LAND AT OAKLEY FARM, BATTLEDOWN, CHELTENHAM

TRANSPORT ASSESSMENT ADDENDUM

ROBERT HITCHINS LIMITED

NOVEMBER 2020

PFA Consulting
Stratton Park House
Wanborough Road
Swindon
SN3 4HG

Tel: 01793 828000
Fax: 01793 835500
Email: admin@pfaplc.com
Web: www.pfaplc.com

engineering the future

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DOCUMENT CONTROL

Job No	H628	
File Reference	G:\workfiles\H628 OAKLEY FARM\REPORTS\H628-DOC04 TA ADDENDUM.docx	
	Name	Date
Prepared By	J Alexander	04 November 2020
Checked By	P Finlayson	04 November 2020

Issue	Date	Comments	Approved
1	13 November 2020	For submission	J Alexander

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PAGE NO.

FIGURES

APPENDICES

1. INTRODUCTION

1.1. This Transport Assessment (TA) Addendum has been prepared by PFA Consulting on behalf of Robert Hitchins Limited (RHL) to provide GCC with the further information requested in their highway's response to the planning application for residential development of up to 250 dwellings on Land at Oakley Farm, Cheltenham. The planning application is in outline with all matters reserved.

1.2. The location of the application site is shown in the context of Cheltenham and the surrounding local highway network in **Figure 1.1**.

1.3. A copy of the Illustrative Masterplan, produced by RHL, is reproduced at **Appendix A**.

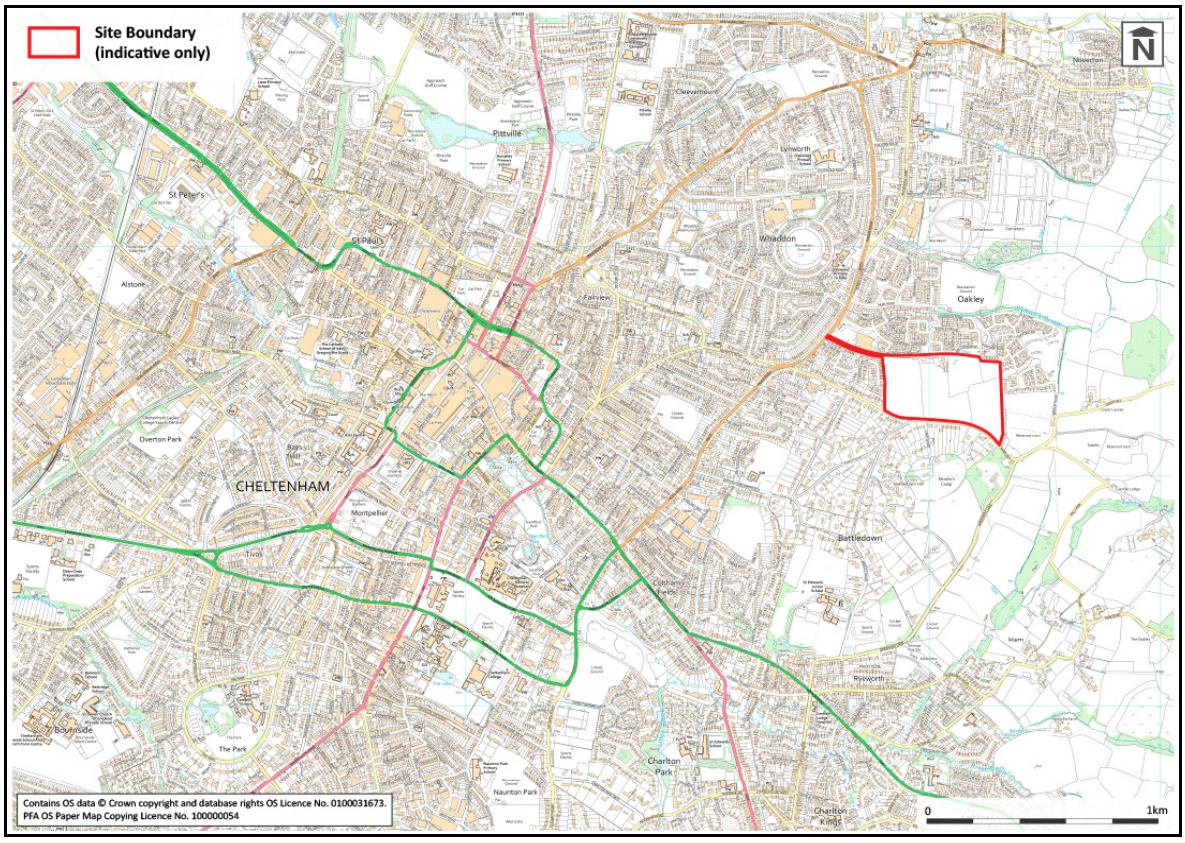


Figure 1.1: Site Location Plan

1.4. GCC's response to the planning application dated 18 August 2020 recommending further information be provided is reproduced at **Appendix B**.

1.5. GCC helpfully set out the further information required into five key topic areas which are as follows:

- Immediate Pedestrian / Cycle Access
- Immediate Vehicle Access
- Improvements to Harp Hill and Priors Road to Active Travel
- Off-Site Vehicle Mitigation
- Residential Travel Plan

1.6. This TA Addendum considers each of the above in turn.

2. IMMEDIATE PEDESTRIAN / CYCLE ACCESS

2.1. GCC has requested a comprehensive drawing showing the full length and width of the proposed shared footway / cycleway on to Priors Road, including details of the proposed toucan crossing and route to Whaddon Road.

2.2. The shared pedestrian / cycle link to Priors Road is considered to be the principal pedestrian / cyclist access to the application site. There is an existing signposted route for cycles from Priors Road to the town centre via Whaddon Road, Prestbury Road and Winchcombe Street

2.3. A preliminary design of the proposed shared footway / cycleway along its entire length is shown in PFA drawing H628/06 Rev B reproduced at a reduced scale at **Appendix C**. The design has considered the recent Department for Transport (DfT) guidance contained in Local Transport Note 1/20 - Cycle Infrastructure Design and the Traffic Signs Manual Chapter 6 with respect to the proposed toucan crossing.

2.4. The applicant is able to confirm that the owner of the land on which the proposed shared footway / cycleway routes within the site would convey a higher access right to allow cycling to occur on the route of the existing public footpath. This can be the subject of a planning condition.

2.5. As the planning application is in outline with all matters reserved, the detail of the shared footway / cycleway would be subject to Reserved Matters applications should outline consent be granted.

3. IMMEDIATE VEHICLE ACCESS

3.1. GCC requested that the preliminary design of the proposed site access junction on Harp Hill provide details of the dimensions of the access and also vehicle tracking. The preliminary design of the site access has therefore been updated to include dimensions and vehicle tracking as shown in PFA drawing H628/02 Rev D at **Appendix D**.

3.2. GCC has raised concerns about the gradient from the proposed site access on Harp Hill into the site. The location of the proposed site access considered the topography of the site; it provides a 1 in 20 gradient at the junction and for the immediate approach to the junction from the site to ensure a safe and suitable access is achievable.

3.3. The topography of the site is not flat and as such to avoid excessive earth works preliminary gradients of 1 in 12.5 have been utilised for the assessments. This gradient has previously been acceptable to GCC and there seems to be no justification or evidence base provided by the highway authority to justify why it is no longer deemed acceptable. A gradient of 1 in 12.5 is not excessive; indeed, it is utilised regularly in the County to good effect given the nature of the topography within the area. It is also acceptable in terms of Building Regulations and supported by Manual for Streets 2 which states under the sub heading Carriageway Gradients:

> **"8.4.2 In hilly areas steeper gradients will frequently be required but a gradient of 8% should be regarded as a practical maximum unless there are particular local difficulties. This is also the maximum gradient that a manual wheelchair user can negotiate (see guidance on footway gradients in Chapter 5)"**

3.4. It is worth noting that the key pedestrian desire lines will be to Priors Road via the shared footway / cycleway; there will be limited need to walk or cycle up to Harp Hill. Furthermore, there are various alternative routes through the POS provided that will give users a choice of routes if they do not wish to walk along the footway adjacent to the road.

3.5. Notwithstanding the above, the site access junction on Harp Hill and the level details of the internal site roads is not a matter for outline consent and will be addressed by Reserved Matters applications should outline consent be granted.

4. IMPROVEMENTS TO HARP HILL AND PRIORS ROAD TO ACTIVE TRAVEL

4.1. GCC have stated that the proposed off-site highway works to Priors Road, comprising a controlled toucan crossing and shared footway / cycleway on the western side of the carriageway to link with the existing signposted cycle route on Whaddon Road (PFA drawing H628/06 Rev B); and proposed highway works to Harp Hill, comprising a new section of footway on the northern side of Harp Hill providing a link between Cheltenham Footpath 86 and the existing footway on the northern side of Harp Hill (PFA drawing H628/05 Rev A); be secured through a planning condition and delivered by a Section 278 agreement prior to first occupation of any dwelling.

4.2. The TA had suggested that RHL would provide a financial contribution to these off-site works; this is still their preference with the level of contribution representing 100% of the cost of the works. However, if a planning obligation is not an option, then RHL would accept that these works be secured by an appropriately worded condition.

5. OFF SITE VEHICLE MITIGATION

5.1. The highway authority has expressed caution is needed on the over reliance of the Junctions 9 modelling of the double roundabout junction of Priors Road / Harp Hill / Hales Road / Hewlett Road and in particular the benefits shown from the proposed mitigation scheme which comprises minor widening to the Harp Hill and Hewlett Road approaches to the junction.

5.2. Whilst GCC confirm that the modelling results of the mitigation have been correctly applied, they consider that in practice the proposed mitigation would not deliver the benefits shown, as the widening is modest and would unlikely change a driver's approach position in any meaningful manner.

5.3. The assessment of mini roundabouts and linked double roundabouts in Junctions 9 is recognised as being difficult to model as the nature of such junctions differ from place to place.

5.4. Paragraph 13.2.1 of the Junctions 9 user guide, 'T-shaped mini roundabouts', raises concerns when modelling mini roundabouts where unbalanced flows can result in roundabouts operating like a priority junction. The paragraph states that:

> **"The most common case is where the junction has a T-shape, particularly if a mini-roundabout replaces an older T-junction and has little or no deflection for the straight-ahead movement(s). At such sites, some drivers may continue to treat the junction as if the original priority system is still partially in place. If this is the case, consider adding a suitable intercept correction to the relevant arms. Otherwise the capacity of these arms may be underestimated by the model."**

5.5. The mini-roundabout model is based on research carried out in the late 1990s. The Junctions 9 user guide recognises that some users noted a tendency for this model to underestimate capacity.

5.6. For 'linked roundabouts' the Junctions 9 user guide states at 13.4.2 that:

> **"Please note that this model is an analytical one rather than being based on empirical studies. As always, you should apply engineering judgement to the application of the model and to the interpretation of the results. Particularly at very closely spaced junctions, there may be interactions between the two junctions that cannot be modelled."**

5.7. To address these recognised shortcomings with assessing the Priors Road / Harp Hill / Hales Road / Hewlett Road double roundabout using Junctions 9, PFA commissioned Systra to build a detailed Paramics Discovery model of the junction for the weekday AM and PM peaks utilising the traffic survey data.

5.8. It is considered that the Paramics Discovery model will provide a better assessment of the operation of the junction and will provide a better understanding of the likely impacts of the additional traffic from the proposed development.

5.9. The Systra Technical Note detailing the 2019 base model development and the 2024 model forecasts both without and with the proposed development is reproduced at **Appendix E**.

5.10. The 2019 base model was created to reflect the weekday AM peak (07:00-10:00) and PM peak (16:00-19:00) periods. The model calibration and validation showed a very good match between modelled and observed turning counts and queue lengths.

5.11. A 2024 reference case model was created applying background TEMPRO traffic growth and a 2024 with development model was creating by adding the development related traffic to the 2024 reference case model.

5.12. The modelling results shows that with the proposed development some additional queuing would occur on the Harp Hill and Hales Road approaches to the junction in the AM peak, and the Hewlett Road approach in the PM peak. The additional queuing can be seen to be less than 10 vehicles and considered unlikely to result in significant delays that can be considered 'severe' in the context of NPPF paragraph 109.

5.13. Notwithstanding the above it is known that Harp Hill is used by "rat-running" traffic travelling between the A40 London Road and B4075 Priors Road via Greenways Lane. It is likely therefore that some of this "rat-running" traffic would be displaced as a result of the proposed development, given that any additional delays on Harp Hill will make "rat-running" less attractive.

5.14. It is considered appropriate therefore to focus any mitigation on enhancing the traffic calming measures on Greenway Lane as opposed to increasing the capacity of the Harp Hill approach to the B4075 roundabout on Priors Road. This will need to be discussed with GCC to establish what further traffic calming measures could potentially be introduced and the level of financial contribution required.

5.15. GCC in their response considers that the additional traffic from the proposed development would result in unmitigated harm at the following junctions:

- Priors Road / Bouncers Lane
- Prestbury Road / Tatchley Lane / Deep Street / Blacksmiths Lane / Bouncers Lane

- A40 London Road / Old Bath Road / Hales Road

5.16. The additional traffic from the proposed development passing through these three junctions in the AM and PM peak hours is relatively small, as can be seen from the **Tables 5.1 & 5.2** below.

Table 5.1: Development Traffic Proportion – AM Peak

Junction	2024 Traffic passing through junction	Development Traffic	% Development Traffic
Priors Road / Bouncers Lane	1,521	34	2.24%
Prestbury Road / Tatchley Lane / Deep Street / Blacksmiths Lane / Bouncers Lane	2,003	30	1.50%
A40 London Road / Old Bath Road / Hales Road	2,246	54	2.40%

Table 5.2: Development Traffic Proportion – PM Peak

Junction	2024 Traffic passing through junction	Development Traffic	% Development Traffic
Priors Road / Bouncers Lane	1,555	34	2.19%
Prestbury Road / Tatchley Lane / Deep Street / Blacksmiths Lane / Bouncers Lane	2,000	30	1.50%
A40 London Road / Old Bath Road / Hales Road	2,349	54	2.30%

5.17. When looking at the results of the capacity assessments within the TA it is considered that the additional traffic from the proposed development would not result in any significant impacts in terms of capacity or highway safety.

5.18. The 2024 future year assessment year was agreed as part of the scoping study; it represents five years after the date of registration of the planning application and included TEMPRO traffic growth and committed developments in the area in accordance with the NPPF Planning Practice Guidance for Transport Assessments. The request by GCC for a 2031 assessment is therefore considered an unreasonable request.

6. RESIDENTIAL TRAVEL PLAN

6.1. The Residential Travel Plan has been updated with more ambitious targets and further measures to encourage sustainable travel. These include the offer of Personalised Travel Planning (PTP) to residents, an annual promotional event and newsletter, and the offer of a £100 'Sustainable Travel Voucher' per residential unit towards either the purchase of bicycles or equipment from a local cycle shop or a bus pass for use on local bus services.

6.2. The updated Residential Travel Plan (H628-DOC02-TP Issue 2) has been submitted as a separate document alongside this TA Addendum.

Appendices

Appendix A

Connection to Prior's Road
see inset below

Open Space/Play Area

Open Space/Play Area

Open Space

HARP HILL

Greenway House

The Oaks

N

Inset

Key:

- Existing Public Right of Way
- Principal Access
- Pedestrian Access
- Possible Emergency Access
- Existing Trees Retained
- Existing Hedgerow Retained
- Proposed Trees
- Proposed New Native Hedgerows
- Residential
- Garages
- Proposed Indicative Landscaped Drainage Pond
- Primary Street (with road narrowing to avoid Root protection Zones)
- Re-graded land with new tree planting
- Proposed Bound Gravel footpaths should be designed to minimise the section of hedgerow to be removed.
- Proposed 3m cycle link to Prior's Road
- Root Protection Areas

Site Name: Land at Oakley Farm	Drawing Number: 333.P.3.9		Revision: E
Drawing Title: Illustrative Masterplan	Drawn By: POK	Date: 01.08.2019	Scale: 1:2000@A3

RobertHitchins
The Complete Development Solution
The Manor, Boddington, Cheltenham, Gloucestershire, GL51 0TJ
Tel: 01242 680694
www.robert-hitchins.co.uk

Appendix B

GCC Highways Planning Liaison Officer

Comment Date: Tue 18 Aug 2020

RECOMMENDATION: Further information

The application proposes upto 250 dwellings with all matters reserved apart from access. The site does not form part of the adopted Joint Core Strategy.

The access strategy can be separated out into key topics of consideration.

Immediate Pedestrian / Cycle access

The application proposes a shared use cycleway/footway on to Priors Road. Insufficient detail as been provided on this connection. Drawing H828/06 (in appendix H) show part of this link, but no dimensions are provided, a comprehensive drawing showing the full length and width is required. It also shows a new toucan crossing and cycleway, the applicant should show details of the cycleway width and design standards, and the visibility of the crossing given the adjoining street trees. Additionally, the proposal oversails the existing public footpath, this is important as it is unlawful to cycle on a footpath, therefore the owner of the site would need to convey a higher access right to allow cycling to occur. Without higher rights existing the site would reply on Harp Hill for cycle access only which is not considered to be suitable due to the gradient.

Immediate Vehicle Access

The proposal provides a new bellmouth onto Harps Hill, this is supported with visibility splays using the 85th percentile approach speeds. The proposal however fails to provide any details of the dimension of the access or any tracking details and as such this access cannot be agreed. The access also needs to account for the entry into the site, observation indicates that there is a considerable gradient from the access into the site. The applicant has provided an indicative long section this shows a 1 in 20 gradient onto Harp Hill, however to access the majority of the development 160m of 1 in 12.5 is shown, this is unacceptable and no greater lengths than 30m are permitted at that gradient, additionally 1 in 20 should be maintained at the junction. The information submitted is lacking in terms of detail of the access and the indicative sections shows significant challenges which even with considerable earth works would be unacceptable.

Improvements to Harp Hill and Priors Road to Active Travel

New footway is proposed on Harp Hill and Cycleway improvements made to Prior Road including a new toucan crossing. The applicant proposes to address these through a planning obligation as a contribution towards the proposals. The Highway Authority is not satisfied through this approach, the works are necessary to deliver the proposal and as such they should be secured through a planning condition and delivered by a section 278 agreement prior to the first occupation of any dwelling. Therefore, any permission granted should include a condition requiring the applicant to deliver the works define in appendix H and I of the TA.

Off Site Vehicle Mitigation
The TA assesses several junctions in accordance with the agreed scoping paper, the applicant has concluded that there is an impact at the junction of Harp Hill/Priors Road/Hales Road and Hewlett Road which requires mitigation and all other junctions assessed will experience no impact. A drawing of a mitigation scheme for the above junction is provided in appendix R of the TA and the applicant proposes to pay the Highway Authority to deliver this scheme. The Highway Authority does not share these conclusions nor the form of scheme delivery as the development requires it to facilitate access, therefore is should be secured through a planning condition and delivered through a section 278 agreement.

The Highway Authority has reviewed the mitigation scheme in appendix R. It is accepted that the Junction 9 modelling report indicates that the scheme is beneficial however caution is needed on the over reliance of the model and practical consideration is also needed on the likely implications of the scheme to drivers.

Recognising that the AM peak is most sensitive in this instance the correct comparison of junction performance through modelling along is a comparison of table 7.2 scenario 2 and table 7.5 scenario 3A. This looks at a 2024 scenario without development and with development and mitigation, the modelling demonstrates that mitigated scenario shows an erosion of capacity on the east roundabout on all arms.

When considering the actual mitigation scheme it is considered that the modelling results are likely to be realised and the junction is more likely to form as recorded in the current geometry as shown in table 7.5 scenario 3. The proposal widens the "flare" length and "entry width" as defined in CD116 of the Design Manual for Roads and Bridges, however due to the reverse curve these benefits do not result in any change to the give way point and the widening is modest so is unlikely to change a drivers approach position in any meaningful manner. Therefore the modelling result of the mitigation scheme are correct by virtual of the method adopted, but in practice is unlikely to actually change in driver behaviour, hence the Highway Authority considers the no mitigation reporting to be more realistic and this shows significant capacity erosion as a result of the scheme.

Additionally, a review of the modelling outputs shows unmitigated harm at the following junctions:

- Priors Road / Bouncers Lane
- Prestbury Road / Tatchley Lane / Deep Street / Blacksmiths Lane / Bouncers Lane
- A40 London Road / Old Bath Road / Hales Road

The above junctions should be re appraised and suitability mitigated with a scheme that has the agreement of the Highway Authority. Additionally, a further

capacity test is required recognising the lack of local plan designation, the future assessment year should be 2031 to match the local plan assessment period, and all assessment should be undertaken using Tempro 7.2b which is the latest release. This may be best reviewed using the GCC Saturn model.

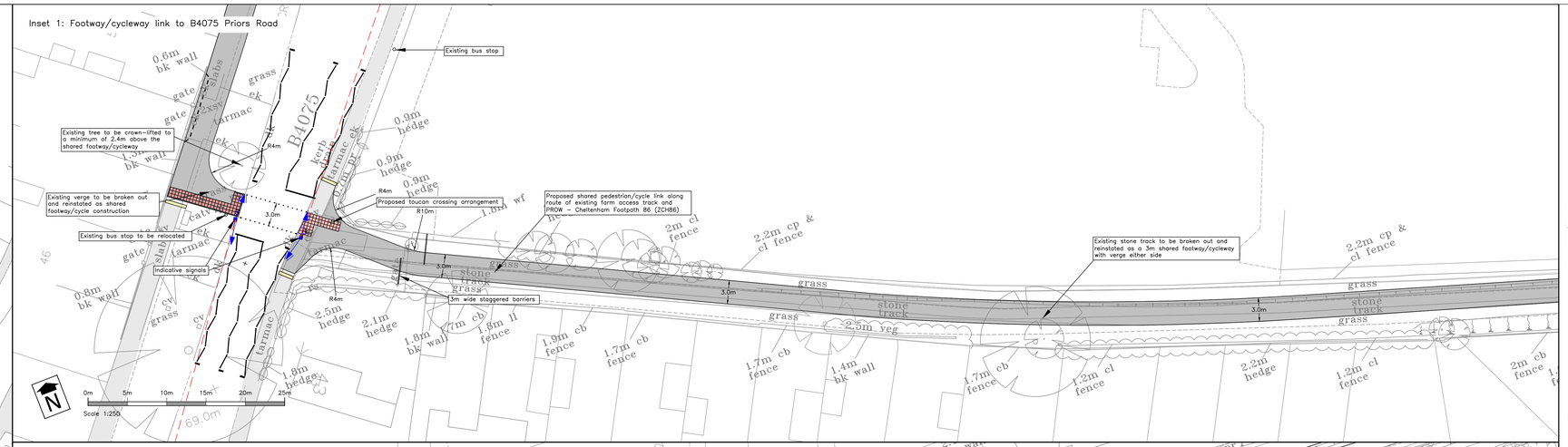
The applicant has submitted a travel plan to reduce the need to travel and encourage sustainable mode of travel. The applicant has indicated that it their intension for make payment to The Highway Authority to deliver this plan on their behalf, this approach overall is considered to be acceptable. A review of the TP shows that it lacks ambition, the targets are too low and doesn't look to promote personal travel planning as a primary treatment. The travel plan needs to be updated to set an ambitious agenda and series of interventions.

It is therefore necessary for the applicant to review the proposal in light of the above comments and submit a TA addendum and new TP addressing these points.

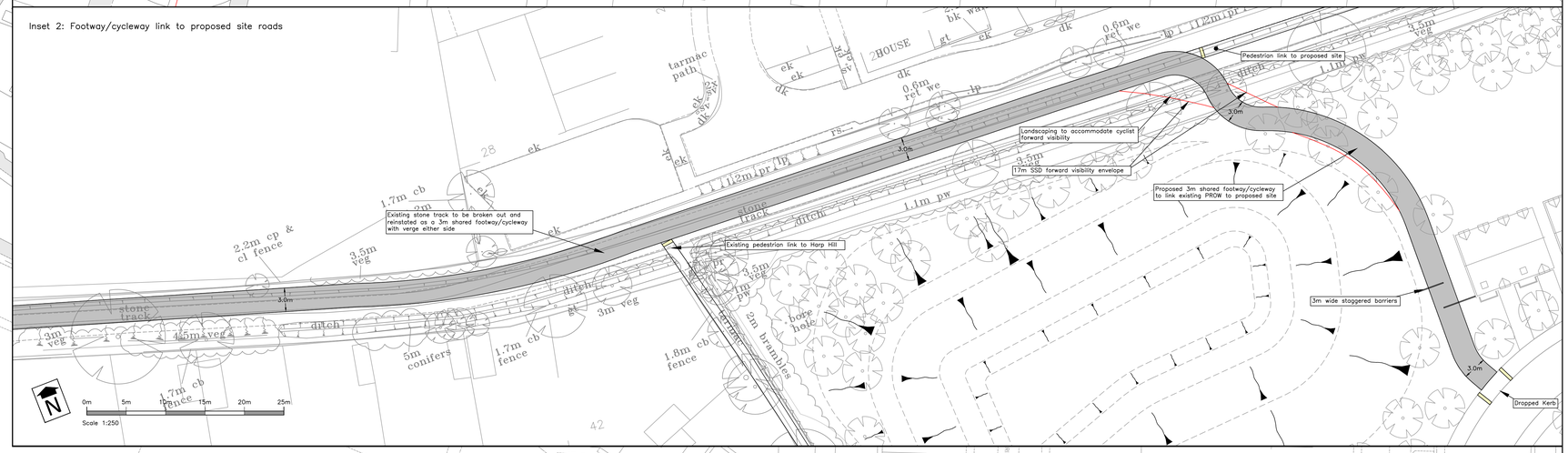
It is also brought to the applicants attention that Manual for Gloucestershire Streets (July 2020) is available which includes details which may assist the preparation of a TA addendum.

Appendix C

Inset 1: Footway/cycleway link to B4075 Priors Road



Inset 2: Footway/cycleway link to proposed site roads



PFA consulting

Stratton Park House, Wanborough Road
Swindon, SN3 4HG

Telephone
01793 828000

Website
www.pfaplc.com

Preliminary
This drawing is produced for initial discussion and illustrative purposes only, and should not be relied upon for tender or pricing purposes.

NOTES

1. Based on Topographical Survey undertaken by Ruxton Surveys shown in Drawings 18169/01–03 dated November 2018, supplemented by Detail OS Mapping.
2. Site Layout based on Drawing Number 333.P.3.9 Rev E by Robert Hitchins, dated 01/08/2019.
3. Footway/cycleway link to be constructed in accordance with the latest version of LTN 1/20.
4. Toucan Crossing to be designed in accordance with Traffic Signs Manual Chapter 6.

KEY

- Existing Footway / Cycleway
- Proposed Footway / Cycleway
- Corduroy Paving

Rev	Date	Description	Drawn	Check
#	21.02.20	First Issue.	RH	ECS
A	26.02.20	Notes amended; drawing status and project title changed.	RH	ECS
B	27.10.20	Plan page size increased; extent of pedestrian/cycle link increased; additional info added; minor amendments.	WDN	PMC

Status
PRELIMINARY

Client
Robert Hitchins
The Complete Development Solution

Project
Land at Oakley Farm, Battledown, Cheltenham

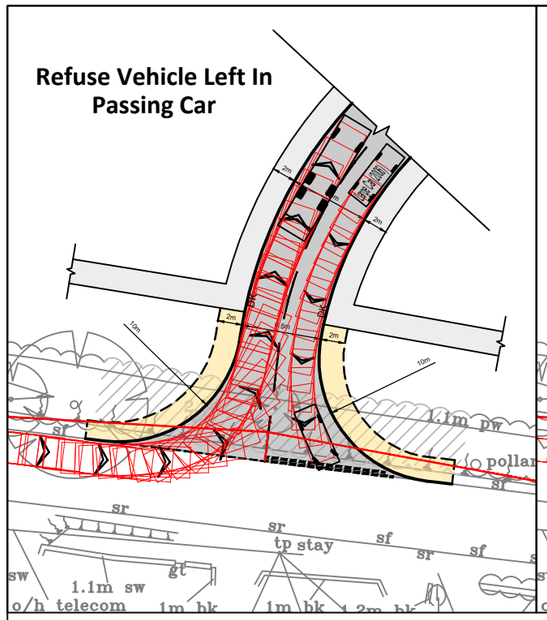
Drawing Title
B4075 Priors Road Pedestrian/Cycle Linkages

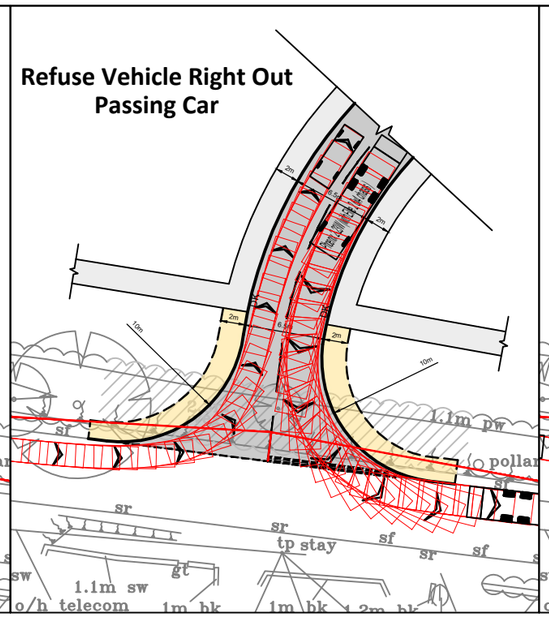
Drawing No.
H628/06 Rev B

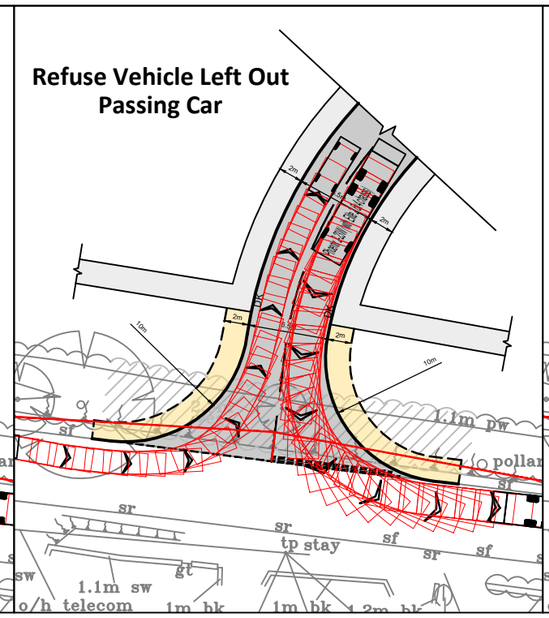
Date: February 2020 | Scale: As shown @ A0

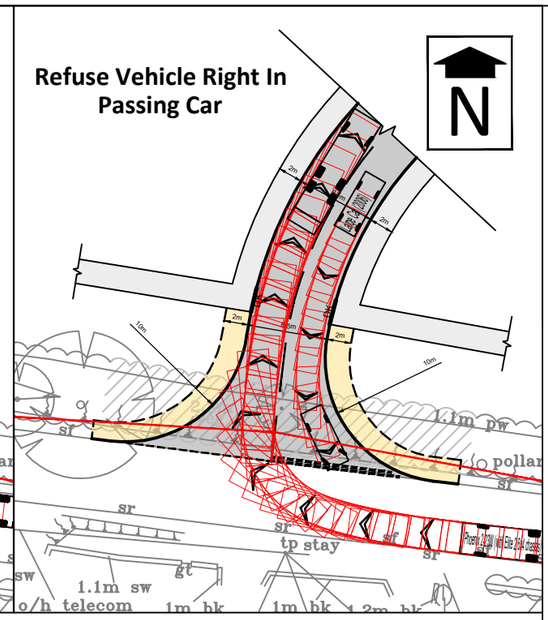
E-Mail: wnienaber@pfaplc.com

Appendix D

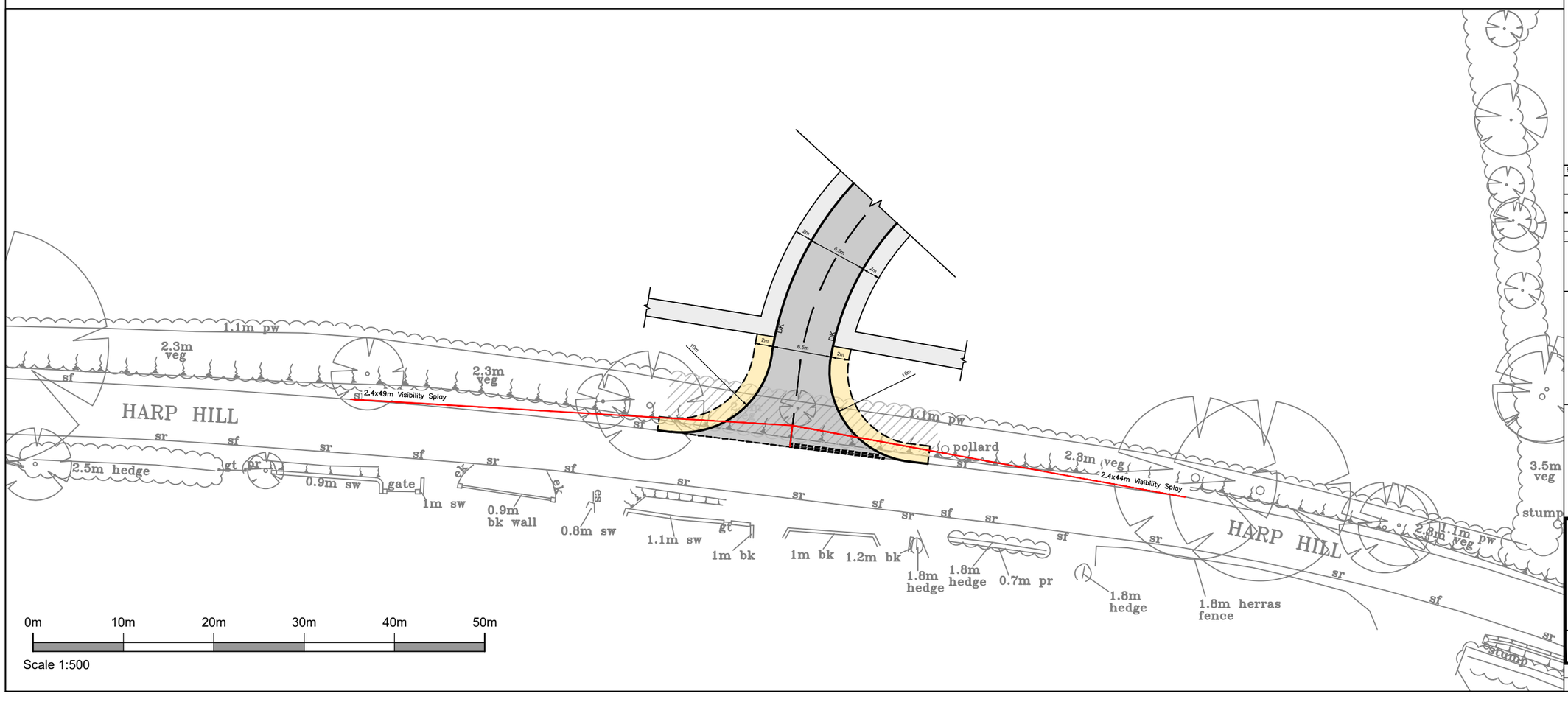








Swept Path Diagrams



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Stratton Park House, Wanborough Road
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Telephone
01793 828000

Website
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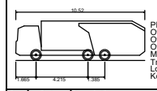
NOTES

1. Based on Topographical Survey undertaken by Ruxton Surveys shown in Drawings 18169/01–03 dated November 2018 and the Illustrative Masterplan produced by Robert Hitchins Ltd shown in drawing 333.P.3.9 dated August 2019.

2. Visibility Splays based on 85th %ile speeds recorded in September 2019.

KEY

- 2.4x49m/2.4x44m Visibility Splays
- Proposed Carriageway
- Proposed Footway/Footpath
- DK Dropped Kerb
- Proposed Service Margin



Phoenix 2-23W (with Elite 2 6x4 chassis)

Overall Length	10.520m
Overall Width	2.530m
Overall Body Height	3.211m
Min Body Ground Clearance	0.416m
Track Width	2.530m
Lock to lock time	4.00s
Kerb to Kerb Turning Radius	9.950m

Rev	Date	Description	Drawn	Check
D	21/11/20	Access widened to 6.5m	TLH	JA
C	04/11/20	Junction dimensions and vehicle tracking added	TLH	JA
B	26/02/20	Illustrative Masterplan Base Updated and Project Title Changed.	RH	ECS
#	18/10/19	First Issue.	THP	ECS

Status
PRELIMINARY

Client
RobertHitchins
The Complete Development Solution

Project
Land at Oakley Farm, Battledown, Cheltenham

Drawing Title
Preliminary Access Arrangements

Drawing No.
H628/02 Rev D

Date: October 2019 | Scale: 1:500 @ A3

E-Mail: espencer@pfaplc.com

Appendix E

TECHNICAL NOTE

LAND AT OAKLEY FARM, CHELTENHAM

PARAMICS MODEL OF PRIORS ROAD/HARP HILL/HALES ROAD/ HEWLETT ROAD DOUBLE ROUNDABOUT – MODEL DEVELOPMENT AND TESTING NOTE

SUMMARY TABLE	
Client/Project owner	PFA Consulting
Project	Land at Oakley Farm, Cheltenham
Title of Document	Paramics Model of Priors Road/Harp Hill/Hales Road/ Hewlett Road Double Roundabout – Model Development and Testing Note
Type of Document	Technical Note
Date	27/10/2020
Reference number	GB01T17L96/13/10/2020
Number of pages	20

1. INTRODUCTION

SYSTRA Ltd (SYSTRA) were commissioned by PFA Consulting (PFA) to develop a Paramics Discovery model of the double roundabout junction at Harp Hill, Priors Road, Hales Road and Hewlett Road and carry out testing for the proposed Land at Oakley Farm, Battledown, Cheltenham development.

2. 2019 BASE MODEL DEVELOPMENT

2.1 Data

2.1.1 PFA provided turn count and queue data for the Harp Hill/Priors Road/Hales Road/Hewlett Road junction, the surveys were carried out by Axiom Traffic Limited on Thursday 26th September 2019, the survey videos were also supplied.

2.1.2 PFA also provided OS Mastermap drawings of the study area.

3. MODEL NETWORK DEVELOPMENT

3.1.1 The Base Model was developed using Paramics Discovery version 23.

3.2 Time Periods

3.2.1 The model time periods were defined as follows, based on the survey data collected:

- AM – 07:00-10:00
- PM – 16:00-19:00

3.3 Network Building

3.3.1 The base network road layout was developed using the OS mapping information, survey video information, aerial mapping and Google Streetview.

3.3.2 The survey data and mapping information allowed the road network to be refined by adjusting kerb lines to accurately reflect what is on the ground and to identify accurate lane point positions and lane arrangements on approach to junctions.

3.3.3 Default lane point positions were altered where relevant throughout the model to better reflect vehicle behaviour through junctions. Lane points were altered throughout the model to achieve more realistic movements and vehicle trajectories. Comparisons were made against mapping information and survey camera information to reflect on site conditions.

3.3.4 All the links in the model were coded as Urban 30mph.

3.3.5 The model extents are shown in Figure 1.

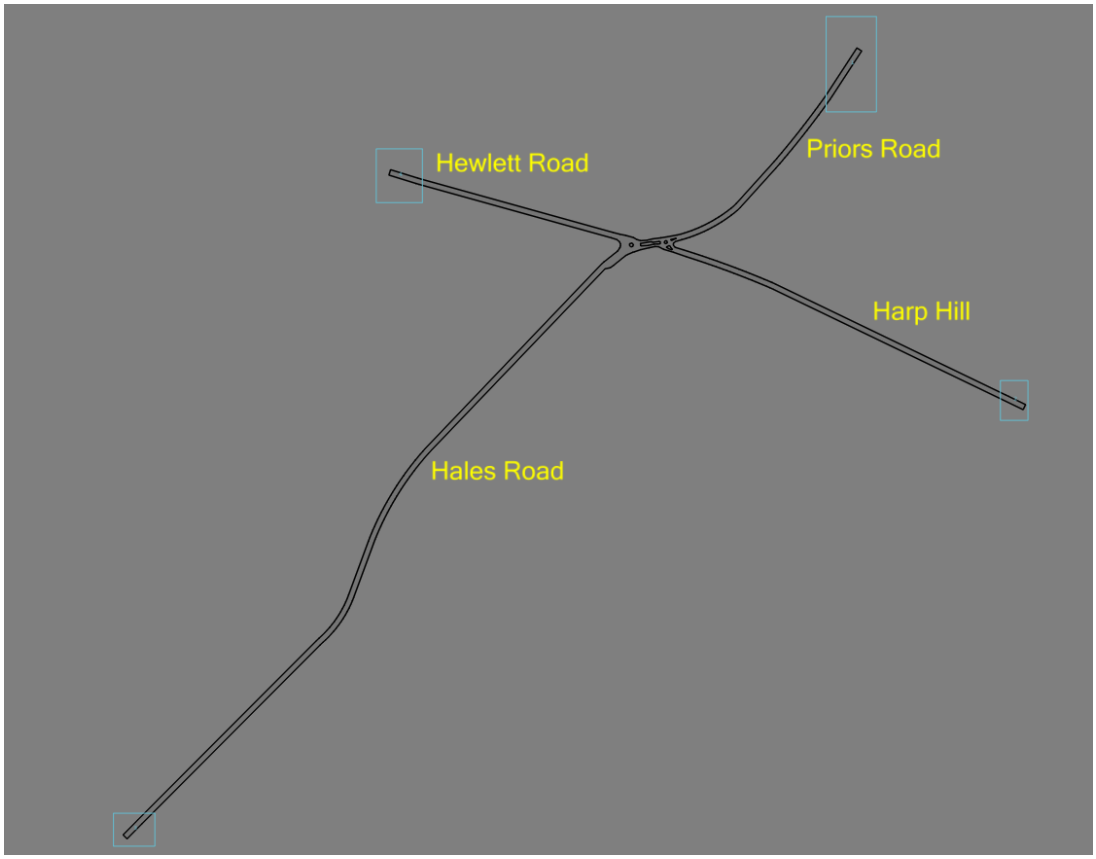


Figure 1. Model Extents

3.3.6 The detail of the roundabout coding is shown in Figure 2.

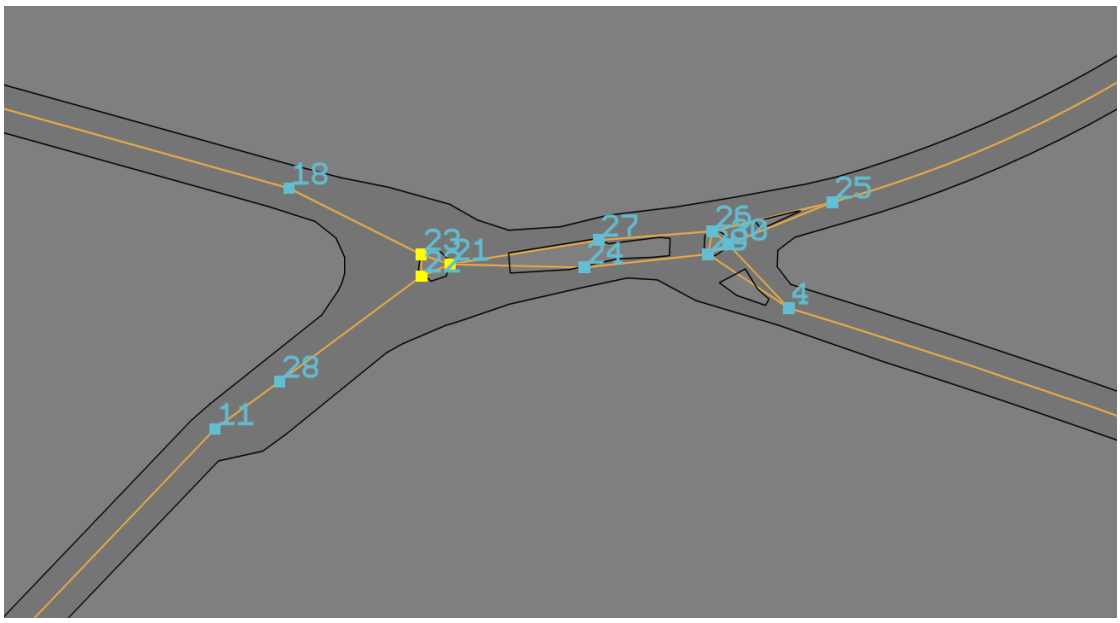


Figure 2. Roundabout Coding Detail

3.3.7 During the review of the survey videos, it was noted that the vehicles on Priors Road often arrive at the mini roundabout in groups. It was determined that this is due to the nearby signalised junction to the north east on Priors Road at the Sainsbury's Access. In order to have vehicles arriving at the mini roundabout on Priors Road in groups in the model, a set of dummy signals was included at node 7 which breaks up and groups the traffic as observed.

3.4 Model Parameters

3.4.1 A number of model parameters were initially coded in line with microsimulation good practice.

3.4.2 Visibility was applied to the give way links at each junction within the model using a default of 30m, in line with best practice. Junction visibility was checked against Google Streetview and Survey Footage data and in three locations the default value was reduced to match the conditions observed.

- Harp Hill – 0m
- Priors Road – 7.5m
- Hewlett Road – 10m

3.4.3 The 'look-through' parameter allows vehicles to calculate their gap acceptance by seeing through a link onto the next upstream link to judge suitable gaps in opposing traffic. The look through parameter has been used in two locations in the model, both on the eastern roundabout.

- 26:30

3.5 Vehicle Types

3.5.1 The vehicle types represented in the model are:

- Car
- Light Goods Vehicles (LGV)
- Medium Goods Vehicle (MGV)

- Heavy Goods Vehicle (HGV)
- Coach

3.5.2 Each vehicle type has individual dynamics such as maximum speed and acceleration which can be edited. During the calibration process no changes were made to the default settings within Paramics Discovery 23.

3.6 Public Transport

3.6.1 No fixed route buses were coded explicitly in the model.

3.7 Routeing Settings

3.7.1 There is no route choice in the model and therefore all routeing setting were left at default.

4. MATRIX DEVELOPMENT

4.1 Zones

4.1.1 Zones are used to control the release and destination of vehicles in the network. The model trip matrix is composed of vehicles travelling from zone to zone. The 2019 Harp Hill Base Model has 4 zones representing the origin and destination of trips within the model study area.

- Zone 1 – Priors Road
- Zone 2 – Harp Hill
- Zone 3 – Hales Road
- Zone 4 – Hewlett Road

4.2 Matrix Levels

4.2.1 Traffic demand is released by vehicle type assigning demand from different matrices. More than one vehicle type can be assigned to a matrix, as long as the proportion of the demand for each type is set.

4.2.2 Two matrix levels were developed for the 2019 Harp Hill Base Model to reflect the traffic demand in the model:

- Matrix 1 – Car and LGV
- Matrix 2 – MGV, HGV and Coach

4.2.3 The matrices were proportioned based on the turn count data. The proportions used are shown in Table 1.

Table 1. Vehicle Type Proportions

Matrix	Vehicle Type	AM Period (07:00-10:00)	PM Period (16:00-19:00)
Matrix 1	Car	88.6%	90.8%
	LGV	11.4%	9.2%
Matrix 2	MGV	75.8%	90.8%
	HGV	20.9%	1.3%
	Coach	3.3%	7.9%

4.3 Matrix Development

4.3.1 The trip matrices were developed directly from the turn count data with each counted movement equating to a zone to zone movement in the model.

4.3.2 The resulting demand matrices are shown in Table 2 and Table 3.

Table 2. 2019 Base AM Demand Matrices

AM (07:00-10:00) Lights					
		Destination Zone			
		1	2	3	4
Origin Zone	1	0	250	1330	512
	2	245	0	71	262
	3	925	61	0	341
	4	335	173	298	0
Lights Total		4803			

AM (07:00-10:00) Heavies					
		Destination Zone			
		1	2	3	4
Origin Zone	1	0	6	46	13
	2	0	0	3	8
	3	64	8	0	12
	4	3	9	10	0
Heavies Total		182			
Overall TOTAL		4985			

Table 3. 2019 Base PM Demand Matrices

PM (16:00-19:00) Lights					
		Destination Zone			
		1	2	3	4
Origin Zone	1	0	237	1029	361
	2	360	0	69	222
	3	1496	51	0	356
	4	764	200	298	0
Lights Total		**5443**			

PM (16:00-19:00) Heavies					
		Destination Zone			
		1	2	3	4
Origin Zone	1	0	8	29	6
	2	2	0	0	5
	3	15	1	0	5
	4	4	1	0	0
Heavies Total		**76**			
Overall TOTAL		**5519**			

4.4 Demand Release Profiles

4.4.1 Paramics Discovery uses demand release profiles to control the release of traffic onto the network. Profiles were developed to reflect the variation in the traffics flows throughout each model period. These ensured vehicles were released onto the network in each period as surveyed. Profiles were developed using traffic survey information collected in September 2019 and applied in 15 minute intervals to proportion the total demand release from the associated zone.

4.4.2 The observed turn count data was used to produce 24 profiles, one for each zone to zone movement for lights and heavies.

5. MODEL CALIBRATION

5.1.1 The calibration process involves checking all work undertaken on the model network or the observed matrices including the network description, model inputs and parameters, to ensure the model achieves satisfactory representation of traffic flows and network conditions.

5.1.2 The calibration and validation of the model was undertaken by comparing modelled turns to the surveyed data set. The model was run 20 times for each model period using a random seed.

5.2 Base Model Calibration

5.2.1 During the calibration process a number of factors were changed from their default values in order to replicate observed vehicle behaviours. These are listed in the following sections.

5.2.2 Gap acceptance modifiers have been used at some locations in order to reduce the levels of queueing in the model to match the observed conditions, where the vehicles have a tendency to accept relatively small gaps in traffic. The default values are Lane Merge = 4,

Lane Cross = 4 and Path Merge = 3. The Locations where this has been changed from default and the values used are as follows:

- 18::23 – Hewlett Road – Lane Merge = 0, lane Cross = 0, Path Cross = 3

5.2.3 Headway factors have been reduced from the default value of 1 on the following links, this has been done to improve vehicle throughput on the Hales Road approach.

- 28:22 – Headway factor – 0.6
- 22:23 – Headway factor – 0.6

5.3 Calibration Results

5.3.1 Detailed comparisons of observed and modelled turn counts occurred throughout the model development process. Comparisons were made on both a periodic and hourly basis to ensure both the total demand and variation within the modelled time periods were robust. The GEH statistic is used in the calibration of a model to compare the difference between an observed flow and a model assigned flow.

5.3.2 The GEH statistic is defined as:

$$GEH = \sqrt{(M-O)^2}/(0.5 \times (M+O))$$

- M = Modelled Flow
- O = Observed Flow

5.3.3 The GEH statistic is used in preference to the absolute or relative flow difference as it can cope with a wide range of flows. Where an absolute difference of 100 vehicles per hour can be important in a low flow, it is less significant in a flow of several thousand vehicles per hour. The guidelines set out in TAG state that 85% of individual hourly flows, in this case turn counts, should have a GEH of less than 5 in order for a model to be considered acceptable.

5.3.4 Table 4 shows the percentage of turn counts which achieve a GEH value of less than 5 and less than 1. There are 12 eligible turn count comparisons within the study area.

Table 4. Turn Count Comparison

Period	Time (hh:mm)	GEH <1	GEH <5
AM	07:00 - 08:00	100%	100%
	08:00 - 09:00	100%	100%
	09:00 - 10:00	100%	100%
PM	16:00 - 17:00	100%	100%
	17:00 - 18:00	100%	100%
	18:00 - 19:00	100%	100%

5.3.5 Table 4 shows that all turns have a GEH of less than 1, which indicates a very high level of calibration.

6. MODEL VALIDATION

6.1 Introduction

6.1.1 The validation process involves the comparisons of modelled outputs against observed data not used in the model calibration process. To undertake model validation the queue length data was used.

6.2 Queue Length Comparisons

6.2.1 Queue length comparisons were carried out for each of the four approaches for the AM and PM periods and are shown in the following figures.

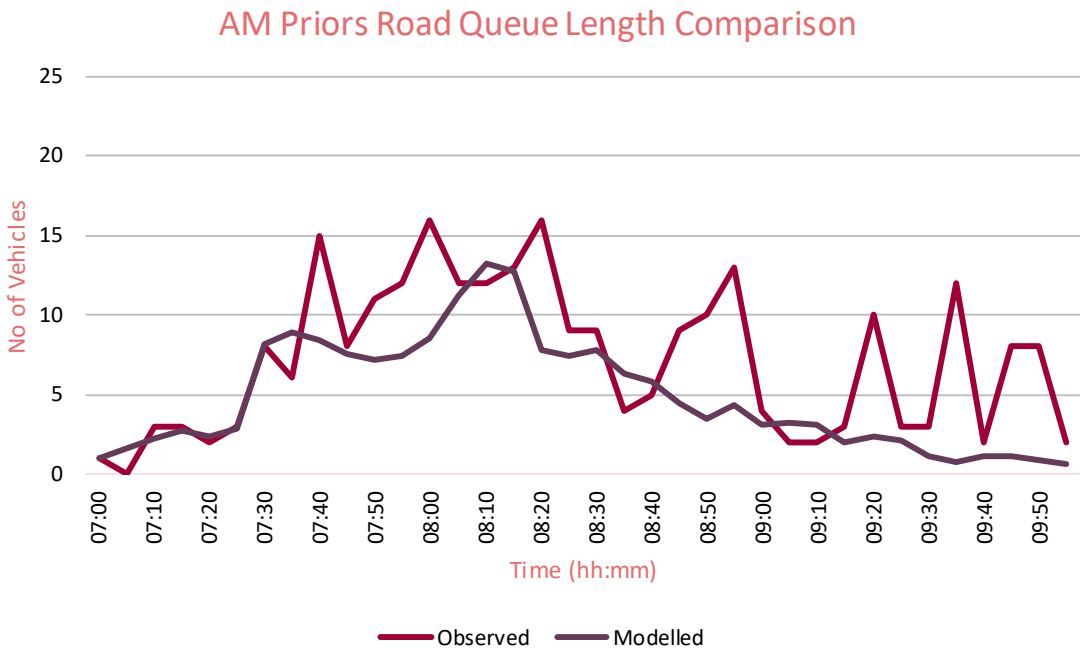


Figure 3. AM Priors Road Queue Length Comparison

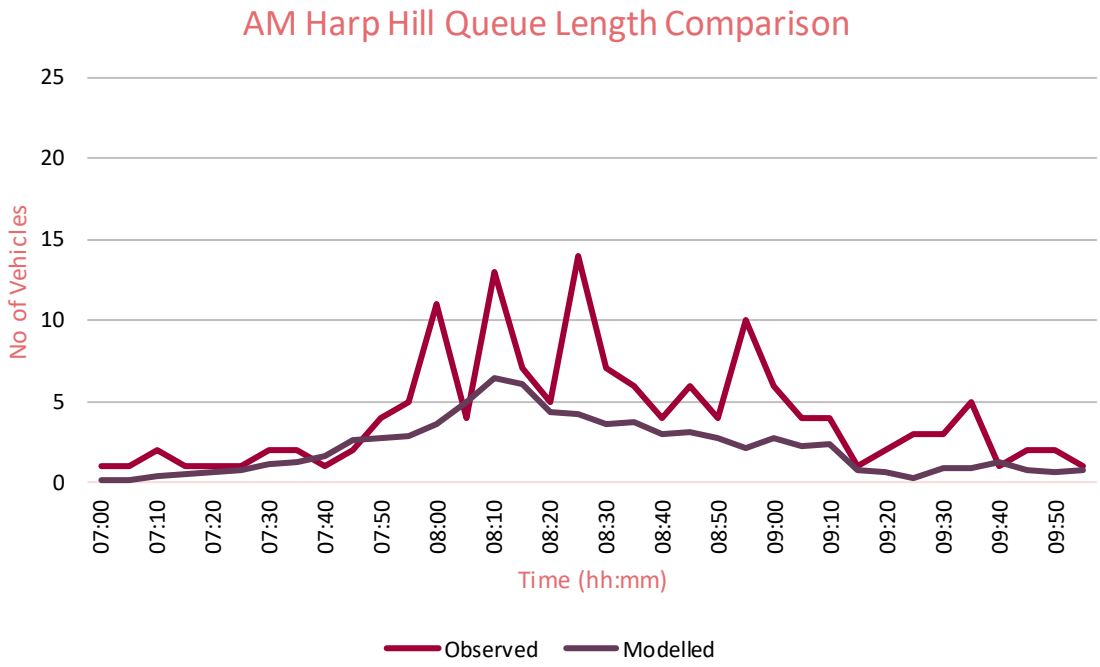


Figure 4. AM Harp Hill Queue Length Comparison

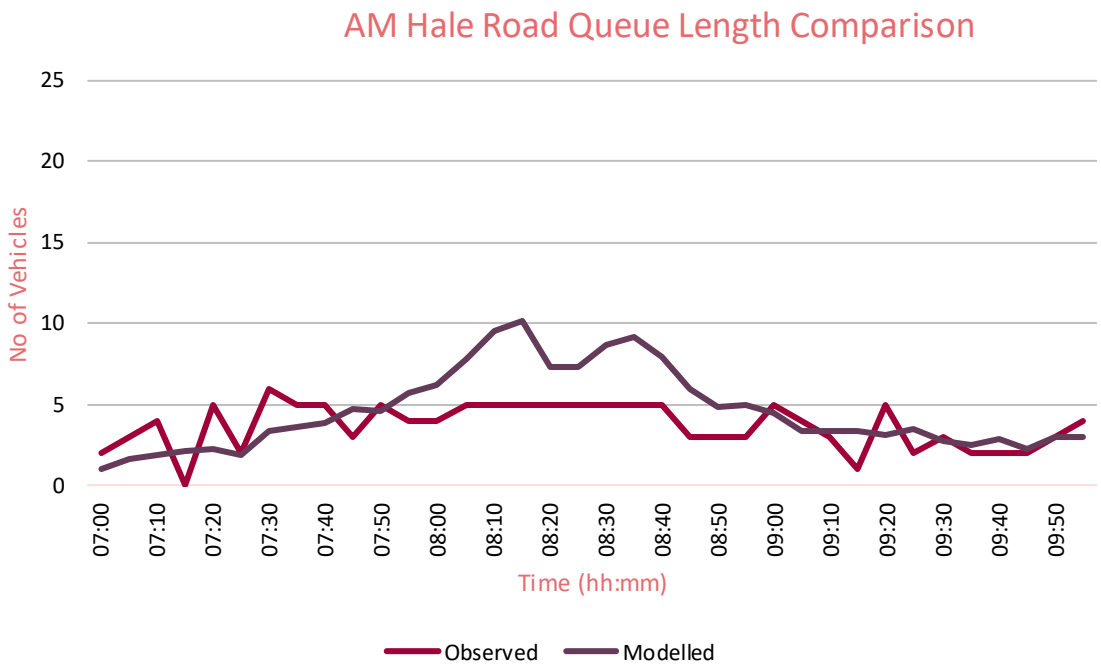


Figure 5. AM Hale Road Queue Length Comparison

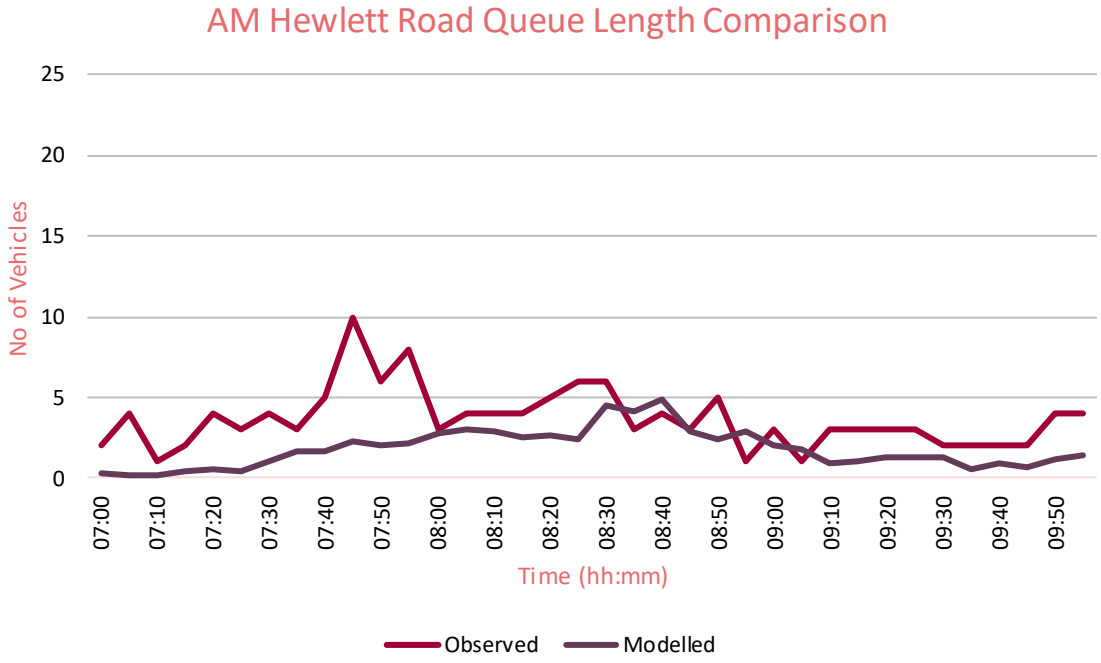


Figure 6. AM Hewlett Road Queue Length Comparison

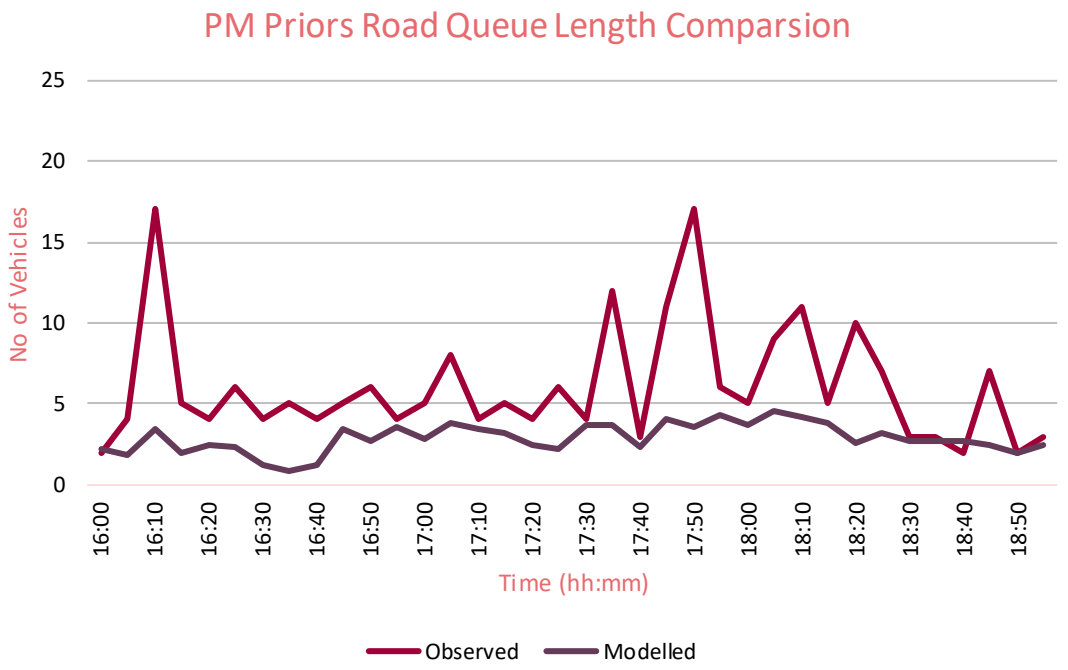


Figure 7. PM Priors Road Queue Length Comparison

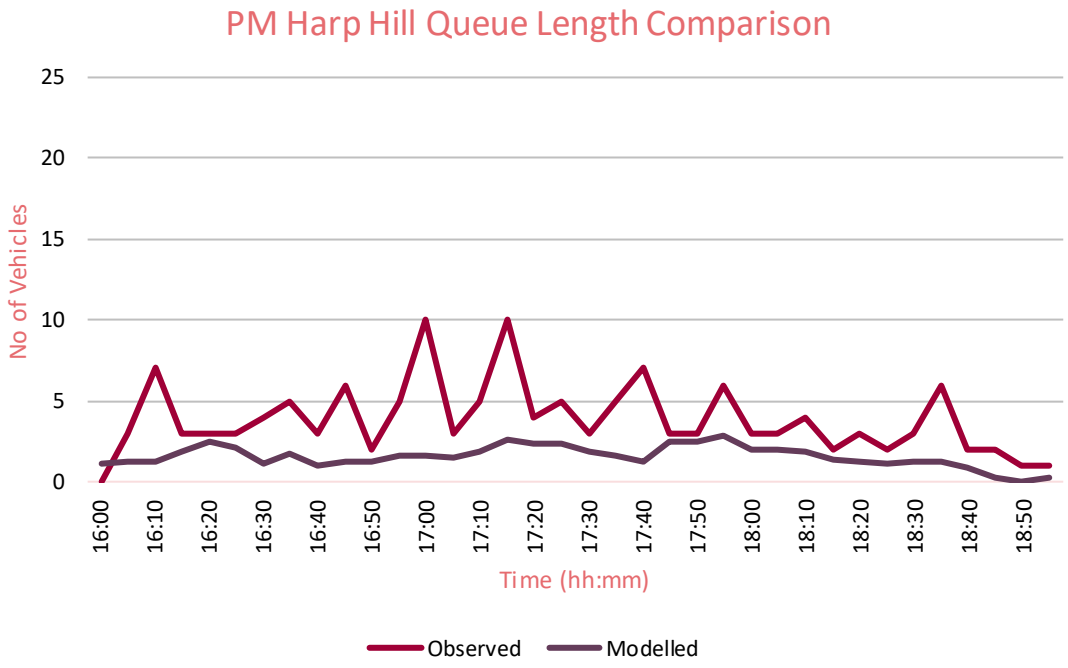


Figure 8. PM Harp Hill Queue Length Comparison

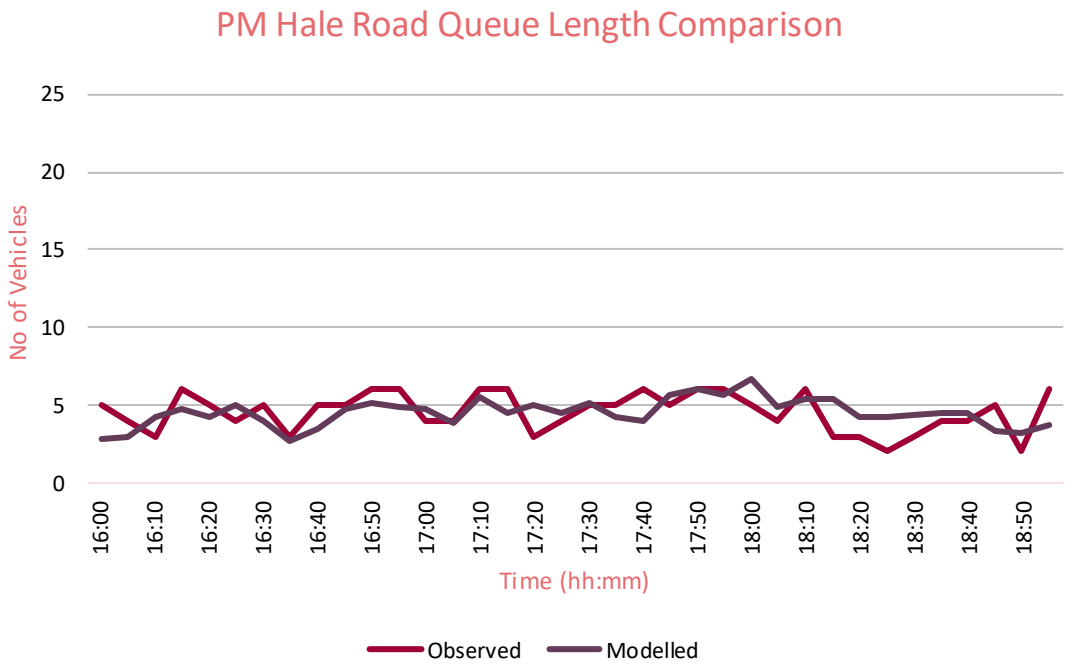


Figure 9. PM Hale Road Queue Length Comparison

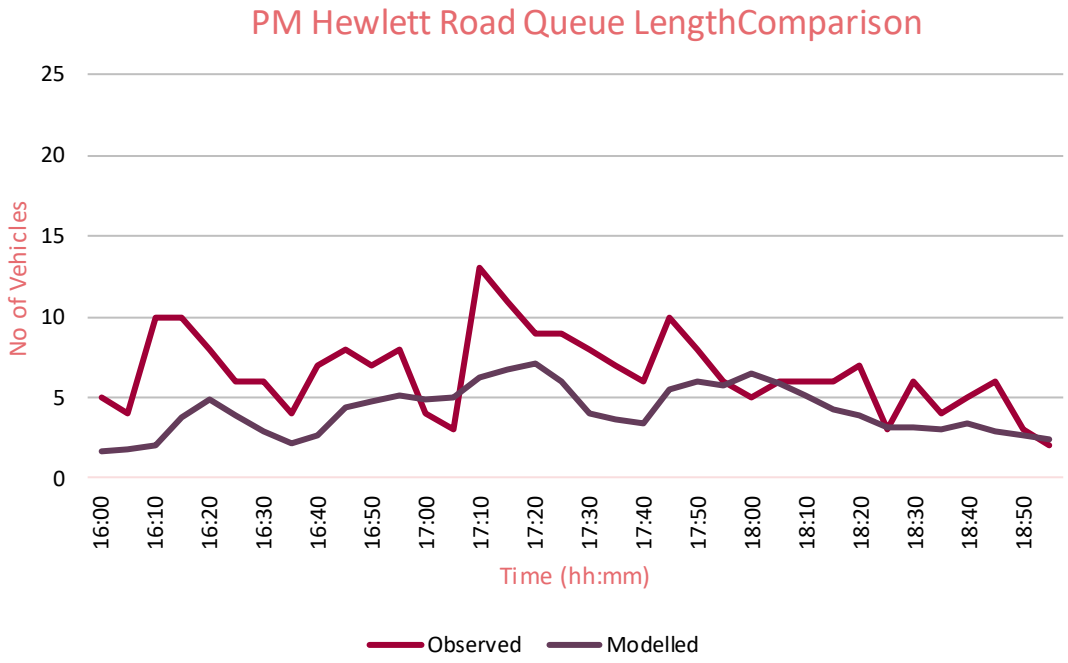


Figure 10. PM Hewlett Road Queue Length Comparison

6.2.2 In general the queue comparison graphs, show a good match between modelled and observed, especially taking in to account the subjective nature of queueing data.

6.2.3 On Hale Road in the AM there is a larger modelled queue than observed. This is because the full extent of the queue cannot be observed from the location of the survey cameras and a maximum of around 5 vehicles has been recorded. In reality it is likely that this queue is longer than recorded and the model reflects this.

6.2.4 On Priors Road and Harp Hill in the PM there are some 'spikes' of increased queue length, observation of the survey video show that these are caused by either extremely tentative drivers or minor incidents such as stalled vehicles which are not reflected in the model.

7. MODEL CALIBRATION/VALIDATION SUMMARY

7.1.1 The 2018 Harp Hill Base models shows a very good match between modelled and observed turn counts and queue lengths and is considered to be an appropriate base for testing the proposed development.

8. 2024 REFERENCE CASE MODEL DEVELOPENT

8.1.1 A 2024 Reference Case model was created in order to have an appropriate base line against which to test the effects of the proposed development.

8.1.2 The 2024 Reference Case network is identical to the 2019 Base Model.

8.1.3 The 2024 Reference Case includes background growth derived from TEMPRO for all modelled movements. The growth factors used were supplied by PFA, and are as below:

- AM = 4.92%
- PM = 4.62%

8.1.4 The resulting 2024 Reference Case matrices are shown in Table 5 and Table 6.

Table 5. 2024 Reference Case AM Demand Matrices

AM (07:00-10:00) Lights					
		Destination Zone			
		1	2	3	4
Origin Zone	1	0	262	1395	537
	2	257	0	74	275
	3	971	64	0	358
	4	351	182	313	0
Lights Total		5039			

AM (07:00-10:00) Heavies					
		Destination Zone			
		1	2	3	4
Origin Zone	1	0	6	48	14
	2	0	0	3	8
	3	67	8	0	13
	4	3	9	10	0
Heavies Total		189			
Overall TOTAL		5228			

Table 6. 2024 Reference Case PM Demand Matrices

PM (16:00-19:00) Lights					
		Destination Zone			
		1	2	3	4
Origin Zone	1	0	248	1077	378
	2	377	0	72	232
	3	1565	53	0	372
	4	799	209	312	0
Lights Total		5694			

PM (16:00-19:00) Heavies					
		Destination Zone			
		1	2	3	4
Origin Zone	1	0	8	30	6
	2	2	0	0	5
	3	16	1	0	5
	4	4	1	0	0
Heavies Total		78			
Overall TOTAL		5772			

9. 2024 DEVELOPMENT MODEL

9.1.1 A 2024 Development model was created to test the effects of the proposed development.

9.1.2 The 2024 Development model network is identical to the 2024 Reference Case Model.

9.1.3 The 2024 development model includes the 2024 Reference Case demand matrices.

9.1.4 The traffic generation for the proposed development was provided by PFA, along with the TRICS information used. The development traffic was included in the model as separate demand sets and is assumed to be made up only of cars. The development traffic amounts to an additional 269 cars in the AM and 299 in the PM. The development traffic matrices are shown in Table 7 and Table 8.

Table 7. 2024 Reference Case AM Demand Matrices

AM (07:00-10:00) Lights					
		Destination Zone			
		1	2	3	4
Origin Zone	1	0	29	0	0
	2	68	0	96	24
	3	0	41	0	0
	4	0	11	0	0
Lights Total		269			

Table 8. 2024 Reference Case PM Demand Matrices

PM (16:00-19:00) Lights					
		Destination Zone			
		1	2	3	4
Origin Zone	1	0	70	0	0
	2	38	0	53	14
	3	0	99	0	0
	4	0	25	0	0
Lights Total		299			

9.1.5 The development trips were profiled hourly using the TRICS data provided, with separate to and from development profiles created and applied.

10. MODEL COMPARISONS

10.1.1 The 2024 Reference Case and 2024 Development models were run 20 times for the AM and PM and queue length results extracted. These are compared to the 2019 Base in the following figures.

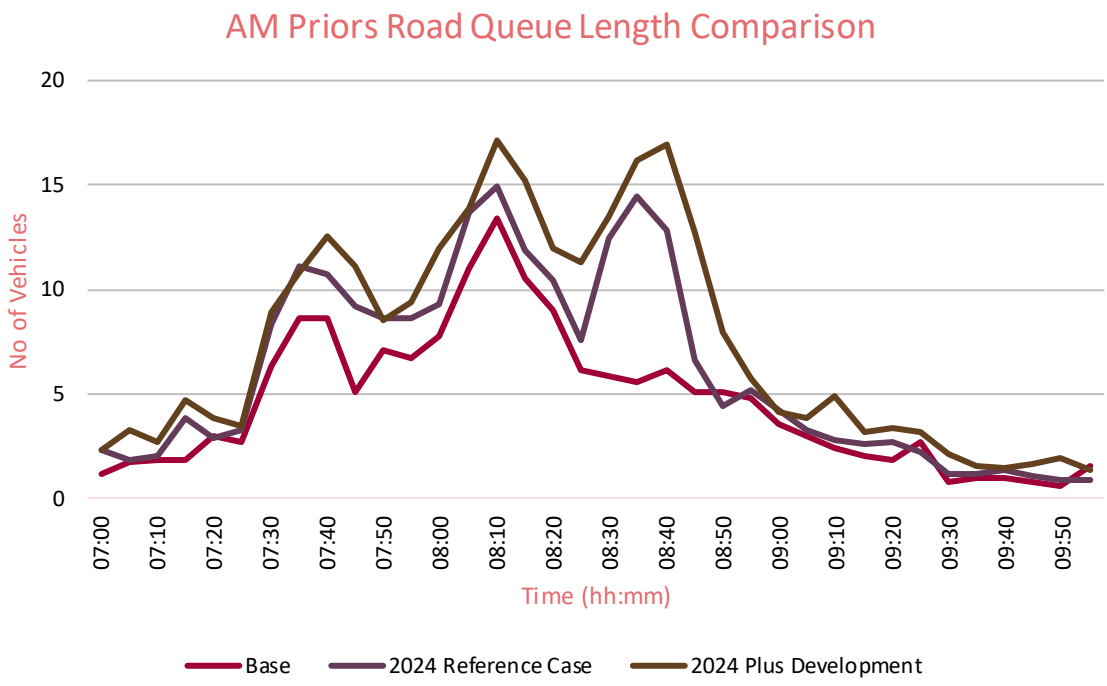


Figure 11. AM Priors Road Queue Length Comparison

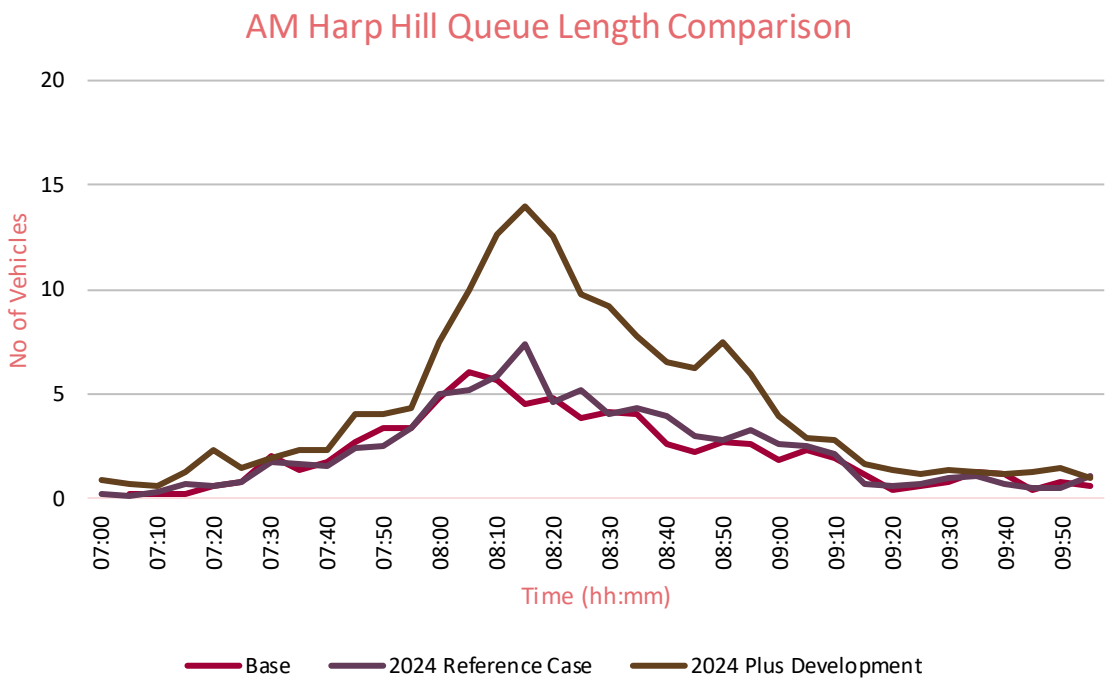


Figure 12. **AM Harp Hill Queue Length Comparison**

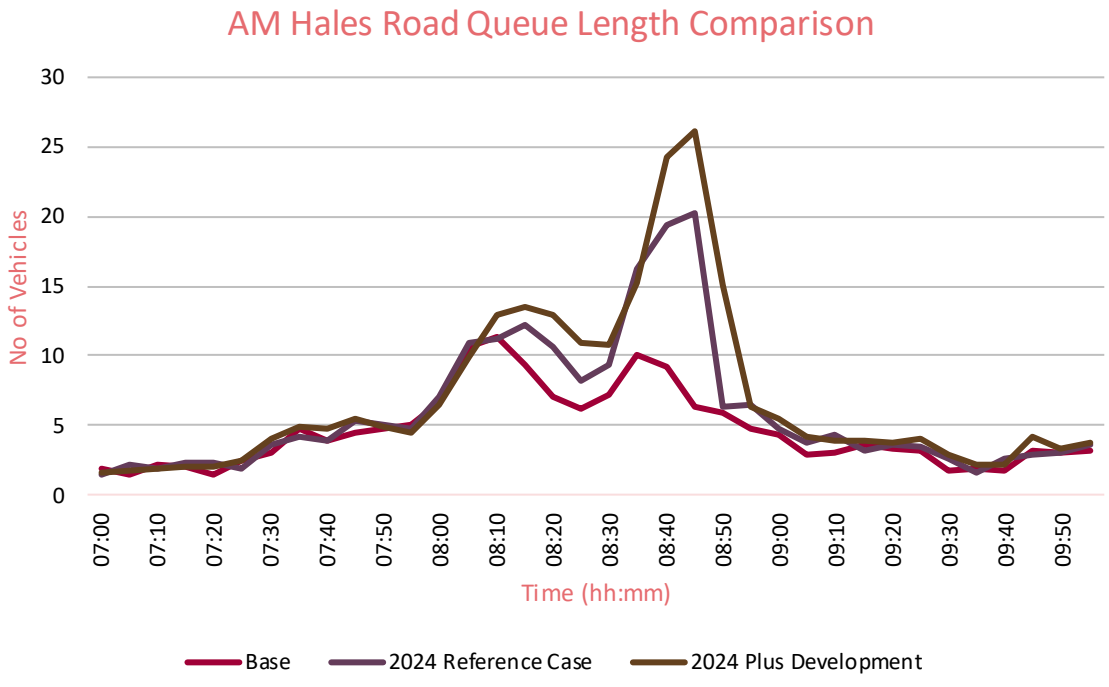


Figure 13. **AM Hales Road Queue Length Comparison**

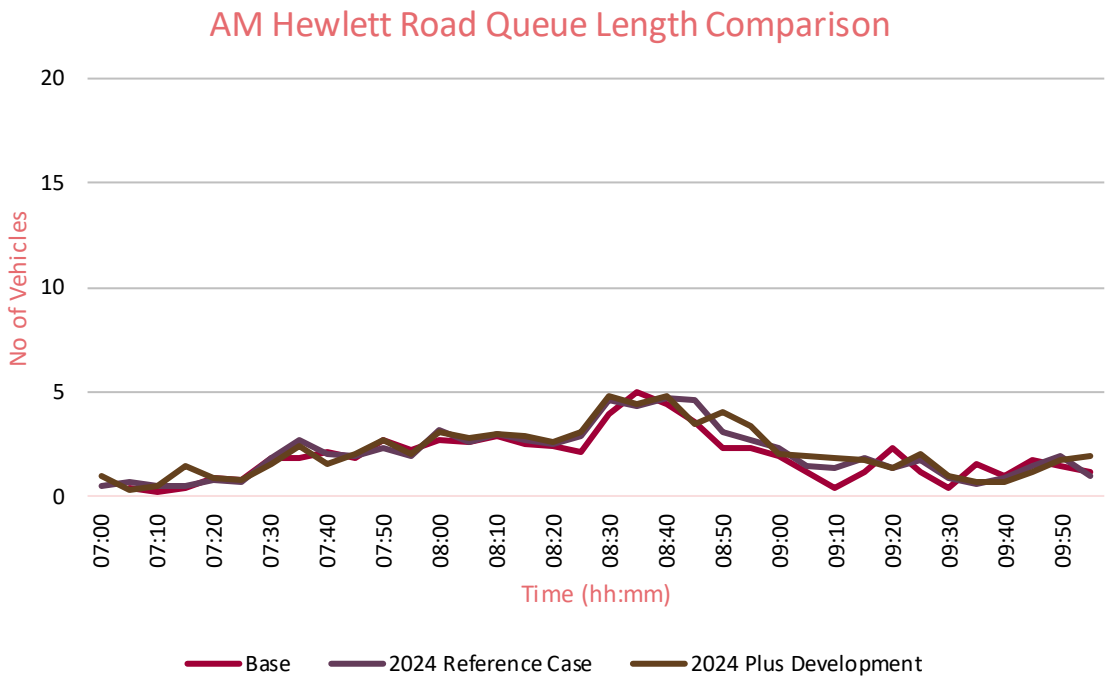


Figure 14. AM Hewlett Road Queue Length Comparison

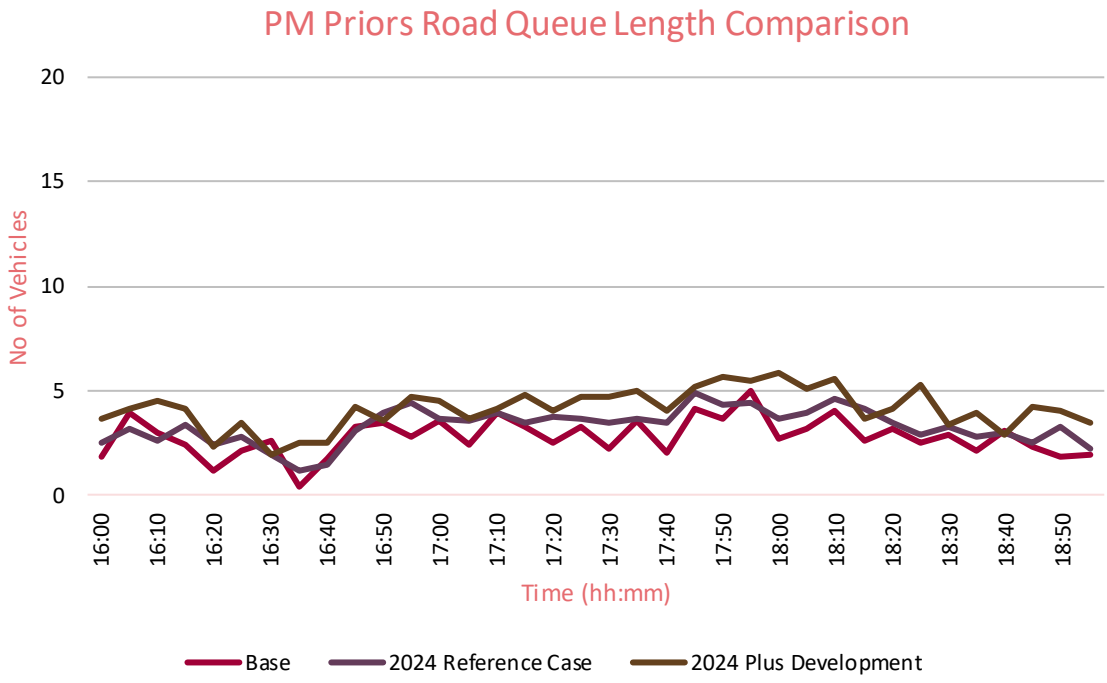


Figure 15. PM Priors Road Queue Length Comparison

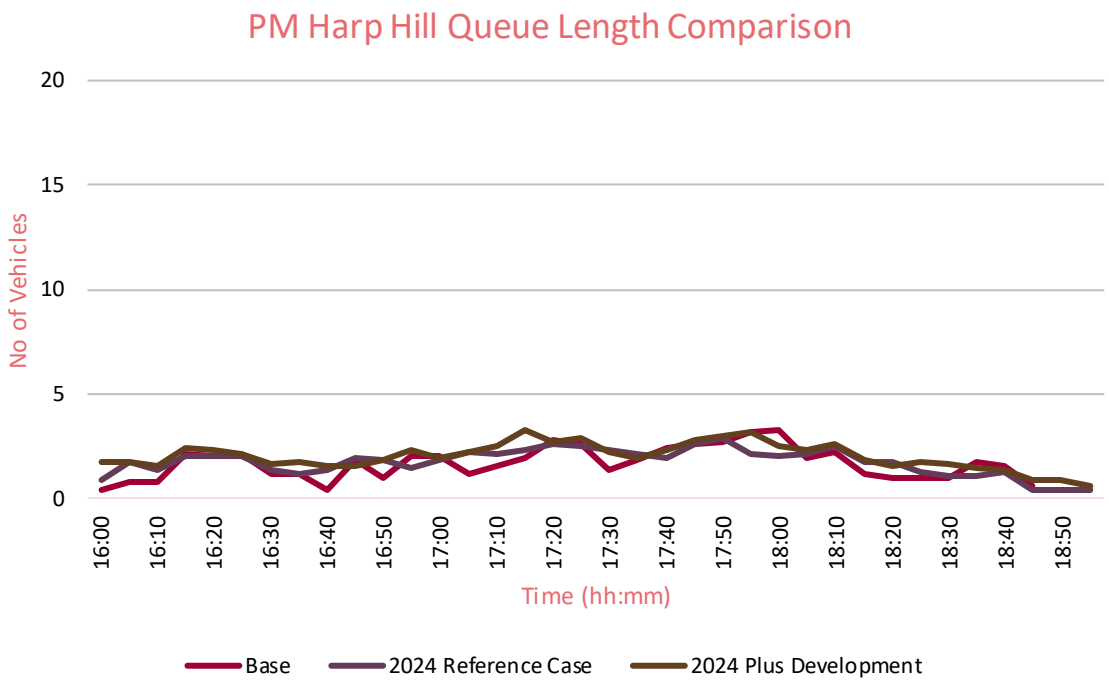


Figure 16. **PM Harp Hill Queue Length Comparison**

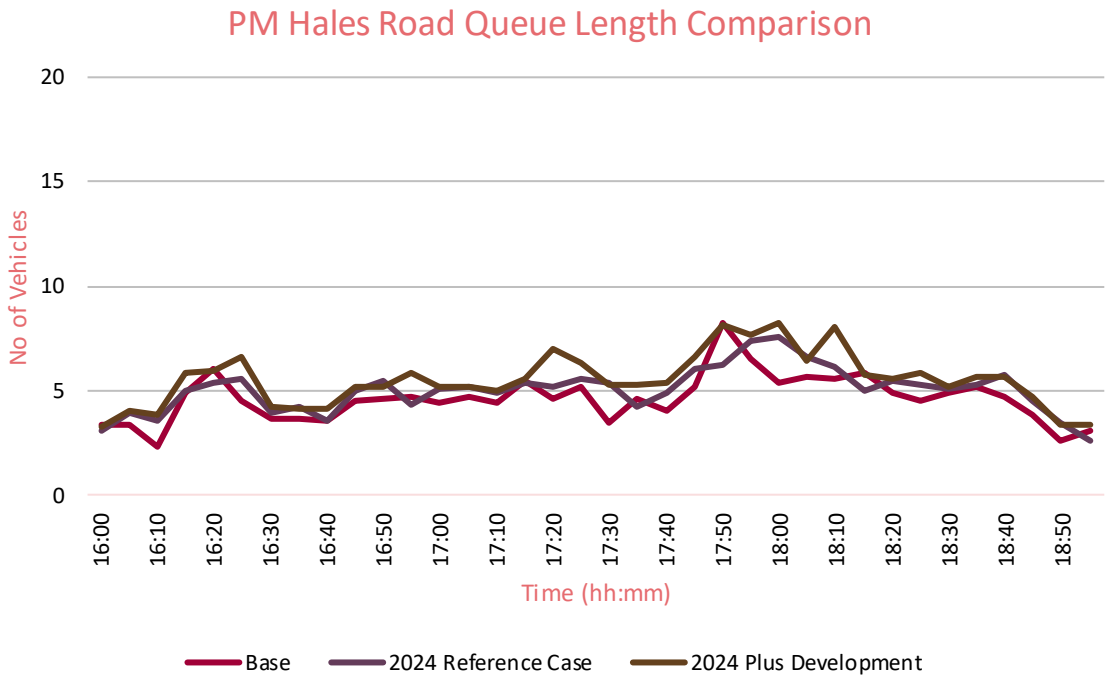


Figure 17. **PM Hales Road Queue Length Comparison**

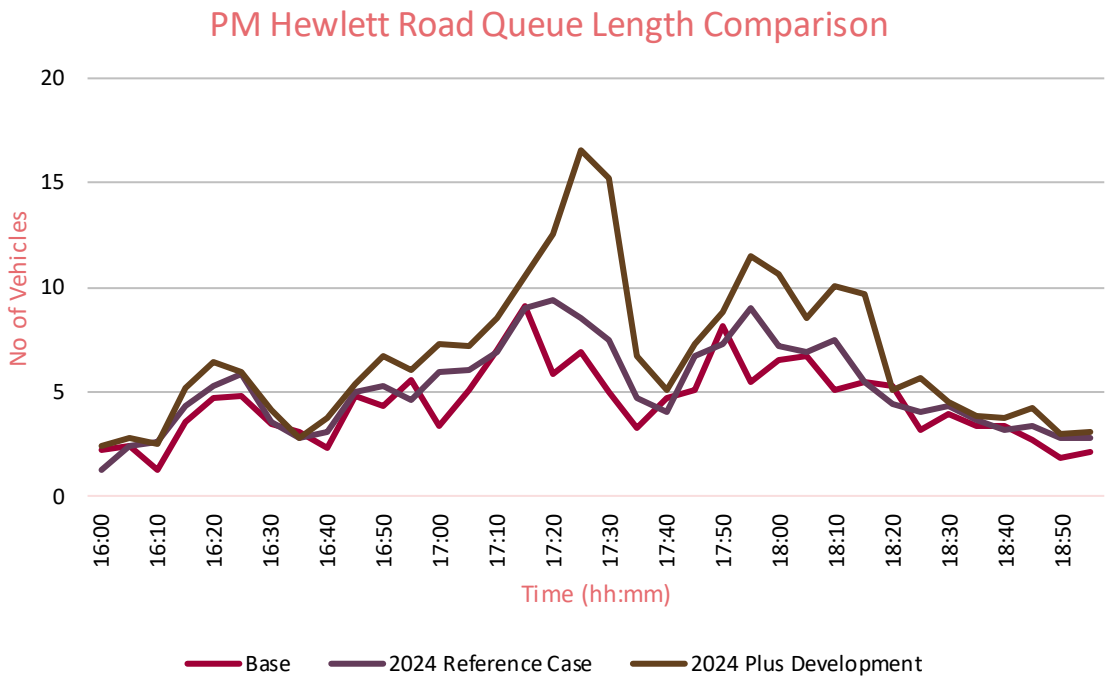


Figure 18. PM Hewlett Road Queue Length Comparison

10.1.2 Figure 12 shows that in the AM the addition of the development trips lead to a small increase in maximum queue on the Harp Hill approach to this roundabout of approximately 7 vehicles.

10.1.3 Figure 13 shows that in the AM the addition of the development trips lead to a small increase in maximum queue on the Hales Road approach to this roundabout of approximately 6 vehicles.

10.1.4 Figure 18 shows that in the PM the addition of the development trips lead to a small increase in maximum queue on the Hewlett Road approach to this roundabout of approximately 6 vehicles.

10.1.5 The rest of the queue comparisons for AM and all of the PM comparisons show little increase in queueing between Reference Case and Development models.

11. SUMMARY

11.1.1 SYSTRA were commissioned by PFA consulting to develop a Paramics Discovery model of the double roundabout junction at Harp Hill, Priors Road, Hales Road and Hewlett Road and carry out testing for the proposed Land at Oakley Farm, Battledown, Cheltenham development.

11.1.2 The 2019 Harp Hill Base model was created using Paramics Discovery version 23 to reflect the weekday AM (07:00-10:00) and PM (16:00-19:00) periods.

11.1.3 The model calibration shows a very good match between modelled and observed turn counts.

11.1.4 The model validation shows a very good match between modelled and observed queue lengths.

11.1.5 Using the 2019 Base Model as a starting point, a 2024 Reference Case model was created including background growth based on TEMPRO growth factor and a 2024 Development model was created by adding development related traffic to the 2024 Reference Case model.

11.1.6 The 2019 Base, 2024 Reference Case and 2024 Development models were compared using queue lengths for all 4 roundabout approaches. These show only small increases in maximum queue length in the Development model when compared to the Reference Case.