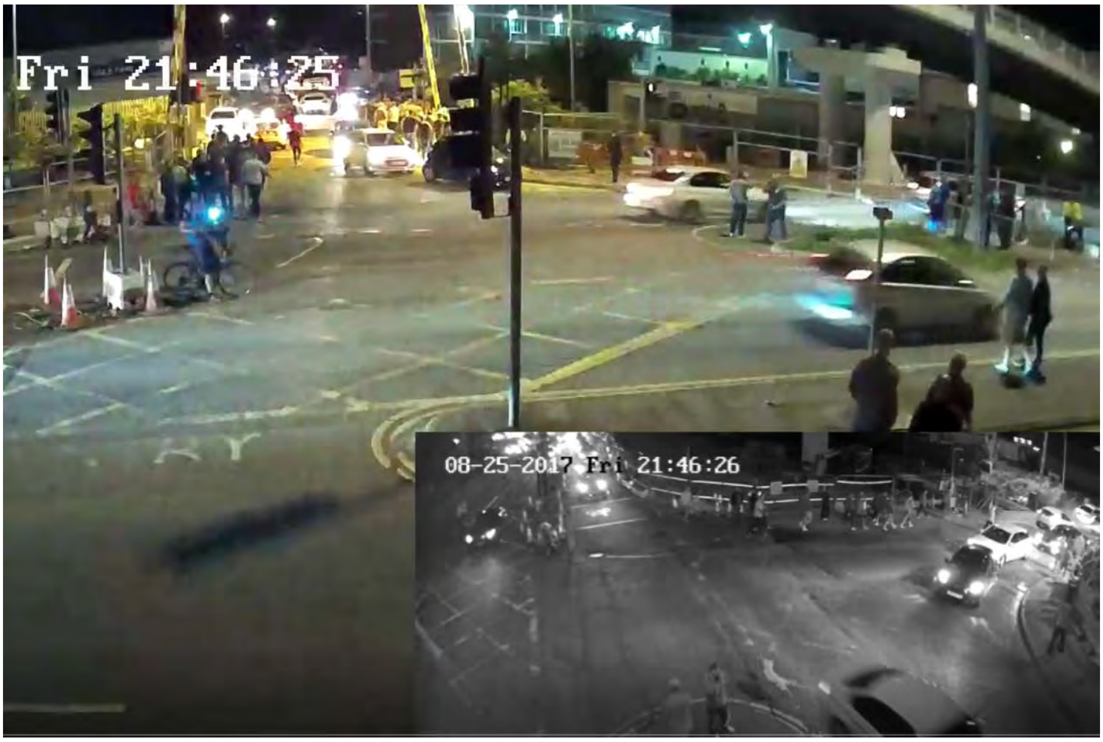


Figure 36 **Screen capture from the 235s Red 3 blocking back incident showing Red blocking back in both directions (21:45)**

Shortly afterwards, at 21:46 there were two similar eastbound blocking back incidents caused by pedestrians blocking Ashton Gate Underpass; Screen captures are shown in *Figure 37* and *Figure 38*. In the second of these the lead vehicle was delayed initially by pedestrians but then the traffic lights changed and it had to wait before being able to proceed.

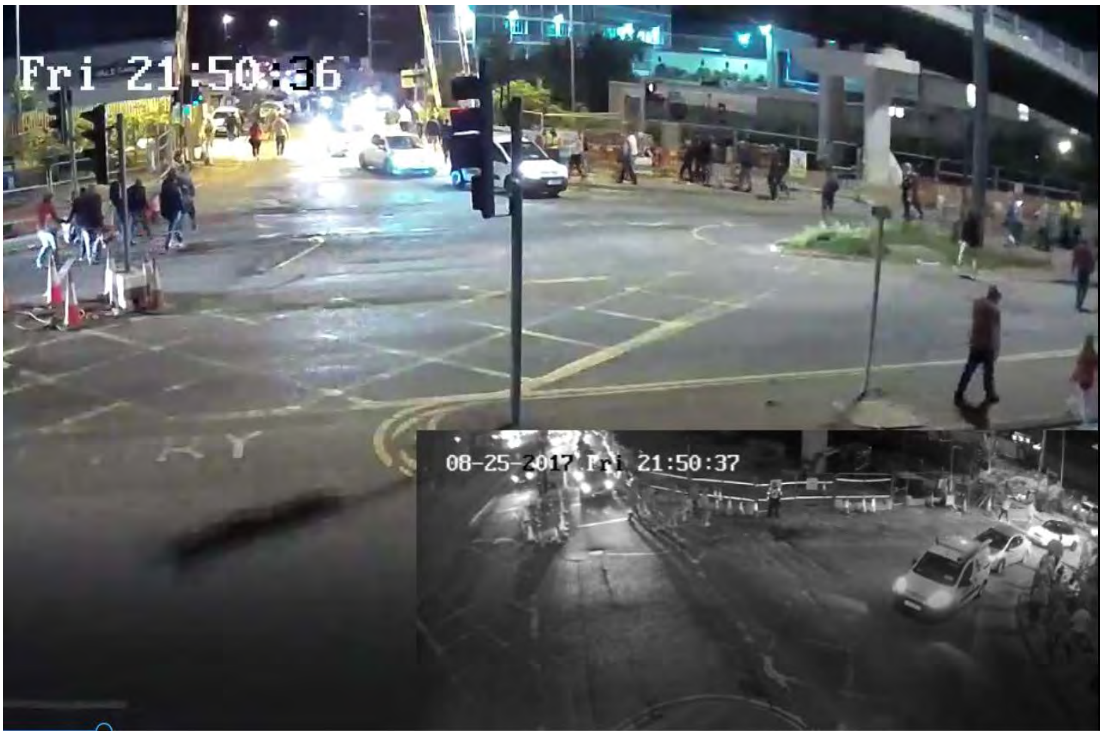
Figure 37 **Screen capture from 7s Red 3 blocking back incident at 21:46 on Day 0**

Figure 38 **Screen capture from 9s Red 2 blocking back incident at 21:46 on Day 0**



A 7s eastbound *Red 2* incident occurred at 21:50 when the lead vehicle from Ashton Vale Road stopped at the junction, either due to pedestrians in the road crossing Ashton Gate Underpass or due to indecision about which route left to take (the vehicle ended up taking Winterstoke Road). A screen capture is shown in *Figure 39*.

Figure 39 **Screen capture from 7s Red 2 blocking back incident at 21:50 on Day 0**



It is noteworthy that in the unlikely event of a train collision with a vehicle stopped on the crossing during football traffic congestion such as that described in the above incidents the potential consequences could be severe despite the relatively low line speed due to the type of vehicles involved (coaches, car transporters for example) and the large number of pedestrians nearby.

Blocking back incidents on other days

On 30th August at 12:25 a 9s *Red 3* incident occurred westbound when an HGV attempting to turn right into Babcock's car park was delayed by a car stopped on the keep clear marked area; this car then reversed out of the way to allow the HGV through. A screen capture is shown in *Figure 40*.

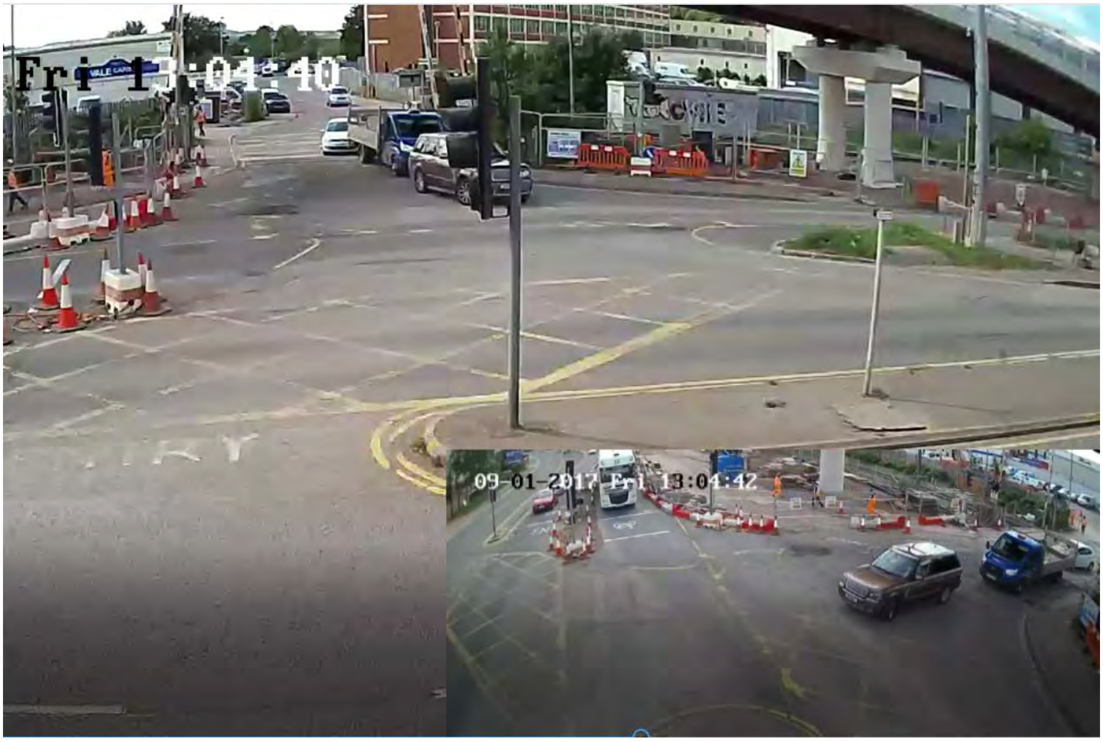
Figure 40 **Screen capture from 9s Red 3 blocking back incident at 12:25 on Day 5**

A similar incident occurred at 06:52 on 1st September when a car was delayed turning right into Babcock by moving eastbound vehicles shortly after the traffic lights changed to green. A screen capture is shown in *Figure 41*.

Figure 41 **Screen capture from 2s Red 1 blocking back incident at 06:52 on Day 7**

On the same day, at 13:04 a 7s *Red 2* incident occurred eastbound when a car travelling towards Ashton Gate Underpass stopped briefly on the junction due to uncertainty about which route to take, causing vehicle behind to stop on the crossing. A screen capture is shown in *Figure 42*.

Figure 42 **Screen capture from 2s Red 1 blocking back incident at 06:52 on Day 7**



Later that day, at 15:58 and then again at 17:02, vehicles travelling eastbound towards Ashton Gate Underpass were delayed by a queue on the underpass causing blocking back at the crossing. The first of these resulted in a 23s *Red 1* incident, the second resulted in a 16s *Red 2* incident. Screen captures are shown in *Figure 43* and *Figure 44*.

Figure 43 **Screen capture from 23s Red 1 blocking back incident at 15:58 on Day 7**

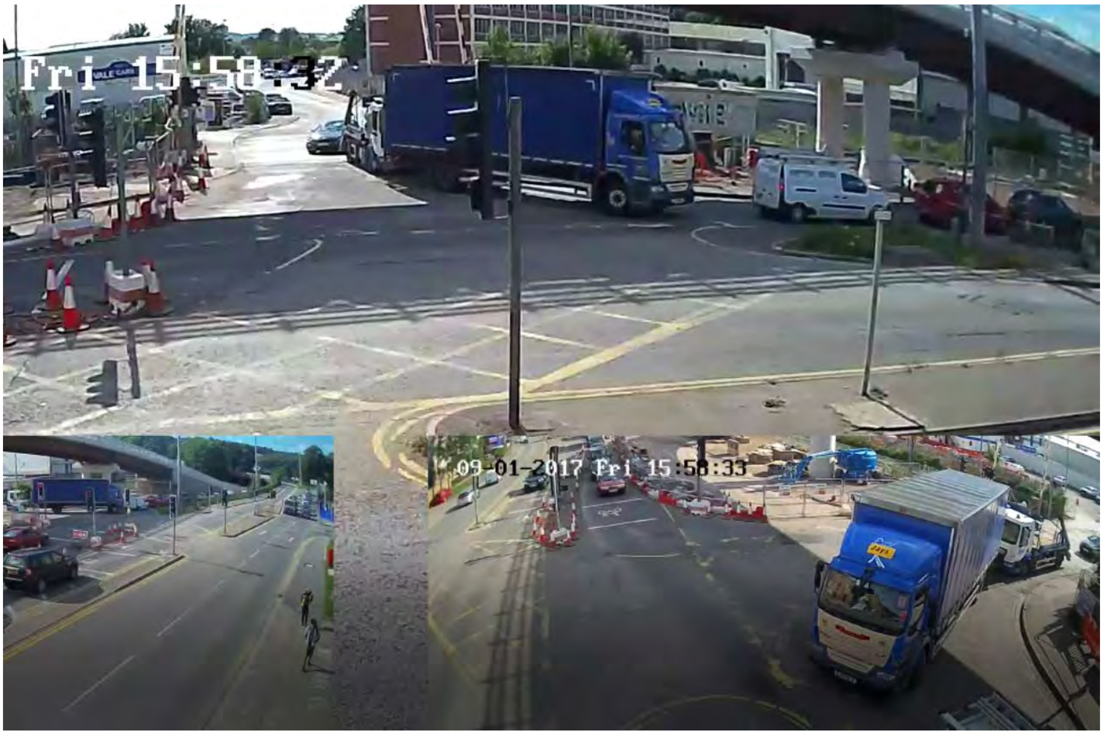


Figure 44 **Screen capture from 16s Red 2 blocking back incident at 17:02 on Day 7**

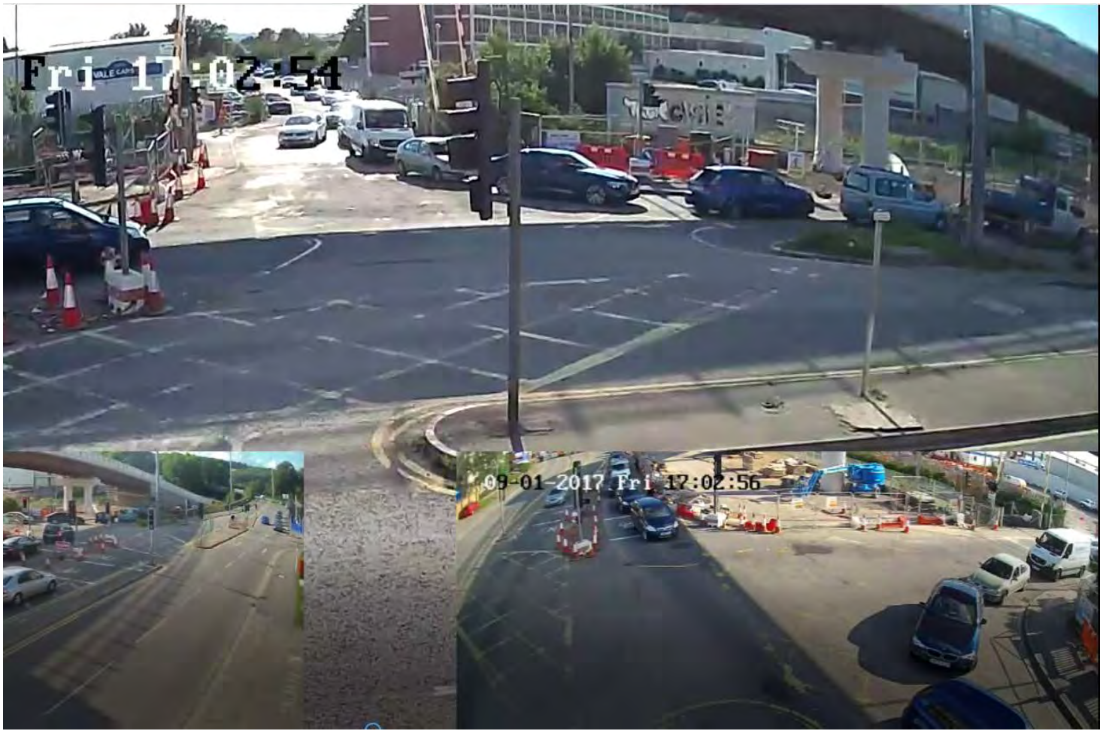


Table 6 Traffic survey blocking back

Ashton Junction		Number of incidents													
		Eastbound							Westbound						
Day		A1	A2	R1	R2	R3	Total	Total Red	A1	A2	R1	R2	R3	Total	Total Red
Day 0 Friday	25/08/17	2	4	1	2	3	12	6	2	3	4	1	2	12	7
Day 1 Saturday	26/08/17	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Day 2 Sunday	27/08/17	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Day 3 Monday	28/08/17	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Day 4 Tuesday	29/08/17	2	2	0	0	0	4	0	0	0	0	0	0	0	0
Day 5 Wednesday	30/08/17	2	2	0	0	0	4	0	0	0	0	0	1	1	1
Day 6 Thursday	31/08/17	1	1	0	0	0	2	0	0	0	0	0	0	0	0
Day 7 Friday	01/09/17	2	2	1	2	0	7	3	0	2	1	1	0	4	2
Day 8 Saturday	02/09/17	0	0	0	0	0	0	0	1	0	0	0	0	1	0
Day 9 Sunday	03/09/17	1	2	0	0	0	3	0	0	0	0	0	0	0	0
Total		10	13	2	4	3	32	9	3	5	5	2	3	18	10
Average per day		1.1	1.4	0.2	0.4	0.3	3.4	0.9	0.3	0.5	0.5	0.2	0.3	1.9	1.1

Amber 1: Rear of queue extends to between 11m and 50m downstream of the crossing.
Amber 2: Rear of queue extends to between the crossing barrier and 11m downstream.
Red 1: Vehicle fouls the barrier but not within 1.25m of the running line.
Red 2: Vehicle fouls the crossing line, or within 1.25m either side of the running line, and are stationary for three or more seconds.
Red 3: Similar to Red 2, but where no escape route is available, either forwards or backwards.

Table 7 **Blocking back survey: maximum duration and BPM criteria exceedances**

Ashton Junction			Maximum duration (s)						No. of BPM criteria exceedances			
			Eastbound			Westbound			Eastbound		Westbound	
Day			A1 or A2	R1	R2 or R3	A1 or A2	R1	R2 or R3	R1	R2 or R3	R1	R2 or R3
Criterion									*> 28s*	*> 10s*	*> 28s*	*> 10s*
Day 0	Friday	25/08/17	66	4	12	125	29	235	0	2	1	2
Day 1	Saturday	26/08/17	0	0	0	0	0	0	0	0	0	0
Day 2	Sunday	27/08/17	0	0	0	0	0	0	0	0	0	0
Day 3	Monday	28/08/17	0	0	0	0	0	0	0	0	0	0
Day 4	Tuesday	29/08/17	18	0	0	0	0	0	0	0	0	0
Day 5	Wednesday	30/08/17	18	0	0	0	0	9	0	0	0	0
Day 6	Thursday	31/08/17	8	0	0	0	0	0	0	0	0	0
Day 7	Friday	01/09/17	48	23	16	15	2	0	0	1	0	0
Day 8	Saturday	02/09/17	0	0	0	21	0	0	0	0	0	0
Day 9	Sunday	03/09/17	19	0	0	0	0	0	0	0	0	0
Total			375	27	70	302	77	274	0	3	1	2
Maximum			66	23	16	125	29	235				

Table 8 Blocking back incidents

Day		Time	Dir	Cat	Cause	Date	Maximum duration (s) EB A1 or A2	EB R1	EB R2 or R3	WB A1 or A2	WB R1	WB R2 or R3
Friday	25-Aug-17	12:50	WB	A1	Car transporter delayed turn left into auction centre	25/08/2017				31		
		13:37	EB	A1	Queue on Ashton Gate underpass	25/08/2017	43					
		13:38	EB	A2		25/08/2017	7					
		13:38	EB	A1		25/08/2017	66					
		14:49	WB	A2	Van stopped after LC, reason unknown (maybe conversation with lorry driver)	25/08/2017				31		
		16:45	EB	A2	Van stopped on wrong side of road attempting to pass car stopped at traffic lights, ultimately van collided with another van	25/08/2017	14					
		18:27	WB	A1	Queuing behind cars stopped on Ashton Vale Rd asking for directions (First car stops causing amber blocking back, second car stops causing red blocking back)	25/08/2017				63		
		18:28	WB	A2		25/08/2017				4		
		18:29	WB	R1		25/08/2017					17	
		18:34	WB	R1	Coach stopped by van parking just to west of crossing, car followed and stopped under barriers	25/08/2017					29	
		18:35	WB	A2		25/08/2017				125		
		18:38	WB	R1	Car transporter delayed by van parked just to west of crossing, car followed and stopped under barriers	25/08/2017					3	
		18:39	WB	R2	Coach delayed by van parked just to west of crossing, car followed and stopped briefly on crossing	25/08/2017						

Day		Time	Dir	Cat	Cause	Date	Maximum duration (s)					
							EB			WB		
							A1 or A2	R1	R2 or R3	A1 or A2	R1	R2 or R3
		21:41	WB	R3	Car transporter turns left into Ashton Vale Road but unable to get through due to parked car just to west of crossing and large number of pedestrians, stopped on crossing with cars behind. Even when transporter clears crossing after 3m55s another car becomes stopped on the crossing. Some of incident coincident with blocking back in other direction.	25/08/2017						235
		21:45	WB	R1		25/08/2017					26	
		21:46	WB	R3		25/08/2017						30
		21:40	EB	R1	Queue of traffic delayed by large number of pedestrians crossing Ashton Gate underpass	25/08/2017		4				
		21:43	EB	R3	Queue of traffic delayed by large number of pedestrians crossing Ashton Gate underpass (blocking back also in other direction)	25/08/2017			12			
		21:45	EB	R3	Queue of traffic delayed by large number of pedestrians crossing Ashton Gate underpass (blocking back also in other direction)	25/08/2017			12			
		21:45	EB	A2		25/08/2017	23					
		21:46	EB	R3		25/08/2017			7			
		21:46	EB	R2		25/08/2017			9			
		21:50	EB	R2	Queue of traffic delayed by large number of pedestrians crossing Ashton Gate underpass	25/08/2017			7			
		21:50	EB	A2		25/08/2017	9					
Tuesday	29-Aug-17	12:20	EB	A1	Queue on Ashton Gate underpass	29/08/2017	7					
		12:20	EB	A2		29/08/2017	4					
		12:20	EB	A1		29/08/2017	8					

Day		Time	Dir	Cat	Cause	Date	Maximum duration (s)					
							EB			WB		
							A1 or A2	R1	R2 or R3	A1 or A2	R1	R2 or R3
		12:20	EB	A2		29/08/2017	18					
Wednesday	30-Aug-17	12:25	WB	R3	HGV stopped on crossing as entrance to Babcock blocked by stopped car at traffic lights which then reversed out of the way	30/08/2017						9
		17:20	EB	A1	Queue on Ashton Gate underpass	30/08/2017	2					
		17:20	EB	A2		30/08/2017	18					
		17:35	EB	A1	Queue on Ashton Gate underpass	30/08/2017	5					
		17:35	EB	A2		30/08/2017	18					
Thursday	31-Aug-17	14:02	EB	A2	Queue on Ashton Gate underpass	31/08/2017	8					
		14:02	EB	A1		31/08/2017	6					
Friday	01-Sep-17	06:52	WB	R1	Car delayed turning right into Babcock by traffic in other direction, vehicles behind stopped on crossing	01/09/2017					2	
		06:52	WB	R2		01/09/2017						
		08:14	WB	A2	Car delayed turning right into Babcock by stopped traffic in other direction	01/09/2017				12		
		09:54	WB	A2	HGV slow turning left immediately after crossing due to to vehicles on other side of road	01/09/2017				15		
		13:04	EB	R2	Car travelling towards Ashton Gate underpass stops briefly due to uncertainty about route	01/09/2017			7			
		15:58	EB	R1	Queue on Ashton Gate underpass	01/09/2017		23				
		15:58	EB	A2		01/09/2017	48					
		17:02	EB	R2	Queue on Ashton Gate underpass, car in queue stopped on crossing.	01/09/2017			16			

Day		Time	Dir	Cat	Cause	Date	Maximum duration (s)					
							EB			WB		
							A1 or A2	R1	R2 or R3	A1 or A2	R1	R2 or R3
		17:22	EB	A1	Queue on Ashton Gate underpass	01/09/2017	9					
		17:22	EB	A2		01/09/2017	11					
		17:22	EB	A1		01/09/2017	22					
Saturday	02/09/2017	13:13	WB	A1	Van west of LC reversing into side road blocked the road which was also narrowed by parked cars	02/09/2017				21		
Sunday	03/09/2017	17:23	EB	A2	Car that had entered the Ashton Gate underpass road decided to reverse, delaying a following car for a short period before it moved forward	03/09/2017	3					
		17:30	EB	A1	Queue on Ashton Gate underpass	03/09/2017	7					
		17:32	EB	A2	Queue on Ashton Gate underpass, exacerbated by crossing pedestrians	03/09/2017	19					

2.6 Road closure time

Figure 32 provides the average time of road closure from the census. This shows that with the current train frequency the crossing is closed to the road for a maximum of about nineteen minutes per day. The weekday average closure time per activation is 3m 2s.

Figure 45 Average time that the road is closed

Barrier down time Ashton Junction					
Day		No. closures	No. trains	Total closure time	Average closure time
Friday	25-Aug-17	3	3	00:09:32	00:03:11
Saturday	26-Aug-17	3	4	00:08:25	00:02:48
Sunday	27-Aug-17	0	0	00:00:00	
Monday	28-Aug-17	2	2	00:04:18	00:02:09
Tuesday	29-Aug-17	6	4	00:18:52	00:03:09
Wednesday	30-Aug-17	4	4	00:11:53	00:02:58
Thursday	31-Aug-17	4	4	00:10:55	00:02:44
Friday	01-Sep-17	4	4	00:12:59	00:03:15
Saturday	02-Sep-17	0	0	00:00:00	
Sunday	03-Sep-17	4	1	00:03:55	00:00:59
Highest		6	4	00:18:52	00:03:15
7 day average		3	3	00:09:18	00:02:42
Weekday average (excl. Bank Hol.)		4	4	00:11:47	00:03:02

Of course, the road is unavailable for much greater than this due to the operation of the road traffic lights for the junction.

The future road closure time will be greater once the MetroWest service is introduced, especially if Parson Street station is within the strike-in for Down direction trains.

2.7 Rail approach and usage

The level crossing is located on a single line section of the line between Parson Street Junction and Portbury. The current train service consists of a small number of freight trains per day and no passenger service. The line does not form part of a diversionary route.

The crossing is controlled by Bristol signal box.

The rail approach to the crossing from the south

Trains travelling north are travelling in the Down direction towards Portbury Docks. The view from the crossing looking south (towards Parson Street Junction) is shown in *Figure 33*. The line is curved on the approach. The line speed is currently 30mph in this direction.

In the event of a collision of an Up direction train with a road vehicle, the curve and supports for the new flyover could exacerbate the consequences of any derailment, although the low line speed would render such escalation unlikely.

Figure 46 View of rail approach to the crossing from the south

The rail approach to the crossing from the north

Trains travelling south are travelling in the Up direction towards Parson Street Junction. The view from the crossing looking north (towards Portbury Docks) is shown in *Figure 34*. The line is curved on the approach.

The line speed is currently 30mph in this direction.

In the event of a collision of a Down direction train with a road vehicle, the curve and the road bridges could exacerbate the consequences of any derailment, although the low line speed would render such escalation unlikely.

Figure 47 View of rail approach to the crossing from the north

2.8 Impact of low sun on the crossing

The crossing is currently provided with LED RTLs, but not extended hoods or an anti-glare, matt road surface to mitigate the impact of low sun.

Below, is the output from the SunCalc application, which has been used to identify the line of the sun at sunrise and sunset at times of year when low sun would come closest to aligning with the road approaches. The shortest and longest days are shown in *Figure 37*.

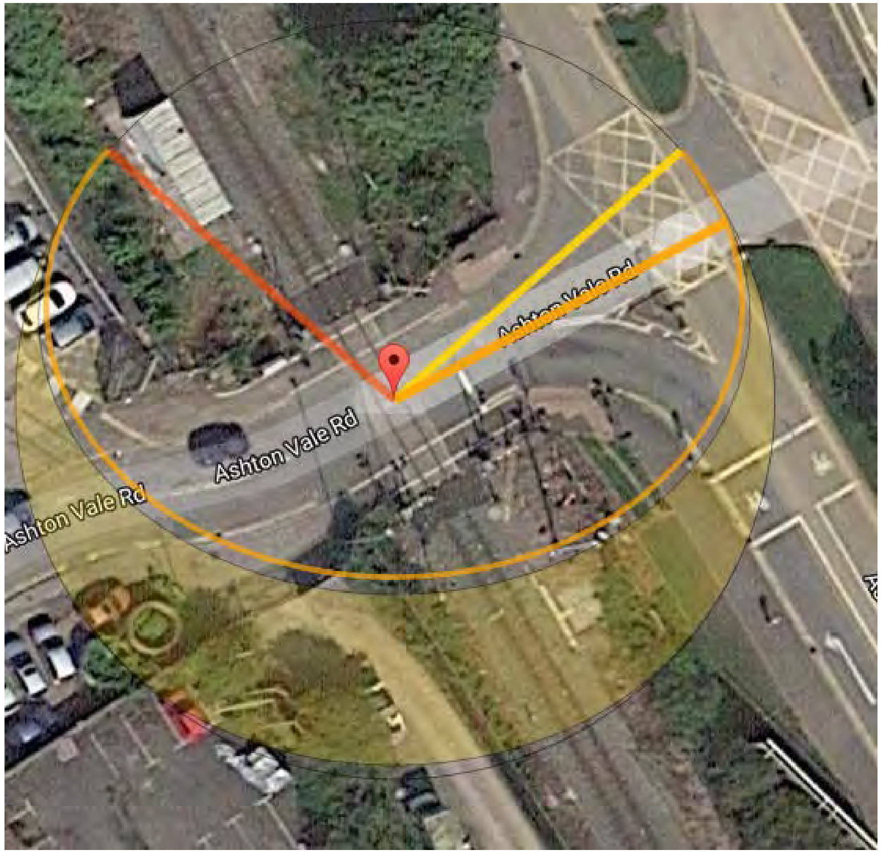
The thin orange curve is the current sun trajectory, and the yellow area around is the variation of sun trajectories during the year. The closer a point is to the centre, the higher is the sun above the horizon.

The yellow line shows the direction of sunrise; the dark orange line the direction of sunset and the mid orange line the direction at a selected time of day.

Figure 48 **Suncalc diagrams**

Shortest Day

Longest Day



Westbound approach

Consideration is given to the impact of low sun on the westbound approach:

- In the early morning the rising summer sun would shine towards the RTLs, potentially washing them out, however the sun would be blocked by buildings on the east side of Winterstoke Road as well as Ashton Gate stadium so this situation is unlikely to occur.

- In the late afternoon and evening, the low winter sun would be straight behind the crossing, potentially causing some glare. The approach is however short and low speed, and the approach is on a level gradient, so this is not considered likely to be a significant issue. Additionally, in most cases vehicles should have been prevented from approaching the RTLs at red by the road traffic lights for the junction.

Eastbound approach

Consideration is given to the impact of low sun on the eastbound approach:

- In the evening, the low winter sun would shine towards the RTLs, potentially washing them out. Some, but not all, of this time the sun would be blocked by buildings further along Ashton Vale Road, the road approach speed is not high, the approach is on a level gradient and the sun would need to impact both the road traffic lights for the junction and the crossing RTLs (albeit these are angled similarly), therefore for these reasons this is not considered likely to be a significant issue.

- In the early morning in summer the rising sun would be behind the RTLs on the approach, however the sun would be blocked by buildings on the east side of Winterstoke Road as well as Ashton Gate stadium so this situation is unlikely to occur.

It would be worthwhile for the level crossing manager to confirm these assertions by visiting the crossing at the appropriate times.

2.9 Incident / near miss history

Incident data relating to level crossings was provided by RSSB for a 10 year period[2]. The breakdown of the incidents at Ashton Junction crossing is shown in *Table 5* and compared with the average number of each incident type over 10 years for the type of crossing. The most significant events are described below:

- There have been seven incidents of vehicles hitting barriers
- A lorry broke down on the crossing
- A barrier lowered onto a vehicle
- A vehicle parked on the crossing
- There have been two incidents of vandalism
- There was an incident of irregular working (failure to take local control when a possession was in place).

The number of reported misuse incidents is well below the national average for an MCB-CCTV crossing.

There has also been a more recent incident of misuse when a lorry hit and damaged a barrier.

It is recognised that not all incidents are reported into RSSB's SMIS database. Incident reporting is not entirely consistent, and also SMIS primarily holds incident data rather than fault data.

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[2] 10 years data to 30th October 2015 was supplied by RSSB and analysed by Sotera; classification codes used in SMIS are quoted here and are not changed by Sotera. The terminology used in past SMIS incidents pre-dates the Transport Committee - Eleventh Report on Safety at level crossings which recommended that the rail industry ***stop using the term "misuse" in relation to accidents at level crossings and instead adopt "deliberate misuse" where the evidence supports this and "accident" where it does not***.

Table 9 Breakdown of Incident History

SMIS classification	Incidents in data set	Average for LC type	Ratio to average for LC type
Train - striking road vehicle or gate at LC	0	0.01	0.00
Train - striking or being struck	0	0.13	0.00
Non-rail vehicles (incl. vehicle on line)	0	4.39	0.00
Person - personal accident	0	0.62	0.00
Level Crossing/LC equipment - misuse/near misses	6	21.33	0.28
Near miss - train with person (not at LC)	0	0.02	0.00
Train - striking animal	0	0.01	0.00
Animals - on the line	2	0.06	31.28
Person - trespass	0	1.22	0.00
Person - vandalism	0	0.45	0.00
Train - signal passed at danger	0	0.13	0.00
Train - running over LC (when unauthorised)	0	0.03	0.00
Irregular working (pre 25/11/2006)	1	0.07	14.48
Irregular Working	0	0.35	0.00
Level crossing - equipment failure	8	7.44	1.07
Signalling system - failure	0	0.18	0.00
Permanent way or works - failure	0	0.04	0.00
All incidents	**17**	**36.94**	**0.46**

Note, the data in this table is not normalised, therefore a crossing with high use would generally be expected to have higher ratios.

2.10 Signalling arrangements

The current, BASRE proposed and MetroWest proposed signalling arrangements are described below.

Current arrangements

The line between Ashton Junction and Portbury Dock is currently token block, with token machines being provided at both protecting signals for the level crossing. The protecting signals are therefore mandatory stopping points for all trains. The crossing is initiated by the signaller; the CCTV picture automatically switches on when the token instrument is operated, providing a prompt for the signaller to initiate the crossing.

Two aspect colour light signals are provided to protect the crossing, with run-by protection provided at the crossing in the event of a SPAD. The overrun distances to the crossing are to standard; 422m in the Down direction and 225m in the Up direction.

The crossing sequence is linked to the road traffic lights for the junction, with the sequence not initiating until the road traffic lights have been set to red. The signaller's panel has indications that the road traffic lights for the junction are at red or that they have failed, in which case the signaller is required to override the road traffic lights and specifically observe the crossing when lowering the barriers. See *Figure 49* for the indications and below for the signalbox instructions.

Ashton Junction Level Crossing (CCTV) – CCTV, MCB and RC Level Crossings controlled by the signaller (TS9 / 6)

The following amplifies the instructions in **Module TS9 / 6**:

Cameras and Monitors

A record of the time and dates of the changeover of cameras and/or monitors must be kept in the level crossing occurrence folder.

Working of Barriers

When a down train is detained signal **BL2191** waiting for an up train to leave the single line, you must open the crossing to road traffic after the up train has passed clear of the crossing and start the closure sequence again for the down train.

A link is provided at the crossing between road and railway circuits, which places and maintains at red Bristol City Council's nearby road junction traffic lights when the crossing is required to be closed. An indication labelled **BCC Road Lights**, which is normally blank, is provided on the work station. When the barriers have been lowered, the white light displayed means that the link is working properly.

Depending on which road junction traffic lights require to be placed to red at the time, a delay of up to 30 seconds may occur between start of the sequence and the barriers beginning to lower.

If the red **failed** light flashes and audible warning is received when you press the **lower** button, this means that the link has failed. You must acknowledge the alarm and tell **Operations Control**.

Unless any other indication is also displayed, all railway circuits continue to function normally and you must not treat it as a **failure of equipment** under **Module TS9 / 6.3**. In the circumstances, road traffic will take longer than usual to pass clear of the crossing. You must specially observe the crossing when lowering the barriers.

Black and white CCTV monitors are currently provided.

Figure 49 Road traffic light indications on the signal panel

BASRE proposals

The BASRE proposal is to replicate the existing arrangements with new interlocking equipment and to recontrol the crossing to TVSC Bristol Temple Meads desk, providing colour CCTV monitors and upgrading the lighting at the crossing as required to support this. Existing track circuits would be replaced by axle counters. The impact on the operation of the crossing will therefore be negligible, apart from signaller workload considerations (these are discussed in *Section 3.4*).

MetroWest proposals

The MetroWest proposal is to provide track circuit block signalling to replace the existing token block. The draft scheme sketch provided (Ref. 10) suggests that signal BL2191 in the Down direction would be moved to 595m from the crossing, which is compliant with standards.

2.11 Future demand and use of the level crossing

Any decision to install a level crossing needs to account for both the current use and any reasonably foreseeable increase in future demand that may affect the risk to passengers and the public.

Key factors that can affect the future use are:

- Planned increases to train services or train speeds;
- Local developments (e.g. opening schools, retail outlets, factories);
- Closure of adjacent level crossings, meaning that the road and pedestrian traffic of any closed crossings now use the one subject to assessment.

No current planning applications could be found that would materially impact on the crossing, and there are no nearby public road level crossings that could be altered or closed that would impact the crossing.

The main impact on the crossing is therefore from rail projects; these are discussed below.

BASRE relock and recontrol

No changes that would materially affect the crossing are proposed by BASRE other than those identified in *Section 2.10*.

MetroWest Phase 1 impact on the crossing

MetroWest is proposing to reintroduce a passenger train service between Bristol and Portishead which would pass over the level crossing. Initially the plan was to double track the line and run two trains per hour per direction, but the final proposal is to retain the single track line and introduce a one train per hour per direction passenger service. The future road closure time will be greater once the MetroWest service is introduced, especially if Parson Street station is within the strike-in for Down direction trains.

It is understood that as a mitigation for the increased road closure time MetroWest is planning to provide a pedestrian ramp from the west side of the crossing to the Ashton Road junction to the north. Without knowing the full detail of the plans, it is considered that this is likely to have only a small impact on the usage of the crossing during normal use or during football matches, unless pedestrians are specifically directed to use it rather than the crossing on football match days.

Possible Ashton Gate station development

MetroWest has assessed the possibility of developing a new station at Ashton Gate, about 250m to the south of Ashton level crossing. At this stage the station is not funded, but it remains a possibility for future development.

It is not clear whether the station would affect the usage of the crossing in any way. There would be no road access to the station on the Down (east) side of the railway, so it would not be expected to significantly impact vehicle usage except perhaps on football if many vehicle drivers who park in areas accessed from Ashton Vale Road were to switch to rail instead.

There would be a pedestrian footbridge at the station, so it is possible this could lead to some reduction in pedestrian use of the crossing. There might be possibilities to promote a walking route via the footbridge to Ashton Gate Stadium on football match days, partially alleviating pedestrian issues around the level crossing.

Introduction of trains stopping at the station might have a significant impact in terms of differential train arrival times and road closure time at Ashton Junction crossing as there would potentially be two station stops within the strike in for Down direction trains. Care would need to be taken to minimise the road closure time; an increased road closure time could lead to increased problems with crossing misuse. On a high workload workstation, minimisation of road closure time may not be a priority for signallers.

3 RISK ASSESSMENT AND RECOMMENDATIONS

3.1 Strategic options assessment

Sotera carried out an initial assessment of the closure and renewal options for the crossing, which was then reviewed and updated in a workshop with Network Rail BASRE personnel on 6th October 2017 in Bristol. The participants of the workshop are presented in *Table 6*.

Table 10 Workshop participants

Present	Role
David Harris	Facilitator /Risk specialist (Sotera)
Peter Dray	Risk specialist (Sotera)
Lee Tyack	Network Rail Project Manager BASRE Stage 4
Joel Bragg	Designated Project Engineer

The assessment of strategic closure or upgrade options is provided in *Table 7*. In this table the ALCRM risk score and FWI are shown for two cases: the current level of usage and for the enhanced train service proposed by MetroWest (1 passenger trains per hour per direction). The ALCRM risks are also converted to cost terms and a NPV provided over 30 years.

[HOLD the 1 passenger train per hour MetroWest ALCRM risks are estimated]

Table 11 Closure / level crossing type assessment

Option/ Crossing type	ALCRM				NPV of safety cost over 30 years		Feasibility	Cost		Justification for cost estimate
	Current usage		MetroWest usage		Current usage	Metrowest usage				
	FWI	Score	FWI	Score				Capital	Annual	
Current crossing type (MCB-CCTV)	5.55E-04	J5	1.51E-03	I4	£25,669	£69,638	Moderate level of risk would be increased significantly by the proposed introduction of the Metrowest timetable. MCB-CCTV provides the highest level of protection and with the high usage and blocking back on football match days a manual lower MCB-CCTV crossing likely provides the most effective solution. Train delays may occur during such times when blocking back can be prolonged. Auto-lower would not be recommended due to the blocking back. Road closure time: will be increased with the proposed Metrowest timetable, particularly in Parson Street station is within the strike-in for Down direction trains. Should Ashton Gate station development go ahead then the road closure time could be further increased. Misuse is currently very low, but the increases to road closure time might lead to some increase in the misuse. Workload: Initially crossing will be recontrolled to Bristol Temple Meads (BTM) workstation at TVSC, although there is a longer term aspiration to control the Portishead line from the Bristol South workstation (this is dependent on the BSSR project). Not possible to separate crossing from signalling desk due to need to set road RTLs before	When renewal required: £2m	£17k	CP6 costs Annual cost based on NR whole life costing information

Option/ Crossing type	ALCRM				NPV of safety cost over 30 years		Feasibility	Cost		Justification for cost estimate
	Current usage		MetroWest usage		Current usage	Metrowest usage				
	FWI	Score	FWI	Score				Capital	Annual	
							crossing wigwags. BTM is the highest workload workstation at TVSC, have had to put into place mitigations to make this manageable with the proposed Metrowest rail traffic. The MetroWest plan is to replace token block with track circuit block which would reduce workload. When the Bristol South workstation is available then workload can be managed between the workstations by changing the fringes. SICA date: calculated to be 17.91 nominal life in January 2010 so assume renewal in 2028.			
Closure (alternative access)	0				£0		There is no current alternative route for road or pedestrian users.			
Closure (link road to existing bridge)	0				£0		There is no current bridge to be linked to.			
Closure (new link road and pedestrian bridge)	0				£0		Metrowest consultation considered link road options from the west; the link road itself was considered feasible and generally acceptable to consultees - but closure of the crossing was not generally supported, especially by those who have land interests or tenants on the industrial estate but who are not based there themselves. Two pedestrian bridge options - to the north and the south were considered by Metrowest, and both considered to have issues insofar as replacement of the LC, but no option at the site of the LC was	£4m		Link road: Assume 540m at £2.2k per metre, allowing for bridging of Longmoor brook, i.e. £1.2m. Pedestrian bridge: assume £1.8m for an accessible bridge at Baron's Close, assume £1m for a ramp to the northwest.

Option/ Crossing type	ALCRM				NPV of safety cost over 30 years		Feasibility	Cost		Justification for cost estimate
	Current usage		MetroWest usage		Current usage	Metrowest usage				
	FWI	Score	FWI	Score				Capital	Annual	
							considered. There is the possibility of pedestrian bridge attached to the Metrobus bridge so long as the crossing is closed, however it is unlikely that there would be space for the ramped bridge that would be required to close the crossing and a ramped bridge at Baron's Close plus the ramp to the northwest might both be required.			
Closure + road bridge in situ	0				£0		Not feasible due to site constraints: Metrobus overbridge and complicated road junction to the east, entrances to the west.			
Closure + underpass in situ	0				£0		Not feasible due to site constraints: Metrobus overbridge and complicated road junction to the east, entrances to the west.			
New pedestrian bridge to alleviate high pedestrian usage on football match days			1.23E-03	I4		£57,133	There might be space for a stepped bridge only and even this would be hard to implement; in order to alleviate football match day pedestrian issues, it would need to cross the entire junction to the east. This would be expensive and may not be feasible. MetroWest is providing a pedestrian ramp from the west side of the crossing to the north; this will meet Ashton Road so will provide an alternative, step free pedestrian route. It is considered unlikely to alleviate the pedestrian problems on football match days as it is a rather longer route than using the crossing. The ramp would make a pedestrian bridge even less likely to be feasible as access space to the ramp would need to be provided.	£2m		Assume £2m for a bespoke stepped bridge crossing the crossing and the junction to the east

Option/ Crossing type	ALCRM				NPV of safety cost over 30 years		Feasibility	Cost		Justification for cost estimate
	Current usage		MetroWest usage		Current usage	Metrowest usage				
	FWI	Score	FWI	Score				Capital	Annual	
New link load to the west to alleviate vehicle traffic especially on football match days			1.36E-03	I4	-	£63,073	It would likely to feasible to provide a link road to the west to alleviate traffic congestion, especially on match days. This would likely alleviate some of the blocking back. Consideration could be given to restricting access over the crossing by vehicle type, so that larger vehicles would need to use the new access, or providing one-way operation. There could be a concern that the through route might lead to additional use by through traffic i.e. as a rat run in the event of road congestion elsewhere. It has been assumed that the vehicle risk at the crossing would be halved, i.e. that approximately 50% of the traffic would use the new access route.	£1.2m		Assume 540m road is required at £2.2k per metre, allowing for bridging of Longmoor brook, i.e. £1.2m.
MCB-OD	5.55E-04	J5	1.51E-03	I4	£25,669	£69,638	Less well suited than MCB-CCTV due to matchday issues and blocking back, and would be complicated to incorporate into road traffic light scheme and the token block signalling. Would alleviate workload issues at TVSC, except in failure conditions.	£2.1m	£18k	CP6 costs 0 SEUs assumed Annual cost based on NR whole life costing information Additional cost likely to interface with road traffic lights.

3.2 Options that involve closure of the crossing

The preferred option from a safety perspective is to close the crossing. The following options were considered:

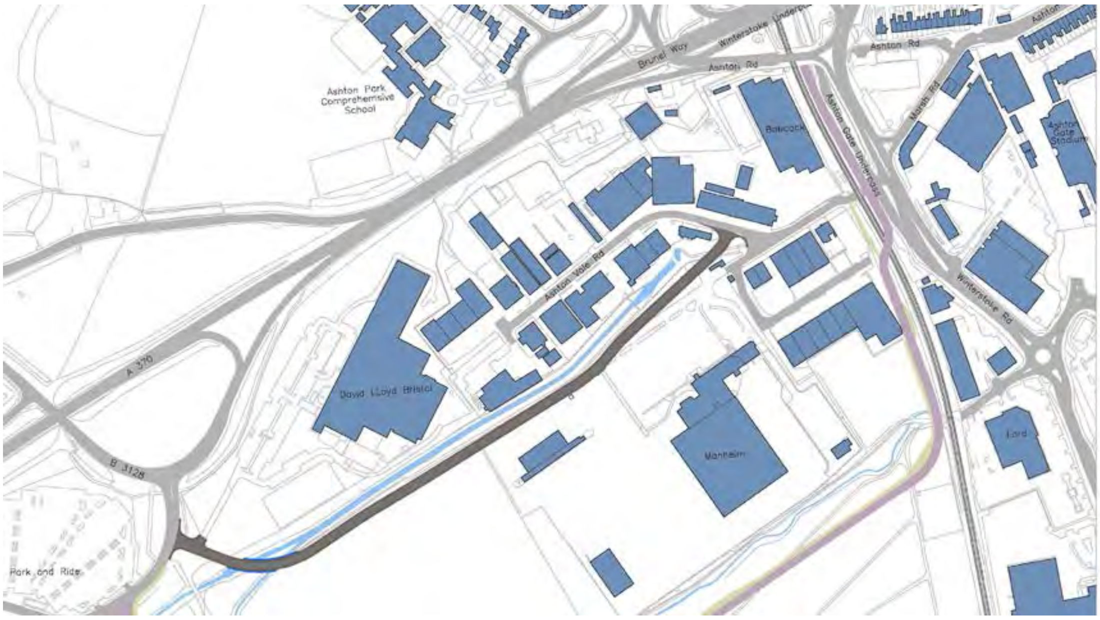
- Crossing closure (currently available alternative access);
- Crossing closure with a diversion to a nearby bridge;
- Crossing closure with a full road bridge or underpass provided;
- Closure (new link road and pedestrian bridge).

The first three of these were not considered to be feasible options that would lead to closure of the crossing, for the following reasons:

- There are no available alternative routes or nearby bridges that could be linked to.
- Bridging options would not be feasible due to the complex road layout, with very little distance to the nearby junction in the east and entrances to businesses in the west. The new MetroBus flyover also prevents road bridge options.

The final option, a new link road to the west and a pedestrian bridge to the east has greater likelihood of being feasible. The MetroWest project carried out ‘micro’ public consultation on this option, having identified several possible routes for a link road to the west and two pedestrian bridging options [Ref. 14]. One of the link road routes is shown in *Figure 50*.

Figure 50 **One of possible alternative vehicle routes identified by MetroWest**



A significant proportion of the respondents supported provision of an alternative route, but wished for the level crossing to remain open to vehicles and pedestrians as well as providing new accesses, rather than being permanently closed. Suggestions were made such as to consider a one-way system or restricted access for certain vehicle types to aid with traffic flow.

The exception to this was from those who have land interests or tenants on the industrial estate but who are not based there themselves. They were strongly against the closure of the level crossing, even with provision of an alternative access. Concerns were raised about the future viability of the industrial estate if the link with Winterstoke Road was removed affecting passing trade and closer connectivity to the urban area.

Two alternative pedestrian accesses were considered as the only viable options:

- Option A – a ramp from close to the entrance to Babcock northwest of the crossing then heading northwest parallel to the railway. This would meet with Aston Road, allowing step free access to the industrial estate from the north. This is shown in *Figure 51.*
- Option B - lies to the south, with a new bridge constructed at the site of Baron's Close pedestrian crossing which would be closed as a result of this scheme. This is shown in *Figure 52.*

Figure 51 Alternative pedestrian route Option A identified by MetroWest

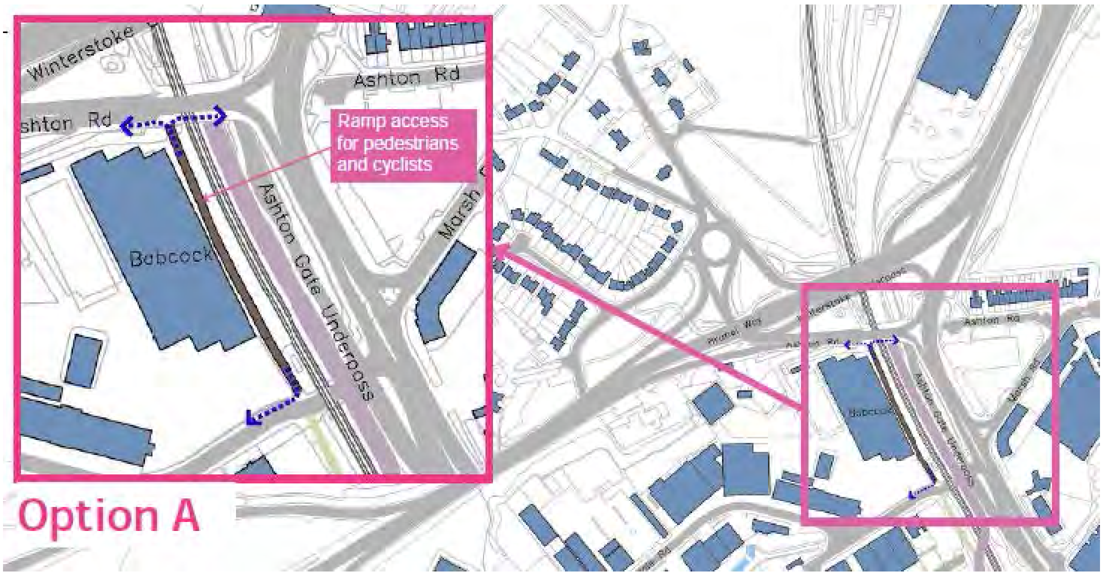
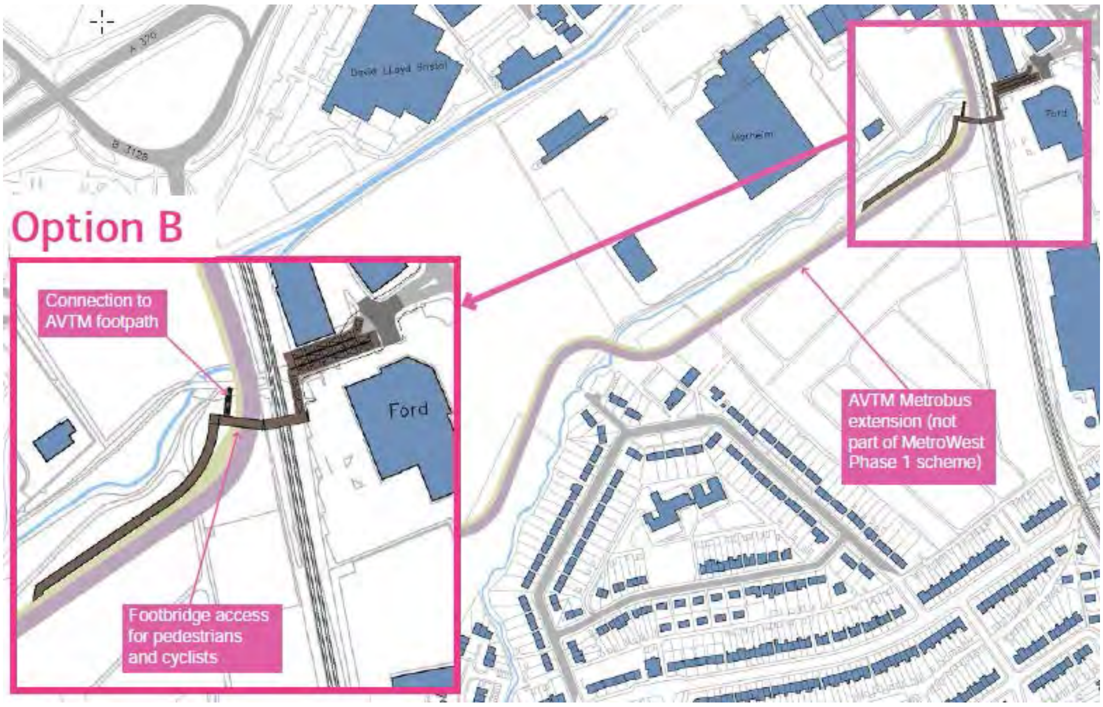


Figure 52 **Alternative pedestrian route Option B identified by MetroWest**



There were mixed opinions on the alternative pedestrian accesses. There was no clear preference between the two options, with many stating that both would be needed in the event of the level crossing being closed permanently.

A number of respondents thought that the natural desire line from the industrial estate was to and from the shops and food outlets further south on Winterstoke Road. It was felt that Option A was directing people too far in the opposite direction and could lead to the creation of informal crossing points along the railway if the fence was compromised.

There were also concerns with regards to the use of the ramp on days when the stadium was in use, as large volumes of people could move onto a width restricted ramp and cause crowding close to the A370 with fast moving traffic.

Option B was a popular choice, but only if Option A was in place as well. Option B was seen to link the industrial estate, Ashton Vale and MetroBus with Winterstoke Road at a more appropriate point than Option A.

Comments regarding the stadium footfall thought that Option B was the only feasible alternative in the event of the level crossing closure, as it is the desire line for MetroBus passengers alighting at Ashton Vale and walking directly to the stadium without a lengthy detour.

However, if delivered on its own, Option B was considered too far south for people wanting to enter the industrial estate from the north who would need to travel almost 600 metres further in total to reach the same point.

No option to provide a pedestrian bridge at the site of the crossing were considered in the consultation, most likely because such an option was not considered to be feasible. It is considered unlikely that there would be sufficient space for a ramped bridge at the site of the current crossing even if the crossing were to be closed because the MetroBus flyover and the proximity to the Ashton Gate underpass create considerable constraints.

It is concluded that level crossing closure might be difficult and expensive to achieve as it might require not just the link road to the west, but also both alternative pedestrian routes. Even then, there is likely to be opposition to the scheme from those who have land interests or tenants on the industrial estate but who are not based there themselves. Any uncertainty created by this would import significant project risk should closure be sought as an outcome.

3.3 Consideration of crossing types

If crossing closure is not feasible, the only alternative is to retain or renew the level crossing. Only a MCB-CCTV and MCB-OD maintain or improve the current level of safety performance. These options are considered below.

Retain MCB-CCTV

The current crossing is not approaching the end of its asset life – its current SICA renewal date is set assessed to be 2028. Therefore there is no need to renew the crossing.

The risk presented by Ashton Junction LC is, according to ALCRM, currently relatively modest for a public road crossing at 5.6 x 10^{-4} FWI per year. This would be unchanged by the BASRE proposals to recontrol the crossing to TVSC.

The risk would be increased by the MetroWest proposals to reintroduce a passenger service over the crossing. With a 1 train per hour per direction passenger service in addition to the current levels of freight usage the risk is predicted to increase by a factor of 1.7 to 1.5 x 10^{-3} FWI per year. This residual risk is equivalent to a monetised cost of approximately £70k in NPV terms over a nominal 30-year life of a crossing with the current usage.

MCB-CCTV provides the best type of crossing to manage the risk from the severe blocking back that can occur on football match days.

The main disadvantages of a MCB-CCTV crossing are:

- The workload implication due to the requirement to manually monitor the crossing within the signalbox via the CCTV. This is discussed below.

- The road closure time would be increased by the proposed train frequency enhancement, particularly if Parson Street station is within the strike-in for Down direction trains. Any future development of a station at Ashton Vale could also exacerbate this.

The current BASRE proposal is to recontrol the crossing to the Bristol Temple Meads (BTM) desk at TVSC. This desk has a high workload, therefore a plan to manage this has been developed:

- Initially upon recontrol the train frequency would be low (as it is currently) so the crossing would not often contribute significantly to the signaller workload.

- The MetroWest proposal is to replace the token block signalling with track circuit block; this would reduce the signaller workload as a result, offsetting the increase in workload due to the additional train frequency over the level crossing.

- When the Bristol South workstation is available then workload can be managed between the workstations at TVSC by reconfiguring the fringes.

- The long term aspiration is to control the Portishead line from the Bristol South workstation. This is dependent on the BSSR project which will transfer control of the final portion of the Bristol PSB area to TVSC, thus fully populating the Bristol South workstation.

It is understood that this plan should ensure that the workload is manageable at each stage.

Renew as an MCB-OD

Renewal as an MCB-OD would provide a broadly similar level of risk as the current crossing type.

An MCB-OD would not incur the workload cost that MCB-CCTV might incur, apart from in failure conditions.

The main disadvantages of an MCB-OD crossing are:

- The road closure time would be increased due to the increase in traffic (similar to the MCB-CCTV option).

- There is significant blocking back at the crossing, in particular on football match days. As a minimum BPM would be required to alleviate the risk of barrier strikes on vehicles, but even so operational disruption could occur should blocking back be prolonged and the crossing enter a failed state.

- MCB-OD would be more complex to provide at Ashton Junction than at other locations due to the interface with the road traffic lights for the junction and also by the need to interface with the token instruments if this is even possible. Possibly it might be necessary to resignal the line, which is not within the BASRE remit.

The cost of renewal as MCB-OD is estimated at £2.1m, based on standard CP6 costs [4], but an enhanced signalling system might be required which would increase this cost to BASRE.

Conclusion about crossing type

Renewal of the crossing is not required and MCB-OD is not more desirable than MCB-CCTV at this location, other than from a signaller workload perspective. Given the additional cost and complexities involved at providing MCB-OD at this location and issues around blocking back, retaining the existing MCB-CCTV is the preferred crossing option for Ashton Junction.

3.4 Options to reduce crossing usage and alleviate congestion on football match days

It is clear from the traffic census that there are significant issues around the crossing on football match days. At a MCB-CCTV crossing, the risk from blocking back is generally well managed and train delays are much more likely than any safety incident (unless the signaller makes an error or the train driver passes a signal at danger). The signaller workload would however be increased in such circumstances and trains could be delayed, the potential for signaller or driver errors is also increased.

There would also be increased likelihood of crossing misuse due to an increased road closure time and the increased likelihood that usage of the crossing by large groups of pedestrians would coincide with approaching trains.

When the passenger train service is introduced by the Metrowest project, the issues around football match days would be expected to become more apparent.

It is understood that the MetroWest project proposes to implement Option A for alternative pedestrian access from its consultation i.e. a ramp from the northwest side of the crossing to meet Ashton Road to the northwest. This will presumably reduce the general pedestrian usage of the crossing to some degree, but it is considered unlikely that it would have a significant impact on pedestrian usage or behaviour in the vicinity of the crossing on football match days because the route is not on the desire line for football fans and would entail an additional walking distance of about 310m.

Consideration is therefore given to other options to alleviate problems associated with football match days:

- A link road to the west to reduce vehicle usage over the crossing.
- A stepped footbridge close to the crossing to reduce pedestrian usage over the crossing.

These are discussed below.

Link road to the west to reduce vehicle usage over the crossing

This option would provide the link road to the west discussed in Section 3.2, whilst retaining the level crossing. It is likely to be feasible as discussed earlier.

This option would have the benefit of reducing the vehicle usage of the crossing. This would help to mitigate any frustration associated with the increased road closure time when passenger services are introduced and should reduce the blocking back experienced at the crossing.

Having access to Ashton Vale Road from the west would bring options for the management of traffic flows, both during normal use and on football match days. For example, it might be possible to ban larger vehicles from using the crossing which could significantly reduce the incidence of some types of blocking back, especially large vehicles being blocked by parked vehicles which was responsible for the very long duration incident in the census. Another option might be to direct all football traffic to use the western access which if effective could significantly reduce blocking back caused by Ashton Gate Underpass being blocked by pedestrians.

The cost of this link road is not known, but has been estimated to be at least £1.2m by Sotera. It is hard to justify this on safety grounds alone, as the risk impact would be modest (the ALCRM safety benefit is equivalent to just £7k over 30 years assuming that the vehicle risk at the crossing is reduced by 50%, however this does not include any risk associated with blocking back). To justify such a scheme the cost associated with train delays would need to be factored into a business case.

Stepped footbridge close to the crossing to reduce pedestrian usage over the crossing

This option would provide a stepped footbridge at the crossing, whilst retaining the level crossing. It is envisaged that the footbridge might attach to the bottom of the MetroBus flyover; space limitations would preclude a ramped bridge, but possibly a stepped bridge might be possible. A site survey would be required to confirm this.

This option would have the benefit of reducing the pedestrian usage of the crossing slightly, and should help to mitigate any frustration associated with the increased road closure time when passenger services are introduced. It would not address any of the blocking back issues on football match days unless it were to also cross Ashton Gate Underpass and Winterstoke Road, and even so might bring limited benefit as many fans would likely take the route of least resistance i.e. the ground level route across the roads as they do currently. It would also introduce hazards associated with falls or dropped objects from the bridge.

The cost of such a bridge is very hard to assess, but likely to be considerable.

Conclusion about additional access

The problems at the crossing associated with football match days are currently limited by the low train frequency; in many cases freight train arrivals are unlikely to coincide with periods of high use before and after a game. Despite this, three trains did coincide with football traffic on 25th August.

In the future, when the proposed MetroWest passenger services are introduced then the problems will be magnified and train delays might sometimes occur; there would also be increased possibility of misuse at the crossing associated with higher road closure times.

Of the two options considered, the link road scheme would appear to be the more likely to be feasible, is likely to be less expensive and would appear to offer greater potential to reduce blocking back. It is not possible to justify the scheme financially on safety grounds, but it is recommended that the MetroWest project considers a fuller business case, accounting for a full range of benefits including:

- Reduced train delays due to blocking back.
- Safety benefits from reduced vehicle usage, misuse and blocking back.
- Reduced asset and performance risk from barrier strikes.

The pedestrian ramp option that MetroWest is proposing to provide would appear to offer limited potential for improvements on football match days unless it is part of some larger scheme or plan to reroute pedestrian flows.

3.5 Options for additional controls for the selected crossing type

The workshop considered the key level crossing hazards. A key input to this part of the workshop was a set of hazards identified in the workshop and during the site visit. The hazards and additional potential controls are presented in *Table 8*.

The following additional controls are recommended for consideration; it may be more appropriate for the MetroWest project than the BASRE project to consider some of these as BASRE is not currently proposing to update the crossing ground plan:

- Provide tactile paving at the footway ends.
- Provide tactile paving and white lines to denote the footway ends.
- Upgrade the trespass guards to a modern type.
- As the passenger train service is introduced and the road closure time increases monitor misuse levels and provide red light enforcement cameras if required.

- Liaise with the council and the police about introducing some means of parking enforcement in the vicinity of the crossing.
- Recommend improved liaison with the police, especially regarding parking enforcement on match days and to emphasise the importance of keeping the crossing and nearby roads clear.
- Liaise with the council to provide signage for the junction with the A3029 when approaching from the west.
- Improved maintenance of keep clear lines for the turn into Babcock.
- Provide enhanced lighting suitable for colour CCTV.
- Ensure that a viable plan to manage the workload at TVSC at all resignalling stages is in place.

Table 12 Results of risk controls assessment workshop

Local hazard	Comment	Existing controls	Possible additional controls	Feasibility	Conclusion
Low sun	May be some sun effect towards sunset in winter, and sunrise in summer, however the buildings either side of the crossing and low road approach speed should help to mitigate the sun impact. There are also road traffic lights.	LED RTLs	Extended hoods	Yes	Not recommended: due to the road speed and there are two sets of lights including the road RTLs so this is unlikely to be a significant issue
			Lower glare road surface	Yes	Not recommended: with significant use by large vehicles maintenance would be prohibitively expensive
Footways	Footways 1.75m width (Up side) and 2.00m wide (Down side). Length 6m. Generally quite level with no identified trip hazards other than associated with current building works and very slightly uneven paving in the YN corner. Metrowest timetable would give TPV of 618 which suggests a 2m width required. Football days give very intense usage and overflow onto road (also on surrounding pavement/road interfaces).	None	Increased footway widths	Yes	Not recommended: footways are wide and the video evidence indicates that users walk down the road apart from on football match days when the benefit of wider footways would be limited as the whole road width is used by pedestrians
Tactile paving	No tactile paving at the crossing, although this is provided at the nearby road crossing points	None	Tactile paving at footway ends	Yes	Recommended
No boundary markings for the pedestrian footways	It is normal to provide a white line denoting the end of the footways, could give rise to very slight risk of a pedestrian being struck by a barrier	CCTV monitoring of barrier lowering	White lines at footway ends	Yes	Recommended
Use in darkness	There is good street lighting. The census showed some pedestrian and cyclist use during darkness.	CCTV lighting Level footways	None recommended		

Local hazard	Comment	Existing controls	Possible additional controls	Feasibility	Conclusion
Trespass / vehicle drives down railway	Trespass guards are of wooden type Confusing nature of junction could give rise to a very slight risk of a vehicle turning down the railway, although the narrow width due to the single line and available street lighting on all roads significantly reduce the likelihood of this	Wooden trespass guards	Trespass guards (modern type)	Yes	Recommended
Crossing length	Length barrier to barrier is short (6m)	None	None recommended		
RTL approach visibility	The crossing RTLs have good visibility on the down side approach (100m), but this is limited on the up side (20m), however the road RTLs have much greater approach visibility on the up side.	RTLs on up side are angled for the close approach after the road RTLs	None recommended: the current arrangement is likely optimum (additional RTLs would increase clutter)		
Cyclist falls	Fairly high level of cyclist use, but rails are perpendicular to the road (now skew). Crossing generally quite level, with only some very slight uneveness at the edge of the deck where a sill is damaged. Use by large, heavy vehicles subjects crossing to significant wear.	Concrete deck panels Maintenance regime	None recommended above standard remedial maintenance		
Misuse	Current misuse levels seem to be low, but potentially this could increase with the MetroWest train service which would increase the road closure time	CCTV monitoring of crossing clear Road traffic lights set to red before crossing sequence is initiated	Red light enforcement cameras	Yes	Monitor misuse with the increased train service and provide if required
Blocking back	There are several notable causes of blocking back: 1. Football traffic combined with parked vehicles just to west of crossing (especially large vehicles including coaches and car transporters) 2. Football traffic combined with pedestrians blocking roads, especially the Aston gate	CCTV monitoring of crossing clear Yellow box marked on crossing and on approach to junction to the east Keep clear on road for the Babcock entrance (rather worn)	Liaison with police to improve parking enforcement in the vicinity of the crossing on football matchdays and to take more proactive measures to keep the crossing clear	Yes	Recommend improved liaison with the police

Local hazard	Comment	Existing controls	Possible additional controls	Feasibility	Conclusion
	underpass slip road 3. Queues on the Ashton gate underpass 4. Large vehicles manoeuvring into the entrance just to the southwest of the crossing 5. Vehicles blocked when turning right into Babcock 6. Vehicles stopping due to confusion / indecision at road layout east of crossing The census showed that some serious and prolonged incidents of blocking back can occur on football matchdays and to a much lesser degree at other times. This might increase with the Metrowest timetable as vehicles would be more bunched and the road available time reduced.		Increased parking enforcement in the vicinity of the crossing	Yes	Recommended through council and police liaison
			Road signing for the junction to the east (i.e. left turns from Ashton Vale Road when heading northeast)	Yes	Recommend persue council to provide signage
			Improved maintenance of keep clear lines for the turn into Babcock	Yes	Recommended, but an ongoing maintenance issue
Dropped objects from skip lorries	Crossing is quite level so this is unlikely if it is maintained to its current state	Crossing surface quite level CCTV monitoring of crossing clear	None recommended		
Temporary road traffic lights could cause vehicles to stop under barriers or on the crossing	A vehicle travelling slowly over the crossing (eastbound) could be stopped at the temporary traffic light with the junction and with only about 4.5m of space could be stopped on the crossing. An example, admittedly in an unusual circumstance, was identified from the census footage	CCTV monitoring of crossing clear	Removal of temporary traffic light	Yes	The temporary lights will be removed. MetroBus is close to completion.

Local hazard	Comment	Existing controls	Possible additional controls	Feasibility	Conclusion
Signalling arrangements	Crossing is unusual in that it is in a token-block section, with the CCTV image initiated by operation of the token machines. This operation is not being changed by BASRE, but Metrowest proposes resignalling to track circuit block.	Protecting signals Run-by protection	None recommended		
Lighting levels not to current standard	This is based on lighting survey report PR045-025-15-05-215-V01		Provide enhanced lighting suitable for colour CCTV	Yes	Lighting to be investigated - upgrade is recommended.
Failure of road traffic lights	Signaller is able to lower the barriers in the event of road traffic light failure. What is the process for this?	Signalbox instruction requires that signaller specifically monitor barrier lowering			
High workload at the TVSC	Workload assessment indicates high workload in TVSC.	Low train frequency initially			A proposed approach to manage the workload is in place: i) Low train frequency on recontrol ii) Replace token system with track circuit block before passenger train service introduced iii) Split workload between workstations at TVSC by moving fringes iv) Eventually move Portishead line to Bristol South workstation
SPAD	Would appear low likelihood as a mandatory stop for token exchange is required at both locations BL2192 shows an overrun distance of 225m to the crossing BL2191 shows an overrun distance of 422m to the crossing.	Overrun protection is provided	None recommended		SPADs are considered to be unlikely as both locations are mandatory stops due to the token exchange points

4 RESIDUAL RISKS

As discussed in *Section 4*, the preferred solution for this crossing is to retain it as the current type (MCB-CCTV). This section presents the residual risk for this crossing type according to ALCRM, with the current and proposed enhanced train frequency. It also compares the risk against the risk at an average MCB-CCTV/OD type crossing across the network. The results of the analysis are presented in *Figure 38*. The blue bars represent the risk at Ashton Junction, the red bars present the average risk from MCB-CCTV/OD.

Figure 53 Crossing risk compared to average crossing risk

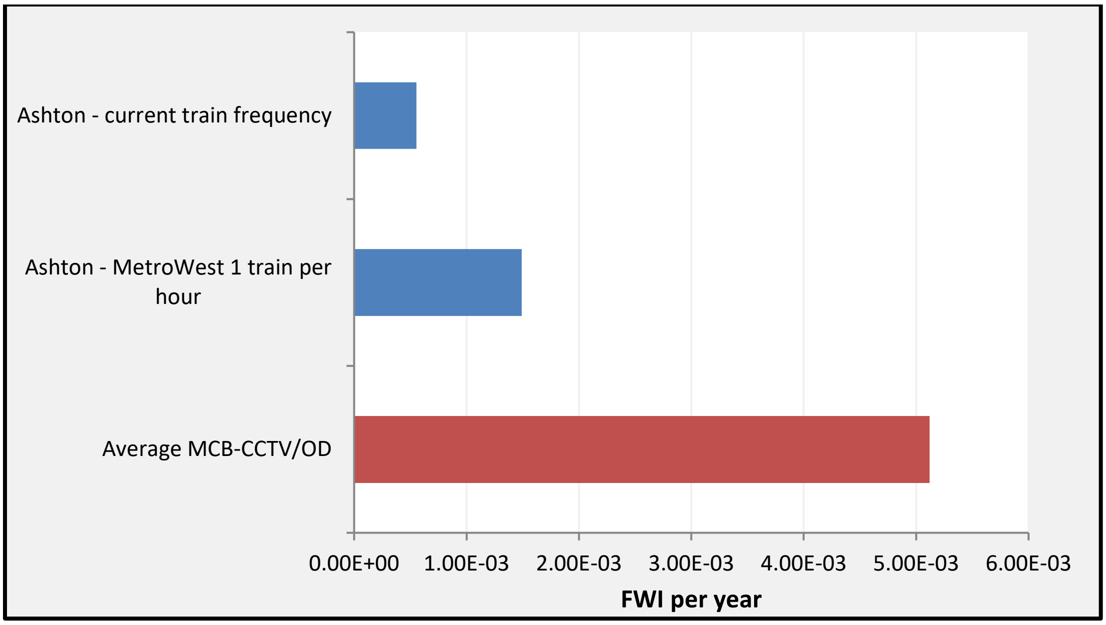


Figure 38 shows that:

- The risk at Ashton Junction as a MCB-CCTV is well below the average risk for this type of crossing, even with the proposed enhanced train frequency.

5 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The following conclusions and recommendations are made from the risk assessment:

Risk is low but there are issues associated with football match days

1. The current safety risk at Ashton Junction is relatively low as the crossing is of a type that offers a high degree of protection (MCB-CCTV) and the train frequency is low.

2. There are however significant issues around the use of the crossing on football match days at the nearby Ashton gate stadium when a large amount of car parking on the industrial estate is used by football fans. The traffic census recorded some significant blocking back incidents, including one when a car transporter and a car behind were stopped on the crossing for almost four minutes.

3. On football match days there were two main causes of blocking back observed:

    - Parking close to the crossing on the west side that blocked or slowed large vehicles from clearing the crossing.

    - Traffic close to the crossing, particularly on Ashton Gate Underpass to the east, being stopped by large groups of pedestrians crossing and walking in the road.

    There were also cases of traffic being stopped by vehicle drivers stopping to talk to pedestrians, possibly in order to obtain directions and of vehicles stopping on the junction to the east of the crossing due to confusion as to which left turn to take.

4. In the unlikely event of a train collision with a vehicle stopped on the crossing on football match days the potential consequences could be severe despite the relatively low line speed due to the type of vehicles involved (coaches, car transporters for example) and the large number of pedestrians nearby.

5. Police were present in the vicinity of the crossing on the football match day but appeared to do only a limited amount to ensure free flow of traffic over the crossing. Indeed, on one occasion a police officer was observed to be standing on the crossing when directing traffic and later on a police van stopped for an extended period very close to the crossing on the northeast side in order to pick up colleagues.

6. Blocking back was also occasionally observed on non-match days, with a number of different causes:

    - Queues northbound on Ashton gate underpass.

- Large vehicles manoeuvring into the entrance just to the southwest of the crossing.
- Vehicles blocked when turning right into Babcock.
- Vehicles stopping due to confusion / indecision at the road layout east of the crossing.

BASRE impact is limited but MetroWest impact is more significant

7. The BASRE project plan is to replicate the existing signalling arrangements with new interlocking equipment and to recontrol the crossing to TVSC Bristol Temple Meads desk, providing colour CCTV monitors and upgrading the lighting at the crossing as required to support this. Existing track circuits would be replaced by axle counters. The train frequency will be unchanged and no other physical changes to the crossing are proposed. The impact on the operation of the crossing will therefore be negligible, apart from signaller workload considerations.

8. By contrast, a following project, MetroWest phase 1, is planning to reintroduce a passenger train service between Bristol and Portishead which would pass over the level crossing. Initially the plan was to double track the line and run two trains per hour per direction, but the final proposal is to retain the single track line and introduce a one train per direction passenger service. To achieve this, MetroWest will provide track circuit block signalling to replace the existing token block.

9. The future road closure time will be greater once the MetroWest service is introduced, especially if Parson Street station is within the strike-in for Down direction trains.

10. The increased train frequency on the line will increase the signaller workload on the BTM panel at TVSC, however this will be offset by the change to track circuit block signalling.

11. There is the possibility of a future station development to the south of the crossing, although this is not currently funded. If this station were developed then it could potentially increase the road closure time further.

12. The MetroWest proposals cause concern that the issues around the crossing on football match days could be exacerbated, and that crossing misuse, which is thought to be quite low currently, could increase with the increase in road closure time.

13. To help alleviate these issues, MetroWest is proposing a pedestrian ramp from the west side of the crossing to meet Ashton Road to the northwest, however this would appear to offer limited potential for improvements on football match days unless it is part of some larger scheme or plan to reroute pedestrian flows.

Closure might be feasible but would be difficult, expensive and uncertain

14. There is one potentially feasible option that could lead to closure of the crossing: provision of a link road from the west, combined with new pedestrian access provisions to the north and the south of the existing crossing.

15. This option would however be expensive, and would come at a cost which is grossly disproportionate to the safety benefit of crossing closure. Pursuing this option would also introduce significant project risk as it would not necessarily lead to outright crossing closure due to objections from land owners who have tenants on the industrial estate.

16. It is therefore concluded that there as are no viable closure options for Ashton Junction and a level crossing will need to be retained at this location.

Retaining the existing MCB-CCTV provides the preferred option

17. The current crossing is not approaching the end of its asset life – its current SICA renewal date is set assessed to be 2028, therefore there is no need to renew the crossing.

18. The risk presented Ashton Junction LC is, according to ALCRM, currently relatively modest for a public road crossing at 5.6 x 10^{-4} FWI per year. This would be unchanged by the BASRE proposals to recontrol the crossing to TVSC. The residual risk is equivalent to a monetised cost of approximately £26k in NPV terms over a nominal 30-year life of a crossing with the current usage.

19. With the planned reintroduction of passenger services by the MetroWest project the risk would increase to 1.5 x10^{-3} FWI per year; this residual risk is equivalent to a monetised cost of approximately £70k in NPV terms over a nominal 30-year life of a crossing with the current usage.

20. MCB-CCTV provides the best type of crossing to manage the risk from the severe blocking back that can occur on football match days.

21. The main disadvantages of a MCB-CCTV crossing are:

- The workload implication due to the requirement to manually monitor the crossing within the signalbox via the CCTV. This is problematic as the BTM workstation at TVSC will have a high workload, the BASRE project has assessed this and has developed plans to manage this.

- The road closure time would be increased by the proposed train frequency enhancement, particularly if Parson Street station is within the strike-in for Down direction trains. Any future development of a station at Ashton Vale could also exacerbate this. This would also apply to any other type of full barrier crossing such as MCB-OD.

22. Renewal as an MCB-OD would provide a broadly similar level of risk as the current crossing type.

23. An MCB-OD would not incur the workload cost that MCB-CCTV might incur, apart from in failure conditions.

24. The main disadvantages of an MCB-OD crossing are:

- The road closure time would be increased due to the increase in traffic (similar to the MCB-CCTV option).
- There is significant blocking back at the crossing, in particular on football match days. As a minimum BPM would be required to alleviate the risk of barrier strikes on vehicles, but even so operational disruption could occur should blocking back be prolonged and the crossing enter a failed state.
- MCB-OD would be more complex to provide at Ashton Junction than at other locations due to the interface with the road traffic lights for the junction and also due to the need to interface with the token instruments if this is even possible. Possibly it might be necessary to resignal the line, which is not within the BASRE remit.

25. Given the additional cost and complexities involved at providing MCB-OD at this location and issues around blocking back, recontrolling the existing MCB-CCTV is the preferred crossing option for BASRE.

MetroWest should consider the best approach to reduce the problems associated with football match days

26. The problems at the crossing associated with football match days are currently limited by the low train frequency; in many cases freight train arrivals are unlikely to coincide with periods of high use before and after a game. Despite this, three trains did coincide with evening football traffic on 25th August when the census footage was captured.

27. In the future, when the proposed MetroWest passenger services are introduced then the problems will be magnified and train delays might sometimes occur; there would also be increased possibility of misuse at the crossing associated with higher road closure times and with large groups of pedestrians potentially coinciding more frequently with approaching trains.

28. Two options to alleviate some of the issues around football match days have been considered. Of these, a link road scheme would appear to be the more likely to be feasible, is likely to be less expensive and would appear to offer greater potential to reduce blocking back. It is not possible to justify the scheme financially on safety grounds, but it is recommended that the MetroWest project considers a fuller business case, accounting for a full range of benefits including:

- Reduced train delays due to blocking back.

- Safety benefits from reduced vehicle usage, misuse and blocking back.

- Reduced asset and performance risk from barrier strikes.

29. The pedestrian ramp option that MetroWest is proposing to provide would appear to offer limited potential for improvements on football match days unless it is part of some larger scheme or plan to reroute pedestrian flows.

30. It is therefore recommended that MetroWest takes account of the findings from the traffic census presented in this report and undertakes a fuller assessment of options to alleviate football match day blocking back at the crossing.

Options for additional controls for the selected crossing type

31. The following additional controls are recommended for consideration; it may be more appropriate for the MetroWest project than the BASRE project to consider some of these as BASRE is not currently proposing to update the crossing ground plan:

- Provide tactile paving at the footway ends.

- Provide tactile paving and white lines to denote the footway ends.

- Upgrade the trespass guards to a modern type.

- As the passenger train service is introduced and the road closure time increases monitor misuse levels and provide red light enforcement cameras if required.

- Liaise with the council and the police about introducing some means of parking enforcement in the vicinity of the crossing.

- Recommend improved liaison with the police, especially regarding parking enforcement on match days and to emphasise the importance of keeping the crossing and nearby roads clear.

- Liaise with the council to provide signage for the junction with the A3029 when approaching from the west.

- Improved maintenance of keep clear lines for the turn into Babcock.

- Provide enhanced lighting suitable for colour CCTV.

- Ensure that a viable plan to manage the workload at TVSC at all resignalling stages is in place.

5.2 Recommendations

Sotera makes the following recommendations:

1. Given the difficulty of closing the crossing, and the additional cost and complexities involved in providing MCB-OD at this location together with issues around blocking back, recontrolling the existing MCB-CCTV to TVSC is the recommended option for the BASRE project.

2. It is recommended that the MetroWest project undertakes a suitable and sufficient risk assessment and takes account of the findings from the traffic census presented in this report to undertake a full assessment of options to alleviate football match day issues associated with blocking back and pedestrian usage.

3. The following additional controls are recommended for consideration; it may be more appropriate for the MetroWest project than the BASRE project to consider some of these as BASRE is not currently proposing to update the crossing ground plan:

    - Provide tactile paving at the footway ends.
    - Provide tactile paving and white lines to denote the footway ends.
    - Upgrade the trespass guards to a modern type.
    - As the passenger train service is introduced and the road closure time increases monitor misuse levels and provide red light enforcement cameras if required.
    - Liaise with the council and the police about introducing some means of parking enforcement in the vicinity of the crossing.
    - Recommend improved liaison with the police, especially regarding parking enforcement on match days and to emphasise the importance of keeping the crossing and nearby roads clear.
    - Liaise with the council to provide signage for the junction with the A3029 when approaching from the west.
    - Improved maintenance of keep clear lines for the turn into Babcock.
    - Provide enhanced lighting suitable for colour CCTV.
    - Ensure that a viable plan to manage the workload at TVSC at all resignalling stages is in place.

MetroWest

Portishead Branch Line (MetroWest Phase 1)

TR040011

Applicant: North Somerset District Council
6.25, Environmental Statement, Volume 4, Technical Appendices, Appendix 16.1: Transport Assessment – Appendix N, Ashton Vale Road
The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009, Regulation 5(2)(a)
Planning Act 2008

Author: CH2M
Date: November 2019

NetworkRail | West of England Local Enterprise Partnership | West of England Combined Authority | HM Government | Bath & North East Somerset Council | Bristol City Council | North Somerset Council | South Gloucestershire Council | travelwest

PORTISHEAD BRANCH LINE DCO SCHEME
(METROWEST PHASE 1)
ENVIRONMENTAL IMPACT ASSESSMENT

Transport Assessment
Appendix N
Ashton Vale Road
Junction Assessments

Prepared for

West of England Councils

July 2018

1 The Square
Temple Quay
Bristol
BS1 6DG

Contents of Appendix N, Ashton Vale Road Junction Assessments

Appendix N to the MetroWest Phase 1 DCO Transport Assessment sets out the analysis that has been carried out considering the Ashton Vale Road junction and level crossing.

- Part 1 of Appendix N – is a Transport Evidence Explanatory Note; this brings together and summarises all the pertinent information related to the assessments of the Ashton Vale Road/Winterstoke Road signal controlled junction and level crossing.

The remainder of the Appendix provides more details of the information and modelling that the Transport Explanatory Note draws on, and includes the following:

- Part 2 – is a technical note outlining the series of traffic counts carried out at the Ashton Vale Road/Winterstoke Road junction since 2014;
- Part 3 – is a technical note describing train operating scenarios at the Ashton Vale Road level crossing;
- Part 4 – sets out the junction modelling carried out using LinSIG; and
- Part 5 – describes development and use of the VISSIM traffic simulation model of the junction area (including model validation and forecasting reports).

Document History

Portishead Branch Line DCO Scheme (MetroWest Phase 1)
Transport Assessment, Appendix N
Ashton Vale Road Junction Assessments

Reference Number: 674946.CS.70.01/TA

Client Name: West of England Councils

This document has been issued and amended as follows:

Version	Date	Description	Created by	Verified by	Approved by
01	June 2018	Draft	SS/LT/GW/DL	HS/LT/DL	HS
02	July 2018	Draft Final	SS/LT/GW/DL	HS/LT/DL	HS
03	July 2018	Final	SS/LT/GW/DL	HS/LT/DL	HS

TECHNICAL MEMORANDUM

MetroWest Phase 1
Ashton Vale Road: Transport Evidence Explanatory Note

PREPARED FOR:	WoE Councils
PREPARED BY:	DL
DATE:	23rd July 2018
PROJECT NUMBER:	674946.CS.70.0
REVISION NO.:	1 1
APPROVED BY:	**DRAFT**

1.0 Introduction

1.1 Background

The MetroWest Phase 1 project comprises the delivery of infrastructure and passenger train operations to introduce new/enhanced rail passenger services across Bristol with a service pattern between Portishead, Bath Spa and Severn Beach, with intermediate stops. This will entail upgrading the existing freight only line between Parson Street junction and Portbury Dock junction (Pill), reinstatement of the current disused line between Portbury Dock junction and Portishead, and various minor works to facilitate the operation of the Phase 1 train services. A new station will be required at Portishead and the former station at Pill will be re-opened.

The Planning Act 2008 introduced the Development Consent Order (DCO) as the means of seeking planning permission for developments categorised as Nationally Significant Infrastructure Projects (NSIP); the scheme is classed as an NSIP. The specific DCO scheme comprises the re-construction of the disused railway line between Portishead and Pill, construction of a new station at Portishead, refurbishment of the disused station in Pill and the enhancement works to the Portbury freight line.

CH2M (now Jacobs) has been appointed to prepare a Transport Assessment (TA) in support of the Portishead Branch Line DCO scheme for MetroWest Phase 1 proposal to reopen the Portishead line with stations at Portishead and Pill. The signal controlled Winterstoke Road/Ashton Vale Road junction and adjacent Ashton Vale level crossing has been considered in some detail as part of the Transport Assessment. This is to specifically assess the impact of increased level crossing closures due to MetroWest Phase 1 services on the Portishead line, and has included analysis using LinSIG and VISSIM models of the junction.

This 'Transport Evidence Explanatory Note' (TEEN) draws together all the key data inputs and findings from the modelling work undertaken to assess the severity of impact on local highway operating conditions with a greater frequency of level crossing closures.

1.2 Ashton Vale Level Crossing

The existing freight only line between Parson Street junction and Portbury Dock junction (Pill), includes the existing Ashton Vale level crossing, which crosses Ashton Vale Road close to its junction with Winterstoke Road, the location of which is shown in **Figure 1**. Ashton Vale Road is the sole road access route into the Ashton Vale Industrial Estate. Winterstoke Road forms a key distributor in southern Bristol, linking the A370 at Ashton Gate with the A38 near Parson Street. The junction is signal-controlled. With its proximity to the road junction, the level crossing is linked to the traffic signals, to prevent traffic from accessing Ashton Vale Road when the level crossing is closed to road vehicles for the passage of trains.

As noted above, MetroWest Phase 1 will introduce an hourly passenger service to Portishead, thus introducing regular passenger trains services through the level crossing at Ashton Vale Road, in addition to the irregular passage of freight trains on the Portbury line related to the Port of Bristol.

After this Introduction, the remainder of this Transport Explanatory Note goes on to consider:

- Section 2 - Traffic counts of the junction in recent years;
- Section 3 - The robustness of assessment tools, LinSIG and VISSIM, against guidance and best practice;
- Section 4 - A summary of level crossing closures times associated with the scheme;
- Section 5 - An assessment of current conditions and current signal operation using LinSIG analyses, and the expected operating outcomes from a 'stand-alone' level closure crossing event with present flows;
- Section 6 - The impacts of level crossing closures associated with the scheme in current and future traffic conditions using VISSIM real-time micro-simulation modelling; and
- Section 7 - An overview on the potential impact taking account of all the modelling findings (LinSIG and VISSIM).

Details in each case are contained in the following documents referenced in this TEEN as appropriate:

- **Technical Memorandum: 'Ashton Vale Road Traffic Counts'**, dated 3rd July 2018;
- **Technical Memorandum: 'Ashton Vale Road: Level Crossing Train Times**, dated 5th July 2018;
- **Technical Memorandum: 'MetroWest (Phase 1): A3029 Winterstoke Road/Ashton Vale Road - LinSIG Modelling'**, dated 6th July 2018;
- **Technical Report: 'MetroWest Phase 1: Winterstoke Road/Ashton Vale Road VISSIM Model Local Model Validation Report'**, dated 6th July 2018; and
- **Technical Report: 'MetroWest Phase 1: Winterstoke Road/Ashton Vale Road VISSIM Model Testing Report'**, dated 6th July 2018.

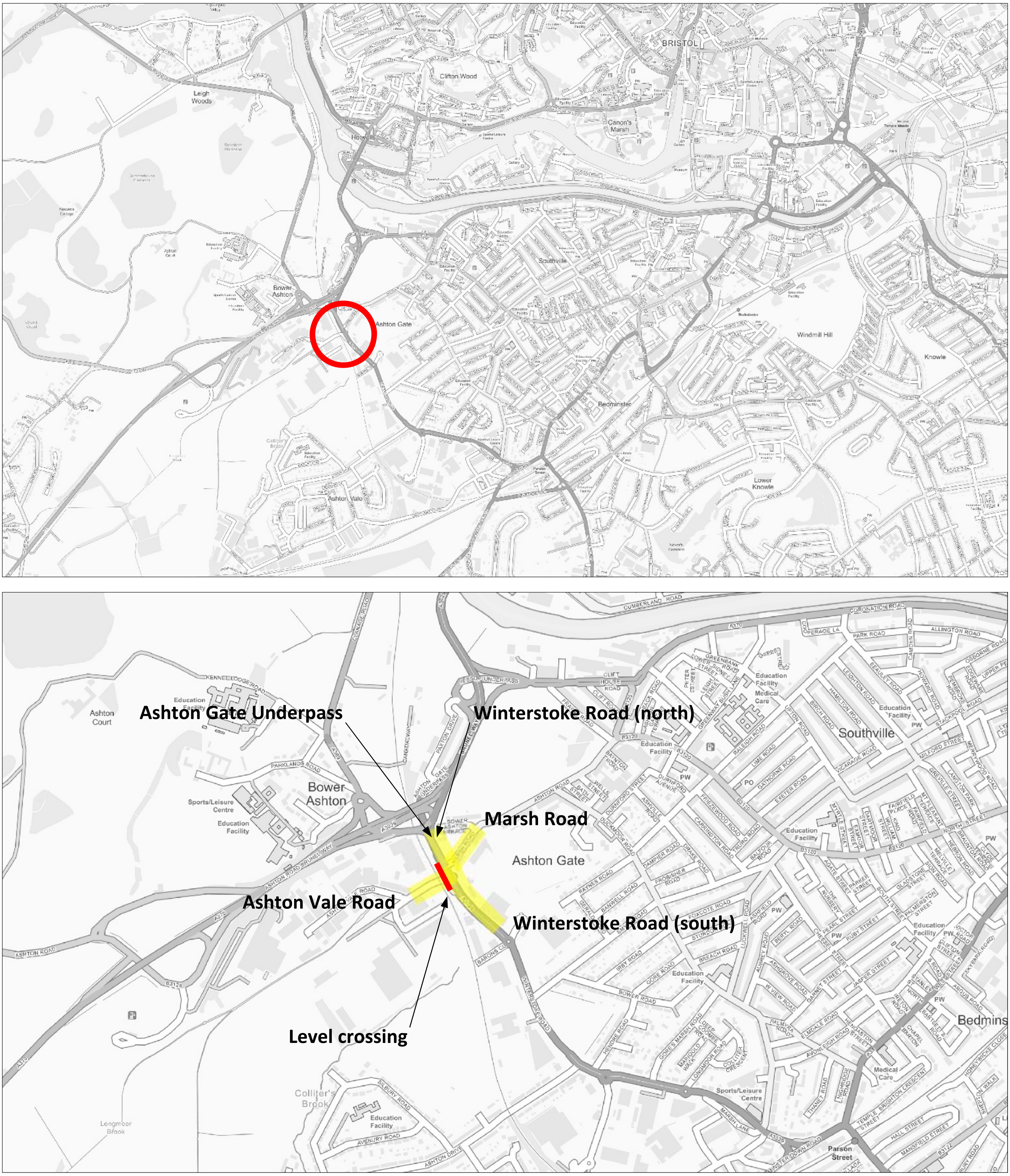


Figure 1: Ashton Vale Road / Winterstoke Road junction
Contains OS data © Crown copyright 2018

2.0 Traffic Count data

The **Technical Memorandum: 'Ashton Vale Road Traffic Counts**', 3rd July 2018 sets out all the data collected at the Winterstoke Road/Ashton Vale Road junction. It is noted that traffic counts have been carried out on five occasions over the period 2014-2018, with the most recent involving comprehensive ATC surveys undertaken over the period Thursday 15th to Wednesday 28th March 2018. The latter were undertaken to verify and validate the 12-hour manual classified traffic count undertaken on the 9th May 2017, which has been used in the LinSIG assessment and, critically, in previously calibrating/ validating the 'base' VISSIM model of the junction.

The analyses of the MCC/ATC data in this Memorandum present, amongst others:

- Table 2: Maximum inflow/outflow by arm over the 24-hour, 12-hour, AM peak hour (8:00-9:00 am) and PM peak hour (5:00-6:00 pm);
- Table 3: As above for just Ashton Vale Road, including additionally 'Maximum Hour Counted';
- Figures 2: 12-hour profiles showing the overall inflow to the junction during the various days covered by the March 2018 ATC surveys, and the mean weekday profile (excluding Fridays);
- Figure 3: 12-hour profiles showing the overall inflow from the 9th May 2017 MCC and the minimum, maximum and average weekday flows from the 2018 ATC surveys (excluding Fridays);
- Figures 4-5: 12-hour profiles showing the traffic flows from/to Ashton Vale Road during the various days covered by the March 2018 ATC surveys, and the mean weekday profile (excluding Fridays; and
- Figure 6-7: 12-hour profiles showing traffic flows from/to Ashton Vale Road from 2014-2017 surveys and the minimum, maximum and average weekday flows from the 2018 ATC surveys (excluding Fridays).

The traffic count figures show clearly that:

- The most recent traffic volumes (ATCs, March 2018) through the Ashton Vale Road/Winterstoke Road junction have reduced overall from previous counts (most notably from the levels observed in the MCC undertaken on the 9th May 2017);
- Whilst the March 2018 ATC survey exhibited a degree of day-to-day variability in movements through the Ashton Vale Road / Winterstoke Road junction, as would be expected, the maximum profile recorded was very similar to the 2017 MCC; and
- Maximum hourly movements for Ashton Vale Road identified in the 2018 surveys (ATC) do not generally coincide with the AM or PM peaks. However, although some are higher, total junction inflows at the same time as maximum Ashton Vale Road flows are typically lower than at peak times, especially when comparing to the PM peak. This is important to note, as a greater reserve capacity and ability to move green time around will exist when Ashton Vale road flows are highest.

The overall 'key' conclusion from the count analyses was that "*it is considered that the traffic counts taken in 2017 are representative of conditions that are present at the junction now, and indeed going back over several years. Comparison of counts over 5 years (2014-2018) indicates that there has been little measurable change in the operation of Ashton Vale Road in the context of the Ashton Vale Road/Winterstoke Road junction. Traffic counted has reduced slightly through the junction overall, and very slightly at Ashton Vale Road itself, though there is a day-to-day variability in movements*". This is despite MetroBus construction works on-going at the time of the 2017 count, which removed the use of the separate left turn lane into Ashton Vale Road. It had been suggested that this would render any modelling analysis based on the 2017 MCC as invalid and potentially atypical. The 2018 ATC surveys undertaken to investigate this show that this is not the case, with the daily overall inflow profile seen in the 2017 survey higher than the average 2018 weekday (excluding Fridays).

3.0 Modelling: LinSig and VISSIM Assessment Tools

3.1 LinSIG

LinSIG is a long-established software package used for assessing the operation of traffic signal junctions. Since its original release in 1985 LinSIG has been the UK industry standard software for the assessment and design of traffic signal junctions. Its unique attribute was and still is the combination of both traffic and controller modelling for comprehensive traffic signal design. The software has been instrumental in advancing UK phase (signal group) based methods of control giving maximum safety and efficiency for all road users.

As will be noted in the discussion on LinSIG modelling later in this Note, and findings, the current controller at the A3029 Winterstoke Road/Ashton Vale Road junction has a complex staging arrangement and sequencing, with certain stages prevented from appearing when a level crossing 'down' input is active. This makes the use of LinSIG particularly appropriate as it can assess:

- Junction operation with a generally consistent 'cyclic' appearance of signal stages, which would generally be the case without a level crossing closure event;
- The non-cyclic appearance of one or more 'demand dependent' stages, where modelling of a sequence containing two or three signal cycles with differing stage 'appearance' assumptions can be undertaken; and
- The operation of a junction over a short period when a specific event takes place, so in this case a level crossing closure followed by one or two cycles when it would be necessary to 'compensate' for the green time lost to Ashton Vale Road.

Whilst 'real-time' micro-simulation modelling undertaken with VISSIM offers the most detailed operational assessment, an advantage of LinSIG is the production of an overall 'Practical Reserve Capacity'(PRC) estimate for the junction under the prevailing flow conditions and/or stage sequence conditions tested. Thus, this software has been additionally employed to assess what level of PRC exists in the base-line case and the flexibility in moving capacity around to provide additional 'compensatory' green time to Ashton Vale Road following a level crossing closure. Provided the same overall level of green time can be provided to Ashton vale Road over the hour, albeit not necessarily cyclically with one or more level crossing closures, then the PRC figure will remain largely unaltered. It is accepted, however, that drivers in this side road could experience slightly longer delay and queuing conditions if arriving shortly before or during the closure.

3.2 VISSIM

Whilst LinSIG could provide a 'robust' assessment of the impact of additional level crossing closures in isolation, the work undertaken for the A3029 Winterstoke Road/Ashton Vale Road has included 'real-time' micro-simulation modelling using VISSIM as an additional and more detailed means of identifying expected junction performance with MetroWest and any adverse impacts.

VISSIM was chosen over other potential 'packages' such as S-Paramics, as this software offers flexibility in several respects, namely the concept of links and connectors which allows the modelling of geometries with any level of complexity. In addition, the VAP logic available within VISSIM can and has been be used to replicate the existing Vehicle Actuated (VA) signal control at the junction, and the 'Special Conditioning' effect of an 'active' level crossing input in suppressing the appearance of certain signal stages during a closure with a reasonable degree of accuracy. The PCMOVA software can also be inter-faced with VISSIM to mimic on-street MOVA operation. However, limitations in replicating the necessary level crossing conditioning logic within PCMOVA meant that it was necessary to continue to use the VAP logic to replicate the added flexibility of using MOVA.

VISSIM can also model the effect of varying traffic flow arrival profiles during a period of interest on one or more approaches. This is of importance where an arrival pattern is particularly 'peaked', which can be the case with Ashton Vale Road. The traffic data described earlier was used to inform these profiles, with vehicle flow matrices developed for specific intervals throughout the model periods. This is not currently possible with LinSIG, which was another reason for assessing the potential MetroWest impacts at this junction with VISSIM as well.

4.0 Train Operating Scenarios

4.1 Key Operational Parameters

The 'key' factors determining the potential operational impact of a given level crossing closure at this junction are as follows:

- The length of time the barriers are likely to be down when a passenger train service passes through the level crossing. This will include the 'advance' time needed before the train arrives to ensure the gates are safely in the 'down' position and the 'clearance' time needed after the last carriage clears the level crossing point; and
- Whether all level crossing events are likely to be 'stand-alone' in nature, or whether there is any real risk of frequent extended closures when two train paths are close together.

The **Technical Memorandum: 'Ashton Vale Road: Level Crossing Train Times'**, 5th July 2018 describes the work done and liaison with Network Rail in determining the likely length of a typical closure period for an 'up' or 'down' passenger train. It also considers the effect of occasional freight train services operating along this line, and the juxtaposition or time spacing of potential level crossing closures when mixed with MetroWest trains operating on an hourly service in each direction. It should be noted that only freight trains serving the Royal Portbury Dock run through the Ashton Vale Road level crossing. MetroWest Phase 1 will introduce regular passenger trains to the line, with one train per hour per direction operating from (broadly) 6am to 11pm on weekdays (slightly reduced hours at weekends).

4.2 Current Freight Train Operations

Freight trains are seldom scheduled with the same regularity and frequency as passenger trains. Hence, current use of the line (and hence level crossing closures) is irregular and (in historic terms) relatively low. Key points and findings are as follows:

- A limit of 10 trains per day was included as a condition within the original planning permission for the new rail link to the port, though this was subsequently amended to 3,650 trains per annum; this retains the same number of trains overall but removes the unduly restrictive daily limit given the bulk nature of port movements; and
- Freight traffic levels are currently relatively low, and several days can pass with no trains at all. This is unusually low demand, and when freight train data was observed in February and March 2016 this revealed up to four freight trains were running per day (two directions) on weekdays, with up to two on weekends. However, it also indicated that out of 30 days for which data was extracted, freight train movements were only actually made on 15 days.

Therefore, it is far more likely that there will be no freight trains operating on the Portbury Dock line in a typical hour, as opposed to a situation where this is regular.

4.3 Future Operating Scenarios

MetroWest Phase 1 will add regular passenger services to the irregular freight trains that use the line now. Timetable planning for MetroWest services has included paths for freight trains to run, with an allowance for at least one freight train to run per hour in every hour. A series of train operating scenarios were therefore identified for the Ashton Vale Road level crossing, which were then taken forward for consideration in traffic modelling of the effects of the level crossing closures (using LinSIG and VISSIM). In broad terms, these are categorised as:

- Typical - the most likely occurrence in a typical hour; with MetroWest passenger services this is assumed to be no freight trains;

- Realistic worst case - a likely occurrence in a typical hour, but one that will not happen more than a few times a day (adding 1 freight train to MetroWest passenger services); and
- Theoretical maximum - 1 freight train per direction in addition to MetroWest passenger services (which while possible in timetabling terms is considered unlikely to occur regularly, if ever).

Table 1 shows the scenarios considered for a future typical hour used to identify potential closure frequency at the Ashton Vale Road level crossing. Note that the potential to run an 'infill' passenger service at peak times has been considered, with inclusion giving a broadly 45-minute interval passenger service for a 3-hour period. However, it should be noted that this is not part of the current development plans for MetroWest Phase 1.

Table 1: Train operation scenarios: typical hourly sequence
Source: based on 'Concept Trains Plans for Various Scenarios 0.3.xlsx' with revised level crossing closure times supplied by NR

Scenario		**Freight trains**			**Passenger trains**			**All trains**
		UP	DOWN	Total	UP	DOWN	Total	per hour
Current operations (WoS)								
Typical:	'up'	1	-	1	-	-	0	1
	'down'	-	1	1	-	-	0	1
Theoretical maximum		1	1	2	-	-	0	2
MetroWest Phase 1 – 1 train per hour per direction (WS)								
Typical		-	-	0	1	1	2	2
Realistic worst case:	'up'	1	-	1	1	1	2	3
	'down'	-	1	1	1	1	2	3
Theoretical worst case		1	1	2	1	1	2	4
MetroWest Phase 1 – 'infill' peak service at 45 min intervals (WS45)								
Typical		-	-	0	1.33	1.33	2.67	2.67
Realistic worst case:	'up'	1	-	1	1.33	1.33	2.67	3.67
	'down'	-	1	1	1.33	1.33	2.67	3.67
Theoretical worst case		1	1	2	1.33	1.33	2.67	4.67

Notes:

UP freight trains run from Portbury to Parson Street Junction, DOWN freight trains run to Portbury

UP passenger trains run from Portishead to Bristol Temple Meads, DOWN passenger trains run to Portishead

Codes in brackets are used in scenario designation for LinSIG and VISSM modelling of the Ashton Vale Road / Winterstoke Road junction – WoS = no passenger trains; WS = MetroWest 1 tph; WS45 = MetroWest infill peak services; NF = no freight trains; 1F = 1 freight train in hour in 1 direction (either direction); 2F = 1 freight train per hour per dir)

4.4 Level Crossing: Expected 'Stand-alone' Closure Durations

The sequences of trains passing the level crossing has been determined from the top-down requirements for passenger and freight trains to serve Portishead and Portbury. Timetabling work carried out by Network Rail to include these trains identified timings within a typical hour. In determining this, future signal control for the level crossing was also considered as part of the works for MetroWest Phase 1. This has resulted in changes for the crossing from the current set-up, that would have the effect of reducing level crossing road closure times to around 2 minutes, with:

- DOWN trains running from Parson Street (to Portbury/Portishead) closing the level crossing to traffic for 1m 50s; and
- UP trains from Pill (i.e. from Portbury/Portishead) closing the level crossing for 2m 05s.

4.5 Indicative Timetables and Closure Frequencies

The data presented in the Technical Memorandum (namely Figure 3) shows that 'gaps' between trains passing the level crossing will typically be around 20 minutes and 35 minutes with just MetroWest passenger services running. With MetroWest passenger services and freight trains running together, the minimum gap between trains passing the level crossing is between around 6 and 10 minutes. Therefore, from a modelling perspective a crossing closure can essentially be treated as a 'standalone' event of around 2 minutes, as the risk of train paths being so close together as to create an extended barrier down time is highly improbable/very low.

The following section which briefly sets out the findings from the LinSIG modelling shows that:

- The expected closure duration will be typically no more than the length of one operational cycle of the traffic signals during the weekday peak hours. In other words, vehicles arriving on the Ashton Vale Road approach would only lose the appearance of the signal stage controlling this phase in a single cycle at most; and
- The expected 'gaps' between successive level crossing closures will be more than sufficient to allow signal controller compensation of green time for Ashton Vale Road in one or more post-closure signal cycles.

5.0 LinSIG Modelling

The Technical Memorandum: 'MetroWest (Phase 1): A3029 Winterstoke Road/Ashton Vale Road - LinSIG Modelling', 6th July 2018 discusses the modelling with this software of the existing normal Method of Control in the weekday peak hours. This assessment work has then considered the impact of a single level crossing closure event of 125 seconds (2m 05s), as could be expected with a DOWN passenger service from Pill passing through this part of the line. All assessment work with LinSIG used the MCC undertaken on the 9th May 2017, with vehicle volumes being converted to Passenger Car Units (PCU).

The following conclusions were drawn from examination of the existing Vehicle Actuated (VA) mode of control, and modelling of the 'base-line' case with all six signal stages assumed to appear (1-2-3-4-5-6) under 'normal' operation. It should be noted that some of these stages are only called if demands exist for certain pedestrian crossings, which is unlikely to be cyclic. As such, the predicted Practical Reserve Capacities (PRC) based on these assumptions can be considered 'worst case':

- Under current VA control, the junction could operate with a signal cycle of up to 146 seconds in the weekday AM peak period and up to 160 seconds in the weekday PM peak period. This assumes all phases extend to their allowable maximum green times. Modelling using the full 1-2-3-4-5-6 stage sequence showed that the 'optimum' cycle times based on the May 2017 flows were 118 and 149 seconds respectively;
- The PRC values for the AM and PM peak hours based on the 'optimum' timings (and full stage sequence appearance) are predicted to be +0.2% and +0.5% respectively. This suggests that there is little spare capacity available in either peak hour now. The critical phases are the Winterstoke Road southbound approach from Brunel Way (Phase I) and Ashton Vale Road (Phase B). The operation of the former is heavily influenced by lane utility on this two-lane approach, with observed nearside lane bias applied in modelling; and
- In the PM peak assessment Ashton Vale Road is predicted to need an 'average' cyclic green time of 20 seconds which is just below its current allowable VA MAX of 24 seconds in this period. As such, there is little or no slack in the allowable MAX for this side road to deal with a need for compensating green time when a level crossing closure occurs now due to existing freight services, or indeed if there is a notable 'peak' in the arrival profile during the peak hour.

During a level crossing closure event the controller is prevented from moving to Stages 1, 2 or 3. As such, the controller can only cycle through a 4-5-6 stage sequence whilst the level crossing input is 'active', with Stage 4 acting as the main stage. The latter is effectively the same as the main Stage 1 controlling Winterstoke Road, except that the left turn to Ashton Vale Road is held on a red signal.

The important thing to note is that a level crossing closure does not 'shut down' the junction. Indeed, the main 'straight-ahead' movements along the A3029 are maintained with lesser side-road interruption than might normally occur. So, whilst Ashton Vale Road clearly loses capacity during the closure period, the main-line A3029 can benefit to a degree in capacity terms.

The assessment of a level crossing closure occurring in the AM or PM peak hours considered a shorter period comprising a pre-closure cycle running at the optimum cycle, a closure period of 125 seconds with only stages 4-5-6 active and a post-closure 'compensation' cycle running normally up to the current maximum cycle time permitted under VA (although with phases maximums not constrained). With MOVA installed as proposed, there will be greater flexibility in allowing the stage controlling Ashton Vale Road to run for longer. LinSIG results show that:

AM Peak Hour

- Although the northbound A3029 traffic to the underpass/Ashton Vale Road is expected to remain within the stop-line capacity achievable, there is likely to be a local increase in the mean maximum queue due to the blocking effect of left turning traffic faced with a longer delay during the 'closure'. The proposed extension of the left turn lane proposed as mitigation will address this; and
- Any additional build-up of queuing traffic on Ashton Vale Road could easily be dealt with by a slightly longer green time for this arm in the post-closure 'normal' cycle.

PM Peak Hour

- Any additional build-up of queuing traffic on Ashton Vale Road would need to be dealt with by a longer compensatory green time for this arm in the post-closure 'normal' cycle than is allowable for now by the current VA MAX setting (24 seconds). it would have to accepted that full 'compensation' may take more than one cycle to achieve (with VA mode maintained), or MOVA control introduced. The latter would allow a higher MAX time to be employed for Ashton Vale Road with greater confidence, in the knowledge that this mode of control actively monitors the 'gaps' in vehicle discharge in electing to hold a stage on green or force a move to another stage; and
- Notwithstanding the above, the expected number of 'peak' vehicle arrivals on Ashton Vale Road in this closure period is only 27 vehicles. As such, the maximum extent of the queue is only expected to increase from 12-20 vehicles, with mean delay changing by no more than circa 38 seconds. This impact is not considered severe in the context of NPPF.

The over-riding conclusion from the LinSIG modelling is that the effect of a single 'stand-alone level crossing event with a barrier down-time for a passenger train of circa 110-125 seconds would have a limited impact on traffic conditions in Ashton Vale Road. Full reasoning for this view is set out in the Technical Memorandum. However, this conclusion is based on existing weekday traffic flows (May 2017) and considered only a single closure 'event'. The VISSIM modelling undertaken has extended the level of modelling to 'real time' consideration, considered the effect of traffic growth, as well as the effect of different train operating scenarios with multiple closures over a longer model period. The results from the VISSIM modelling work are outlined in the next part of the Note below.

6.0 VISSIM Modelling

6.1 Base Model Development: LMVR

As with the LinSIG modelling, the base VISSIM model used the weekday count undertaken on the 9th May 2017 for calibration. However, as noted in Section 2, the volumes observed on this weekday correlate very well with the ATC data collected in March 2018. If anything, the peak flows are marginally higher than the average Monday-Thursday figures in the March 2018 data.

The **Technical Report: 'MetroWest Phase 1: Winterstoke Road/Ashton Vale Road VISSIM Model Local Model Validation Report**', 6th July 2018 sets out the calibration 'fit' with the MCC data, and the validation 'fit' with moving observer journey time surveys undertaken at the same time. Tables

3.2-3.5 in the LMVR sets out the calibration fit achieved against the AM count data (7:00-10:00 am), with Tables 3.6-3.9 showing the corresponding results for the PM (4:00-7:00 pm). As might be expected with what is a 'single junction' model with no route choice, this is very good and well within the acceptability criteria set out in the Design Manual for Roads and Bridges (DMRB). However, notwithstanding the relatively simplicity of the model in terms of network extent, it is still a requirement to confirm/prove the calibration fit with count data. It also demonstrates that the VAP controller modelling is correct and achieves the capacities for the various movements through the junction necessary to 'pass' or accommodate the observed flows in each hour.

As noted above, validation was undertaken against moving car surveys that were carried out on the 9th and 10th May 2017. These were carried out within the AM and PM peak periods along three routes, which are detailed in the LMVR. The fact that the journey time data used related to May 2017 was the reason for retaining the use of the MCC undertaken on the 9th May 2017 for calibration purposes, despite the availability of later count data undertaken in March 2018. Whilst the left turn lane into Ashton Vale Road was out of service due to MetroBus related roadworks at this time, this was reflected in the 'base' modelling by excluding use of the lane.

The DMRB acceptability guide-line states in the case of journey times that these shall be within 15% (or 1 minute, if higher) on >85% of all routes considered. In the case of this model, this effectively meant that all routes needed to comply. Tables 4.1 and 4.2 in the LMVR show that this level of validation fit was in fact achieved. The LMVR thus concludes that "*checks have shown that the models validate to TfL and DMRB acceptability criteria. Together with the calibration results, the validation checks confirm that the model is fit for purpose for assessing the impact of the MetroWest Phase 1 scheme and for testing measures aimed at alleviating the impact of longer and more frequent level crossing closures*". In view of this the VISSIM models were subsequently taken forward for model testing.

6.2 Model Testing and Outcomes

The **Technical Report: 'MetroWest Phase 1: Winterstoke Road/Ashton Vale Road VISSIM Model Testing Report'**, 6th July 2018, sets out the results of all scenarios tested with the VISSIM model. Table 2.1 in this report sets out all the scenarios tested as part of the VISSIM work. In respect of 'future' or forecast scenarios this included the following for the weekday 7:00-10:00 am and 4:00-7:00 pm periods:

- A 2021 'base-line' or 'Without Scheme (WoS) situation. This considered a scenario with no level crossing closures associated with freight train services, and additionally a scenario whereby there was assumed to be one freight train per hour (tph) in one direction. Note that 'Total Closures' given in Table 2.1 relates to the modelled closures per hour, so not the total number in the entire three-hour periods;
- A 2021 'With Scheme (WS) situation, both with proposed mitigation (+M) and without any change. Both scenarios assumed an hourly MetroWest passenger service in each direction and, in addition, a freight service operating in one direction every hour (so three level crossing closures per hour); and
- A series of 'With Scheme' sensitivity tests, all with mitigation, and considering:
  - The above 'With Scheme' scenario but with no freight train services assumed to run in these periods. This is arguably the more likely situation that will arise in view of the low number of freight train paths which occur now;
  - MetroWest services operating on a 'peak' frequency of 45 minutes with, additionally, a freight train service assumed to run every hour in one direction or the other; and
  - MetroWest services operating on a 'peak' frequency of 45 minutes with, additionally, a freight train service assumed to run every hour in both directions.

As noted earlier in this explanatory note, the ‘peak’ service frequency of 45 minutes is not what is being sought under the Development Consent Order (DCO) for MetroWest Phase 1. As such, these specific sensitivity tests were only done for information/completeness.

The Technical Report presents a wide range of comparative journey time results and maximum queue length profiles. In respect of this explanatory note, the discussion below concentrates on the results from the ‘With Scheme’ tests with an hourly MetroWest service. Findings were as follows:

- Predicted (2021) route journey times in the weekday 8:00-9:00 am and 5:00-6:00 pm hours (Tables 3.1 and 3.2) were not shown to be materially different when comparing the 2021 ‘base-line’ (with/without freight) with the ‘Scheme’ case. The results for the Winterstoke Road northbound approach in the AM peak hour as, with LinSIG, confirmed the need for the proposed mitigation in extending the left turn lane. The results for Ashton Vale Road in the critical PM peak hour show that the expected mean journey time could increase by around 38 seconds. This was in fact the same level of change predicted by LinSIG for drivers on the Ashton Vale Road approach when modelling a ‘stand-alone’ closure. This demonstrates a very high correlation in the results for ‘expected outcome’ using two quite different traffic modelling software packages;
- Figure D8 in the Model Testing report shows the expected change in the maximum queue length profile on Ashton Vale Road in the PM peak period (4:00-7:00 pm). This compares a 2021 ‘Do Nothing’ situation with no level crossing closures against a ‘With Scheme’ MetroWest scenario with one hourly service in each direction but no freight trains. The report notes in discussion that “*The graphs also highlight short spikes in queuing on Ashton Vale Road during both the AM (Figure D4) and PM (Figure D8) coinciding with level crossing closures. These spikes are particularly acute during the PM when there are greater volumes exiting the industrial estate with queue lengths roughly doubling from Do-Nothing levels. However, these spikes are relatively ‘short-lived’ and the graphs show that queue lengths typically return to ambient Do-Nothing levels within three to five minutes*”. Within VISSIM the queue lengths are expressed in metres, with the PM graph showing that the maximum length following a closure could extend to circa 100 metres (from typically a length of 50-60 metres). The LinSIG work investigating the effect of a closure concluded that the maximum queue length could change from a typical one of 12 vehicles to around one of 20 vehicles following a closure. The typical occupancy length taken for a queuing vehicle is generally taken to be 5.65 metres, so the expected queue length change predicted by LinSIG and expressed in metres would be from 68-113 metres. There is thus again a high correlation in the queue length change results obtained using the two software packages; and
- Figure D5 showed that a higher frequency of level crossing closure is predicted to result in a net queue length reduction benefit on the Winterstoke Road southbound approach to the junction in the PM peak period. As noted in the earlier dialogue on LinSIG modelling, this is because this movement will experience less interruption and get proportionally more green time when the potential stage sequence is limited to 4-5-6 during a closure. Noting that this and the Ashton Vale Road phases are the critical ones in operating terms, the fact that a higher capacity can be achieved on the southbound Winterstoke Road during a closure means there is greater potential to give compensating green time to Ashton Vale Road in the one or more ‘normal’ signal cycles following a closure.

As with LinSIG, the VISSIM results thus confirm that an hourly train service proposed under MetroWest Phase 1 can be delivered without detriment to the local highway conditions within the vicinity of the Winterstoke Road /Ashton Vale Road junction.

7.0 Overview

The Transport Evidence Explanatory Note (TEEN) has drawn together all the modelling work (LinSIG and VISSIM) done to assess the potential impact of increased level crossing closures on Ashton Vale Road and the adjacent Winterstoke Road junction. As part of this the valid use of the 9th May 2017

MCC is explained and confirmed as 'typical' of current weekday volumes. The derivation of the typical level crossing closure time, which forms a key input to the modelling, is also explained.

The modelling results obtained from both LinSIG and VISSIM exhibit a high degree of correlation in predicting the additional delay and level of queuing expected on Ashton Vale Road following a level crossing closure during the critical weekday PM peak period. Both confirm that any expected impact would not be severe, whilst recovery to normal operating conditions on this side road is likely to be achievable in only one or two signal cycles following the lifting of the barrier. The main reasons for what is expected to be broadly a 'neutral' impact, and certainly not a severe one, are as follows:

- The expected barrier down-time is no longer than the typical cycle times needed now in the weekday AM and PM peak hours. As such, drivers arriving on the Ashton Vale Road approach would, at worst, have the appearance of the stage controlling this arm curtailed only once;
- Lost green time to Ashton Vale Road incumbent on a closure is capable of being compensated for fully in the first 'normal' cycle following the event, or at worst two cycles;
- The expected closure frequency with two passenger trains per hour and even an intervening freight service, have sufficient duration between them to ensure full 'compensation' and return to normal traffic operation between successive closures; and
- Whilst additional green (compensation) time is needed to clear the build-up of queuing in Ashton Vale Road post-closure, the critical southbound movement on the A3029 also benefits from less interruptions to its green time during the closure when only a 4-5-6 stage sequence operates. As such, these effects tend to cancel each other out when considering the overall capacity and PRC at the junction over a given hour.

Part 2:
Ashton Vale Road Traffic Counts

Contents:

- Technical Note: 'MetroWest Phase 1, Ashton Vale Road Traffic Counts', 3rd July 2018

TECHNICAL MEMORANDUM

MetroWest Phase 1
Ashton Vale Road Traffic Counts

PREPARED FOR:	WoE Councils
PREPARED BY:	GW
DATE:	3rd July 2018
PROJECT NUMBER:	674946.CS.70.01
REVISION NO.:	1
APPROVED BY:	**DRAFT**

1.0 Introduction

The MetroWest Phase 1 project comprises the delivery of infrastructure and passenger train operations to provide enhanced services on the Severn Beach line, local stations on the Bath to Bristol line and for a reopened Portishead Branch Line with stations at Portishead and Pill. The re-opened Portishead Branch Line will maintain the existing freight train operations as well as re-introduce passenger train services on an hourly basis.

The project is being led by North Somerset Council on behalf of the four West of England (WoE) councils. Infrastructure for the Portishead line and stations at Portishead and Pill is to be consented through the Portishead Branch Line Development Consent Order (DCO) scheme, with some infrastructure falling within Network Rail's General Permitted Development (GPD) rights. CH2M (now Jacobs) has been appointed to prepare a Transport Assessment (TA) in support of the DCO.

The Ashton Vale Road / Winterstoke Road signal controlled junction and adjacent Ashton Vale level crossing, the location of which is shown in Figure 1, has been considered in some detail as part of the Transport Assessment. This is to specifically assess the impact of increased level crossing closures due to MetroWest Phase 1 services on the Portishead line, and has included analysis using LinSIG and VISSIM models of the junction; details of these models are not discussed in this technical note.

The purpose of this note is to set out and discuss some of the key information collected in traffic counts, that have been carried out to understand the way traffic moves through the junction and level crossing to provide information for traffic modelling. Ashton Vale Road is the sole access to the industrial estate, which contains traffic generators that can cause surges in demand, such as Manheim Car Auctions. It is used as an ad hoc parking area when there are football matches at the Ashton Gate Stadium. There have also been changes in the area that could affect flows, such as the opening of the South Bristol Link, construction of MetroBus skew bridge over the junction. And with counts having taken place over the course of 5 years, a key aim of this note is to draw-out common data from each, enabling comparisons to be made of the way that traffic flows have changed (or otherwise) at the Ashton Vale Road / Winterstoke Road junction over that time.

Note that other surveys have taken place in the area of the Ashton Vale Road / Winterstoke Road junction that are reported in Appendix C to the MetroWest Phase 1 DCO Transport Assessment (Report of Surveys); this included non-motorised user counts and parking surveys. Also, other information has been collected specifically to feed into the VISSIM modelling process. This has included pedestrian and cycle movements (crossing the main arms of the junction), as well as journey time surveys of traffic on the approaches to the junction. The description of VISSIM modelling of the junction in Appendix N of the Transport Assessment includes further information.

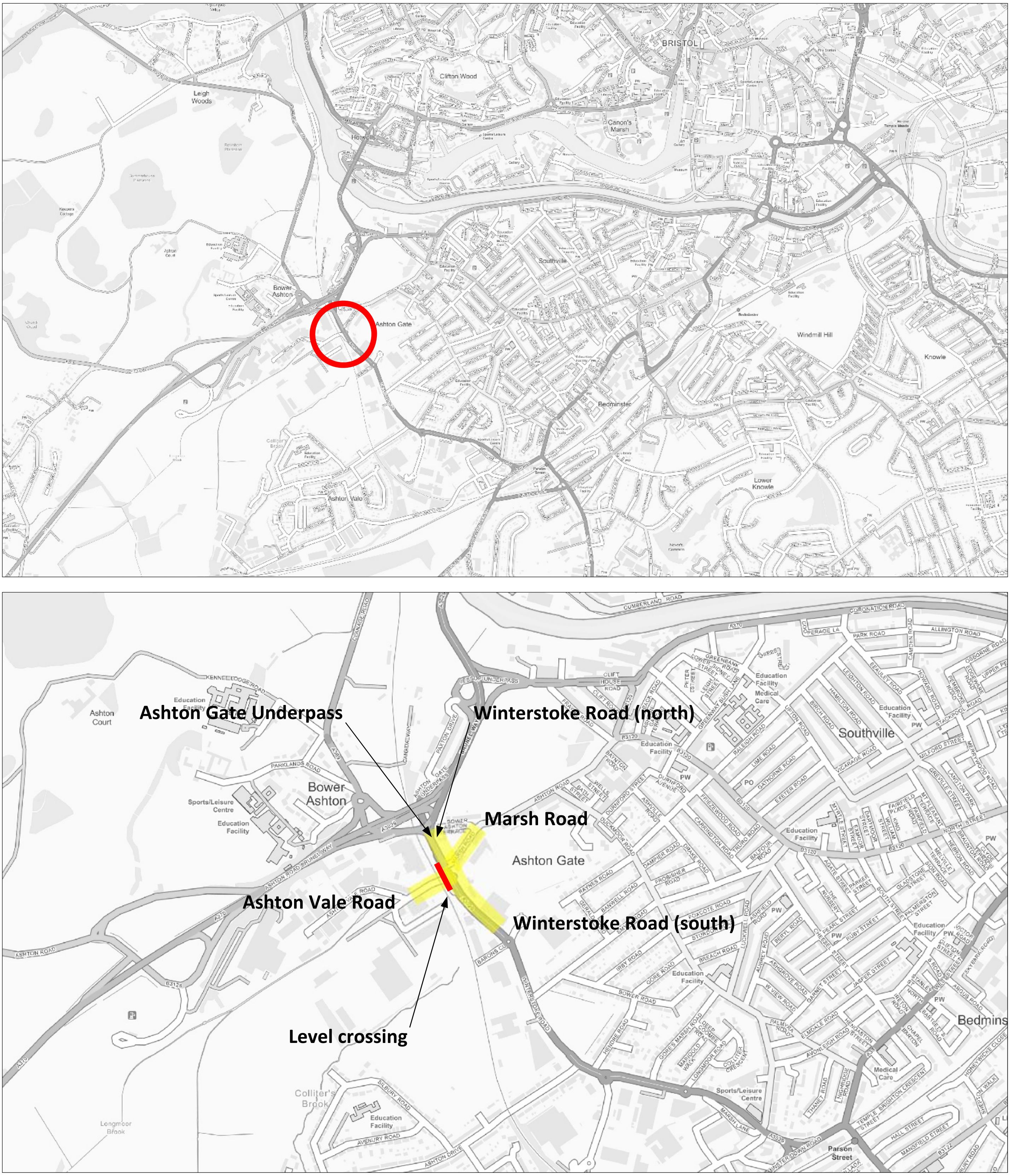


Figure 1: Ashton Vale Road / Winterstoke Road junction
Contains OS data © Crown copyright 2018

2.0 Traffic counts carried out

Traffic counts have been undertaken on five occasions, in each of the years 2014-2018, though the detailed scope of counts in each year has varied:

- 2014 – Manual classified count (MCC) of movements on Ashton Vale Road (across the level crossing) for a total of 7 hours across the day; Tuesday 14th January 2014, including AM peak (2.5hrs from 07:00 to 09:30), inter-peak (2hrs from 11:00 to 13:00) and PM peak (2.5hrs from 16:00 to 18:30);
- 2015 – Automatic traffic counts (ATCs), classified, of movements on Ashton Vale Road (across the level crossing); 14 days from Tuesday 3rd to Monday 16th March 2015 inclusive, 24 hours;
- 2016 – MCC of most movements at the junction, including all traffic movements from Winterstoke Road south of the junction and all movements from Ashton Vale Road (separately recording movements from Ashton Vale Road to the Ashton Gate Underpass where other counts, except in 2018, record this within the movement to Winterstoke Road north); Tuesday 8th March 2016, 12hr counts from 07:00 to 19-00;
- 2017 – MCC of all movements at the junction, including all traffic movements from Winterstoke Road approaches both north and south of the junction (Winterstoke Road north and Ashton Gate Underpass combined), and all movements from Ashton Vale Road and Marsh Road; 9th May 2017, 12hr counts from 07:00 to 19:00. This count was commissioned to provide full information about the junction for inclusion in subsequent traffic modelling; and
- 2018 – ATCs, classified, of all movements at the junction (as in the 2017 manual classified count), though with separation of Winterstoke Road north and Ashton Gate Underpass into separate arms; Thursday 15th to Wednesday 28th March 2018 inclusive, 24 hours.

The different elements of the junction and combinations of movements covered in each of the surveys are shown in Table 1.

Table 1: Movements included in each of the counts (movements are 'to' and 'from' unless noted)
Source: 2014-2018 Traffic counts

		2018 ATCs 15-28 Mar	**2017 MCC Tue 9 May**	**2016 MCC Tue 8 Mar**	**2015 ATCs 3-16 Mar**	**2014 MCC Tue 14 Jan**
Ashton Vale Rd	24hr	Y	-	-	Y	-
	12hr	Y	Y	Y	Y	-
	AM peak	Y	Y	Y	Y	Y
	PM peak	Y	Y	Y	y	Y
Winterstoke Rd (south)	24hr	Y	-	-	-	-
	12hr	Y	Y	Y	-	-
	AM peak	Y	Y	Y	-	-
	PM peak	Y	Y	Y	-	-
Marsh Road	24hr	Y	-	-	-	-
	12hr	Y	Y	-	-	-
	AM peak	Y	Y	-	-	-
	PM peak	Y	Y	-	-	-
Winterstoke Rd (north)	24hr	Y	-	-	-	-
	12hr	Y	Y	'to' only	-	-
	AM peak	Y	Y	'to' only	-	-
	PM peak	Y	Y	'to' only	-	-
Ashton Gate Underpass	24hr	'to' only	-	-	-	-
(northbound	12hr	'to' only	'to' only	'to' only	-	-
movements only)	AM peak	'to' only	'to' only	'to' only	-	-
	PM peak	'to' only	'to' only	'to' only	-	-

3.0 Count results

3.1 Junction overall

The only counts that cover the whole junction are the 2018 ATCs and 2017 MCC. Table 2 shows total junction movements from the 2017 and 2018 counts, broken down by the arms of the junction, inflow, outflow and 2-way movements, and time periods.

Table 2: Total junction in- and outflow, including individual arms
Source: 2017-2018 Traffic counts

From/to arm	**2018 ATCs (15-28 Mar)**			**2017 MCC (Tuesday 9 May)**		
	INTO junction	OUT OF junction	2-WAY	INTO junction	OUT OF junction	2-WAY
24-hr						
Winterstoke Rd (N) & A.G.Undps	16,936	14,720	31,656	-	-	-
Marsh Road	1,806	2,929	4,735	-	-	-
Winterstoke Rd (South)	15,290	16,477	31,767	-	-	-
Ashton Vale Road	1,726	1,633	3,358	-	-	-
TOTAL	35,758	35,758	71,516	-	-	-
12-hr (07:00-19:00)						
Winterstoke Rd (N) & A.G.Undps	13,308	11,608	24,917	15,141	12,686	27,827
Marsh Road	1,600	2,370	3,971	1,515	2,989	4,504
Winterstoke Rd (South)	11,991	13,170	25,162	13,064	14,276	27,340
Ashton Vale Road	1,600	1,350	2,950	1,698	1,467	3,165
TOTAL	28,500	28,500	56,999	31,418	31,418	62,836
AM peak (08:00-09:00)						
Winterstoke Rd (N) & A.G.Undps	1,249	995	2,244	1,354	1,058	2,412
Marsh Road	250	274	524	196	295	491
Winterstoke Rd (South)	1,128	1,248	2,376	1,202	1,284	2,486
Ashton Vale Road	58	167	225	78	193	271
TOTAL	2,684	2,684	5,368	2,830	2,830	5,660
PM peak (17:00-18:00)						
Winterstoke Rd (N) & A.G.Undps	1,285	1,139	2,424	1,422	1,318	2,740
Marsh Road	123	274	397	139	384	523
Winterstoke Rd (South)	1,071	1,216	2,287	1,199	1,258	2,457
Ashton Vale Road	179	28	207	229	29	258
TOTAL	2,658	2,658	5,315	2,989	2,989	5,978

Note: 2018 ATC figures are average weekday across surveyed period, excluding Fridays.

Figures 2 and 3 illustrate counts in more detail, with profiles of total amount of traffic entering the junction over the course of a 12-hour day (07:00-19:00) drawn from these surveys, as follows:

- Figure 2: Total junction inflow – 2018 counts, 12hr profile by survey day
- Figure 3: Total junction inflow – 2017 & 2018 counts, 12hr profile (average weekday)

Figure 2 shows profiles for each of the 14 days that the ATCs were operational in March 2018. This indicates that weekday movements through the junction follow a similar pattern, albeit with variation around an average value (also shown on the chart). There are distinct peaks in the morning (08:00-09:00) and evening (16:00-18:00), though flows throughout the day are not significantly lower. Weekend profiles are completely different. The profile for Saturday 17th March 2018 demonstrates the way that a football match at the nearby Ashton Gate Stadium can affect traffic. As such, there are two peaks, in the middle of the day (which is higher than a comparable time on a weekday) and around 5pm (the end of the match). However, on Saturday 24th March (with no event at the stadium), while there is still a middle of the day peak, it is lower, and there is no 5pm peak.

Figure 3 shows a comparison of profiles generated by the 2018 and 2017 counts. The 2018 counts have been summarised to three comparative lines, all based on weekdays; a profile of the average weekday, with corresponding maximum and minimum profiles. Alongside these, the 2017 profile is plotted. It is immediately noticeable that the 2017 profile is very similar to the 'maximum' profile; indeed, the total 12-hour junction inflow in 2017 was slightly higher than the 'maximum' in 2018 (2017 12hr inflow of 31,418 compared to 2018 maximum 12hr inflow of 31,172). More pertinently, the 2017 profile indicates consistently more traffic through the junction in 2017 than an average weekday in 2018 (some 12% more). This is despite the presence of road works affecting the junction during the survey on Tuesday 9th May 2017, notably the absence of the left turn lane into Ashton Vale Road which was coned off and unavailable to traffic.

3.2 Ashton Vale Road

Table 3 summarises various count totals for movements into and out of Ashton Vale Road.

Table 3: Ashton Vale Road
Source: 2014-2018 Traffic counts

		2018 ATCs 15-28 Mar	**2017 MCC Tue 9 May**	**2016 MCC Tue 8 Mar**	**2015 ATCs 3-16 Mar**	**2014 MCC Tue 14 Jan**
24-hour	OUT of ind.est	1,726	-	-	1,871	-
	INTO ind.est	1,633	-	-	1,784	-
	2-way	3,358	-	-	3,655	-
12-hour (07:00-19:00)	OUT of ind.est	1,600	1,698	1,628	1,709	-
	INTO ind.est	1,350	1,467	1,527	1,497	-
	2-way	2,950	3,165	3,155	3,206	-
AM peak (08:00-09:00)	OUT of ind.est	58	78	65	69	54
	INTO ind.est	167	193	173	182	169
	2-way	225	271	238	251	223
PM peak (17:00-18:00)	OUT of ind.est	179	229	191	189	192
	INTO ind.est	28	29	26	40	47
	2-way	207	258	217	229	239
Maximum hour counted	OUT of ind.est	256	229	221	241	229
	at…	16:00	17:00	16:00	16:00	16:00
	INTO ind.est	234	241	212	214	169
	at…	09:00	07:00	07:00	09:00	08:00
	2-way	358	313	350	348	337
	at…	12:00	07:00	10:00	16:00	12:00

Note: 2018 and 2015 ATC figures are average weekday across surveyed period, excluding Fridays.

Ashton Vale Road is the only element of the junction that has been counted in every one of the surveys from 2014 to 2018, and therefore provides a good indication of the way that movements have changed. Figures 4-11 (inclusive) illustrate the various counts graphically, as follows:

- Figure 4: Traffic FROM Ashton Vale Road – 2018 counts, 12hr profile by survey day
- Figure 5: Traffic INTO Ashton Vale Road – 2018 counts, 12hr profile by survey day
- Figure 6: Traffic FROM Ashton Vale Road – 2014, 2015, 2016, 2017 & 2018 counts, 12hr profile
- Figure 7: Traffic INTO Ashton Vale Road – 2014, 2015, 2016, 2017 & 2018 counts, 12hr profile
- Figure 8: Ashton Vale Road 2014-18 – 24hr totals
- Figure 9: Ashton Vale Road 2014-18 – 12hr totals
- Figure 10: Ashton Vale Road 2014-18 – AM peak hour
- Figure 11: Ashton Vale Road 2014-18 – PM peak hour

3.2.1 Pattern of movements

Figures 4 and 5 show the individual daily profiles from and to Ashton Vale Road from the March 2018 ATCs. The patterns of movement are similar day to day, with a morning peak of movements into the industrial area, tailing off across the remainder of the day, and distinct outward peaks in both the late morning and evening. There is a degree of variation in the quantum of traffic, not least allied to the incidence of auctions at the Manheim site (on Monday, Tuesday and Thursday).

An outlier occurs on Saturday 17th March when, as noted previously, a football match at Ashton Gate Stadium generates significant peaks in traffic going into the industrial area (to park) in the early afternoon, and leaving around 5pm soon after the end of the match. In comparison, other weekends generate significantly lower traffic on Ashton Vale Road.

3.2.2 Maximum hourly flows

Table 4 shows the maximum hourly flows counted for movements from Ashton Vale Road into the junction, with corresponding movements into Ashton Vale Road in Table 5. The tables also include the comparative peak direction flow (AM peak into Ashton Vale Road and PM peak out of Ashton Vale Road), as well as total junction inflows. This includes the total junction inflow in the maximum Ashton Vale Road hour, alongside the corresponding values from each survey day from the 2018 ATCs. Finally, the tables include 2017 total junction inflow values for comparison. Figures 12-15 show the relationship between total junction inflows at the times of maximum Ashton Vale Road flows with corresponding AM and PM peaks, as well as 2017 and 2018 average peak time inflows.

The maximum hourly movements for Ashton Vale Road (identified from the 2018 ATCs) do not generally directly coincide with the AM or PM peak hours (hours beginning 08:00 and 17:00 respectively), though the quantum is not significantly different. Although, the largest single hourly flow to or from Ashton Vale Road was recorded at 17:00 on Saturday 17th March, which is specifically linked with people leaving the football match at Ashton Gate Stadium. On weekdays, the maximum flow hours ‘to’ Ashton Vale Road are associated with the AM peak (hours beginning 07:00, 08:00 and 09:00). Maximum hourly flows ‘from’ Ashton Vale Road were mostly recorded at the start of the PM peak (hour beginning 16:00 or 15:00), with some in the middle of the day.

However, as an indication of total junction usage and capacity, it is useful to consider the total junction inflow. In general, although some are higher, total junction inflows at the same time as maximum Ashton Vale Road flows are typically lower than at peak times, especially when comparing to the PM peak. Comparison with the 2017 peak periods indicates a greater difference, as 2017 flows into the junction are generally higher than in 2018.

3.2.3 Changes over time

Figures 6 and 7 show profiles from/to Ashton Vale Road from all the surveys (2014-2018), including average, maximum and minimum counts from 2018 ATCs. These illustrate a similar pattern of movements over time. The maximum and minimum profiles from the 2018 ATCs almost entirely encompass all the other counts, indicating that daily variability is essentially the same now as it was previously. Again though, 2017 values are generally higher than 2018 averages.

Figures 8, 9 10 and 11 graphically illustrate the values in Table 3, indicating that, in general, 2018 movements into and out of the Ashton Vale Road industrial area are broadly similar to previous years, with a slight reduction over time for most movements.

Table 4: FROM Ashton Vale Road – maximum hourly flows
Source: 2018 Traffic counts

Count day	FROM Ashton Vale Road				Total Junction INFLOW			
	Max. count	**Hour begin**	**PM peak (max.dir)**	**At max. count hr. begin**	**2018 AM peak**	**2018 PM peak**	**2017 AM peak**	**2017 PM peak**
Thursday 15 Mar	256	16:00	182	2,704	2,759	2,710		
Friday 16 Mar	188	12:00	91	2,584	2,742	2,507		
Saturday 17 Mar	290	17:00	290	2,281	1,121	2,281		
Sunday 18 Mar	10	14:00	4	1,247	286	889		
Monday 19 Mar	219	12:00	177	2,211	2,385	2,741		
Tuesday 20 Mar	238	16:00	187	2,938	2,869	2,628		
Wednesday 21 Mar	245	16:00	177	2,573	2,751	2,525		
Thursday 22 Mar	252	16:00	172	2,670	2,656	2,684	2,830	2,989
Friday 23 Mar	212	12:00	125	2,423	2,568	2,826		
Saturday 24 Mar	31	10:00	9	2,033	1,088	1,680		
Sunday 25 Mar	13	13:00	6	2,070	870	1,262		
Monday 26 Mar	238	15:00	81	2,706	2,248	2,107		
Tuesday 27 Mar	236	15:00	71	2,706	2,175	2,160		
Wednesday 28 Mar	239	15:00	85	2,798	2,039	2,053		
AV.WKDY (ex Fri)	211	16:00	142	2,691	2,485	2,451		

Note: 'AM peak' denotes the hour beginning 08:00; 'PM peak' denotes the hour beginning 17:00

Table 5: TO Ashton Vale Road – maximum hourly flows
Source: 2018 Traffic counts

Count day	TO Ashton Vale Road				Total Junction INFLOW			
	Max. count	**Hour begin**	**AM peak (max.dir)**	**At max. count hr. begin**	**2018 AM peak**	**2018 PM peak**	**2017 AM peak**	**2017 PM peak**
Thursday 15 Mar	229	09:00	182	2,482	2,759	2,710		
Friday 16 Mar	173	07:00	173	2,323	2,742	2,507		
Saturday 17 Mar	152	13:00	22	2,673	1,121	2,281		
Sunday 18 Mar	7	11:00	0	1,008	286	889		
Monday 19 Mar	218	09:00	166	2,246	2,385	2,741		
Tuesday 20 Mar	214	07:00	177	2,649	2,869	2,628		
Wednesday 21 Mar	203	07:00	156	2,572	2,751	2,525		
Thursday 22 Mar	234	09:00	154	2,395	2,656	2,684	2,830	2,989
Friday 23 Mar	201	07:00	154	2,409	2,568	2,826		
Saturday 24 Mar	25	08:00	25	1,088	1,088	1,680		
Sunday 25 Mar	12	10:00	3	1,807	870	1,262		
Monday 26 Mar	234	08:00	234	2,248	2,248	2,107		
Tuesday 27 Mar	186	08:00	186	2,175	2,175	2,160		
Wednesday 28 Mar	160	07:00	110	2,236	2,039	2,053		
AV.WKDY (ex Fri)	189	07:00	171	2,395	2,485	2,451		

Note: 'AM peak' denotes the hour beginning 08:00; 'PM peak' denotes the hour beginning 17:00

3.3 Other arms of the junction

Tables 6-8 (inclusive) summarise count information for Winterstoke Road (North) combined with the Ashton Gate Underpass, Marsh Road and Winterstoke Road (South) respectively. Figures 16-31 (inclusive) illustrate this information graphically, as follows:

- Figure 16: Winterstoke Road (north) 2014-18 – 24hr totals
- Figure 17: Winterstoke Road (north) 2014-18 – 12hr totals
- Figure 18: Winterstoke Road (north) 2014-18 – AM peak hour
- Figure 19: Winterstoke Road (north) 2014-18 – PM peak hour
- Figure 20: Winterstoke Road (south) 2014-18 – 24hr totals
- Figure 21: Winterstoke Road (south) 2014-18 – 12hr totals
- Figure 22: Winterstoke Road (south) 2014-18 – AM peak hour
- Figure 23: Winterstoke Road (south) 2014-18 – PM peak hour
- Figure 24: Marsh Road 2014-18 – 24hr totals
- Figure 25: Marsh Road 2014-18 – 12hr totals
- Figure 26: Marsh Road 2014-18 – AM peak hour
- Figure 27: Marsh Road 2014-18 – PM peak hour
- Figure 28: Ashton Gate Underpass 2014-18 – 24hr totals
- Figure 29: Ashton Gate Underpass 2014-18 – 12hr totals
- Figure 30: Ashton Gate Underpass 2014-18 – AM peak hour
- Figure 31: Ashton Gate Underpass 2014-18 – PM peak hour

Although comparative information is not available for all movements and all years, as already identified for total junction inflows, counts indicate a general reduction in traffic through the junction in 2018, when compared to other 2017.

Table 6: Winterstoke Road (North) & Ashton Gate Underpass combined
Source: 2014-2018 Traffic counts

		2018 ATCs 15-28 Mar	**2017 MCC Tue 9 May**	**2016 MCC Tue 8 Mar**	**2015 ATCs 3-16 Mar**	**2014 MCC Tue 14 Jan**
24-hour	Into junction	16,936	-			
	Out of junction	14,720	-	<<<	not counted	>>>
	2-way	31,656	-			
12-hour	Into junction	13,308	15,141			
(07:00-19:00)	Out of junction	11,608	12,686	<<<	not counted	>>>
	2-way	24,917	27,827			
AM peak	Into junction	1,249	1,354			
(08:00-09:00)	Out of junction	995	1,058	<<<	not counted	>>>
	2-way	2,244	2,412			
PM peak	Into junction	1,285	1,422			
(17:00-18:00)	Out of junction	1,139	1,318	<<<	not counted	>>>
	2-way	2,424	2,740			

Table 7: Marsh Road
Source: 2014-2018 Traffic counts

		2018 ATCs 15-28 Mar	**2017 MCC Tue 9 May**	**2016 MCC Tue 8 Mar**	**2015 ATCs 3-16 Mar**	**2014 MCC Tue 14 Jan**
24-hour	Into junction	1,806	-			
	Out of junction	2,929	-	<<<	not counted	>>>
	2-way	4,735	-			
12-hour	Into junction	1,600	1,515			
(07:00-19:00)	Out of junction	2,370	2,989	<<<	not counted	>>>
	2-way	3,971	4,504			
AM peak	Into junction	250	196			
(08:00-09:00)	Out of junction	274	295	<<<	not counted	>>>
	2-way	524	491			
PM peak	Into junction	123	139			
(17:00-18:00)	Out of junction	274	384	<<<	not counted	>>>
	2-way	397	523			

Table 8: Winterstoke Road (South)
Source: 2014-2018 Traffic counts

		2018 ATCs 15-28 Mar	**2017 MCC Tue 9 May**	**2016 MCC Tue 8 Mar**	**2015 ATCs 3-16 Mar**	**2014 MCC Tue 14 Jan**
24-hour	Into junction	15,290	-	-		
	Out of junction	16,477	-	-	<<< not counted	>>>
	2-way	31,767	-	-		
12-hour	Into junction	11,991	13,064	14,473		
(07:00-19:00)	Out of junction	13,170	14,276	-	<<< not counted	>>>
	2-way	25,162	27,340	-		
AM peak	Into junction	1,128	1,202	1,191		
(08:00-09:00)	Out of junction	1,248	1,284	-	<<< not counted	>>>
	2-way	2,376	2,486	-		
PM peak	Into junction	1,071	1,199	1,183		
(17:00-18:00)	Out of junction	1,216	1,258	-	<<< not counted	>>>
	2-way	2,287	2,457	-		

4.0 Summary

The most recent traffic count (ATCs, March 2018) indicate that traffic flows through the Ashton Vale Road / Winterstoke Road junction have reduced overall from previous counts. This is most notable for Winterstoke Road itself, where flows have lower by around 10% (comparing 2018 average weekdays with the 2017 count). It is likely that this is a result of evolving traffic changes since the South Bristol Link (SBL) road was opened, as the SBL provides an alternative route for some journeys that use Winterstoke Road.[1] The effect of this is important though, as total junction inflow feeds through to calculations of reserve capacity in the junction when modelling the traffic signals.

The 2018 ATCs indicated a degree of day-to-day variability in movements through the Ashton Vale Road / Winterstoke Road junction. Within this variation, the maximum profile recorded is very similar to the 2017 MCC (Figures 2 & 3). Day to day variation is more marked on Ashton Vale Road than the other arms of the junction, though Ashton Vale Road only accounts for around 5% of all junction inflows. Again though, 2018 counts show very similar patterns to previous years, if anything slightly lower; indeed the maximum day profile counted in 2018 is not much higher than a similar profile from the 2017 count.

It is particularly apposite to note this for movements into the Ashton Vale Road industrial estate (Figure 7), which indicates that this movement (from Winterstoke Road south to Ashton Vale Road) was higher in 2017 than on average in 2018. This is in spite of MetroBus construction works on-going at the time of the 2017 count that restricted use of one lane out for this movement. The view of enumerators for this survey was that the lane restriction had no effect on the operation of the junction, and this is supported by the counts for 2017 being higher than the average in 2018.

The maximum hourly movements for Ashton Vale Road (identified from the 2018 ATCs) do not generally coincide with the AM or PM peaks. However, although some are higher, total junction inflows at the same time as maximum Ashton Vale Road flows are typically lower than at peak times, especially when comparing to the PM peak. Comparison with the 2017 peak period junction inflows indicates a greater difference, as 2017 flows into the junction are generally higher than in 2018

Overall therefore, it is considered that the traffic counts taken in 2017 are representative of conditions that are present at the junction now, and indeed going back over several years. Comparison of counts over 5 years (2014-2018) indicates that there has been little measurable change in the operation of Ashton Vale Road in the context of the Ashton Vale Road / Winterstoke Road junction. Traffic counted has reduced slightly through the junction overall, and very slightly at Ashton Vale Road itself, though there is a day-to-day variability in movements.

[1] The South Bristol Link road opened a few months before the 2017 count, but changes in traffic behaviour typically take some time to fully materialise.

Figure 2: Total junction inflow – 2018 counts, 12hr profile by survey day

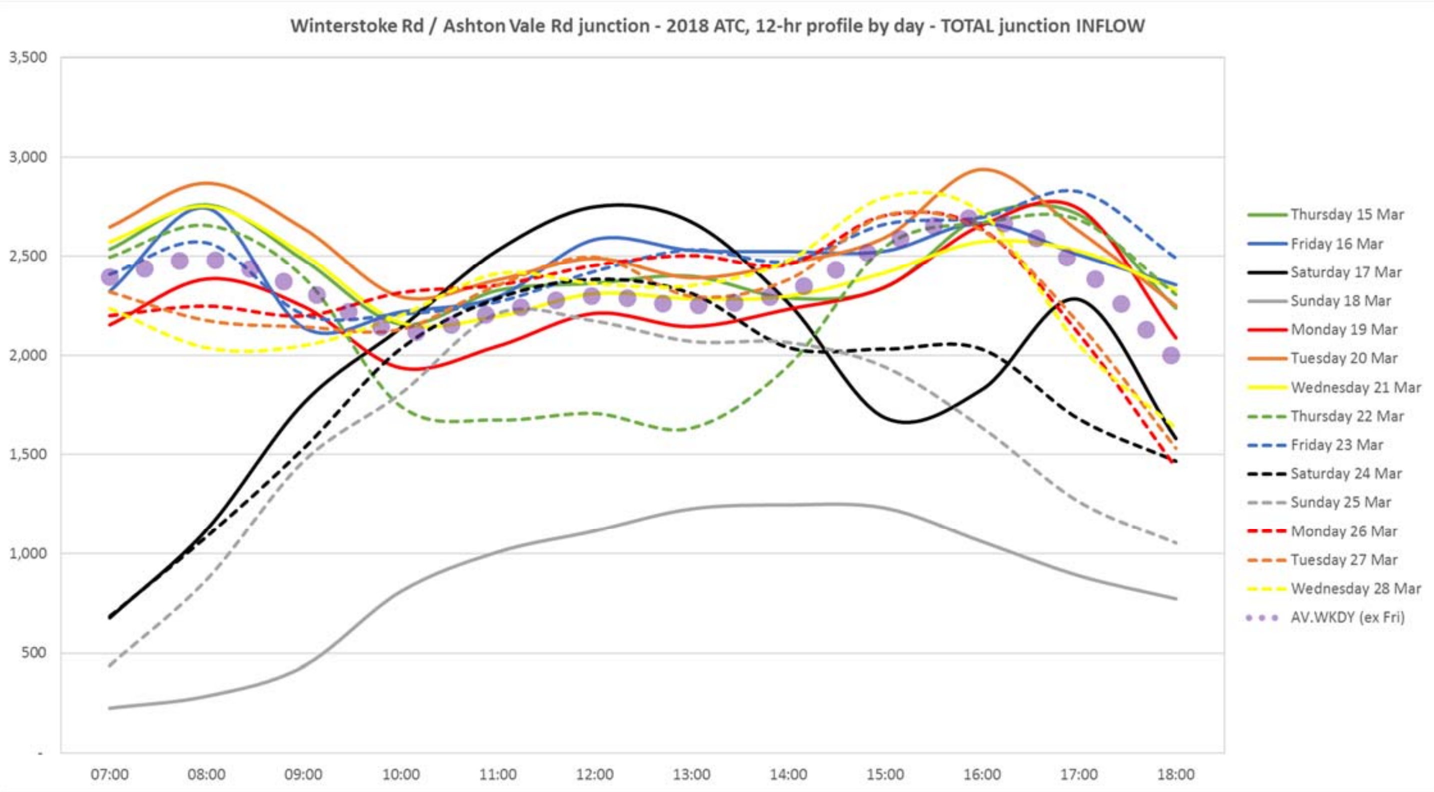


Figure 3: Total junction inflow – 2017 & 2018 counts, 12hr profile (average weekday)

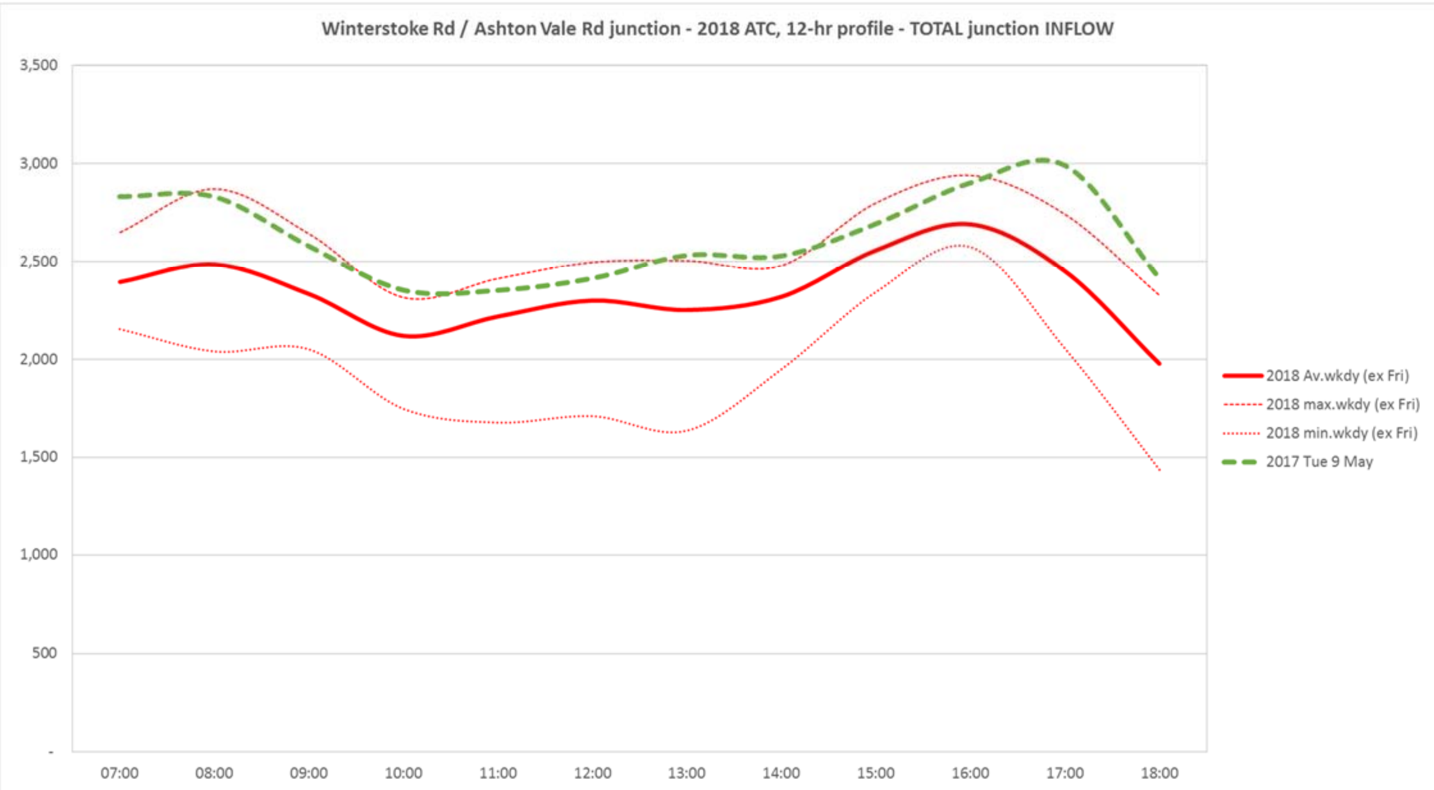


Figure 4: Traffic FROM Ashton Vale Road – 2018 counts, 12hr profile by survey day

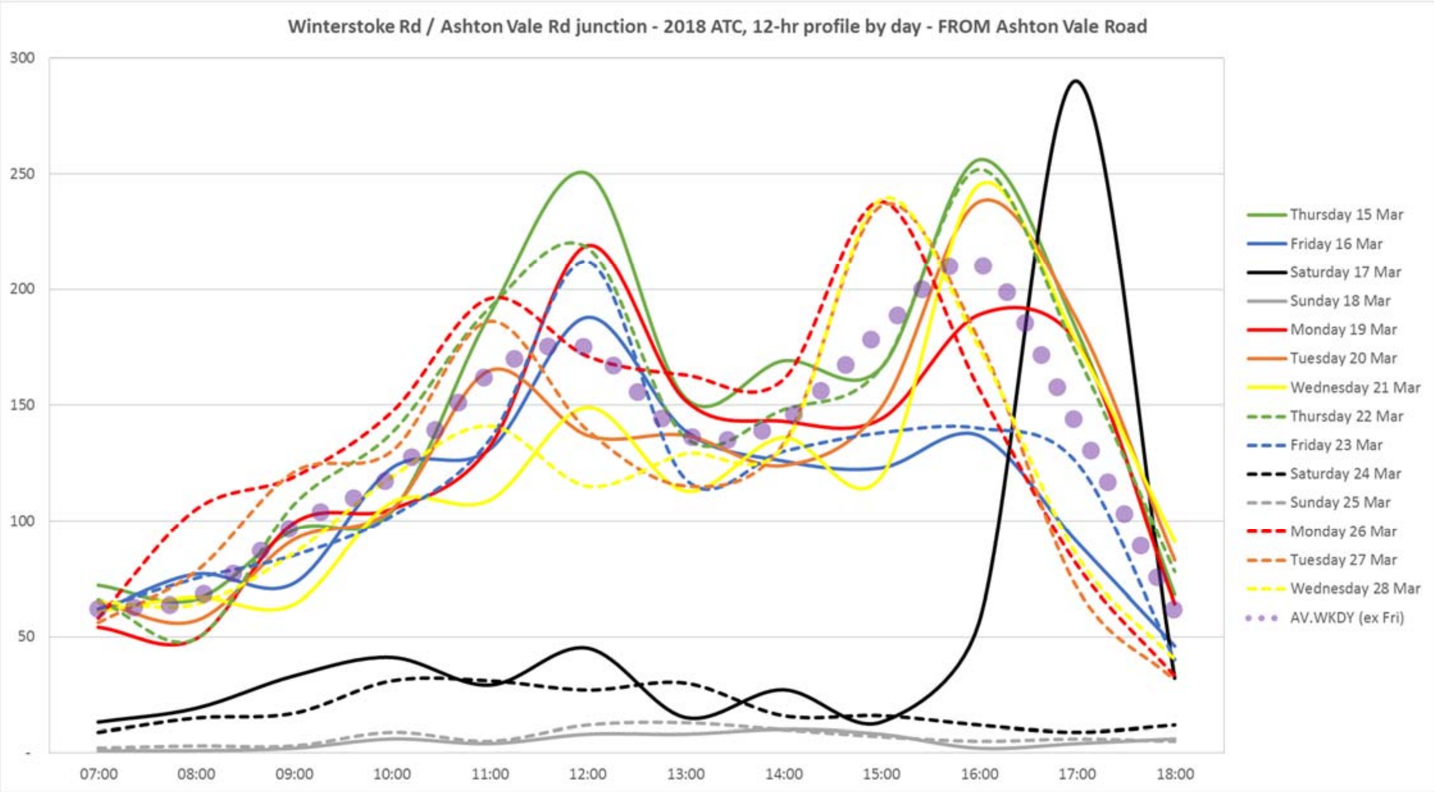


Figure 5: Traffic INTO Ashton Vale Road – 2018 counts, 12hr profile by survey day

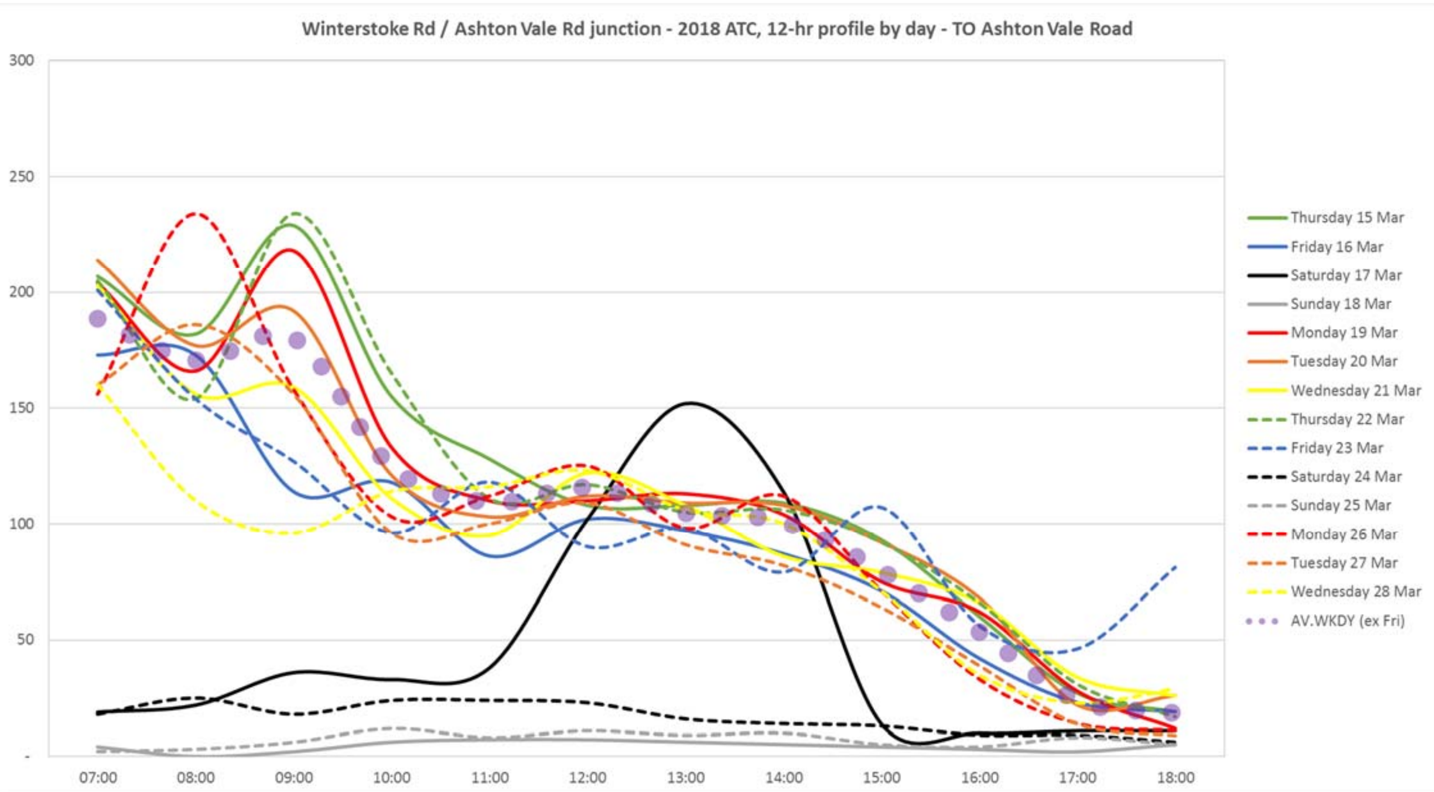


Figure 6: Traffic FROM Ashton Vale Road – 2014, 2015, 2016, 2017 & 2018 counts, 12hr profile

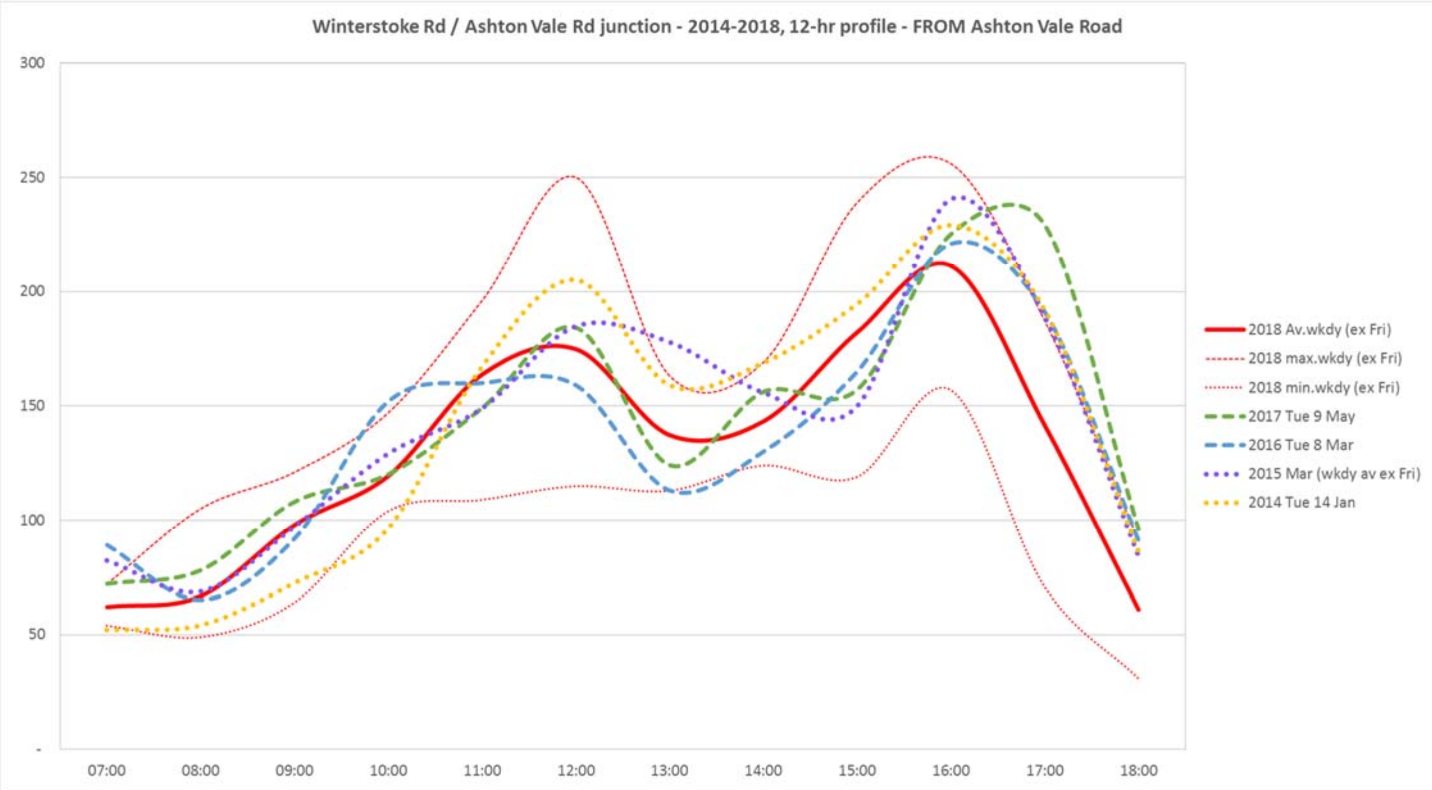


Figure 7: Traffic INTO Ashton Vale Road – 2014, 2015, 2016, 2017 & 2018 counts, 12hr profile

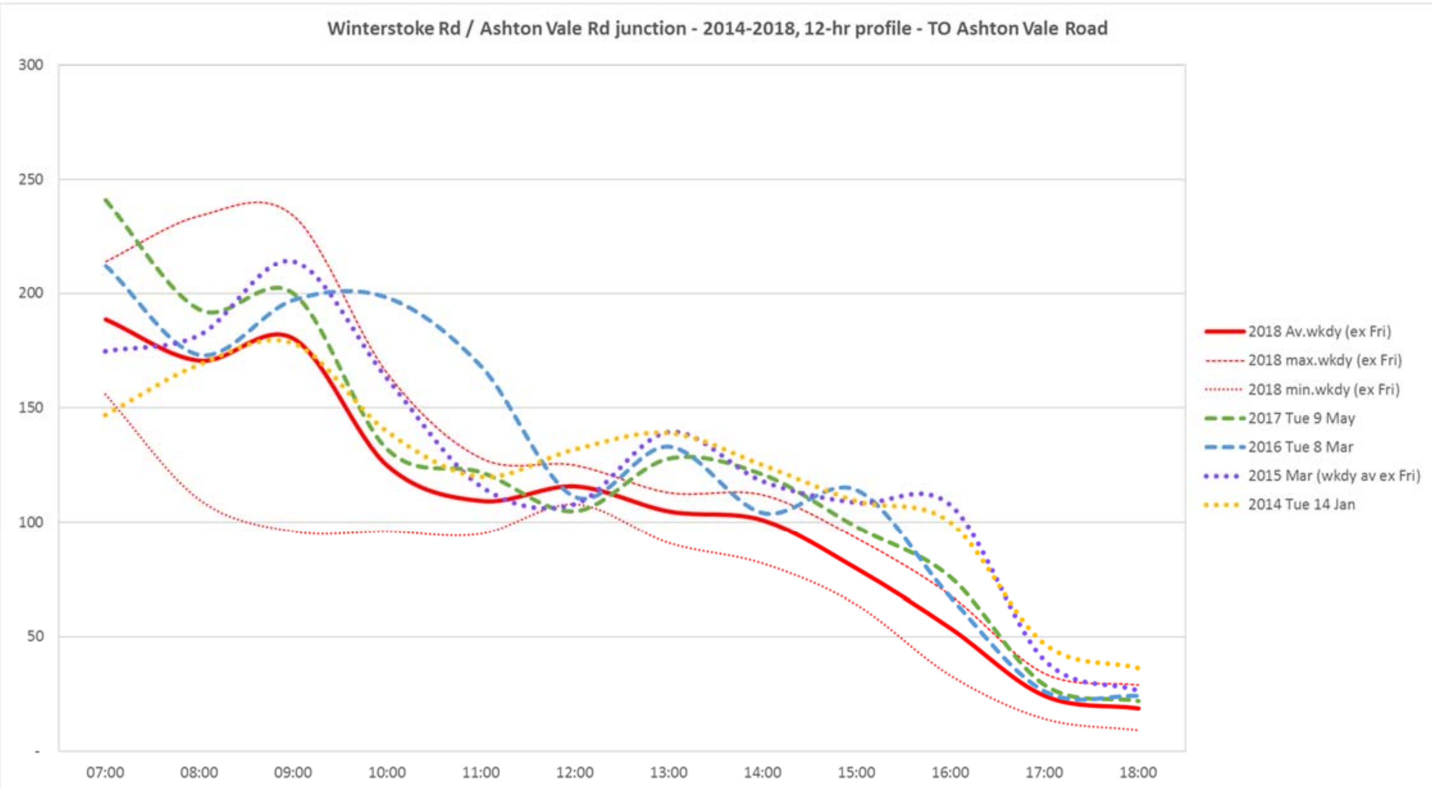


Figure 8: Ashton Vale Road 2014-18 – 24hr totals

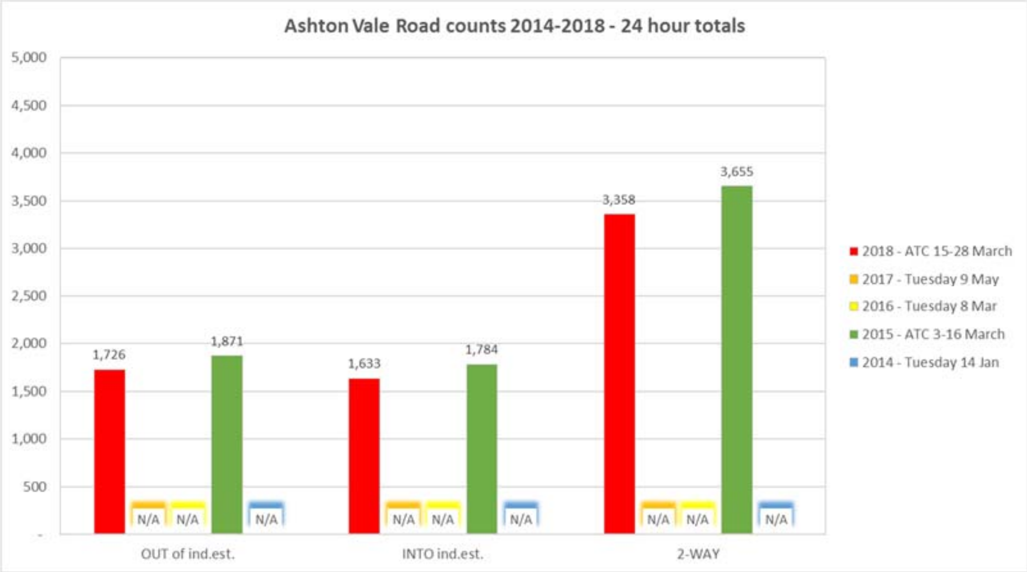


Figure 10: Ashton Vale Road 2014-18 – AM peak hour

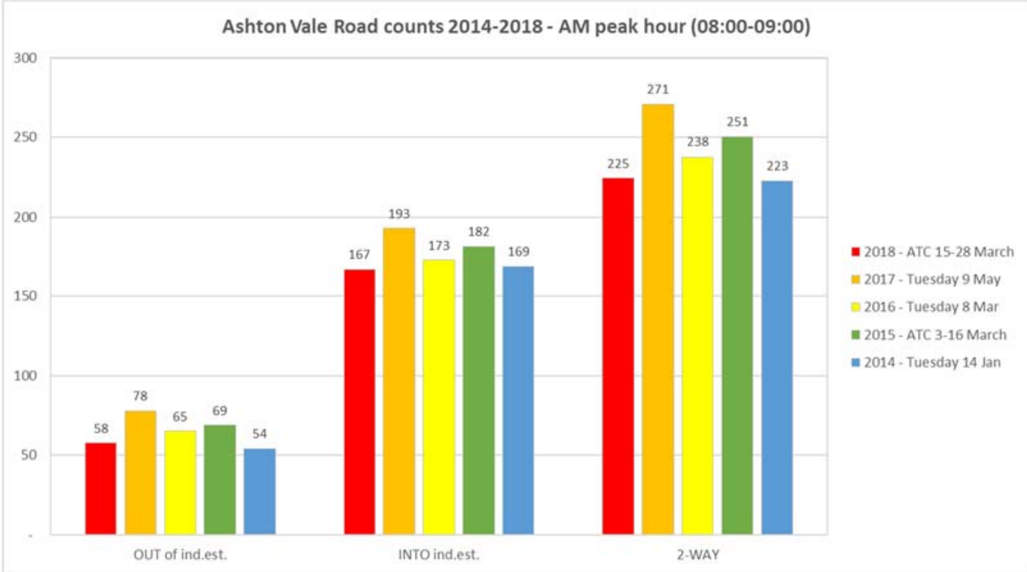


Figure 9: Ashton Vale Road 2014-18 – 12hr totals

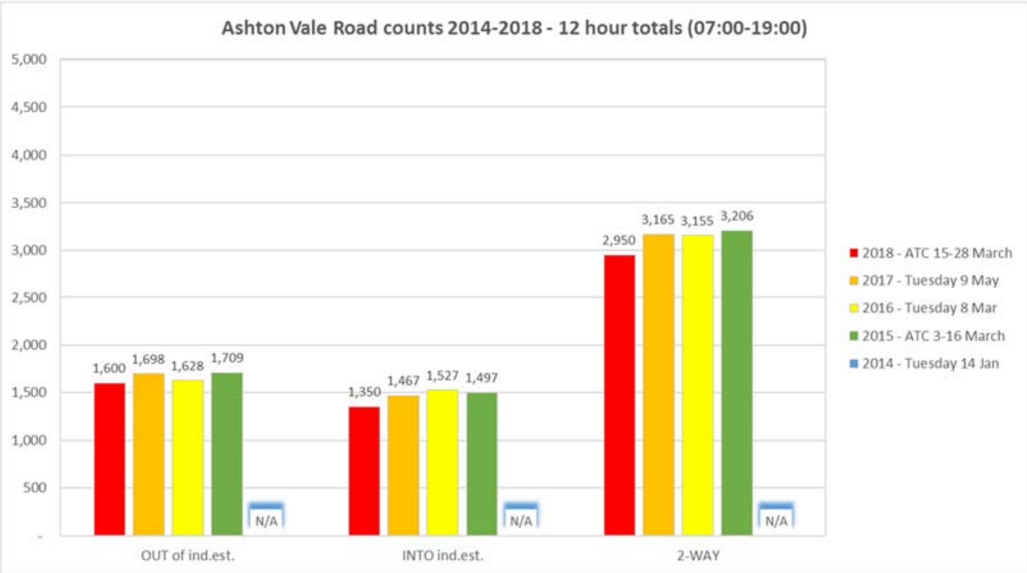


Figure 11: Ashton Vale Road 2014-18 – PM peak hour

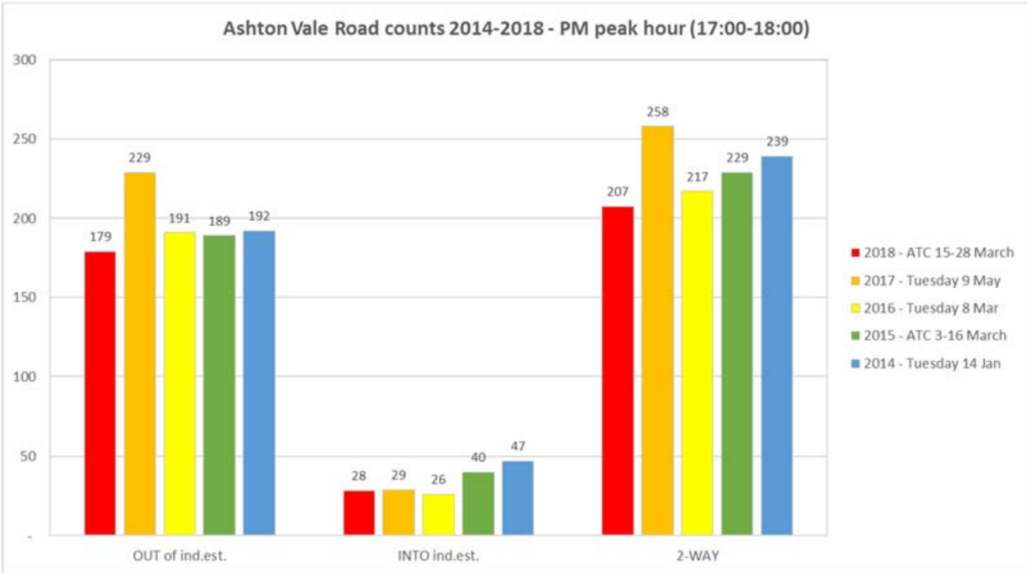


Figure 12: FROM Ashton Vale Road – maximum movements – AM comparison

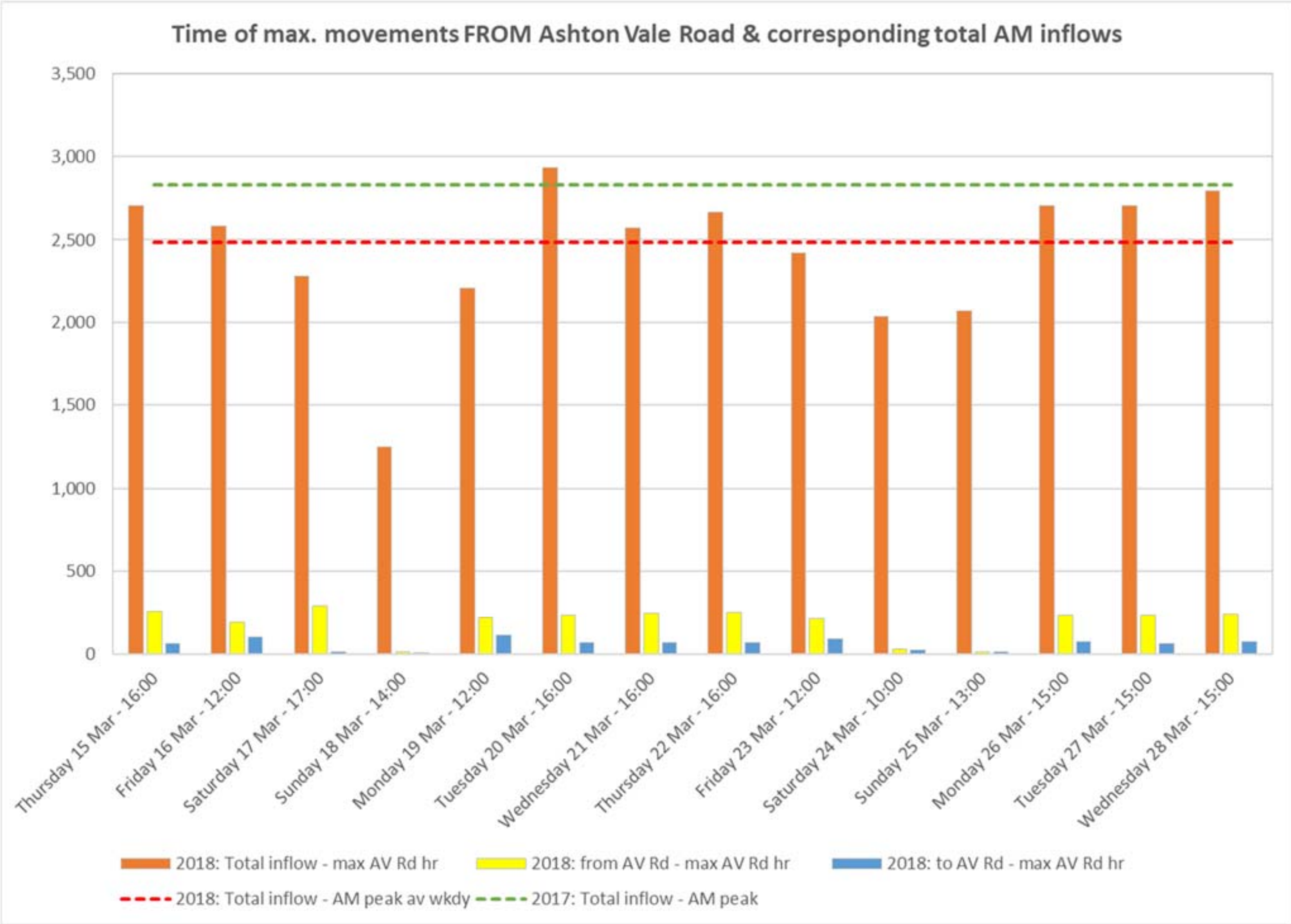


Figure 13: FROM Ashton Vale Road – maximum movements – PM comparison

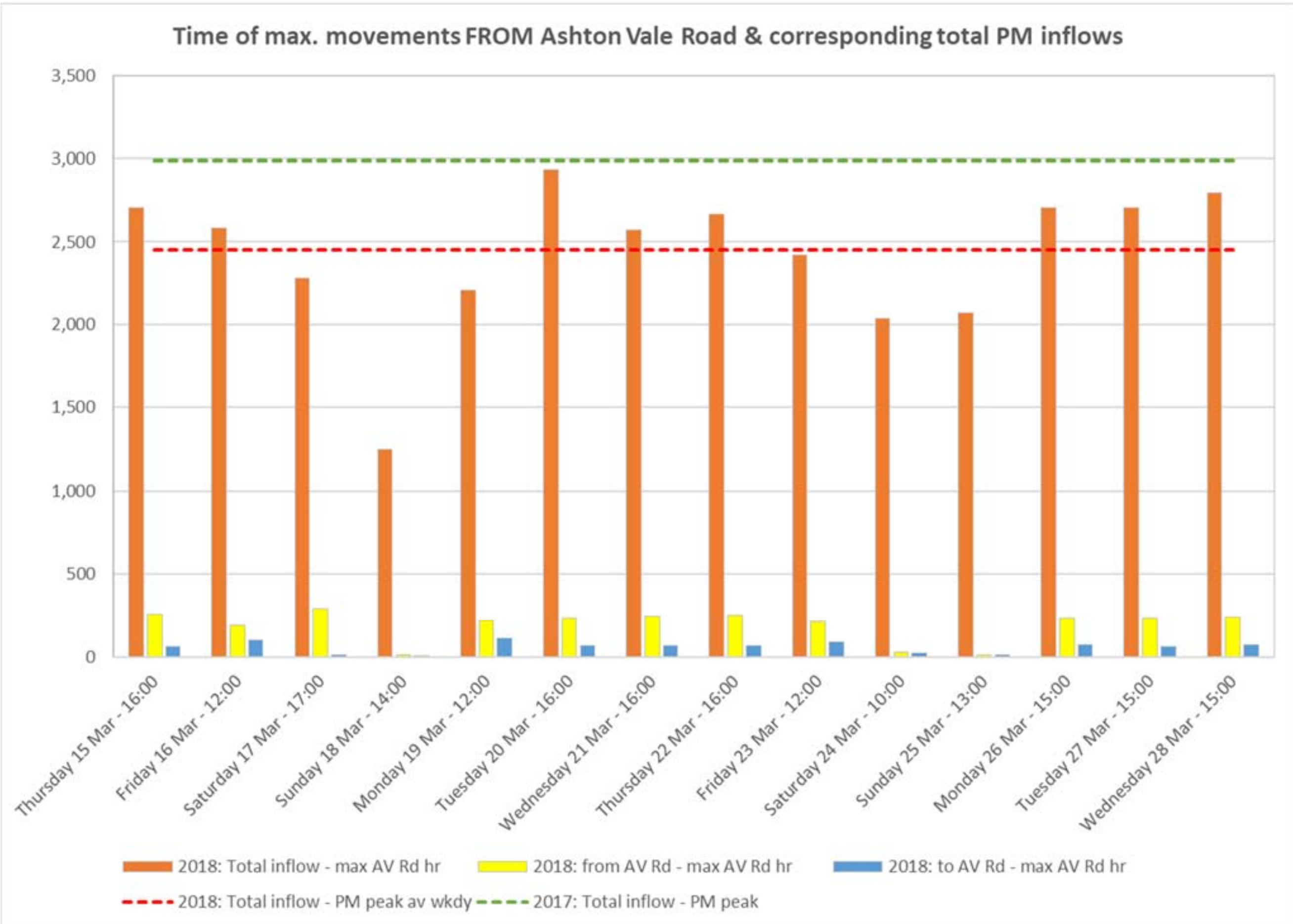


Figure 14: TO Ashton Vale Road – maximum movements – AM comparison

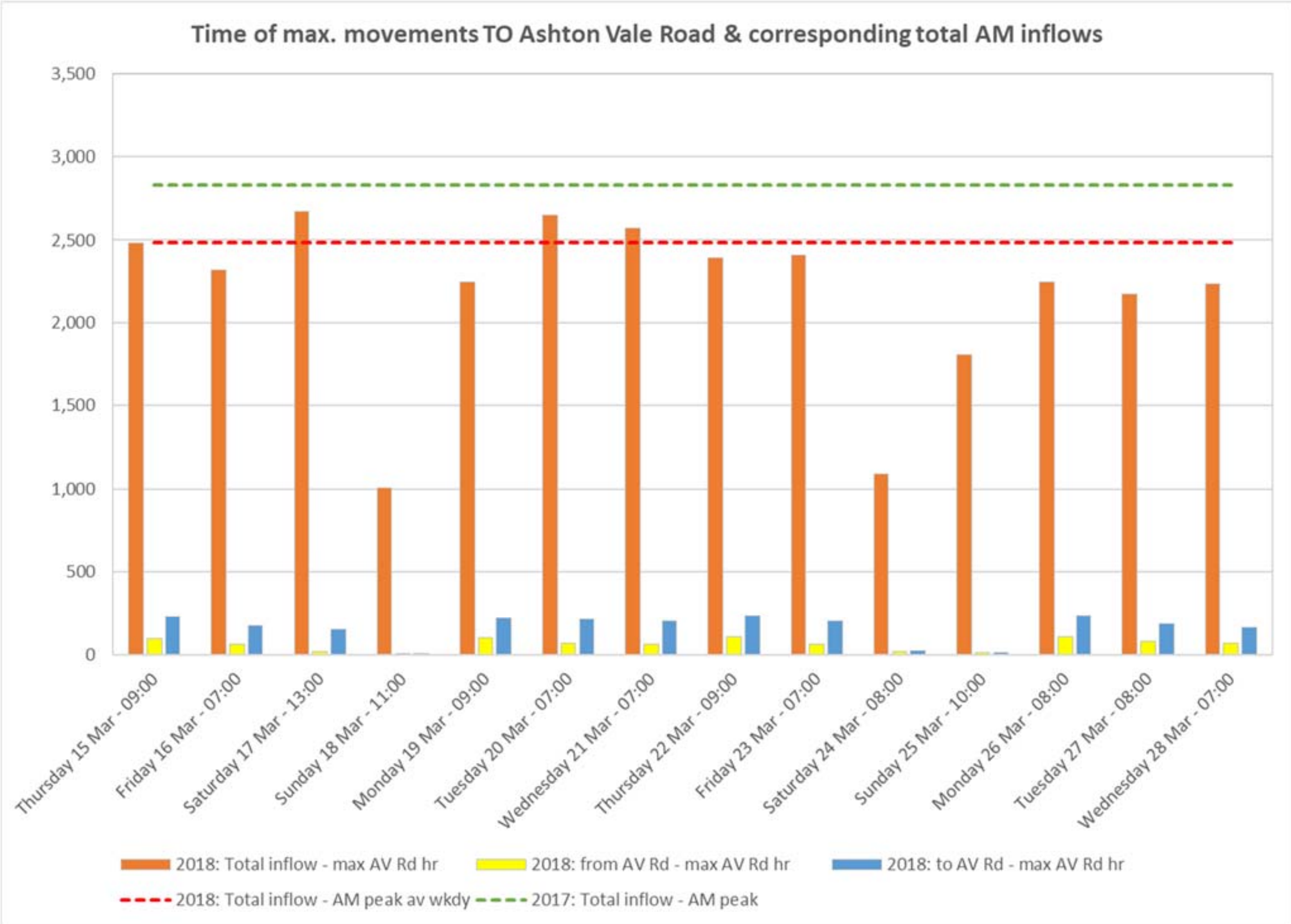


Figure 15: TO Ashton Vale Road – maximum movements – PM comparison

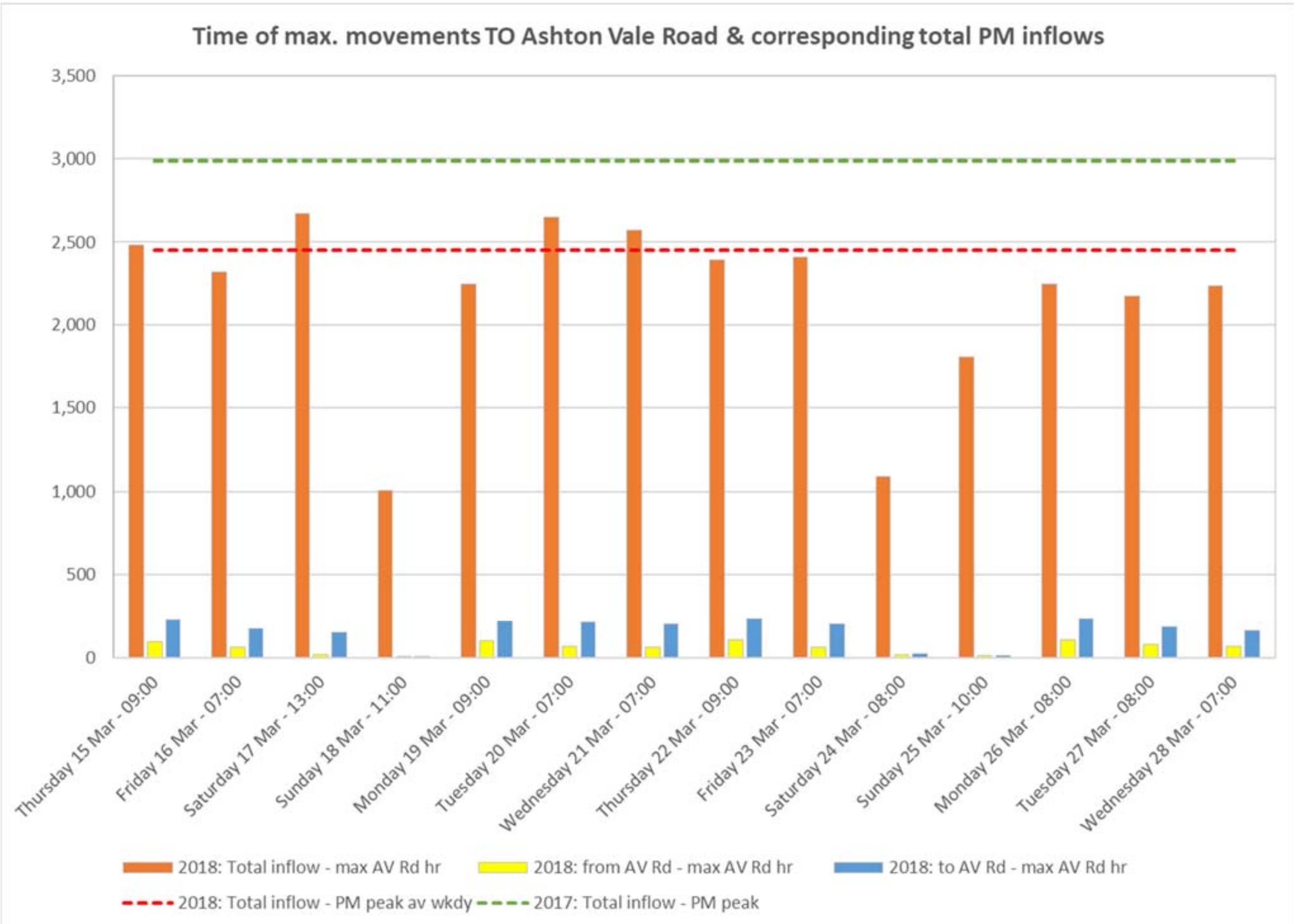
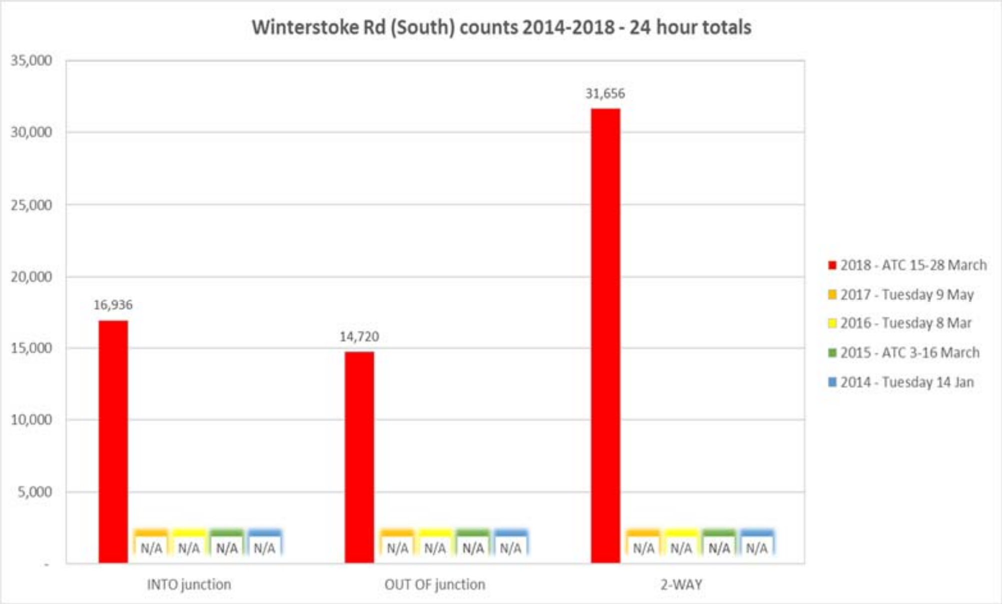
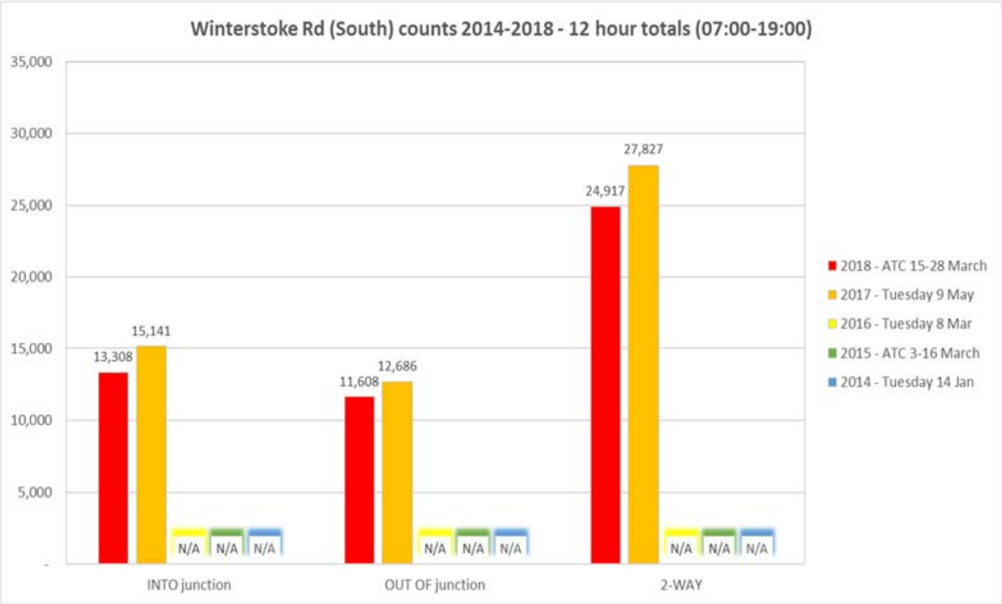


Figure 16: Winterstoke Road (north) 2014-18 – 24hr totals



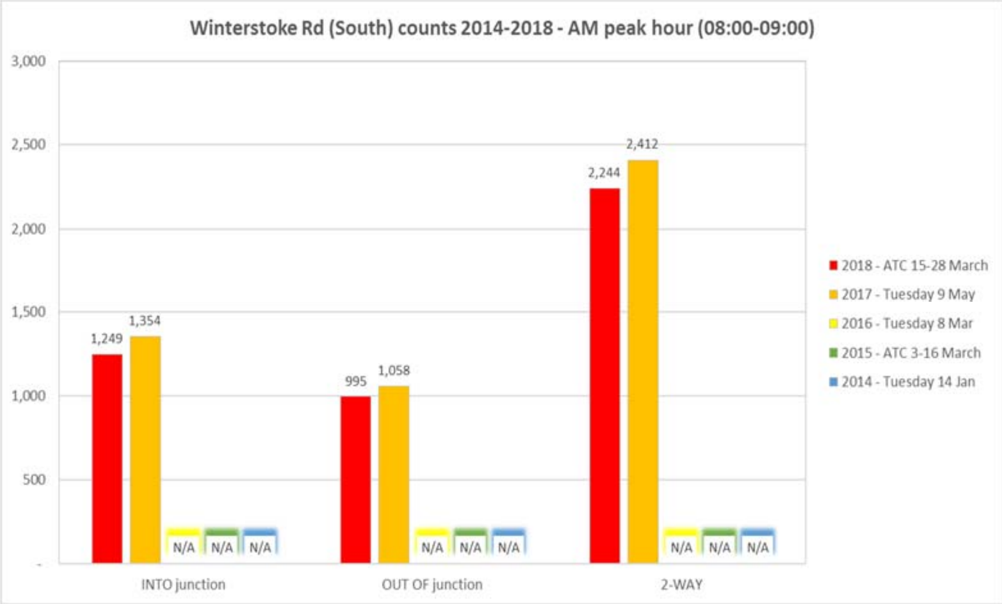
Note: combined flows with Ashton Gate Underpass

Figure 17: Winterstoke Road (north) 2014-18 – 12hr totals



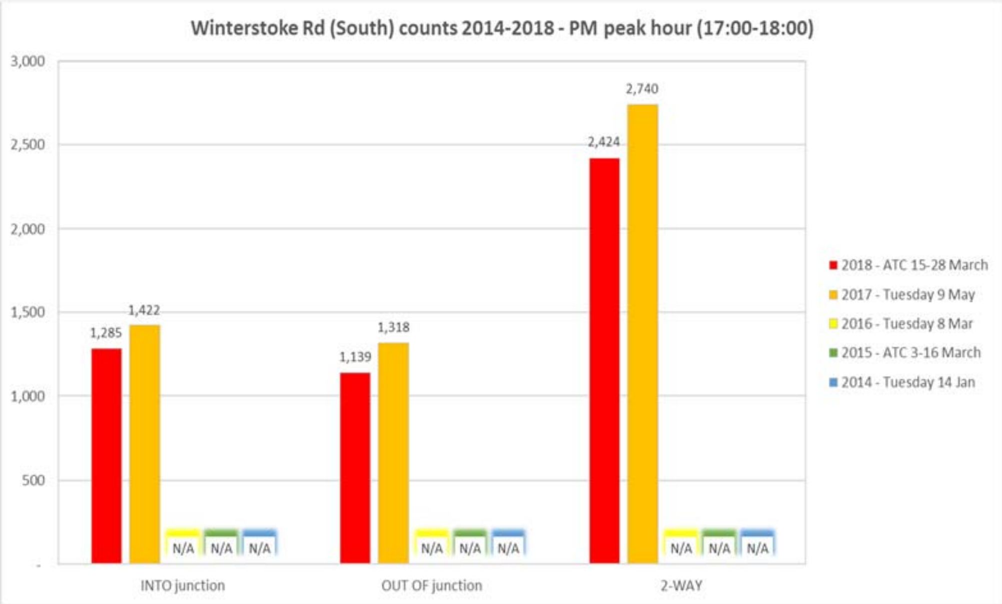
Note: combined flows with Ashton Gate Underpass

Figure 18: Winterstoke Road (north) 2014-18 – AM peak hour



Note: combined flows with Ashton Gate Underpass

Figure 19: Winterstoke Road (north) 2014-18 – PM peak hour



Note: combined flows with Ashton Gate Underpass

Figure 20: Winterstoke Road (south) 2014-18 – 24hr totals

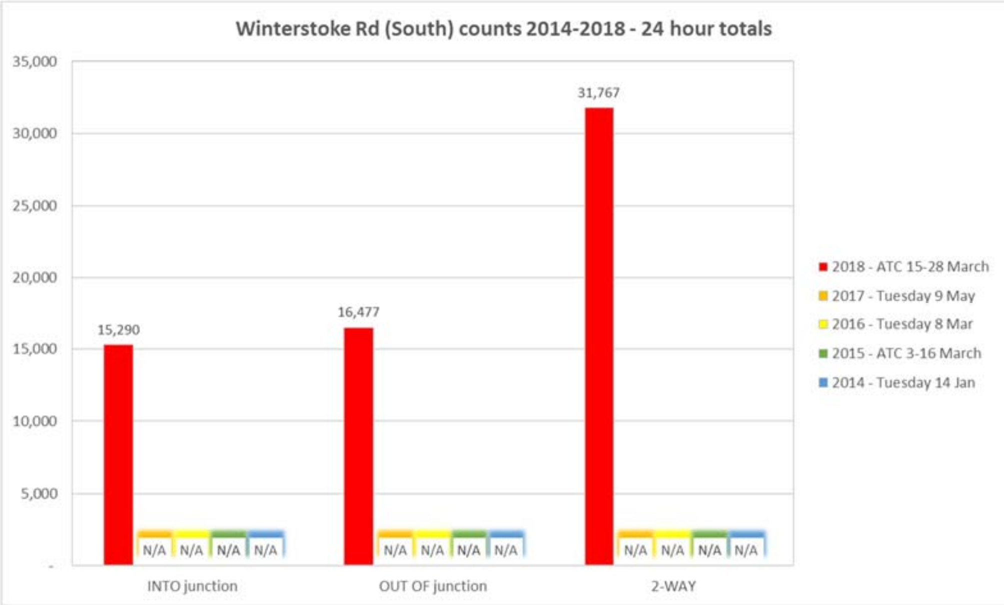


Figure 22: Winterstoke Road (south) 2014-18 – AM peak hour

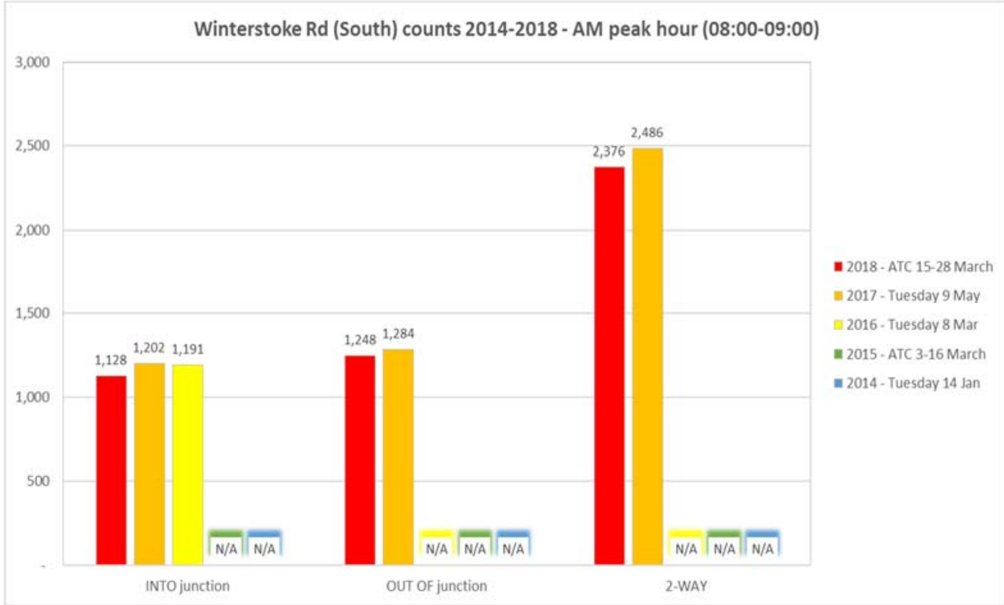


Figure 21: Winterstoke Road (south) 2014-18 – 12hr totals

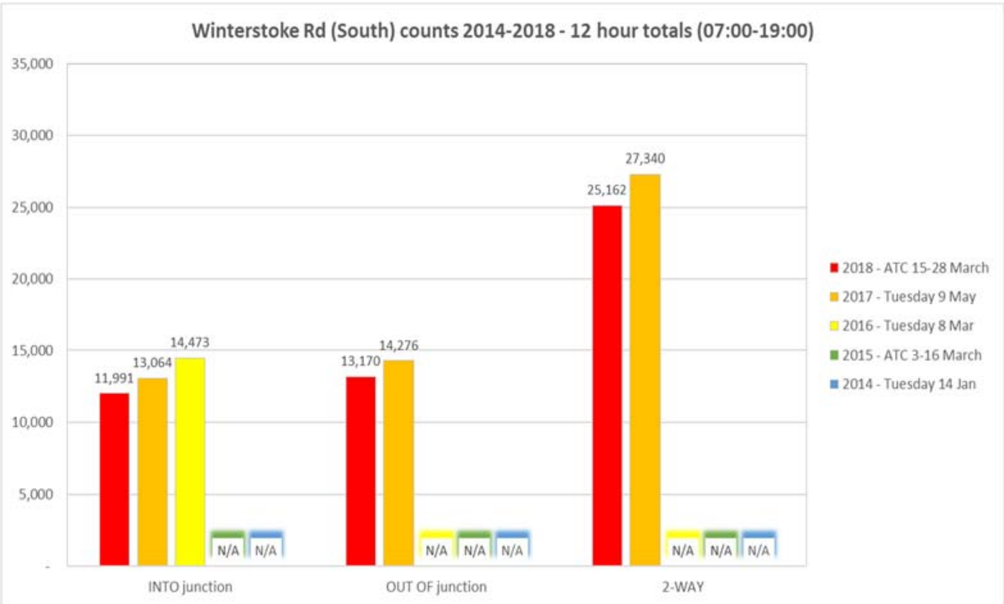


Figure 23: Winterstoke Road (south) 2014-18 – PM peak hour

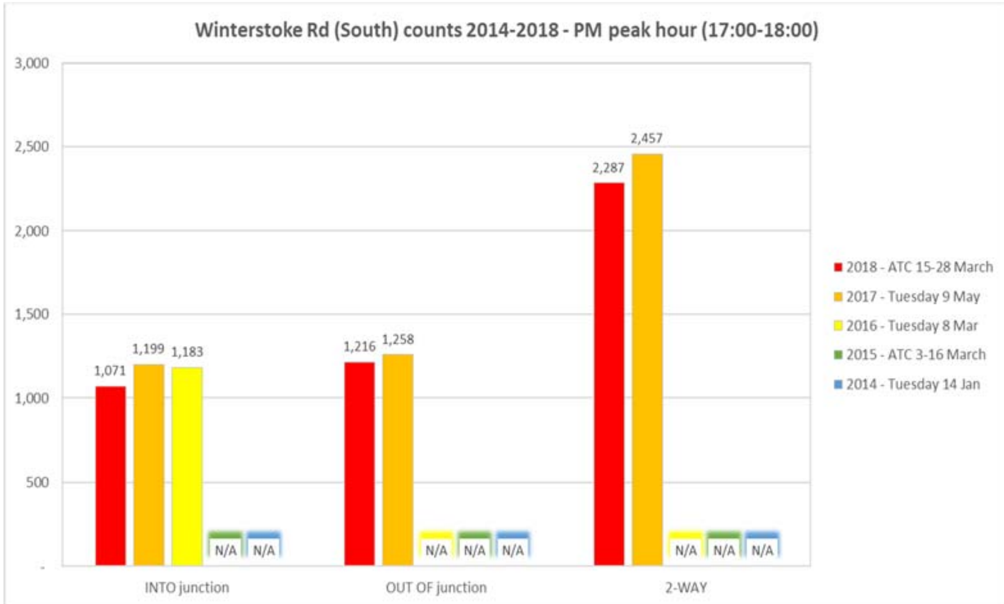


Figure 24: Marsh Road 2014-18 – 24hr totals

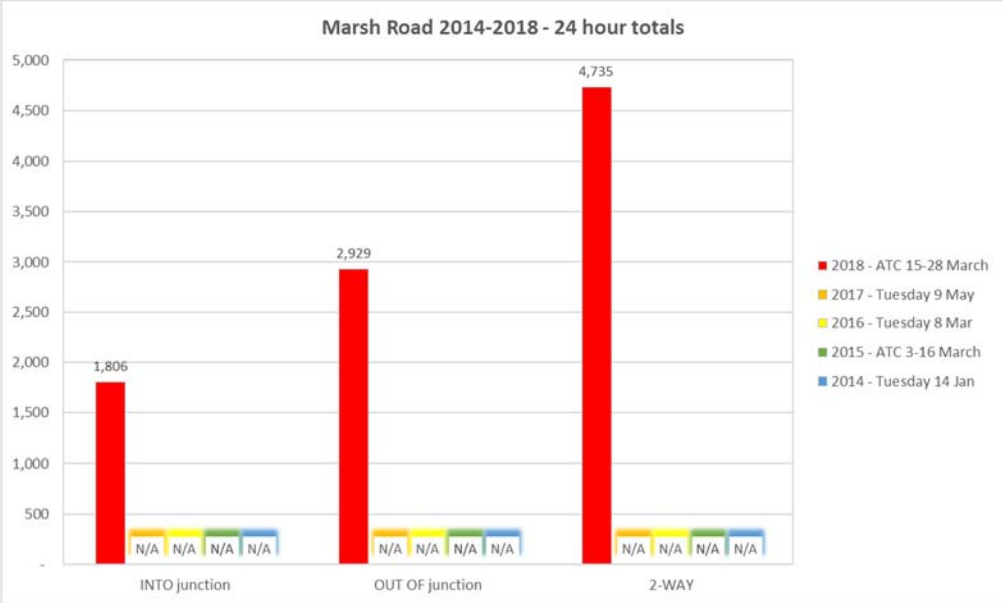


Figure 25: Marsh Road 2014-18 – 12hr totals

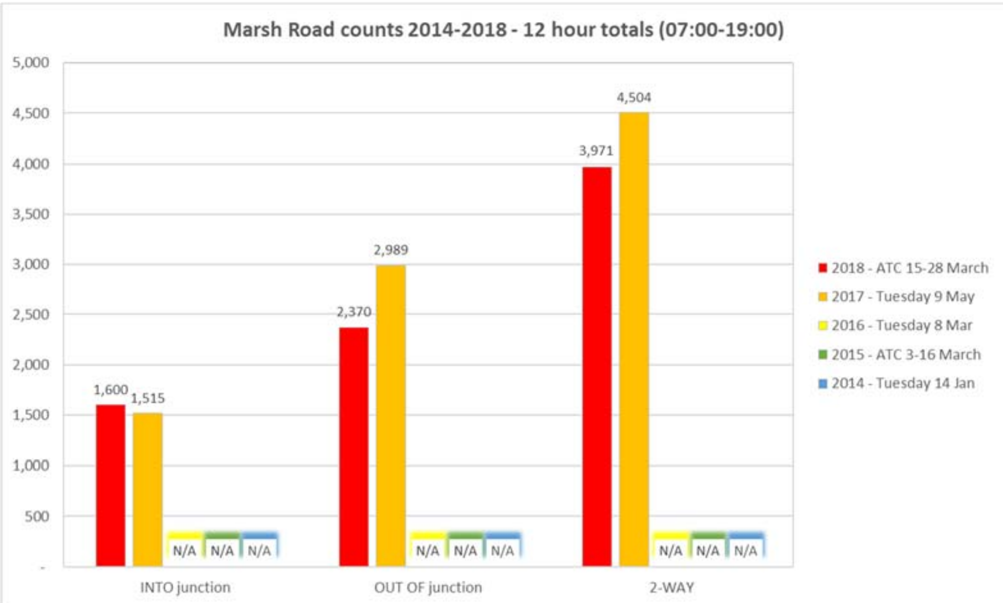


Figure 26: Marsh Road 2014-18 – AM peak hour

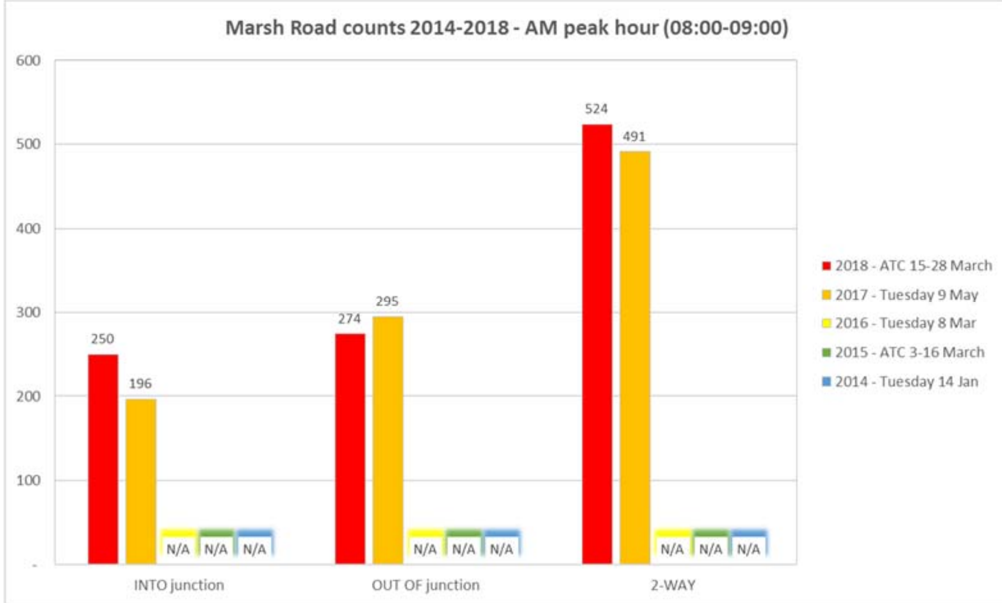


Figure 27: Marsh Road 2014-18 – PM peak hour

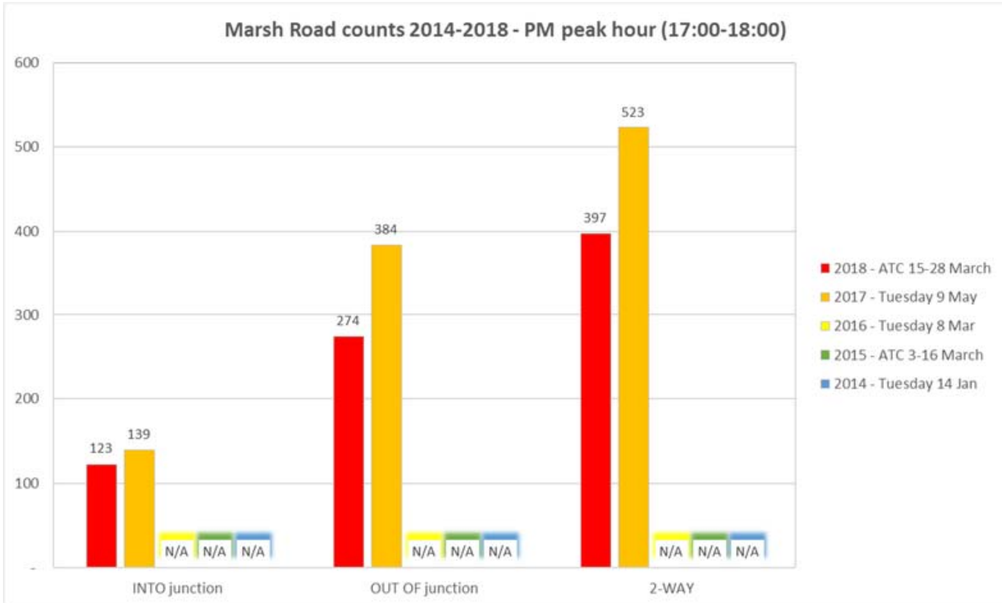


Figure 28: Ashton Gate Underpass 2014-18 – 24hr totals

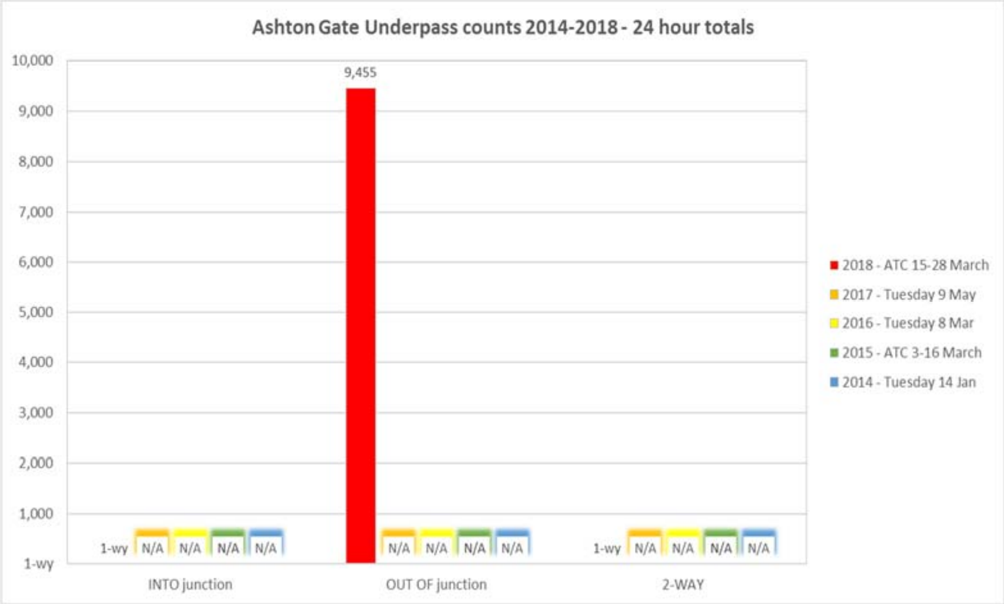


Figure 30: Ashton Gate Underpass 2014-18 – AM peak hour

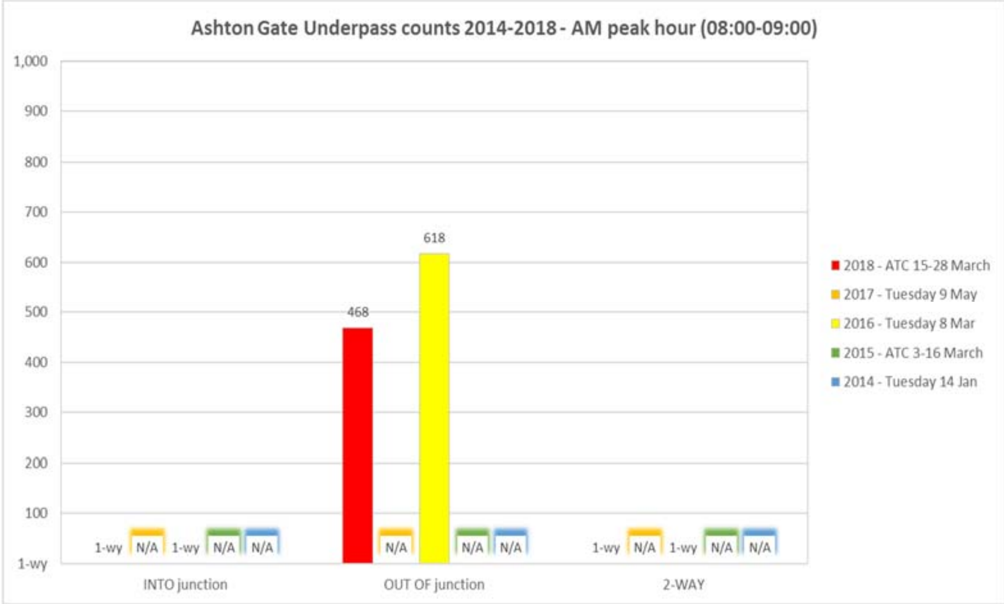


Figure 29: Ashton Gate Underpass 2014-18 – 12hr totals

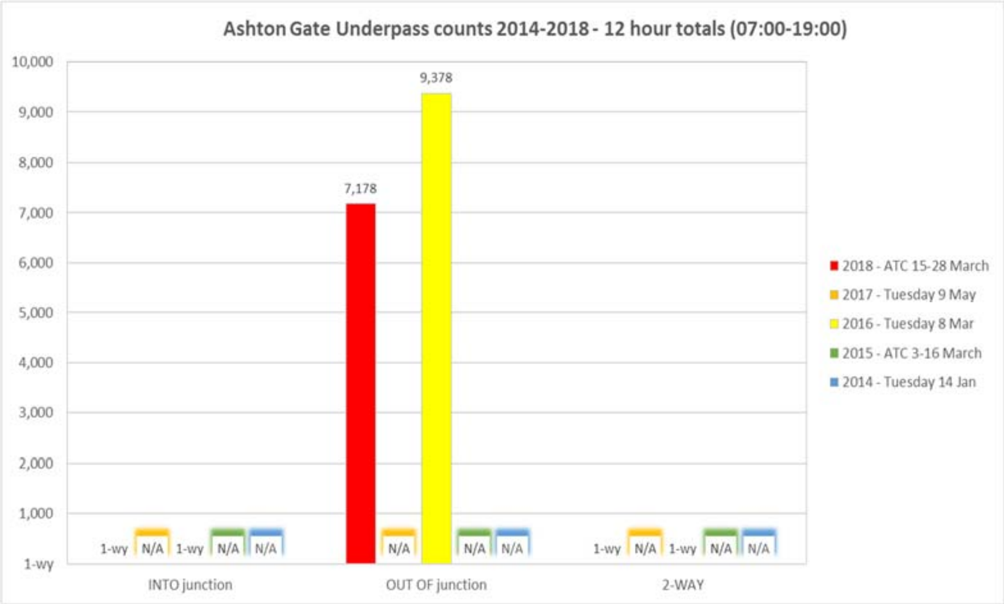
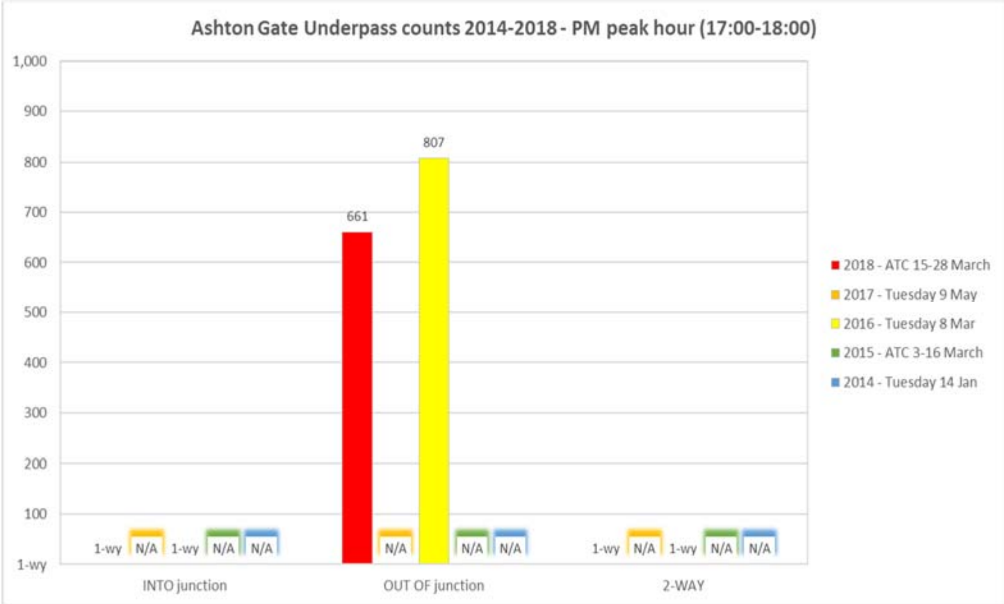


Figure 31: Ashton Gate Underpass 2014-18 – PM peak hour



Part 3:
Ashton Vale Road Level Crossing Train Times

Contents:

- Technical Note: 'MetroWest Phase 1, Ashton Vale Road Level Crossing Train Times', 3rd July 2018

TECHNICAL MEMORANDUM

MetroWest Phase 1
Ashton Vale Road Level Crossing Train Times

PREPARED FOR:	WoE Councils
PREPARED BY:	GW
DATE:	5th July 2018
PROJECT NUMBER:	674946.CS.70.01
REVISION NO.:	1
APPROVED BY:	**DRAFT**

1.0 Introduction

The MetroWest Phase 1 project comprises the delivery of infrastructure and passenger train operations to provide enhanced services on the Severn Beach line, local stations on the Bath to Bristol line and for a reopened Portishead Branch Line with stations at Portishead and Pill. The re-opened Portishead Branch Line will maintain the existing freight train operations as well as re-introduce passenger train services on an hourly basis.

The project is being led by North Somerset Council on behalf of the four West of England (WoE) councils. Infrastructure for the Portishead line and stations at Portishead and Pill is to be consented through the Portishead Branch Line Development Consent Order (DCO) scheme, with some infrastructure falling within Network Rail's General Permitted Development (GPD) rights. CH2M (now Jacobs) has been appointed to prepare a Transport Assessment (TA) in support of the DCO.

The Ashton Vale Road / Winterstoke Road signal controlled junction and adjacent Ashton Vale level crossing, the location of which is shown in Figure 1, has been considered in some detail as part of the Transport Assessment. This is to specifically assess the impact of increased level crossing closures due to MetroWest Phase 1 services on the Portishead line, and has included analysis using LinSIG and VISSIM models of the junction. [1]

The purpose of this note is to set out key assumptions relating to train services through the level crossing, based on work carried out by Network Rail as part of its GRIP3/4 analysis of the scheme.

2.0 Ashton Vale Level Crossing

The Ashton Vale Level Crossing is located on the current freight-only line that serves Royal Portbury Dock of the Port of Bristol. The freight spur into the dock was built from the Portishead railway line north of Pill, and opened in 2002. The Portbury dock line is linked to main Bristol-Taunton line at Parson Street junction, and although has a section of twin-track near Parson Street Junction, is single-track through the level crossing itself. The track layout in this area (and through the level crossing) will not be changing for the implementation of MetroWest Phase 1 with an hourly passenger service.

[1] Details of LinSIG assessments of Ashton Vale Road / Winterstoke Road junction can be found in the technical note 'MetroWest (Phase 1): A3029 Winterstoke Road/Ashton Vale Road – LinSIG Modelling'. Details of VISSIM modelling can be found in the 'MetroWest Phase 1: Winterstoke Road/Ashton Vale Road VISSIM Model Testing Report'. Both reports are part of the MetroWest Phase 1 DCO Transport Assessment.

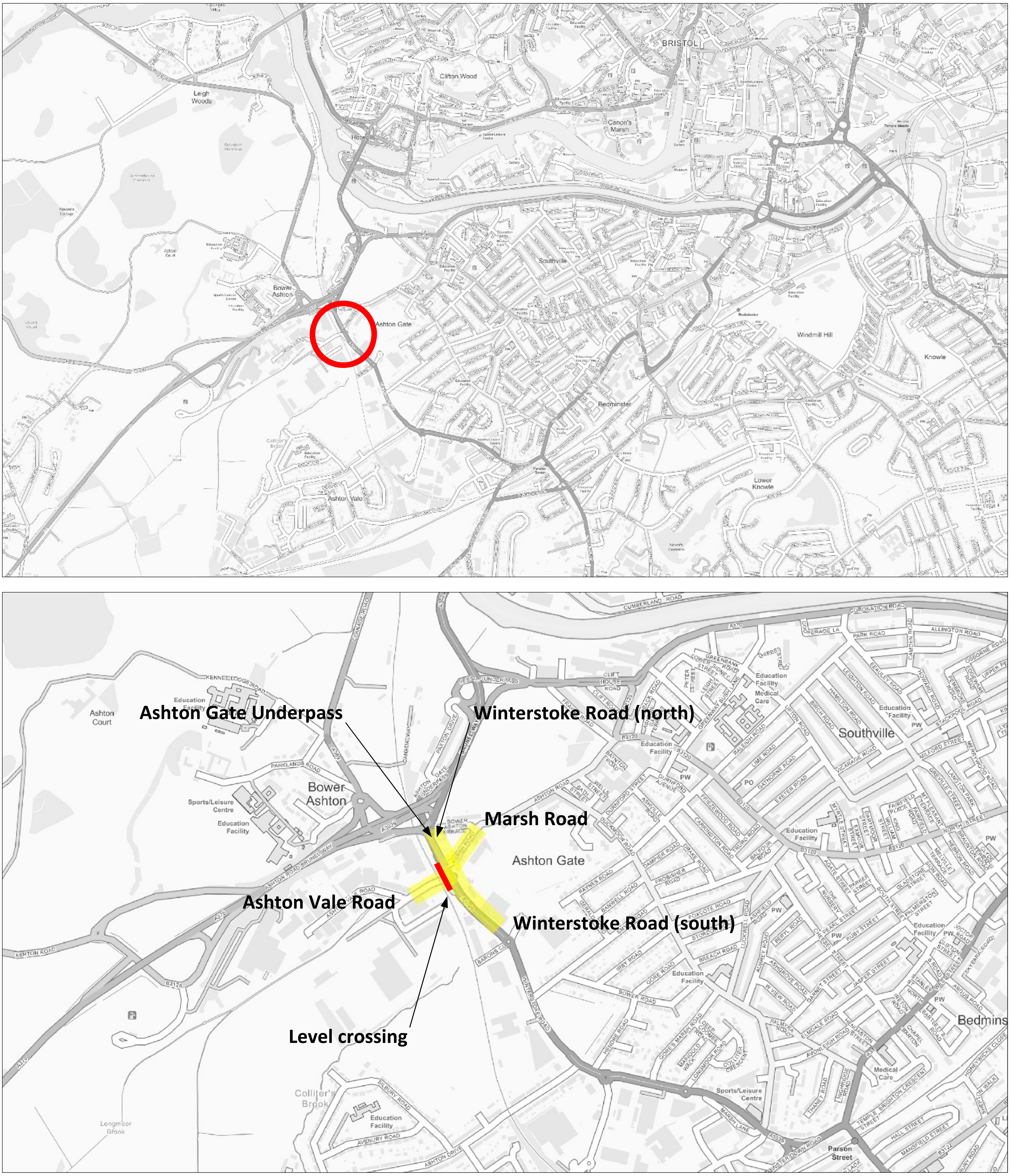


Figure 1: Ashton Vale Road / Winterstoke Road junction

Contains OS data © Crown copyright 2018

3.0 Train operating scenarios

Only freight trains serving the Royal Portbury Dock run through the Ashton Vale Road level crossing. MetroWest Phase 1 will introduce regular passenger trains to the line, with one train per hour per direction operating from (broadly) 6am to 11pm on weekdays (slightly reduced hours at weekends).

3.1 Current freight train operations

As freight trains are seldom scheduled with the same regularity and frequency as passenger trains, current use of the line (and hence level crossing closures) is irregular and (in historic terms) relatively low. A limit of 10 trains per day was included as a condition within the original planning permission for the new rail link to the port, though this was subsequently amended to 3,650 trains per annum; this retains the same number of trains overall, but reflects that the bulk nature of port movements could mean a daily limit would be restrictive. Within this limit, specific access rights are held by train operators to cover flows between the port and various destinations.

The working timetable for the Portbury branch can have as many as 26 freight trains indicated (2-way), but in practice most of these do not run on a daily basis. Not least because many paths are alternative between the same origin-destination at relatively close timings, to take into account variation in shipping access, which would by definition never all be used. Traffic levels are currently relatively low, and several days can pass with no trains at all. This is unusually low demand, and when freight train data was observed in February and March 2016 this revealed up to four freight trains were running per day (two directions) on weekdays, with up to two on weekends. However, it also indicated that out of 30 days for which data was extracted, freight train movements were only actually made on 15 days. It was also noted though from this analysis that rail freight movements could coincide with the off-peak and peak periods on the local highway network.

In essence therefore, in a typical hour, it is far more likely that there will be no freight trains operating on the Portbury dock line.

3.2 Future operating scenarios

MetroWest Phase 1 will add regular passenger services to the irregular freight trains that use the line now. Timetable planning for MetroWest services has included paths for freight trains to run, with an allowance for at least one freight train to run per hour in every hour. Theoretically, one freight train can run in each direction in each hour, though this is considered unlikely to ever be required (and may even not be practical in the port area or further afield on the main line).

Recognising that freight services can run any hour, but in practice are far more likely to be ad hoc, a series of train operating scenarios have been identified for the Ashton Vale Road level crossing, which have been taken forward for consideration in traffic modelling of the effects of the level crossing closures (using LinSIG and VISSIM). In broad terms, these are categorised as:

- Typical – the most likely occurrence in a typical hour; with MetroWest passenger services this is assumed to be no freight trains;
- Realistic worst case – a likely occurrence in a typical hour, but one that will not happen more than a few times a day (adding 1 freight train to MetroWest passenger services); and
- Theoretical maximum – 1 freight train per direction in addition to MetroWest passenger services (which while possible in timetabling terms is considered unlikely to occur regularly, if ever).

In addition, it is potentially possible to run an 'infill' passenger service at peak times. This would give a broadly 45-minute interval passenger service for a 3-hour period. It should be noted that this is not part of the current development plans for MetroWest Phase 1, and would require additional rolling stock to be sourced over and above the hourly service anticipated. Table 1 sets out a series of scenarios for future typical hour that have been identified at the Ashton Vale Road level crossing.

Table 1: Train operation scenarios: typical hourly sequence
Source: based on 'Concept Trains Plans for Various Scenarios 0.3.xlsx' with revised level crossing closure times supplied by NR

Scenario		**Freight trains**			**Passenger trains**			**All trains**
		UP	DOWN	Total	UP	DOWN	Total	per hour
Current operations (WoS)								
Typical:	'up'	1	-	1	-	-	0	1
	'down'	-	1	1	-	-	0	1
Theoretical maximum		1	1	2	-	-	0	2
MetroWest Phase 1 – 1 train per hour per direction (WS)								
Typical		-	-	0	1	1	2	2
Realistic worst case:	'up'	1	-	1	1	1	2	3
	'down'	-	1	1	1	1	2	3
Theoretical worst case		1	1	2	1	1	2	4
MetroWest Phase 1 – 'infill' peak service at 45 min intervals (WS45)								
Typical		-	-	0	1.33	1.33	2.67	2.67
Realistic worst case:	'up'	1	-	1	1.33	1.33	2.67	3.67
	'down'	-	1	1	1.33	1.33	2.67	3.67
Theoretical worst case		1	1	2	1.33	1.33	2.67	4.67

Notes:

UP freight trains run from Portbury to Parson Street Junction, DOWN freight trains run to Portbury

UP passenger trains run from Portishead to Bristol Temple Meads, DOWN passenger trains run to Portishead

Codes in brackets are used in scenario designation for LinSIG and VISSM modelling of the Ashton Vale Road / Winterstoke Road junction – WoS = no passenger trains; WS = MetroWest 1 tph; WS45 = MetroWest infill peak services; NF = no freight trains; 1F = 1 freight train in hour in 1 direction (either direction); 2F = 1 freight train per hour per dir)

4.0 Level crossing closures

4.1 Closure duration

The sequences of trains passing the level crossing has been determined from the top-down requirements for passenger and freight trains to serve Portishead and Portbury. Timetabling work carried out by Network Rail to include these trains has identified timings within a typical hour. As part of this, future signal control for the level crossing has also been considered as part of the works for MetroWest Phase 1. This has resulted in definition of signaling changes for the crossing from the current set-up, that reduce level crossing road closure times to around 2 minutes, with:

- DOWN trains running from Parson Street (to Portbury/Portishead) closing the level crossing to traffic for 1m 50s; and
- UP trains from Pill (i.e. from Portbury/Portishead) closing the level crossing for 2m 05s.

Table 2 indicates the effects that these closure times have in aggregate over a typical hour for the train operating scenarios in Table 1.

Table 2: Train operation scenarios: typical hourly sequence
Source: based on 'Concept Trains Plans for Various Scenarios 0.3.xlsx' with revised level crossing closure times supplied by NR

Scenario		**Level crossing closure times (totals in average hour)**		
		UP	DOWN	Total
Current operations (WoS)				
Typical (1F):	'up'	2m 05s	-	2m 05s
	'down'	-	1m 50s	1m 50s
Theoretical maximum (2F)		2m 05s	1m 50s	3m 55s
MetroWest Phase 1 – 1 train per hour per direction (WS)				
Typical (NF)		2m 05s	1m 50s	3m 55s
Realistic worst case (1F):	'up'	4m 10s	1m 50s	6m 00s
	'down'	2m 05s	3m 40s	5m 45s
Theoretical worst case (2F)		4m 10s	3m 40s	7m 50s
MetroWest Phase 1 – 'infill' peak service at 45 min intervals (WS45)				
Typical (NF)		2m 46s	2m 26s	5m 13s
Realistic worst case (1F):	'up'	4m 51s	2m 26s	7m 18s
	'down'	2m 46s	4m 16s	7m 03s
Theoretical worst case (2F)		4m 51s	4m 16s	9m 08s

Notes:

UP freight trains run from Portbury to Parson Street Junction, DOWN freight trains run to Portbury

UP passenger trains run from Portishead to Bristol Temple Meads, DOWN passenger trains run to Portishead

Codes in brackets are used in scenario designation for LinSIG and VISSM modelling of the Ashton Vale Road / Winterstoke Road junction – WoS = no passenger trains; WS = MetroWest 1 tph; WS45 = MetroWest infill peak services; NF = no freight trains; 1F = 1 freight train in hour in 1 direction (either direction); 2F = 1 freight train per hour per dir)

4.2 Indicative timetables and closure sequences

Figure 2 brings together the train operating scenarios and level crossing closure times from Tables 1 and 2, and presents the timings the passage of trains at the level crossing in a typical hour. This indicates the relationship between consecutive trains passing through the level crossing in each scenario presented. Figure 3 illustrates the level crossing closures graphically. Figures 4 and 5 present similar information for scenarios based on an 'infill' (45-minute interval) peak time passenger service.

The timings in Figure 2 indicate that gaps between trains passing the level crossing will typically be around 20 minutes and 35 minutes with just MetroWest passenger services running, which is very similar to the situation if two freight trains were to run in the same hour today. With MetroWest passenger services and freight trains running together, the minimum gap between trains passing the level crossing is between around 6 and 10 minutes, but in each scenario, there is a gap of at least 25 minutes at some point in a typical hour. If an 'infill' peak service was introduced, minimum gaps could fall to around 3-5 minutes, though again a gap of between 25 and 30 minutes between trains would still occur at some point in the sequence.

5.0 Summary

MetroWest Phase 1 will introduce regular passenger trains to the Portbury/Portishead line, serving Portishead on an hourly basis. This will in turn entail two closures of the Ashton Vale Road level crossing to traffic being added to existing freight train closures. Currently though, while freight trains could run on the Portbury dock line once or twice an hour, there are actually only a few trains a week, and sometimes none on any given day.

As such, in most typical hours, the Ashton Vale Level crossing will close twice; 1m 50s for a 'down' passenger train from Bristol Temple Meads to Portishead; and 2m 05s for an 'up' passenger train from Portishead. An additional closure of either 1m 50s or 2m 05s would also occur if a there is a freight train to or from the port (respectively).

Gaps between trains, and hence closures of the level crossing to traffic, will be around 20 mins and 35 mins with 1 passenger train per hour per direction and no freight trains, reducing to 6-10 minutes if a freight train runs. In each scenario though, there is one gap of at least 25 minutes between trains.

SCENARIO	Note that this is for a standard hour, so times also apply to other hours			Road closes *time*	Closure duration *min:sec*	Road opens *time*	Min time to next closure *min:sec*
CURRENT - 5/6 times a week 2	1 freight train per hr (up) - NO passenger trains						estimated
	Freight	UP	from Portbury	09:08:55	02:05	09:11:00	57:55
				TOTAL /hr	02:05		
CURRENT - 5/6 times a week 1	1 freight train per hr (down) - NO passenger trains						estimated
	Freight	DOWN	to Portbury	09:08:40	01:50	09:10:30	58:10
				TOTAL /hr	01:50		
CURRENT - theoretical maximum (rarely occurs)	1 freight train per hr per dir - NO passenger trains						estimated
	Freight	UP	from Portbury	09:07:55	02:05	09:10:00	17:10
	Freight	DOWN	to Portbury	09:27:10	01:50	09:29:00	38:55
				TOTAL /hr	03:55		
FUTURE - most of the time	1 passenger train per hr per dir - NO freight trains						estimated
	Pasenger	UP	from Portishead	08:58:25	02:05	09:00:30	19:10
	Passenger	DOWN	to Portishead	09:19:40	01:50	09:21:30	36:55
				TOTAL /hr	03:55		
FUTURE - absolute worst case (would rarely occur)	1 passenger train per hr per dir - 1 freight train per hr per dir						1 Unit B
	Pasenger	UP	from Portishead	08:54:25	02:05	08:56:30	11:25
	Freight	UP	from Portbury	09:07:55	02:05	09:10:00	09:40
	Passenger	DOWN	to Portishead	09:19:40	01:50	09:21:30	05:40
	Freight	DOWN	to Portbury	09:27:10	01:50	09:29:00	25:25
				TOTAL /hr	07:50		
FUTURE - realistic worst case 2	1 passenger train per hr per dir - 1 freight train per hr in one direction (up)						1 Unit CU
	Passenger	UP	from Portishead	08:58:25	02:05	09:00:30	08:25
	Freight	UP	from Portbury	09:08:55	02:05	09:11:00	08:40
	Passenger	DOWN	to Portishead	09:19:40	01:50	09:21:30	36:55
				TOTAL /hr	06:00		
FUTURE - realistic worst case 1	1 passenger train per hr per dir - 1 freight train per hr in one direction (down)						1 Unit CD
	Pasenger	UP	from Portishead	08:58:25	02:05	09:00:30	08:10
	Freight	DOWN	to Portbury	09:08:40	01:50	09:10:30	09:10
	Passenger	DOWN	to Portishead	09:19:40	01:50	09:21:30	36:55
				TOTAL /hr	05:45		

Figure 2: Ashton Vale Road Level Crossing closure times in a standard hour (table)

Source: based on 'Concept Trains Plans for Various Scenarios 0.3.xlsx' with revised level crossing closure times supplied by NR

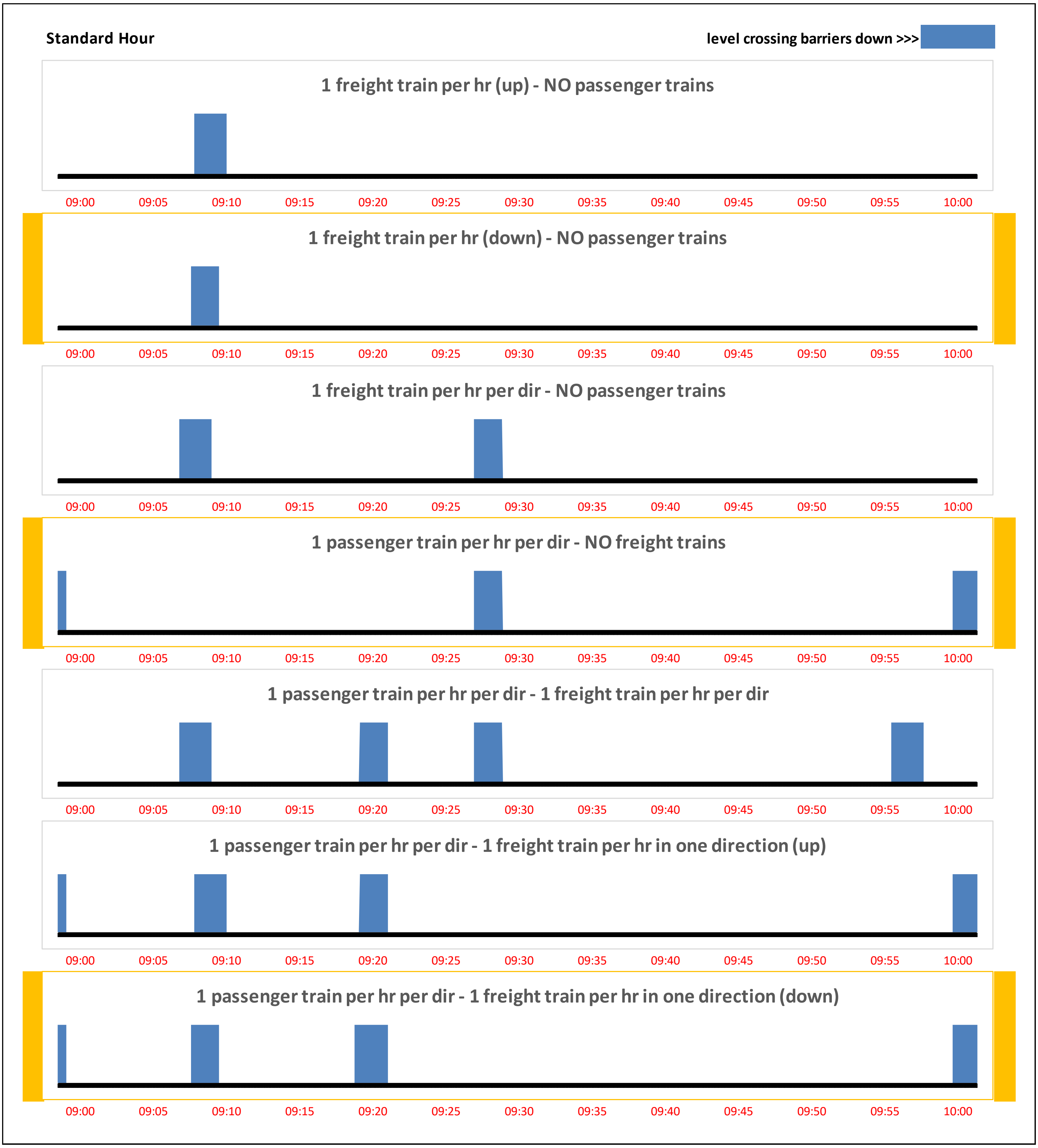


Figure 3: Ashton Vale Road Level Crossing closure times in a standard hour (chart)

Source: based on 'Concept Trains Plans for Various Scenarios 0.3.xlsx' with revised level crossing closure times supplied by NR

SCENARIO	Note that this is for a standard hour, so times also apply to other hours			Road closes *time*	Closure duration *min:sec*	Road opens *time*	Min time to next closure *min:sec*
CURRENT - 5/6 times a week 2	1 freight train per hr (up) - NO passenger trains						estimated
	Freight	UP	from Portbury	07:08:55	02:05	07:11:00	57:40
	Freight	DOWN	to Portbury	08:08:40	01:50	08:10:30	58:25
	Freight	UP	from Portbury	09:08:55	02:05	09:11:00	57:55
				TOTAL /hr	02:00		
CURRENT - 5/6 times a week 1	1 freight train per hr (down) - NO passenger trains						estimated
	Freight	DOWN	to Portbury	07:08:40	01:50	07:10:30	58:25
	Freight	UP	from Portbury	08:08:55	02:05	08:11:00	57:40
	Freight	DOWN	to Portbury	09:08:40	01:50	09:10:30	58:10
				TOTAL /hr	01:55		
CURRENT - theoretical maximum (rarely occurs)	1 freight train per hr per dir - NO passenger trains						estimated
	Freight	UP	from Portbury	07:07:55	02:05	07:10:00	17:10
	Freight	DOWN	to Portbury	07:27:10	01:50	07:29:00	38:55
	Freight	UP	from Portbury	08:07:55	02:05	08:10:00	17:10
	Freight	DOWN	to Portbury	08:27:10	01:50	08:29:00	38:55
	Freight	UP	from Portbury	09:07:55	02:05	09:10:00	17:10
	Freight	DOWN	to Portbury	09:27:10	01:50	09:29:00	38:55
				TOTAL /hr	03:55		
45-minute - no freight	1 passenger train every 45 mins per dir - NO freight trains						estimated
	Passenger	UP	from Portishead	07:13:55	02:05	07:16:00	04:10
	Passenger	DOWN	to Portishead	07:20:10	01:50	07:22:00	36:55
	Passenger	UP	from Portishead	07:58:55	02:05	08:01:00	04:10
	Passenger	DOWN	to Portishead	08:05:10	01:50	08:07:00	36:55
	Passenger	UP	from Portishead	08:43:55	02:05	08:46:00	04:10
	Passenger	DOWN	to Portishead	08:50:10	01:50	08:52:00	36:55
	Passenger	UP	from Portishead	09:28:55	02:05	09:31:00	04:10
	Passenger	DOWN	to Portishead	09:35:10	01:50	09:37:00	36:55
				TOTAL /hr	05:13		
45-minute - absolute worst case (would rarely occur)	1 passenger train every 45 mins per dir - 1 freight train per hr per dir						45 minute cycles
	Freight	UP	from Portbury	07:08:55	02:05	07:11:00	02:55
	Passenger	UP	from Portishead	07:13:55	02:05	07:16:00	04:10
	Passenger	DOWN	to Portishead	07:20:10	01:50	07:22:00	04:40
	Freight	DOWN	to Portbury	07:26:40	01:50	07:28:30	25:25
	Freight	UP	from Portbury	07:53:55	02:05	07:56:00	02:55
	Passenger	UP	from Portishead	07:58:55	02:05	08:01:00	04:10
	Passenger	DOWN	to Portishead	08:05:10	01:50	08:07:00	09:10
	Freight	DOWN	to Portbury	08:16:10	01:50	08:18:00	10:55
	Freight	UP	from Portbury	08:28:55	02:05	08:31:00	12:55
	Passenger	UP	from Portishead	08:43:55	02:05	08:46:00	04:10
	Passenger	DOWN	to Portishead	08:50:10	01:50	08:52:00	09:10
	Freight	DOWN	to Portbury	09:01:10	01:50	09:03:00	20:55
	Freight	UP	from Portbury	09:23:55	02:05	09:26:00	02:55
	Passenger	UP	from Portishead	09:28:55	02:05	09:31:00	04:10
	Passenger	DOWN	to Portishead	09:35:10	01:50	09:37:00	09:10
	Freight	DOWN	to Portbury	09:46:10	01:50	09:48:00	20:55
				TOTAL /hr	10:27		
45-minute - realistic worst case 2	1 passenger train every 45 mins per dir - 1 freight train per hr in one direction (up)						estimated
	Freight	UP	from Portbury	07:08:55	02:05	07:11:00	02:55
	Passenger	UP	from Portishead	07:13:55	02:05	07:16:00	04:10
	Passenger	DOWN	to Portishead	07:20:10	01:50	07:22:00	31:55
	Freight	UP	from Portbury	07:53:55	02:05	07:56:00	02:55
	Passenger	UP	from Portishead	07:58:55	02:05	08:01:00	04:10
	Passenger	DOWN	to Portishead	08:05:10	01:50	08:07:00	21:55
	Freight	UP	from Portbury	08:28:55	02:05	08:31:00	12:55
	Passenger	UP	from Portishead	08:43:55	02:05	08:46:00	04:10
	Passenger	DOWN	to Portishead	08:50:10	01:50	08:52:00	31:55
	Freight	UP	from Portbury	09:23:55	02:05	09:26:00	02:55
	Passenger	UP	from Portishead	09:28:55	02:05	09:31:00	04:10
	Passenger	DOWN	to Portishead	09:35:10	01:50	09:37:00	31:55
				TOTAL /hr	08:00		
45-minute - realistic worst case 1	1 passenger train every 45 mins per dir - 1 freight train per hr in one direction (down)						estimated
	Passenger	UP	from Portishead	07:13:55	02:05	07:16:00	04:10
	Passenger	DOWN	to Portishead	07:20:10	01:50	07:22:00	04:40
	Freight	DOWN	to Portbury	07:26:40	01:50	07:28:30	30:25
	Passenger	UP	from Portishead	07:58:55	02:05	08:01:00	04:10
	Passenger	DOWN	to Portishead	08:05:10	01:50	08:07:00	09:10
	Freight	DOWN	to Portbury	08:16:10	01:50	08:18:00	25:55
	Passenger	UP	from Portishead	08:43:55	02:05	08:46:00	04:10
	Passenger	DOWN	to Portishead	08:50:10	01:50	08:52:00	09:10
	Freight	DOWN	to Portbury	09:01:10	01:50	09:03:00	25:55
	Passenger	UP	from Portishead	09:28:55	02:05	09:31:00	04:10
	Passenger	DOWN	to Portishead	09:35:10	01:50	09:37:00	09:10
	Freight	DOWN	to Portbury	09:46:10	01:50	09:48:00	25:55
				TOTAL /hr	07:40		

Figure 4: Ashton Vale Road Level Crossing closure times in 3-hour period for 45 min 'infill' service (table)

Source: based on 'Concept Trains Plans for Various Scenarios 0.3.xlsx' with revised level crossing closure times supplied by NR

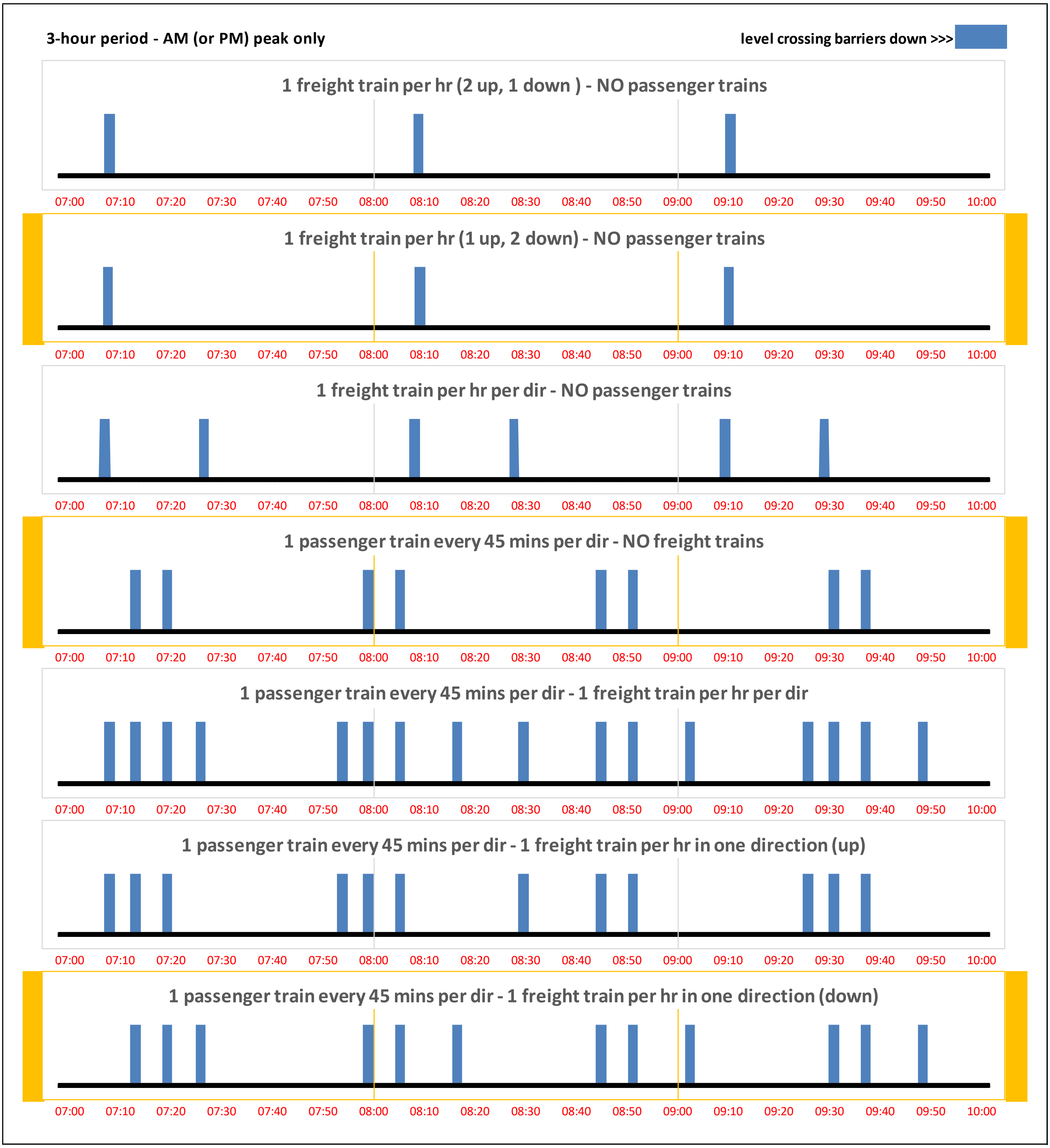


Figure 5: Ashton Vale Road Level Crossing closure times in 3-hour period for 45 min 'infill' service (chart)

Source: based on 'Concept Trains Plans for Various Scenarios 0.3.xlsx' with revised level crossing closure times supplied by NR

Part 4:
Junction Modelling – LinSIG

Contents:

TECHNICAL MEMORANDUM

MetroWest (Phase 1): A3029 Winterstoke Road/Ashton Vale Road – LinSIG Modelling

PREPARED FOR:	North Somerset Council
PREPARED BY:	DL
APPROVED BY:	HS
DATE:	6th July 2018
PROJECT NUMBER:	674946.CS.70.01
REVISION NO.:	Version 0.1

1.0 Introduction

CH2M is currently updating a Transport Assessment (TA) in support of the MetroWest Phase 1 proposals involving the re-introduction of passenger rail services between Bristol and Portishead. The increase in use of existing sections of the railway line could mean that closure times at the level crossing on Ashton Vale Road adjacent to the A3029 Winterstoke Road/Ashton Vale Road signal controlled junction (see **Figure 1**) could be more frequent, resulting in a greater impact on operational conditions on the local highway network.

Figure 1: A3029 Winterstoke Road/Ashton Vale Road, Existing Layout

The purpose of this Technical Note is to present the results of LinSIG modelling which assesses the impact of an hourly MetroWest rail service in each direction, and to support the introduction of the proposed mitigation measures at this junction which includes:

- The extension of the left turning lane into Ashton Vale Road on the Winterstoke Road northbound approach; and
- The introduction of MOVA control (Micro-processor Optimised Vehicle Actuation)

ch2m

The Technical Note is structured as follows:

- Section 2 explains how the existing Method of Control at the junction works now. It also presents the LinSIG assessment results for the existing layout; and
- Section 3 considers a typical 'closure' scenario with a passenger train passing through the junction. Unlike the base-line scenario which considers a recurrent stage sequence over the full duration of each weekday peak hour, these analyses focus attention on a shorter period covering the level crossing barrier 'down' time and the following one to two signal cycles; and
- Finally, Section 4 provides a summary and conclusions concerning the likely impact of a 'closure' on the overall junction capacity and operating conditions on Ashton Vale Road.

2.0 Base Modelling Assessment

2.1 Traffic Data

Traffic flows for these assessments have been taken from a turning count survey undertaken by North Somerset Council (NSC) on carried out on Tuesday 9th May 2017. These 'base year' traffic flows were converted to passenger car units (PCUs) through the application of the following PCU factors: cars and LGVs = 1, HGVs = 2.3, buses = 2.5, motorcycles = 0.4 and pedal cycles = 0.2.

In the May 2017 survey, the count undertaken on the northbound Winterstoke Road approach did not differentiate between the two 'straight-ahead movement to Ashton Gate underpass (Phase A) and that to Ashton Road for the A370 West/A369 (Phase G). As such, the proportional split observed in the MCC survey undertaken in March 2016 was used. As noted later blow, this 'split' is particularly critical in the weekday AM peak hour, when the flow to Ashton Gate underpass is particularly dominant.

During the May 2017 survey the junction was affected by the AVTN (MetroBus) works in the area, insofar as the separate left turn lane into Ashton Vale Road was closed off by coning. Separate ATC counts undertaken on Thursday 15th to Wednesday 28th March 2018 have subsequently been used to verify that, despite these works, the flows throughout the day on Tuesday 0th May 2017 were typical of normal weekday conditions and were not reduced. A full comparison of count data available for the Winterstoke Road/Ashton Vale Road/Marsh Road junction is contained in the report '**MetroWest Phase 1 Ashton Vale Road Traffic Counts**', dated 22nd June 2018

Traffic demand sets were created for the AM (8:00-9:00 am) and PM (5:00-6:00 pm).

2.2 Modelling Methodology

2.2.1 General

The junction layout, including number of lanes and flare lengths, was coded into LinSig using as-built layout information from NSC. Lane saturation flows were based on RR67 calculations using the geometry taken from the layout drawing. Observations of peak hour conditions and the traffic data suggests that there are specific issues which affect the operation of the junction, and which needed to be reflected in the modelling as follows:

- The split in the A3029 Winterstoke Road northbound 'straight-ahead' movement between traffic heading inbound via the Ashton Gate underpass and vehicles travelling outbound on the A370/A369. The March 2016 MCC showed that the movement toward the underpass was notably more dominant, particularly in the AM peak. This is critical, as this movement is catered for by the lane immediately adjacent to the short 'flared' left turn lane into Ashton Vale Road. As such, excess queuing in the left turn flare exceeding the storage capacity of this short lane could have significant implications for operational conditions. As noted above, the appropriate traffic split for each peak hour was taken from the March 2016 MCC, when these movements were separately counted;

- The amount of left turning traffic capable of storing within the left turn flare during a level crossing closure before the adjacent ahead lane is impeded. Video survey footage of the junction during a level crossing closure showed that around eight or nine vehicles could be accommodated in this lane before the queue encroached onto the adjacent ahead lane, this blocking and impeding the 'ahead' movement to the Ashton Gate underpass. However, there is some potential for vehicles to use the ghost island hatching to bypass queuing extending from the left turn lane for a short length. Taking all this into consideration, a left turn flare length of 10 PCUs was used in the LinSIG modelling;
- Exit blocking from the Ashton Gate underpass in the AM peak hour due to capacity limitations imposed by the merging/weaving capacity at the slip-road entry to the A370 Brunel Way. No specific allowance was made for this by, say, lowering the calculated saturation flow for this 'straight-ahead' movement (Phase A). However, the performance here was checked in the 'closure' scenario tests to ensure that effects did not result in a large increase in the Degree of Saturation for Phase A, to the extent that a close to capacity situation could be a possible outcome under 'free exit' conditions;
- The respective driver usage of the two approach lanes on the southbound Winterstoke Road from Brunel Way. Whilst both entry lanes can cater for the 'straight-ahead' movement, the outer lane on exit eventually terminates as a right turn only lane at the downstream roundabout junction with Barons Close and Wedlock Way. As the dominant southbound movement at the roundabout is 'ahead' on the A3029, drivers electing to use the outside lane on approach to the Marsh Road junction must at some point make a lane change into the nearside lane on exit, although the distance available to do this is some 260 metres. Notwithstanding this, site observations show that there is dis-utility of this outer lane when compared to the nearside lane. To reflect this imbalance in lane usage it was assumed that 'ahead' driver use was equally likely. This together with a relatively high left turn flow into Marsh Roade created a high bias towards use of the nearside lane.

2.2.2 Signal Controller: Method of Control and Operating Mode

Normal Method of Control

Traffic signal controller parameters such as phase minima, phase inter-green values and stages were input in accordance with the controller configuration (TR2500) supplied by the Bristol City Council Traffic Signals team.

Under 'normal' cyclic operating conditions with no level crossing closure, and 'demands' present for all phases including all pedestrian crossings, the signals can operate on a 1-2-3-4-5-6 staging sequence as shown in **Figure 2**.

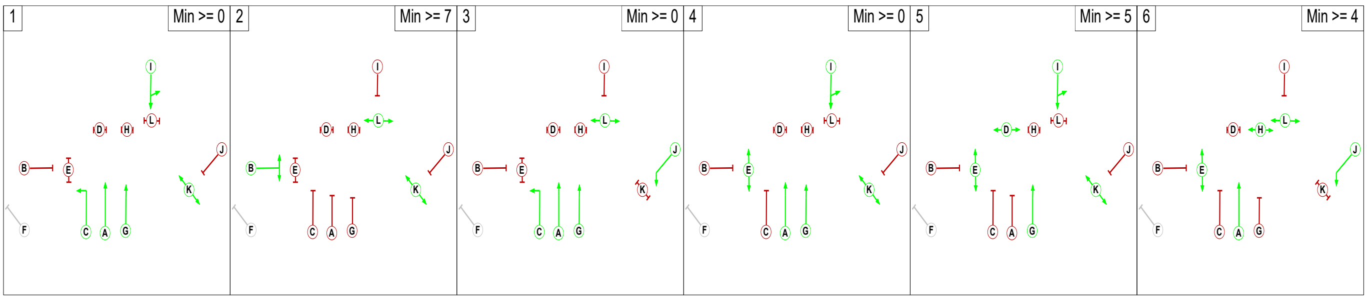


Figure 2: A3029 Winterstoke Road/ Ashton Vale Road 'Normal' Staging Sequence

It is important to note that lot of these stages will only appear if there is a demand for a specific phase, which may not occur cyclically. Examples include:

- Stage 3: which only appears if there is a demand for Marsh Road (Phase J);
- Stage 4: which only occurs normally if there if a demand for the pedestrian crossing over Ashton Vale Road (Phase E). However, as noted later, a level crossing input will prevent the appearance of Stages 1, 2 and 3 and, as such, demands for Phases A, G or I on Winterstoke Road will call/extend Stage 4 under this scenario;
- Stage 5: which only appears if there is a demand for the pedestrian crossing over the exit to the Ashton Gate underpass (Phase D); and
- Stage 6: which only appears if there is a demand for the pedestrian crossing over the exit to the westbound A370 and A369 (Phase H).

As such, 'base case' modelling of a 1-2-3-4-5-6 stage sequence every cycle can be considered a 'worst case' typical scenario in the absence of the specific consideration of a level crossing closure event.

Effect of a Level Crossing Closure

During a period when the level crossing on the Ashton Vale Road arm is down, the signal controller is configured to run a stage sequence that prevents both the left turn into Ashton Vale Road and the movement out from this side road from appearing, but enables other movements to operate as normal. This has the effect of suppressing or preventing the appearance of Stages 1-3, with only the stages shown in **Figure 3** allowed to operate. As before, this sequence assumes that all pedestrian crossing phases are demanded, which call Stages 5 and 6. Stage 4 will be called and extended by Phases A, G and I. It is important to note that the critical phases on Winterstoke Road are kept running in Stage 4 during a level crossing closure, with potential continuity only interrupted in the northbound direction by a demand for the crossing on the Ashton Gate underpass exit (Phase D) and in the southbound direction by a demand for Marsh Road or the crossing over the A370 West/A369 exit (Phases J and H).

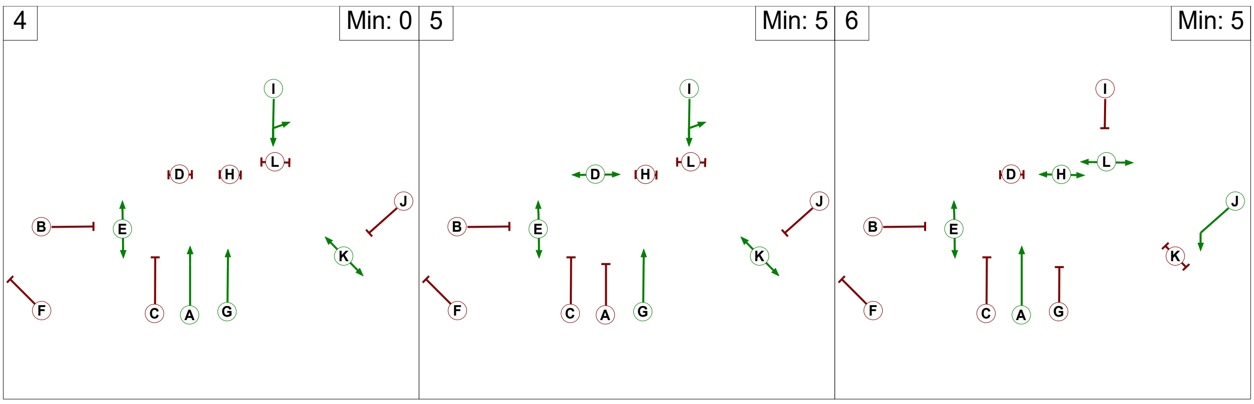


Figure 3: A3049 Winterstoke Road/ Ashton Vale Road: Level Crossing Closure Staging Sequence

Mode of Operation

Although most of the traffic signals in the City Centre operate under the centralised SCOOT UTC system as the normal mode of control, the Winterstoke Road/Ashton Vale Road junction operates under 'local' Vehicle Actuated (VA) mode. This decision is largely influenced by the need to make specific 'stage allowance' intervention in the event of a level crossing closure, which is most easily handled by local controller conditioning of the VA control. Under VA control the ability of the controller to respond to fluctuating traffic conditions, which would include a post level crossing closure situation, is governed by the allowable phase maximums in the different time of day plans (MAX SETS).

In the weekday AM (7:00-10:00 am) and PM peak (3:00-7:00 pm) periods the current operational MAX SETS are MAX B and MAX C. The VA configuration settings in terms of the maximum time a phase green can run in these two weekday periods are set out below:

Phase	MAX B	MAX C	Notes
A	40	30	A3029 Northbound: To Ashton Gate Underpass
B	20	24	Ashton Vale Road
C	20	20	Left turn to Ashton Vale Road
D	0	0	Pedestrian crossing: No MAX
E	0	0	Pedestrian crossing: No MAX
F	0	0	Unused Phase
G	30	20	A3029 Northbound: To A370(W) and A369
H	0	0	Pedestrian crossing: No MAX
I	60	70	A3029 Southbound
J	12	12	Marsh Road
K	0	0	Pedestrian crossing: No MAX

The important points to note are as follows:

- Phase I controlling the southbound A3029 is the one having the ability to drive up the operational cycle time, and can extend up to 70 seconds in the PM peak (Stage 1). Under a level crossing closure scenario, it can similarly extend Stage 4;
- Ashton Vale Road is currently tightly constrained under VA, and can only extend Stage 2 for up to 24 seconds in the critical PM peak period (even if a longer green time was in fact needed after a level crossing closure). Altering the mode of control here to MOVA would allow greater opportunity for increasing the maximum green time allowable for Phase B. This is because, unlike VA, MOVA monitors the density of traffic discharge during green and would not allow Ashton Vale Road to run an unnecessarily long green time to the detriment of Winterstoke road if the headways or 'gaps' between vehicles crossing the stop-line became unduly extended. The same principle would apply in the MOVA monitoring of other traffic phases running on green in other stages.

2.3 Assessment Results

2.3.1 No Closure Scenario

Two scenarios have been considered for the weekday AM and PM peak periods as follows

- A 'full' stage sequence of 1-2-3-4-5-6 with timings optimised to give the most likely operational cycle time. In doing so, the resultant phase timings were checked to ensure that phase maximums (VA) were not violated. If so, any falling beyond the allowable MAX were adjusted to the maximum permissible in the respective period; and
- An assumed 1-2-3-4-5-6 stage sequence with all phases running to their allowable maximums. This give the maximum cycle the controller 'could' run to now in the weekday peak periods. It should be noted, however, that this may not necessarily be the most efficient use of green time, as it is often the case that MAX Plan timings can become out-of-date and may not necessarily reflect the relative proportions of green time needed by critical phases with the current traffic pattern.

Tables 1 and 2 below compare the results of the LinSig assessments for the AM peak hour (8:00-9:00 am). Full LinSIG summary results are included in **Annex A**.

Table 1: Winterstoke Rd/Ashton Vale Rd: Existing Layout and Normal Method of Control - OPTIMISED - AM

Arm/Movement)	**Operating Statistics**			
	Current Flow(PCU)	Degree of Saturation (%)	Mean Maximum Queue (PCU)	Mean Delay (seconds/PCU)
A3029 NBD: To Ashton Vale Road and Ashton Gate Underpass	230/719	61.6%	8	7.7/21.1
A3029 NBD: to A370(W) and A369	357	26.2%	3	5.7
Ashton Vale Road	114	89.1%	7	145.6
A3029 SBD: Including LT to Marsh Road	898/578	89.8%/55.9%	22/9	29.9/14.0
Marsh Road	211	75.5%	6	49.6

Notes:

A full 1-2-3-4-5-6 Stage Sequence has been assumed/modelled, with an optimum cycle time of 118 seconds

Figures for the A3029 SBD approach show respective results for the nearside and outer lanes, due to assumed 'bias' in the use of the nearside lane.

Table 2: Winterstoke Rd/Ashton Vale Rd: Existing Layout and Normal Method of Control - VA MAXIMA -AM

Arm/Movement)	**Operating Statistics**			
	Current Flow(PCU)	Degree of Saturation (%)	Mean Maximum Queue (PCU)	Mean Delay (seconds/PCU)
A3029 NBD: To Ashton Vale Road and Ashton Gate Underpass	230/719	66.7%	12	11.2/13.3
A3029 NBD: to A370(W) and A369	357	27.3%	5	9.2
Ashton Vale Road	114	42.0%	5	68.3
A3029 SBD: Including LT to Marsh Road	898/578	94.6%/58.9%	35/12	58.2/24.1
Marsh Road	211	76.4%	9	68.1

Notes:

A full 1-2-3-4-5-6 Stage Sequence has been assumed/modelled with all phases assumed to run the allowable MAX (VA). In the AM peak period this would give a MAX cycle of 146 seconds

Figures for the A3029 SBD approach show respective results for the nearside and outer lanes, due to assumed 'bias' in the use of the nearside lane.

The results for this period show that:

- Results are heavily influenced by the respective assumed usage of the two approach lanes on the southbound A3029 entry from Brunel Way;
- Under the 'optimised' scenario the controller runs Ashton Vale Road on a minimum green time given the low demand in this period. This results in high delays which are not reflected in journey times used in parallel VISSIM modelling. Part of the reason is possibly the pessimistic assumption that all stages appear cyclically. However, in practice, the VA MAX setting for Ashton

Vale Road (20 seconds) will allow this stage to run longer than the minimum as required. Table 2 shows the result with Ashton Vale Road operating at its MAX, which shows a degree of saturation of only 42.0% and average delay more than halved; and

- It is clear from the LinSIG analyses for this period that the critical approaches governing junction performance are West Ashton Road and the southbound A3029 (Phases B and I). Whilst the northbound flow on the A3029 to Ashton Gate Underpass is also high in this period, it is evident that the constraint on flow is likely to be the downstream merge/weave capacity onto Brunel Way, as opposed to 'potential' stop-line capacity here.

Tables 3 and 4 below show the corresponding results for the weekday PM peak hour (5:00-6:00 pm).

Table 3: Winterstoke Rd/Ashton Vale Rd: Existing Layout and Normal Method of Control - OPTIMISED - PM

Arm/Movement)	**Operating Statistics**			
	Current Flow(PCU)	Degree of Saturation (%)	Mean Maximum Queue (PCU)	Mean Delay (seconds/PCU)
A3029 NBD: To Ashton Vale Road and Ashton Gate Underpass	37/774	60.7%	13	11.2/25.3
A3029 NBD: to A370(W) and A369	407	30.8%	6	8.4
Ashton Vale Road	232	87.3%	13	108.1
A3029 SBD: Including LT to Marsh Road	906/521	89.6%/49.5%	28/11	33.9/16.1
Marsh Road	139	62.8%	4	53.0

Notes:

A full 1-2-3-4-5-6 Stage Sequence has been assumed/modelled, with an optimum cycle time of 149 seconds

Figures for the A3029 SBD approach show respective results for the nearside and outer lanes, due to assumed 'bias' in the use of the nearside lane.

The PM peak hour results, when outflow from Ashton Vale Road is more critical, shows similar features to the AM peak hour scenario. These are as follows:

- The critical phases governing junction operation and performance again are Ashton Vale Road and the southbound A3029 approaches (Phases B and I). As before, results are heavily influenced by the relative lane usage or 'bias' assumed on the southbound Winterstoke Road entry;
- In the 'optimised' scenario, the results assume that Ashton Vale Road gets 'and needs' 20 seconds which is just below its allowable VA MAX of 24 seconds in this period. In consequence the results for Ashton Vale Road in Tables 3 and 4 are similar, whereas there was a big difference in the AM (Tables 1 and 2). A key point to note is that there is little or no slack in the allowable MAX for this side road to deal with a need for compensating green time when a level crossing closure occurs now due to existing freight services.

It is notable that, unlike the AM peak hour, the 'optimised' cycle time in the PM peak at 149 seconds is very close to its operational MAX under VA (160 seconds). The results show that, with all phases allowed to run to the MAX, there is little operational benefit, with the nearside lane on the southbound A3029 running at just over practical capacity (90.0%).

Table 4: Winterstoke Rd/Ashton Vale Rd: Existing Layout and Normal Method of Control - VA MAXIMA - PM

Arm/Movement)	Operating Statistics			
	Current Flow(PCU)	Degree of Saturation (%)	Mean Maximum Queue (PCU)	Mean Delay (seconds/PCU)
A3029 NBD: To Ashton Vale Road and Ashton Gate Underpass	37/774	61.1%	15	13.4/12.9
A3029 NBD: to A370(W) and A369	407	30.9%	6	9.1
Ashton Vale Road	232	78.7%	12	92.1
A3029 SBD: Including LT to Marsh Road	906/521	92.7%/51.3%	36/11	53.9/22.6
Marsh Road	129	55.2%	6	62.3

Notes:

A full 1-2-3-4-5-6 Stage Sequence has been assumed/modelled with all phases assumed to run the allowable MAX (VA). In the PM peak period this would give a MAX cycle of 160 seconds

Figures for the A3029 SBD approach show respective results for the nearside and outer lanes, due to assumed 'bias' in the use of the nearside lane.

2.3.2 With Level Crossing Closure

The above modelling for the normal situation has assumed that no level crossing closure occurs throughout the modelled hours. However, a full 1-2-3-4-5-6 stage sequence is assumed to occur cyclically in determining typical delays/queues each cycle over the hour. In mimicking the effect of a level crossing closure the same approach cannot be used. This because closures will be limited to a small number of specific events in each hour. In other words, they will not occur cyclically.

To model a 'closure event' with LINSIG a smaller timeframe was employed to mimic a set number of cycles incorporating:

- A pre-closure cycle running optimised timings as described above;
- One or two cycles running the 'closure' 4-5-6 stage sequence during the expected barrier down-time. In separate work undertaken examining passenger train service scenarios associated with MetroWest it is estimated that the duration of the level crossing down-times would be as follows:
  - 2 minutes and 5 seconds for a train coming from Portishead; and
  - 1 minute and 50 seconds for a train going to Portishead.
- A post-closure cycle (or cycles) running extended 'compensatory' green time for Ashton Vale Road as required. The objective of this was to ascertain how much green time beyond the current VA Maxima would be needed to clear the build-up of queuing on Ashton Vale Road following a closure, and whether this could be actioned in a single cycle or need more.

Tables 5 and 6 below show the bespoke modelling of a four-cycle sequence for a closure 'event' within each hour comprising the following sequence 1-2-3-4-5-6-4-5-6-4-5-6-1-2-3-4-5-6. This gives rise to the following modelled time internal:

- AM: A 373 second period comprising an initial optimum cycle of 118 seconds, two cycles with a 4-5-6 stage sequence within the 125 second 'closure' period and a following 'necessary' compensatory cycle (determined as 130 seconds); and

- PM: A 434 second period comprising an initial optimum cycle of 149 seconds, two cycles with a 4-5-6 stage sequence within the 125 second 'closure' period and a following 'necessary' compensatory cycle (determined as 160 seconds). Note that the length of the compensatory cycle was not assumed to be longer than the MAX that the controller could operate at now in the PM peak period.

To model these smaller time periods, it was necessary to 'scale' the hourly traffic flows to represent the arrival demand expected over the four cycles considered.

Table 5: Winterstoke Road/Ashton Vale Road: Level Crossing Closure Event (4nr cycles) - AM

Arm/Movement)	**Operating Statistics**			
	Current Flow(PCU)	Degree of Saturation (%)	Mean Maximum Queue (PCU)	Mean Delay (seconds/PCU)
A3029 NBD: To Ashton Vale Road and Ashton Gate Underpass	24/74	83.4%	31	16.4/54.4
A3029 NBD: to A370(W) and A369	37	26.8%	5	6.0
Ashton Vale Road	12	87.9%	10	138.1
A3029 SBD: Including LT to Marsh Road	95/57	88.4/55.3%	30/10	31.4/14.2
Marsh Road	22	82.9%	8	57.4

Notes:

A 1-2-3-4-5-6-4-5-6-4-5-6-1-2-3-4-5-6 Stage Sequence has been assumed/modelled, with an overall time of 373 seconds

Figures for the A3029 SBD approach show respective results for the nearside and outer lanes, due to assumed 'bias' in the use of the nearside lane

Table 6: Winterstoke Road/Ashton Vale Road: Level Crossing Closure Event (4nr cycles) - PM

Arm/Movement)	**Operating Statistics**			
	Current Flow(PCU)	Degree of Saturation (%)	Mean Maximum Queue (PCU)	Mean Delay (seconds/PCU)
A3029 NBD: To Ashton Vale Road and Ashton Gate Underpass	4/92	62.7%	18	15.4/42.6
A3029 NBD: to A370(W) and A369	48	26.8%	9	9.4
Ashton Vale Road	27	88.6%	20	129.7
A3029 SBD: Including LT to Marsh Road	107/61	88.3/48.5%	40/13	39.1/19.2
Marsh Road	16	60.2%	6	58.7

Notes:

A 1-2-3-4-5-6-4-5-6-4-5-6-1-2-3-4-5-6 Stage Sequence has been assumed/modelled, with an overall time of 434 seconds

Figures for the A3029 SBD approach show respective results for the nearside and outer lanes, due to assumed 'bias' in the use of the nearside lane

The results and LinSIG models show that:

AM Peak Hour

- Although the northbound A3029 traffic to the underpass/Ashton Vale Road remains within the stop-line capacity achievable, there is a local increase in the mean maximum queue (8-31 PCU) due to the blocking effect of left turning traffic faced with a longer delay during the 'closure'. As such, the proposed extension of the left turn lane proposed as mitigation is wholly justified. This has not been modelled in this LinSIG work per-se, but can be expected to improve conditions by reducing the risk of impedance to northbound straight-ahead traffic accessing the underpass;
- Any additional build-up of queuing traffic on Ashton Vale Road would easily be dealt with by a slightly longer green time for this arm in the post-closure 'normal' cycle. The analyses suggest that the 'typical' cycle time would need to rise from 118-130 seconds, giving a green time of 18 seconds for Ashton Vale Road. It should be noted that this is within the permissible range allowed by the VA MAX setting used now in this period (20 seconds); and
- The expected number of vehicle arrivals on Ashton Vale Road in this closure period is only 12 vehicles. The maximum extent of the queue only expected to increase from 5-10 vehicles. With mean delay changing by circa 70 seconds (138.1-68.3).

PM Peak Hour

- As expected, the effect of the level crossing on the capacity/operation of the straight-ahead northbound A3029 traffic to Ashton Gate underpass is negligible. This is because the left turn into Ashton Vale Road is negligible in the PM peak hour, and even less so during a closure event;
- Any additional build-up of queuing traffic on Ashton Vale Road would need to be dealt with by a longer compensatory green time for this arm in the post-closure 'normal' cycle than is allowable for now by the current VA MAX setting (24 seconds). The analyses suggest that the 'typical' cycle time would need to rise from 149-160 seconds, with necessary green time allocated to Ashton Vale Road rising from 19-39 seconds. It is questionable whether simply increasing the VA MAX to this level would be wise, given the tendency for this mode to maintain extensions when flow rates fall well below 'saturated' level. As such, it would have to accepted that full 'compensation' may take more than one cycle to achieve (with VA mode maintained), or MOVA control introduced. The latter would allow a higher MAX time to be employed for Ashton Vale Road with greater confidence, in the knowledge that this mode of control actively monitors the 'gaps' in vehicle discharge in electing to hold a stage on green or force a move to another stage; and
- The expected number of 'peak' vehicle arrivals on Ashton Vale Road in this closure period is still only 27 vehicles. The maximum extent of the queue only expected to increase from 12-20 vehicles. With mean delay changing by no more than circa 38 seconds (129.7-92.1).

In overall terms, the LinSIG modelling shows that the effect of a single level crossing event with a barrier down-time for a passenger train of circa 110-125 seconds would have a limited impact on traffic conditions in Ashton Vale Road. This is because:

- The expected barrier down-time is no longer than the typical cycle times needed now in the weekday AM and PM peak hours. As such, drivers arriving on the Ashton Vale Road approach would, at worst, have the appearance of the stage controlling this arm curtailed only once; and
- Lost green time to Ashton Vale Road incumbent on the closure is capable of being compensated for fully in the first 'normal' cycle sequence following the event (and the lifting of the restriction on the appearance of Stage 2). Whilst the LinSIG results do predict a change in the extent of the maximum queue and average delay to drivers using Ashton Vale Road in both peak hours, the numbers of affected drivers are small whilst the change can hardly be regarded as severe in the context of NPPF.

3.0 Summary and Conclusions

This Technical Note has presented the results from LinSIG modelling of the Winterstoke Road/Ashton Vale Road signal controlled junction with typical 2017 weekday peak hour flows. The present Method of Control and mode has been discussed, as well as current operating constraints. The results presented for the 'normal' situation consider both 'optimised' cycle times, as well as the maximum cycle times the controller could give in the weekday peak hours with current VA maxima. It is important to note that, whilst this base-line case assumes no level crossing closures, it does assume that a full 1-2-3-4-5-6 stage sequence occurs each cycle. This is probably optimistic, and so pessimistic in capacity terms, as it assumes that the pedestrian crossings calling Stages 4, 5 and 6 are always demanded. This is considered unlikely in normal operation given the level of pedestrian flow in the area.

The results from the base-line testing shows that:

- Operation and so the LinSIG results are heavily influenced by the respective assumed usage of the two approach lanes on the southbound A3029 entry from Brunel Way. Whilst both entry lanes can cater for the 'straight-ahead' movement, the outer lane on exit eventually terminates as a right turn only lane at the downstream roundabout junction with Barons Close and Wedlock Way. As the dominant southbound movement at the roundabout is 'ahead' on the A3029, drivers electing to use the outside lane on approach to the Marsh Road junction must at some point make a lane change into the nearside lane on exit, although the distance available to do this is some 260 metres. A bias has been allowed for in the LinSIG modelling to reflect the higher nearside lane usage;
- It is clear from the LinSIG analyses for both periods that the critical approaches governing junction performance are West Ashton Road and the southbound A3029 (Phases B and I). Whilst the northbound flow on the A3029 to Ashton Gate Underpass is also high in the AM peak hour, it is evident that the constraint on flow is likely to be the downstream merge/weave capacity onto Brunel Way, as opposed to 'potential' stop-line capacity here;
- In the 'optimised' PM peak scenario, the results show that Ashton Vale Road gets 'and needs' 20 seconds, which is just below its allowable current VA MAX of 24 seconds in this period. A key point to note is that there is little or no slack in the allowable MAX for this side road to deal with a need for compensating green time when a level crossing closure occurs now due to existing freight services.

The results suggest that there is little reserve capacity available at the junction now in either peak hour, whilst assuming the controller runs to the maximum cycle time it can in each period does nothing to change this potential outcome or conclusion.

The analyses have then looked at the impact of a level crossing closure 'event' in each peak hour. To do this the assessments have considered a shorter four-cycle period covering a pre-closure cycle, the closure period and a post-closure cycle incorporating 'compensation' time for Ashton Vale Road. The level crossing closure period which has been modelled is 125 seconds, which has been derived from separate work on MetroWest train paths and scheduling. The results of the assessment has shown that:

- Although the northbound A3029 traffic to the underpass/Ashton Vale Road in the AM peak hour remains within the stop-line capacity achievable, there is a local increase in the mean maximum queue (8-31 PCU) due to the blocking effect of left turning traffic faced with a longer delay during the 'closure'. As such, the proposed extension of the left turn lane proposed as mitigation is wholly justified; and

- In the PM peak hour, any additional build-up of queuing traffic on Ashton Vale Road would need to be dealt with by a longer compensatory green time for this arm in the post-closure 'normal' cycle. What would be needed is greater than allowed for now by the current VA MAX setting (24 seconds). The analyses suggest that the 'typical' cycle time would need to rise from 149-160 seconds, with necessary green time allocated to Ashton Vale Road rising from 19-39 seconds. It is questionable whether simply increasing the VA MAX to this level would be wise, given the tendency for this mode to maintain extensions when flow rates fall well below 'saturated' level. As such, it would have to accepted that full 'compensation' may take more than one cycle to achieve (with VA mode maintained), or MOVA control introduced. The latter would allow a higher MAX time to be employed for Ashton Vale Road with greater confidence, in the knowledge that this mode of control actively monitors the 'gaps' in vehicle discharge in electing to hold a stage on green or force a move to another stage. In consequence, the installation of MOVA as advocated is recommended as part of MetroWest mitigation.

In overall terms, the LinSIG modelling shows that the effect of a single level crossing event with a barrier down-time for a passenger train of circa 110-125 seconds can be expected to have a limited impact on traffic conditions in Ashton Vale Road. This is because:

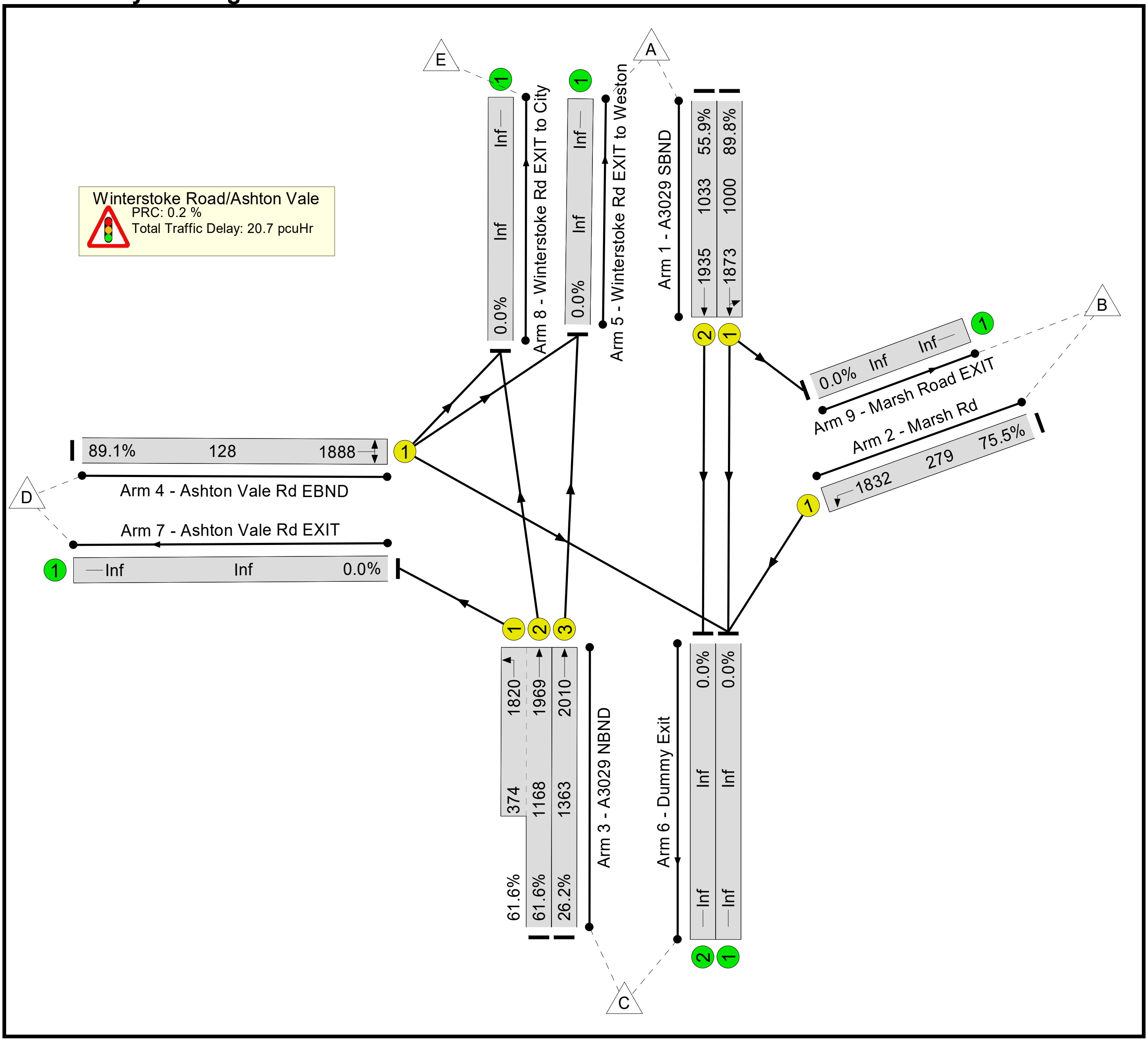
- The expected barrier down-time is no longer than the typical cycle times needed now in the weekday AM and PM peak hours. As such, drivers arriving on the Ashton Vale Road approach would, at worst, have the appearance of the stage controlling this arm curtailed only once;
- Lost green time to Ashton Vale Road incumbent on the closure is capable of being compensated for fully in the first 'normal' cycle sequence following the event (and the lifting of the restriction on the appearance of Stage 2). Whilst the LinSIG results do predict a change in the extent of the maximum queue and average delay to drivers using Ashton Vale Road in both peak hours, the numbers of affected drivers are small whilst the change can hardly be regarded as severe in the context of NPPF;
- Further to the point above, the closure frequency with two passenger trains per hour and even an intervening freight service have sufficient duration between them to ensure full 'compensation' and return to normal traffic operation is achieved between each event; and
- Whilst additional green time will be needed to clear the build-up of queuing in Ashton Vale Road post-closure, the critical southbound movement on the A3029 also benefits from less interruptions to its green time during the closure when only a 4-5-6 stage sequence operates. These effects thus tend to cancel each other out when considering the capacity retained for these critical phases over the four cycle sequence considered.

ANNEX A:
LinSIG Summary Results - Normal Operation

A3029 Winterstoke Road/Ashton Vale Road - Existing Layout and Normal Stage Sequence: No Level Crossing Closure

Scenario 4: '2017 AM (No Rail)-Optimised' (FG11: 'AM May 2017 Count', Plan 1: 'No Closure Sequence')

Network Layout Diagram



Network Results

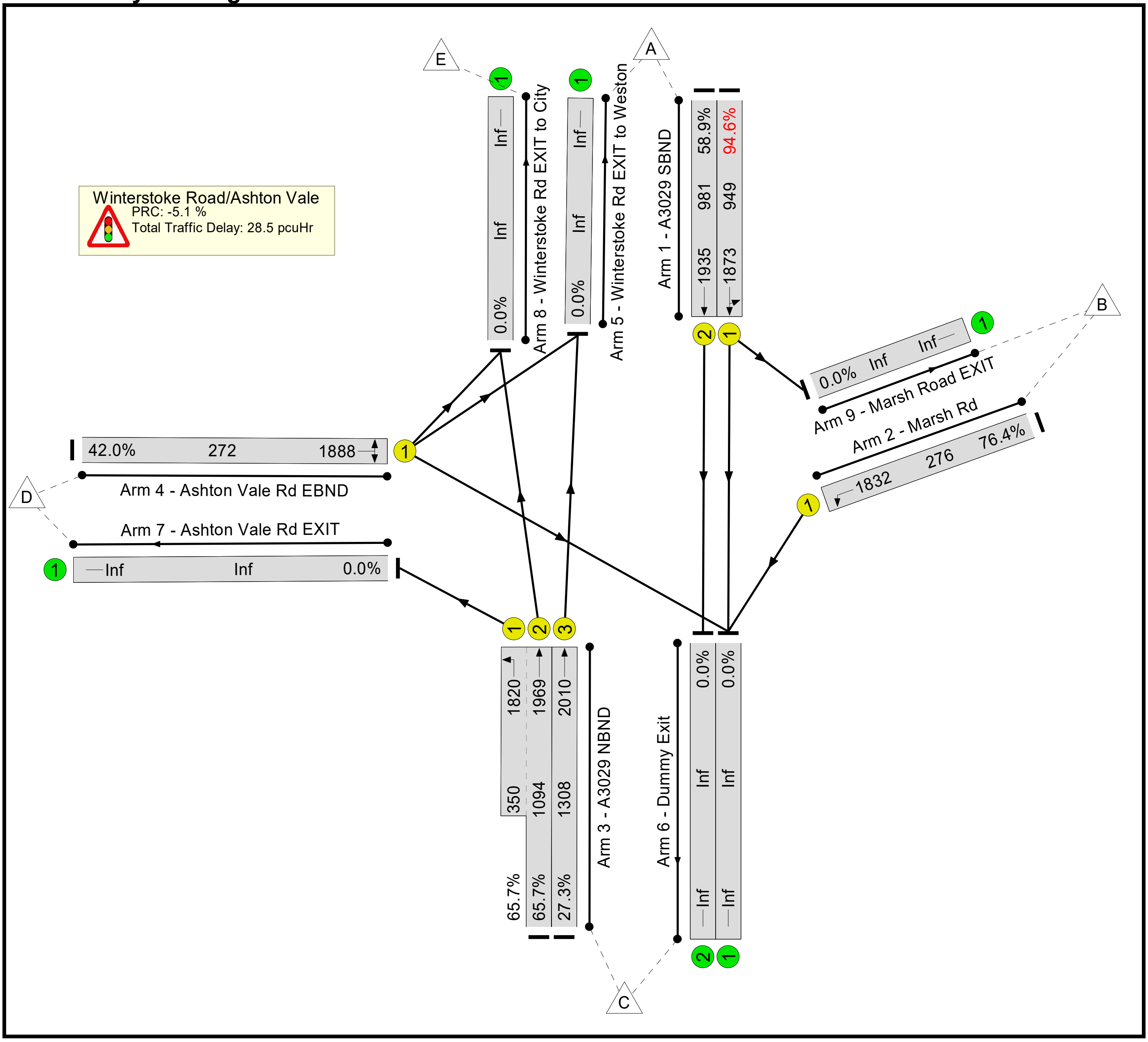
Item	Lane Description	Lane Type	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Mean Max Queue (pcu)
Network: Winterstoke Rd-Ashton Vale Rd	-	-	-		-	-	-	-	-	-	**89.8%**	**0**	**0**	**0**	**20.7**	-	-
Winterstoke Road/Ashton Vale	-	-	-		-	-	-	-	-	-	**89.8%**	**0**	**0**	**0**	**20.7**	-	-
1/1	A3029 SBND Ahead Left	U	I		2	61	-	898	1873	1000	89.8%	-	-	-	7.5	29.9	21.3
1/2	A3029 SBND Ahead	U	I		2	61	-	578	1935	1033	55.9%	-	-	-	2.2	14.0	8.8
2/1	Marsh Rd Left	U	J		2	16	-	211	1832	279	75.5%	-	-	-	2.9	49.6	5.2
3/2+3/1	A3029 NBND Left Ahead	U	A C		2	79:39	-	949	1969:1820	1168+374	61.6 : 61.6%	-	-	-	2.9 (1.5+1.3)	10.9 (7.7:21.1)	7.4
3/3	A3029 NBND Ahead	U	G		2	78	-	357	2010	1363	26.2%	-	-	-	0.6	5.7	2.9
4/1	Ashton Vale Rd EBND Left Right Left2	U	B		1	7	-	114	1888	128	89.1%	-	-	-	4.6	145.6	6.6

C1 - Winterstoke Rd/Marsh Rd/Ashton Vale Rd — PRC for Signalled Lanes (%): 0.2 — Total Delay for Signalled Lanes (pcuHr): 20.66 — Cycle Time (s): 118

PRC Over All Lanes (%): 0.2 — Total Delay Over All Lanes(pcuHr): 20.66

Scenario 5: '2017 AM (No Rail)-MAX VA' (FG11: 'AM May 2017 Count', Plan 1: 'No Closure Sequence')

Network Layout Diagram

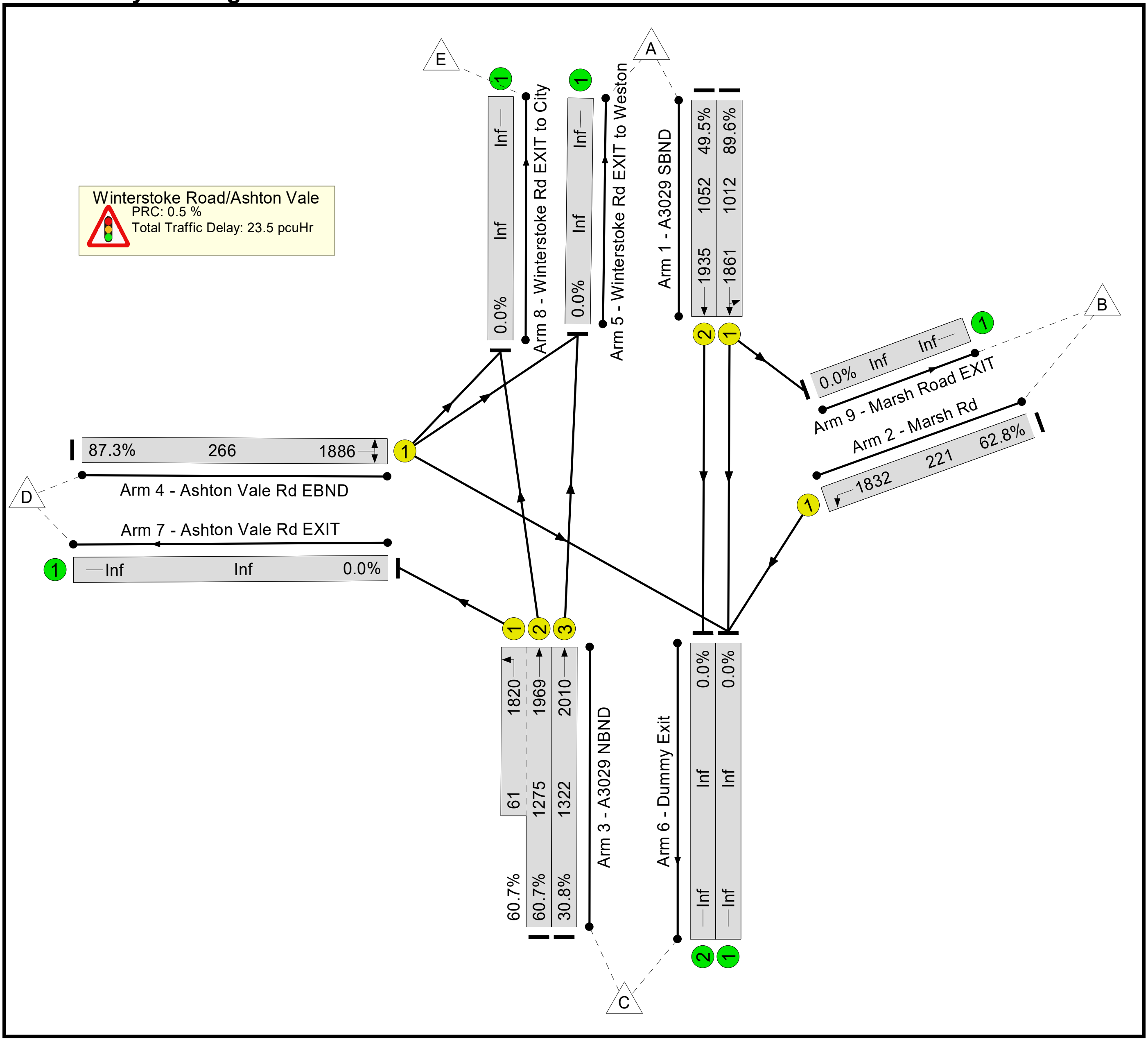


Network Results

Item	Lane Description	Lane Type	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Mean Max Queue (pcu)
Network: Winterstoke Rd-Ashton Vale Rd	**-**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**94.6%**	**0**	**0**	**0**	**28.5**	**-**	**-**
Winterstoke Road/Ashton Vale	**-**	**-**	**-**		**-**	**-**	**-**	**-**	**-**	**-**	**94.6%**	**0**	**0**	**0**	**28.5**	**-**	**-**
1/1	A3029 SBND Ahead Left	U	I		2	72	-	898	1873	949	94.6%	-	-	-	14.5	58.2	34.6
1/2	A3029 SBND Ahead	U	I		2	72	-	578	1935	981	58.9%	-	-	-	3.9	24.1	11.3
2/1	Marsh Rd Left	U	J		2	20	-	211	1832	276	76.4%	-	-	-	4.0	68.1	8.2
3/2+3/1	A3029 NBND Left Ahead	U	A C		2	94:74	-	949	1969:1820	1094+350	65.7 : 65.7%	-	-	-	3.1 (2.2+0.9)	11.7 (11.2:13.3)	12.0
3/3	A3029 NBND Ahead	U	G		2	93	-	357	2010	1308	27.3%	-	-	-	0.8	8.2	4.5
4/1	Ashton Vale Rd EBND Left Right Left2	U	B		1	20	-	114	1888	272	42.0%	-	-	-	2.2	68.3	4.6

C1 - Winterstoke Rd/Marsh Rd/Ashton Vale Rd   PRC for Signalled Lanes (%): -5.1   Total Delay for Signalled Lanes (pcuHr): 28.46   Cycle Time (s): 146
PRC Over All Lanes (%): -5.1   Total Delay Over All Lanes(pcuHr): 28.46

Scenario 6: '2017 PM (No Rail)-Optimised' (FG12: 'PM May 2017 Count', Plan 1: 'No Closure Sequence')
Network Layout Diagram



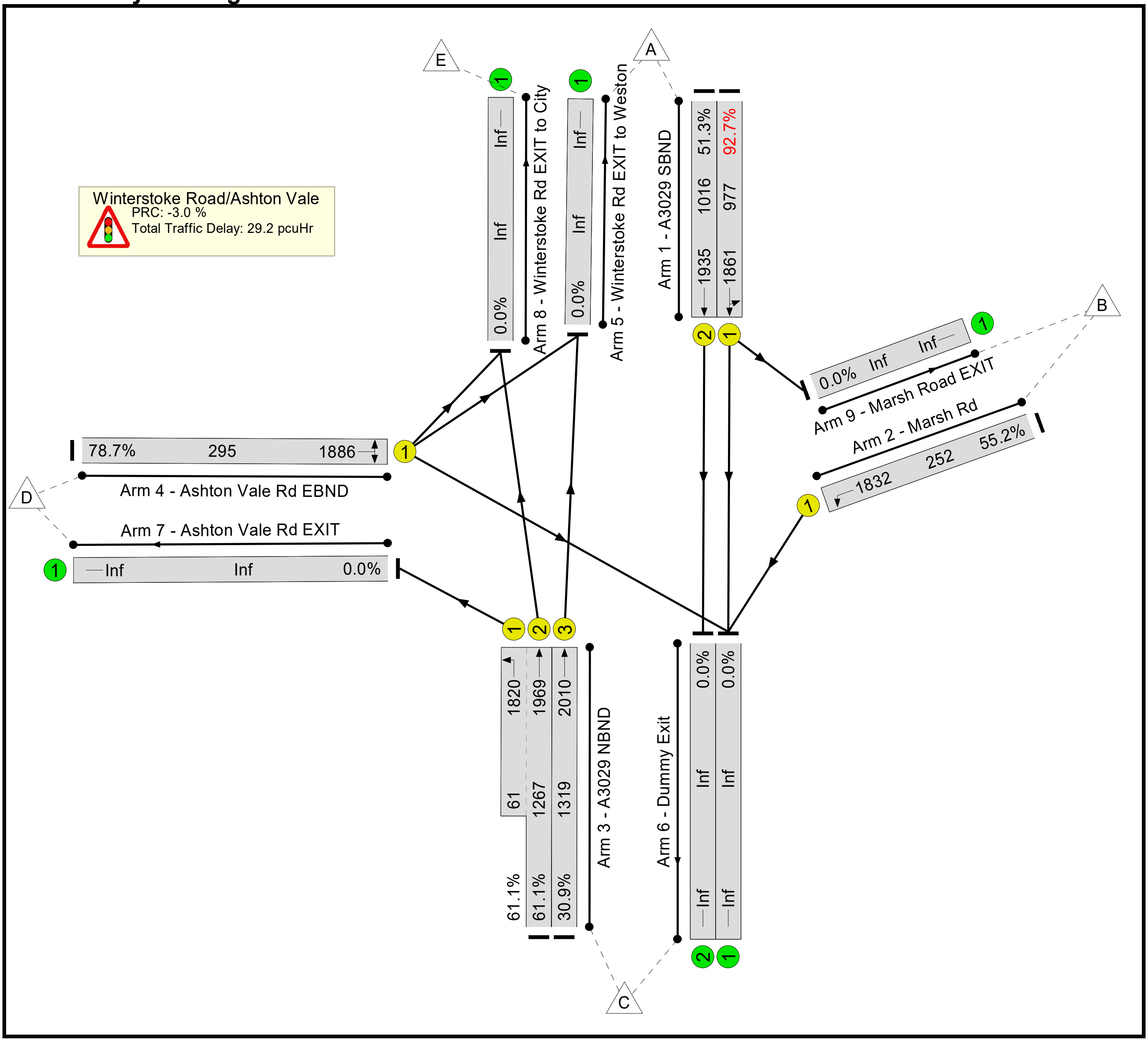
Network Results

Item	Lane Description	Lane Type	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Mean Max Queue (pcu)
Network: Winterstoke Rd-Ashton Vale Rd	-	-	-		-	-	-	-	-	-	**89.6%**	**0**	**0**	**0**	**23.5**	-	-
Winterstoke Road/Ashton Vale	-	-	-		-	-	-	-	-	-	**89.6%**	**0**	**0**	**0**	**23.5**	-	-
1/1	A3029 SBND Ahead Left	U	I		2	79	-	906	1861	1012	89.6%	-	-	-	8.5	33.9	27.9
1/2	A3029 SBND Ahead	U	I		2	79	-	521	1935	1052	49.5%	-	-	-	2.3	16.1	10.2
2/1	Marsh Rd Left	U	J		2	16	-	139	1832	221	62.8%	-	-	-	2.0	53.0	3.8
3/2+3/1	A3029 NBND Left Ahead	U	A C		2	97:42	-	811	1969:1820	1275+61	60.7 : 60.7%	-	-	-	2.7 (2.4+0.3)	11.9 (11.2:25.3)	12.8
3/3	A3029 NBND Ahead	U	G		2	96	-	407	2010	1322	30.8%	-	-	-	0.9	8.4	5.3
4/1	Ashton Vale Rd EBND Left Right Left2	U	B		1	20	-	232	1886	266	87.3%	-	-	-	7.0	108.1	12.3

C1 - Winterstoke Rd/Marsh Rd/Ashton Vale Rd
PRC for Signalled Lanes (%): 0.5 — Total Delay for Signalled Lanes (pcuHr): 23.49 — Cycle Time (s): 149
PRC Over All Lanes (%): 0.5 — Total Delay Over All Lanes(pcuHr): 23.49

Scenario 7: '2017 PM (No Rail)-MAX VA' (FG12: 'PM May 2017 Count', Plan 1: 'No Closure Sequence')

Network Layout Diagram



Network Results

Item	Lane Description	Lane Type	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Mean Max Queue (pcu)
Network: Winterstoke Rd-Ashton Vale Rd	-	-	-		-	-	-	-	-	-	**92.7%**	**0**	**0**	**0**	**29.2**	-	-
Winterstoke Road/Ashton Vale	-	-	-		-	-	-	-	-	-	**92.7%**	**0**	**0**	**0**	**29.2**	-	-
1/1	A3029 SBND Ahead Left	U	I		2	82	-	906	1861	977	92.7%	-	-	-	13.6	53.9	36.0
1/2	A3029 SBND Ahead	U	I		2	82	-	521	1935	1016	51.3%	-	-	-	3.3	22.6	10.7
2/1	Marsh Rd Left	U	J		2	20	-	139	1832	252	55.2%	-	-	-	2.4	62.3	5.4
3/2+3/1	A3029 NBND Left Ahead	U	A C		2	104:84	-	811	1969:1820	1267+61	61.1 : 61.1%	-	-	-	3.0 (2.9+0.1)	13.4 (13.4:12.9)	14.4
3/3	A3029 NBND Ahead	U	G		2	103	-	407	2010	1319	30.9%	-	-	-	1.0	9.1	5.9
4/1	Ashton Vale Rd EBND Left Right Left2	U	B		1	24	-	232	1886	295	78.7%	-	-	-	5.9	92.1	11.6

C1 - Winterstoke Rd/Marsh Rd/Ashton Vale Rd
PRC for Signalled Lanes (%): -3.0
PRC Over All Lanes (%): -3.0
Total Delay for Signalled Lanes (pcuHr): 29.23
Total Delay Over All Lanes(pcuHr): 29.23
Cycle Time (s): 160

ANNEX B:
LinSIG Summary Results - ‘With’ Level Crossing Closure

A3029 Winterstoke Road/Ashton Vale Road - Level Crossing Closure EVENTS

Network Results

Scenario 8: '2017 AM (125s Closure)' (FG13: 'AM May 2017 - Closure Sequence', Plan 2: '110-125 Closure Seq')

Item	Lane Description	Lane Type	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Mean Max Queue (pcu)
Network: Winterstoke Rd-Ashton Vale Rd	-	-	-		-	-	-	-	-	-	**88.4%**	**0**	**0**	**0**	**2.6**	-	-
Winterstoke Road/Ashton Vale	-	-	-		-	-	-	-	-	-	**88.4%**	**0**	**0**	**0**	**2.6**	-	-
1/1	A3029 SBND Ahead Left	U	I		6	208	-	95	1874	108	88.4%	-	-	-	0.8	31.4	29.9
1/2	A3029 SBND Ahead	U	I		6	208	-	57	1935	111	51.3%	-	-	-	0.2	14.2	10.0
2/1	Marsh Rd Left	U	J		6	48	-	22	1832	27	82.9%	-	-	-	0.4	57.9	7.5
3/2+3/1	A3029 NBND Left Ahead	U	A C		6:4	250:119	-	98	1969:1820	89+29	83.4 : 83.4%	-	-	-	0.7 (0.3+0.4)	25.7 (16.4:54.4)	30.3
3/3	A3029 NBND Ahead	U	G		6	250	-	37	2010	138	26.8%	-	-	-	0.1	6.0	4.4
4/1	Ashton Vale Rd EBND Left Right Left2	U	B		2	25	-	12	1886	14	87.9%	-	-	-	0.5	138.1	9.8

C1 - Winterstoke Rd/Marsh Rd/Ashton Vale Rd	PRC for Signalled Lanes (%):	1.9	Total Delay for Signalled Lanes (pcuHr):	2.63	Cycle Time (s):	373
	PRC Over All Lanes (%):	1.9	Total Delay Over All Lanes(pcuHr):	2.63		

Scenario 9: '2017 PM (125s Closure)' (FG14: 'PM May 2017 - Closure Sequence', Plan 2: '110-125 Closure Seq')

Item	Lane Description	Lane Type	Full Phase	Arrow Phase	Num Greens	Total Green (s)	Arrow Green (s)	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Capacity (pcu)	Deg Sat (%)	Turners In Gaps (pcu)	Turners When Unopposed (pcu)	Turners In Intergreen (pcu)	Total Delay (pcuHr)	Av. Delay Per PCU (s/pcu)	Mean Max Queue (pcu)
Network: Winterstoke Rd-Ashton Vale Rd	-	-	-		-	-	-	-	-	-	**88.6%**	**0**	**0**	**0**	**3.3**	-	-
Winterstoke Road/Ashton Vale	-	-	-		-	-	-	-	-	-	**88.6%**	**0**	**0**	**0**	**3.3**	-	-
1/1	A3029 SBND Ahead Left	U	I		6	236	-	107	1862	121	88.3%	-	-	-	1.2	39.1	39.1
1/2	A3029 SBND Ahead	U	I		6	236	-	61	1935	126	48.5%	-	-	-	0.3	19.2	12.2
2/1	Marsh Rd Left	U	J		6	48	-	16	1832	27	60.2%	-	-	-	0.3	58.7	5.5
3/2+3/1	A3029 NBND Left Ahead	U	A C		6:4	278:147	-	96	1969:1820	147+6	62.7 : 62.7%	-	-	-	0.4 (0.4+0.0)	16.5 (15.4:42.6)	18.0
3/3	A3029 NBND Ahead	U	G		6	278	-	48	2010	153	31.3%	-	-	-	0.1	9.4	8.1
4/1	Ashton Vale Rd EBND Left Right Left2	U	B		2	58	-	27	1890	30	88.6%	-	-	-	1.0	129.7	19.8

C1 - Winterstoke Rd/Marsh Rd/Ashton Vale Rd	PRC for Signalled Lanes (%):	1.6	Total Delay for Signalled Lanes (pcuHr):	3.29	Cycle Time (s):	434
	PRC Over All Lanes (%):	1.6	Total Delay Over All Lanes(pcuHr):	3.29		

Part 5:
Junction Modelling – VISSIM

Contents:

- ‘MetroWest Phase 1, Winterstoke Road/Ashton Vale Road VISSIM Model, Local Model Validation Report’, 6th July 2018
- ‘MetroWest Phase 1, Winterstoke Road/Ashton Vale Road VISSIM Model, Testing Report’, 6th July 2018

MetroWest Phase 1: Winterstoke Road/Ashton Vale Road VISSIM Model Local Model Validation Report

Prepared for

North Somerset Council

July 2018

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Document history

Report: MetroWest Phase 1: Winterstoke Road/Ashton Vale Road VISSIM Model Local Model Validation Report

Reference: 674946.CS.70.01
Client: North Somerset Council

This document has been issued and amended as follows:

Version	Date	Description	Created by	Verified by	Approved by
1	15 June 2018	Draft	SS	LT	HS
2	6 July 2018	Final	SS	LT	HS

Contents

Acronyms and Abbreviations

ATC	Automatic Traffic Counter
DMRB	Design Manual for Roads and Bridge
LMVR	Local Model Validation Report
MCC	Manually Classified Count
MOVA	Microprocessor Optimised Vehicle Actuation
VPH	Vehicles Per Hour

SECTION 1

Introduction

1.1 Background

The West of England (WoE) Councils comprising of Bath & North-East Somerset, Bristol City, North Somerset and South Gloucestershire, together with the West of England Combined Authority (WCA), and working alongside Network Rail (NR), Great Western Railway (GWR) and the wider rail industry, are progressing plans to deliver a series of strategic enhancements to the local rail network over the next five years and beyond, through the MetroWest Programme. The programme currently comprises:

- the MetroWest Phase 1 scheme;
- the MetroWest Phase 2 scheme;
- the Portway Park & Ride station scheme; and
- a range of new station/re-opening schemes, subject to separate business cases and smaller scale localised enhancement schemes.

The MetroWest Phase 1 project is being led by North Somerset Council, and comprises the delivery of infrastructure and passenger train operations to provide enhanced services on the Severn Beach line, local stations on the Bath to Bristol line and for a reopened Portishead Branch Line with stations at Portishead and Pill. The re-opened Portishead Branch Line will maintain the existing freight train operations as well as re-introduce passenger train services on an hourly basis.

MetroWest Phase 1 includes infrastructure to be consented through a Development Consent Order (DCO) and infrastructure which falls within Network Rail's General Permitted Development rights (the GPD works). The passenger train service is to be delivered through either the Department for Transport's re-franchising process or via a bi-lateral agreement between the four councils and a train operating company (TOC). The project is to be delivered by the rail industry and the four councils, and is being led by North Somerset Council on behalf of the four West of England (WoE) councils.

CH2M (now Jacobs) has been appointed to prepare a Transport Assessment (TA) in support of the Portishead Branch Line Development Consent Order (DCO) scheme (MetroWest Phase 1) proposal to reopen the Portishead line with stations at Portishead and Pill in North Somerset ("the DCO scheme").

A key element of the MetroWest Phase 1 project is reopening of the Portishead branch line, and within this is the reinstatement of passenger services on the currently freight-only Portbury dock line (which splits from the Portishead line north of Pill). As such, the scheme will therefore increase the number of trains using the level crossing on Ashton Vale Road adjacent to the Winterstoke Road/Ashton Vale Road signal controlled junction. These signals are configured such that, during level crossing closures, traffic entering and exiting Ashton Vale Road is held on red whilst the other arms are serviced within a restricted staging sequence. There is therefore a need to understand the impact of the MetroWest Phase 1 scheme on operational conditions at this junction.

1.2 Purpose of Report

The purpose of this report is to explain the methodology used in the creation of a base VISSIM micro-simulation traffic model of Winterstoke Road/Ashton Vale Road signal controlled junction and adjacent Ashton Vale Road level crossing. The results of the model calibration and validation checks are also presented. These checks aim to prove the model's fitness for purpose for assessing the impact of increased level crossing closures times on the signals associated with the MetroWest Phase 1 scheme and for testing measures aimed at alleviating the impact of longer and more frequent closures.

1.3 Structure of Report

Following this introduction, the remainder of this report is structured as follows:

- **Section 2**: Network Development, including software specification, model parameters, coverage and durations, signal timings employed and public transport routes modelled;
- **Section 3**: Model Calibration, including traffic data used, matrix development, model adjustments to improve fit and results of observed and modelled 'turning' count comparisons;
- **Section 4**: Model Validation, including results of the observed and modelled travel time comparisons and checks on the number of seed runs used; and
- **Section 5**: Summary, including overall fit of the model and an assessment of its fitness for purpose in assessing the impact of the MetroWest Phase 1 scheme and associated highway works.

Network Development

2.1 Software Specification

The Winterstoke Road/Ashton Vale Road VISSIM model has been developed using Version 8.00-06 of the software. This was the latest version of the software at the time of model development.

2.2 Network Coverage

The model network includes the Winterstoke Road/Ashton Vale Road junction and its approach arms comprising the A3029 Winterstoke Road, Marsh Road and Ashton Vale Road, as well as the Ashton Vale level crossing and railway line. The extents of the modelled network can be seen in Figure 2.1.

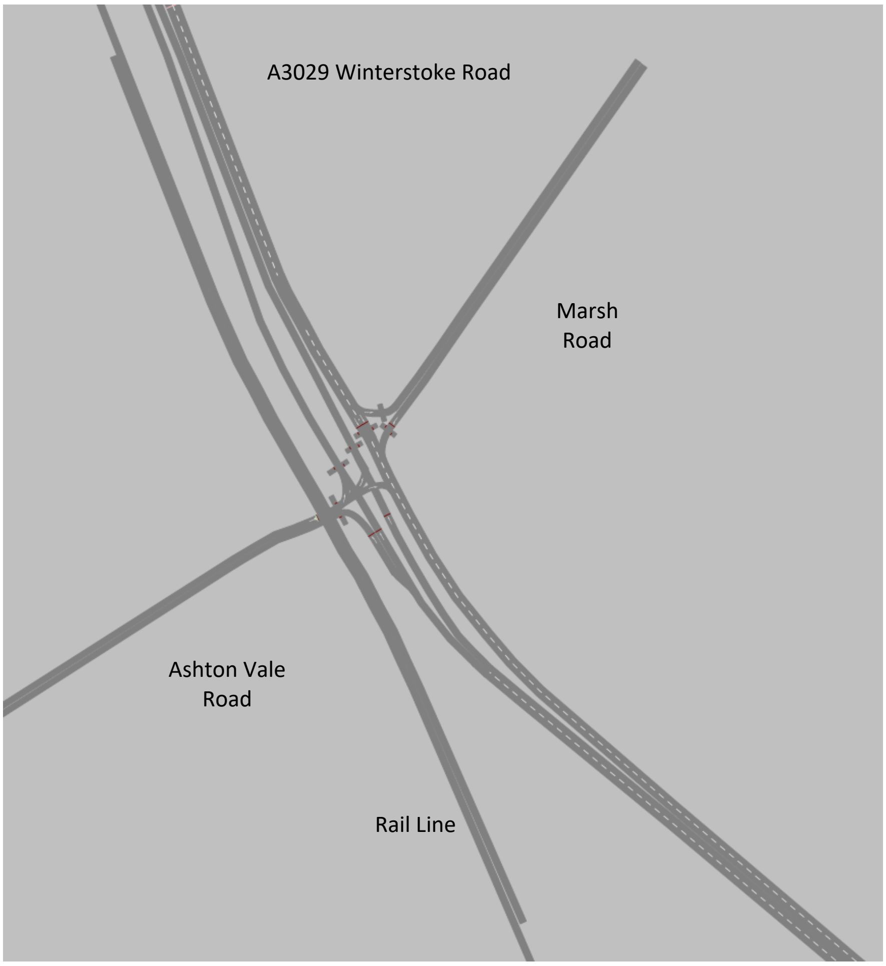


Figure 2.1: Wraxall Rd Roundabout VISSIM Model Extents

2.3 Time Periods Modelled

The model simulates the weekday morning (7:00-10:00am) and evening (4:00-7:00pm) peak periods within the local highway network.

2.4 Model Parameters

The 'urban' link type has been applied to all links within the models. The link type includes modifications to the default driver behaviour parameters as detailed in Table 2.1.

Table 2.1: Model Urban Link Type Behaviour Parameter Changes

Parameter	Value	Comments
Average Standstill Distance	1.5m	The average standstill distance defines the average desired distance between stopped vehicles. It has a variation between -1.0 m and +1.0 m which is normally distributed. The value of 1.5m represents a reduction from the default 2.0m in line with micro-simulation best-practice guidelines published by Highways England.
Number of Observed Vehicles	10	The number of observed vehicles determines how well drivers predict the movement of others and react accordingly. The value of 10 represents an increase from the default value of 4 to allow for more accurate modelling of network operation.
Reaction to Red/Amber at Signals	Stop	To account for the fact that VISSIM treats the red-amber periods at signal as green time, an adjustment to the default has been made. Doing so ensures that vehicle behaviour will more accurately reflect actual reaction times of drivers as they receive red-amber followed by green.
Waiting time before diffusion	90s	The removal of vehicles from the network (a phenomenon called 'diffusion' in VISSIM) occurs when a vehicle is unable to change lanes within a specified time due to a lack of adequate gaps. Due to traffic signal cycle times, often being in excess of 60 seconds, the default time of 60 seconds has been increased.

2.5 Network Coding

The network was created using aerial photography which was scaled to the necessary level. Aerial photography acted as a base mapping, which allowed junction geometry to be checked to ensure that the network incorporated in the model was representative. Lane widths and flare lengths have been checked using the base mapping and as-built layout information for the Winterstoke Road/Ashton Vale Road junction, together with site visit photos and Google Streetview.

2.6 Traffic Signals

A signal controller has been included within the model in order to replicate the existing signalised junction. To model the operation of the signals, the full traffic signal controller configuration was obtained from Bristol City Council. The signals within the model have been coded using VISVAP in order to accurately simulate the Vehicle Actuated (VA) mode of control in operation at the site as well as the restrictive stage sequence in operation when the level crossing is down. The relevant VA MaxSets in the controller configuration have been used in the AM and PM peak models.

Model Calibration

3.1 Modelled Traffic

3.1.1 Traffic Data

To provide data for the development of the VISSIM model, traffic count information was collected at the junction. The data collected included manually classified turning counts (MCCs), journey time surveys and pedestrian counts at crossing points. These were all collected on 9th May 2017 with the counts carried out between 7:00am and 7:00pm and disaggregated at 15-minute intervals to provide in-flow profile information.

3.1.2 Validity of Data

At the time of the surveys the left turn filter lane on the Winterstoke Road northbound carriageway was closed because of traffic management associated with the Ashton Vale to Temple Meads MetroBus fly-over construction. There was therefore a concern that these works could have affected volumes at the site, with traffic levels potentially lower due to reduced capacity on the Winterstoke Road northbound approach arm.

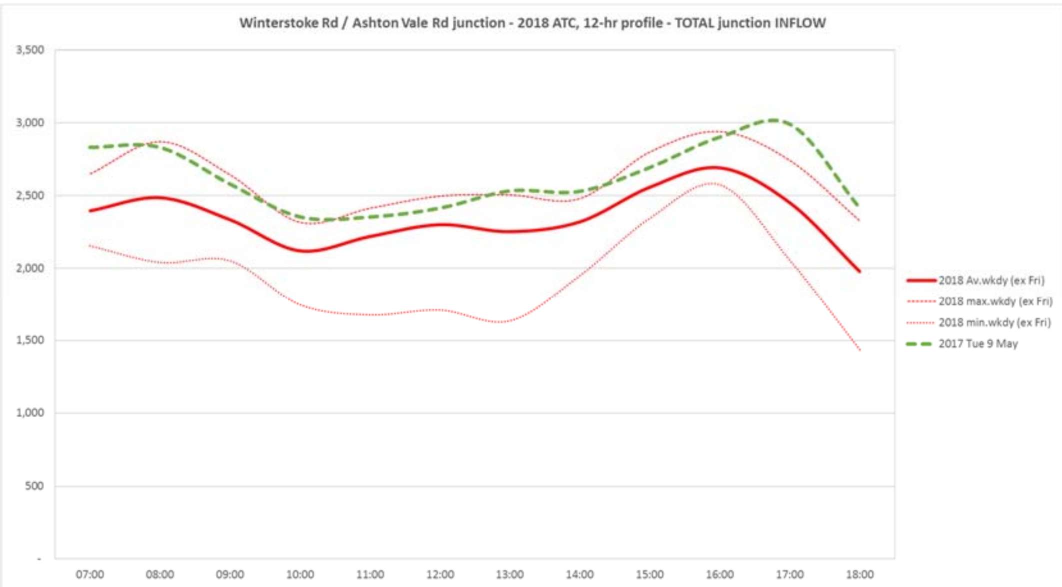


Figure 3.1: Comparison of May 2017 and March 2018 Total Junction In-Flows

A detailed analysis of various traffic counts carried out at the Winterstoke Road/Ashton Vale Road junction is presented in the 'MetroWest Phase 1: Ashton Vale Road Traffic Counts' Technical Note (May 2018). Figure 3.1 (above), which is an extract from that Technical Note, compares the 9th May 2017 count with an average, minimum and maximum total junction in-flow from counts carried out between the 15th and 28th March 2018. The graph shows that the 2017 profile indicates consistently more traffic through the junction in 2017 than an average weekday in 2018 (some 12% more).

The analyses in the 'MetroWest Phase 1: Ashton Vale Road Traffic Counts' Technical Note therefore concluded that the weekday traffic count taken in 2017 was representative of conditions that are present at the junction now in a weekday. Traffic counted has reduced slightly through the junction overall when comparing the 2017 and 2018 in-flow and very slightly at Ashton Vale Road itself, though there is a day-to-day variability in movements.

3.1.3 Vehicle Inputs/Routes

The flows used in the model have been derived through the collection, analysis and subsequent assembly of classified count data surveyed at the junction. The sum of the entry flows (from the turning counts) for each VISSIM entry point were apportioned by these turning percentages to derive the flows for use in the model. The approach ensures that any differences in traffic arrival profile and turning proportions over the modelled period are fully reflected in the model.

The Ashton Vale Level Crossing junction VISSIM model uses static assignment. Static assignment allows traffic, based on route movements, to be allocated a turning movement at the time they enter the simulation. There is no route choice within the model network and so no need to run the models to achieve assignment convergence criteria. Note that whilst vehicles have no route choice from origin to destination they are still free to select different lanes on multi-lane sections.

3.2 Model Adjustments

During the calibration process, the model network and matrices were fined-tuned to achieve the fit with the observed turning count information. Any errors, such as the incorrect specification of ‘routes’ defining vehicle paths through intersections, were also highlighted and corrected. Calibration adjustments were made to the ‘base network’ to ensure that changes would be consistent between the AM and PM model scenarios.

The 2017 traffic and journey time data used for developing the base-line model reflects volumes and conditions during the works to construct the MetroBus fly-over. As such, the base model coding assumes that vehicles cannot use the Winterstoke Road northbound left-turn into Ashton Vale Road, which was coned off at the time. This ensures that reduced capacity with its exclusion is reflected in the base model. The left turn lane will, however, be reinstated for forecasting and option testing.

3.3 Calibration Checks

Model calibration has been carried out through the comparison of observed and modelled turning movements at the Winterstoke Road/Ashton Vale Road junction for every hour modelled. These have been based on 10 seed runs with different random seed values in each modelled period.

3.3.1 Calibration Methodology

The GEH statistic has been adopted as the main indicator of the extent to which modelled flows match the corresponding observed values with a GEH of five or less indicating an acceptable level of fit as per the guidelines set out in WebTAG/DMRB (see Table 3.1). Additionally, the WebTAG/DMRB flow criteria of being within 100 vehicles per hour (vph) for flows under 700 vph, or being within 15% if greater than 700vph has also been assessed.

Table 3.1: DMRB Assignment Validation, Acceptability Criteria

Criteria and Measures	**Acceptability Guideline**
<u>Assigned hourly flows compared with observed flows</u>	
Individual flows within 15% for flows 700-2,700vph	>85% of flows
Individual flows within 100vph for flows < 700vph	>85% of flows
Individual flows within 400vph for flows > 2,700vph	>85% of flows
Total screen-line flows (>5 links) to be within 5%	All (nearly all) screen-lines
GEH statistic	
Individual flows: GEH < 5	>85% of cases
<u>Modelled journey times compared with observed times</u>	
Journey times within 15% (or 1 minute, if higher)	>85% of routes

3.3.2 Calibration Results

3.3.2.1 AM peak

Tables 3.2 to 3.5 present the calibration results comparing observed and modelled link and turning flows for the modelled weekday AM peak period. The results demonstrate that the modelled link flows represent a high correlation to the observed traffic data and that capacity of the signals is being correctly modelled. The link and turn count flow criteria exceeded the guidelines, with 100% of link flows and 100% of turns have a GEH<5.

The linear regression of the modelled total flows and observed total flows was also analysed. A high co-efficient correlation (R2) was achieved and the results are shown in Figure 3.2. The value of R2 =1 implies a perfect match while R2=0 an imperfect match between the observed and modelled flows. The resulting value of R2 provides further confirmation that the traffic movements at the junction are comparable with observed data to a reasonably high degree.

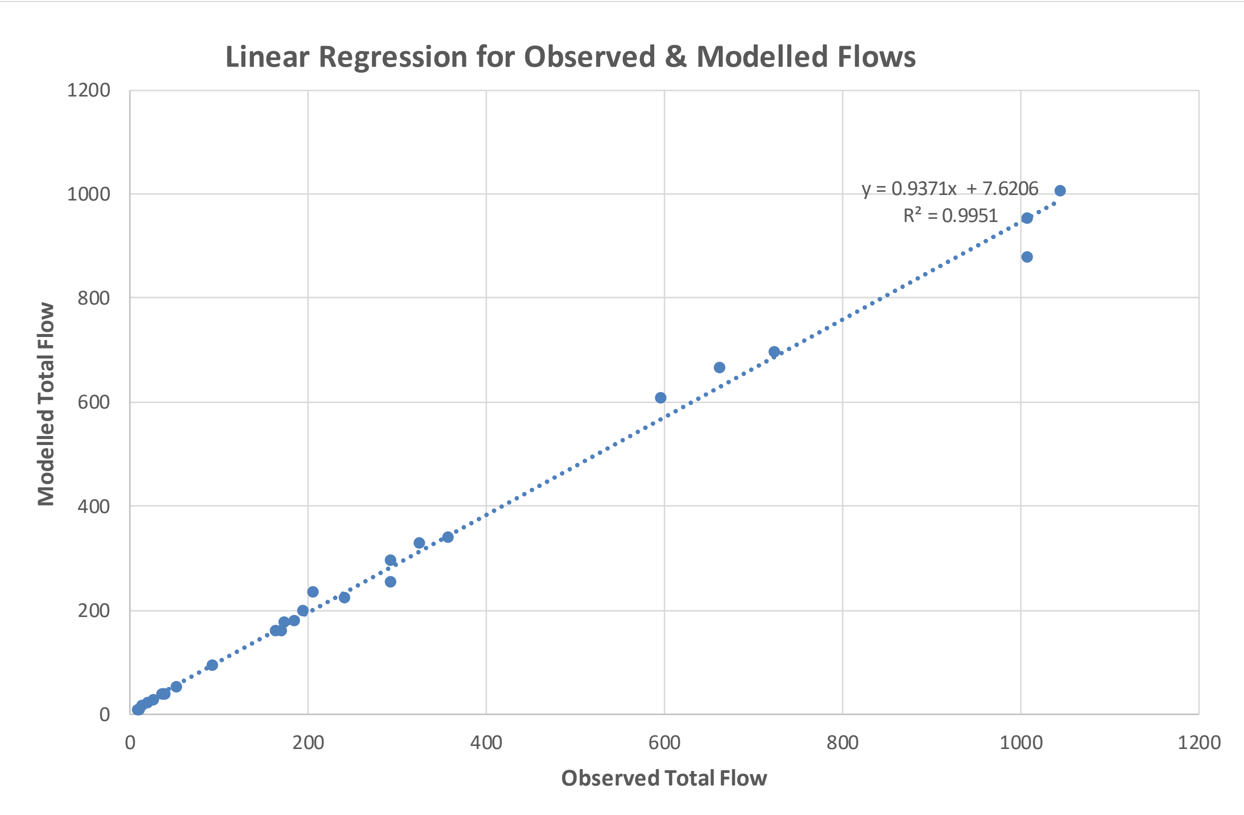


Figure 3.2 Linear Regression for Observed and Modelled Flows of the Base Model – AM Peak

Table 3.2: AM Flow Calibration (Light vehicles) - Links

Junction Name	Time Periods	From Arm	Observed	Model Flow	Diff	% Diff	GEH <5	DMRB Flow
Ashton Vale Level Crossing	07:00-08:00	A3029 North	1154	1125	-29	-3%	✓	✓
		Marsh Road	159	152	-7	-4%	✓	✓
		A3029 South	1167	1115	-52	-4%	✓	✓
		Ashton Vale Road	36	40	4	11%	✓	✓
	08:00-09:00	A3029 North	1239	1157	-82	-7%	✓	✓
		Marsh Road	183	187	4	2%	✓	✓
		A3029 South	1072	1073	1	0%	✓	✓
		Ashton Vale Road	50	51	1	2%	✓	✓
	09:00-10:00	A3029 North	1149	1017	-132	-11%	✓	✓
		Marsh Road	87	87	0	0%	✓	✓
		A3029 South	966	962	-4	0%	✓	✓
		Ashton Vale Road	70	69	-1	-1%	✓	✓

Table 3.3: AM Flow Calibration (Heavy's vehicles) – Links

Junction Name	Time Periods	From Arm	Observed	Model Flow	Diff	% Diff	GEH <5	DMRB Flow
Ashton Vale Level Crossing	07:00-08:00	A3029 North	60	61	1	2%	✓	✓
		Marsh Road	6	8	2	33%	✓	✓
		A3029 South	101	102	1	1%	✓	✓
		Ashton Vale Road	36	33	-3	-8%	✓	✓
	08:00-09:00	A3029 North	101	103	2	2%	✓	✓
		Marsh Road	12	11	-1	-8%	✓	✓
		A3029 South	92	99	7	8%	✓	✓
		Ashton Vale Road	27	27	0	0%	✓	✓
	09:00-10:00	A3029 North	103	84	-19	-18%	✓	✓
		Marsh Road	7	7	0	0%	✓	✓
		A3029 South	97	104	7	7%	✓	✓
		Ashton Vale Road	35	37	2	6%	✓	✓

Table 3.4: AM Flow Calibration (Light vehicles) – Turns

Junction Name	Time Period	From Arm	To Arm	Obs	Model Flow	Diff	% Diff	GEH <5	DMRB Flow
Ashton Vale Level Crossing	07:00-08:00	A3029 North	Marsh Road	201	224	23	11%	✓	✓
			A3029 South	953	901	-52	-5%	✓	✓
		Marsh Road	A3029 South	159	152	-7	-4%	✓	✓
		A3029 South	Ashton Vale Road	172	166	-6	-3%	✓	✓
			A3029 Underpass	666	638	-28	-4%	✓	✓
			A3029 North	329	311	-18	-5%	✓	✓
		Ashton Vale Road	A3029 Underpass	18	22	4	22%	✓	✓
			A3029 North	4	6	2	50%	✓	✓
			A3029 South	14	12	-2	-14%	✓	✓
	08:00-09:00	A3029 North	Marsh Road	275	234	-41	-15%	✓	✓
		Marsh Road	A3029 South	964	923	-41	-4%	✓	✓
			A3029 South	183	187	4	2%	✓	✓
		A3029 South	Ashton Vale Road	142	162	20	14%	✓	✓
			A3029 Underpass	623	611	-12	-2%	✓	✓
			A3029 North	307	300	-7	-2%	✓	✓
		Ashton Vale Road	A3029 Underpass	24	25	1	4%	✓	✓
			A3029 North	6	7	1	17%	✓	✓
			A3029 South	20	19	-1	-5%	✓	✓
	09:00-10:00	A3029 North	Marsh Road	233	205	-28	-12%	✓	✓
			A3029 South	916	812	-104	-11%	✓	✓
		Marsh Road	A3029 South	87	87	0	0%	✓	✓
		A3029 South	Ashton Vale Road	137	146	9	7%	✓	✓
			A3029 Underpass	556	548	-8	-1%	✓	✓
			A3029 North	273	268	-5	-2%	✓	✓
		Ashton Vale Road	A3029 Underpass	31	35	4	13%	✓	✓
			A3029 North	8	10	2	25%	✓	✓
			A3029 South	31	24	-7	-23%	✓	✓

Table 3.5: AM Flow Calibration (Heavy's vehicles) – Turns

Junction Name	Time Period	From Arm	To Arm	Obs	Model Flow	Diff	% Diff	GEH <5	DMRB Flow
Ashton Vale Level Crossing	07:00-08:00	A3029 North	Marsh Road	5	10	5	100%	✓	✓
			A3029 South	55	51	-4	-7%	✓	✓
		Marsh Road	A3029 South	6	8	2	33%	✓	✓
		A3029 South	Ashton Vale Road	14	15	1	7%	✓	✓
			A3029 Underpass	58	58	0	0%	✓	✓
			A3029 North	29	29	0	0%	✓	✓
		Ashton Vale Road	A3029 Underpass	22	18	-4	-18%	✓	✓
			A3029 North	7	4	-3	-43%	✓	✓
			A3029 South	7	11	4	57%	✓	✓
	08:00-09:00	A3029 North	Marsh Road	19	21	2	11%	✓	✓
			A3029 South	82	82	0	0%	✓	✓
		Marsh Road	A3029 South	12	11	-1	-8%	✓	✓
		A3029 South	Ashton Vale Road	32	16	-16	-50%	✓	✓
			A3029 Underpass	41	55	14	34%	✓	✓
			A3029 North	19	28	9	47%	✓	✓
		Ashton Vale Road	A3029 Underpass	15	14	-1	-7%	✓	✓
			A3029 North	4	3	-1	-25%	✓	✓
			A3029 South	8	10	2	25%	✓	✓
	09:00-10:00	A3029 North	Marsh Road	10	18	8	80%	✓	✓
			A3029 South	93	66	-27	-29%	✓	✓
		Marsh Road	A3029 South	7	7	0	0%	✓	✓
		A3029 South	Ashton Vale Road	34	15	-19	-56%	✓	✓
			A3029 Underpass	42	60	18	43%	✓	✓
			A3029 North	21	29	8	38%	✓	✓
		Ashton Vale Road	A3029 Underpass	22	17	-5	-23%	✓	✓
			A3029 North	7	6	-1	-14%	✓	✓
			A3029 South	6	14	8	133%	✓	✓

3.3.2.2 PM peak

Table 3.6 to 3.9 show the calibration results for the PM peak period model. The results demonstrate that the modelled link flows represent a high correlation to the observed traffic data. The link and turn count flow criteria exceeded the guidelines, with 100% of link flows, (Lights and Heavy's) and 100% of turns had a GEH<5 (Lights) and 96% (Heavys).

The linear regression of the PM peak period modelled total flows and observed total flows was also analysed. A high co-efficient correlation (R2) was achieved and the results are shown in Figure 3.3. The value of R2 =1 implies a perfect match while R2=0 an imperfect match between the observed and modelled flows. Again, the resulting value of R2 provides further confirmation that the traffic movements at the junction are comparable with observed data to a reasonably high degree during this period.

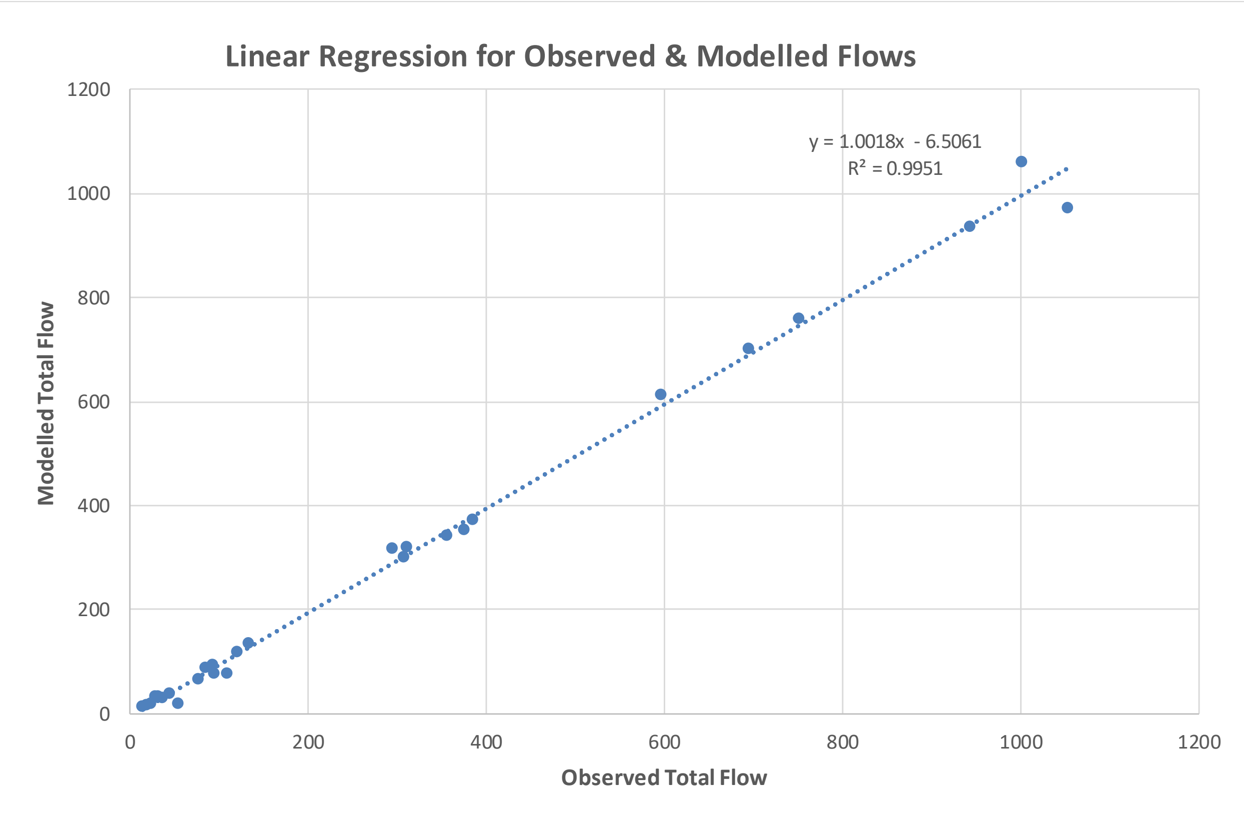


Figure 3.3 Linear Regression for Observed and Modelled Flows of the Base Model – PM Peak

Table 3.6: PM Flow Calibration (Light vehicles) – Links

Junction Name	Time Periods	From Arm	Observed	Model Flow	Diff	% Diff	GEH <5	DMRB Flow
Ashton Vale Level Crossing	16:00-17:00	A3029 North	1286	1209	-77	-6%	✓	✓
		Marsh Road	116	113	-3	-3%	✓	✓
		A3029 South	1039	988	-51	-5%	✓	✓
		Ashton Vale Road	208	191	-17	-8%	✓	✓
	17:00-18:00	A3029 North	1357	1381	24	2%	✓	✓
		Marsh Road	132	132	0	0%	✓	✓
		A3029 South	1133	1111	-22	-2%	✓	✓
		Ashton Vale Road	219	169	-50	-23%	✓	✓
	18:00-19:00	A3029 North	1222	1239	17	1%	✓	✓
		Marsh Road	86	87	1	1%	✓	✓
		A3029 South	906	911	5	1%	✓	✓
		Ashton Vale Road	86	80	-6	-7%	✓	✓

Table 3.7: PM Flow Calibration (Heavy's vehicles) – Links

Junction Name	Time Periods	From Arm	Observed	Model Flow	Diff	% Diff	GEH <5	DMRB Flow
Ashton Vale Level Crossing	16:00-17:00	A3029 North	79	82	3	4%	✓	✓
		Marsh Road	5	6	1	20%	✓	✓
		A3029 South	68	73	5	7%	✓	✓
		Ashton Vale Road	14	13	-1	-7%	✓	✓
	17:00-18:00	A3029 North	23	31	8	35%	✓	✓
		Marsh Road	2	2	0	0%	✓	✓
		A3029 South	30	41	11	37%	✓	✓
		Ashton Vale Road	5	3	-2	-40%	✓	✓
	18:00-19:00	A3029 North	18	13	-5	-28%	✓	✓
		Marsh Road	0	0	0	0%	✓	✓
		A3029 South	20	19	-1	-5%	✓	✓
		Ashton Vale Road	4	3	-1	-25%	✓	✓

Table 3.8: PM Flow Calibration (Light vehicles) – Turns

Junction Name	Time Period	From Arm		Obs	Model Flow	Diff	% Diff	GEH <5	DMRB Flow
Ashton Vale Level Crossing	07:00-08:00	A3029 North	Marsh Road	305	300	-5	-2%	✓	✓
			A3029 South	981	909	-72	-7%	✓	✓
		Marsh Road	A3029 South	116	113	-3	-3%	✓	✓
		A3029 South	Ashton Vale Road	29	19	-10	-34%	✓	✓
			A3029 Underpass	667	650	-17	-3%	✓	✓
			A3029 North	343	319	-24	-7%	✓	✓
		Ashton Vale Road	A3029 Underpass	86	88	2	2%	✓	✓
			A3029 North	29	31	2	7%	✓	✓
			A3029 South	93	72	-21	-23%	✓	✓
	08:00-09:00	A3029 North	Marsh Road	374	346	-28	-7%	✓	✓
			A3029 South	983	1035	52	5%	✓	✓
		Marsh Road	A3029 South	132	132	0	0%	✓	✓
		A3029 South	Ashton Vale Road	19	19	0	0%	✓	✓
			A3029 Underpass	736	732	-4	-1%	✓	✓
			A3029 North	378	360	-18	-5%	✓	✓
		Ashton Vale Road	A3029 Underpass	106	77	-29	-27%	✓	✓
			A3029 North	36	28	-8	-22%	✓	✓
			A3029 South	77	64	-13	-17%	✓	✓
	09:00-10:00	A3029 North	Marsh Road	294	314	20	7%	✓	✓
			A3029 South	928	925	-3	0%	✓	✓
		Marsh Road	A3029 South	86	87	1	1%	✓	✓
		A3029 South	Ashton Vale Road	14	16	2	14%	✓	✓
			A3029 Underpass	589	600	11	2%	✓	✓
			A3029 North	303	295	-8	-3%	✓	✓
		Ashton Vale Road	A3029 Underpass	43	36	-7	-16%	✓	✓
			A3029 North	15	13	-2	-13%	✓	✓
			A3029 South	28	31	3	11%	✓	✓

Table 3.9: PM Flow Calibration (Heavy's vehicles) - Turns

Junction Name	Time Period		From Arm	Obs	Model Flow	Diff	% Diff	GEH <5	DMRB Flow
Ashton Vale Level Crossing	07:00-08:00	A3029 North	Marsh Road	6	19	13	217%	✓	✓
			A3029 South	73	63	-10	-14%	✓	✓
		Marsh Road	A3029 South	5	6	1	20%	✓	✓
		A3029 South	Ashton Vale Road	26	1	-25	-96%	×	✓
			A3029 Underpass	28	50	22	79%	✓	✓
			A3029 North	14	22	8	57%	✓	✓
		Ashton Vale Road	A3029 Underpass	8	6	-2	-25%	✓	✓
			A3029 North	3	2	-1	-33%	✓	✓
			A3029 South	3	5	2	67%	✓	✓
	08:00-09:00	A3029 North	Marsh Road	3	7	4	133%	✓	✓
			A3029 South	20	24	4	20%	✓	✓
		Marsh Road	A3029 South	2	2	0	0%	✓	✓
		A3029 South	Ashton Vale Road	6	0	-6	100%	✓	✓
			A3029 Underpass	16	28	12	75%	✓	✓
			A3029 North	8	13	5	63%	✓	✓
		Ashton Vale Road	A3029 Underpass	4	1	-3	-75%	✓	✓
			A3029 North	1	1	0	0%	✓	✓
			A3029 South	0	1	1	0%	✓	✓
	09:00-10:00	A3029 North	Marsh Road	2	3	1	50%	✓	✓
			A3029 South	16	10	-6	-38%	✓	✓
		Marsh Road	A3029 South	0	0	0	0%	✓	✓
		A3029 South	Ashton Vale Road	6	1	-5	-83%	✓	✓
			A3029 Underpass	9	13	4	44%	✓	✓
			A3029 North	5	5	0	0%	✓	✓
		Ashton Vale Road	A3029 Underpass	3	2	-1	-33%	✓	✓
			A3029 North	0	0	0	0%	✓	✓
			A3029 South	1	1	0	0%	✓	✓

SECTION 4

Model Validation

4.1 General

Validation is the process whereby modelled outputs are compared against independently collected observed data. In this case, comparisons with observed travel times have been used to assess the overall robustness of the models and ensure that typical operational conditions within the modelled network are being simulated accurately.

4.2 Journey Times

4.2.1 Observed Data

In order to obtain journey time data, moving car surveys were carried out along a number of routes on the 9th and 10th May 2017. This was carried out within the AM and PM peak periods. The full results from the journey time survey can be found in **Appendix A.** In all, three routes were used for the AM and PM peak. The routes used are shown in **Table 4.1**.

Table 4.1: Journey Time Routes

Routes	Directions	Description
1	Northbound	From A3029 Sainsbury's Rbt to Ashton Gate Underpass, passing Paxton Drive
2	Southbound	From A370 Brunel Way to A3029 Stadium
3	Eastbound	From Ashton Vale Road to the A3029 Junction stop line

4.2.2 Acceptability Criteria

Acceptability criteria set out by Transport for London (TfL) in their latest micro-simulation best-practice guidelines recommend that:

- Average modelled travel times be within 15% of the corresponding observed values on 85% of routes.

Further guidance provided in the Design Manual for Road & Bridges (DMRB) suggests a suitable overall fit to have been achieved once:

- 85% of routes validate to within 15% of the corresponding observed values, or within one minute (if higher).

4.3 Validation Results

Model validation has been undertaken using 10 simulation seed runs. The travel time validation results for the AM modelled period can be seen in Table 4.2, and the PM modelled period in Table 4.3. The results show a good match between observed and modelled journey times. Critically, modelled journey times within core AM (8:00-9:00am) and PM (5:00-6:00pm) assessment hours are all within 15% of observed journey times meeting both TfL and DMRB acceptability guidelines.

Table 4.2: Journey Time Validation results – AM Peak

Road Name	Route	Dir	Time Period	Obs (s)	Mod (s)	Diff (s)	% Diff	Pass/ Fail
A3029 Winterstoke Road	1	NB	0700-0800	191	157	-34	-18%	Pass
	1	NB	0800-0900	227	208	-19	-8%	Pass
	1	NB	0900-1000	177	147	-30	-17%	Pass
A3029 Winterstoke Road	2	SB	0700-0800	99	112	13	13%	Pass
	2	SB	0800-0900	121	129	8	7%	Pass
	2	SB	0900-1000	102	103	2	2%	Pass
Ashton Vale Road	3	EB	0700-0800	77	90	13	17%	Pass
	3	EB	0800-0900	96	121	25	26%	Pass
	3	EB	0900-1000	N/A	90	N/A	N/A	N/A

Table 4.3: Journey Time Validation results – PM Peak

Road Name	Route	Dir	Time Period	Obs (s)	Mod (s)	Diff (s)	% Diff	Pass/ Fail
A3029 Winterstoke Road	1	NB	1600-1700	112	153	41	37%	Pass
	1	NB	1700-1800	190	161	-29	-15%	Pass
	1	NB	1800-1900	99	134	35	35%	Pass
A3029 Winterstoke Road	2	SB	1600-1700	121	132	11	9%	Pass
	2	SB	1700-1800	137	129	-8	-6%	Pass
	2	SB	1800-1900	93	99	7	7%	Pass
Ashton Vale Road	3	EB	1600-1700	132	133	1	1%	Pass
	3	EB	1700-1800	106	120	15	14%	Pass
	3	EB	1800-1900	62	94	33	53%	Pass

Summary and Conclusions

5.1 Summary

This report has explained the process employed in the creation of a VISSIM micro-simulation traffic model of the Winterstoke Road/Ashton Vale Road signal controlled junction and adjacent Ashton Vale Road level crossing. The report has described the development of the model and set out the traffic data used to create the model matrices. It has also presented the results of calibration and validation checks that seek to ensure that observed traffic volumes and operational conditions within the modelled network replicate observed conditions.

5.2 Conclusions

Model calibration has been achieved through comparison of observed and modelled turning movements for every hour modelled. The calibration results achieved by the model not only confirmed the accuracy in the input of observed traffic flows into the model, but also confirm that the modelling of signals, saturation flows, gap acceptances and reduced speed areas offer a realistic representation of reality and replicate operational conditions within the modelled network.

The models have been validated through comparison of observed (floating car observer) and modelled journey times on the approaches to the junction. These checks have shown that the models validate to TfL and DMRB acceptability criteria. Together with the calibration results, the validation checks confirm that the model is fit for purpose for assessing the impact of the MetroWest Phase 1 scheme and for testing measures aimed at alleviating the impact of longer and more frequent level crossing closures.

Appendix A: Observed Journey Time Results

ROUTE 1:		Distance (m)
1	A3029 Sainsbury's Rbt, Passing store access arm	0
2	A3029 Stadium Rbt, Entering Rbt	460
3	A3029/Ashton Vale Jct, Passing stopline	700
4	A3029 Ashton Gate Underpass, Passing Paxton Drive	1025

ROUTE 2:		Distance (m)
1	A370 Brunel Way, Entering from Jessops Underpass	0
2	A370/A3029, Entering Ashton Rd	340
3	A3029/Marsh Lane Jct, Crossing stopline	550
4	A3029 Stadium Rbt, Entering Rbt	805

ROUTE 3:		Distance (m)
1	Ashton Vale Rd, Passing Avonline	0
2	Ashton Vale Rd, Passing Manheim Access	100
3	Ashton Vale Rd / A3029 Jct, Passing stopline	270

ROUTE 1:

1	A3029 Sainsbury's Rbt, Passing store access arm
2	A3029 Stadium Rbt, Entering Rbt
3	A3029/Ashton Vale Jct, Passing stopline
4	A3029 Ashton Gate Underpass, Passing Paxton Drive

AM PEAK	1	2	3	4	Start	1-2	2-3	3-4	Sum
9th May	07:01:26	07:02:17	07:02:43	07:03:08	07:07:53	00:00:51	00:00:26	00:00:25	00:01:42
	07:10:16	07:11:19	07:11:51	07:12:14	08:07:53	00:01:03	00:00:32	00:00:23	00:01:58
	07:19:51	07:21:02	07:21:23	07:21:46	09:07:53	00:01:11	00:00:21	00:00:23	00:01:55
	07:30:03	07:31:11	07:31:55	07:34:29	10:07:53	00:01:08	00:00:44	00:02:34	00:04:26
	07:43:42	07:45:16	07:46:58	07:49:34	11:07:53	00:01:34	00:01:42	00:02:36	00:05:52
	07:59:53	08:02:19	08:03:38	08:05:24	12:07:53	00:02:26	00:01:19	00:01:46	00:05:31
	08:15:53	08:17:26	08:18:38	08:21:00	13:07:53	00:01:33	00:01:12	00:02:22	00:05:07
	08:30:05	08:31:34	08:32:29	08:33:28	14:07:53	00:01:29	00:00:55	00:00:59	00:03:23
	08:42:23	08:43:50	08:44:27	08:45:22	15:07:53	00:01:27	00:00:37	00:00:55	00:02:59
	08:53:18	08:54:02	08:54:47	08:55:15	16:07:53	00:00:44	00:00:45	00:00:28	00:01:57
	09:03:29	09:06:03	09:07:11	09:07:39	17:07:53	00:02:34	00:01:08	00:00:28	00:04:10
	09:15:07	09:16:04	09:16:26	09:16:50	18:07:53	00:00:57	00:00:22	00:00:24	00:01:43

INTER-PEAK	1	2	3	4	Start	1-2	2-3	3-4	Sum
9th May	10:58:52	10:59:45	11:00:05	11:00:28	10:58:52	00:00:53	00:00:20	00:00:23	00:01:36
	11:06:54	11:07:34	11:07:57	11:08:19	11:58:52	00:00:40	00:00:23	00:00:22	00:01:25
	11:13:19	11:14:03	11:14:23	11:14:46	12:58:52	00:00:44	00:00:20	00:00:23	00:01:27
10th May	11:09:07	11:09:51	11:10:14	11:10:38	10:58:52	00:00:44	00:00:23	00:00:24	00:01:31
	11:13:46	11:14:25	11:15:05	11:15:25	11:58:52	00:00:39	00:00:40	00:00:20	00:01:39
	11:18:23	11:19:10	11:19:33	11:19:55	12:58:52	00:00:47	00:00:23	00:00:22	00:01:32

PM PEAK	1	2	3	4	Start	1-2	2-3	3-4	Sum
9th May	16:00:50	16:01:37	16:02:07	16:02:31	16:00:50	00:00:47	00:00:30	00:00:24	00:01:41
	16:12:14	16:13:21	16:13:45	16:14:10	16:12:14	00:01:07	00:00:24	00:00:25	00:01:56
	16:26:14	16:27:00	16:27:22	16:27:46	16:26:14	00:00:46	00:00:22	00:00:24	00:01:32
	16:39:08	16:40:14	16:40:48	16:41:15	16:39:08	00:01:06	00:00:34	00:00:27	00:02:07
	16:51:47	16:52:49	16:53:20	16:53:51	16:51:47	00:01:02	00:00:31	00:00:31	00:02:04
	17:02:41	17:03:43	17:04:01	17:04:24	17:02:41	00:01:02	00:00:18	00:00:23	00:01:43
	17:16:25	17:18:42	17:19:28	17:21:56	17:16:25	00:02:17	00:00:46	00:02:28	00:05:31
	17:34:31	17:36:53	17:37:17	17:38:03	17:34:31	00:02:22	00:00:24	00:00:46	00:03:32
	17:50:41	17:51:42	17:52:07	17:52:34	17:50:41	00:01:01	00:00:25	00:00:27	00:01:53
	18:03:36	18:04:29	18:04:53	18:05:19	18:03:36	00:00:53	00:00:24	00:00:26	00:01:43
	18:21:53	18:22:33	18:22:52	18:23:14	18:21:53	00:00:40	00:00:19	00:00:22	00:01:21
	18:33:44	18:34:24	18:35:05	18:35:30	18:33:44	00:00:40	00:00:41	00:00:25	00:01:46
	18:44:52	18:45:34	18:46:13	18:46:38	18:44:52	00:00:42	00:00:39	00:00:25	00:01:46
					Min	00:00:40	00:00:18	00:00:22	00:01:21
					Max	00:02:22	00:00:46	00:02:28	00:05:31
					Avg	00:01:07	00:00:29	00:00:36	00:02:12

ROUTE 2:

1	A370 Brunel Way, Entering from Jessops Underpass (Passing 40mph Limit Signs)
2	A370/A3029, Entering Ashton Rd (Passing start of island)
3	A3029/Marsh Lane Jct, Crossing stopline
4	A3029 Stadium Rbt, Entering Rbt

	1	2	3	4	Start	1-2	2-3	3-4	Sum
	07:05:48	07:06:13	07:06:43	07:07:11	07:05:48	00:00:25	00:00:30	00:00:28	00:01:23
	07:15:16	07:15:41	07:17:23	07:17:49	07:15:16	00:00:25	00:01:42	00:00:26	00:02:33
	07:26:05	07:26:28	07:27:05	07:27:29	07:26:05	00:00:23	00:00:37	00:00:24	00:01:24
	07:40:21	07:40:46	07:41:04	07:41:32	07:40:21	00:00:25	00:00:18	00:00:28	00:01:11
	07:55:52	07:56:15	07:57:13	07:57:37	07:55:52	00:00:23	00:00:58	00:00:24	00:01:45
	08:11:00	08:11:24	08:11:57	08:12:34	08:11:00	00:00:24	00:00:33	00:00:37	00:01:34
	08:25:01	08:25:29	08:26:54	08:27:20	08:25:01	00:00:28	00:01:25	00:00:26	00:02:19
	08:37:42	08:38:33	08:39:57	08:40:22	08:37:42	00:00:51	00:01:24	00:00:25	00:02:40
	08:48:33	08:48:56	08:50:05	08:50:42	08:48:33	00:00:23	00:01:09	00:00:37	00:02:09
	08:59:57	09:00:24	09:00:47	09:01:19	08:59:57	00:00:27	00:00:23	00:00:32	00:01:22
	09:11:37	09:12:02	09:12:38	09:13:01	09:11:37	00:00:25	00:00:36	00:00:23	00:01:24
	09:20:21	09:20:47	09:21:57	09:22:20	09:20:21	00:00:26	00:01:10	00:00:23	00:01:59
INTER-PEAK	1	2	3	4	Start	1-2	2-3	3-4	Sum
9th May	11:04:13	11:04:35	11:05:24	11:05:50	11:04:13	00:00:22	00:00:49	00:00:26	00:01:37
	11:10:53	11:11:19	11:11:36	11:12:09	12:04:13	00:00:26	00:00:17	00:00:33	00:01:16
	11:16:10	11:16:31	11:18:26	11:18:51	13:04:13	00:00:21	00:01:55	00:00:25	00:02:41
10th May	11:11:23	11:11:45	11:12:25	11:12:56	11:04:13	00:00:22	00:00:40	00:00:31	00:01:33
	11:16:10	11:16:37	11:17:08	11:17:31	12:04:13	00:00:27	00:00:31	00:00:23	00:01:21
	11:21:19	11:21:42	11:22:29	11:22:55	13:04:13	00:00:23	00:00:47	00:00:26	00:01:36
PM PEAK	1	2	3	4	Start	1-2	2-3	3-4	Sum
	16:08:05	16:08:37	16:09:19	16:09:49	16:08:05	00:00:32	00:00:42	00:00:30	00:01:44
	16:22:20	16:22:44	16:23:34	16:24:00	16:22:20	00:00:24	00:00:50	00:00:26	00:01:40
	16:34:20	16:34:49	16:35:28	16:36:35	16:34:20	00:00:29	00:00:39	00:01:07	00:02:15
	16:46:46	16:47:14	16:48:52	16:49:20	16:46:46	00:00:28	00:01:38	00:00:28	00:02:34
	16:57:30	16:57:53	16:58:41	16:59:22	16:57:30	00:00:23	00:00:48	00:00:41	00:01:52
	17:10:00	17:10:27	17:11:36	17:12:19	17:10:00	00:00:27	00:01:09	00:00:43	00:02:19
	17:26:57	17:27:24	17:28:57	17:29:24	17:26:57	00:00:27	00:01:33	00:00:27	00:02:27
	17:45:48	17:46:20	17:47:22	17:48:09	17:45:48	00:00:32	00:01:02	00:00:47	00:02:21
	17:59:26	17:59:53	18:01:02	18:01:28	17:59:26	00:00:27	00:01:09	00:00:26	00:02:02
	18:14:48	18:15:14	18:15:57	18:16:20	18:14:48	00:00:26	00:00:43	00:00:23	00:01:32
	18:28:53	18:29:19	18:29:59	18:30:25	18:28:53	00:00:26	00:00:40	00:00:26	00:01:32
	18:40:35	18:41:04	18:41:49	18:42:13	18:40:35	00:00:29	00:00:45	00:00:24	00:01:38
	18:50:47	18:51:16	18:51:50	18:52:16	18:50:47	00:00:29	00:00:34	00:00:26	00:01:29
					Min	00:00:23	00:00:34	00:00:23	00:01:29
					Max	00:00:32	00:01:38	00:01:07	00:02:34
					Avg	00:00:28	00:00:56	00:00:33	00:01:57

ROUTE 3:

1	Ashton Vale Rd, Passing Avonline
2	Ashton Vale Rd, Passing Manheim Access
3	Ashton Vale Rd / A3029 Jct, Passing stopline

Tuesday 9th May

1	2	3	Start	1-2	2-3	Total
07:00:15	07:00:36	07:01:22	07:00:15	00:00:21	00:00:46	00:01:07
07:03:38	07:04:00	07:05:08	07:03:38	00:00:22	00:01:08	00:01:30
07:07:20	07:07:46	07:08:45	07:07:20	00:00:26	00:00:59	00:01:25
07:12:30	07:12:51	07:13:22	07:12:30	00:00:21	00:00:31	00:00:52
07:18:26	07:18:48	07:18:56	07:18:26	00:00:22	00:00:08	00:00:30
07:23:34	07:24:04	07:24:51	07:23:34	00:00:30	00:00:47	00:01:17
07:33:46	07:34:07	07:35:19	07:33:46	00:00:21	00:01:12	00:01:33
07:40:20	07:40:41	07:40:54	07:40:20	00:00:21	00:00:13	00:00:34
07:45:50	07:46:13	07:48:02	07:45:50	00:00:23	00:01:49	00:02:12
07:55:44	07:56:09	07:57:33	07:55:44	00:00:25	00:01:24	00:01:49
08:01:29	08:01:57	08:02:10	08:01:29	00:00:28	00:00:13	00:00:41
08:08:29	08:08:49	08:09:53	08:08:29	00:00:20	00:01:04	00:01:24
08:16:13	08:16:35	08:18:50	08:16:13	00:00:22	00:02:15	00:02:37
08:21:01	08:21:08	08:23:38	08:21:01	00:00:07	00:02:30	00:02:37
08:27:39	08:28:08	08:29:29	08:27:39	00:00:29	00:01:21	00:01:50
08:33:09	08:33:33	08:35:22	08:33:09	00:00:24	00:01:49	00:02:13
08:38:07	08:38:31	08:39:36	08:38:07	00:00:24	00:01:05	00:01:29
08:43:31	08:43:59	08:45:07	08:43:31	00:00:28	00:01:08	00:01:36
08:51:01	08:51:28	08:52:25	08:51:01	00:00:27	00:00:57	00:01:24
08:55:30	08:55:52	08:56:10	08:55:30	00:00:22	00:00:18	00:00:40
09:00:54	09:01:20	09:01:58	09:00:54	00:00:26	00:00:38	00:01:04
			Min	00:00:07	00:00:08	00:00:30
			Max	00:00:30	00:02:30	00:02:37
			Avg	00:00:23	00:01:04	00:01:27

1	2	3
11:00:52	11:01:15	11:01:30
11:11:42	11:12:06	11:14:46
11:21:35	11:22:00	11:24:56
11:29:28	11:29:52	11:30:34
11:39:42	11:40:07	11:41:33
11:51:23	11:51:50	11:51:58
12:00:31	12:00:54	12:01:26
12:11:36	12:11:59	12:12:31
12:20:45	12:21:01	12:22:00
12:32:00	12:32:18	12:36:28
12:40:27	12:41:01	12:42:21
12:50:06	12:50:24	12:52:05
12:59:41	13:00:10	13:02:08
14:00:59	14:01:21	14:02:39
14:14:45	14:15:09	14:15:18
14:24:22	14:24:43	14:25:12
14:31:49	14:32:08	14:33:46
14:40:21	14:40:43	14:44:04
14:50:52	14:51:11	14:51:21
14:59:51	15:00:15	15:01:49

Start	1-2	2-3	Total
11:00:52	00:00:23	00:00:15	00:00:38
11:11:42	00:00:24	00:02:40	00:03:04
11:21:35	00:00:25	00:02:56	00:03:21
11:29:28	00:00:24	00:00:42	00:01:06
11:39:42	00:00:25	00:01:26	00:01:51
11:51:23	00:00:27	00:00:08	00:00:35
12:00:31	00:00:23	00:00:32	00:00:55
12:11:36	00:00:23	00:00:32	00:00:55
12:20:45	00:00:16	00:00:59	00:01:15
12:32:00	00:00:18	00:04:10	00:04:28
12:40:27	00:00:34	00:01:20	00:01:54
12:50:06	00:00:18	00:01:41	00:01:59
12:59:41	00:00:29	00:01:58	00:02:27
14:00:59	00:00:22	00:01:18	00:01:40
14:14:45	00:00:24	00:00:09	00:00:33
14:24:22	00:00:21	00:00:29	00:00:50
14:31:49	00:00:19	00:01:38	00:01:57
14:40:21	00:00:22	00:03:21	00:03:43
14:50:52	00:00:19	00:00:10	00:00:29
14:59:51	00:00:24	00:01:34	00:01:58
Min	00:00:16	00:00:08	00:00:29
Max	00:00:34	00:04:10	00:04:28
Avg	00:00:23	00:01:24	00:01:47

1	2	3	Start	1-2	2-3	Total
16:00:33	16:00:56	16:02:19	16:00:33	00:00:23	00:01:23	00:01:46
16:04:45	16:05:07	16:06:09	16:04:45	00:00:22	00:01:02	00:01:24
16:09:54	16:10:18	16:11:41	16:09:54	00:00:24	00:01:23	00:01:47
16:15:10	16:15:36	16:16:08	16:15:10	00:00:26	00:00:32	00:00:58
16:19:32	16:19:47	16:19:57	16:19:32	00:00:15	00:00:10	00:00:25
16:25:02	16:25:19	16:25:30	16:25:02	00:00:17	00:00:11	00:00:28
16:30:05	16:30:28	16:31:25	16:30:05	00:00:23	00:00:57	00:01:20
16:34:40	16:35:29	16:37:43	16:34:40	00:00:49	00:02:14	00:03:03
16:39:49	16:40:10	16:43:18	16:39:49	00:00:21	00:03:08	00:03:29
16:43:58	16:44:28	16:47:20	16:43:58	00:00:30	00:02:52	00:03:22
16:52:41	16:53:00	16:56:26	16:52:41	00:00:19	00:03:26	00:03:45
16:59:54	17:00:22	17:04:28	16:59:54	00:00:28	00:04:06	00:04:34
17:05:20	17:07:00	17:09:10	17:05:20	00:01:40	00:02:10	00:03:50
17:10:27	17:10:48	17:11:42	17:10:27	00:00:21	00:00:54	00:01:15
17:14:45	17:15:02	17:16:25	17:14:45	00:00:17	00:01:23	00:01:40
17:18:57	17:19:15	17:20:18	17:18:57	00:00:18	00:01:03	00:01:21
17:27:13	17:27:32	17:27:56	17:27:13	00:00:19	00:00:24	00:00:43
17:31:47	17:32:12	17:33:37	17:31:47	00:00:25	00:01:25	00:01:50
17:35:52	17:36:11	17:37:33	17:35:52	00:00:19	00:01:22	00:01:41
17:42:51	17:43:16	17:44:32	17:42:51	00:00:25	00:01:16	00:01:41
17:48:21	17:48:37	17:48:53	17:48:21	00:00:16	00:00:16	00:00:32
17:53:00	17:53:15	17:56:43	17:53:00	00:00:15	00:03:28	00:03:43
17:58:44	17:59:01	17:59:49	17:58:44	00:00:17	00:00:48	00:01:05
18:08:57	18:09:14	18:09:28	18:08:57	00:00:17	00:00:14	00:00:31
18:13:12	18:13:31	18:14:15	18:13:12	00:00:19	00:00:44	00:01:03
18:18:20	18:18:38	18:19:46	18:18:20	00:00:18	00:01:08	00:01:26
18:23:05	18:23:25	18:24:54	18:23:05	00:00:20	00:01:29	00:01:49
18:29:30	18:29:47	18:29:59	18:29:30	00:00:17	00:00:12	00:00:29
18:37:07	18:37:33	18:37:43	18:37:07	00:00:26	00:00:10	00:00:36
18:42:55	18:43:12	18:44:06	18:42:55	00:00:17	00:00:54	00:01:11
18:53:15	18:53:32	18:54:22	18:53:15	00:00:17	00:00:50	00:01:07
			Min	00:00:15	00:00:10	00:00:25
			Max	00:01:40	00:04:06	00:04:34
			Avg	00:00:24	00:01:20	00:01:44

MetroWest Phase 1: Winterstoke Road/Ashton Vale Road VISSIM Model Testing Report

Prepared for

North Somerset Council

July 2018

CH2M
1 The Square, Temple Quay
Bristol, BS1 6DG

Document history

Report: MetroWest Phase 1: Winterstoke Road/Ashton Vale Road VISSIM Model Testing Report

Reference: 674946.CS.70.01

Client: North Somerset Council

This document has been issued and amended as follows:

Version	Date	Description	Created by	Verified by	Approved by
1	22 June 2018	Draft	SS	LT	HS
2	6 July 2018	Final	SS	LT	HS

Contents

Appendices

Acronyms and Abbreviations

ATC	Automatic Traffic Counter
DMRB	Design Manual for Roads and Bridge
LMVR	Local Model Validation Report
MCC	Manually Classified Count
MOVA	Microprocessor Optimised Vehicle Actuation
NTEM	National Trip End Model
VPH	Vehicles Per Hour

SECTION 1

Introduction

1.1 Background

The West of England (WoE) Councils comprising of Bath & North-East Somerset, Bristol City, North Somerset and South Gloucestershire, together with the West of England Combined Authority (WCA), and working alongside Network Rail (NR), Great Western Railway (GWR) and the wider rail industry, are progressing plans to deliver a series of strategic enhancements to the local rail network over the next five years and beyond, through the MetroWest Programme. The programme currently comprises:

- the MetroWest Phase 1 scheme;
- the MetroWest Phase 2 scheme;
- the Portway Park & Ride station scheme; and
- a range of new station/re-opening schemes, subject to separate business cases and smaller scale localised enhancement schemes.

The MetroWest Phase 1 project is being led by North Somerset Council, and comprises the delivery of infrastructure and passenger train operations to provide enhanced services on the Severn Beach line, local stations on the Bath to Bristol line and for a reopened Portishead Branch Line with stations at Portishead and Pill. The re-opened Portishead Branch Line will maintain the existing freight train operations as well as re-introduce passenger train services on an hourly basis.

MetroWest Phase 1 includes infrastructure to be consented through a Development Consent Order (DCO) and infrastructure which falls within Network Rail's General Permitted Development rights (the GPD works). The passenger train service is to be delivered through either the Department for Transport's re-franchising process or via a bi-lateral agreement between the four councils and a train operating company (TOC). The project is to be delivered by the rail industry and the four councils, and is being led by North Somerset Council on behalf of the four West of England (WoE) councils.

CH2M (now Jacobs) has been appointed to prepare a Transport Assessment (TA) in support of the Portishead Branch Line Development Consent Order (DCO) scheme (MetroWest Phase 1) proposal to reopen the Portishead line with stations at Portishead and Pill in North Somerset ("the DCO scheme").

A key element of the MetroWest Phase 1 project is reopening of the Portishead branch line, and within this is the reinstatement of passenger services on the currently freight-only Portbury dock line (which splits from the Portishead line north of Pill). As such, the scheme will therefore increase the number of trains using the level crossing on Ashton Vale Road adjacent to the Winterstoke Road/Ashton Vale Road signal controlled junction. These signals are configured such that, during level crossing closures, traffic entering and exiting Ashton Vale Road is held on red whilst the other arms are serviced within a restricted staging sequence. There is therefore a need to understand the impact of the MetroWest Phase 1 scheme on operational conditions at this junction.

1.2 Purpose of Report

The purpose of this report is to explain the methodology and results from forecast VISSIM micro-simulation traffic modelling of the Winterstoke Road/Ashton Vale Road junction and level crossing under a range of Do-Nothing and MetroWest scheme scenarios. The assessment includes scenarios incorporating highway works and measures aimed at alleviating the impact of longer and more frequent level crossing closures on the local highway network.

1.3 Structure of Report

Following this introduction, the remainder of this report is structured as follows:

- **Section 2**: Methodology, including the approach employed in the modelling work, forecasting and other modelling assumptions;
- **Section 3**: Testing Results, including the result from the VISSIM modelling comparing the forecast Do-Nothing situation to a range of MetroWest scenarios;
- **Section 4**: Conclusions, including a summary of the modelling work and some conclusions based on the findings from the testing.

Methodology

2.1 Modelling Approach

The assessment has been carried out using the Winterstoke Road/Ashton Vale Road VISSIM model. This was developed using Version 8.00-06 of the software. This was the latest version of the software at the time of model development. The model network includes the Winterstoke Road/Ashton Vale Road junction and its approach arms comprising the A3029 Winterstoke Road, Marsh Road and Ashton Vale Road, as well as the Ashton Vale level crossing and railway line. The extents of the modelled network can be seen in Figure 2.1.

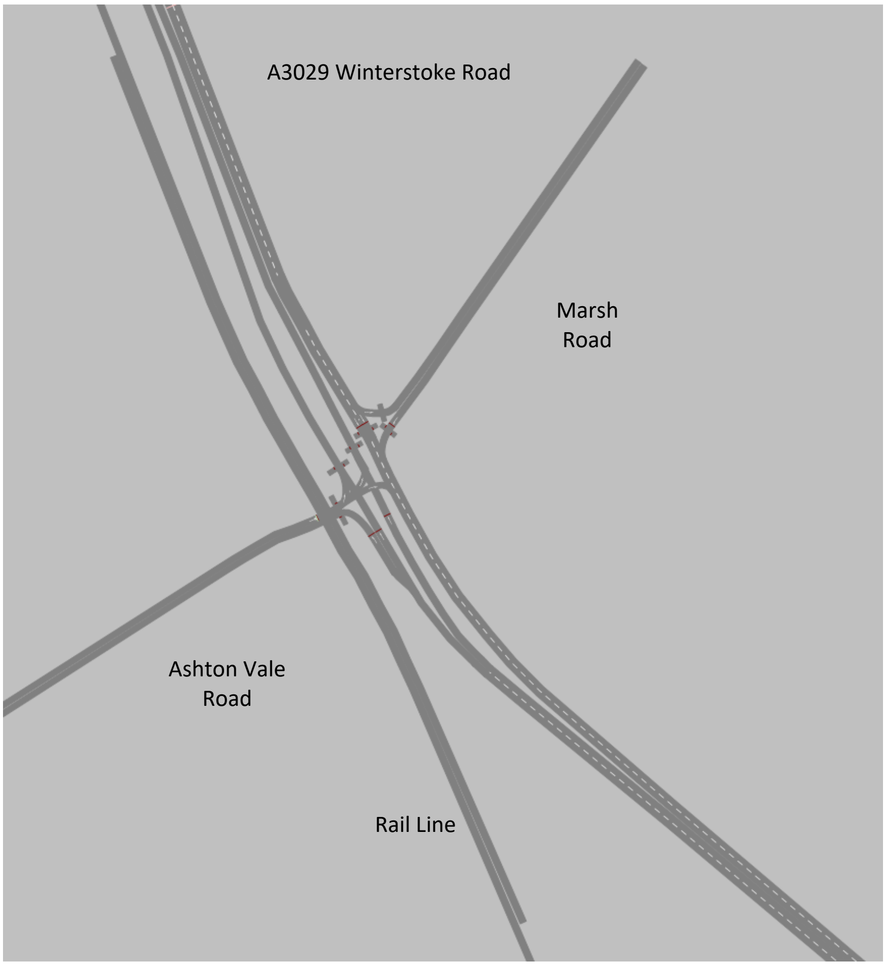


Figure 2.1: Winterstoke Road/Ashton Vale Road VISSIM Model Extents

2.2 Forecast Traffic

The testing has been carried out for a 2021 forecast year. This is expected to be the opening year of the MetroWest Phase 1 scheme. Traffic growth in the VISSIM model has been assumed in line with TEMPRO forecasts from the National Trip End Model (NTEM). This provides growth between the 2017 base year and 2021 forecast year of 5.8 per cent in the weekday AM peak period and 5.4 per cent in the PM peak period. This growth with applied in the model to the Winterstoke Road ahead through-movements only under the assumption that the growth trips to and from Ashton Vale Road and Marsh Lane would be constrained.

2.3 Scenarios Tested

Table 2.1 lists the range of Do-Nothing and MetroWest scheme scenarios tested in the VISSIM model and summarises the assumptions employed within each.

Table 2.1: Modelled Scenarios

Scenario name	Year	Freight	Scheme	Measures	Period	Total Closures
BASE MODELLING ONLY						
2017_AM_NF_WoS	2017	No	No	No	AM	0
2017_PM_NF_WoS	2017	No	No	No	PM	0
FUTURE WITHOUT SCHEME						
2021_AM_NF_WoS	2021	No	No	No	AM	0
2021_PM_NF_WoS	2021	No	No	No	PM	0
2021_AM_1F_WoS	2021	1 tph in one dir	No	No	AM	1
2021_PM_11_WoS	2021	1 tph in one dir	No	No	PM	1
FUTURE WITH SCHEME (1tph)						
2021_AM_1F_WS	2021	1 tph in one dir	1 tph	No	AM	3
2021_PM_1F_WS	2021	1 tph in one dir	1 tph	No	PM	3
2021_AM_1F_WS+M	2021	1 tph in one dir	1 tph	Yes	AM	3
2021_PM_1F_WS+M	2021	1 tph in one dir	1 tph	Yes	PM	3
SENSITIVITY TESTS						
2021_AM_1F_WS45+M	2021	1 tph in one dir	45min peak freq	Yes	AM	4 or 5
2021_PM_1F_WS45+M	2021	1 tph in one dir	45min peak freq	Yes	PM	4 or 5
2021_AM_NF_WS+M	2021	No	1 tph	Yes	AM	2
2021_PM_NF_WS+M	2021	No	1 tph	Yes	PM	2
2021_AM_2F_WS45+M	2021	1 tph in each dir	45min peak freq	Yes	AM	5 or 6
2021_PM_2F_WS45+M	2021	1 tph in each dir	45min peak freq	Yes	PM	5 or 6

2.4 Rail Assumptions

As shown in Table 2.1, there are a range of potential rail scenarios involving movements of both MetroWest Phase 1 passenger trains and freight trains that currently use the railway that passes through the level crossing. Network Rail has carried out operational analysis of these rail scenarios in RailSys which has informed the frequency and duration level crossing closures assumed in the VISSIM model. The outcomes from this work and the rail pattern and level crossing closure times associated with an hourly MetroWest service are contained in **Appendix A**. The RailSys output from a 45-minute MetroWest service are shown in **Appendix B**.

2.5 Highway Measures

The highway measures proposed as part of the MetroWest scheme include an extension of the Winterstoke Road left turn lane to a length of circa 150 metres. These works are shown in Drawing No. 674946.BD.29.01-SK31 contained in **Appendix B**. The aim of this change is to ensure that vehicles queuing to turn left into Ashton Vale Road during level crossing closures can be stored without impeding the adjacent ahead movement. This measure has been directly coded into the relevant 'measures' scenarios in the VISSIM model as a longer left turn flare as per the layout drawing.

The other main element of the MetroWest highway measures works in this locality is an upgrade of the mode of control of the Winterstoke Road/Ashton Vale Road signals to MOVA This is a highly adaptive form of signal control that can respond very quickly to changes in traffic volumes. Typically, MOVA would be modelled through linking VISSIM to the PCMOVA software. However, this was not possible in the simulation due to the complication of operating MOVA with the level crossing. Consequently, MOVA has been modelled by proxy by an increase in the phase maxima used in the VAP logic file.

Testing Results

3.1 General

The 2021 forecast scenarios were run for 15 seed runs to provide robust mean output results. The models were configured to provide outputs focused on the performance of affected arms. This included mean journey times on Winterstoke Road in the northbound and southbound directions and on the Ashton Vale Road approach to the junction. Queue lengths were also recorded at each stop line at the junction with queue lengths recorded every minute so that the queue length profile between scenarios could be compared.

3.2 Journey Times

Tables 3.1 and 3.1 compare, respectively, the mean hourly journey times (in seconds) for the AM peak (8:00-9:00am) and PM peak (5:00-6:00pm) hours.

Table 3.1: Mean Journey Time (seconds) Comparison, AM Peak Hour (8:00-9:00am)

Route	2021_NF_ WoS	2021_F_ WoS	2021_F_ WS	2021_F_ WS+M	2021_F_ WS45+M	2021_NF_ WS+M	2021_2F_ WS45+M
A3029 NB	278	275	353	203	202	205	200
A3029 SB	181	194	181	168	169	171	160
Ashton Vale	122	124	136	130	136	128	143

Table 3.2: Mean Journey Time (seconds) Comparison, PM Peak Hour (5:00-6:00pm)

Route	2021_NF_ WoS	2021_F_ WoS	2021_F_ WS	2021_F_ WS+M	2021_F_ WS45+M	2021_NF_ WS+M	2021_2F_ WS45+M
A3029 NB	213	212	211	212	215	211	211
A3029 SB	267	229	191	216	189	229	164
Ashton Vale	120	137	158	141	170	130	186

The results show that the MetroWest scheme without highway measures, and assuming a coincidence with a freight train movement (‘2021_F_WS’), is predicted to increase mean journey times on Winterstoke Road northbound by around 75 seconds in the AM compared to the Do-Nothing scenario (‘2021_NF_WoS’). Delays on Ashton Vale Road also increase by 14 seconds. During the PM, there is no increase on Winterstoke Road, but Ashton Vale Road is expected to experience an increase in mean journey time of 38 seconds.

The proposed measures under scenario ‘2021_F_WS+M’ are predicted to be effective at alleviating the impact of the MetroWest scheme even when assuming a worst-case scenario alongside an assumed freight rail movement every hour. Mean journey times compared to the Do-Nothing actually show an improvement on Winterstoke Road northbound with a reduction in journey times from 278 to 203 seconds. This is likely to be a result of a combination of longer flared approach and higher green times resulting from the introduction of MOVA control. There is a slight improvement in mean journey times on Ashton Vale Road in the AM peak hour, and in the PM peak hour the measures reduce the increase in delay from 38 to 21 seconds over to the Do-Nothing scenario.

If a freight rail movement were to occur during the weekday peak hours, as could happen at the moment without MetroWest, the relative impact of the MetroWest scheme compared to the 'current' situation is much less, especially on Ashton Vale Road during the PM. Mean PM peak hour journey times under this scenario are predicted to be 137 seconds. As such, the impact of the MetroWest scheme with highway measures is only four seconds during the PM. The impact on this arm in the AM is also reduced when compared to the Do-Nothing situation assuming one freight rail movement.

The impact of the MetroWest scheme is also notably lesser when tested with no freight rail movements. Since the actual number of freight movements is only around six per week with few if any happening during peak periods, this scenario ('2021_NF_WS+M') is likely to be the most realistic. A comparison with the Do-Nothing scenario ('2021_NF_WoS') shows that the impact on Ashton Vale Road of MetroWest amounts to an increase in mean journey time of six seconds in the AM and 10 seconds in PM. Elsewhere, there is are reductions in delay on Winterstoke Road southbound of nearly 40 seconds in the PM peak hour.

Sensitivity testing with a 45-minute MetroWest service and assuming one freight movement per hour ('2021_F_WS45+M'), not surprisingly, increases the impact of MetroWest on delays at the Winterstoke Road/Ashton Vale Road junction compared to an hourly service. Mean journey times on Ashton Vale Road are predicted to increase by 14 seconds in the AM and 50 seconds in the PM compared to the Do-Nothing situation even with highway measures. This represents an increase in mean delay of six and 29 seconds in the AM and PM, respectively, relative to the comparable hourly MetroWest service pattern.

The results for the absolute worst-case scenario involving a 45-minute MetroWest service and two freight rail movements per hour ('2021_2F_WS45+M') show greater impacts over the scenario assuming only one freight rail movement ('2021_F_WS45+M'). Consequently, the impacts compared to the Do-Nothing scenario, assuming no freight rail movement, are greater with an increase in mean journey times on Ashton Vale Road of 21 seconds in the AM and 66 seconds in the PM, or 19 and 49 seconds respectively when compared to the Do-Nothing scenario with freight.

3.3 Queue Lengths

The range of scenarios modelled and multiple stop lines at the Winterstoke Road/Ashton Vale Road junction means that a large number of maximum queue length profile graphs have been generated from the model output. The high number of scenarios also means that it is not possible to display the results from every scenario on the same graph. Consequently, scenarios have been paired-up with those with which the profiles can be logically compared. The resulting graphs can be found in **Appendices D to G.** The most relevant graphs are reproduced below for ease of illustration in discussion on the results.

3.3.1 Do-Nothing vs MetroWest (No Freight)

Appendix D contains graphs comparing the maximum queue length (in metres) profile for the 2021 Do-Nothing (No Freight) and the 2021 MetroWest Scheme (No Freight) with highway measures. This is considered to be the most likely scenario for both the Do-Nothing and Scheme scenarios. Examination of the graphs show little change on most arms in the AM with the exception of a notable improvement in queuing on the Winterstoke Road northbound approach to the junction in the AM (Figure D3, reproduced below). This reflects the betterment in terms of junction operation through the extension of the left turn flare on this arm and the introduction of MOVA control.

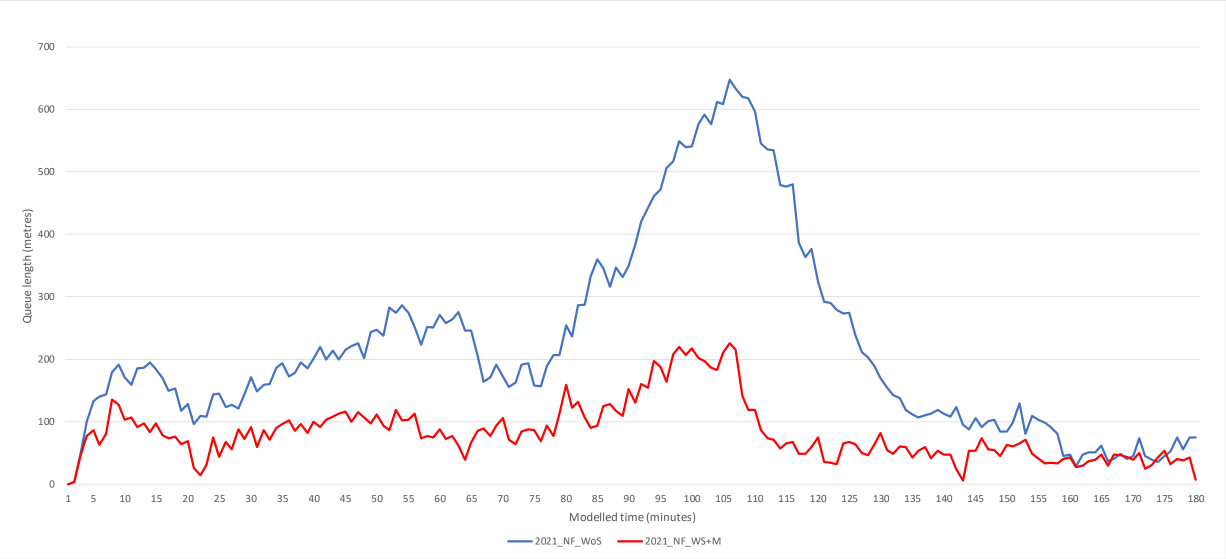


Figure D3 (from Appendix D): Maximum Queue Length Profile, 2021 Do-Nothing (No Freight) vs 2021 MetroWest (No Freight) plus Measures, Winterstoke Road Northbound, AM Peak Period

The graphs also highlight short spikes in queuing on Ashton Vale Road during both the AM (Figure D4) and PM (Figure D8, also reproduced below) coinciding with level crossing closures. These spikes are particularly acute during the PM when there are greater volumes exiting the industrial estate with queue lengths roughly doubling from Do-Nothing levels. However, these spikes are relatively short-lived and the graphs show that queue lengths typically return to ambient Do-Nothing levels within three to five minutes.

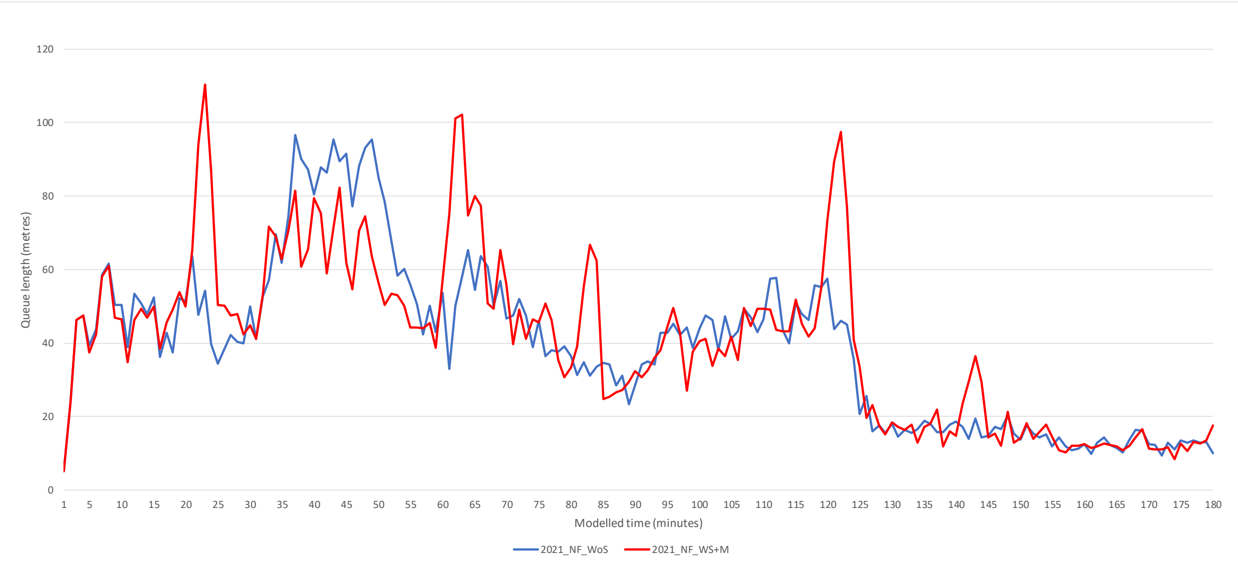


Figure D8 (from Appendix D): Maximum Queue Length Profile, 2021 Do-Nothing (No Freight) vs 2021 MetroWest (No Freight) plus Measures, Ashton Vale Road, PM Peak Period

Notably, the impact of MetroWest on the Winterstoke Road southbound approach is a reduction in maximum queue lengths throughout much of the PM peak period. This is shown in Figure D5 (reproduced below). This improvement in queuing reflects the more frequent level crossing closures in the MetroWest scheme scenario during which this arm receives a greater proportion of green time within the restricted sequence compared to the full stage sequence under normal conditions.

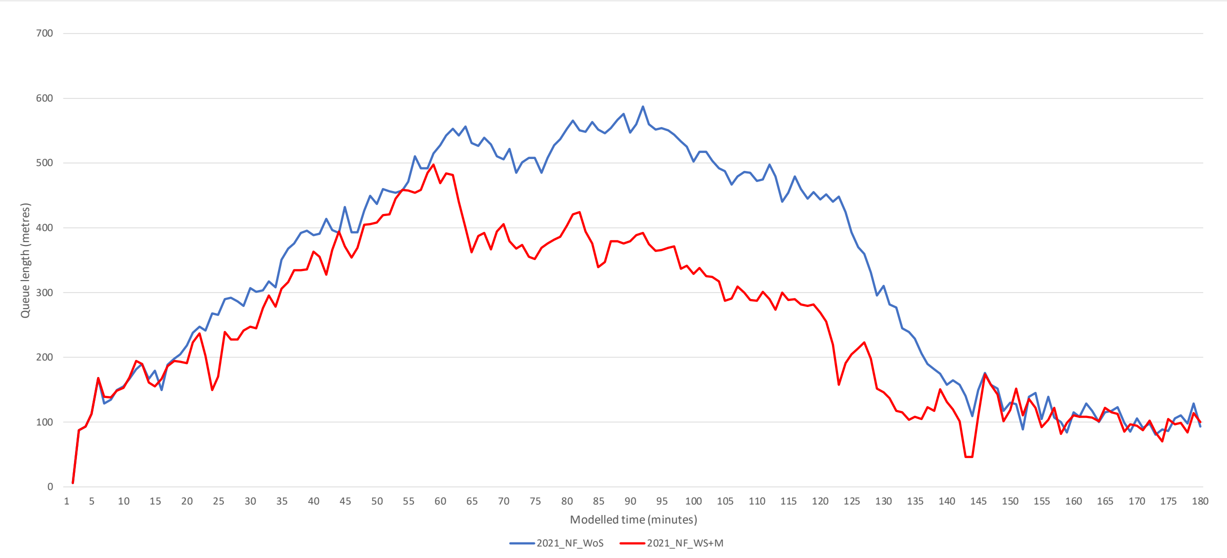


Figure D5 (from Appendix D): Maximum Queue Length Profile, 2021 Do-Nothing (No Freight) vs 2021 MetroWest (No Freight) plus Measures, Winterstoke Road Southbound, PM Peak Period

3.3.2 Do-Nothing vs MetroWest (With Freight)

Appendix E contains graphs comparing the maximum queue length (in metres) profile for the 2021 Do-Nothing and the 2021 MetroWest Scheme with measures with both including one freight movement per hour. As before, queuing during the AM is comparable between the two scenarios except for an improvement on Winterstoke Road northbound. Queue lengths on Ashton Vale Road show similar spikes where freight movements coincide in the two scenarios, particularly during the PM peak period as shown in Figure E8 (reproduced below).

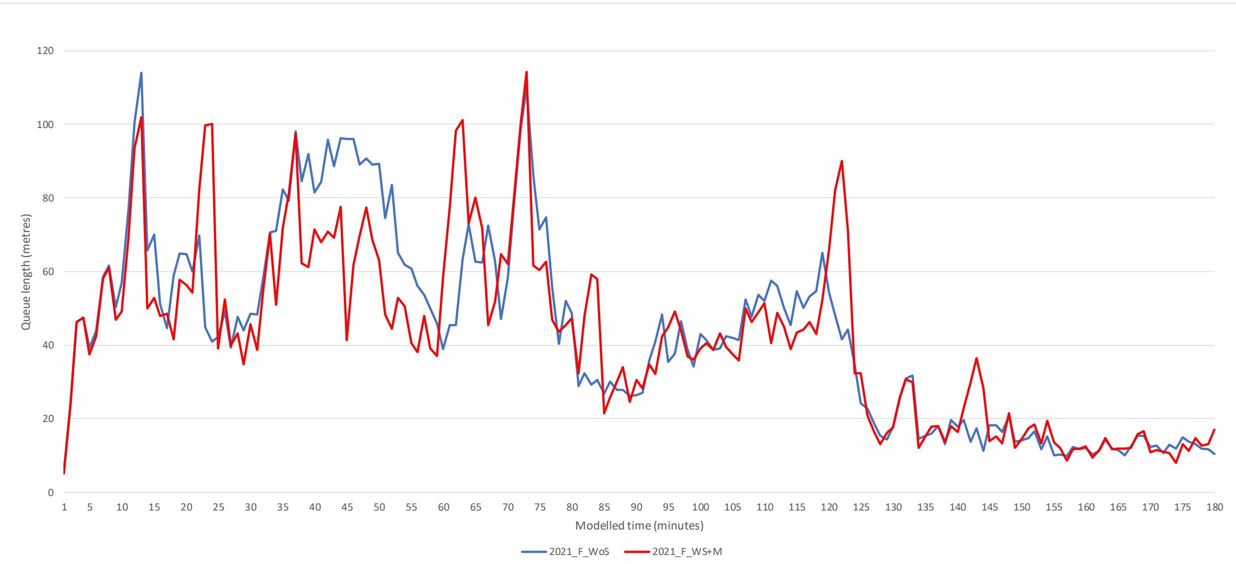


Figure E8 (from Appendix E): Maximum Queue Length Profile, 2021 Do-Nothing (With Freight) vs 2021 MetroWest (With Freight) plus Measures, Ashton Vale Road, PM Peak Period

3.3.3 MetroWest Without and With Highway Measures

Appendix F contains queue length profile graphs comparing MetroWest (with freight) without and with the proposed highway measures. These comparisons aim to illustrate the effectiveness of the proposed measures in ameliorating some of the impact of more frequent and longer level crossing closures. For instance, Figure F3 (reproduced below) highlights a significant reduction in queuing on the Winterstoke Road northbound approach to the junction.

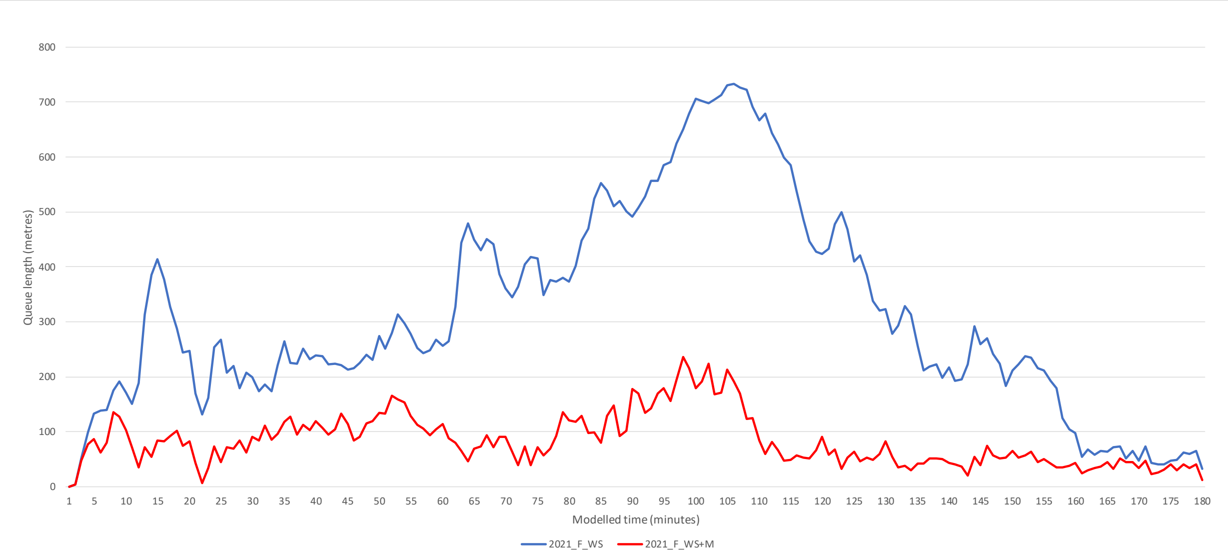


Figure F3 (from Appendix E): Maximum Queue Length Profile, 2021 MetroWest (With Freight) vs 2021 MetroWest (With Freight) plus Measures, Winterstoke Road Northbound, AM Peak Period

For the Ashton Vale Road arm, Figures F4 and F8 (reproduced below) show that the proposed highway measures, in particular the assumed longer green times associated with MOVA control, results in shorter overall queue lengths in both the AM and PM, and enables queues to recover faster compared to the scenario where no measures is included.

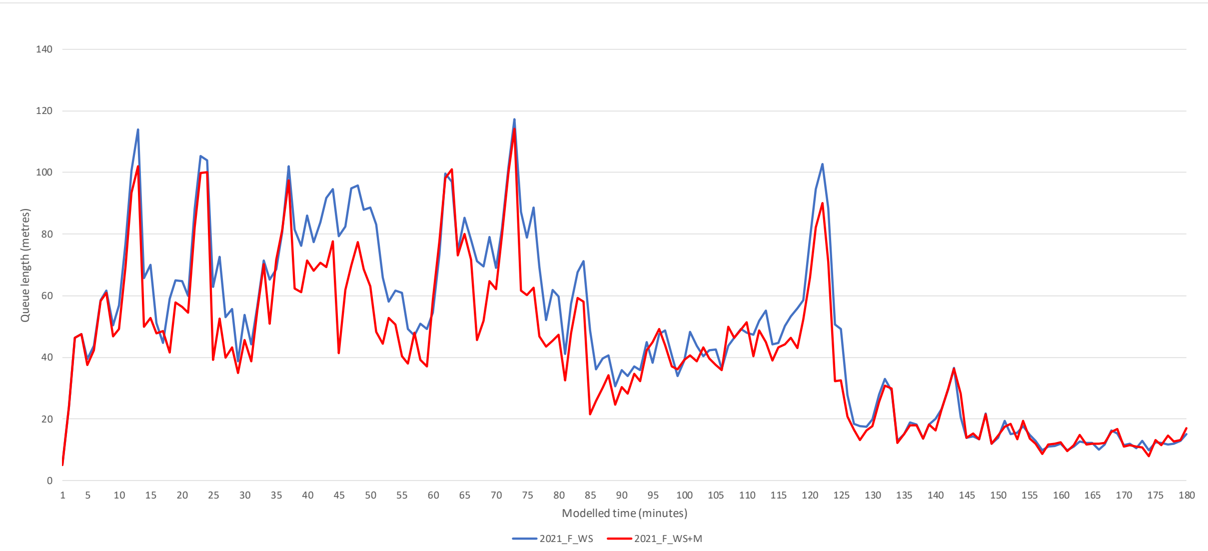


Figure F8 (from Appendix F): Maximum Queue Length Profile, 2021 MetroWest (With Freight) vs 2021 MetroWest (With Freight) plus Measures, Ashton Vale Road, PM Peak Period

3.3.4 Do-Nothing (With Freight) vs 45 Min MetroWest (With Freight)

Appendix G contains graphs comparing the ‘worst-case’ Do-Nothing and MetroWest scenarios with the latter assuming a 45-minute service frequency and two freight movements per hour. The graphs show generally improved levels of queueing across most arms in the AM under the MetroWest scenario, especially on Winterstoke Road northbound, with the exception being more frequent and longer spikes in queuing on Ashton Vale Road (see Figure G4, reproduced below).

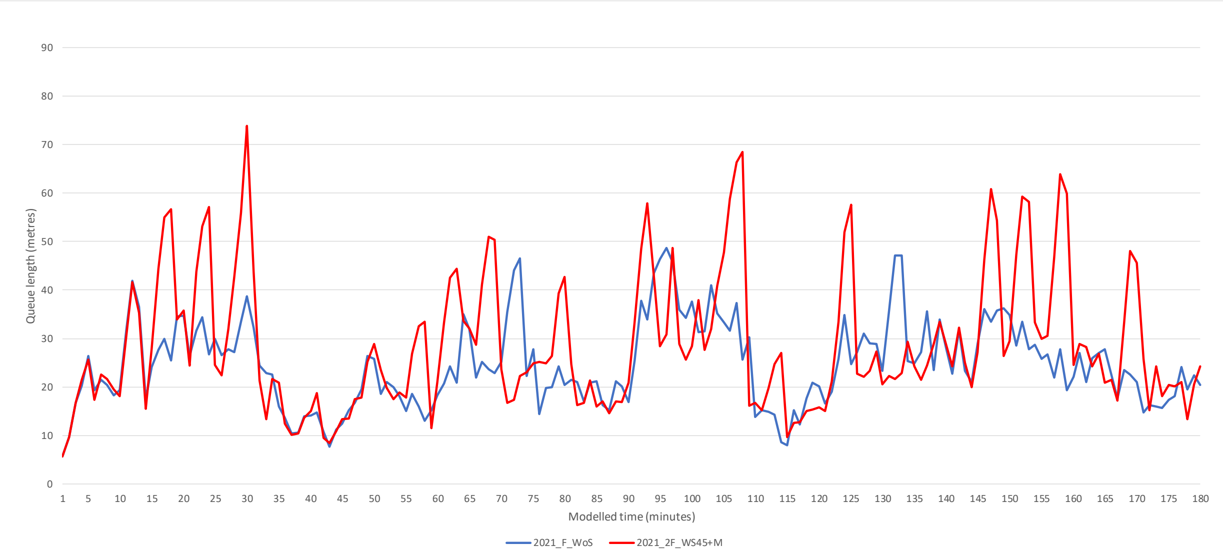


Figure G4 (from Appendix G): Max. Queue Length Profile, 2021 Do-Nothing (With Freight) vs 2021 45 min MetroWest (With 2 Freight) plus Measures, Ashton Vale Road, AM Peak Period

During the PM, Figure G5 (reproduced below) shows that reductions in queuing on Winterstoke Road southbound predicted under other MetroWest scenarios are lower under this 'worst-case'. This reflects the higher number of level crossing closures and hence increased green time to Winterstoke Road.

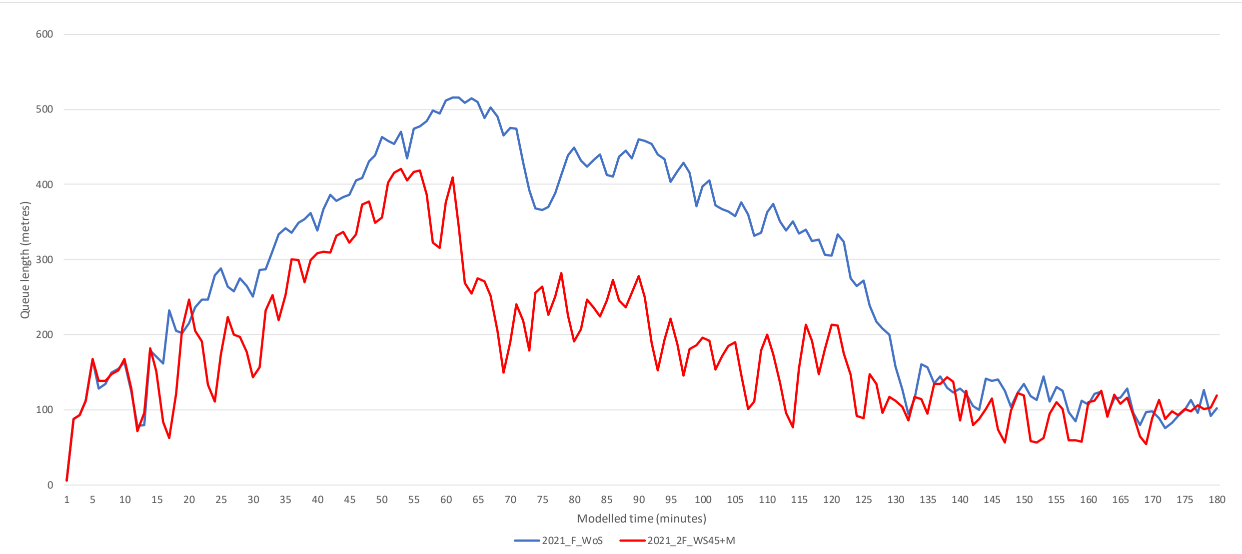


Figure G5 (from Appendix G): Max. Queue Length Profile, 2021 Do-Nothing (With Freight) vs 2021 45 min MetroWest (With 2 Freight) plus Measures, Winterstoke Road Southbound, PM Peak Period

Figure G8 (reproduced below) shows that on Ashton Vale Road, there are some similarities in the short spikes in queuing between these two scenarios. Under the MetroWest scenario there are, however, more frequent spikes associated with the higher number of rail services and level crossing closures. These spikes are expected to be more sustained than under other MetroWest scenarios and show greater queuing than the Do-Nothing but in some instances queues fall to lower levels reflecting the benefits of increases green time assumed in the MetroWest scenario.

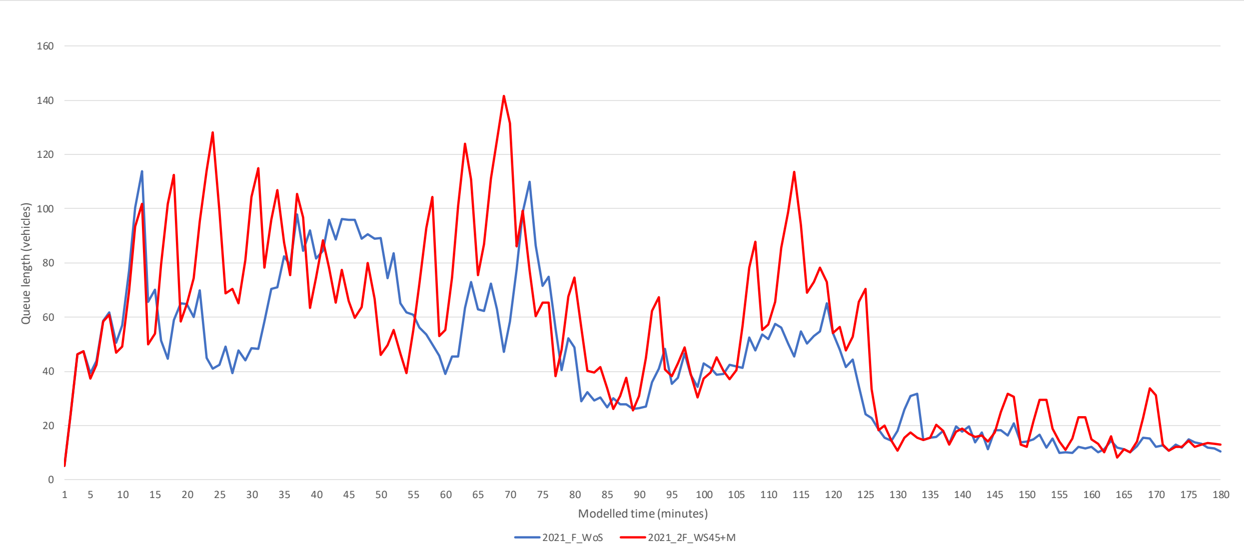


Figure G8 (from Appendix G): Max. Queue Length Profile, 2021 Do-Nothing (With Freight) vs 2021 45 min MetroWest (With 2 Freight) plus Measures, Ashton Vale Road, PM Peak Period

Conclusions

This report has presented the results of an assessment of the impact of MetroWest Phase 1 proposals on operational conditions within the local highway network on the approaches to the Winterstoke Road/Ashton Vale Road traffic signals and adjacent level crossing. MetroWest Phase 1 will result in greater use of the railway line that passes through this level crossing leading to potentially longer and more frequent level crossing closures during which traffic on Winterstoke Road turning left into Ashton Vale Road, and on Ashton Vale Road are held on red. There is therefore a need to understand the impact of the scheme and associated highway measures.

The assessment has been carried out using a VISSIM micro-simulation traffic model which has been developed for the Winterstoke Road/Ashton Vale Road junction and adjacent level crossing. This model has been calibrated using recent turning count data collected during 2017 and validated to moving car observer journey times also collected during 2017. The calibration and validation checks meet and exceed the required acceptability criteria and demonstrate that the model is fit for purpose of assessing the impact of MetroWest and testing associated highway measures.

A broad range of 2021 forecast Do-Nothing and MetroWest scenarios have been tested using the model. For the Do-Nothing scenario, this includes scenarios assuming no rail movements, a scenario which is typically of most peak periods at the junction, to a scenario where one rail freight movement per hour occurs, which could potentially happen with existing freight passages. The MetroWest scheme has been tested without and with highway measures, without/with freight and for both an hourly service pattern and 45-minute services. Mean peak hour journey times through the junction and maximum queue length profiles have been output from the model and compared across these scenarios.

The majority of MetroWest scheme scenarios modelled included highway measures aimed at ameliorating the impact of more frequent level crossing closures on the local highway network. This includes an extension of the Winterstoke Road left turn flare into Ashton Vale Road to a length of 150 metres. The highway measures also include the proposed upgrade of the traffic signal controller mode of operation from VA to more flexible and adaptive MOVA control. The latter has been modelled by proxy in VISSIM through the use of higher VA Max values. In reality, MOVA is likely to operate more intelligently resulting in better conditions than those modelled.

The testing has shown that, with highway measures, the overall impact of the MetroWest scheme on the local highway network is reasonable. The extension of the Winterstoke Road left turn flare is effective at alleviating the impact of level crossing closures during the weekday AM peak period. Indeed, mean journey times and queue lengths are expected to improve on this arm with the proposed MetroWest highway works. The modelling shows that with MetroWest and highway measures the impact on mean journey times on the Ashton Vale Road approach is small at six seconds in the AM peak, and 10 second in the PM compared to the Do-Nothing (assuming no freight movements in either scenario). Queue lengths on this arm show more frequent and longer spikes, but return to Do-Nothing levels within minutes.

The modelling has highlighted reductions in queuing and delay on the Winterstoke Road southbound approach to the signals with MetroWest and highway measures during the PM peak period. The modelling suggests that more frequent level crossing closures reduces queuing on this approach. This is because this arm receives more frequent green within the restricted Stage 4,5 6 sequence that the signals operate with the level crossing down. This reflects a greater proportion of green time within each cycle compared to the full Stage 1 to 6 sequence that the signals could run under normal operating conditions with no level crossing closure.

It is also apposite to consider briefly that analysis of the junction using LinSIG (see the Winterstoke Road/Ashton Vale Road LinSIG Modelling technical note for details) sets out how the current junction control works and that how, following a closure of around two minutes, any build-up of queuing traffic on Ashton Vale Road could be addressed by additional compensation green time applied over no more than two signals cycles post-closure (PM peak). And that this could be a single cycle if the MOVA Stage MAX green time is allowed to be set high (for example, at around 40 seconds). The trade-off would be the impact on the southbound Winterstoke Road approach from Brunel Way, as LinSIG analysis clearly show that the two critical phases are Ashton Vale Road and the southbound A3029. The northbound A3029 traffic phases all appear to have considerable capacities based on potential capacity through the stop-lines here. In reality, the dominant flow through to the A370 underpass is constrained by the merge/weaving capacity onto Brunel Way, and northbound flow through the junction to the underpass can't reach the theoretical capacity level which the green time/unrestrained saturation flow dictates is possible with exit blocking.

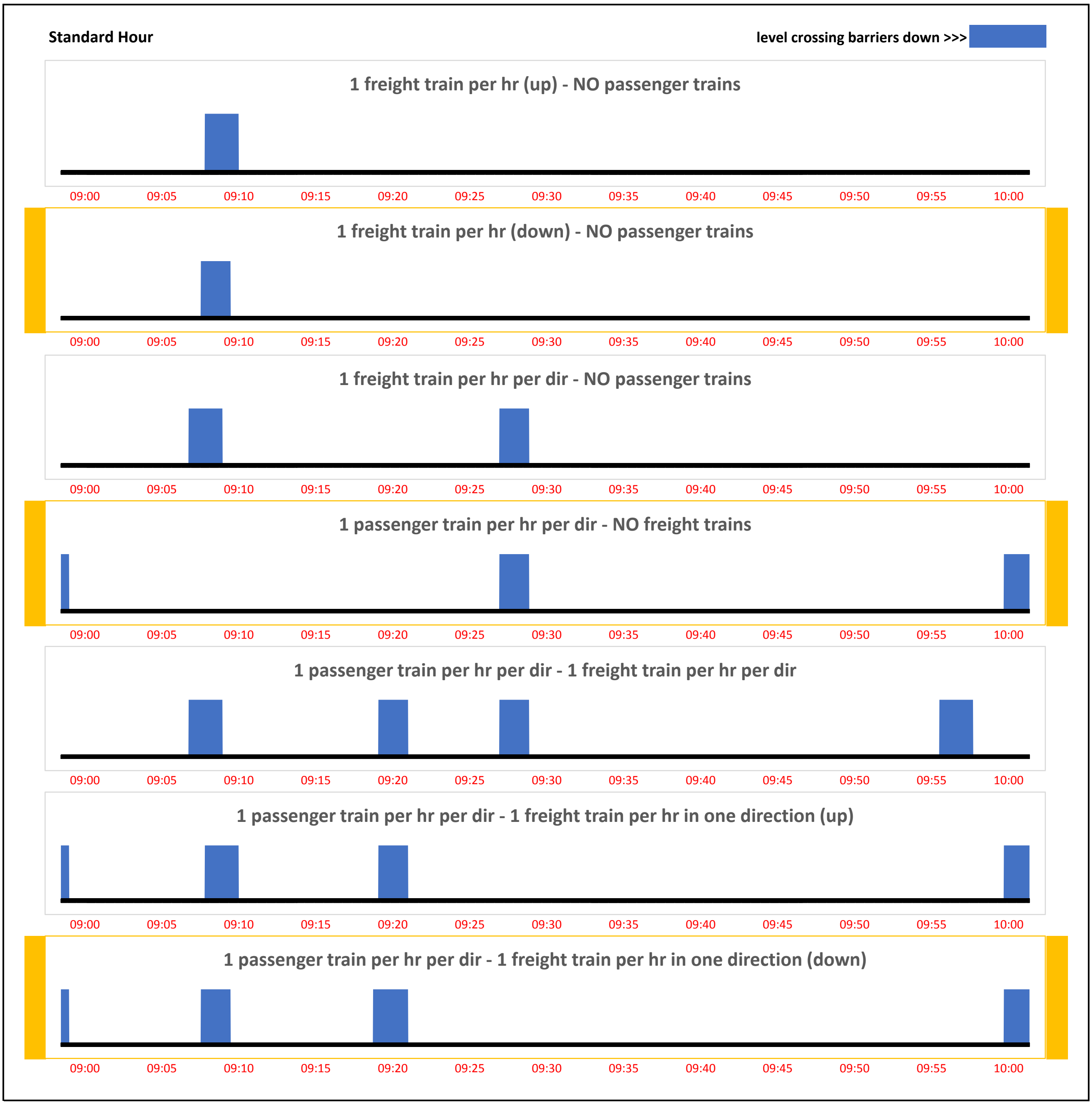
Bearing in mind the discussion of the results of LinSIG modelling, it is then evident from the VISSIM modelling that level crossing closures can, in fact, benefit the Winterstoke Road southbound approach. This is because the signals don't have to service Ashton Vale Road when the level crossing is down so Winterstoke Road southbound receives more green within the cycle during these periods. The VISSIM modelling indicates an improvement in Winterstoke Road southbound queuing and delay for the MetroWest scenarios compared to the Do-Nothing, so it appears that the reallocation of green from Winterstoke Road southbound to Ashton Vale Road needed to recover from a level crossing closure is more than compensated for by the extra green Winterstoke Road southbound receives during closures.

Overall, testing of the MetroWest Phase 1 operations and junction improvements confirms that an hourly train service can be delivered without detriment to the local highway conditions within the vicinity of the Winterstoke Road /Ashton Vale Road junction. Indeed, modelling suggests that a 45-minute rail service could also be accommodated, although this would be at the cost of increased delays on Ashton Vale Road of circa 50 seconds over the Do-Nothing in the PM peak period.

Note that testing presented in this report is robust in that it has assumed growth in through-traffic passing along Winterstoke Road. It is also important to note that, in reality, MOVA will be far more adaptive and intelligent than the way that MOVA can be modelled theoretically. It is therefore likely that the assessment set out in this report is conservative, and conditions will be better than those modelled.

Appendix A:
Rail Service/Level Crossing Closure Assumptions (Hourly Service)

				USING 'CALCULATED' TIMES WITH signalling mitigation Road closes *time*	Closure duration *min:sec*	Road opens *time*	Min time to next closure *min:sec*
Note that this is for a standard hour, so times also apply to other hours							
CURRENT - 5/6 times a week 2	1 freight train per hr (up) - NO passenger trains						estimated
	Freight	UP	from Portbury	09:08:55	02:05	09:11:00	57:55
				TOTAL /hr	02:05		
CURRENT - 5/6 times a week 1	1 freight train per hr (down) - NO passenger trains						estimated
	Freight	DOWN	to Portbury	09:08:40	01:50	09:10:30	58:10
				TOTAL /hr	01:50		
CURRENT - theoretical maximum (RARE)	1 freight train per hr per dir - NO passenger trains						estimated
	Freight	UP	from Portbury	09:07:55	02:05	09:10:00	17:10
	Freight	DOWN	to Portbury	09:27:10	01:50	09:29:00	38:55
				TOTAL /hr	03:55		
FUTURE - most of the time	1 passenger train per hr per dir - NO freight trains						estimated
	Pasenger	UP	from Portishead	08:58:25	02:05	09:00:30	19:10
	Passenger	DOWN	to Portishead	09:19:40	01:50	09:21:30	36:55
				TOTAL /hr	03:55		
FUTURE - absolute worst case (RARE)	1 passenger train per hr per dir - 1 freight train per hr per dir						1 Unit B
	Pasenger	UP	from Portishead	08:54:25	02:05	08:56:30	11:25
	Freight	UP	from Portbury	09:07:55	02:05	09:10:00	09:40
	Passenger	DOWN	to Portishead	09:19:40	01:50	09:21:30	05:40
	Freight	DOWN	to Portbury	09:27:10	01:50	09:29:00	25:25
				TOTAL /hr	07:50		
FUTURE - realistic worst case 2	1 passenger train per hr per dir - 1 freight train per hr in one direction (up)						1 Unit CU
	Pasenger	UP	from Portishead	08:58:25	02:05	09:00:30	08:25
	Freight	UP	from Portbury	09:08:55	02:05	09:11:00	08:40
	Passenger	DOWN	to Portishead	09:19:40	01:50	09:21:30	36:55
				TOTAL /hr	06:00		
FUTURE - realistic worst case 1	1 passenger train per hr per dir - 1 freight train per hr in one direction (down)						1 Unit CD
	Pasenger	UP	from Portishead	08:58:25	02:05	09:00:30	08:10
	Freight	DOWN	to Portbury	09:08:40	01:50	09:10:30	09:10
	Passenger	DOWN	to Portishead	09:19:40	01:50	09:21:30	36:55
				TOTAL /hr	05:45		


Standard Hour
level crossing barriers down >>>
1 freight train per hr (up) - NO passenger trains
1 freight train per hr (down) - NO passenger trains
1 freight train per hr per dir - NO passenger trains
1 passenger train per hr per dir - NO freight trains
1 passenger train per hr per dir - 1 freight train per hr per dir
1 passenger train per hr per dir - 1 freight train per hr in one direction (up)
1 passenger train per hr per dir - 1 freight train per hr in one direction (down)
09:00
09:05
09:10
09:15
09:20
09:25
09:30
09:35
09:40
09:45
09:50
09:55
10:00

Appendix B:
Rail Service/Level Crossing Closure Assumptions (45 Min Service)

USING 'CALCULATED' TIMES

WITH signalling mitigation

Note that this is for a standard hour, so times also apply to other hours

CURRENT - 5/6 times a week 2

1 freight train per hr (up) - NO passenger trains			Road closes *time*	Closure duration *min:sec*	Road opens *time*	Min time to next closure *min:sec*
						estimated
Freight	UP	from Portbury	07:08:55	02:05	07:11:00	57:40
Freight	DOWN	to Portbury	08:08:40	01:50	08:10:30	58:25
Freight	UP	from Portbury	09:08:55	02:05	09:11:00	57:55
			TOTAL /hr	02:00		

CURRENT - 5/6 times a week 1

1 freight train per hr (down) - NO passenger trains			Road closes *time*	Closure duration *min:sec*	Road opens *time*	Min time to next closure *min:sec*
						estimated
Freight	DOWN	to Portbury	07:08:40	01:50	07:10:30	58:25
Freight	UP	from Portbury	08:08:55	02:05	08:11:00	57:40
Freight	DOWN	to Portbury	09:08:40	01:50	09:10:30	58:10
			TOTAL /hr	01:55		

CURRENT - theoretical maximum (RARE)

1 freight train per hr per dir - NO passenger trains			Road closes *time*	Closure duration *min:sec*	Road opens *time*	Min time to next closure *min:sec*
						estimated
Freight	UP	from Portbury	07:07:55	02:05	07:10:00	17:10
Freight	DOWN	to Portbury	07:27:10	01:50	07:29:00	38:55
Freight	UP	from Portbury	08:07:55	02:05	08:10:00	17:10
Freight	DOWN	to Portbury	08:27:10	01:50	08:29:00	38:55
Freight	UP	from Portbury	09:07:55	02:05	09:10:00	17:10
Freight	DOWN	to Portbury	09:27:10	01:50	09:29:00	38:55
			TOTAL /hr	03:55		

45-minute - no freight

1 passenger train every 45 mins per dir - NO freight trains			Road closes *time*	Closure duration *min:sec*	Road opens *time*	Min time to next closure *min:sec*
						estimated
Passenger	UP	from Portishead	07:13:55	02:05	07:16:00	04:10
Passenger	DOWN	to Portishead	07:20:10	01:50	07:22:00	36:55
Passenger	UP	from Portishead	07:58:55	02:05	08:01:00	04:10
Passenger	DOWN	to Portishead	08:05:10	01:50	08:07:00	36:55
Passenger	UP	from Portishead	08:43:55	02:05	08:46:00	04:10
Passenger	DOWN	to Portishead	08:50:10	01:50	08:52:00	36:55
Passenger	UP	from Portishead	09:28:55	02:05	09:31:00	04:10
Passenger	DOWN	to Portishead	09:35:10	01:50	09:37:00	36:55
			TOTAL /hr	05:13		

45-minute - absolute worst case (RARE)

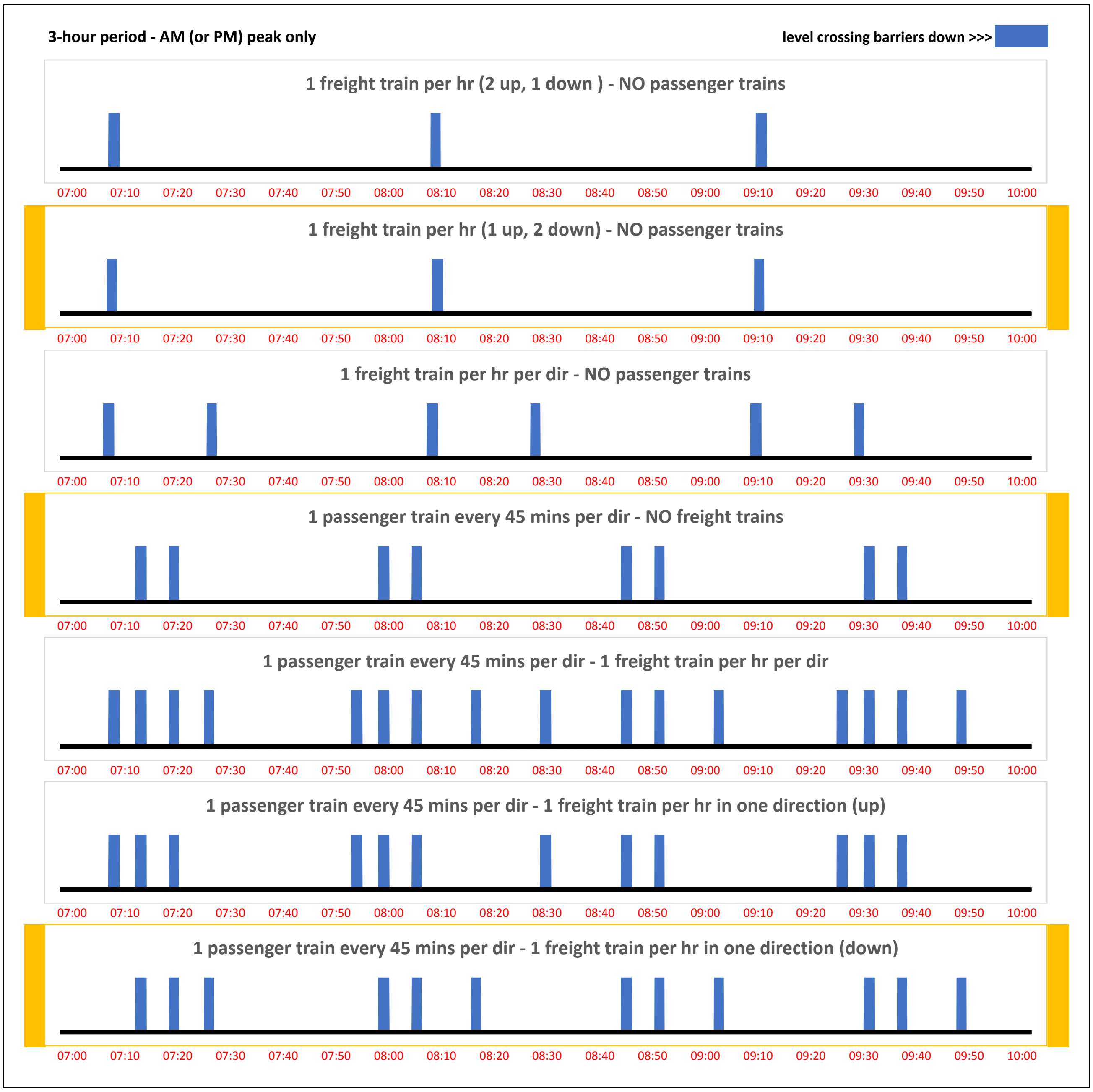
1 passenger train every 45 mins per dir - 1 freight train per hr per dir			Road closes *time*	Closure duration *min:sec*	Road opens *time*	Min time to next closure *min:sec*
						45 minute cycles
Freight	UP	from Portbury	07:08:55	02:05	07:11:00	02:55
Passenger	UP	from Portishead	07:13:55	02:05	07:16:00	04:10
Passenger	DOWN	to Portishead	07:20:10	01:50	07:22:00	04:40
Freight	DOWN	to Portbury	07:26:40	01:50	07:28:30	25:25
Freight	UP	from Portbury	07:53:55	02:05	07:56:00	02:55
Passenger	UP	from Portishead	07:58:55	02:05	08:01:00	04:10
Passenger	DOWN	to Portishead	08:05:10	01:50	08:07:00	09:10
Freight	DOWN	to Portbury	08:16:10	01:50	08:18:00	10:55
Freight	UP	from Portbury	08:28:55	02:05	08:31:00	12:55
Passenger	UP	from Portishead	08:43:55	02:05	08:46:00	04:10
Passenger	DOWN	to Portishead	08:50:10	01:50	08:52:00	09:10
Freight	DOWN	to Portbury	09:01:10	01:50	09:03:00	20:55
Freight	UP	from Portbury	09:23:55	02:05	09:26:00	02:55
Passenger	UP	from Portishead	09:28:55	02:05	09:31:00	04:10
Passenger	DOWN	to Portishead	09:35:10	01:50	09:37:00	09:10
Freight	DOWN	to Portbury	09:46:10	01:50	09:48:00	20:55
			TOTAL /hr	10:27		

45-minute - realistic worst case 2

1 passenger train every 45 mins per dir - 1 freight train per hr in one direction (up)			Road closes *time*	Closure duration *min:sec*	Road opens *time*	Min time to next closure *min:sec*
						estimated
Freight	UP	from Portbury	07:08:55	02:05	07:11:00	02:55
Passenger	UP	from Portishead	07:13:55	02:05	07:16:00	04:10
Passenger	DOWN	to Portishead	07:20:10	01:50	07:22:00	31:55
Freight	UP	from Portbury	07:53:55	02:05	07:56:00	02:55
Passenger	UP	from Portishead	07:58:55	02:05	08:01:00	04:10
Passenger	DOWN	to Portishead	08:05:10	01:50	08:07:00	21:55
Freight	UP	from Portbury	08:28:55	02:05	08:31:00	12:55
Passenger	UP	from Portishead	08:43:55	02:05	08:46:00	04:10
Passenger	DOWN	to Portishead	08:50:10	01:50	08:52:00	31:55
Freight	UP	from Portbury	09:23:55	02:05	09:26:00	02:55
Passenger	UP	from Portishead	09:28:55	02:05	09:31:00	04:10
Passenger	DOWN	to Portishead	09:35:10	01:50	09:37:00	31:55
			TOTAL /hr	08:00		

45-minute - realistic worst case 1

1 passenger train every 45 mins per dir - 1 freight train per hr in one direction (down)			Road closes *time*	Closure duration *min:sec*	Road opens *time*	Min time to next closure *min:sec*
						estimated
Passenger	UP	from Portishead	07:13:55	02:05	07:16:00	04:10
Passenger	DOWN	to Portishead	07:20:10	01:50	07:22:00	04:40
Freight	DOWN	to Portbury	07:26:40	01:50	07:28:30	30:25
Passenger	UP	from Portishead	07:58:55	02:05	08:01:00	04:10
Passenger	DOWN	to Portishead	08:05:10	01:50	08:07:00	09:10
Freight	DOWN	to Portbury	08:16:10	01:50	08:18:00	25:55
Passenger	UP	from Portishead	08:43:55	02:05	08:46:00	04:10
Passenger	DOWN	to Portishead	08:50:10	01:50	08:52:00	09:10
Freight	DOWN	to Portbury	09:01:10	01:50	09:03:00	25:55
Passenger	UP	from Portishead	09:28:55	02:05	09:31:00	04:10
Passenger	DOWN	to Portishead	09:35:10	01:50	09:37:00	09:10
Freight	DOWN	to Portbury	09:46:10	01:50	09:48:00	25:55
			TOTAL /hr	07:40		


3-hour period - AM (or PM) peak only
level crossing barriers down >>>
1 freight train per hr (2 up, 1 down) - NO passenger trains
1 freight train per hr (1 up, 2 down) - NO passenger trains
1 freight train per hr per dir - NO passenger trains
1 passenger train every 45 mins per dir - NO freight trains
1 passenger train every 45 mins per dir - 1 freight train per hr per dir
1 passenger train every 45 mins per dir - 1 freight train per hr in one direction (up)
1 passenger train every 45 mins per dir - 1 freight train per hr in one direction (down)
07:00 07:10 07:20 07:30 07:40 07:50 08:00 08:10 08:20 08:30 08:40 08:50 09:00 09:10 09:20 09:30 09:40 09:50 10:00

Appendix C:
Proposed Highway Measures Drawings

DO NOT SCALE. This drawing is to be read in conjunction with all relevant Architects, Engineers and Specialist Manufacturer's drawings and specifications. If in doubt please consult the Engineer.

Notes:

1. All dimensions are in metres unless noted otherwise.
2. Ground levels have been estimated from the limited spot height information gained from the OS mapping and from Topographical Survey that was commissioned as part of the AVTM MetroBus project.
3. The heights of structures and extent of earthworks must therefore be seen within this context of available information.
4. It has not been possible to obtain utility information.

KEY:

- Proposed new kerb
- Proposed kerb edging
- Temporary construction compound
- Existing road markings
- Proposed road markings
- Proposed shared cycle/footway
- Existing shared cycle/footway

Rev	By	Chkd	Apprvd	Date	Description
F	ADS	LT	-	11/06/20118	Traffic signal detector loops added (3/38/81m FSL) Toucan crossing by Babcok removed
E	OHP	MF	ADL	26/02/2018	Tactile paving updated
D	MF	ADL	ADL	05/10/2017	Minor amendments
C	OHP	KS	ADL	04/10/2017	Title amendments
B	OHP	KS	ADL	28/09/2017	Minor amendments
A	MF/OHP	MF	ADL	22.09.17	Design amended to tie in to extended topo survey.

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Project
PORTISHEAD BRANCH LINE
METROWEST PHASE 1

Drawing
ASHTON VALE ROAD / WINTERSTOKE ROAD

Drawn by: ADS Date: 20/11/2015
Checked by: MF Date: 01/08/2017
Approved by: AL Date: 01/08/2017

Drawing No. 674946.BD.29.01-SK31
Revision F

Drawing Scale: 1:500 @ A1

: \\brsfpp01\Proj\Consulting\Projects\674946 NSC - 2016 Bristol Framework\674946.BD.29.01 Ashton Vale Alternate Access\90 AutoCAD\91 AutoCAD\ 674946.BD.29.01-SK31 Rev F.dwg

Appendix D: Queue Profile Results, 2021 Do-Nothing (No Freight) vs 2021 MetroWest (No Freight) with Highway Measures

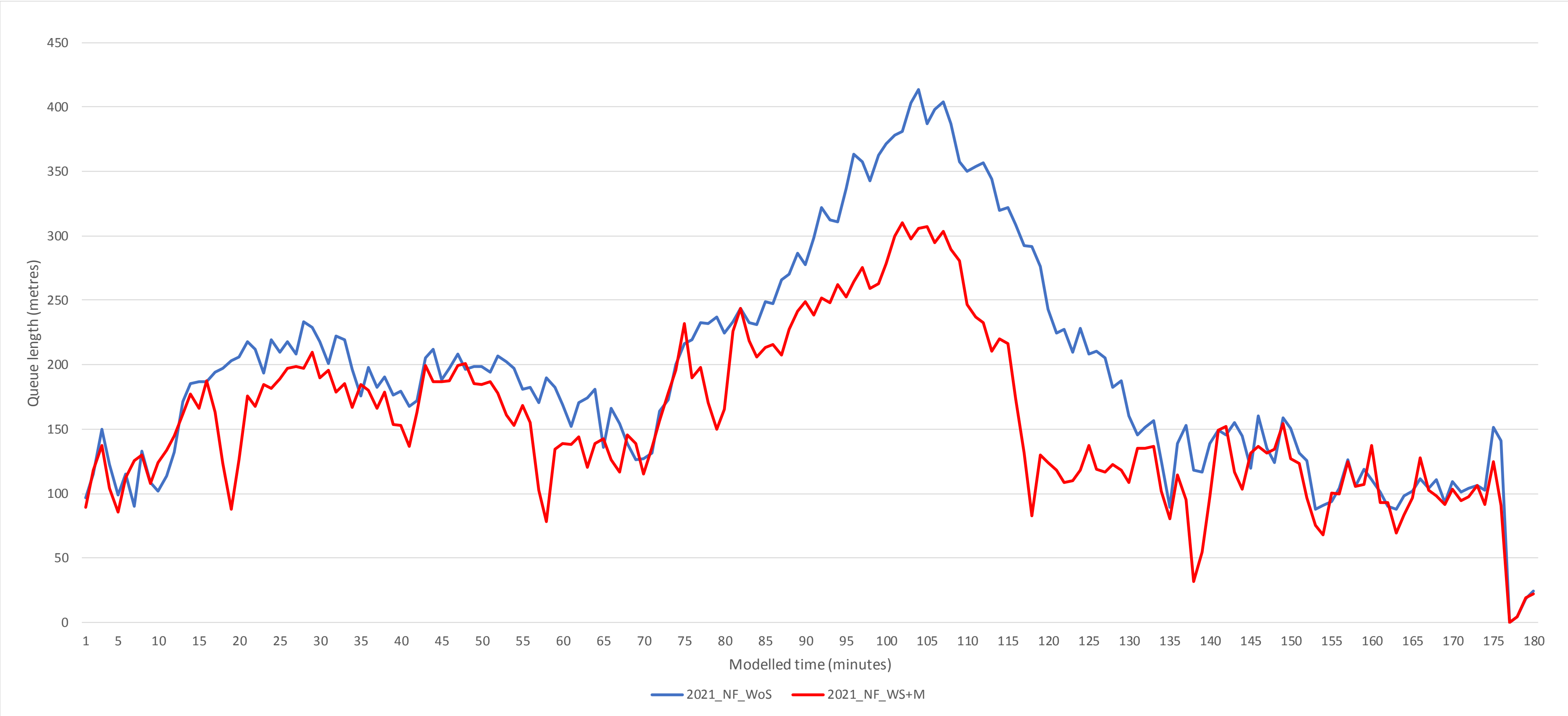

Figure D1: Maximum Queue Length Profile, 2021 Do-Nothing (No Freight) vs 2021 MetroWest (No Freight) plus Mitigation, Winterstoke Road Southbound, AM Peak Period

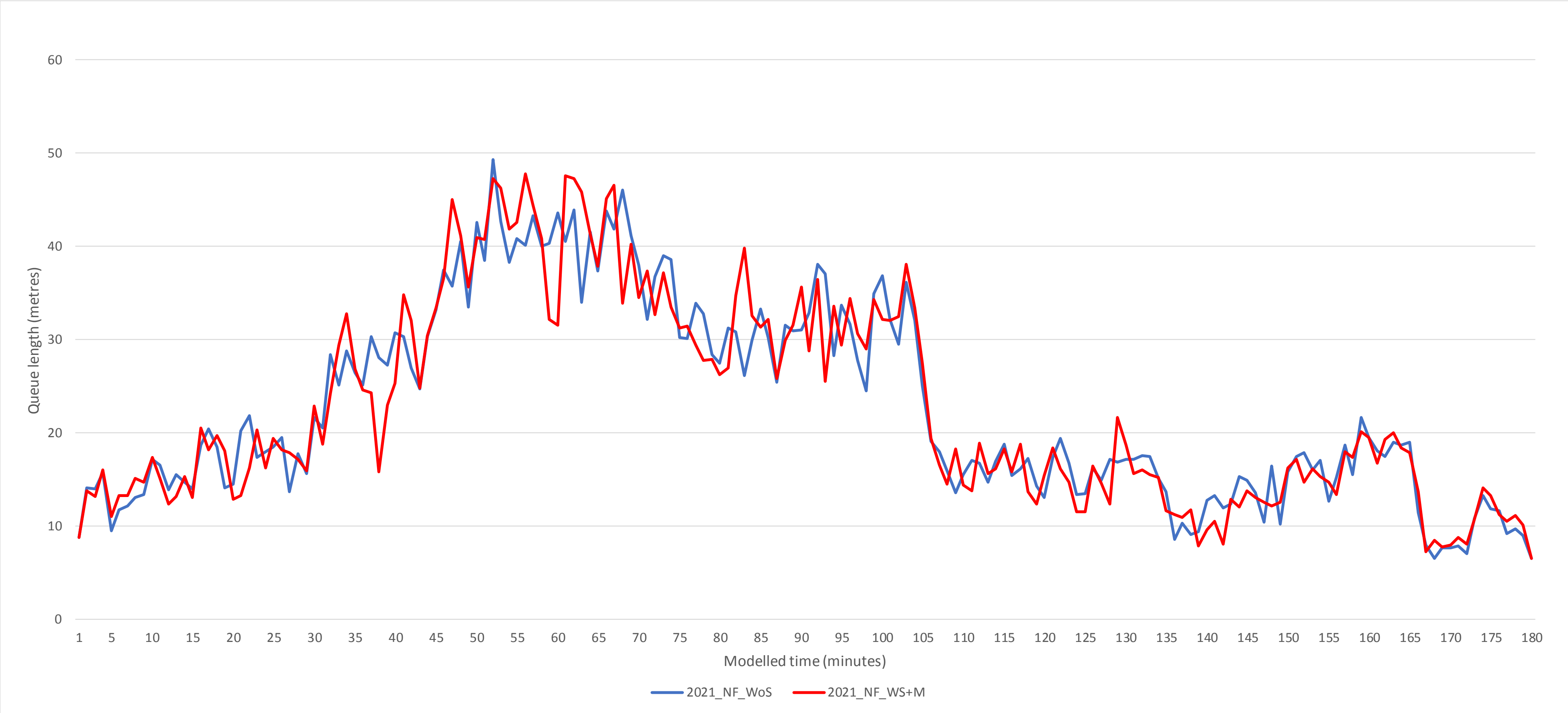

Figure D2: Maximum Queue Length Profile, 2021 Do-Nothing (No Freight) vs 2021 MetroWest (No Freight) plus Mitigation, Marsh Lane, AM Peak Period

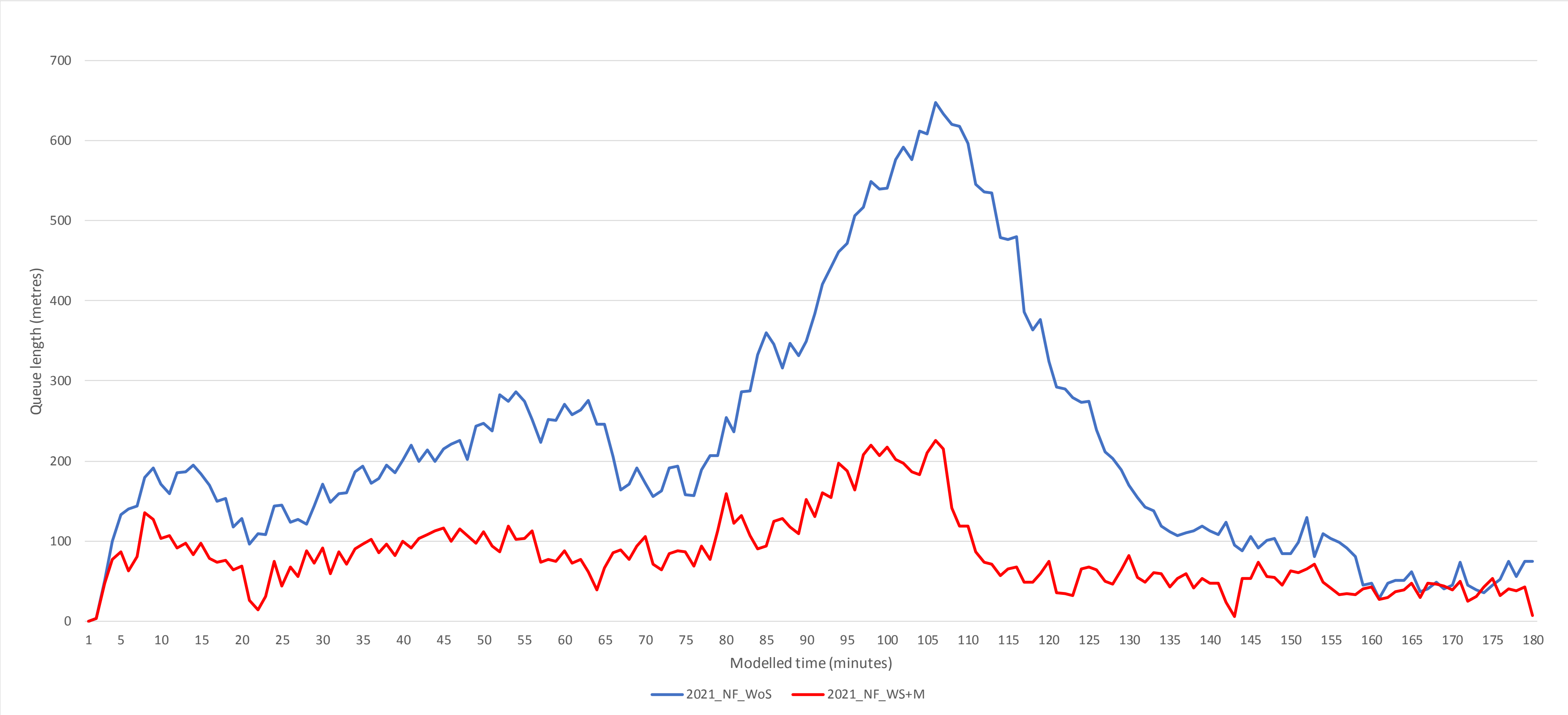

Figure D3: Maximum Queue Length Profile, 2021 Do-Nothing (No Freight) vs 2021 MetroWest (No Freight) plus Mitigation, Winterstoke Road Northbound, AM Peak Period

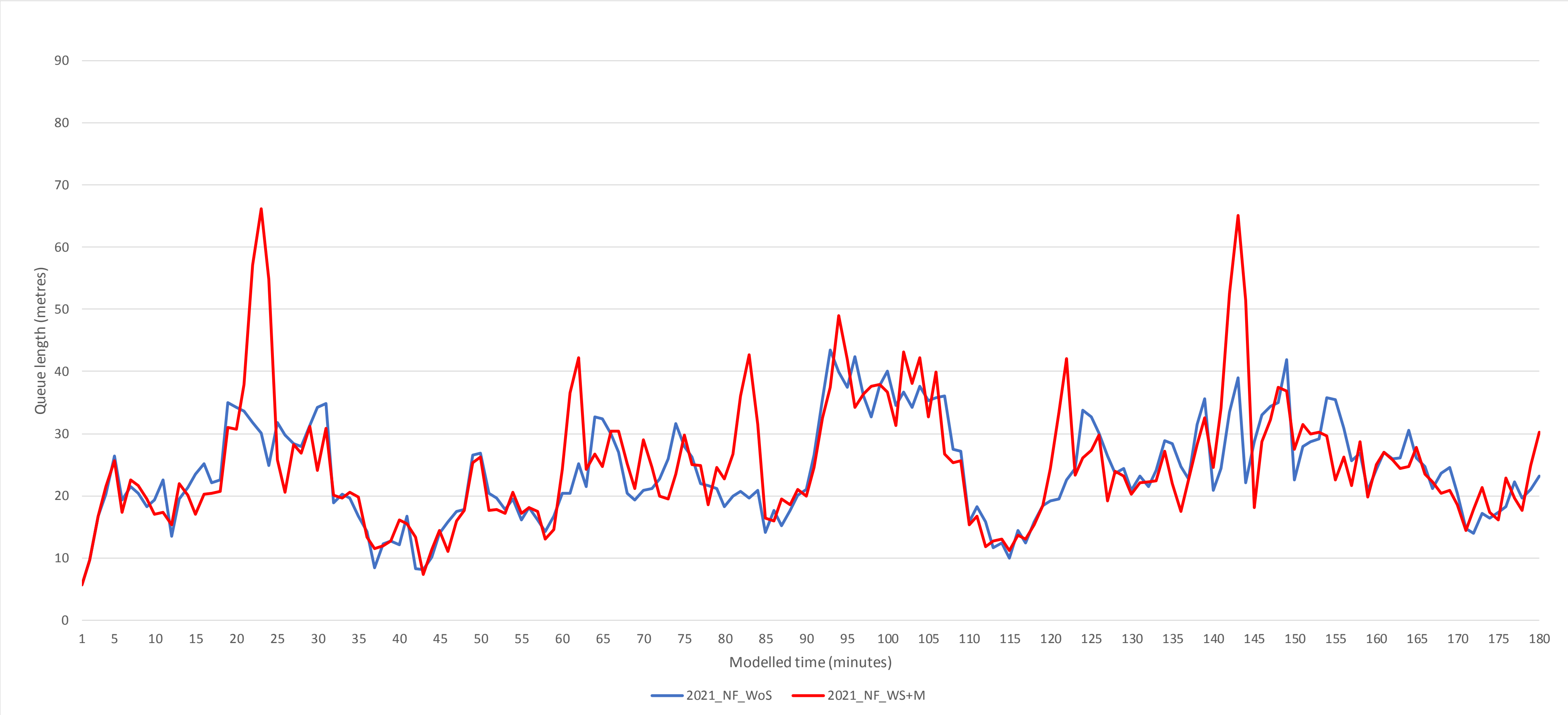

Figure D4: Maximum Queue Length Profile, 2021 Do-Nothing (No Freight) vs 2021 MetroWest (No Freight) plus Mitigation, Ashton Vale Road, AM Peak Period

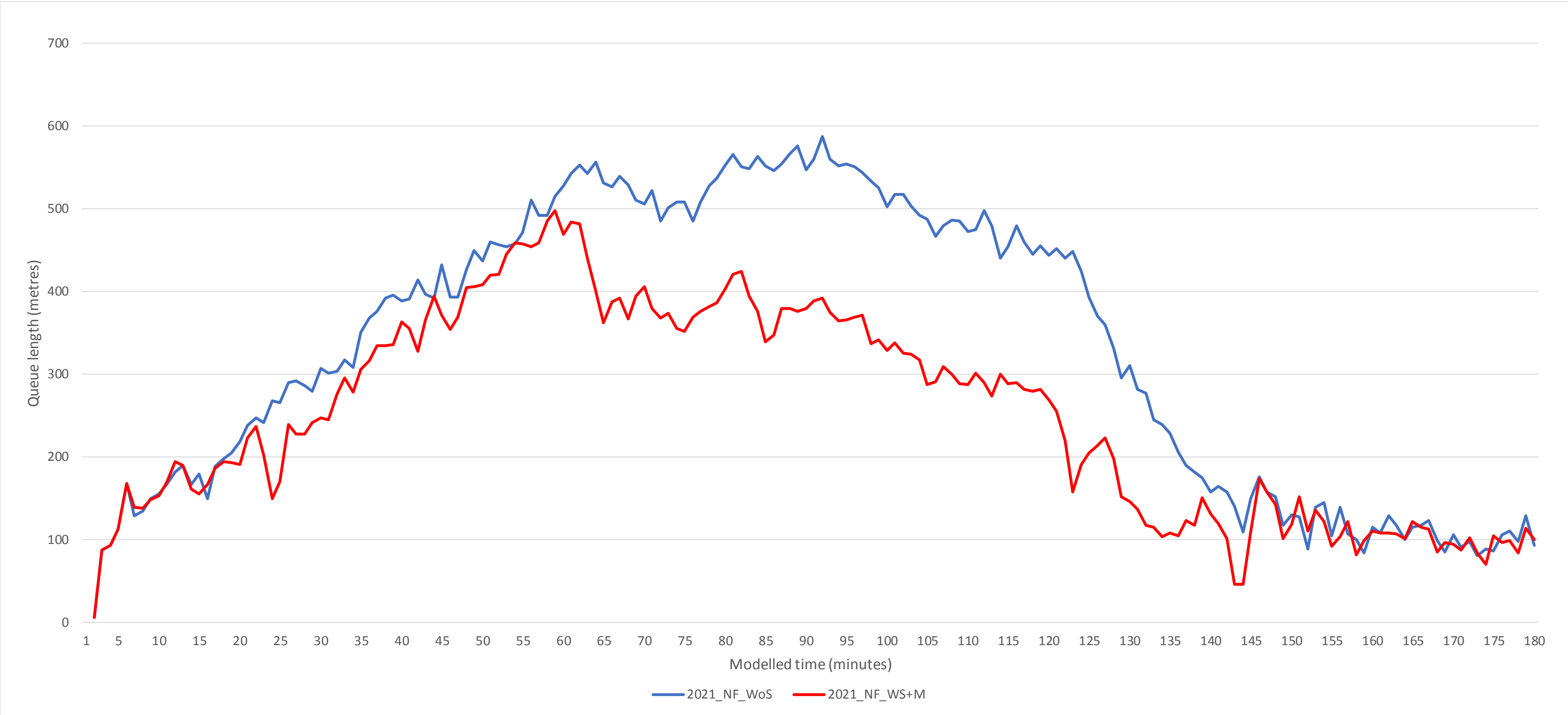

Figure D5: Maximum Queue Length Profile, 2021 Do-Nothing (No Freight) vs 2021 MetroWest (No Freight) plus Mitigation, Winterstoke Road Southbound, PM Peak Period

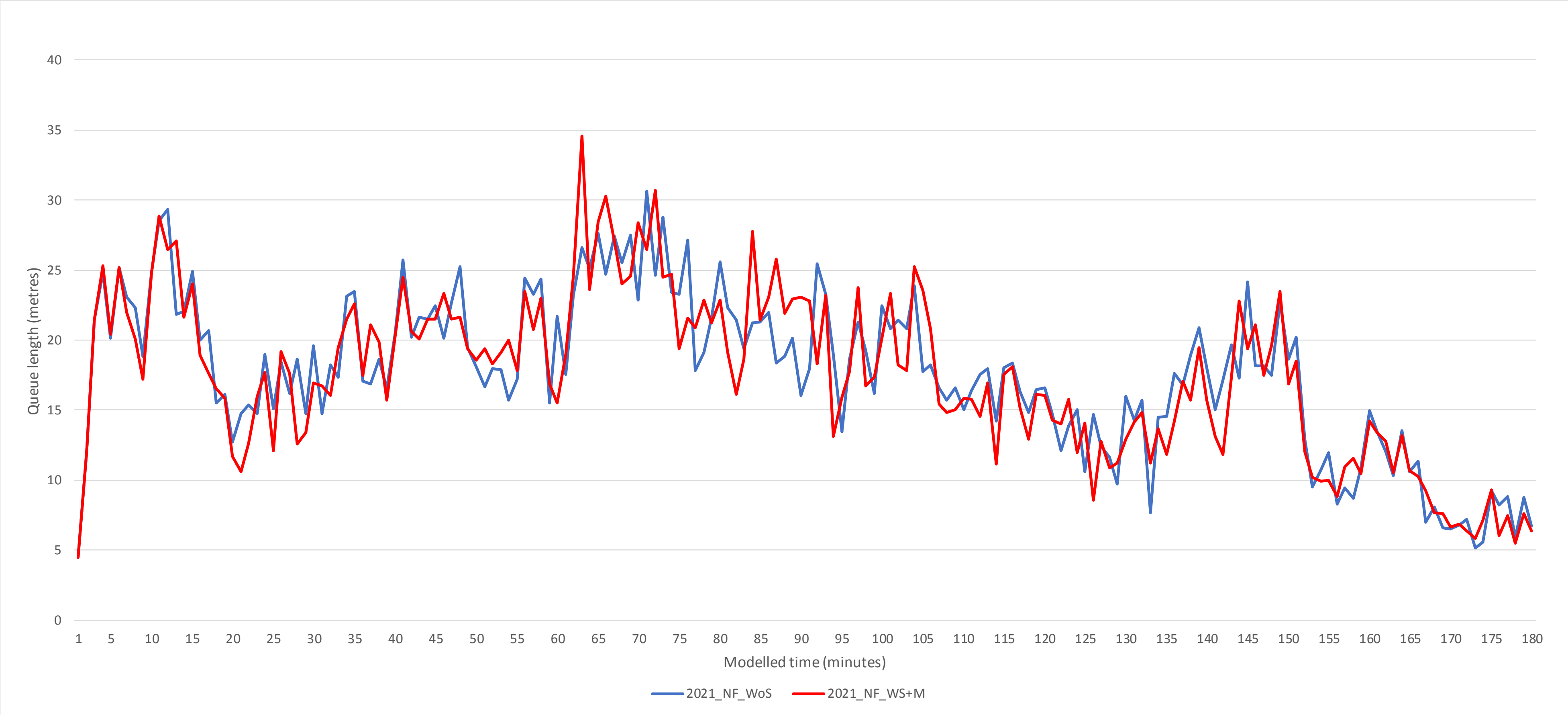

Figure D6: Maximum Queue Length Profile, 2021 Do-Nothing (No Freight) vs 2021 MetroWest (No Freight) plus Mitigation, Marsh Lane, PM Peak Period

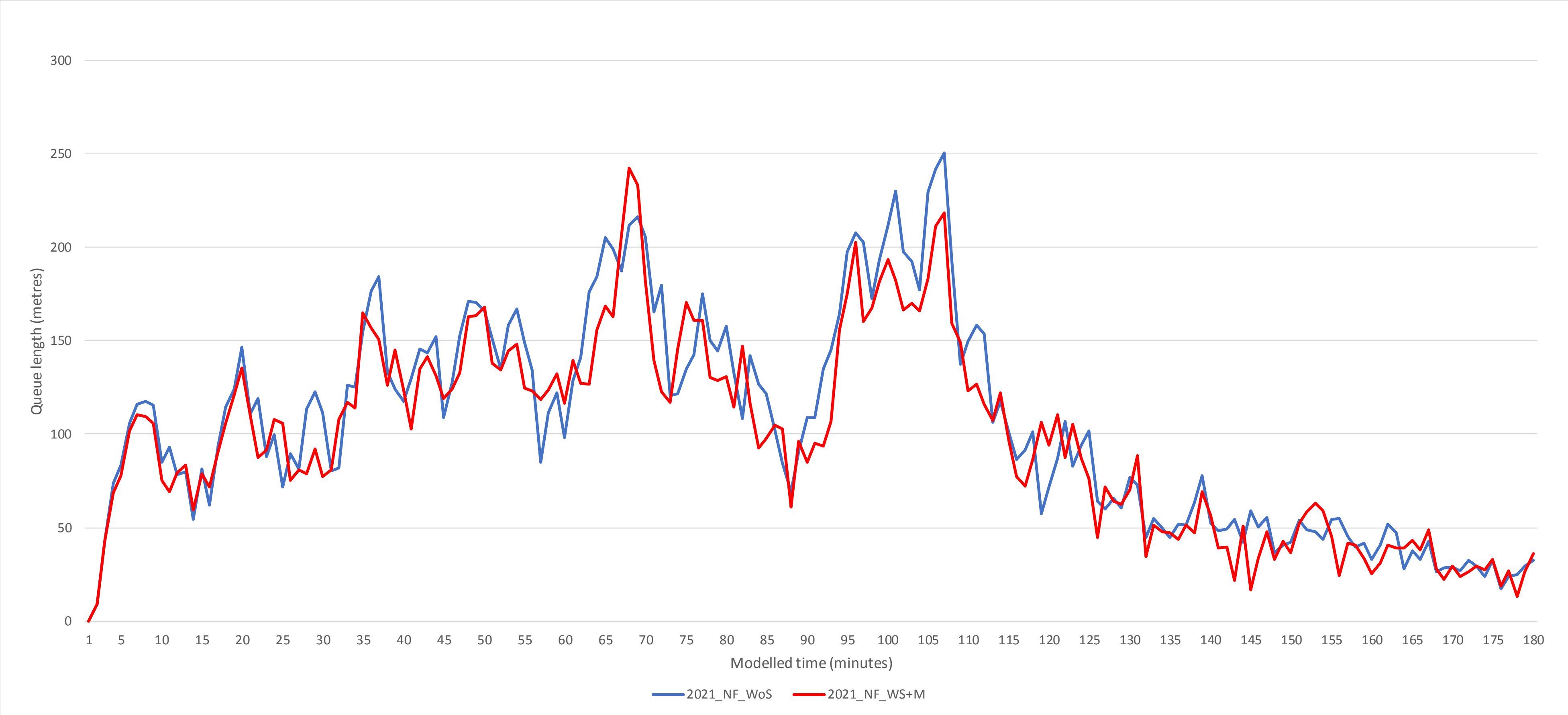

Figure D7: Maximum Queue Length Profile, 2021 Do-Nothing (No Freight) vs 2021 MetroWest (No Freight) plus Mitigation, Winterstoke Road Northbound, PM Peak Period

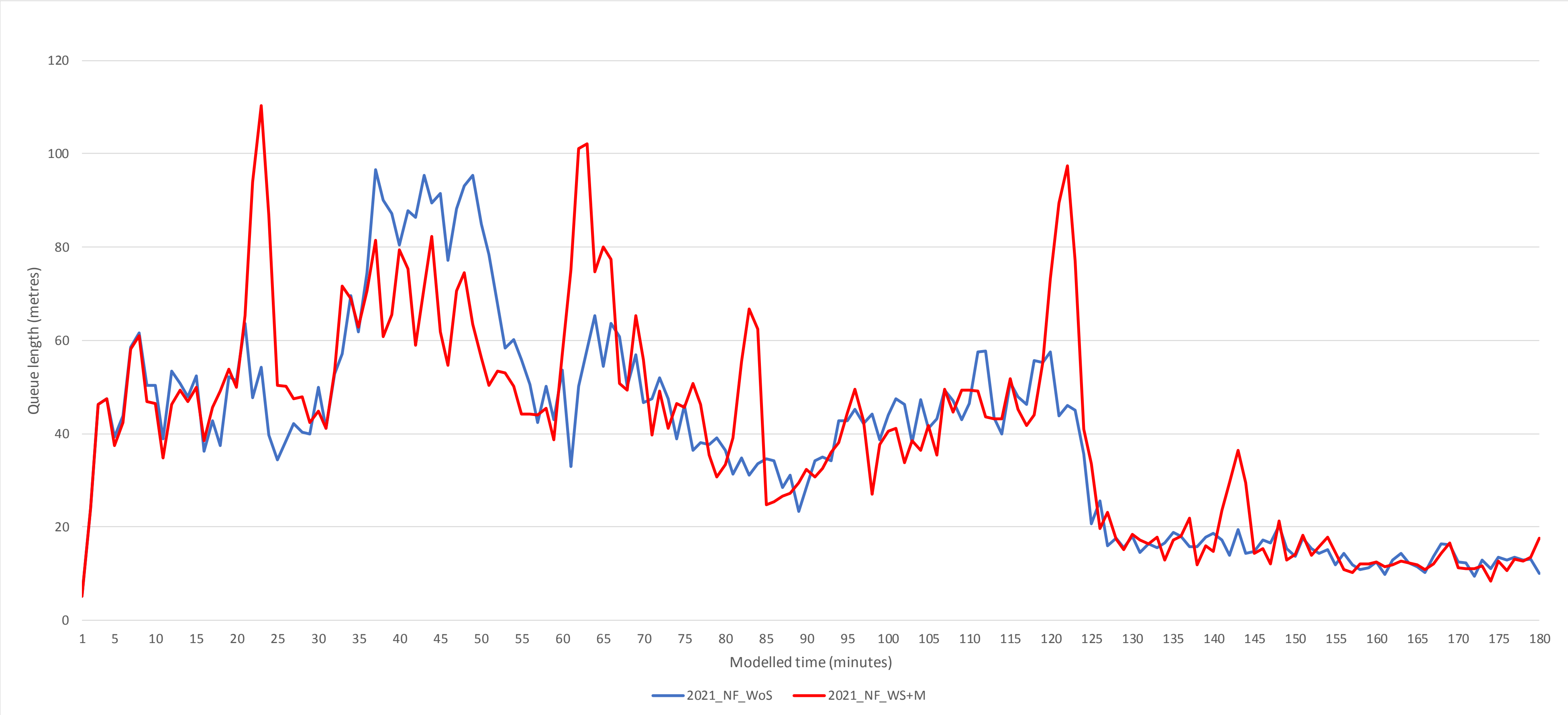

Figure D8: Maximum Queue Length Profile, 2021 Do-Nothing (No Freight) vs 2021 MetroWest (No Freight) plus Mitigation, Ashton Vale Road, PM Peak Period

Appendix E: Queue Profile Results, 2021 Do-Nothing (With Freight) vs 2021 MetroWest (With Freight) with Highway Measures

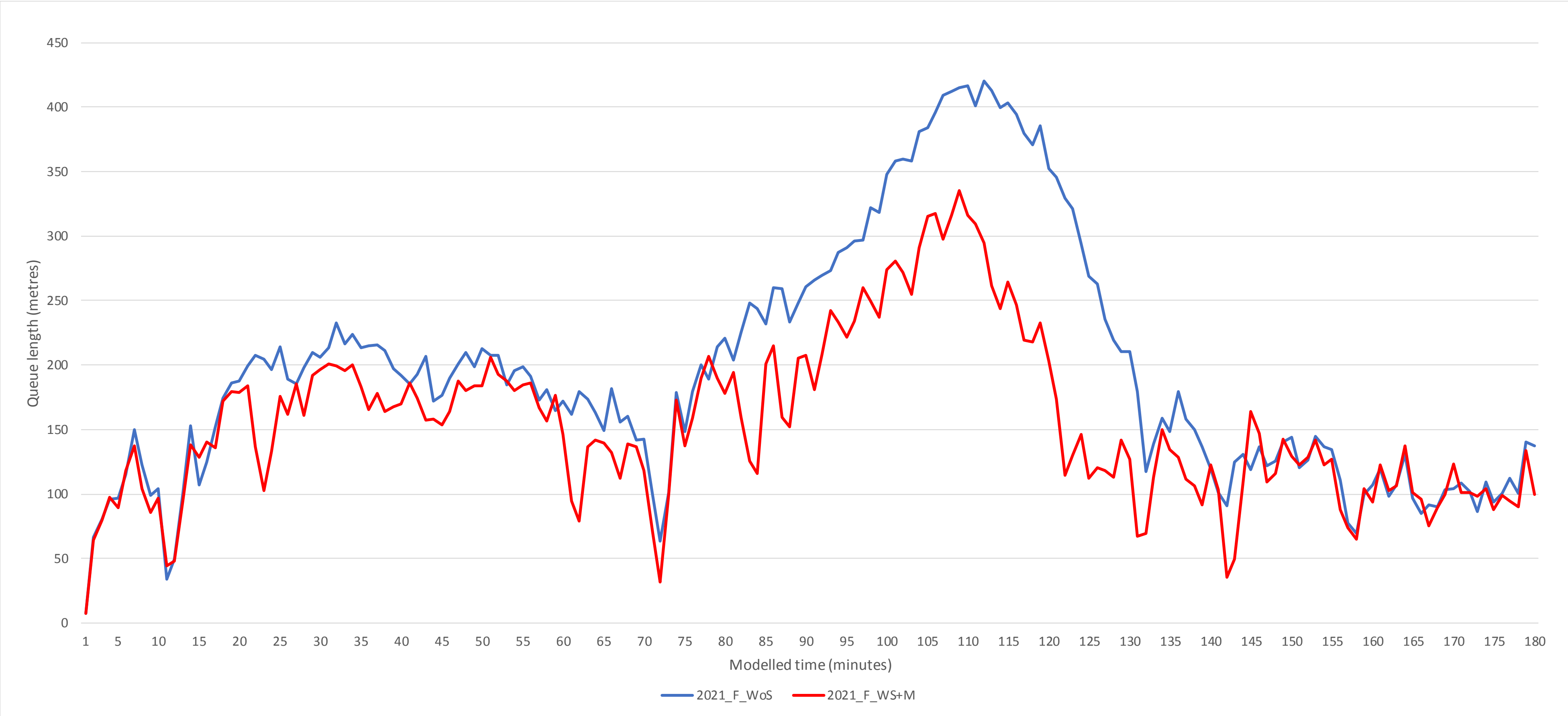

Figure E1: Maximum Queue Length Profile, 2021 Do-Nothing (With Freight) vs 2021 MetroWest (With Freight) plus Mitigation, Winterstoke Road Southbound, AM Peak Period

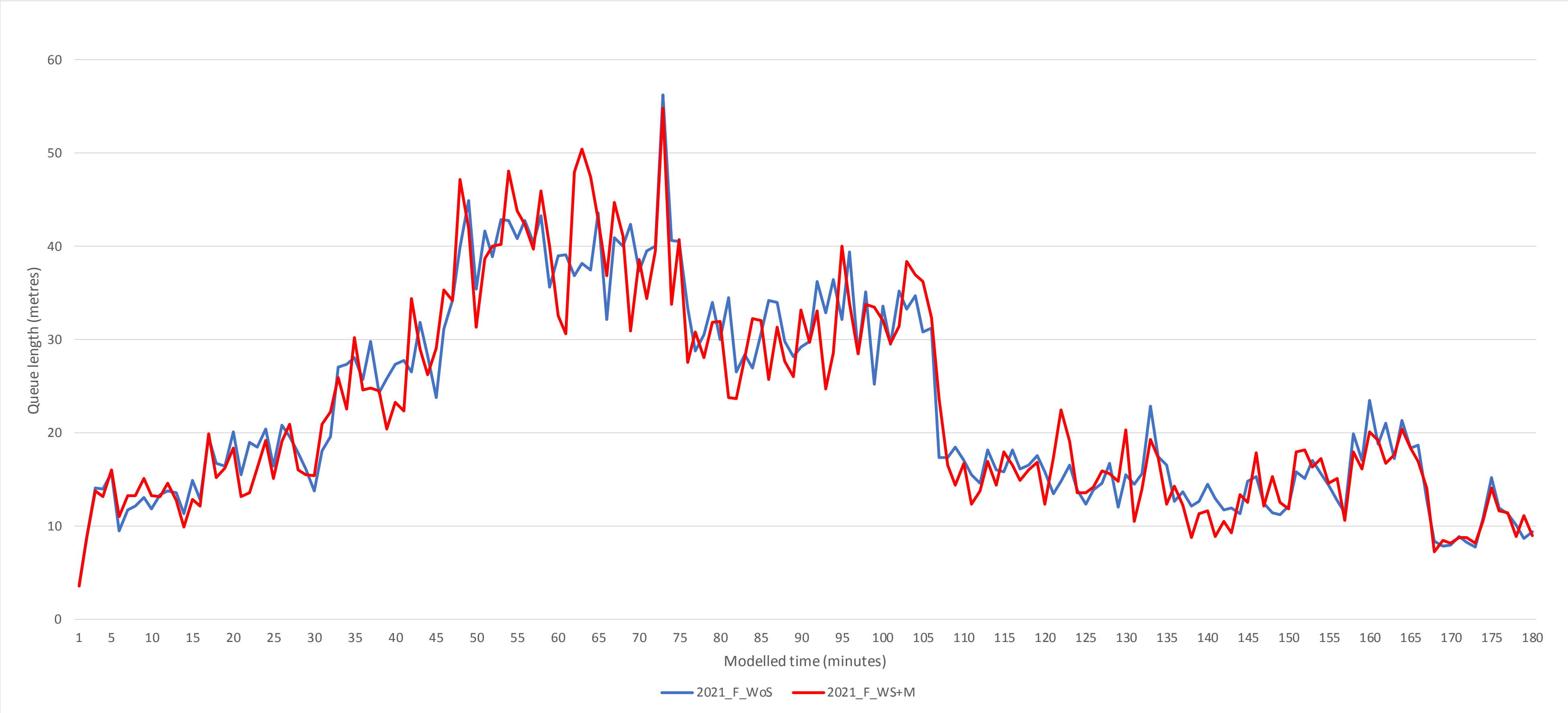

Figure E2: Maximum Queue Length Profile, 2021 Do-Nothing (With Freight) vs 2021 MetroWest (With Freight) plus Mitigation, Marsh Lane, AM Peak Period

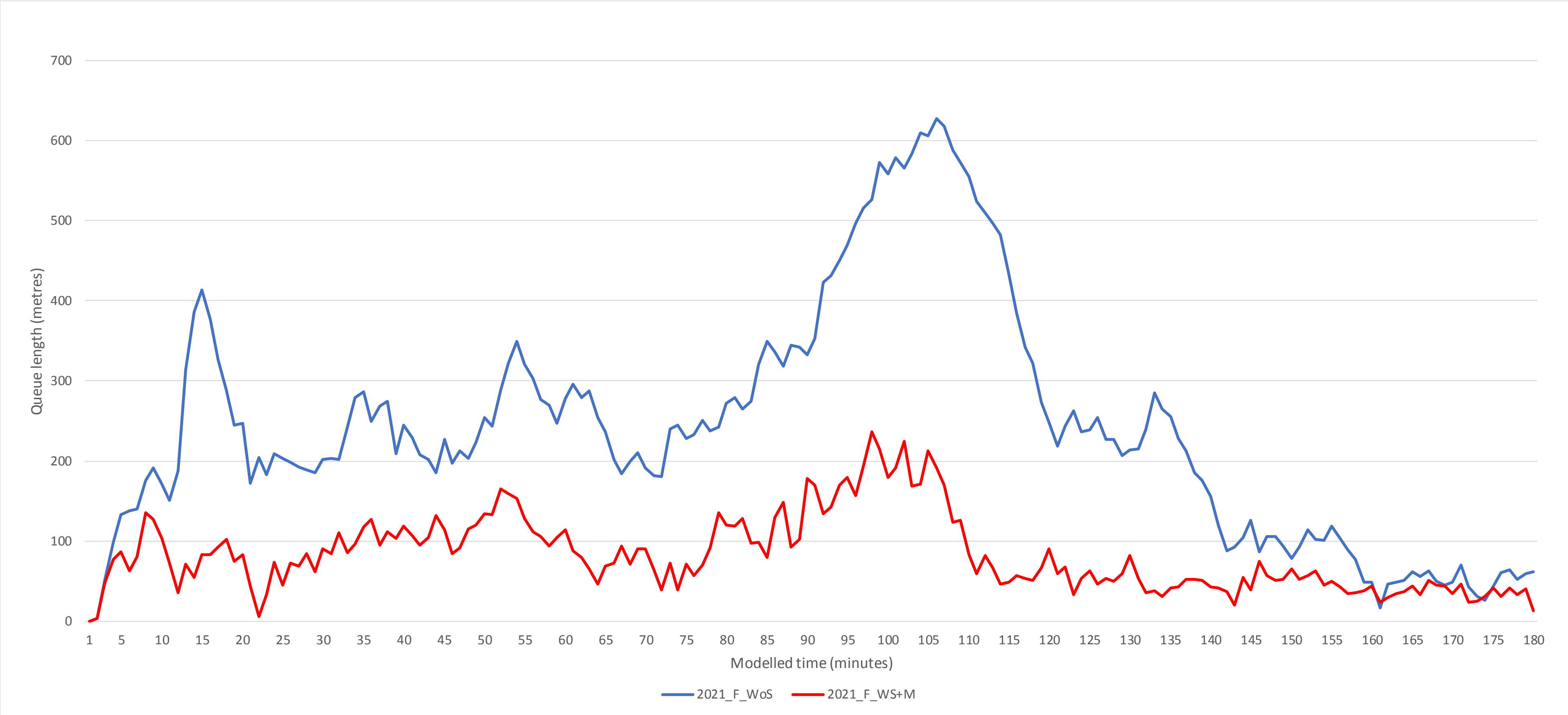

Figure E3: Maximum Queue Length Profile, 2021 Do-Nothing (With Freight) vs 2021 MetroWest (With Freight) plus Mitigation, Winterstoke Road Northbound, AM Peak Period

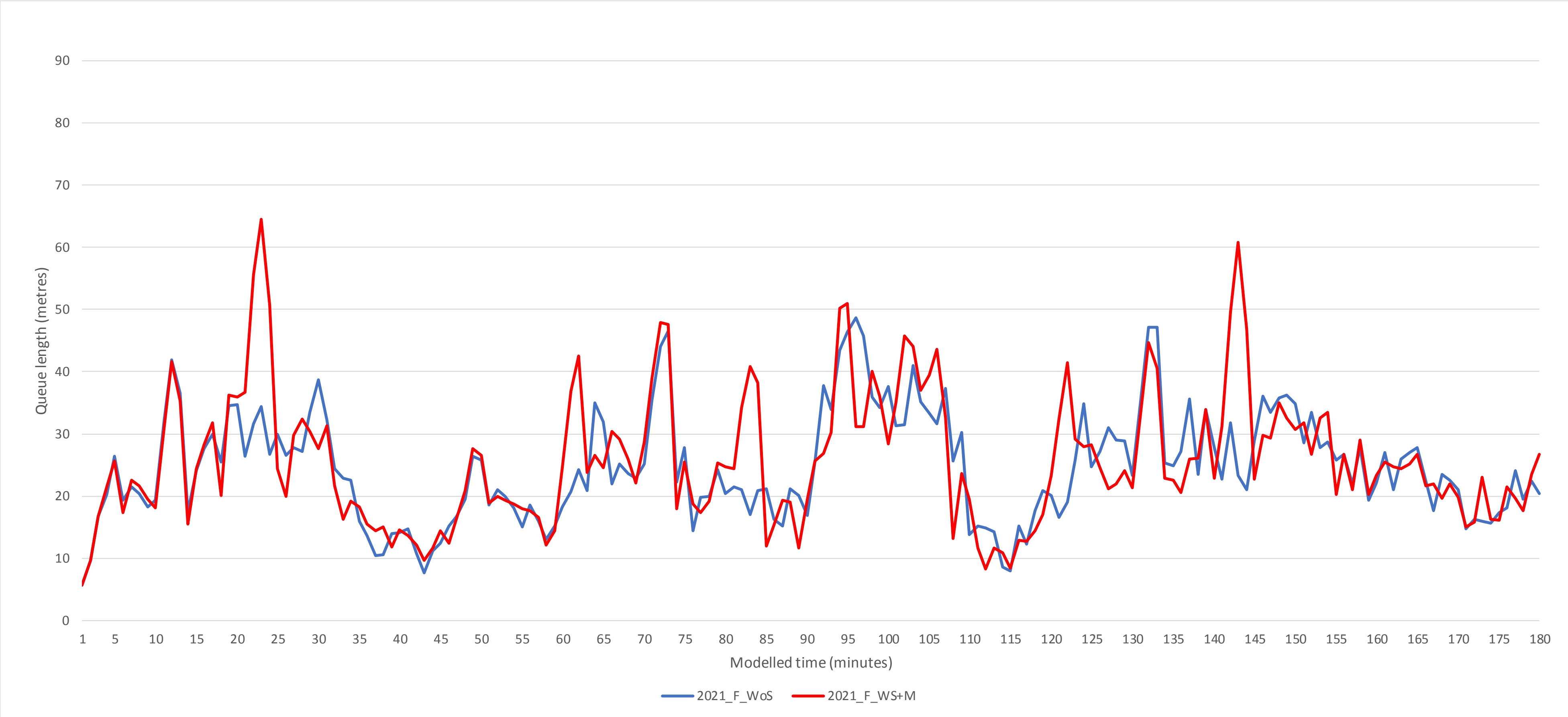

Figure E4: Maximum Queue Length Profile, 2021 Do-Nothing (With Freight) vs 2021 MetroWest (With Freight) plus Mitigation, Ashton Vale Road, AM Peak Period

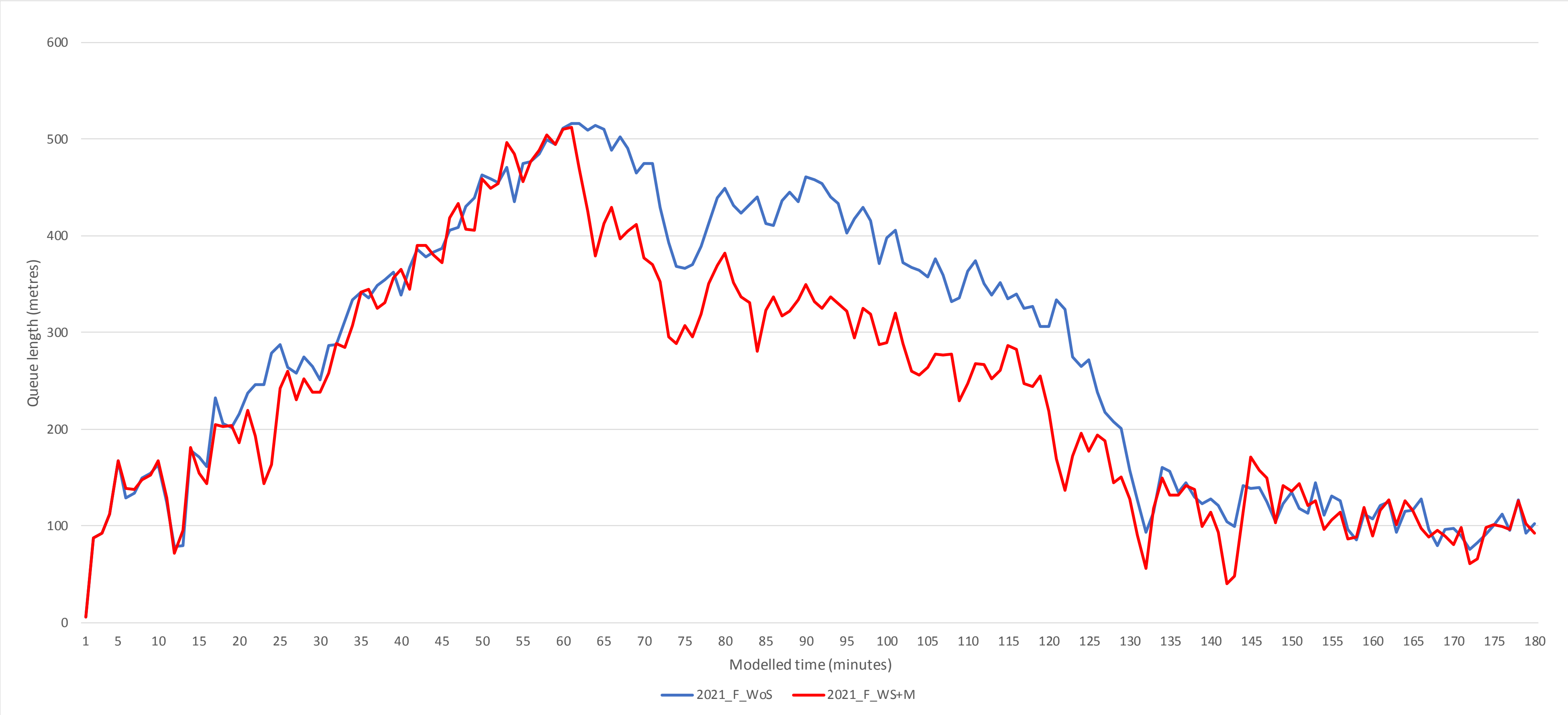

Figure E5: Maximum Queue Length Profile, 2021 Do-Nothing (With Freight) vs 2021 MetroWest (With Freight) plus Mitigation, Winterstoke Road Southbound, PM Peak Period

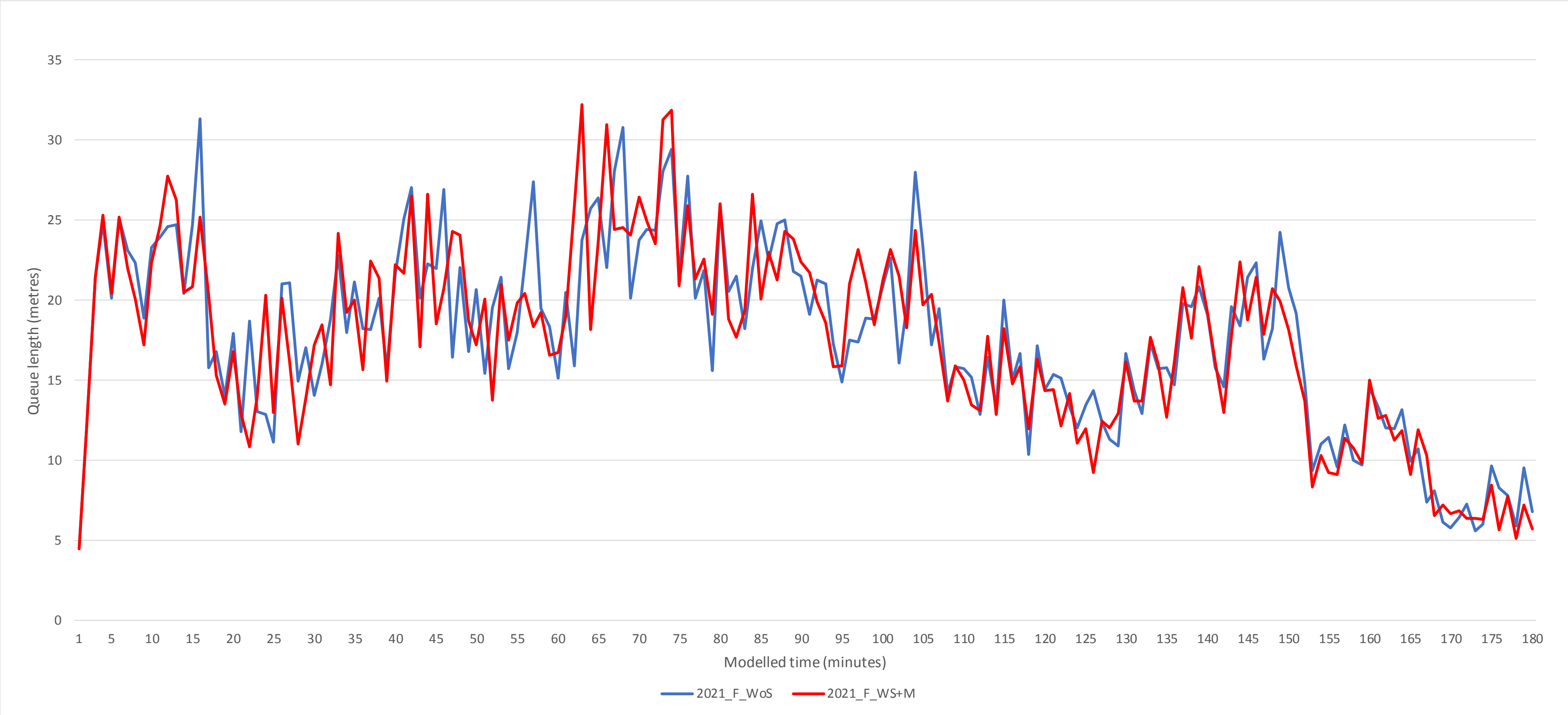

Figure E6: Maximum Queue Length Profile, 2021 Do-Nothing (With Freight) vs 2021 MetroWest (With Freight) plus Mitigation, Marsh Lane, PM Peak Period

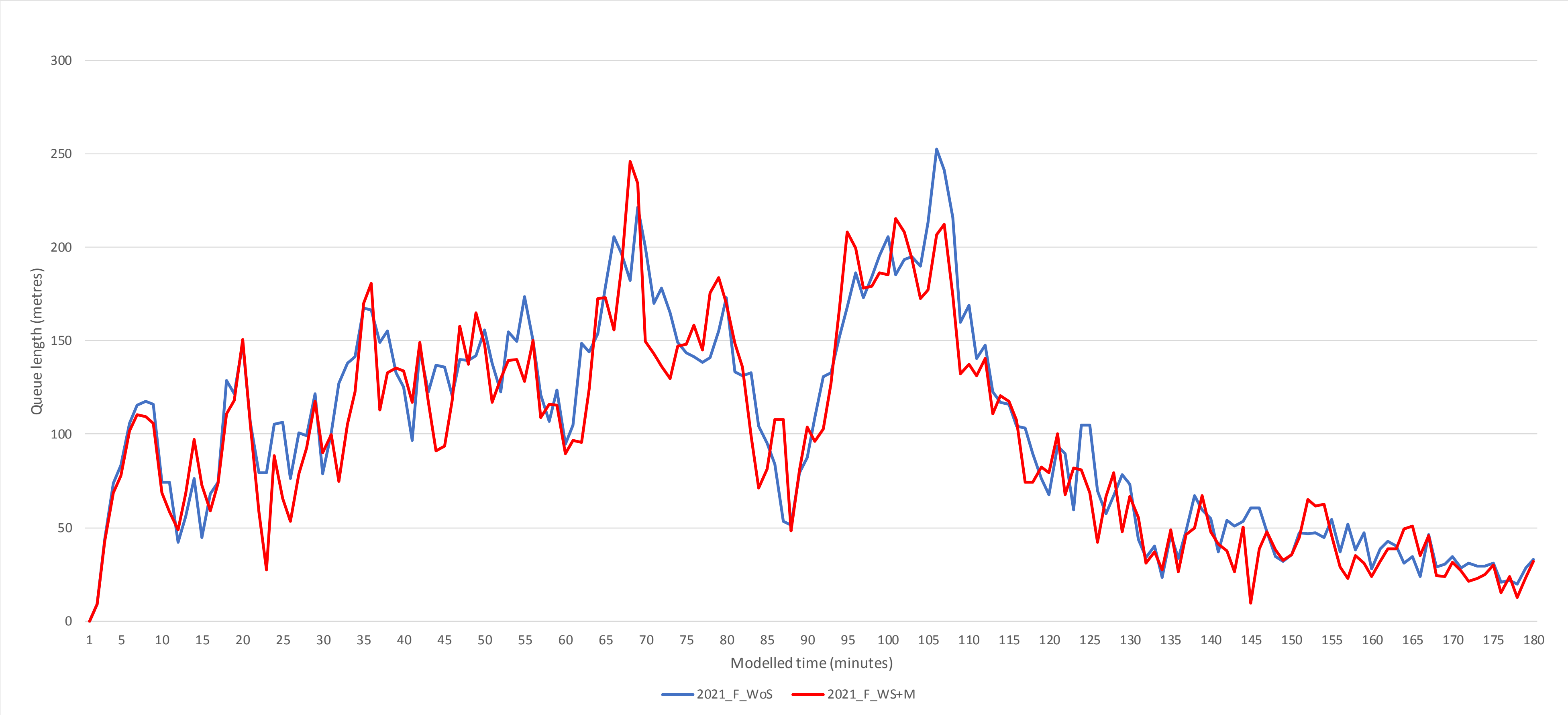

Figure E7: Maximum Queue Length Profile, 2021 Do-Nothing (With Freight) vs 2021 MetroWest (With Freight) plus Mitigation, Winterstoke Road Northbound, PM Peak Period

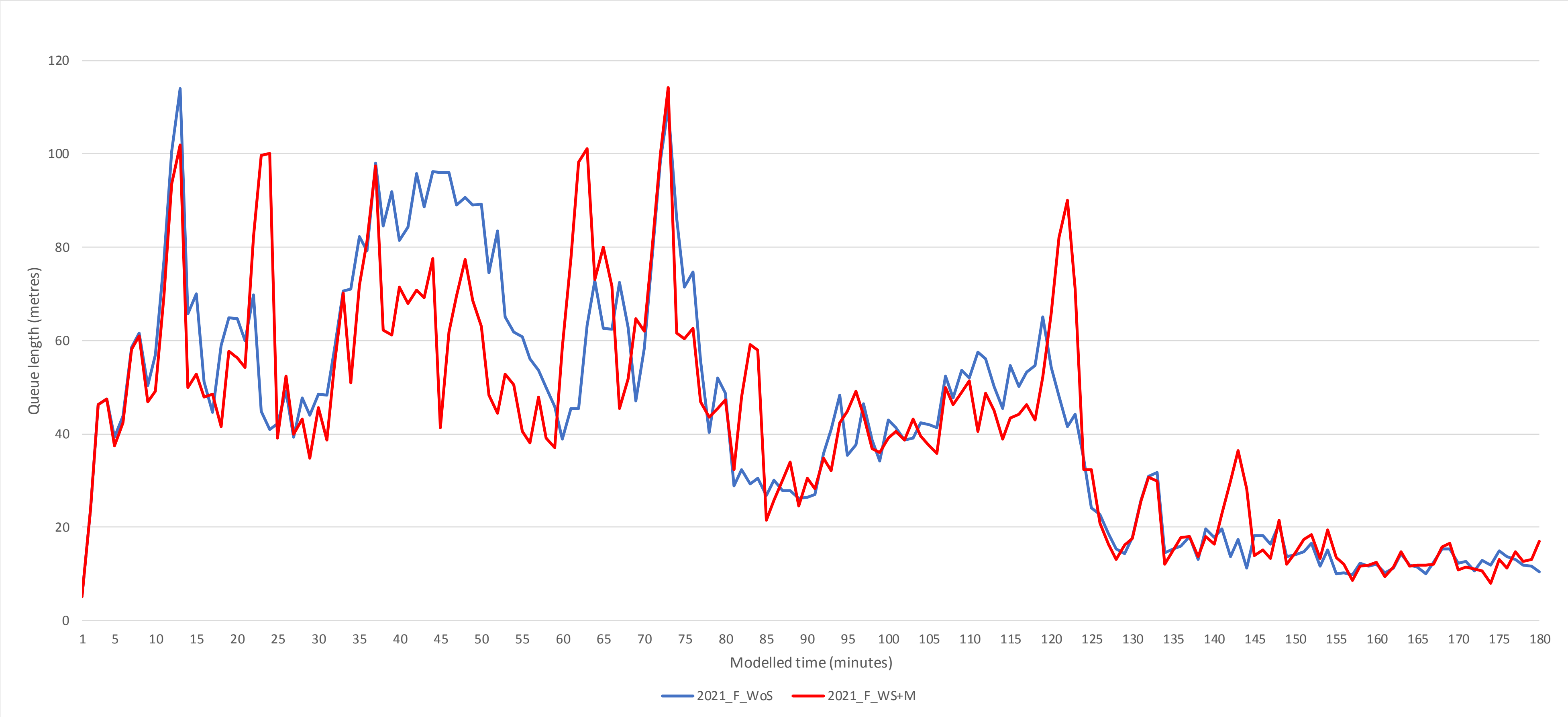

Figure E8: Maximum Queue Length Profile, 2021 Do-Nothing (With Freight) vs 2021 MetroWest (With Freight) plus Mitigation, Ashton Vale Road, PM Peak Period

Appendix F:
Queue Profile Results, 2021 MetroWest Without Measures vs 2021 MetroWest With Highway Measures

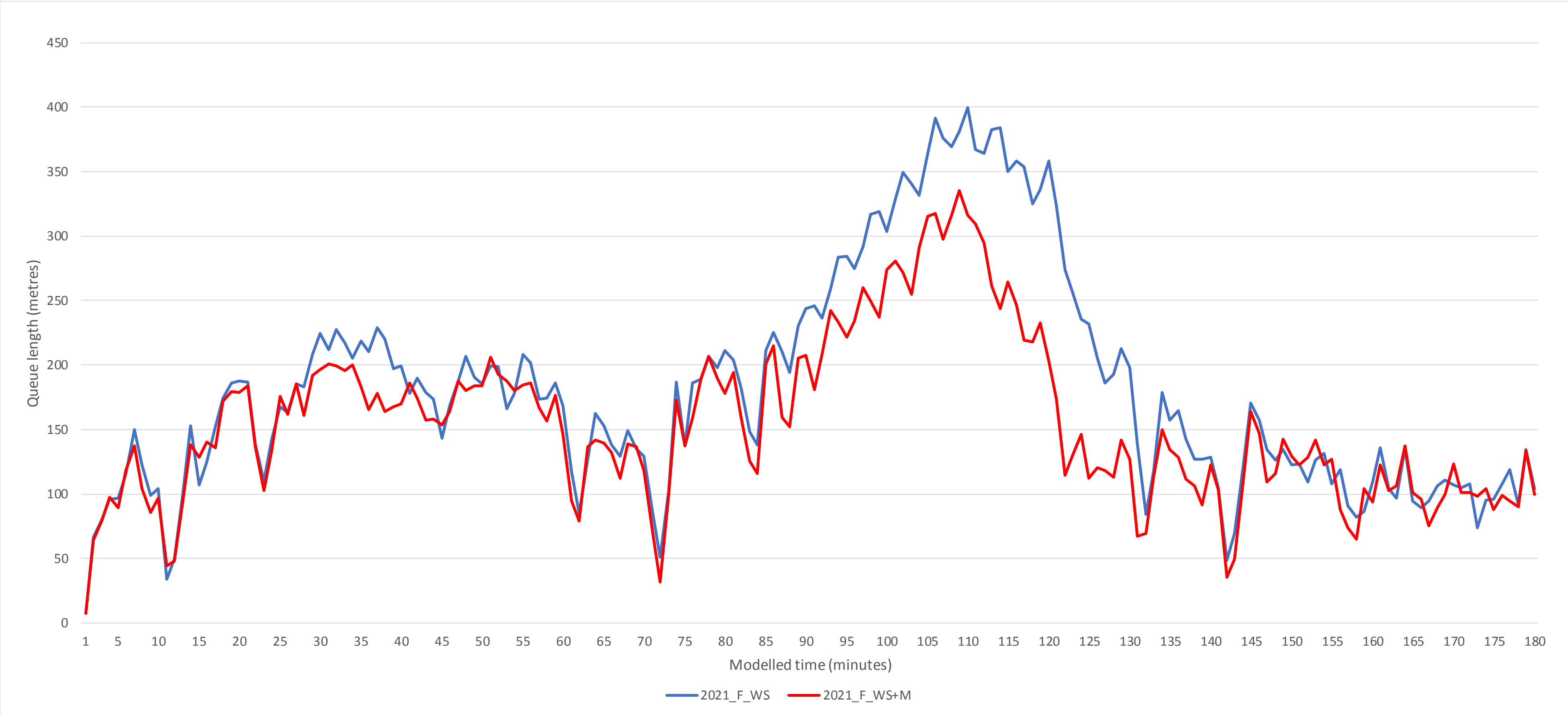

Figure F1: Maximum Queue Length Profile, 2021 MetroWest (With Freight) vs 2021 MetroWest (With Freight) plus Mitigation, Winterstoke Road Southbound, AM Peak Period

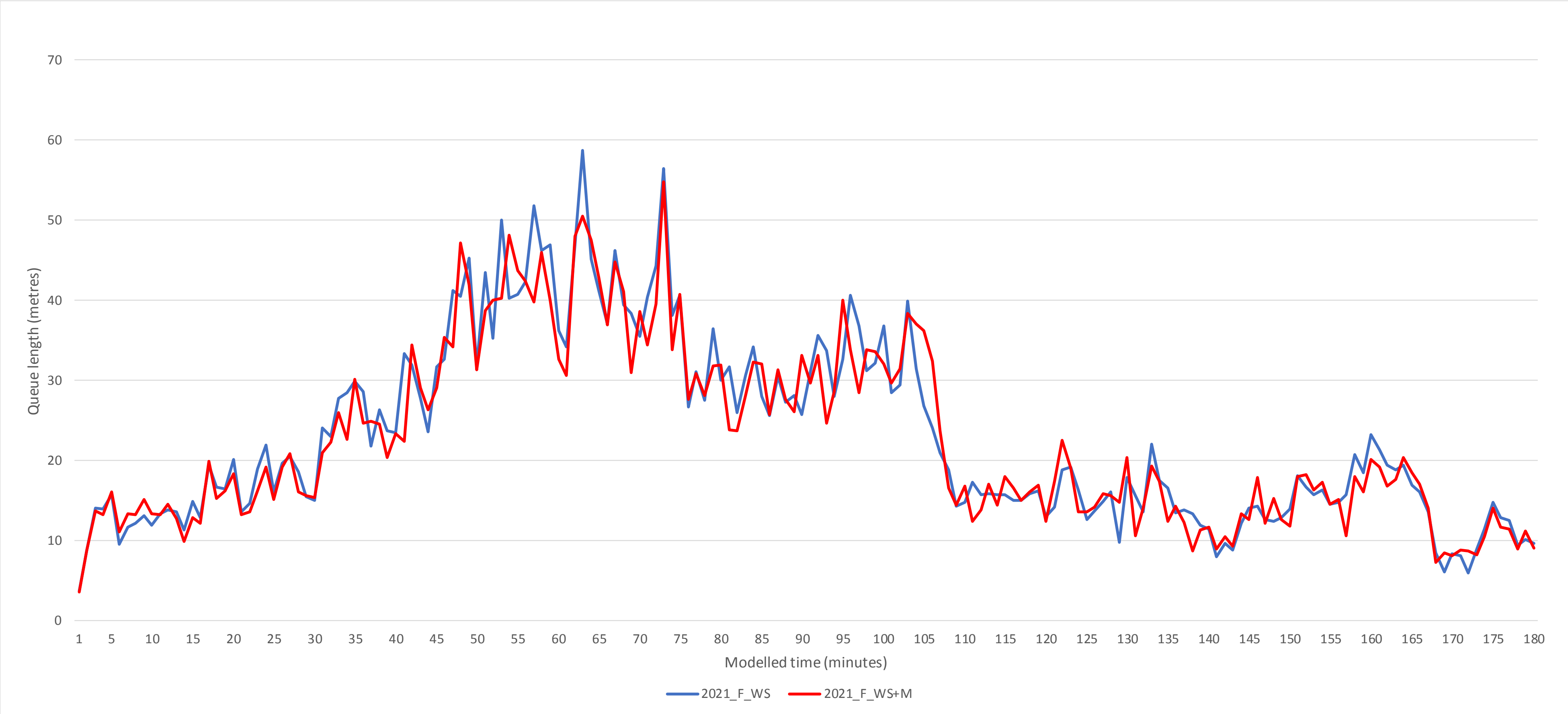

Figure F2: Maximum Queue Length Profile, 2021 MetroWest (With Freight) vs 2021 MetroWest (With Freight) plus Mitigation, Marsh Lane, AM Peak Period

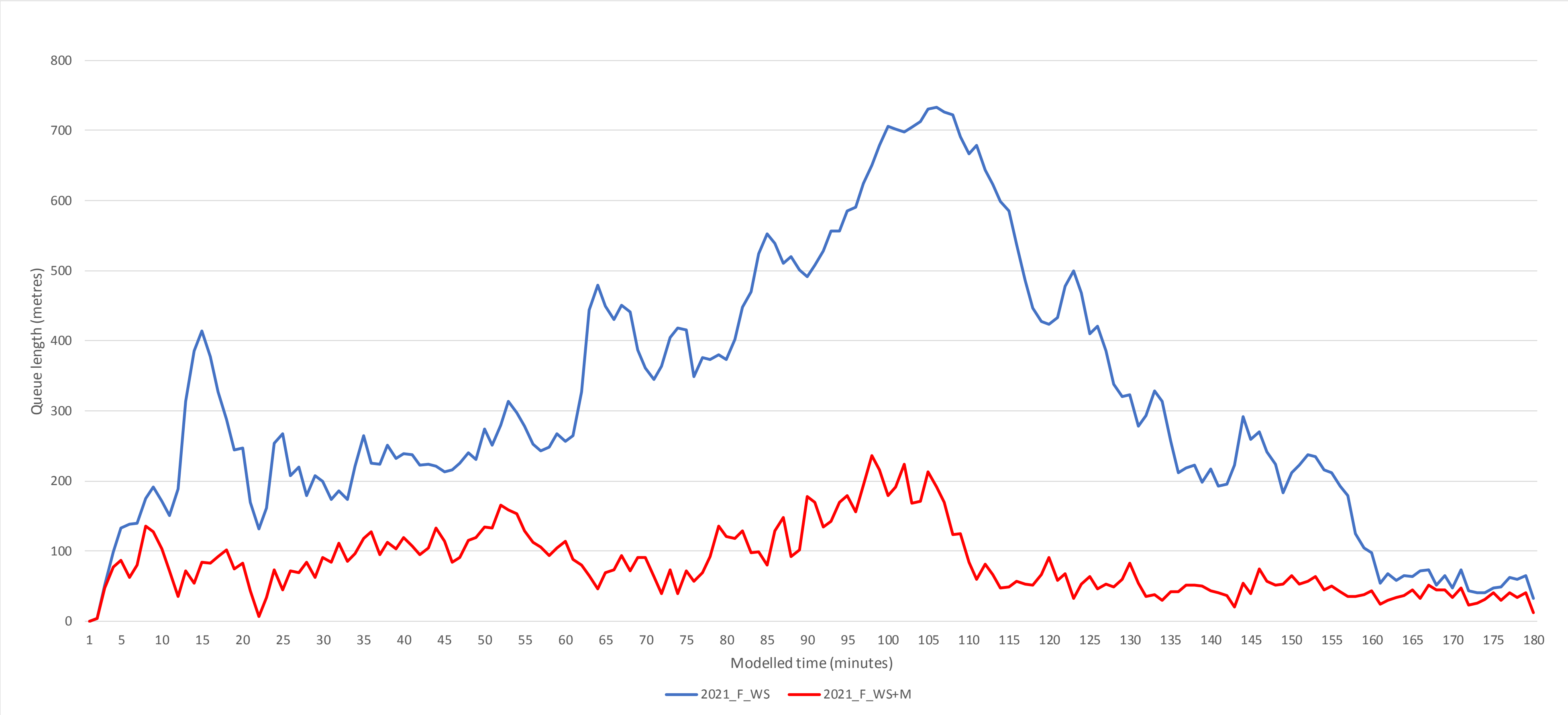

Figure F3: Maximum Queue Length Profile, 2021 MetroWest (With Freight) vs 2021 MetroWest (With Freight) plus Mitigation, Winterstoke Road Northbound, AM Peak Period

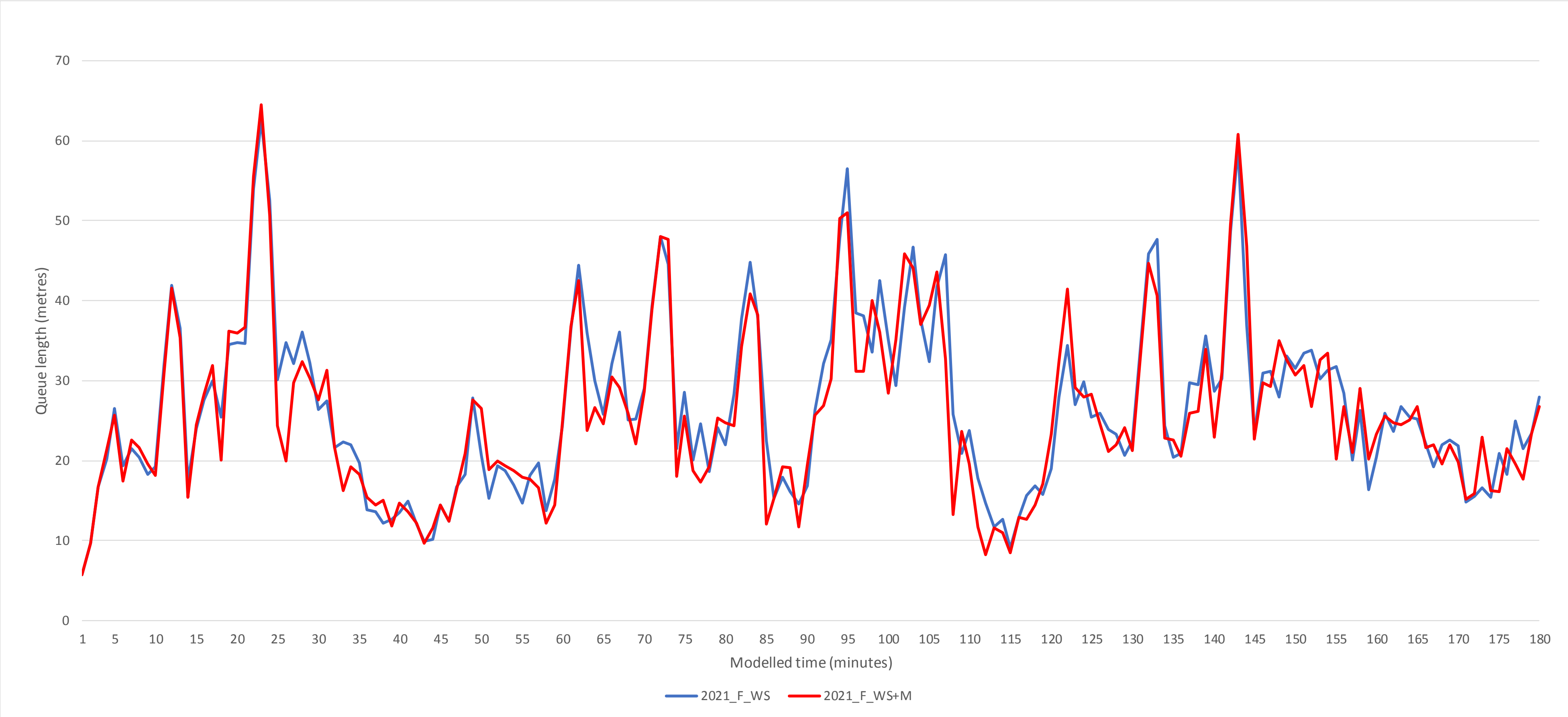

Figure F4: Maximum Queue Length Profile, 2021 MetroWest (With Freight) vs 2021 MetroWest (With Freight) plus Mitigation, Ashton Vale Road, AM Peak Period

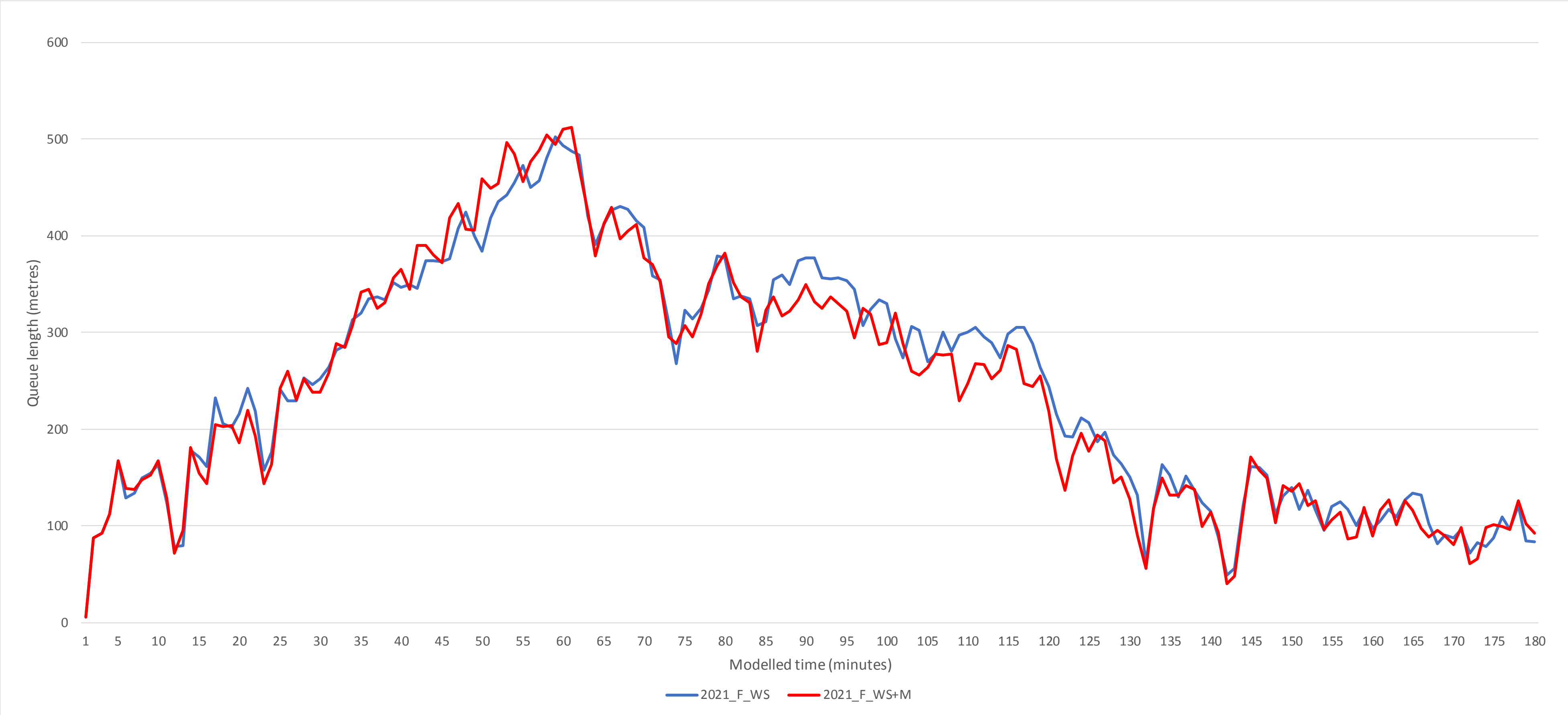

Figure F5: Maximum Queue Length Profile, 2021 MetroWest (With Freight) vs 2021 MetroWest (With Freight) plus Mitigation, Winterstoke Road Southbound, PM Peak Period

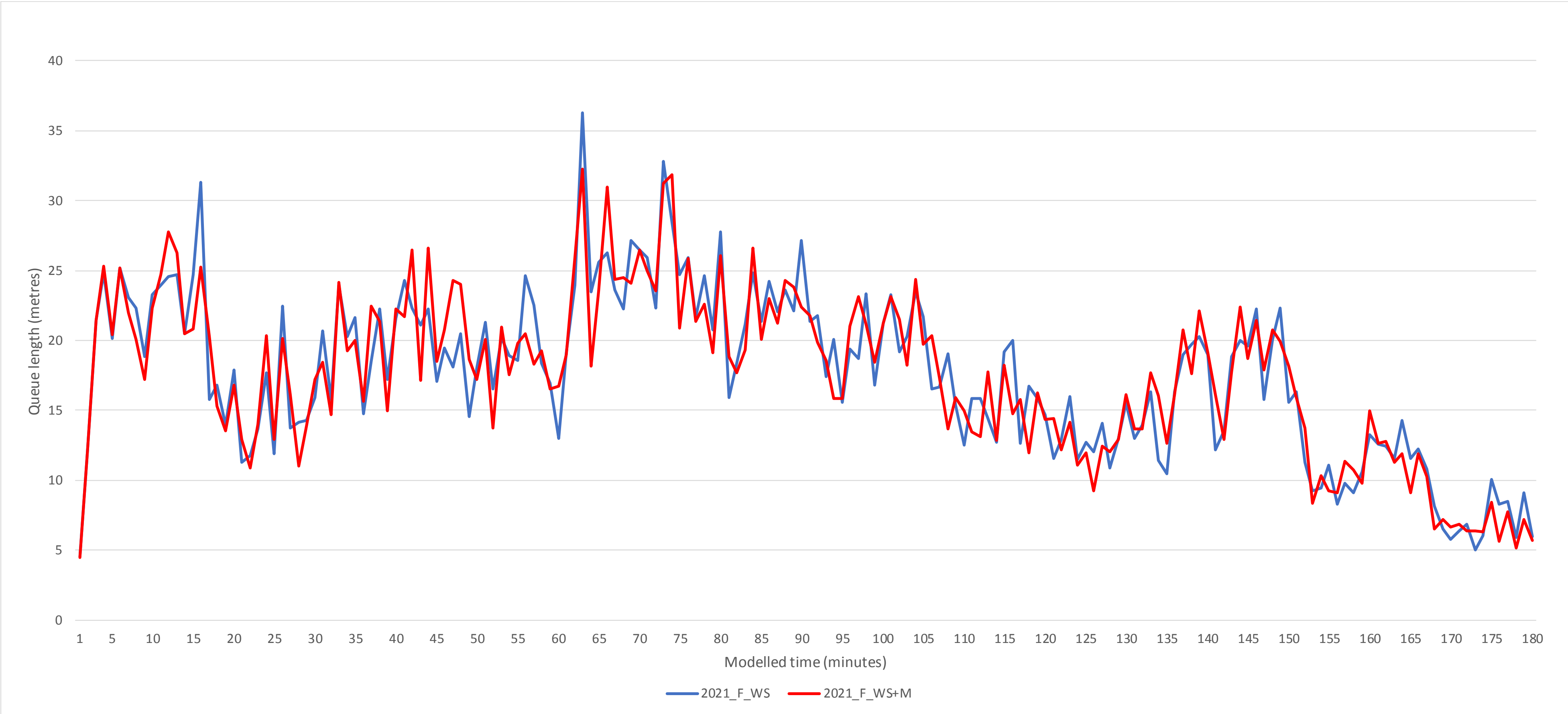

Figure F6: Maximum Queue Length Profile, 2021 MetroWest (With Freight) vs 2021 MetroWest (With Freight) plus Mitigation, Marsh Lane, PM Peak Period

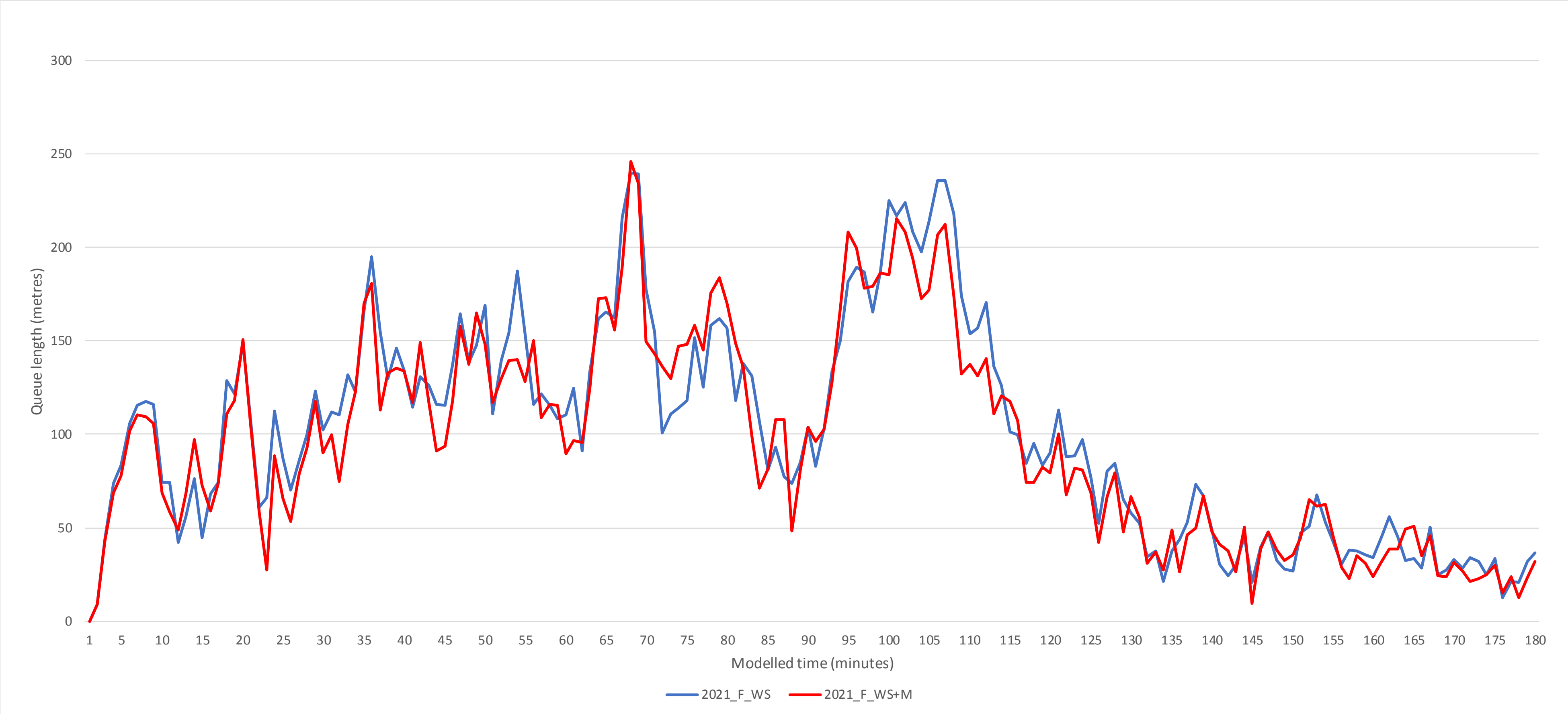

Figure F7: Maximum Queue Length Profile, 2021 MetroWest (With Freight) vs 2021 MetroWest (With Freight) plus Mitigation, Winterstoke Road Northbound, PM Peak Period

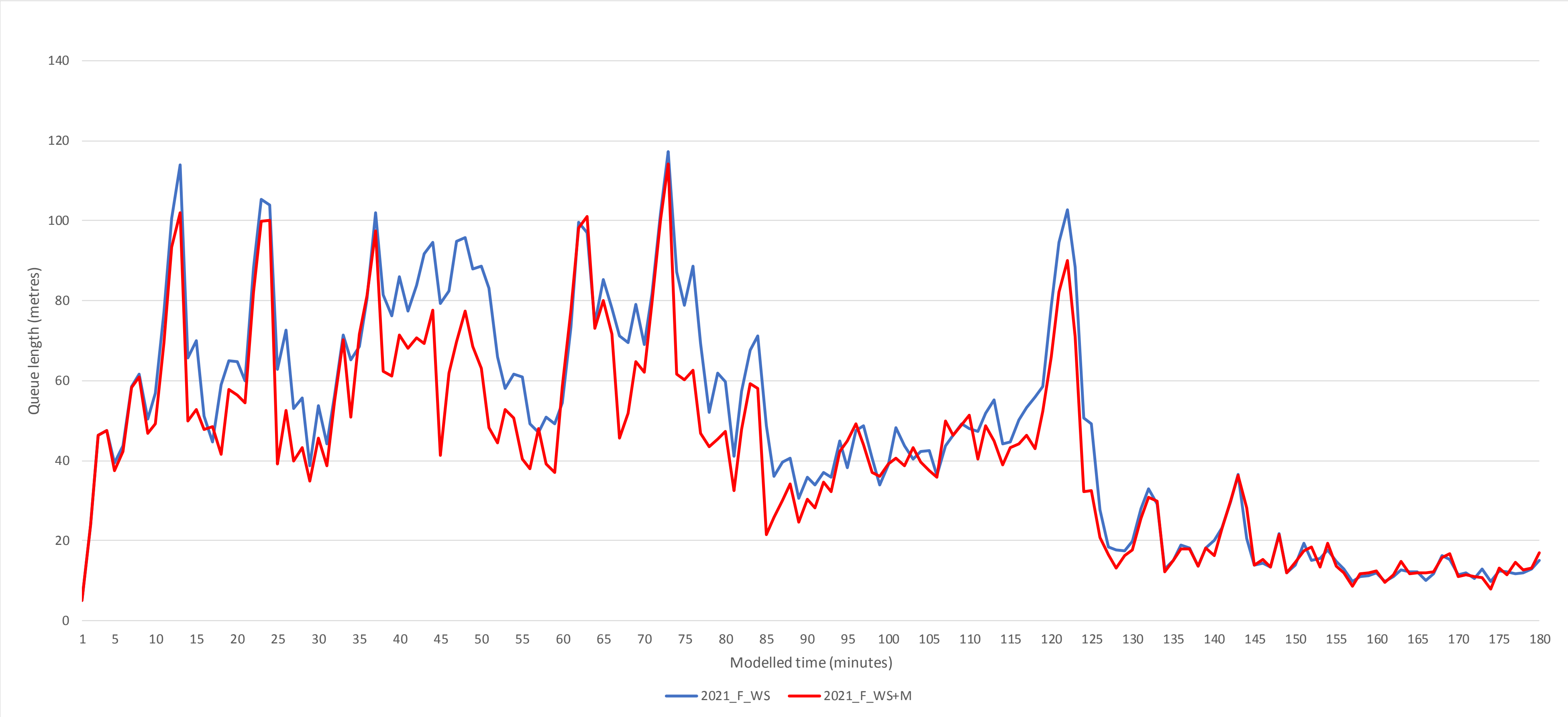

Figure F8: Maximum Queue Length Profile, 2021 MetroWest (With Freight) vs 2021 MetroWest (With Freight) plus Mitigation, Ashton Vale Road, PM Peak Period

Appendix G:
Queue Profile Results, 2021 Do-Nothing (With Freight) vs 2021 45 Min MetroWest (With 2 Freight) with Highway Measures

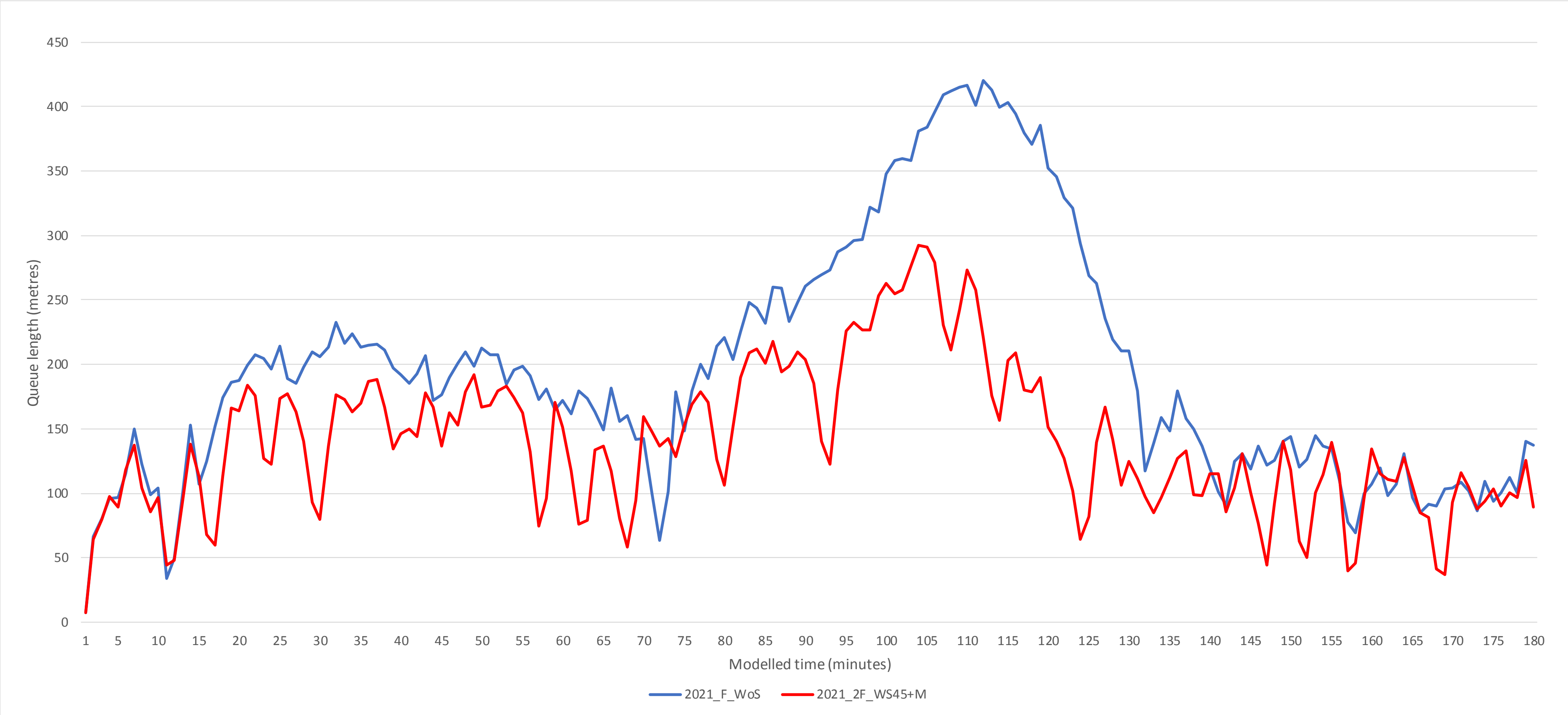

Figure G1: Max. Queue Length Profile, 2021 Do-Nothing (With Freight) vs 2021 45 min MetroWest (With 2 Freight) plus Mitigation, Winterstoke Road Southbound, AM Peak Period

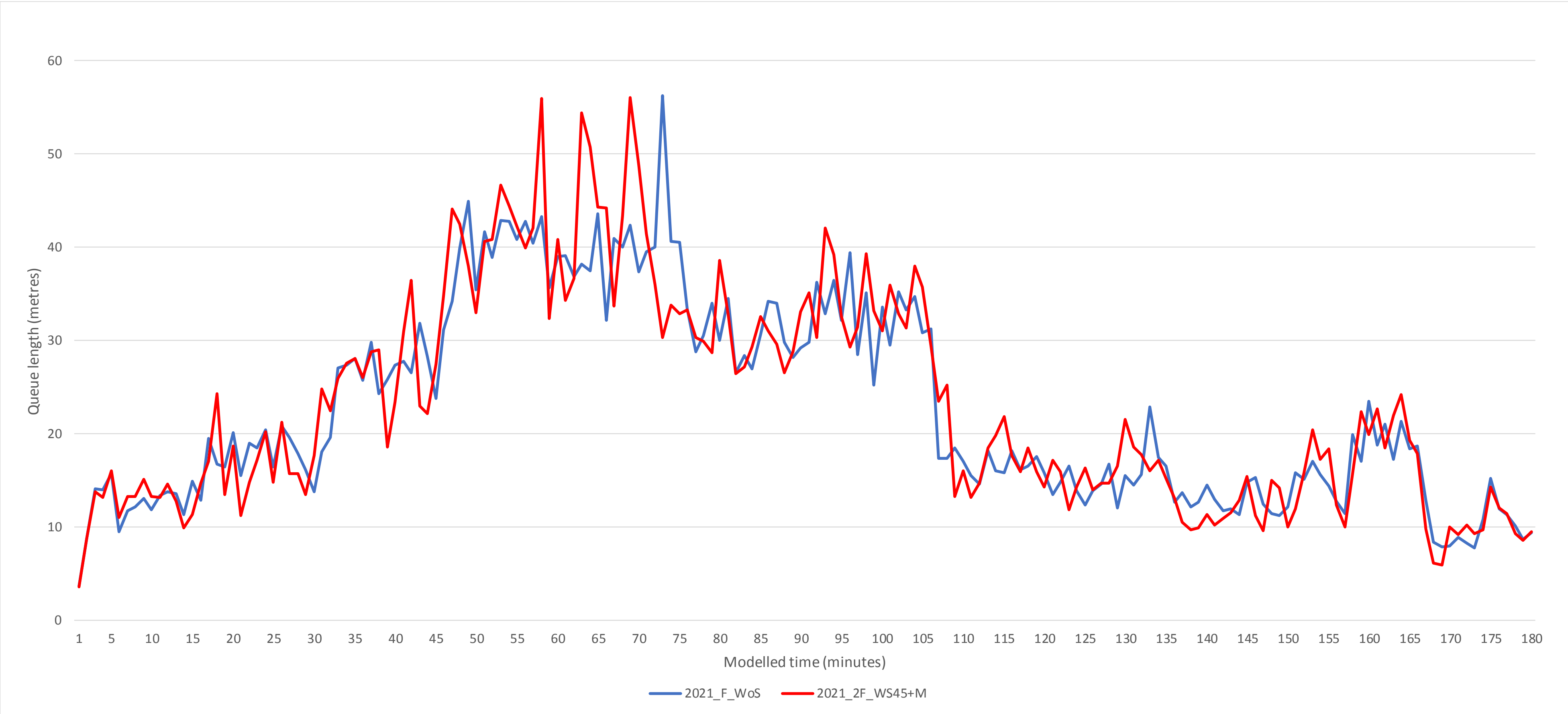

Figure G2: Max. Queue Length Profile, 2021 Do-Nothing (With Freight) vs 2021 45 min MetroWest (With 2 Freight) plus Mitigation, Marsh Lane, AM Peak Period

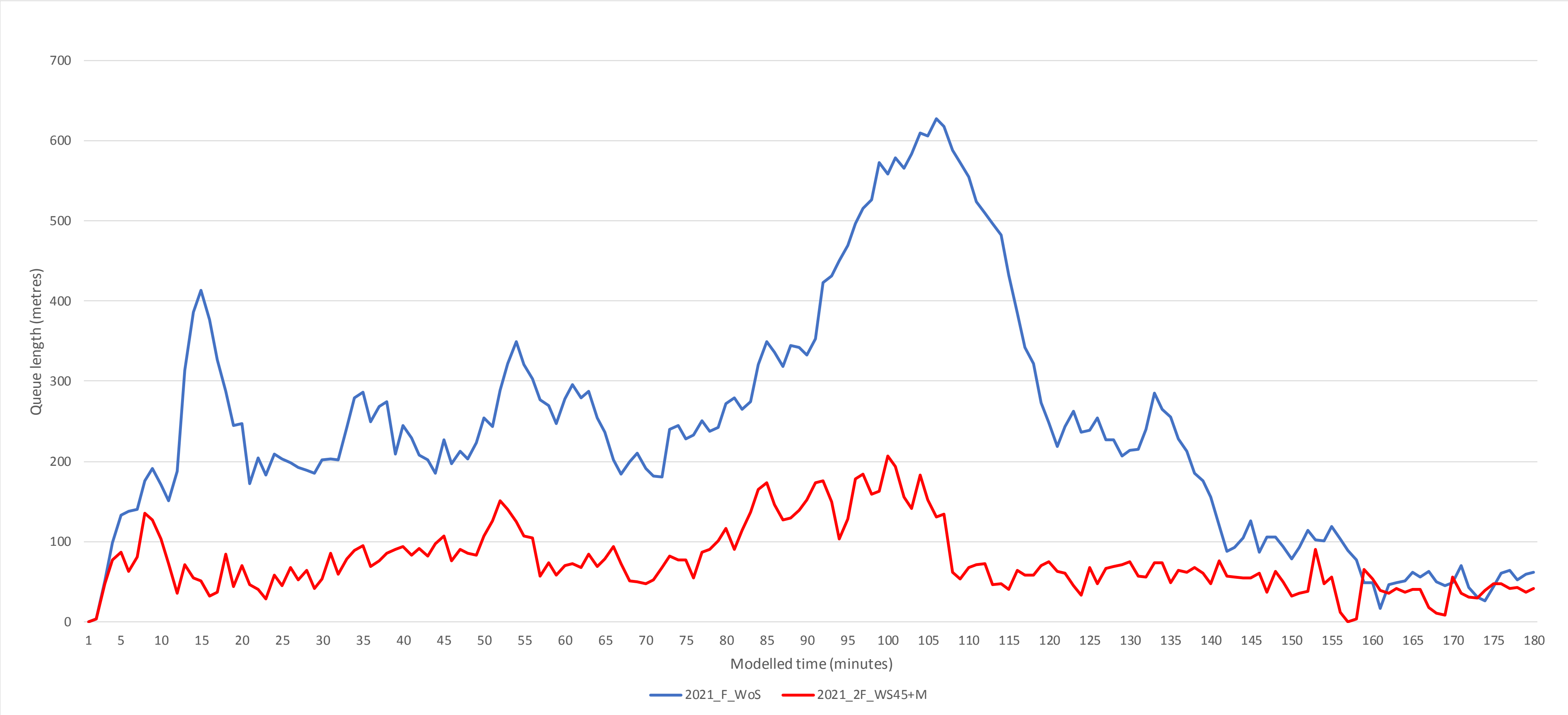

Figure G3: Max. Queue Length Profile, 2021 Do-Nothing (With Freight) vs 2021 45 min MetroWest (With 2 Freight) plus Mitigation, Winterstoke Road Northbound, AM Peak Period

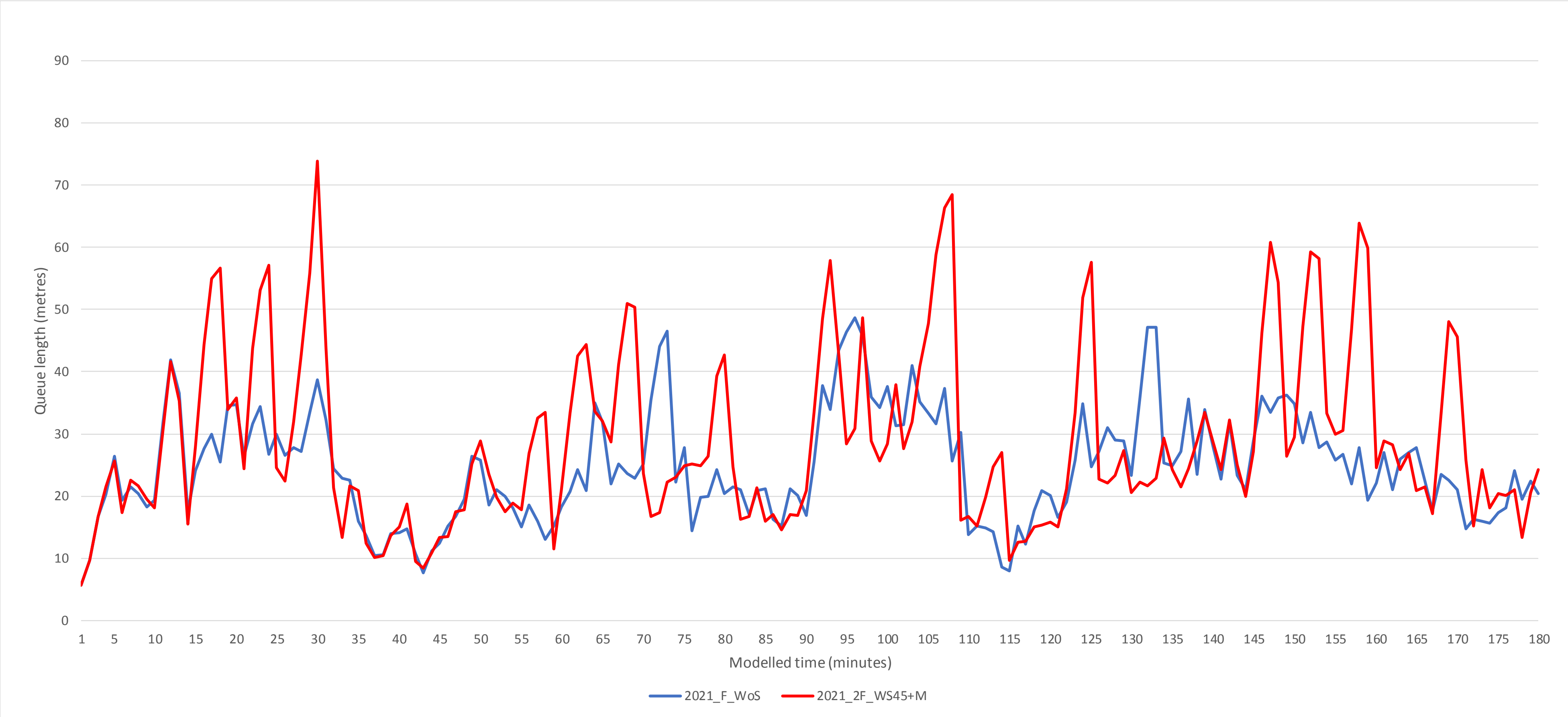

Figure G4: Max. Queue Length Profile, 2021 Do-Nothing (With Freight) vs 2021 45 min MetroWest (With 2 Freight) plus Mitigation, Ashton Vale Road, AM Peak Period

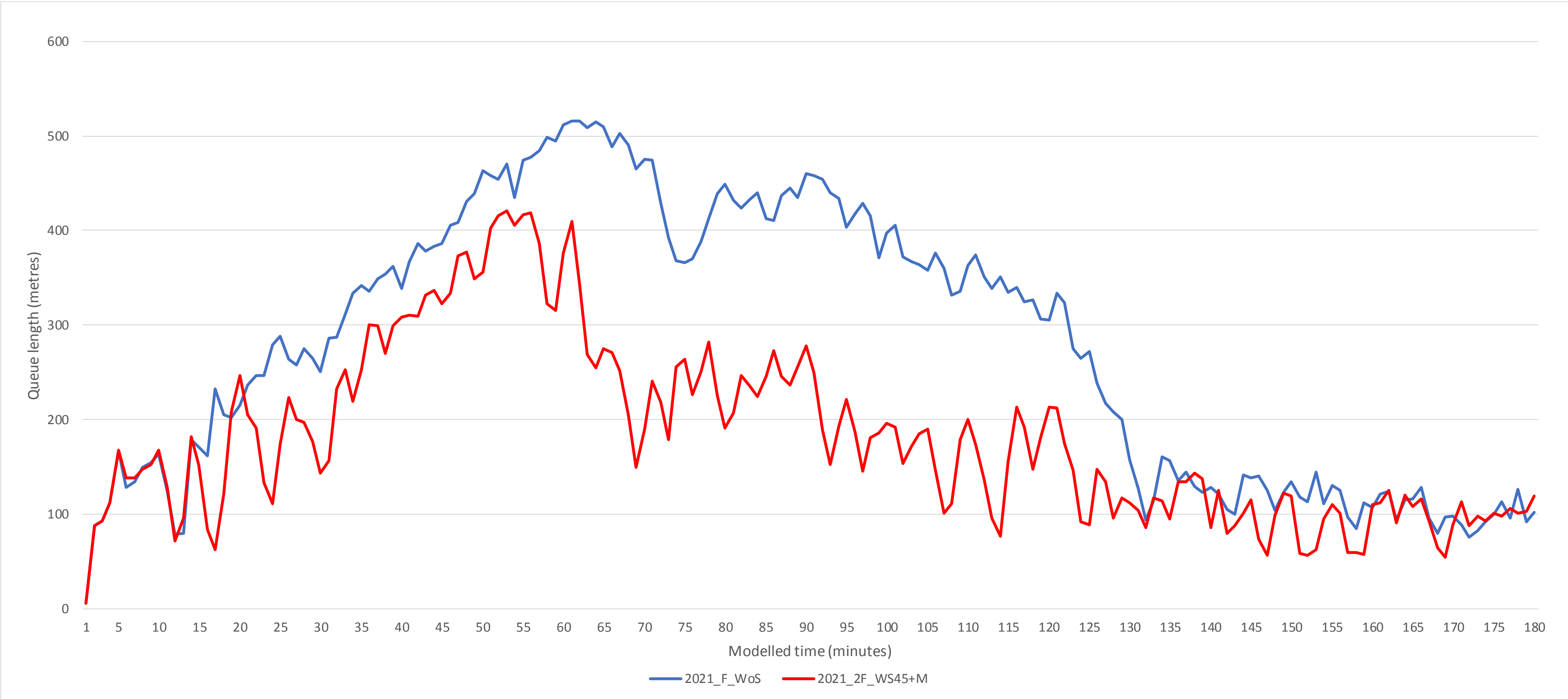

Figure G5: Max. Queue Length Profile, 2021 Do-Nothing (With Freight) vs 2021 45 min MetroWest (With 2 Freight) plus Mitigation, Winterstoke Road Southbound, PM Peak Period

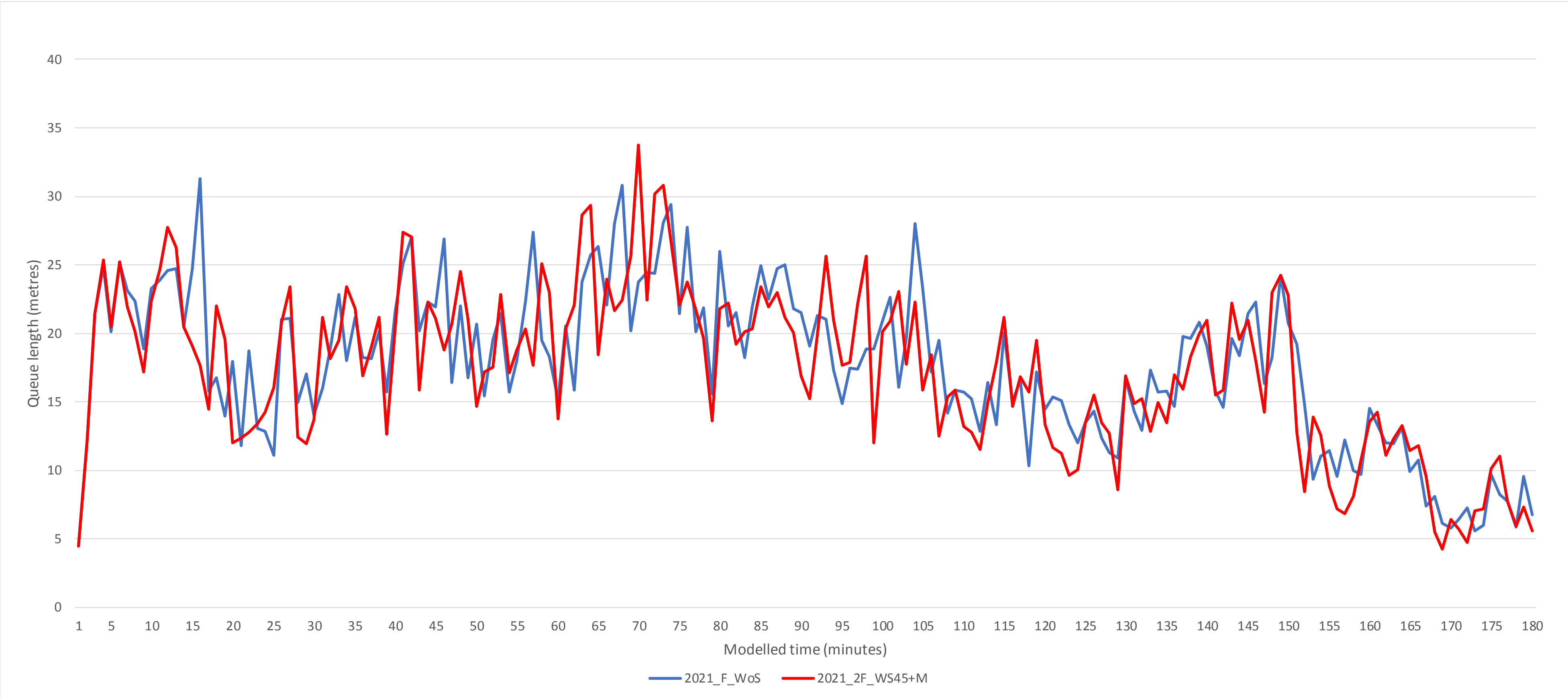

Figure G6: Max. Queue Length Profile, 2021 Do-Nothing (With Freight) vs 2021 45 min MetroWest (With 2 Freight) plus Mitigation, Marsh Lane, PM Peak Period

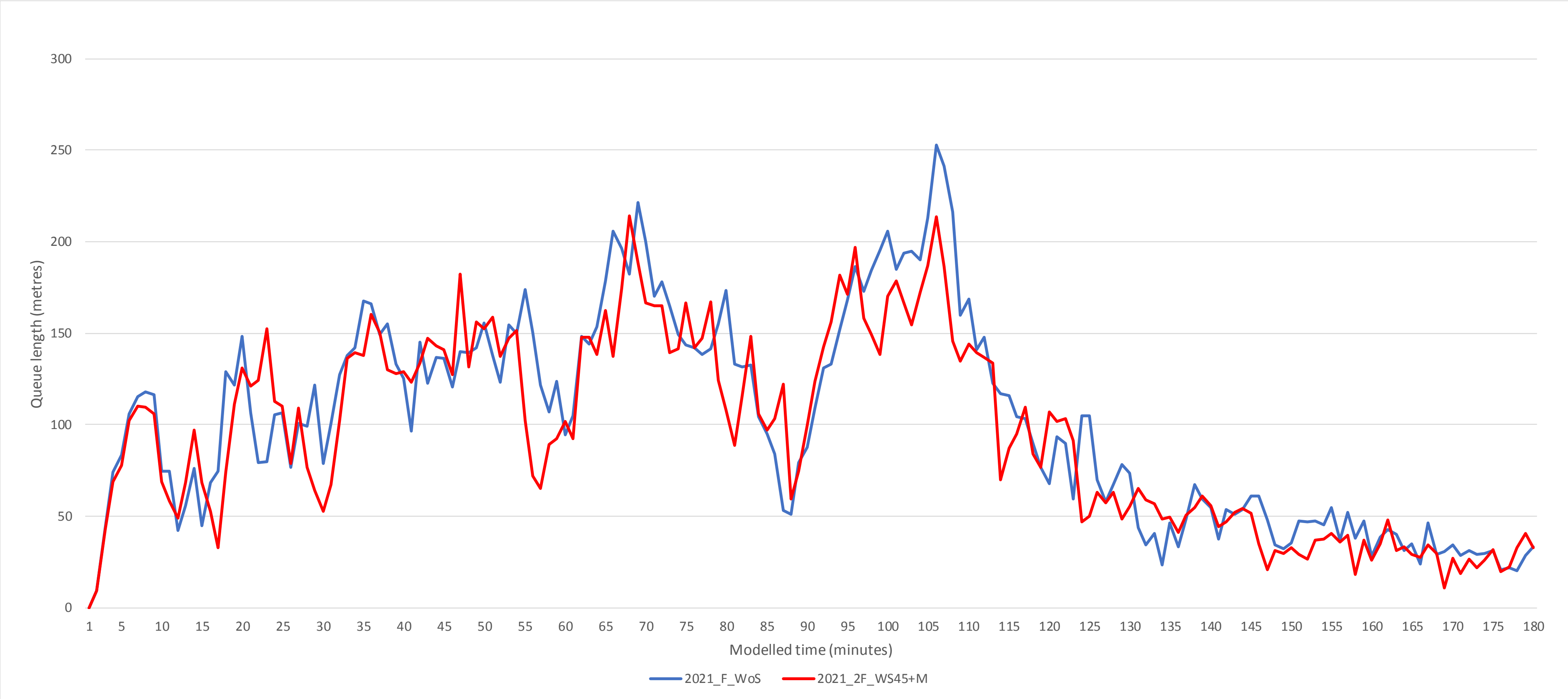

Figure G7: Max. Queue Length Profile, 2021 Do-Nothing (With Freight) vs 2021 45 min MetroWest (With 2 Freight) plus Mitigation, Winterstoke Road Northbound, PM Peak Period

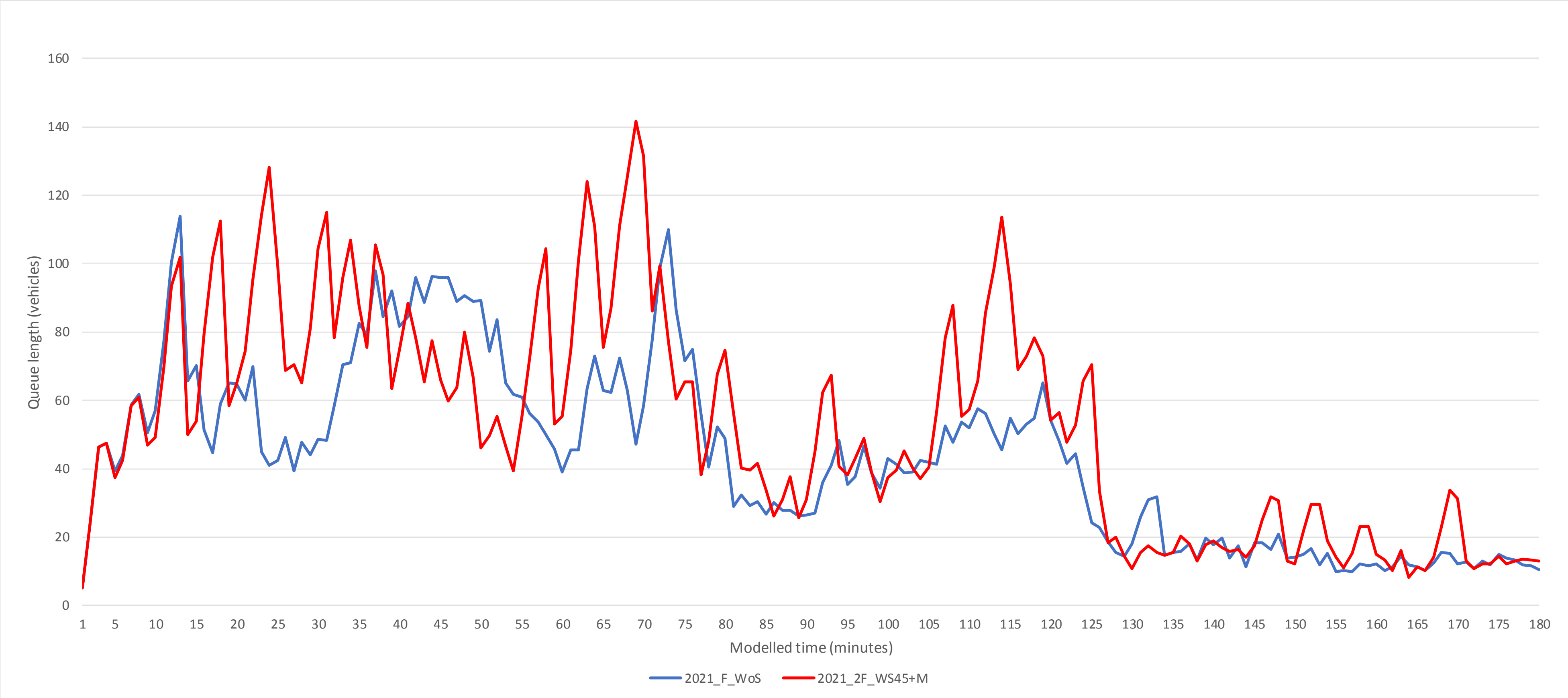

Figure G8: Max. Queue Length Profile, 2021 Do-Nothing (With Freight) vs 2021 45 min MetroWest (With 2 Freight) plus Mitigation, Ashton Vale Road, PM Peak Period