MODELLING GROUP

Modelling Impact Assessment Report

MG0193 – Elsenham, Stansted

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1 INTRODUCTION

1.1 Project Background

1.1.1 Modelling Group Ltd were commissioned by Ardent Consulting Engineers to carry out a microsimulation model-based study of the area of Mountfitchet, Essex.

1.1.2 The aim has been to create a robust and reliable platform for the assessment and mitigation of any impacts in the year 2027 resultant of the proposed development of 130 units on the B1051 in nearby Elsenham, which is expected to have an impact on the network within Mountfitchet to the southwest.

FIGURE 1.1: MODEL EXTENTS & LOCATION OF PROPOSED DEVELOPMENT

1.1.3 The future year scenario modelling has been developed within the agreed 2022 base year VISSIM model. Please see **Appendix A** for LMVR document *MG0193 - Elsenham, Stansted_LMVR_R_05-B_with_Appendices*.

1.2 Report Purpose

1.2.1 This report summarises the full future year modelling process, including the methodology for testing and analysing the comparative performance of all analysed options, the improvements achieved as a result of any mitigation proposals, and the details of any remaining impacts resultant of the proposed development scheme.

1.3 Report Structure

1.3.1 This report is structured as follows:

- **Section 2: Modelling Methodology** – Including details of the model development process and of all scenarios tested to date;
- **Section 3: Model Performance Analysis** – Including comparative network-wide performance statistics and analysis;
- **Section 4: Modelling Summary and Recommendations**

2 MODELLING METHODOLOGY

2.1 Overview

2.1.1 Consistent with the base VISSIM model, the focus of the assessment is on the road network within Mountfitchet and includes the following key junctions:

- J1 - B1051/Lower St
- J2 - B1051 Lower St/Mountfitchet Castle St/Church Rd/B1051 Chapel St
- J3 - Church Rd/Station Rd
- J4 - B1051 Chapel Hill/St John's Rd/Woodfield Terrace
- J5 - B1383 Cambridge Rd/B1051 Chapel Hill/B1383 Silver St/Bentfield Rd

FIGURE 2.1: MODEL EXTENTS & JUNCTIONS

2.1.2 The VISSIM model has been developed using the following specification.

No.	Model Element	Details
1	VISSIM Version	Version 2020 (Service Pack 14)
2	Model Assessment Year	2022 (Base), 2027 (Future Year)
3	Model Time Periods	AM Peak • Warm Up Period = 0715-0745hrs • Peak Period = 0745-0845hrs • Cool Down Period = 0845-0915hrs PM Peak • Warm Up Period = 1630-1700hrs • Peak Period = 1700-1800hrs • Cool Down Period = 1800-1830hrs

No.	Model Element	Details
4	Model Units	Length: • Kilometres • Metres Speed: • Miles per hour (mph) Acceleration: • Metres/second squared (m/s^2)

5	Vehicle Types Used	• Cars
		• Light Goods Vehicles (LGVs)
		• Heavy Goods Vehicles (HGVs) – which include:
		  • Ordinary Goods Vehicle 1 (OGV1)
		  • Ordinary Goods Vehicle 2 (OGV2)
		• Buses/Coaches (modelled as public transport routes)
		• Motorcycles

TABLE 2.1 MODEL SPECIFICATION

2.2 Scenarios Tested

2.2.1 Various scenarios have been put forward for testing to gain a detailed understanding of the impact the development may have on the network. As such, comparisons are made against both consented schemes and unconsented schemes. The aim of including a comparison against unconsented schemes is to gauge the relative impact on the network that the proposed development of 130 units (the focus of this study) would have compared to other developments that may be approved.

2.2.2 A set of sensitivity tests is also included which assumes a 15% reduction in consented/unconsented scheme traffic travelling through the modelled network due to various factors such as hybridised working practices including working from home.

2.2.3 The scenarios tested include:

- 2027 Base – including the consented development scheme growth in the area
- 2027 Base + Development – as above, plus the proposed development of 130 units on the B1051 in nearby Elsenham
- 2027 Base Sensitivity Model – includes consented and unconsented schemes
- 2027 Base Sensitivity Model + Development – as above, plus the proposed development of 130 units on the B1051 in nearby Elsenham
- 2027 Base (SENS2) – including the 15% reduction in consented development scheme growth travelling through the network
- 2027 Base (SENS2) + Development – as above, plus the proposed development of 130 units on the B1051 in nearby Elsenham
- 2027 Base (SENS3) – including the 15% reduction in consented and unconsented development scheme growth travelling through the network

- 2027 Base (SENS3) + Development – as above, plus the proposed development of 130 units on the B1051 in nearby Elsenham

2.2.4 The flows for these scenarios have been provided by Ardent Consulting Engineers. See **Appendix B** for details. The proposed development (130 units) is forecast to add:

- In the AM Peak, 22 vehicles travelling westbound & 7 vehicles travelling eastbound through the network
- In the PM Peak, 9 vehicles travelling westbound & 19 vehicles travelling eastbound through the network

2.3 Network Development

Details on the proposed mitigation on Grove Hill (B1051)

2.3.1 Consented infrastructure on Grove Hill (B1051), expected to be implemented by 2027, is included on all scenarios modelled. The proposed mitigation includes an additional detector to register the presence (demand and extension) of vehicles located just east of the parking bays (location of secondary queue). The aim of this is to minimise the occurrences of demand not being recorded due to the delay of vehicles reaching the stop line detectors in time (see Figure 2.2).

FIGURE 2.2 – APPROXIMATE LOCATION OF PROPOSED DETECTOR

2.3.2 This mitigation measure, including detector type, range, exact location, and other operational variables needs to be assessed further before implementation. However, the concept, as demonstrated in the previous results (2027 Future Base and Proposed Models – 1st Iteration, submitted in August 2022) appears to minimise the congestion.

2.3.3 Adjustments to the maximum green times have been made in the latest modelling to account for the increased demand at the junction and to allow enough time for vehicles in the secondary queue to travel through the westbound stop line. Furthermore, the changes were also made to better balance the impact of traffic travelling through the network in both directions. These updated timings have been kept consistent between the 'with' and 'without' development scenarios to understand the impact on travel times and provide a consistent testing platform. It is however possible that further adjustments would be made on site to mitigate the additional development traffic and provide further reductions in journey time. The signal timings used, with base model timings included for reference, are shown in Table 2.2.

Phase	AM Peak			PM Peak		
	Base Max	2027 'without Dev' Scenarios	2027 'with Dev' Scenarios	Base Max	2027 'without Dev' Scenarios	2027 'with Dev' Scenarios
A (EB)	14	20	20	30	30	30
B (WB)	34	40	40	14	26	26

TABLE 2.2 MITIGATION MAXIMUM GREEN TIMES (SECONDS)

Network Changes made since previous modelling

2.3.4 Extension of links on Grove Hill B1051, Lower Street, Silver Street and Church Road to ensure that latent demand is kept to a minimum and the full impacts to delay are included in the model (see Figure 2.3).

FIGURE 2.3 LINKS EXTENDED TO INCLUDE FULL DEMAND

2.4 Traffic Assignment Methodology

2.4.1 Consistent with the base modelling, the assignment has been setup using static routes (end to end) and vehicle inputs. However, the volumes and distributions used for the static assignment have been derived using LinSig as it provides the tools necessary to estimate an Origin-Destination (O-D) Matrix based on a set of measured traffic counts.

2.4.2 Once a suitable matrix was obtained, (GEH < 3 when comparing modelled and demand counts), the matrix for each vehicle type was converted into static routes using a spreadsheet (*Linsig_to_VISSIM_Matrix_Conversion_v3.xlsx*).

3 MODEL PERFORMANCE ANALYSIS

3.1 Overview

3.1.1 The impact of the development on the local network in all future year scenario tests has been assessed using the following model outputs:

- Journey time comparison for the main routes through the network.
- Queue comparison for each approach, profiled in 5-minute intervals;
- Overall network performance statistics, including average per vehicle speed and delay, as well as network-wide average delay etc;

3.2 Random Seed Runs

3.2.1 The modelled scenario results have been averaged over 20 seeds to reflect daily fluctuations in overall network operation.

3.3 Journey Time Comparison

3.3.1 Consistent with the approach used in the base model, the main east/west routes for through traffic in Mountfitchet have been compared. Each direction is broken down into smaller sections to illustrate the relative performance of each.

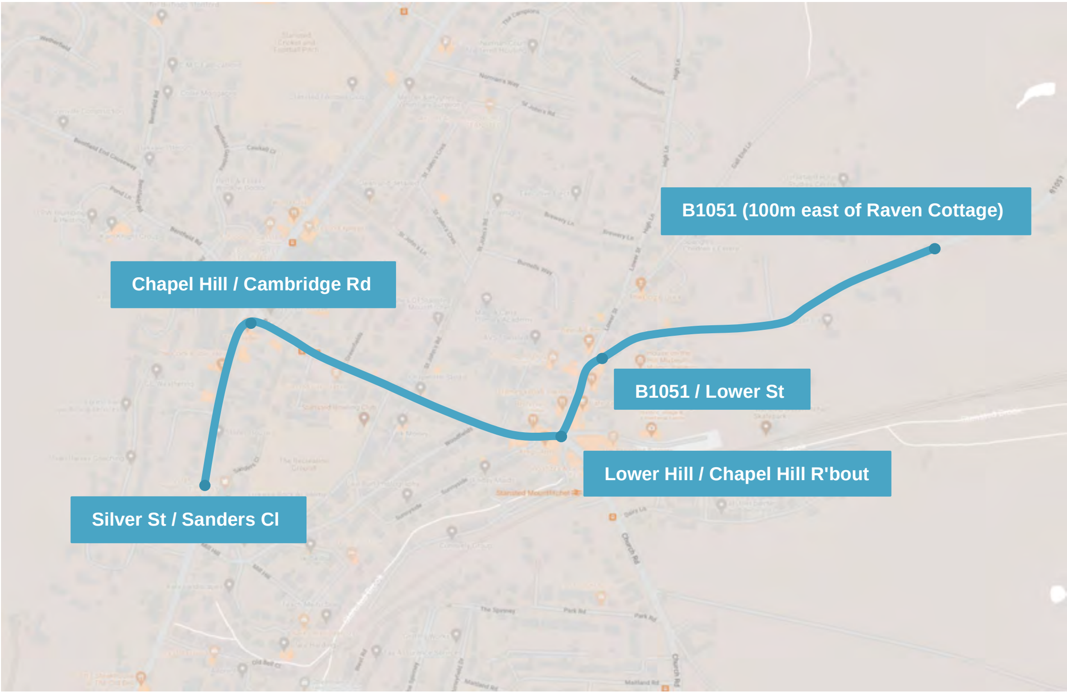


FIGURE 3.1 ROUTES ASSESSED (WB & EB) FOR JOURNEY TIME

3.3.2 Furthermore, due to the increase in traffic/delay on both the B1051 and Silver Street in 2027, additional sections have been added to ensure the full journey time is covered.

3.3.3 These sections are:

9991	WB\SB	B1051 Extended section to cover full demand	-	B1051 (100m east of Raven Cottage)
9992	NB\EB	Silver Street Extended section to cover full demand	-	Silver St / Sanders Cl

3.3.4 **Tables 3.1 – 3.2**, summarise the total journey time through the network (end to end). The Base model results (September 2022) have been included to gain an understanding of how all 2027 scenarios impact on the existing network. For a more detailed breakdown by section, please refer to **Appendix C**.

3.3.5 The results are interpreted as follows:

AM Peak

3.3.6 To get an understanding of how the committed schemes impact on the network, the 2022 Base is compared against the 2027 Base, showing that there is a 48s (15%) increase WB/SB and a 100s (33%) increase NB/EB.

3.3.7 The 2027 Base + Dev when compared to the 2027 Base shows a 29s (8%) increase WB/SB and a 33s (8%) increase NB/EB.

3.3.8 Comparing the 2027 Base + Sens, which includes both consented and unconsented schemes against the 2027 Base shows a 183s (49%) increase WB/SB and a 63s (16%) increase NB/EB. This suggests that the unconsented schemes would have a significantly higher journey time impact on the network compared to the proposed development (2027 Base + Dev):

- 154s (41%) higher WB/SB (183s vs 29s)
- 30s (8%) higher NB/EB (63s vs 33s)

3.3.9 When the 2027 Base + Sens + Dev is compared against the 2027 Base + Sens, the WB\SB direction sees an increase of 167s (30%). The NB\EB direction sees a 30s (6%) increase.

3.3.10 Moving on to the additional sensitivity tests (SENS2 and SENS3) which assume a 15% reduction in consented/unconsented scheme traffic, the overall journey times are lower when comparing like for like against the scenarios with full demand. The key statistics are:

- The 2027 Base (SENS2) vs the Base sees 32s (10%) increase WB/SB and a 77s (26%) increase NB/EB
- The 2027 Base + Dev (SENS2) when compared to the 2027 Base (SENS2) shows a 29s (8%) increase WB/SB and a 22s (6%) increase NB/EB
- Comparing the 2027 Base (SENS3) against the 2027 Base (SENS2) shows a 74s (21%) increase WB/SB and a 29s (8%) increase NB/EB. Again, this suggests that the

unconsented schemes would have a higher journey time impact on the network compared to the proposed development (2027 Base + Dev (SENS2)):

  - 45s (13%) higher WB/SB (74s vs 29s)
  - 7s (2%) higher NB/EB (29s vs 22s)

- For the 2027 Base (SENS3) + Dev versus the 2027 Base (SENS3), the WB\SB direction sees an increase of 51s (12%), and the NB\EB direction sees a 22s (5%) increase

PM Peak

3.3.11 In the PM Peak, the 2022 Base compared against the 2027 Base, shows that there is a 126s (42%) increase WB/SB and an 86s (28%) increase NB/EB.

3.3.12 The 2027 Base + Dev when compared to the 2027 Base shows a 47s (11%) increase WB/SB and a 37s (9%) increase NB/EB.

3.3.13 Comparing the 2027 Base + Sens, which includes both consented and unconsented schemes against the 2027 Base shows a 177s (41%) increase WB/SB and a 69s (18%) increase NB/EB. As seen in the AM Peak, this also suggests that the unconsented schemes would have a significantly higher journey time impact on the network compared to the proposed development (2027 Base + Dev):

- 130s (30%) higher WB/SB (177s vs 47s)
- 32s (9%) higher NB/EB (69s vs 37s)

3.3.14 When the 2027 Base + Sens + Dev is compared against the 2027 Base + Sens, the WB\SB direction sees an increase of 64s (11%). The NB\EB direction sees a 43s (9%) increase.

3.3.15 Comparing the additional sensitivity tests (SENS2 and SENS3), as in the AM Peak, the overall journey times are lower when comparing like for like against the scenarios with full demand. The key statistics are:

- The 2027 Base (SENS2) vs the Base sees 64s (21%) increase WB/SB and a 66s (21%) increase NB/EB
- The 2027 Base + Dev (SENS2) when compared to the 2027 Base (SENS2) shows a 29s (8%) increase WB/SB and a 22s (6%) increase NB/EB
- Comparing the 2027 Base (SENS3) against the 2027 Base (SENS2) shows a 63s (17%) increase WB/SB and a 37s (10%) increase NB/EB. Again, this suggests that the unconsented schemes would have a higher journey time impact on the network compared to the proposed development (2027 Base + Dev (SENS2)):
  - 34s (9%) higher WB/SB (63s vs 29s)

    - 15s (4%) higher NB/EB (37s vs 22s)
- Finally, for the 2027 Base (SENS3) + Dev versus the 2027 Base (SENS3), the WB\SB direction sees an increase of 82s (19%), and the NB\EB direction sees a 28s (7%) increase

Conclusions

3.3.16 Based on the above journey time analysis, the following key points are concluded:

- The development impact when compared to consented scheme growth (2027 Base vs 2027 Base + Dev / 2027 Base (SENS2) vs 2027 Base (SENS2) + Dev), sees an overall increase in journey time in the range of 6-11% and an average of 8%
- The unconsented scheme traffic has a higher impact than the proposed development on the network, with worst case differences in the AM Peak of 154s (41%) higher WB/SB (183s vs 29s) and 30s (8%) higher NB/EB (63s vs 33s); In the PM Peak the worst case differences are 130s (30%) higher WB/SB (177s vs 47s) and 32s (9%) higher NB/EB (69s vs 37s)
- As can be expected, if both the proposed development and unconsented scheme traffic are added to the network, the impact would be even more pronounced

Route	Direction	Description			Base Model	2027 Base	2027 Base + Dev	AVG DIFF.		2027 Base + Sens	2027 Base + Sens + Dev	AVG DIFF.		2027 Base (SENS2)	2027 Base (SENS2) + DEV	AVG DIFF.		2027 Base (SENS3)	2027 Base (SENS3) + DEV	AVG DIFF.	
					Avg	Avg	Avg	Diff.	% Diff.	Avg	Avg	Diff.	% Diff.	Avg	Avg	Diff.	% Diff.	Avg	Avg	Diff.	% Diff.
1	WB\SB	B1051 Extended section to cover full demand	-	Silver St / Sanders Cl	325	373	402	**29**	**8%**	556	723	**167**	**30%**	357	386	**29**	**8%**	431	482	**51**	**12%**
2	NB\EB	Silver Street Extended section to cover full demand	-	B1051 (100m east of Raven Cottage)	303	403	436	**33**	**8%**	467	497	**30**	**6%**	380	402	**22**	**6%**	409	431	**22**	**5%**

TABLE 3.1 AM PEAK JOURNEY TIME COMPARISON

Route	Direction	Description			Base Model	2027 Base	2027 Base + Dev	AVG DIFF.		2027 Base + Sens	2027 Base + Sens + Dev	AVG DIFF.		2027 Base (SENS2)	2027 Base (SENS2) + DEV	AVG DIFF.		2027 Base (SENS3)	2027 Base (SENS3) + DEV	AVG DIFF.	
					Avg	Avg	Avg	Diff.	% Diff.	Avg	Avg	Diff.	% Diff.	Avg	Avg	Diff.	% Diff.	Avg	Avg	Diff.	% Diff.
1	WB\SB	B1051 Extended section to cover full demand	-	Silver St / Sanders Cl	303	430	477	**47**	**11%**	607	671	**64**	**11%**	368	397	**29**	**8%**	431	513	**82**	**19%**
2	NB\EB	Silver Street Extended section to cover full demand	-	B1051 (100m east of Raven Cottage)	306	392	429	**37**	**9%**	461	504	**43**	**9%**	371	394	**23**	**6%**	409	436	**28**	**7%**

TABLE 3.2 PM PEAK JOURNEY TIME COMPARISON

3.4 Queue Comparison

3.4.1 This section summarises the queue profiles for the key approaches that see the biggest impact across scenarios in the network:

- B1051 Grove Hill (Queue Location 2, in advance of parking bays)
- Silver Street (impacted by additional right turning traffic onto Chapel Hill)

3.4.2 Queues have been measured in VISSIM using these queue definition settings:

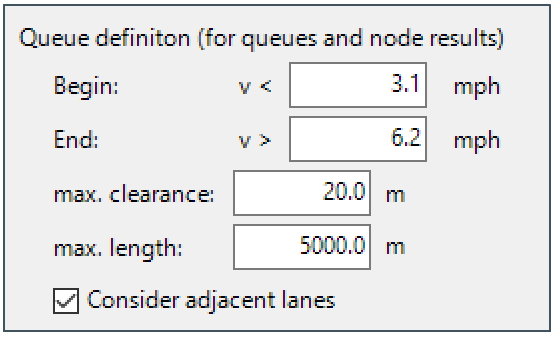


FIGURE 3.2 QUEUE DEFINITION SETTINGS

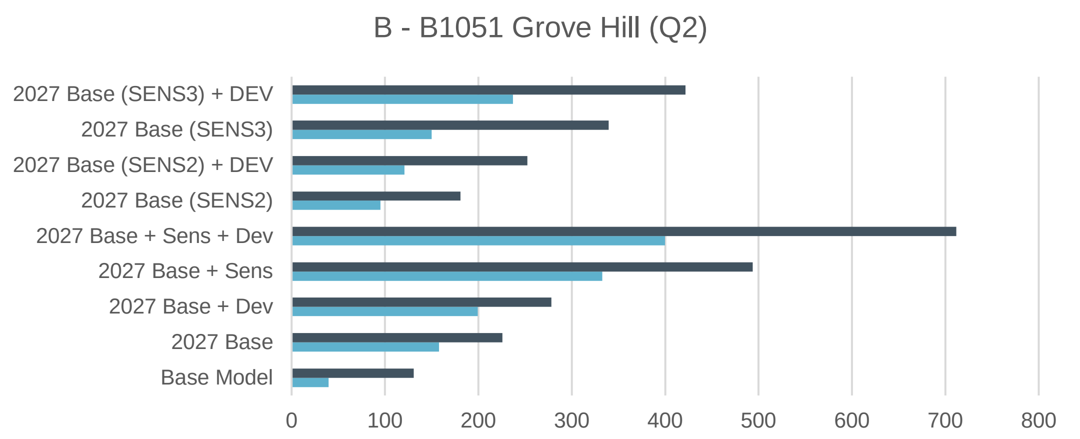
Note on Queue Comparison

3.4.3 Please note that due to the subjective nature of queue measurements on site, the base modelling did not use queue data for validation purposes. Instead. these served as a calibration aid and overall, the modelled profiles were largely comparable to those measured on site. In contrast, journey time data was used to validate the base models to DfT's TAG Unit 3.1 and TfL's Modelling Guidelines and as such the journey time comparisons in Section 3.3 are a more reliable tool to assess the relative impact of scenarios tested.

3.4.4 **Figure 3.3** shows the Grove Hill queue comparison for the AM and PM Peaks. Note that the 2022 Base model results have also been included for reference. In both peaks, the 2027 queues are significantly higher than in the 2022 Base. Queue levels between the *2027 Base* and *2027 Base + Dev* Scenarios are similar, although the increase in development traffic does increase maximum queues by 40-50m. In the AM Peak the maximum queue ranges between 226m-278m with the 2027 Base + Dev scenario having the high value. This is also true in the PM Peak where the 2027 Base + Dev scenario has a maximum queue of 199m compared to 158m in the 2027 Base scenario.

3.4.5 The '*with sensitivity*' scenarios see another significant increase in maximum queues when compared to the 2022 Base and 2027 '*without sensitivity*' scenarios, highlighting the limited capacity that the B1051 Grove Hill signalised junction has. The maximum queueing ranges between 333m-712m with the AM Peak experiencing the highest queue levels. Again, as with the '*without sensitivity*' scenarios the '*with dev*' scenarios see overall higher queue levels.

3.4.6 The 'SENS2' and 'SENS3' scenarios follow a similar pattern albeit with lower maximum queue levels.



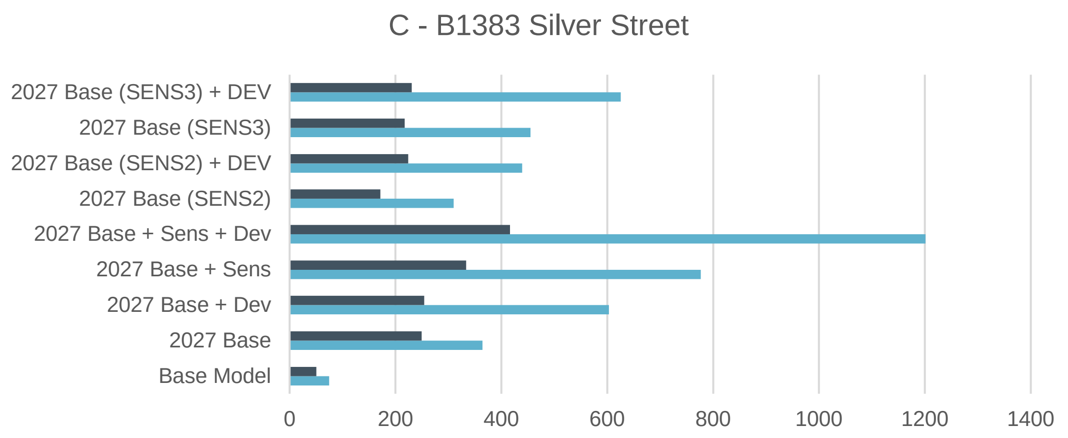
	Base Model	2027 Base	2027 Base + Dev	2027 Base + Sens	2027 Base + Sens + Dev	2027 Base (SENS2)	2027 Base (SENS2) + DEV	2027 Base (SENS3)	2027 Base (SENS3) + DEV
AM	131	226	278	494	712	181	252	339	422
PM	40	158	199	333	400	95	121	150	237

FIGURE 3.3 AVERAGE MAX QUEUE PROFILE – GROVE HILL – Q2

3.4.7 **Figure 3.4** shows the differences in queuing on Silver Street, caused by the right turn onto Chapel Hill. Both peaks experience significant increases in maximum queue levels in 2027 when compared to the 2022 Base. The '*with dev*' scenarios see an increase over the '*without development*' scenarios, with the PM Peak experiencing maximum queues of 603m (2027 Base + Dev) and 1201m (2027 Base + Sens + Dev).

3.4.8 The results suggest that even in the 2027 Base, there are likely to be capacity issues at the B1383 Silver Street / B1051 Chapel Hill Junction caused not only by the additional right turning traffic onto Chapel Hill, but also slow moving traffic on Chapel Hill itself caused by on street parking.

3.4.9 Again, the 'SENS2' and 'SENS3' scenarios follow a similar pattern, albeit with lower maximum queue levels.



	Base Model	2027 Base	2027 Base + Dev	2027 Base + Sens	2027 Base + Sens + Dev	2027 Base (SENS2)	2027 Base (SENS2) + DEV	2027 Base (SENS3)	2027 Base (SENS3) + DEV
AM	50	250	254	333	416	171	224	217	231
PM	75	364	603	777	1201	310	440	455	626

FIGURE 3.4 AVERAGE MAX QUEUE PROFILE – B1383 SILVER STREET

3.5 Overall Network Performance Statistics

3.5.1 This section summarises the network performance statistics. Network performance data is split into two main types – average per vehicle data, and total network statistics (taken over the peak hour).

3.5.2 Data is then further broken down as follows:

- Per Trip Average Per Vehicle Data:
  - Delay – defined as average time spent in a delay state (i.e. being held below desired speed due to network conditions);
  - Speed – defined as the overall average speed per trip, in miles per hour;
- Total Network Data:
  - Travel Time – defined as the total cumulative travel time of all vehicles completing trips within the peak hour;
  - Delay Time – defined as the total cumulative time spent in a delay state by all vehicles during the peak hour;
  - Vehicles Active – defined as the total number of vehicles still active within the network at the end of the peak hour;
  - Vehicles Arrived – defined as the total number of completed trips by the end of the peak hour;
  - Latent Demand – defined as the total number of vehicles (demand) stuck outside of the network at the end of the evaluation interval (generally due to queueing and delays).

3.5.3 **Tables 3.3-3.4** show a summary of network performance data for the AM and PM peak periods respectively. The 2022 Base model results have also been included for reference.

AM Peak

3.5.4 The AM Peak 2027 Base shows an increase in average delay per vehicle of 41 seconds when compared to the 2022 Base and the percentage delay per trip increases by 8%. Comparing the 2027 '*without sensitivity*' results, the 2027 Base + Dev sees a 11 second increase in delay per vehicle over the 2027 Base, equating to a 3% increase in delay per trip. Comparing the '*with sensitivity*' scenarios shows a 37s increase in delay per vehicle when comparing the 2027 Base + Sens + Dev against the 2027 Base + Sens, equating to a 7% increase in delay per trip.

3.5.5 For the SENS2 and SENS3 scenario tests, 2027 Base (SENS2) shows an increase in average delay per vehicle of 30 seconds when compared to the 2022 Base and the percentage delay per trip increases by 4%. The 2027 Base (SENS2) + Dev sees a 10 second increase in delay per vehicle over the 2027 Base (SENS2), equating to a 3% increase in delay per trip. Comparing the (SENS3) scenarios shows a 15s increase in delay per vehicle when comparing the 2027 Base (SENS3) + Dev against the 2027 Base (SENS3), equating to a 4% increase in delay per trip.

PM Peak

3.5.6 The PM Peak 2027 Base shows an increase in average delay per vehicle of 47 seconds when compared to the 2022 Base and the percentage delay per trip increases by 9%. Comparing the 2027 '*without sensitivity*' results, the 2027 Base + Dev sees a 16 second increase in delay per vehicle over the 2027 Base, equating to a 4% increase in delay per trip. Comparing the '*with sensitivity*' scenarios shows a 22s increase in delay per vehicle when comparing the 2027 Base + Sens + Dev against the 2027 Base + Sens, equating to a 4% increase in delay per trip.

3.5.7 For the SENS2 and SENS3 scenario tests, 2027 Base (SENS2) shows an increase in average delay per vehicle of 35 seconds when compared to the 2022 Base and the percentage delay per trip increases by 5%. The 2027 Base (SENS2) + Dev sees a 10 second increase in delay per vehicle over the 2027 Base (SENS2), equating to a 3% increase in delay per trip. Comparing the (SENS3) scenarios shows a 17s increase in delay per vehicle when comparing the 2027 Base (SENS3) + Dev against the 2027 Base (SENS3), equating to a 4% increase in delay per trip.

	AM Peak								
Network Performance Data	**Base Model**	**2027 Base**	**2027 Base + Dev**	**2027 Base + Sens**	**2027 Base + Sens + Dev**	**2027 Base (SENS2)**	**2027 Base (SENS2) + DEV**	**2027 Base (SENS3)**	**2027 Base (SENS3) + DEV**
Number of vehicles in the network at end of simulation	89	200	195	252	310	169	183	192	212
Number of vehicles that have left the network at end of simulation	2521	2716	2752	2817	2789	2715	2731	2751	2761
Total travel time (h) of vehicles in network	320187	618834	659114	800961	918154	582641	619929	650116	701468
Average speed (mph)	12.11	14.21	13.59	11.60	10.20	14.96	14.32	13.81	13.02
Total delay time (h) of Vehicles in network	85446	214752	248490	379482	496373	179681	211544	238015	284713
Average Delay per vehicle (secs)	32.74	73.68	84.31	123.64	160.15	62.29	72.58	80.85	95.75
Latent Demand (Vehicles) - not able to enter network due to congestion	0	2	0	1	1	0	0	0	0
Percentage delay per trip	**26.69%**	**34.70%**	**37.70%**	**47.38%**	**54.06%**	**30.84%**	**34.12%**	**36.61%**	**40.59%**

TABLE 3.3: AM PEAK NETWORK PERFORMANCE STATISTICS

	PM Peak								
Network Performance Data	**Base Model**	**2027 Base**	**2027 Base + Dev**	**2027 Base + Sens**	**2027 Base + Sens + Dev**	**2027 Base (SENS2)**	**2027 Base (SENS2) + DEV**	**2027 Base (SENS3)**	**2027 Base (SENS3) + DEV**
Number of vehicles in the network at end of simulation	78	170	190	229	266	156	166	168	194
Number of vehicles that have left the network at end of simulation	2568	2907	2914	2938	2928	2801	2819	2864	2867
Total travel time (h) of vehicles in network	299484	673991	731650	816010	893674	618596	655877	688994	749359
Average speed (mph)	13.18	15.16	14.20	12.95	11.91	15.90	15.28	14.80	13.82
Total delay time (h) of Vehicles in network	78437	236043	288410	367552	442096	193328	224127	252277	307249
Average Delay per vehicle (secs)	29.64	76.72	92.91	116.06	138.41	65.38	75.08	83.19	100.36
Latent Demand (Vehicles) - not able to enter network due to congestion	0	0	0	0	0	0	0	0	0
Percentage delay per trip	**26.19%**	**35.02%**	**39.42%**	**45.04%**	**49.47%**	**31.25%**	**34.17%**	**36.62%**	**41.00%**

TABLE 3.4 PM PEAK NETWORK PERFORMANCE STATISTICS

4 MODELLING SUMMARY & RECOMMENDATIONS

4.1 Overview

4.1.1 Modelling Group Ltd were commissioned by Ardent Consulting Engineers to carry out a microsimulation model-based study of the area of Mountfitchet. The aim has been to create a robust and reliable platform for assessment and mitigation of any impacts in the year 2027 resultant of the proposed development of 130 units on the B1051 in nearby Elsenham, which is expected to have an impact on the network within Mountfitchet to the southwest.

4.2 Modelling Scope & Purpose

4.2.1 A validated Base model to September 2022 conditions was used as a platform to test the following 2027 Future Year Scenarios:

- 2027 Base – including the consented development scheme growth in the area
- 2027 Base + Development – as above, plus the proposed development of 130 units on the B1051 in nearby Elsenham
- 2027 Base Sensitivity Model – includes consented and unconsented schemes
- 2027 Base Sensitivity Model + Development – as above, plus the proposed development of 130 units on the B1051 in nearby Elsenham
- 2027 Base (SENS2) – including the 15% reduction in consented development scheme growth travelling through the network
- 2027 Base (SENS2) + Development – as above, plus the proposed development of 130 units on the B1051 in nearby Elsenham
- 2027 Base (SENS3) – including the 15% reduction in consented and unconsented development scheme growth travelling through the network
- 2027 Base (SENS3) + Development – as above, plus the proposed development of 130 units on the B1051 in nearby Elsenham

4.3 Summary of Model Performance Analysis

Journey Times

4.3.1 Based on the journey time analysis, the following key points are concluded:

- The development impact when compared to consented scheme growth (2027 Base vs 2027 Base + Dev / 2027 Base (SENS2) vs 2027 Base (SENS2) + Dev), sees an overall increase in journey time in the range of 6-11% and an average of 8%
- The unconsented scheme traffic has a higher impact than the proposed development on the network, with worst case differences in the AM Peak of 154s (41%) higher

WB/SB (183s vs 29s) and 30s (8%) higher NB/EB (63s vs 33s); In the PM Peak the worst case differences are 130s (30%) higher WB/SB (177s vs 47s) and 32s (9%) higher NB/EB (69s vs 37s)

- As can be expected, if both the proposed development and unconsented scheme traffic are added to the network, the impact would be even more pronounced.

Queue Lengths

4.3.2 With regards to queuing, westbound queues on the B1051 Grove Hill (Q2) in the 2027 Base are significantly higher than in the 2022 Base. Queue levels between the *2027 Base* and *2027 Base + Dev* Scenarios are similar, although the increase in development traffic does increase maximum queues by 40-50m.

4.3.3 The '*with sensitivity*' scenarios see another significant increase in maximum queues when compared to the 2022 Base and 2027 '*without sensitivity*' scenarios, highlighting the limited capacity that the B1051 Grove Hill signalised junction has. The maximum queueing ranges between 333m-712m with the AM Peak experiencing the highest queue levels. Again, as with the '*without sensitivity*' scenarios the '*with dev*' scenarios see overall higher queue levels.

4.3.4 Queues on Silver Street, caused by the right turn onto Chapel Hill experience significant increases in 2027 when compared to the 2022 base. The '*with dev*' scenarios see an increase over the '*without development*' scenarios, with the PM Peak experiencing maximum queues of 603m (2027 Base + Dev) and 1201m (2027 Base + Sens + Dev).

4.3.5 The results suggest that even in the 2027 Base, there are likely to be capacity issues at the B1383 Silver Street / B1051 Chapel Hill Junction caused not only by the additional right turning traffic onto Chapel Hill, but also slow moving traffic on Chapel Hill itself caused by on street parking.

4.3.6 The 'SENS2' and 'SENS3' scenarios for both approaches follow a similar pattern albeit with lower maximum queue levels.

Network Performance

4.3.7 The AM Peak 2027 Base shows an increase in average delay per vehicle of 41 seconds when compared to the 2022 Base and the percentage delay per trip increases by 8%. Comparing the 2027 '*without sensitivity*' results, the 2027 Base + Dev sees a 11 second increase in delay per vehicle over the 2027 Base, equating to a 3% increase in delay per trip. Comparing the '*with sensitivity*' scenarios shows a 37s increase in delay per vehicle when comparing the 2027 Base + Sens + Dev against the 2027 Base + Sens, equating to a 7% increase in delay per trip.

4.3.8 The PM Peak 2027 Base shows an increase in average delay per vehicle of 47 seconds when compared to the 2022 Base and the percentage delay per trip increases by 9%. Comparing the 2027 '*without sensitivity*' results, the 2027 Base + Dev sees a 16 second increase in delay per vehicle over the 2027 Base, equating to a 4% increase in delay per trip. Comparing the '*with sensitivity*' scenarios shows a 22s increase in delay per vehicle when comparing the 2027 Base + Sens + Dev against the 2027 Base + Sens, equating to a 4% increase in delay per trip.

4.3.9 In both peaks, the 'SENS2' and 'SENS3' scenarios follow a similar pattern albeit with lowers levels of delay per vehicle.

4.4 Conclusion

4.4.1 In summary, the modelling results show that not only does the proposed development traffic have less of an impact than already consented scheme traffic (Base 2027), but also significantly less impact than unconsented scheme traffic (2027 Base + Sens).

4.4.2 The development impact when compared to consented scheme growth (2027 Base vs 2027 Base + Dev / 2027 Base (SENS2) vs 2027 Base (SENS2) + Dev), sees an overall increase in journey time in the range of 6-11% and an average of 8%.

4.4.3 In contrast, the unconsented scheme impact when compared to consented scheme growth (2027 Base vs 2027 Base + Sens / 2027 Base (SENS2) vs 2027 Base (SENS3)), sees a worst case increase in journey time of 183s (49%) in the AM Peak and 177s (41%) in the PM Peak.

APPENDIX A:

LOCAL MODEL VALIDATION REPORT

Local Model Validation Report

MG0193 – Elsenham, Stansted

Carl Moreno

16 November 2022

ARDENT

DOCUMENT CONTROL ISSUE SHEET

Project & document details

Project name	Elsenham, Stansted
Project number	MG0193
Document title	Local Model Validation Report
Document reference	\05_Technical\04_Reports & Notes\01_Existing Base

Document history

Issue	Status	Reason for issue	Issued to
B	2nd Issue	Model updated with Sept 2022 Data	Ardent

Issue control

Issue	Date	Author	Contributors	Approved	Date
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APPENDICES

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1 INTRODUCTION

1.1 Project Overview

1.1.1 Modelling Group have been commissioned by Ardent Consulting Engineers to undertake VISSIM modelling associated with the proposed development of 130 units on the B1051 in nearby Elsenham, which is expected to have an impact on the network within Mountfitchet to the southwest.

1.2 Previous Modelling

1.2.1 A Base model was produced back in June 2022 using survey data collected in May 2022. Unfortunately, the site conditions were affected by road closures nearby which diverted higher than usual flows into the network. As such, it was decided to revalidate the model produced using new survey data collected in September 2022. No diversions / other issues were reported on site during collection in September.

1.3 Modelling Scope & Purpose

1.3.1 For this project, a base model of the road network around Mountfitchet has been developed to 2022 traffic conditions, providing a realistic platform for undertaking future year testing. Future year models for 2027 will then be developed to firstly understand the network operation prior to the introduction of the development and then including the development to determine the impacts.

1.4 Model Specification

1.4.1 The VISSIM model has been developed using the following specification.

No.	Model Element	Details
1	VISSIM Version	Version 2020 (Service Pack 09)
2	Base Model Year	2022
3	Model Time Periods	AM Peak • Warm Up Period = 0715-0745hrs • Peak Period = 0745-0845hrs • Cool Down Period = 0845-0915hrs PM Peak • Warm Up Period = 1630-1700hrs • Peak Period = 1700-1800hrs • Cool Down Period = 1800-1830hrs
4	Model Units	Length: • Kilometres • Metres Speed: • Miles per hour (mph) Acceleration: • Metres/second squared (m/s²)

No.	Model Element	Details

5	Vehicle Types Used	• Cars
		• Light Goods Vehicles (LGVs)
		• Heavy Goods Vehicles (HGVs) – which include:
		  • Ordinary Goods Vehicle 1 (OGV1)
		  • Ordinary Goods Vehicle 2 (OGV2)
		• Buses/Coaches (modelled as public transport routes)
		• Motorcycles

TABLE 1.1 MODEL SPECIFICATION

Mapping

1.4.2 Geometric calculations for the base model construction were derived from Ordnance-Survey (OS) mapping purchased (filename: *Promap-1892463-1991904-720-0.Dwg*). Secondary sources such as online satellite imagery and Google Street View were also utilised to inform the link length, lane width and number of lane parameters in the model.

Modelled Results

1.4.3 The modelled results have been output with a model resolution of 5-time steps per second and have been based on 20 different random seed runs, starting with seed 42 and with an incremental increase of 10. 20 random seed runs represent a virtual month and allows a more informed set of results to be obtained from the model.

1.5 Model Periods

1.5.1 The model consists of AM and PM periods, which both include a thirty-minute warm up period, an hour for the peak period itself and then a thirty-minute cool down period. The AM and PM model periods are defined in **Table 1.1**.

1.5.2 The AM and PM peak periods have been calculated using survey data. The IN flows for each site have been analysed and summarised in **Table 1.2**.

Peak Hour ID	Total - Avg	Total - Sum
07:00-08:00	900	4500
07:15-08:15	1008	5041
07:30-08:30	1073	5366
07:45-08:45	**1080**	**5402**
08:00-09:00	1056	5279
08:15-09:15	998	4992
08:30-09:30	912	4558
08:45-09:45	813	4063
09:00-10:00	732	3658
16:00-17:00	925	4626
16:15-17:15	966	4832
16:30-17:30	1050	5252
16:45-17:45	1100	5502
17:00-18:00	**1113**	**5566**
17:15-18:15	1071	5356
17:30-18:30	973	4866
17:45-18:45	883	4415
18:00-19:00	822	4111

TABLE 1.2 PEAK HOURS IDENTIFIED

1.6 Traffic Assignment Methodology

1.6.1 As the network modelled has no real route choice, the assignment has been setup using static routes (end to end) and vehicle inputs. However, the volumes and distributions used for the static assignment have been derived using LinSig as it provides the tools necessary to estimate an Origin-Destination (O-D) Matrix based on a set of measured traffic counts. LinSig uses a mathematical method called entropy maximisation.

1.6.2 This technique aims to estimate the most probable O-D matrix which will fit the traffic counts. This does not mean that this is necessarily the correct matrix only that the estimated matrix is the best possible estimate from the information contained within the traffic turning counts.

1.6.3 Once a suitable matrix was obtained, (GEH < 3 when comparing modelled and surveyed counts), the matrix for each vehicle type was converted into static routes using a spreadsheet (*Linsig_to_VISSIM_Matrix_Conversion.xlsx*).

1.6.4 Each peak hour input was factored by the 15-minute time % values below, which represents a proportion of the peak hour. For inputs that do not correspond to junctions surveyed, for example Dairy Lane, the site average % split values were used.

Street	Lower Street	Grove Hill	Mountf. Car Park	Church Rd	Station Rd	St Johns Rd	Cambridge Rd	Silver Street	Bentfield Rd	Site Average
Jct	J1 (A)	J1 (B)	J2 (B)	J3 (B)	J3 (C)	J4 (A)	J5 (A)	J5 (C)	J5 (D)	
07:15	13%	18%	28%	23%	22%	14%	19%	23%	18%	19%
07:30	22%	29%	25%	21%	51%	21%	25%	23%	22%	23%
07:45	**22%**	**22%**	**34%**	**27%**	**46%**	**21%**	**28%**	**23%**	**31%**	**26%**
08:00	**25%**	**32%**	**16%**	**25%**	**14%**	**64%**	**24%**	**23%**	**26%**	**25%**
08:15	**25%**	**23%**	**25%**	**23%**	**22%**	**7%**	**26%**	**26%**	**19%**	**25%**
08:30	**28%**	**23%**	**25%**	**24%**	**19%**	**7%**	**22%**	**28%**	**25%**	**24%**
08:45	16%	24%	19%	26%	22%	200%	24%	25%	32%	24%
09:00	15%	19%	63%	15%	5%	143%	19%	22%	23%	20%
16:30	24%	26%	20%	17%	9%	13%	25%	23%	30%	21%
16:45	23%	25%	18%	19%	5%	39%	25%	21%	19%	22%
17:00	**29%**	**29%**	**26%**	**25%**	**18%**	**13%**	**26%**	**25%**	**14%**	**25%**
17:15	**25%**	**27%**	**27%**	**26%**	**34%**	**39%**	**27%**	**26%**	**28%**	**27%**
17:30	**21%**	**23%**	**19%**	**26%**	**14%**	**30%**	**24%**	**25%**	**33%**	**25%**
17:45	**25%**	**21%**	**29%**	**23%**	**35%**	**17%**	**23%**	**23%**	**25%**	**23%**
18:00	13%	21%	32%	26%	22%	30%	21%	20%	12%	21%
18:15	14%	19%	15%	19%	7%	13%	22%	21%	17%	19%

TABLE 1.3 PEAK HOUR PROFILE SPLIT

1.7 Model Extents

1.7.1 The base VISSIM model focuses on the main network in Mountfitchet and includes the following key junctions:

- J1 - B1051/Lower St
- J2 - B1051 Lower St/Mountfitchet Castle St/Church Rd/B1051 Chapel St
- J3 - Church Rd/Station Rd
- J4 - B1051 Chapel Hill/St John's Rd/Woodfield Terrace

- J5 - B1383 Cambridge Rd/B1051 Chapel Hill/B1383 Silver St/Bentfield Rd

1.7.2 The model extents are shown in **Figures 1.1 and 1.2**.

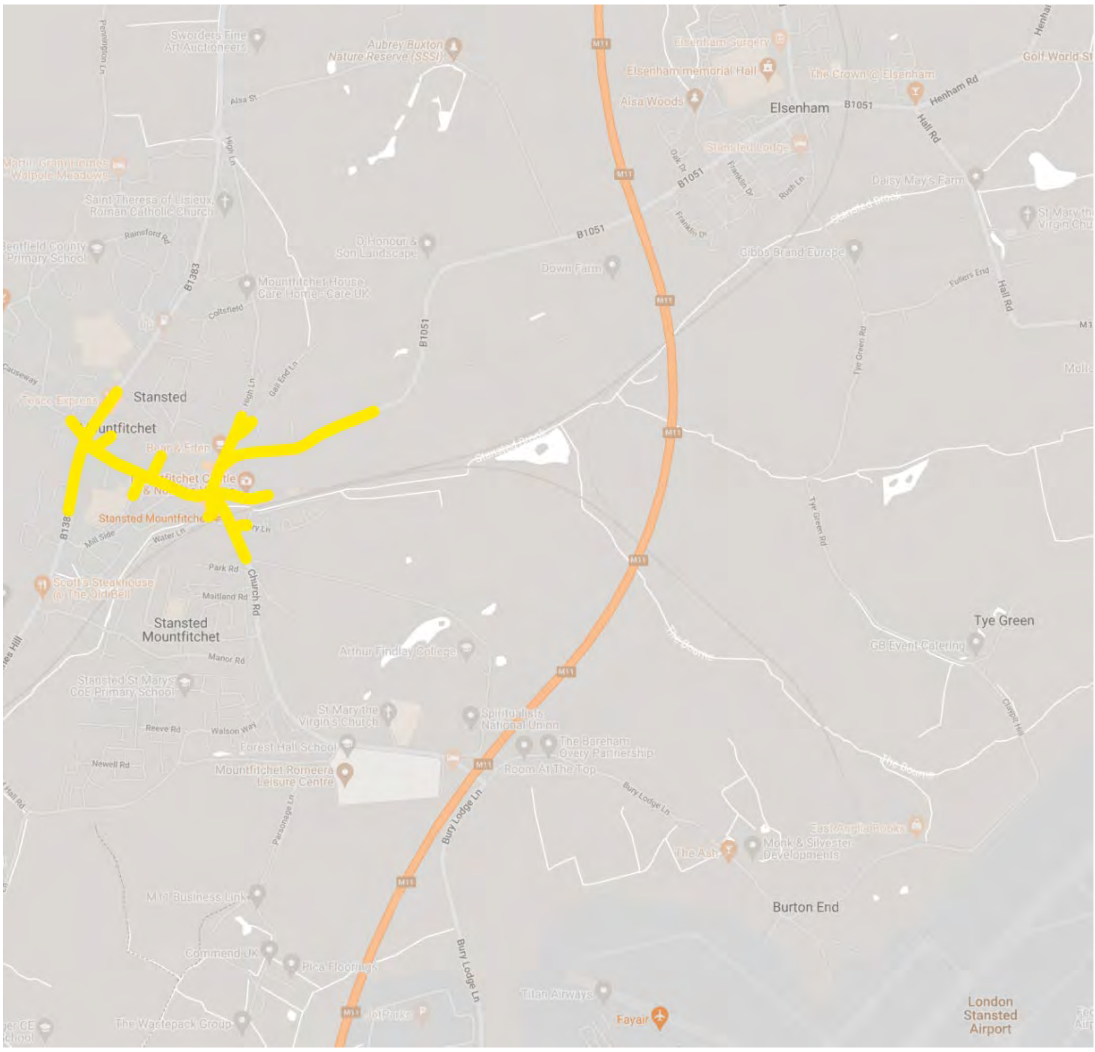


FIGURE 1.1: MODEL EXTENTS & WIDER CONTEXT

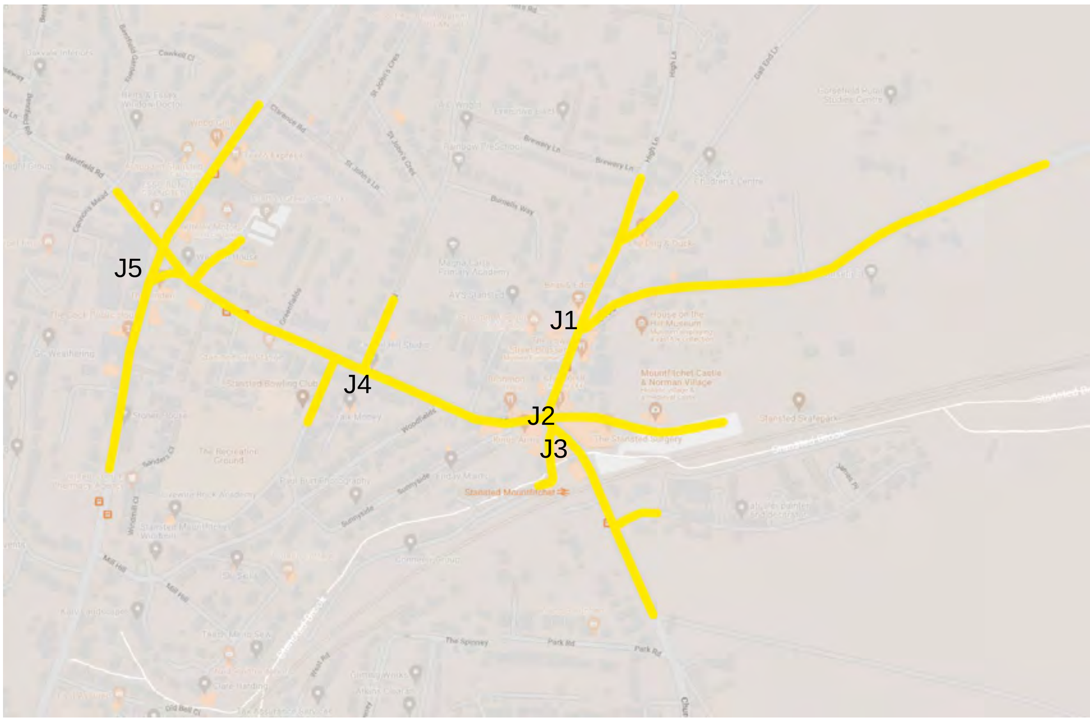


FIGURE 1.2: MODEL EXTENTS – NETWORK DETAIL

2 INPUT DATA PREPARATION

2.1 Data Sources – Non-Surveyed

2.1.1 The following sections detail data sources used for non-surveyed modelled elements.

Desired Speed Distributions

2.1.2 The speed limit desired speed distributions within the model have been calculated from Department for Transport (DfT) statistics or, where national data is not available for certain speed bands, based on Transport for London (TfL) speed profiles.

2.1.3 Further details of the distributions for the various speed limits and vehicle types are provided in **Appendix A**.

Desired Speed Distributions – Turns

2.1.4 Within the network, various speed distributions have been created for vehicles negotiating turns of various radii within different speed limits.

2.1.5 Whilst this is not a requirement of DfT's TAG Unit 3.1 Guidance, it is recommended in Transport for London (TfL's) Modelling Guidelines.

2.1.6 To account for various speed limits, different vehicle types and to allow a set of distributions to apply to both urban and rural locations, a simplistic approach has been adopted to derive speed bands for instances of high and low braking. This is shown in **Table 2.1**.

	Speed Band		
	High Braking		Low Braking
Speed limit	from	to/from	to
20 mph	10	15	20
30 mph	20	25	30
40 mph	30	35	40
50 mph	40	45	50
60 mph	50	55	60
70 mph	60	65	70

TABLE 2.1: TURNS – SPEED BANDS FOR DIFFERENT SPEED LIMITS

2.1.7 Further details on this approach can be found in **Appendix B**.

2.2 Speed Limits

2.2.1 A global speed limit of 30 mph is in operation in the modelled network as shown in **Figure 2.1**.

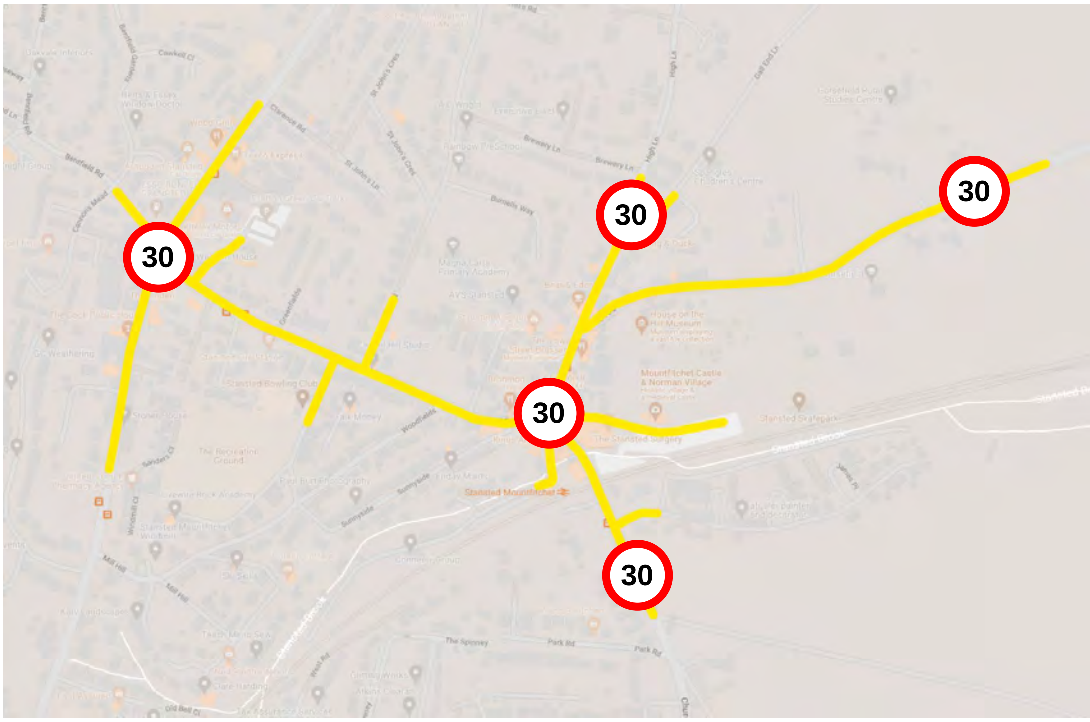


FIGURE 2.1: MODEL EXTENTS – MODELLED NETWORK SPEED LIMITS

2.3 Signal Data

2.3.1 Details of the signals within the modelled network are provided in **Table 2.2** and their locations in **Figure 2.2**.

Signal Controller No.	Name/Description	Type
1	01J17 - B1051 Grove Hill/Lower Street, Stanstead	Vehicle Actuated Junction
2	Ped Crossing on B1383	Pelican Crossing
901	Priority_Control	Bespoke program to control overtaking of parked vehicles on Chapel Hill. Described in more detail in **Section 2.7.7**

TABLE 2.2: SIGNAL CONTROLLER SUMMARY

2.3.2 Signal Controller 1 has been coded based on the signal specification and *as-built* drawing provided, using a VAvap_setup template provided by TfL which simulates the operation of a vehicle actuated junction. The following maximum greens have been applied based on information contained in the signal specification.

Stage	AM Peak	PM Peak
1	14s	30s
2	34s	14s

TABLE 2.3 MAXIMUM GREENS USED FOR SIGNAL CONTROLLER 1

2.3.3 Signal Controller 2 has been coded using VISSIM's own pedestrian crossing controller. It has been assumed that a clearance time of 10 seconds is provided for pedestrians to safely finish crossing the road before the traffic stage starts. A clearance time of 5 seconds is provided between the end of the traffic stage and the start of the pedestrian stage. Please note this has been included for display purposes only (not demanded by pedestrians as no survey was available).

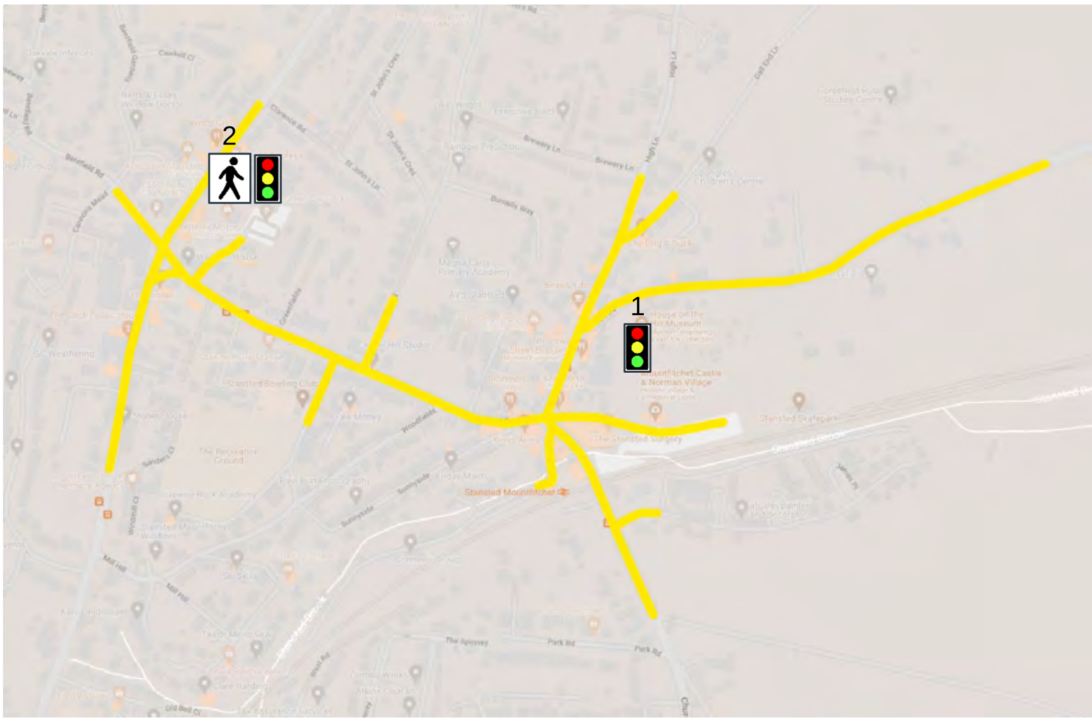


FIGURE 2.2 LOCATION OF SIGNALISED JUNCTIONS

2.3.4 Signal Controller 901 is a bespoke piece of logic which has been developed to model the behaviour along B1051 Chapel Hill in an attempt to replicate how drivers pass a series of parked cars in busy periods (further details provided in *Section 2.7* of this report).

2.4 Public Transport

2.4.1 For identifying the public transport routes within the network, the websites - https://moovitapp.com and https://bustimes.org - have been used to extract the locations of the bus stops, the bus routes and the frequencies within the AM and PM modelled periods.

2.4.2 Details of the public transport routes within the modelled network (calculated in *PT Data.xlsx*) are provided in **Table 2.4**.

Identifier	Name	Provider	Frequency (in peak hour)
1	7 (to Bishop's Stortford)	Central Connect	AM = 1 PM = 0
2	7 (to Stansted Airport)	Central Connect	AM = 1 PM = 1
3	7A (to Bishop's Stortford)	Central Connect	AM = 0 PM = 1
4	7A (to Stansted Airport)	Central Connect	AM = 0 PM = 0
5	441 (to Takeley)	Stephensons of Essex	AM = 0 PM = 0
6	441 (to Saffron Walden)	Stephensons of Essex	AM = 0 PM = 0
7	301 (to Saffron Walden)	Stephensons of Essex	AM = 1 PM = 0
8	301 (to Bishop's Stortford)	Stephensons of Essex	AM = 1 PM = 1

Identifier	Name	Provider	Frequency (in peak hour)
9	306 (to Wicken Bonhunt)	Central Connect	AM = 0 PM = 0
10	306 (to Bishop's Stortford)	Central Connect	AM = 1 PM = 0

TABLE 2.4: PUBLIC TRANSPORT SUMMARY

2.4.3 Each of these bus routes has been modelled as a static 'PT Line' within VISSIM, with the appropriate route stops activated. The times that the buses enter the model has also been calculated to account for the distance and speed on the links between the bus entry point and the first bus stop to be visited.

2.4.4 A map of the bus stops within the network is shown in **Figure 2.3**.

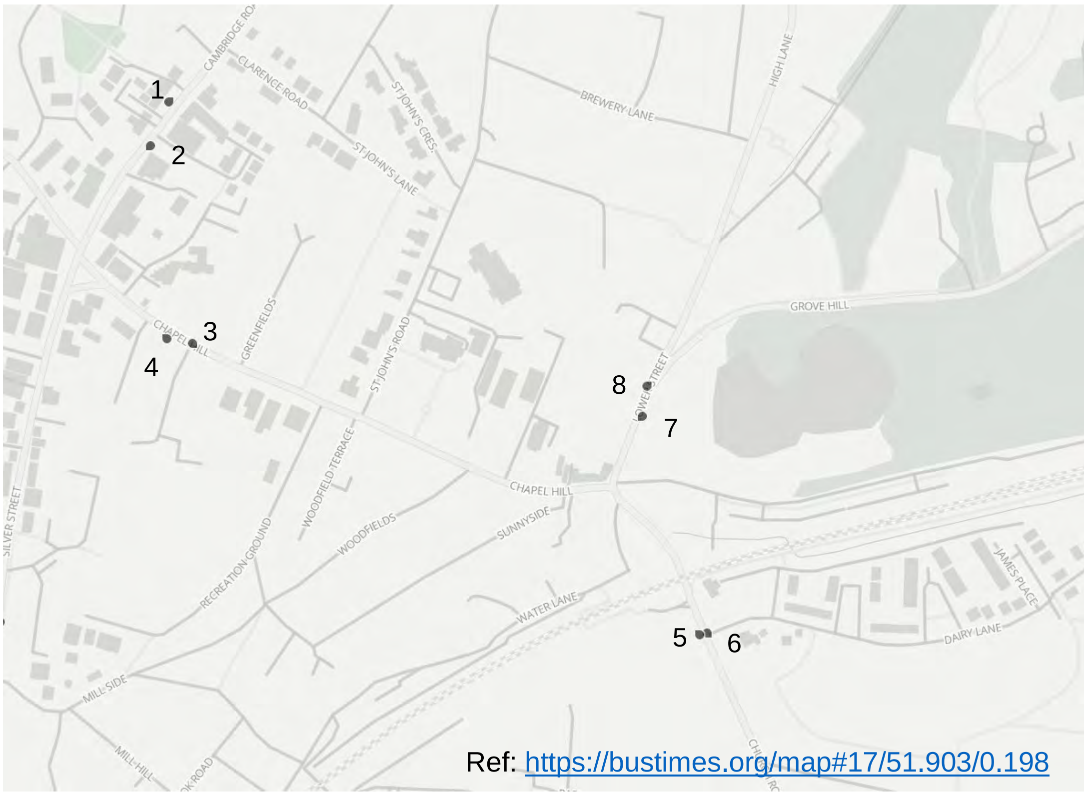


FIGURE 2.3 BUS STOP LOCATIONS

2.4.5 Further details of the bus stops are provided in **Table 2.5**.

Map Ref No.	Name	Location	Direction
1	Stansted Mountfitchet, opp Clarence Road	Cambridge Rd	Northbound
2	Stansted Mountfitchet, adj Clarence Road	Cambridge Rd	Southbound
3	Stansted Mountfitchet Chapel Hill (SE-bound)	Chapel Hill	Eastbound
4	Stansted Mountfitchet Chapel Hill (NW-bound)	Chapel Hill	Westbound
5	Stansted Mountfitchet, opp Railway Station	Church Rd	Northbound
6	Stansted Mountfitchet, o/s Railway Station	Church Rd	Southbound
7	Stansted Mountfitchet Lower Street (SW-bound)	Lower St	Southbound
8	Stansted Mountfitchet Lower Street (NE-bound)	Lower St	Northbound

TABLE 2.5: BUS STOP DETAILS

2.4.6 For the bus stop dwell times and in the absence of any site data, an empirical distribution has been used at each of the stops. This has a time range of 15-20 seconds to model stops more dynamically and to replicate varying numbers of passengers boarding and alighting.

2.5 Data Sources – Traffic Survey Data

2.5.1 Details of traffic survey data commissioned as part of this study are shown in **Figure 2.4**. In summary, the following traffic surveys were commissioned for this project:

- Manually Classified Count (MCC) – Wednesday 21st September 2022
- Automatic Traffic Count (ATC) – Wednesday 21st – Tuesday 27th September 2022
- Queue lengths – Wednesday 21st September 2022
- Journey times – Historic TomTom data – Wednesday 21st September 2022
- Parking Surveys – Wednesday 21st September 2022
- Pedestrian Surveys – Wednesday 21st September 2022

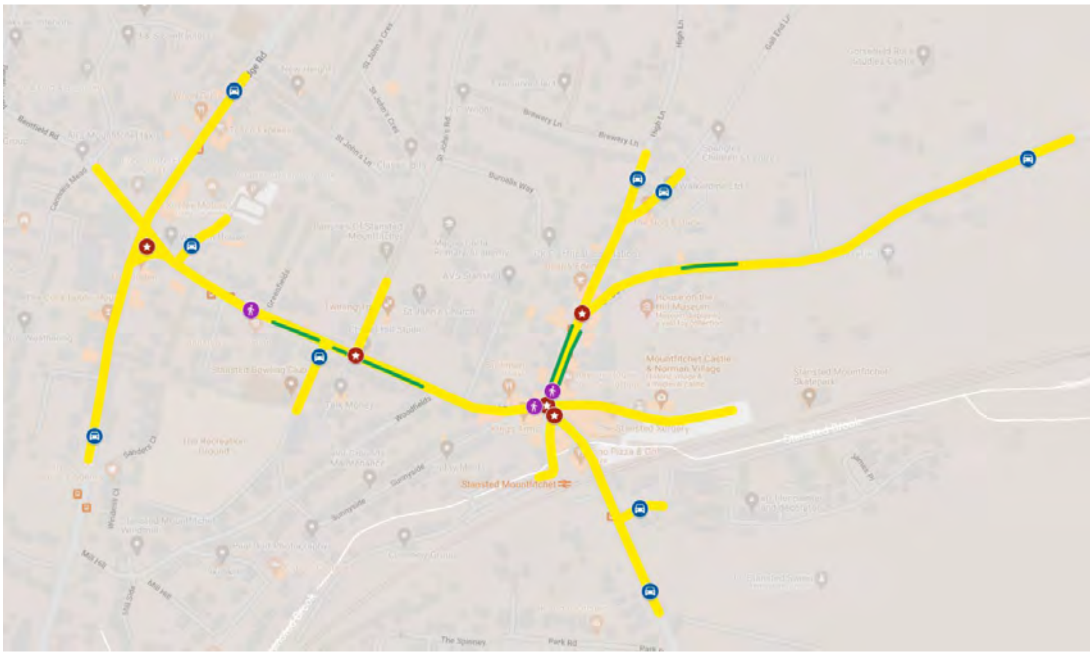


FIGURE 2.4 SURVEY DATA COLLECTED

Link to survey mapping

2.6 Pedestrians

2.6.1 Several pedestrian crossings (zebra crossings) are located in the modelled area and although these are not heavily used, pedestrians have been included in 15-minute time slices based on survey data to ensure interaction with traffic is accounted for.

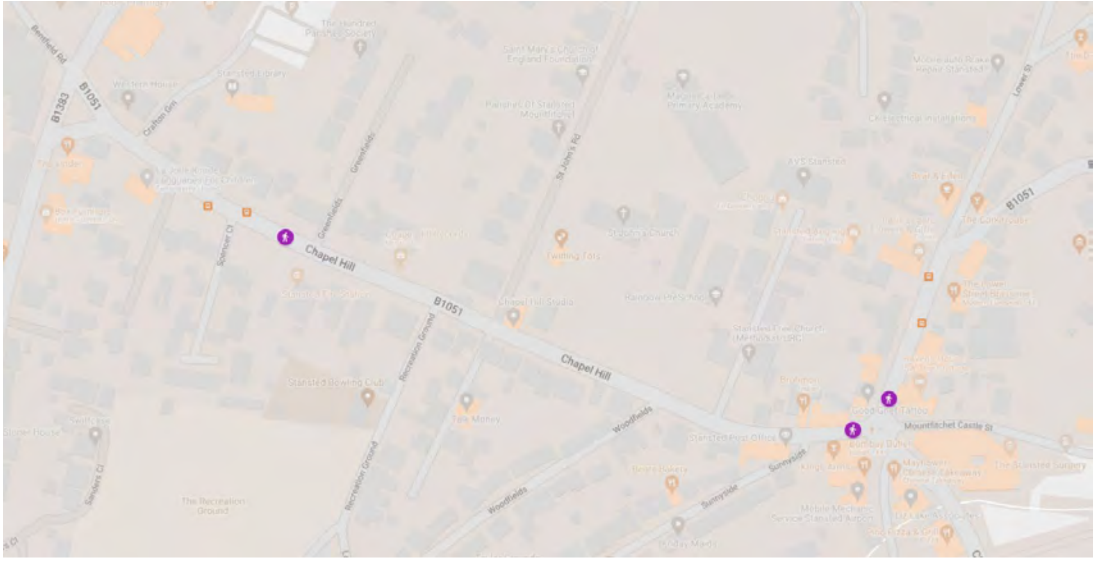


FIGURE 2.5 LOCATION OF PEDESTRIAN CROSSINGS

2.7 Parking

2.7.1 One of the key aspects of this model is the inclusion of parking that takes place in Mountfitchet as highlighted in **Figure 2.6**. These locations include:

1) B1051 Chapel Hill - Section 1
2) B1051 Chapel Hill - Section 2
3) Lower Street – Section 1
4) Lower Street – Section 2
5) B1051 Grove Hill – Section 1

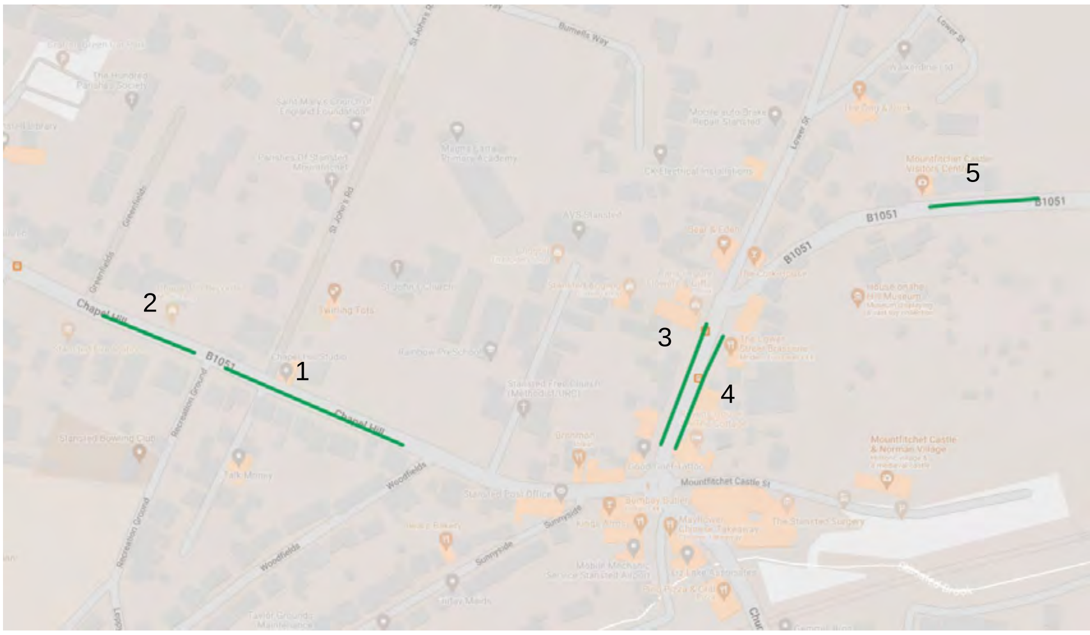


FIGURE 2.6 PARKING LOCATIONS

2.7.2 Parking bay demand was reflected based on information in the parking surveys carried out on Wednesday 21st September 2022 (**Appendix C**)**.** To make it easier to control both the arrival and departure times of each individual parking vehicle, these were modelled on separate links so that each dwell time was unique to that vehicle. **Figure 2.7** shows a series of links for each vehicle (including its input, static and parking route) that enters the network and parks. Each of the link sets is allocated to a parking location for ease of use. It has also been assumed that vehicles access the bays from the same direction of travel.

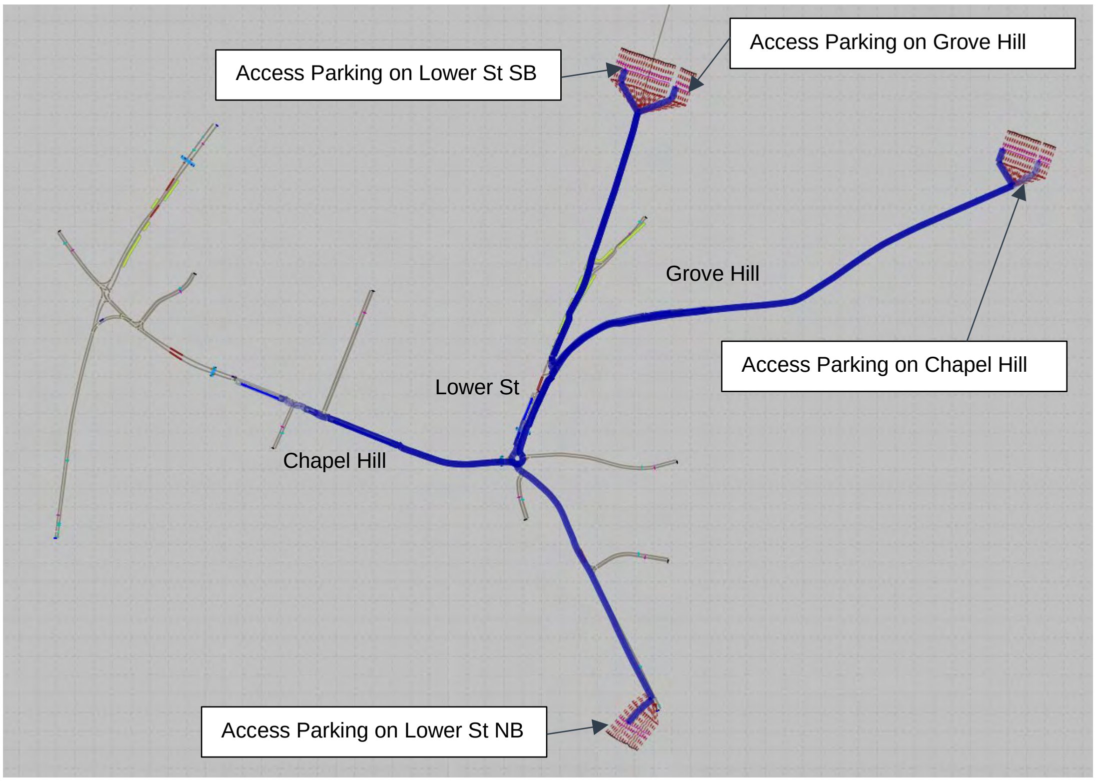


FIGURE 2.7 LINKS ADDED TO MODEL PARKING

2.7.3 Lower Street has parking available in parallel bays, which combined with the narrowing of the carriageway width, causes slow moving traffic. This is represented in the model using reduced speed areas and priority markers.

2.7.4 Chapel Hill and Grove Hill Parking is more complex as it takes place on-street, forcing both sides of the road to give way to each other, causing significant delay. The methodology used to model this behaviour is summarised in the following paragraphs.

Chapel Hill Parking

2.7.5 In modelling the parking on Chapel Hill, it has been assumed that overtaking in the opposing lane will always take place at the start of the line of bays (worst case scenario) as it would prove difficult to model all the possible gaps in bays where vehicles could store temporarily, waiting for opposing traffic, as they move through the area. To model the interaction between traffic travelling in both directions through the area, a series of priority rules have been placed on both the side with parking and the non-impeded side of the road as follows:

- Eastbound vehicles give way at location A to westbound vehicles that have entered the on-street parked cars section (location Y in **Figure 2.8**)
- Similarly, if an eastbound vehicle has entered the on-street parked cars section (location X), the west vehicles will give way at location B.
- Vehicles stored in locations C and D (between parking bays) give way to oncoming traffic. Furthermore, to avoid blocking this area, if several westbound vehicles are waiting at location C, Vehicles at location B will wait until the area is cleared.

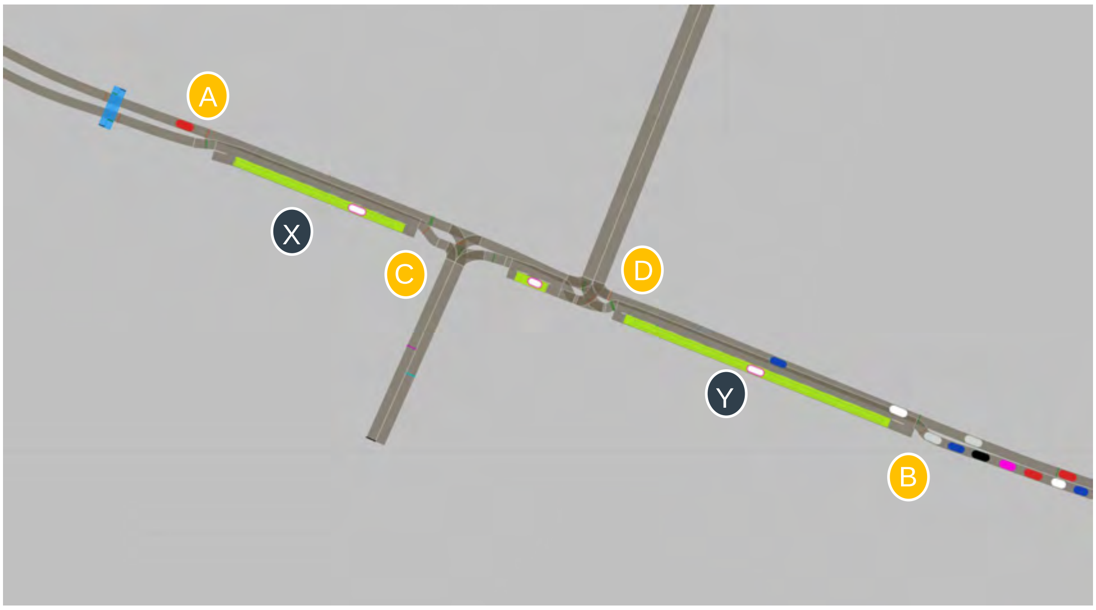


FIGURE 2.8 PRIORITY RULES ON CHAPEL HILL (PARKING)

2.7.6 During periods of low traffic, this strategy works well. However when traffic volume increases, one direction results in a constant flow of traffic and does not allow the opposite direction to enter the parking area. In the AM Peak the dominant flow is westbound and in the PM Peak, this is eastbound. This resulted in a situation where the models would constantly 'lock up' as there was not an equal use of the road network in each direction. The lockup occurred mostly due to blocking back to the Chapel Road / Lower Street Roundabout.

2.7.7 To mitigate this, an additional layer of control was required using signals and Vehicle Actuated Programming (VAP) logic as follows:

- Signals are positioned at locations 1 and 2 (see **Figure 2.9**), used to control the flow of traffic in each direction using VAP logic. When one of the signals is on green and the other on red, vehicles are counted in the direction with priority and once the maximum limit is reached, as defined in the logic, the other direction receives green instead. The same thing then happens in this direction until the maximum limit is reached. The aim of this strategy is to ensure that each direction gets the opportunity to move through the area in platoons. As part of the calibration / validation process, the following maximum limits were defined as per **Table 2.6**.

Max Vehicle Count	AM Peak	PM Peak
West	6	5
East	7	7

TABLE 2.6 MAXIMUM VEHICLES ALLOWED IN EACH PLATOON

- If the direction with priority (green signal) has a drop in demand (detector headway more than 3 seconds) then priority will switch to the other direction.
- Detectors have been added at locations 3,4,5 to help minimise the times the network 'locks up'. When vehicles block back to these detectors and occupy them for more than 4 seconds, then the signals are triggered to push more traffic through in the required direction; Green signal at location 1 when detector 4 is triggered, green signal at location 2 when detector 3 is triggered.
- When detector 5 is triggered, a red signal is given to location 1 to ensure the parking area is not blocked to westbound traffic.

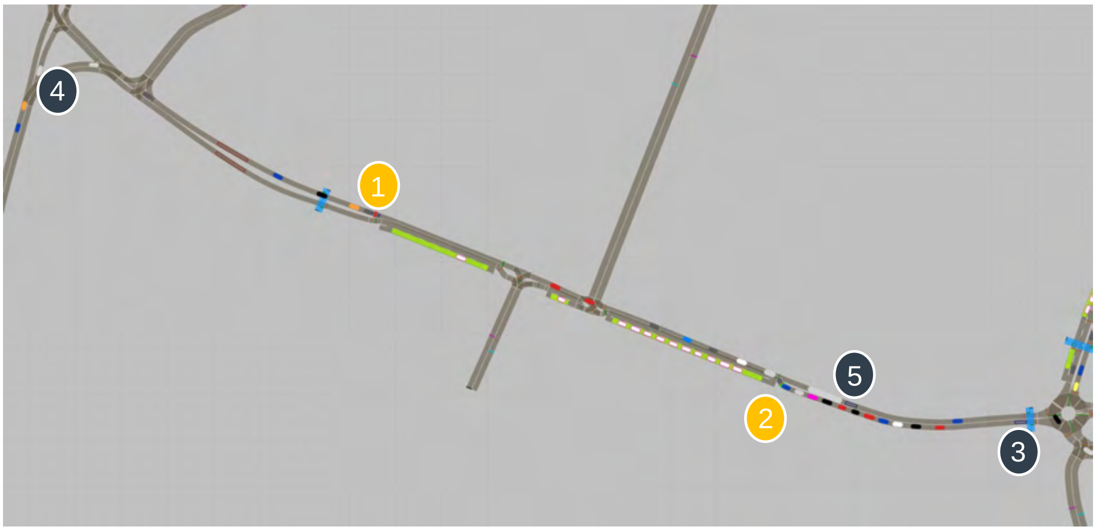


FIGURE 2.9 ADDITIONAL CONTROL USING SIGNALS

Grove Hill Parking

2.7.8 Site observations show that capacity issues occur for westbound traffic on Grove Hill due to the gap left at the on-street parking location for vehicles travelling eastbound to overtake parked vehicles and to ensure that the area near the signals does not get blocked. Typically, 2-3 vehicles travelling westbound store at the stop line and the remaining vehicles wait just east of the parking bays. The issue with this is that when the west stream signals have a green aspect, the first three vehicles make it through the junction but the stage maxes out as the remaining vehicles do not join the back of the queue / get detected in time. This behaviour has been replicated in the model as follows:

- Vehicles at location A give priority to those at location B / already at location X (see **Figure 2.10**). A headway is also positioned near location C so that as vehicles slow down on approach to the stop line, vehicles upstream at location A leave a gap along location X.

- Vehicles at location B give priority to those already travelling westbound at location X.

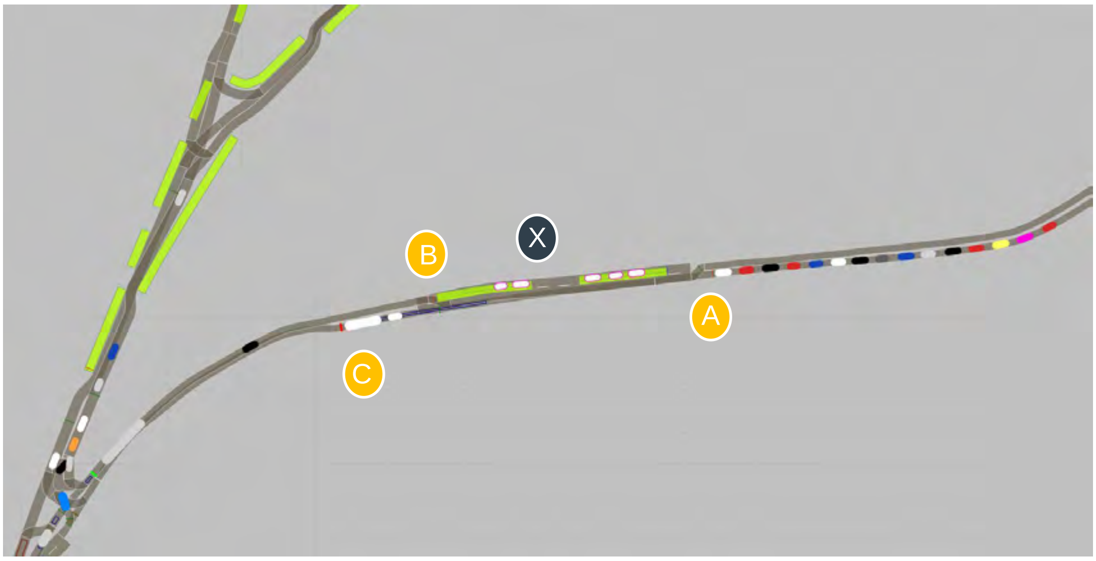


FIGURE 2.10 GROVE HILL PARKING

2.8 Driver Behaviour

2.8.1 There are three driving behaviours used within the models, as follows:

Number	Name	Usage/Comments
1	Urban (motorized) [Default]	Primary behaviour used on most links
4	Footpath (no interaction) [Default]	Used at Pedestrian Crossings
1001	Parking (From PTV Parallel Left 12.inpx Example)	Used for links with Parking bays in nearside lane in order to account for lateral behaviour and effects of blocking time distribution

TABLE 2.7: DRIVER BEHAVIOUR SETTINGS USED

3 MODEL CALIBRATION

3.1 Calibration Guidelines and Criteria

3.1.1 The calibration of the VISSIM model has been based on DfT's TAG Unit 3.1 and TfL's Modelling Guidelines, where appropriate.

3.1.2 Further details of the specific checks and criteria used can be found in **Appendix D**.

3.2 Link Flows

3.2.1 To ensure that the correct flows were entering/exiting the model, a comparison of the model flows and ATCs measured on site was carried out.

3.2.2 The results are summarised below for the AM and PM peak models, with more detail provided in **Appendix E**.

AM PEAK – ALL VEHICLES	
Total number of movements	18
Total number of movements GEH =< 5	18
Total percent of movements GEH =< 5	**100.00%**
Total number of movements GEH =< 10	18
Total percent of movements GEH =< 10	**100.00%**
Total number of movements Flow Criteria	18
Total percent of movements Flow Criteria	**100.00%**

TABLE 3.1: LINK FLOW CALIBRATION – AM PEAK

PM PEAK – ALL VEHICLES	
Total number of movements	18
Total number of movements GEH =< 5	18
Total percent of movements GEH =< 5	**100.00%**
Total number of movements GEH =< 10	18
Total percent of movements GEH =< 10	**100.00%**
Total number of movements Flow Criteria	18
Total percent of movements Flow Criteria	**100.00%**

TABLE 3.2: LINK FLOW CALIBRATION – PM PEAK

3.2.3 The results above show that all counts compared (AM and PM Peaks) have a GEH < 5, showing that overall, the flows loaded into the model represent September 2022 flows. Note that September 2022 ATC 3 (B1051) data collected was faulty. As such, at this location, the May 2022 survey data was used instead.

3.3 Junction Flows

3.3.1 The modelled turning counts at each of the junctions have been compared against the observed data collected in September 2022.

3.3.2 The results of the comparisons for the AM and PM peaks are summarised in **Tables 3.3 – 3.8**. **Appendix F** includes more detailed comparisons for All Vehicles, Light Vehicles and Heavy Vehicles.

AM PEAK – ALL VEHICLES	
Total number of movements	46
Total number of movements GEH =< 5	46
Total percent of movements GEH =< 5	**100.00%**
Total number of movements GEH =< 10	46
Total percent of movements GEH =< 10	**100.00%**
Total number of movements Flow Criteria	46
Total percent of movements Flow Criteria	**100.00%**

TABLE 3.3: TURNING COUNT CALIBRATION – AM PEAK ALL VEHICLES

AM PEAK – LIGHTS	
Total number of movements	46
Total number of movements GEH =< 5	46
Total percent of movements GEH =< 5	**100.00%**
Total number of movements GEH =< 10	46
Total percent of movements GEH =< 10	**100.00%**
Total number of movements Flow Criteria	46
Total percent of movements Flow Criteria	**100.00%**

TABLE 3.4: TURNING COUNT CALIBRATION – AM PEAK LIGHTS

AM PEAK – HEAVIES	
Total number of movements	46
Total number of movements GEH =< 5	46
Total percent of movements GEH =< 5	**100.00%**
Total number of movements GEH =< 10	46
Total percent of movements GEH =< 10	**100.00%**
Total number of movements Flow Criteria	46
Total percent of movements Flow Criteria	**100.00%**

TABLE 3.5: TURNING COUNT CALIBRATION – AM PEAK HEAVIES

3.3.3 **Tables 3.3 – 3.5** show that the AM peak model achieves the TAG criteria for turning counts, when looking at all vehicles and individually at the light and heavy vehicle classes.

PM PEAK – ALL VEHICLES	
Total number of movements	46
Total number of movements GEH =< 5	46
Total percent of movements GEH =< 5	**100.00%**
Total number of movements GEH =< 10	46
Total percent of movements GEH =< 10	**100.00%**
Total number of movements Flow Criteria	46
Total percent of movements Flow Criteria	**100.00%**

TABLE 3.6: TURNING COUNT CALIBRATION – PM PEAK ALL VEHICLES

PM PEAK – LIGHTS	
Total number of movements	46
Total number of movements GEH =< 5	46
Total percent of movements GEH =< 5	**100.00%**
Total number of movements GEH =< 10	46
Total percent of movements GEH =< 10	**100.00%**
Total number of movements Flow Criteria	46
Total percent of movements Flow Criteria	**100.00%**

TABLE 3.7: TURNING COUNT CALIBRATION – PM PEAK LIGHTS

PM PEAK – HEAVIES	
Total number of movements	46
Total number of movements GEH =< 5	46
Total percent of movements GEH =< 5	**100.00%**
Total number of movements GEH =< 10	46
Total percent of movements GEH =< 10	**100.00%**
Total number of movements Flow Criteria	46
Total percent of movements Flow Criteria	**100.00%**

TABLE 3.8: TURNING COUNT CALIBRATION – PM PEAK HEAVIES

3.3.4 In the PM peak, **Tables 3.6 – 3.8** all show that the PM peak model achieves the TAG criteria for turning counts, when looking at all vehicles and individually at the light and heavy vehicle classes.

3.4 Queue Lengths

3.4.1 Due to the subjective nature of queue measurements on site, modelled and observed queue comparisons have been provided for information only. These served as a calibration aid and overall, the modelled profiles are largely comparable to those measured on site. **Appendix G** summarises the queue comparison.

3.5 PM Peak specific changes

3.5.1 Although every attempt has been made to keep parameters consistent between peaks, there was a need to make the following small PM Peak specific changes:

- Lower Street – Priority Rules 74 & 75, gap times changed from 1.0s to 3.0s and 0.0s to 3.0s respectively. This is to replicate the additional delays to traffic observed due to higher parking activity in the PM Peak compared to the AM Peak.

3.6 Model Calibration Summary

3.6.1 This section has detailed the techniques and comparisons that have been used to calibrate the model and ensure that it represents the nature of the network around Mountfitchet.

3.6.2 The ATC flow and junction flow comparisons show that the model meets TAG criteria, and the network includes the correct amount of traffic for each junction.

4 MODEL VALIDATION

4.1 Validation Guidelines & Criteria

4.1.1 The validation of the VISSIM model has been on DfT's TAG Unit 3.1 and TfL's Modelling Guidelines.

4.1.2 Further details of the specific checks and criteria used can be found in **Appendix D**.

4.2 Exit Flows

4.2.1 The first validation check was on the exit flows, to ensure that the vehicles in the model reached their destinations within the AM and PM peak periods.

4.2.2 **Tables 4.1 & 4.2** summarise the comparisons of the modelled vs. demand exit flows, with more detailed results provided in **Appendix E**.

AM PEAK – ALL VEHICLES	
Total number of counts considered	13
VISSIM model counts with GEH <5	13
% of VISSIM model counts with GEH <5	**100.00%**
VISSIM model counts within TAG Unit 3.1 Criteria	13
% of VISSIM model counts within TAG Unit 3.1 Criteria	**100.00%**

TABLE 4.1 EXIT FLOW VALIDATION – AM PEAK

PM PEAK – ALL VEHICLES	
Total number of counts considered	13
VISSIM model counts with GEH <5	13
% of VISSIM model counts with GEH <5	**100.00%**
VISSIM model counts within TAG Unit 3.1 Criteria	13
% of VISSIM model counts within TAG Unit 3.1 Criteria	**100.00%**

TABLE 4.2 EXIT FLOW VALIDATION – PM PEAK

4.2.3 The results show that all the exit flows have a GEH less than 5 and meet the Individual Flow criteria.

4.3 Journey Times – General Traffic

4.3.1 The modelled journey times have been compared against the observed data for the route shown in **Figure 4.1**. This represents the main east/west route for through traffic in Mountfitchet. Each direction is broken down into smaller sections to illustrate how each of these performs against observed data. Please note that the average journey times of modelled vehicles parking has been taken out of the assessment due to the likelihood that results will be skewed for the longer parking durations.

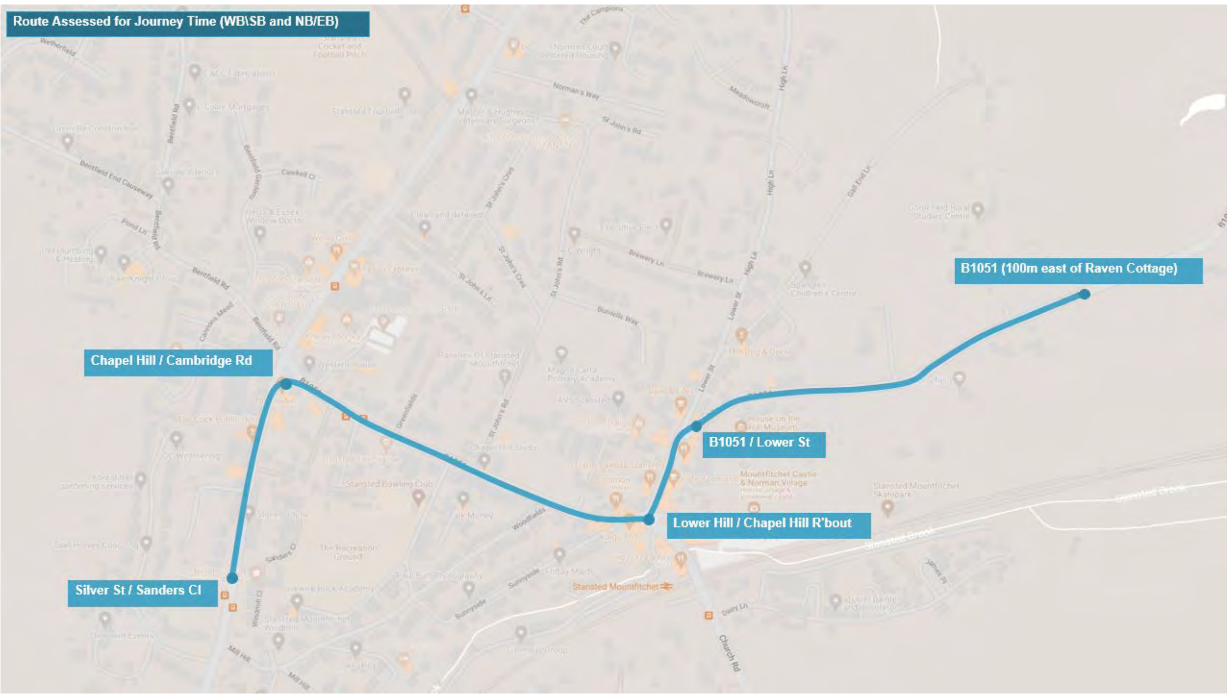


FIGURE 4.1 ROUTE ASSESSED FOR JOURNEY TIME VALIDATION

4.3.2 The results of the comparisons for the AM and PM peak periods are summarised in **Tables 4.3** & **4.4**, with more detailed comparisons provided in **Appendix H**.

AM PEAK (07:30 – 08:30) SUMMARY	
Vehicle Class	ALL (Except Parked Veh.)
Total number of sections considered	8
Number of VISSIM sections with 15% of observed	4
% of VISSIM sections within 15% of observed	**50.0%**
Number of VISSIM sections within 60s of observed	8
% of VISSIM sections within 60s of observed	**100.0%**
Number of VISSIM sections meeting at least one set of criteria	8
% of VISSIM sections meeting at least one set of criteria	**100.0%**

TABLE 4.3: JOURNEY TIME VALIDATION – AM PEAK

4.3.3 **Table 4.3** shows that in the AM peak, 50.0% (4/8) of the sections are within 15%. However, those that are outside of this range have small relative difference values:

- JT Section 101 – B1051 (100m east of Raven Cottage) – B1051/Lower St Junction = 18% (17s) difference
- JT Section 102 – B1051/Lower St Junction - Lower Hill / Chapel Hill R'bout = -18% (-6s) difference
- JT Section 104 – Chapel Hill / Cambridge Rd - Silver St / Sanders Cl = -16% (-4s) difference
- JT Section 201 – Silver St / Sanders Cl – Chapel Hill / Cambridge Rd = -16% (-5s) difference

PM PEAK (17:00 – 18:00) SUMMARY	
Vehicle Class	ALL (Except Parked Veh.)
Total number of sections considered	8
Number of VISSIM sections with 15% of observed	7
% of VISSIM sections within 15% of observed	87.5%
Number of VISSIM sections within 60s of observed	8
% of VISSIM sections within 60s of observed	100.0%
Number of VISSIM sections meeting at least one set of criteria	8
% of VISSIM sections meeting at least one set of criteria	100.0%

TABLE 4.4: JOURNEY TIME VALIDATION – PM PEAK

4.3.4 **Table 4.4** shows that in the PM peak, 87.5% (7/8) of cases of the sections are within 15%. The section which falls outside of the 15% is:

- JT Section 201 – Silver St / Sanders Cl – Chapel Hill / Cambridge Rd = -38% (-16s) difference

4.3.5 However, referring to **Table 4.5**, considering the overall route (end to end) in both directions and peaks, the results show that all routes are within a maximum modelled to observed difference of 15%.

Route	Direction	Description			AM Peak			PM Peak		
					Actual Diff.	% Diff.	Within 15%	Actual Diff.	% Diff.	Within 15%
1	WB\SB	B1051 (100m east of Raven Cottage)	-	Silver St / Sanders Cl	15	6%	✓	-5	-2%	✓
2	NB\EB	Silver St / Sanders Cl	-	B1051 (100m east of Raven Cottage)	-16	-7%	✓	-17	-8%	✓

TABLE 4.5 OVERALL ROUTE JOURNEY TIME VALIDATION

4.4 Model Error Log Analysis

AM Peak

4.4.1 The AM peak error logs have been reviewed and these show no significant issues to impact on the network performance.

PM Peak

4.4.2 The PM peak error logs have been reviewed and these show no significant issues to impact on the network performance.

4.5 Model Validation Summary

4.5.1 This section has detailed the comparisons undertaken to validate the model and ensure that it represents the nature of the network around Mountfitchet.

4.5.2 The exit flows and journey time comparisons show that the model meets TAG criteria, and the performance reflects the data collected from the various sources.

4.5.3 The review of the error logs also shows no issues that have a significant impact on the network performance.

5 MODELLING CONCLUSIONS

5.1 Overview

5.1.1 Modelling Group have been commissioned by Ardent Consulting Engineers to undertake VISSIM modelling associated with the proposed development of 130 units on the B1051 in nearby Elsenham, which is expected to have an impact on the network within Mountfitchet to the southwest.

5.2 Modelling Scope & Purpose

5.2.1 For this project, a base model and future year models were required to be developed.

5.2.2 A base model has been developed of the road network around Mountfitchet, to provide a realistic platform for undertaking future year testing.

5.3 Model Calibration Summary

5.3.1 Various modelling techniques and comparisons have been used to calibrate the model and ensure that it represents the nature of the network around Mountfitchet.

5.3.2 The entry flow and junction flow comparisons show that the model meets TAG criteria, and the network includes the correct amount of traffic for each junction.

5.3.3 The visual observations show that the key elements of congestion and queuing around the area are present in the model.

5.4 Model Validation Summary

5.4.1 Comparisons have been undertaken to validate the model and ensure that it represents the nature of the network around Mountfitchet.

5.4.2 The exit flows and journey time comparisons show that the model meets TAG criteria, and the performance reflects the data collected from the various sources.

5.4.3 The review of the error logs also shows no issues that have a significant impact on the network performance.

5.5 Overall Conclusions

5.5.1 The model has been successfully calibrated and validated to match a range of observed data collected and is therefore a suitable base for future year testing.

APPENDIX A:

SPEED PROFILES TECHNICAL NOTE

Prepared by:	Daniel Bent	Reviewed by:	Luke Best
Client:	Internal	Date:	16 June 2021

Standardised Speed Distributions – DfT Statistics

1 INTRODUCTION

1.1 The speed limit desired speed distributions within the model have been calculated from Department for Transport (DfT) statistics or, where national statistics are not available, based on Transport for London (TfL) speed profiles.

2 SPEED PROFILES CALCULATED

2.1 The following speed profiles have been based on the DfT SPE0111 **2019** dataset:

- 20mph Built Up Roads
- 30mph Built Up Roads
- National Speed Limit – Single Carriageway Road
- Motorways

2.2 The data has been obtained from the following link:

HTTPS://WWW.GOV.UK/GOVERNMENT/STATISTICAL-DATA-SETS/SPE01-VEHICLE-SPEEDS

2.3 Due to no data being available, the following speed profiles have been based on the DfT SPE0102 **2014** dataset (latest available data):

- 40mph Built Up Roads

2.4 The data has been obtained from AECOM during a previous modelling exercise.

2.5 Due to no data being available, the following speed profiles have been based on the DfT SPE0111 **2009** dataset – Table TRA9906 (latest available data):

- Dual Carriageway Non-Built Up Roads

2.6 The data has been obtained from the following link:

HTTP://WEBARCHIVE.NATIONALARCHIVES.GOV.UK/20110218142807/HTTP:/DFT.GOV.UK/PGR/STATISTICS/DATATABLESPUBLICATIONS/TSGB/

Mobile 07305 069654 Website www.modelling.group
Email daniel@modelling.group
Registered Office Crosby Court, 28 George St, Birmingham B3 1QG

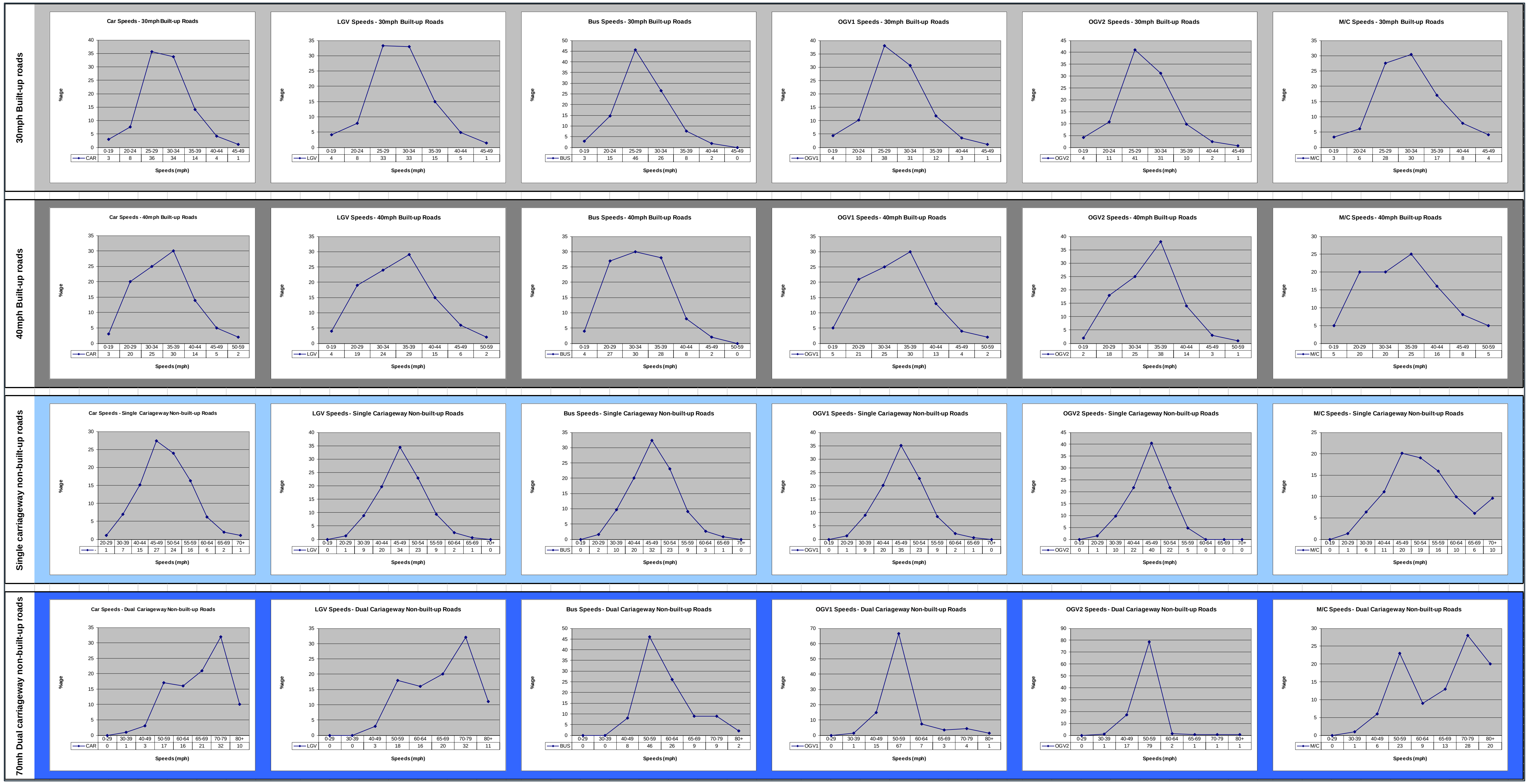
2.7 The associated speed graphs for these profiles are detailed on the following page.

3 TFL SPEED PROFILES

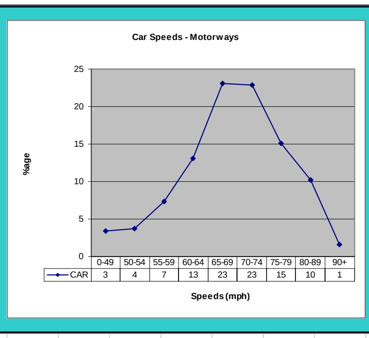
3.1 The 10mph and 50mph speed profiles have been based on the latest TfL template, as no information is available in the DfT statistics for these speed limits.

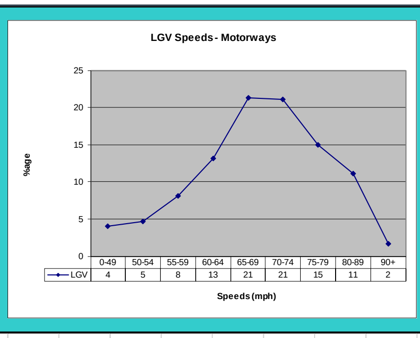
4 SPEED DISTRIBUTIONS IN VISSIM

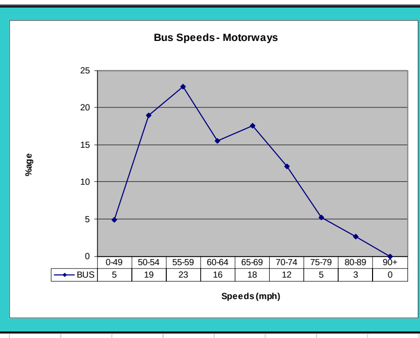
4.1 For use in VISSIM, the upper and lower bands of each speed profile and for each vehicle type have been removed to reduce the effect of any outliers or anomalies in the statistics.

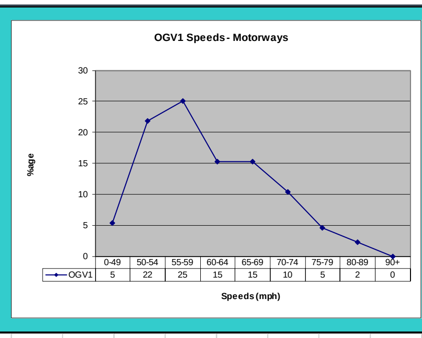

30mph Built-up roads
Car Speeds - 30mph Built-up Roads
%age
Speeds (mph)
0-19 | 20-24 | 25-29 | 30-34 | 35-39 | 40-44 | 45-49
CAR | 3 | 8 | 36 | 34 | 14 | 4 | 1
LGV Speeds - 30mph Built-up Roads
LGV | 4 | 8 | 33 | 33 | 15 | 5 | 1
Bus Speeds - 30mph Built-up Roads
BUS | 3 | 15 | 46 | 26 | 8 | 2 | 0
OGV1 Speeds - 30mph Built-up Roads
OGV1 | 4 | 10 | 38 | 31 | 12 | 3 | 1
OGV2 Speeds - 30mph Built-up Roads
OGV2 | 4 | 11 | 41 | 31 | 10 | 2 | 1
M/C Speeds - 30mph Built-up Roads
M/C | 3 | 6 | 28 | 30 | 17 | 8 | 4
40mph Built-up roads
Car Speeds - 40mph Built-up Roads
0-19 | 20-29 | 30-34 | 35-39 | 40-44 | 45-49 | 50-59
CAR | 3 | 20 | 25 | 30 | 14 | 5 | 2
LGV Speeds - 40mph Built-up Roads
LGV | 4 | 19 | 24 | 29 | 15 | 6 | 2
Bus Speeds - 40mph Built-up Roads
BUS | 4 | 27 | 30 | 28 | 8 | 2 | 0
OGV1 Speeds - 40mph Built-up Roads
OGV1 | 5 | 21 | 25 | 30 | 13 | 4 | 2
OGV2 Speeds - 40mph Built-up Roads
OGV2 | 2 | 18 | 25 | 38 | 14 | 3 | 1
M/C Speeds - 40mph Built-up Roads
M/C | 5 | 20 | 20 | 25 | 16 | 8 | 5
Single carriageway non-built-up roads
Car Speeds - Single Cariageway Non-built-up Roads
20-29 | 30-39 | 40-44 | 45-49 | 50-54 | 55-59 | 60-64 | 65-69 | 70+
- | 1 | 7 | 15 | 27 | 24 | 16 | 6 | 2 | 1
LGV Speeds - Single Cariageway Non-built-up Roads
0-19 | 20-29 | 30-39 | 40-44 | 45-49 | 50-54 | 55-59 | 60-64 | 65-69 | 70+
LGV | 0 | 1 | 9 | 20 | 34 | 23 | 9 | 2 | 1 | 0
Bus Speeds - Single Cariageway Non-built-up Roads
BUS | 0 | 2 | 10 | 20 | 32 | 23 | 9 | 3 | 1 | 0
OGV1 Speeds - Single Cariageway Non-built-up Roads
OGV1 | 0 | 1 | 9 | 20 | 35 | 23 | 9 | 2 | 1 | 0
OGV2 Speeds - Single Cariageway Non-built-up Roads
OGV2 | 0 | 1 | 10 | 22 | 40 | 22 | 5 | 0 | 0 | 0
M/C Speeds - Single Cariageway Non-built-up Roads
M/C | 0 | 1 | 6 | 11 | 20 | 19 | 16 | 10 | 6 | 10
70mh Dual carriageway non-built-up roads
Car Speeds - Dual Cariageway Non-built-up Roads
0-29 | 30-39 | 40-49 | 50-59 | 60-64 | 65-69 | 70-79 | 80+
CAR | 0 | 1 | 3 | 17 | 16 | 21 | 32 | 10
LGV Speeds - Dual Cariageway Non-built-up Roads
LGV | 0 | 0 | 3 | 18 | 16 | 20 | 32 | 11
Bus Speeds - Dual Cariageway Non-built-up Roads
BUS | 0 | 0 | 8 | 46 | 26 | 9 | 9 | 2
OGV1 Speeds - Dual Cariageway Non-built-up Roads
OGV1 | 0 | 1 | 15 | 67 | 7 | 3 | 4 | 1
OGV2 Speeds - Dual Cariageway Non-built-up Roads
OGV2 | 0 | 1 | 17 | 79 | 2 | 1 | 1 | 1
M/C Speeds - Dual Cariageway Non-built-up Roads
M/C | 0 | 1 | 6 | 23 | 9 | 13 | 28 | 20

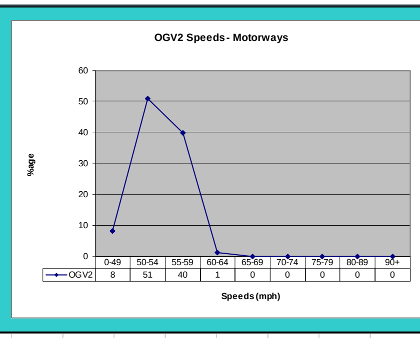
70mph Motorways

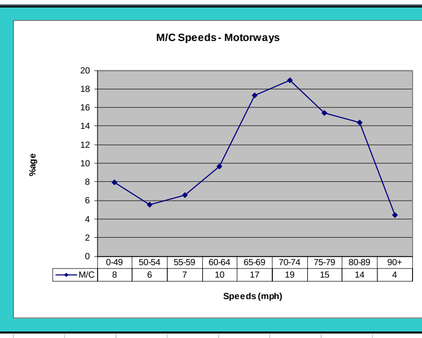




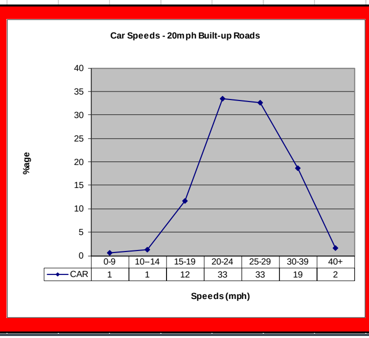


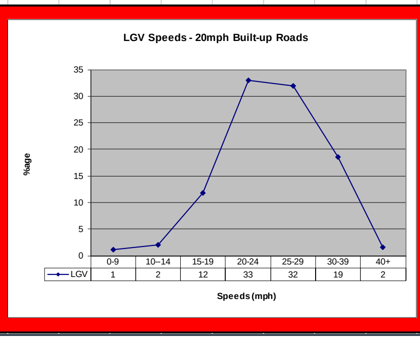


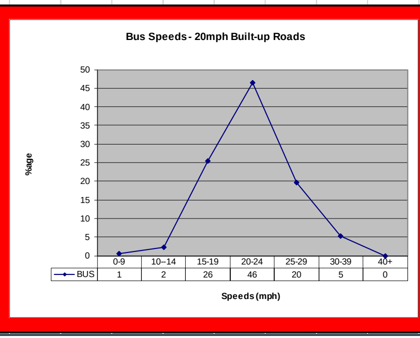


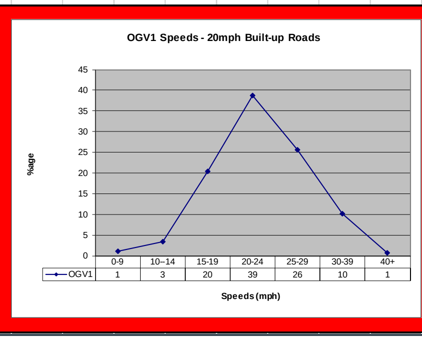


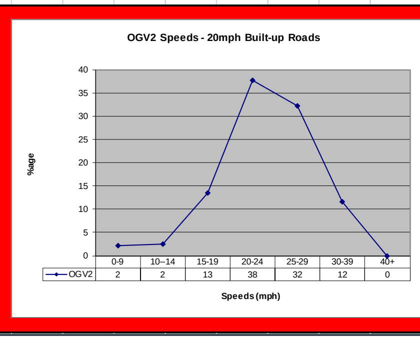
20mph Built-up roads

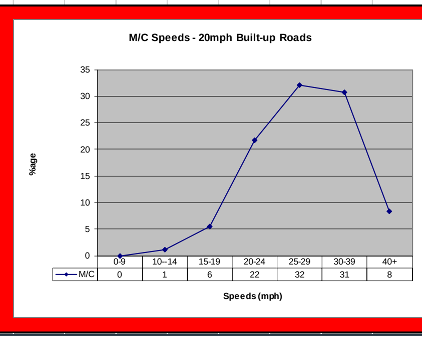












APPENDIX B:

SPEED PROFILES - TURNS TECHNICAL NOTE

Prepared by:	Daniel Bent	Reviewed by:	Luke Best
Client:	Internal	Date:	23 June 2021

Standardised Speed Distributions – Turns

1 INTRODUCTION

1.1 This note describes the methodology used to determine speed distributions for vehicles negotiating turns of various radii on carriageway with different speed limits.

1.2 These are required in line with TfL's Modelling Guidelines, which suggests that distributions should be used for turns, dependent on radii (see **Figure 1.1**).

V226 Reduced Speed Areas

Reduced speed areas are used in Vissim models for a variety of purposes, most importantly to:

- Replicate lower speeds used by turning vehicles within the model;
- Represent localised changes in speeds due to network geometry or driver psychology; and
- Calibrate saturation flows at junction stoplines.

The TfL Traffic Modelling Guidelines recommend that reduced speed areas should be placed at all stoplines and wherever road geometry or other factors cause drivers to decelerate, for example bends, turning movements, speed reduction measures, complex junction layouts or where there is poor visibility.

Suitable desired speed distributions should be associated with each reduced speed area, which will be checked by the MAE. Where separate distributions are applied to

FIGURE 1.1: TFL MODEL AUDITING PROCESS (V3.5) – REDUCED SPEED AREAS

2 SPEED PROFILES FOR DIFFERING SPEED LIMITS

2.1 To account for various speed limits, different vehicle types and to allow a set of distributions to apply to both urban and rural locations, a simplistic approach has been adopted to derive speed bands for instances of high and low braking. This is shown in **Table 2.1**.

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Email luke@modelling.group
Registered Office Crosby Court, 28 George St, Birmingham B3 1QG

Speed limit	Speed Band		
		High Braking	Low Braking
	from	to/from	to
20 mph	10	15	20
30 mph	20	25	30
40 mph	30	35	40
50 mph	40	45	50
60 mph	50	55	60
70 mph	60	65	70

TABLE 2.1: SPEED BANDS FOR DIFFERENT SPEED LIMITS

2.2 The thought process behind the speed banding is that for locations where higher braking is required, vehicles tend to slow down 5-10mph below the speed limit. For locations where lower braking is required, vehicles slow down up to 5mph below the speed limit, and down to the speed limit if the vehicles assigned speed distribution is over that at all.

2.3 A more simplified breakdown of the speed profiles created are shown in **Table 2**.

Speed Profile		Speed Band (mph)	
VISSIM No.	Name	Lower	Upper
100	RSA – 20mph Braking – High	10	15
101	RSA – 20mph Braking – Low	15	20
102	RSA – 30mph Braking – High	20	25
103	RSA – 30mph Braking – Low	25	30
104	RSA – 40mph Braking – High	30	35
105	RSA – 40mph Braking – Low	35	40
106	RSA – 50mph Braking – High	40	45
107	RSA – 50mph Braking – Low	45	50
108	RSA – 60mph Braking – High	50	55
109	RSA – 60mph Braking – Low	55	60
110	RSA – 70mph Braking – High	60	65
111	RSA – 70mph Braking – Low	65	70

TABLE 2.2: VISSIM SPEED DISTRIBUTIONS

3 SUMMARY

3.1 These developed speed distributions allow for both a consideration of the turning radii, the vehicle type and the speed limit. This allows vehicle speeds on corners in the modelled network to be more representative of on-street conditions.

3.2 It should be noted that these speed distributions provide a starting point in model calibration and validation process and any further, more refined speed profiles to account for site specific behaviour should be developed, justified and modelled.

APPENDIX C:

PARKING SURVEY

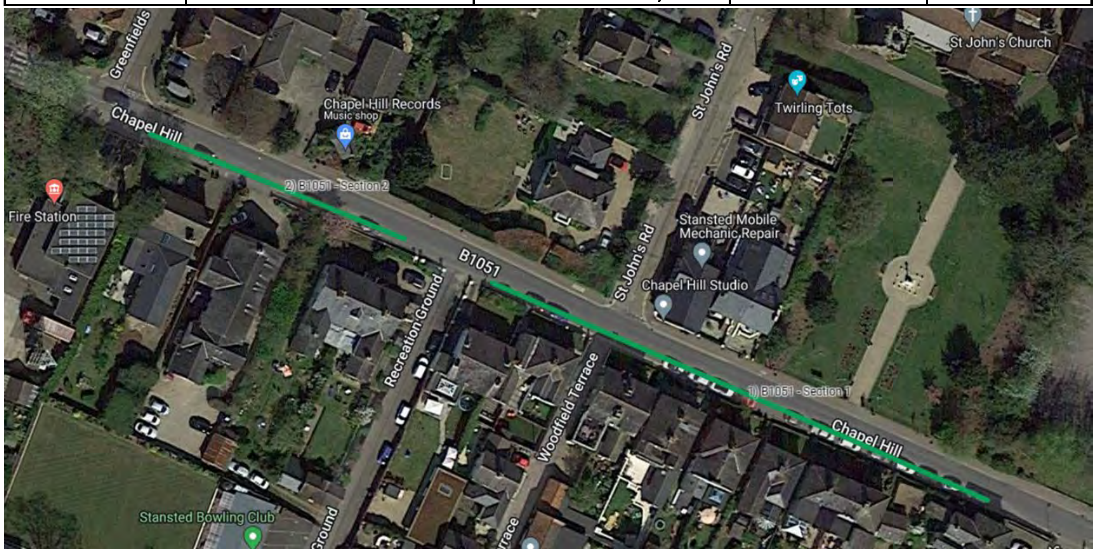
1 - B1051 Chapel Hill - Section 1				
Arrival Time	Arrival Time (15 minutes)	Departure Time	Duration of stay	Vehicle Class
In at start time	07:00	07:13:05		Car
In at start time	07:00	08:05:56		Car
In at start time	07:00	08:17:28		Car
In at start time	07:00	08:31:01		Car
In at start time	07:00	09:12:28		Car
In at start time	07:00	11:06:31		Car
In at start time	07:00	11:13:39		Car
In at start time	07:00	11:54:50		Car
In at start time	07:00	End of the survey time		Car
In at start time	07:00	End of the survey time		Car
07:17:45	07:15	08:32:39	01:14:54	Car
08:09:40	08:00	08:12:14	00:02:34	Car
08:39:14	08:30	14:54:36	06:15:22	Car
08:52:40	08:45	08:54:42	00:02:02	Lgv
09:24:35	09:15	09:50:15	00:25:40	Lgv
In at start time	16:00	End of the survey time		Car
In at start time	16:00	End of the survey time		Car
In at start time	16:00	End of the survey time		Car
In at start time	16:00	16:24:39		Car
In at start time	16:00	17:36:31		Car
In at start time	16:00	16:17:46		Car
16:23:53	16:15	16:25:27	00:01:34	Lgv
16:35:54	16:30	16:42:54	00:07:00	Car
16:56:57	16:45	17:30:21	00:33:24	Lgv
17:08:28	17:00	17:16:38	00:08:10	Car
17:27:04	17:15	End of the survey time		Car
17:42:45	17:30	End of the survey time		Car
17:52:11	17:45	18:00:01	00:07:50	Car
17:57:50	17:45	End of the survey time		Car
18:29:27	18:15	19:14:42	00:45:15	Car
18:39:17	18:30	End of the survey time		Car

2 - B1051 Chapel Hill - Section 2				
Arrival Time	Arrival Time (15 minutes)	Departure Time	Duration of stay	Vehicle Class
In at start time	07:00	End of the survey time		Car
In at start time	07:00	End of the survey time		Car
In at start time	07:00	End of the survey time		Lgv
In at start time	07:00	20:25:00		Car
07:27:30	07:15	18:44:14	11:16:44	Car
08:36:03	08:30	08:38:10	00:02:07	Car
09:22:26	09:15	09:25:40	00:03:14	Ogv 1
09:50:24	09:45	09:50:40	00:00:16	Lgv
18:02:46	18:00	18:03:39	00:00:53	Car

3 - Lower Street - Section 1				
Arrival Time	Arrival Time (15 minutes)	Departure Time	Duration of stay	Vehicle Class
In at start time	07:00	08:52:35		Car
In at start time	07:00	09:53:50		Lgv
07:07:18	07:00	07:10:02	00:02:44	Car
07:49:48	07:45	07:51:04	00:01:16	Lgv
07:52:03	07:45	07:52:24	00:00:21	Car
07:57:14	07:45	07:58:10	00:00:56	Car
08:01:02	08:00	08:01:44	00:00:42	Lgv
08:08:29	08:00	09:04:36	00:56:07	Lgv
08:09:04	08:00	08:39:30	00:30:26	Car
08:43:27	08:30	09:20:10	00:36:43	Car
08:53:01	08:45	08:53:10	00:00:09	Car
08:59:48	08:45	09:16:18	00:16:30	Car
09:07:10	09:00	09:35:15	00:28:05	Car
09:18:24	09:15	09:29:16	00:10:52	Car
09:21:56	09:15	10:17:40	00:55:44	Car
09:29:31	09:15	10:51:20	01:21:49	Car
09:37:45	09:30	09:52:16	00:14:31	Car
09:52:25	09:45	10:53:52	01:01:27	Car
09:55:25	09:45	10:58:42	01:03:17	Car
13:20:25	13:15	16:51:37	03:31:12	Car
15:00:10	15:00	16:53:31	01:53:21	Lgv
16:15:55	16:15	16:22:15	00:06:20	Car
16:23:28	16:15	16:48:40	00:25:12	Car
16:48:52	16:45	17:05:39	00:16:47	Car
16:54:53	16:45	16:57:03	00:02:10	Car
16:55:26	16:45	19:30:10	02:34:44	Car
16:58:44	16:45	17:02:08	00:03:24	Car
17:10:54	17:00	18:09:22	00:58:28	Car
17:38:52	17:30	18:34:40	00:55:48	Car
18:13:50	18:00	19:12:33	00:58:43	Car
18:39:24	18:30	18:42:55	00:03:31	Car
18:45:58	18:45	20:05:45	01:19:47	Car

4 - Lower Street - Section 2				
Arrival Time	Arrival Time (15 minutes)	Departure Time	Duration of stay	Vehicle Class
In at start time	07:00	07:05:52		Lgv
07:02:37	07:00	07:05:52	00:03:15	Car
07:07:50	07:00	07:08:29	00:00:39	Car
07:16:28	07:15	07:26:43	00:10:15	Ogv 1
07:19:07	07:15	07:30:05	00:10:58	Lgv
07:36:59	07:30	07:37:46	00:00:47	Car
07:42:50	07:30	07:43:42	00:00:52	Car
07:44:36	07:30	07:45:56	00:01:20	Car
07:45:41	07:45	07:48:26	00:02:45	Car
07:52:58	07:45	08:19:23	00:26:25	Lgv
07:59:01	07:45	07:59:18	00:00:17	Bus
08:00:37	08:00	08:00:44	00:00:07	Lgv
08:04:40	08:00	08:22:05	00:17:25	Car
08:11:59	08:00	08:45:57	00:33:58	Car
08:18:06	08:15	08:51:16	00:33:10	Car
08:19:15	08:15	08:21:04	00:01:49	Car
08:19:50	08:15	08:21:33	00:01:43	Car
08:30:41	08:30	08:38:48	00:08:07	Car
08:35:30	08:30	09:10:12	00:34:42	Car
08:38:04	08:30	08:53:10	00:15:06	Lgv
08:47:04	08:45	11:13:49	02:26:45	Lgv
08:49:11	08:45	09:28:03	00:38:52	Car
08:50:21	08:45	08:55:21	00:05:00	Lgv
08:53:29	08:45	13:37:23	04:43:54	Car
08:53:35	08:45	10:02:31	01:08:56	Car
08:56:36	08:45	09:38:19	00:41:43	Lgv
09:18:05	09:15	09:19:28	00:01:23	Car
09:28:14	09:15	09:37:05	00:08:51	Car
09:31:35	09:30	09:32:36	00:01:01	Car
09:38:53	09:30	09:50:16	00:11:23	Lgv
09:39:57	09:30	10:09:52	00:29:55	Car
09:50:24	09:45	10:19:39	00:29:15	Car

In at start time	16:00	16:04:40		Car
In at start time	16:00	16:06:02		Car
In at start time	16:00	16:12:30		Car
In at start time	16:00	16:54:05		Car
In at start time	16:00	19:04:22		Car
16:03:39	16:00	16:48:29	00:44:50	Car
16:13:19	16:00	17:02:28	00:49:09	Car
16:13:35	16:00	16:14:19	00:00:44	Car
16:14:49	16:00	16:41:21	00:26:32	Car
16:20:05	16:15	16:20:16	00:00:11	Car
16:36:11	16:30	16:36:21	00:00:10	Car
16:56:33	16:45	17:01:01	00:04:28	Car
16:57:12	16:45	23:23:00	06:25:48	Car
16:57:25	16:45	17:19:40	00:22:15	Car
16:59:54	16:45	17:00:01	00:00:07	Car
17:00:41	17:00	17:02:01	00:01:20	Car
17:17:49	17:15	18:04:18	00:46:29	Lgv
17:19:19	17:15	17:24:53	00:05:34	Lgv
17:26:40	17:15	17:39:34	00:12:54	Lgv
17:32:32	17:30	17:48:35	00:16:03	Car
17:42:56	17:30	20:15:53	02:32:57	Car
17:49:10	17:45	19:12:37	01:23:27	Car
18:02:46	18:00	18:05:14	00:02:28	Ogv 1
18:14:19	18:00	18:32:40	00:18:21	Lgv
18:27:42	18:15	19:29:59	01:02:17	Car
18:36:00	18:30	End of the survey time		Car
5 - B1051 Grove Hill - Section 1				
Arrival Time	Arrival Time (15 minutes)	Departure Time	Duration of stay	Vehicle Class
In at start time	07:00	End of the survey time		Car
In at start time	07:00	07:32:56		Car
In at start time	07:00	08:36:51		Car
07:59:24	07:45	08:48:21	00:48:57	Car
In at start time	16:00	13:04:46		Car
In at start time	16:00	14:09:58		Car
12:52:40	12:45	End of the survey time		Car
14:09:37	14:00	End of the survey time		Car
16:21:06	16:15	End of the survey time		Car




Stansted Angling
Fishing shop
Alter by Joanna
First Class Turkish Barbers - Stansted
Paris Legore Flowers & Gifts
Florist
Lower St. Tanning Salon
The Dog House
Vanity Fayre Hair & Beauty Salon
The Lower Street Brasserie
Modern European · ££
4) Lower St - Section
End of Tenancy Cleansing Stansted...
3) Lower St - Section
Elsenham Cabs
Lower St
Kings Family Butchers
Butchers
Flames kebab stansted
Cafe Yeomans
The Queen's Head
Crimson 8
Chinese · ££
Brohmon
Indian
Tapers The Barber Shop
Mountfitchet C
Mountfitchet Castle Visitors Centre
B1051
5) B1051 - Section 1
B1051

APPENDIX D:

CALIBRATION & VALIDATION CRITERIA

TECHNICAL NOTE

Prepared by:	Daniel Bent	Reviewed by:	Luke Best
Client:	Internal	Date:	29 June 2021

Calibration & Validation – Guidance & Criteria

1 INTRODUCTION

1.1 This note describes the guidance and criteria used to calibrate and validate microsimulation models.

2 CALIBRATION & VALIDATION DEFINITIONS

2.1 Calibration and validation are the main processes required to ensure that a base year microsimulation model developed is representative of on-street conditions.

2.2 The definitions of these processes are as follows:

- Calibration – the process of checking modelled outputs against observed data that has been used to develop model inputs. An example of this would be the comparison of observed junction turning flows that have been used to build the origin-destination (O-D) matrices for the model.
- Validation – the process of checking modelled outputs against *independent* observed data, that has **not** been used for model inputs. An example of this would be the comparison of modelled journey times against site data.

2.3 When calibrating a microsimulation model, the following comparisons are usually made between modelled and observed outputs:

- Junction Turning Flows
- Entry Flows
- Screen-line Counts
- Queue Lengths
- Other Site Observations – for example bus dwell times, parking durations, signal timings

2.4 When validating a microsimulation model, the following comparisons are usually made between modelled and observed outputs:

- Journey Times

- Exit Flows
- Screen-line Counts
- Saturation Flows

3 CALIBRATION & VALIDATION GUIDANCE

3.1 There are two primary pieces of guidance that inform the calibration and validation criteria for microsimulation models:

- Department for Transport's (DfT's) Transport Analysis Guidance (TAG).
- Transport for London's (TfL's) Model Auditing Process (MAP).

The specific documents that are most relevant are:

- DfT TAG Unit M3.1 – Highway Assignment Modelling, May 2020.
- TfL's MAP Version 3.5 – Engineer Guide for Design Engineer (DE), Checking Engineer (CE) and Model Auditing Engineer (MAE), March 2017.

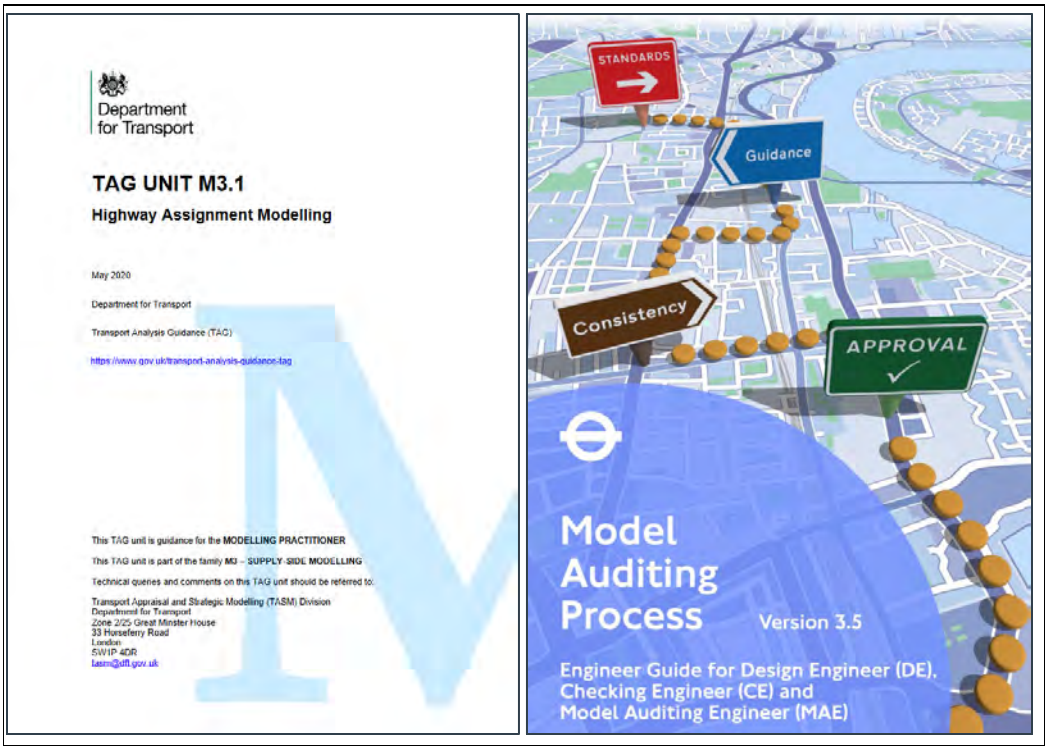


FIGURE 3.1: CALIBRATION & VALIDATION GUIDANCE

4 CALIBRATION CRITERIA

4.1 To ensure that the modelled outputs are representative of the observed data, TAG Unit 3.1 and TfL's MAP guidelines detail specific criteria that must be met.

4.2 The following sections detail the criteria required for each of the data comparisons.

Junction Turning Flows

4.3 For junction turning flows, there are two comparisons that need to be made:

- The absolute and percentage differences between modelled and observed flows
- The GEH (Geoffrey E. Havers) statistic, which is a Chi-squared statistic that incorporates both the relative and absolute errors. This is defined as:

$$GEH = \sqrt{\frac{(M-C)^2}{(M+C)/2}}$$

where: GEH is the GEH statistic

M is the modelled flow

C is the observed flow

4.4 TAG Unit 3.1's criteria and guidelines for turning movements is defined in Table 2 in the guidance and shown in **Figure 4.1**.

Table 2 Link Flow and Turning Movement Validation Criteria and Guidelines

Criteria	Description of Criteria	Guideline
1	Individual flows within 100 veh/h of counts for flows less than 700 veh/h	> 85% of cases
	Individual flows within 15% of counts for flows from 700 to 2,700 veh/h	
	Individual flows within 400 veh/h of counts for flows more than 2,700 veh/h	
2	GEH < 5 for individual flows	> 85% of cases

FIGURE 4.1: TAG UNIT 3.1 – FLOW CALIBRATION/VALIDATION CRITERIA

4.5 TAG Unit 3.1 states that modelled flows that meet either criterion should be regarded as satisfactory.

4.6 TAG Unit 3.1 also details further requirements for the link flow and turning count comparisons, including:

- The criteria should be applied to both link flows and turning movements
- The comparisons should be presented for All Vehicles, Cars and Heavy Vehicles (if sufficiently accurate counts have been collected).

- The comparisons should be presented separately for each peak period modelled.

Entry Flows

4.7 TfL's MAP v3.5 guidelines (section V304 – Traffic Flow Comparison) states that:

"All entry links into the network should show modelled flows within 5% of observed flows. This requirement should be achieved for all entry links as vehicle flows on external links are direct input values."

4.7.1 TAG Unit 3.1 also references validation of the trip matrices (*para. 3.3.7 and Table 1*), with differences between modelled flows and counts required to be within 5%.

4.7.2 The GEH statistic is also compared, with a value less than 3 deemed suitable in accordance with TfL Guidelines.

Screen-line Counts

4.8 For screen-line counts, which could take the form of comparing modelled outputs to Automatic Traffic Counts (ATCs), the same criteria as for Junction Turning Counts should be used (see **Figure 4.1**).

Queue Lengths

4.9 Section V305 of TfL's MAP v3.5 guidance gives details on the comparison of modelled and observed queues. Whilst there are no strict criteria to measure against, the guidance states:

"Modelled queues should, however, correlate reasonably with site observations of queuing behaviour and any significant discrepancies may indicate that areas of the model require further calibration."

4.10 It should also be noted that TfL guidance states that queue length comparison is **not** considered a suitable validation criterion.

Other Site Observations

4.11 For other site observations such as bus dwell times, parking durations and signal timings, there is no set criteria for comparing modelled and observed outputs. However, TfL's MAP v3.5 guidance recommends providing comparisons to provide further evidence that the model is representative of on-street conditions.

5 VALIDATION CRITERIA

5.1 To ensure that the modelled outputs are representative of the observed data, TAG Unit 3.1 and TfL's MAP guidelines detail specific criteria that must be met.

5.2 The following sections detail the criteria required for each of the data comparisons.

Journey Times

5.3 For journey times, the measure which should be used is the percentage difference between modelled and observed journey times.

5.4 TAG Unit 3.1's criteria and guidelines for journey times is defined in Table 3 in the guidance and shown in **Figure 5.1**.

5.5

Table 3 Journey Time Validation Criterion and Guideline

Criteria	Guideline
Modelled times along routes should be within 15% of surveyed times (or 1 minute, if higher than 15%)	> 85% of routes

FIGURE 5.1: TAG UNIT 3.1 – JOURNEY TIME VALIDATION CRITERIA

Exit Flows

5.6 The comparison of exit flows can be used for validation, as only the entry flows are directly input (a calibration measure) and the performance of the network determines the numbers of vehicles that reach each exit. For exit flow validation, the same criteria as for Junction Turning Counts should be used (see **Figure 4.1**).

Screen-line Counts

5.7 For screen-line counts, which could take the form of comparing modelled outputs to ATCs, the same criteria as for Junction Turning Counts should be used (see **Figure 4.1**).

Saturation Flows

5.8 Section V303 of TfL's MAP v3.5 guidance provides details on the comparison of observed and modelled saturation flows. This is required as it provides a measure of the capacity of signal-controlled approaches.

5.9 TfL's guidance states that:

"Modelled saturation flow values should be within 10% of observed values, or values used in any corresponding approved LINSIG or TRANSYT modelling."

The guidance further states that:

“If saturation flows are seen to vary between peaks in the associated MAP Stage 3-approved LINSIG or TRANSYT models (e.g. due to tidal movements), those saturation flows should be validated separately within each VISSIM base model.”

6 SUMMARY

6.1 This note describes the guidance and criteria used to calibrate and validate microsimulation models.

6.2 The calibration and validation criteria assessed and reported on will depend on the nature of the base model being developed and Modelling Group will liaise and collaborate with external auditors during the modelling process to agree the criteria to be used.

APPENDIX E:

CALIBRATION/VALIDATION RESULTS – LINK & EXIT FLOWS

AM Peak Summary

Total number of counts considered	18
VISSIM model counts with GEH <3	18
% of VISSIM counts with GEH <3	100.00%
VISSIM model counts with GEH <5	18
% of VISSIM counts with GEH <5	100.00%
VISSIM model counts with GEH <10	18
% of VISSIM counts with GEH <10	100.00%
VISSIM model counts meeting WebTAG Unit 3.1 criteria	18
% of VISSIM counts meeting WebTAG Unit 3.1 flow criteria	100.00%

AM Peak	07:45	to	08:45

JUNCTION / MOVEMENT			Vehicle Flow		DIFFERENCE		GEH Criteria Met?		FLOW			
			All									
ATC No.	ATC Name	Month/Year	Observed	Modelled	Diff.	% Diff.	GEH	GEH	FLOW	<700	700 – 2700	>2700
NB	ATC 1 - Lower St/High Ln	Sept 2022	211	205	-6	-3%	0.42	✓	✓			
SB			222	244	22	10%	1.44	✓	✓			
NB	ATC 2 - Lower St/Gall End Ln		8	4	-4	-48%	1.52	✓	✓			
SB			5	4	-1	-25%	0.62	✓	✓			
WB	ATC 3 - B1051	May 2022	287	301	14	5%	0.82	✓	✓			
EB			208	204	-4	-2%	0.28	✓	✓			
WB	ATC 4 - Dairy Ln	Sept 2022	27	20	-7	-26%	1.44	✓	✓			
EB			16	11	-5	-30%	1.28	✓	✓			
NB	ATC 5 - Church Rd		368	350	-18	-5%	0.95	✓	✓			
SB			382	369	-13	-3%	0.67	✓	✓			
NB	ATC 6 - Recreation Ground		5	4	-1	-14%	0.32	✓	✓			
SB			7	5	-2	-29%	0.82	✓	✓			
NB	ATC 7 - Crafton Green		17	16	-1	-4%	0.16	✓	✓			
SB			27	21	-6	-22%	1.22	✓	✓			
NB	ATC 8 - B1383 South		601	627	26	4%	1.06	✓	✓			
SB			729	812	83	11%	3.00	✓	✓			
NB	ATC 9 - B1383 North		382	427	45	12%	2.24	✓	✓			
SB			519	576	57	11%	2.45	✓	✓			

PM Peak Summary

Total number of counts considered	18
VISSIM model counts with GEH <3	18
% of VISSIM counts with GEH <3	100.00%
VISSIM model counts with GEH <5	18
% of VISSIM counts with GEH <5	100.00%
VISSIM model counts with GEH <10	18
% of VISSIM counts with GEH <10	100.00%
VISSIM model counts meeting WebTAG Unit 3.1 criteria	18
% of VISSIM counts meeting WebTAG Unit 3.1 flow criteria	100.00%

PM Peak	17:00	to	18:00

JUNCTION / MOVEMENT			Vehicle Flow		DIFFERENCE		GEH Criteria Met?		FLOW			
			All									
ATC No.	ATC Name	Month/Year	Observed	Modelled	Diff.	% Diff.	GEH	GEH	FLOW	<700	700 – 2700	>2700
NB	ATC 1 - Lower St/High Ln	Sept 2022	243	245	2	1%	0.15	✓	✓			
SB			141	147	6	4%	0.50	✓	✓			
NB	ATC 2 - Lower St/Gall End Ln		6	3	-3	-47%	1.28	✓	✓			
SB			10	4	-6	-59%	2.17	✓	✓			
WB	ATC 3 - B1051	May 2022	191	210	19	10%	1.34	✓	✓			
EB			310	319	9	3%	0.51	✓	✓			
WB	ATC 4 - Dairy Ln	Sept 2022	19	15	-4	-20%	0.89	✓	✓			
EB			26	23	-3	-10%	0.54	✓	✓			
NB	ATC 5 - Church Rd		399	390	-9	-2%	0.44	✓	✓			
SB			309	281	-28	-9%	1.63	✓	✓			
NB	ATC 6 - Recreation Ground		5	4	-1	-20%	0.47	✓	✓			
SB			7	6	-1	-14%	0.39	✓	✓			
NB	ATC 7 - Crafton Green		31	29	-2	-7%	0.42	✓	✓			
SB			26	19	-7	-26%	1.41	✓	✓			
NB	ATC 8 - B1383 South		785	818	33	4%	1.18	✓	✓			
SB			626	650	24	4%	0.95	✓	✓			
NB	ATC 9 - B1383 North		510	567	57	11%	2.46	✓	✓			
SB			498	515	17	3%	0.76	✓	✓			

AM Peak Summary	
Total number of counts considered	13
VISSIM model counts with GEH <3	13
% of VISSIM counts with GEH <3	100.00%
VISSIM model counts meeting WebTAG Unit 3.1 criteria	13
% of VISSIM counts meeting WebTAG Unit 3.1 flow criter	100.00%

AM Peak	07:45	to	08:45

Exit Point	Vehicle Flow		DIFFERENCE		GEH Criteria Met?		FLOW			
	All									
Location	Exit Flow	Modelled Flow	Diff.	% Diff.	GEH	GEH	FLOW	<700	700 – 2700	>2700
Lower St/High Ln	207	205	-2	-1%	0.14	✓	✓			
Lower St/Gall End Ln	4	4	0	0%	0.00	✓	✓			
B1051	209	204	-5	-2%	0.35	✓	✓			
Dairy Ln	12	11	-1	-8%	0.29	✓	✓			
Church Rd	373	369	-4	-1%	0.21	✓	✓			
Recreation Ground	5	5	0	0%	0.00	✓	✓			
Crafton Green	16	16	0	0%	0.00	✓	✓			
B1383 South	853	812	-41	-5%	1.42	✓	✓			
B1383 North	432	427	-5	-1%	0.24	✓	✓			
Bentfield Rd	133	131	-2	-2%	0.17	✓	✓			
St John's Rd	47	45	-2	-4%	0.29	✓	✓			
Station Rd	48	46	-2	-4%	0.29	✓	✓			
Mountfitchet Castle St	67	68	1	1%	0.12	✓	✓			

PM Peak Summary	
Total number of counts considered	13
VISSIM model counts with GEH <3	13
% of VISSIM counts with GEH <3	100.00%
VISSIM model counts meeting WebTAG Unit 3.1 criteria	13
% of VISSIM counts meeting WebTAG Unit 3.1 flow criter	100.00%

PM Peak	17:00	to	18:00

Exit Point	Vehicle Flow		DIFFERENCE		GEH Criteria Met?		FLOW			
	All									
Location	Exit Flow	Modelled Flow	Diff.	% Diff.	GEH	GEH	FLOW	<700	700 – 2700	>2700
Lower St/High Ln	249	245	-4	-2%	0.25	✓	✓			
Lower St/Gall End Ln	3	3	0	0%	0.00	✓	✓			
B1051	324	319	-5	-2%	0.28	✓	✓			
Dairy Ln	24	23	-1	-4%	0.21	✓	✓			
Church Rd	294	281	-13	-4%	0.77	✓	✓			
Recreation Ground	5	6	1	20%	0.43	✓	✓			
Crafton Green	29	29	0	0%	0.00	✓	✓			
B1383 South	649	650	1	0%	0.04	✓	✓			
B1383 North	572	567	-5	-1%	0.21	✓	✓			
Bentfield Rd	133	128	-5	-4%	0.44	✓	✓			
St John's Rd	12	11	-1	-8%	0.29	✓	✓			
Station Rd	56	56	0	0%	0.00	✓	✓			
Mountfitchet Castle St	110	106	-4	-4%	0.38	✓	✓			

APPENDIX F:

CALIBRATION RESULTS – TURNING COUNTS

AM Peak Summary	
Total number of counts considered	46
VISSIM model counts with GEH <3 (Critical Links only)	46
% of VISSIM counts with GEH <3	100.00%
VISSIM model counts with GEH <5	46
% of VISSIM counts with GEH <5	100.00%
VISSIM model counts with GEH <10	46
% of VISSIM counts with GEH <10	100.00%
VISSIM model counts meeting WebTAG Unit 3.1 criteria	46
% of VISSIM counts meeting WebTAG Unit 3.1 flow criteria	100.00%

AM Peak 07:45 to 08:45

JUNCTION / MOVEMENT			Vehicle Flow		DIFFERENCE		GEH Criteria Met?		FLOW				Critical Link
Junction	Approach	Turn	All Observed	All Modelled	Diff.	% Diff.	GEH	GEH	FLOW	<700	700 – 2700	>2700	
Lower St / B1051 Grove Hill	Lower Street N	Left	17	17	0	0%	0.00	✓	✓				Y
		Ahead	245	230	-15	-6%	0.97	✓	✓				Y
	B1051	Left	282	293	11	4%	0.65	✓	✓				Y
		Right	12	12	0	0%	0.00	✓	✓				Y
	Lower Street S	Ahead	209	196	-13	-6%	0.91	✓	✓				Y
		Right	190	186	-4	-2%	0.29	✓	✓				Y
Chapel Hill / Church Rd Mini R'bout	Lower Street	Left	23	24	1	4%	0.21	✓	✓				Y
		Ahead	268	267	-1	0%	0.06	✓	✓				Y
		Right	232	225	-7	-3%	0.46	✓	✓				Y
		U-Turn	3	3	0	0%	0.00	✓	✓				Y
	Mountfitchet Castle St	Left	15	13	-2	-13%	0.53	✓	✓				Y
		Ahead	5	3	-2	-40%	1.00	✓	✓				Y
		Right	12	11	-1	-8%	0.29	✓	✓				Y
		U-Turn	0	0	0	0%	0.00	✓	✓				Y
	Church Rd	Left	134	116	-18	-13%	1.61	✓	✓				Y
		Ahead	239	227	-12	-5%	0.79	✓	✓				Y
		Right	30	27	-3	-10%	0.56	✓	✓				Y
		U-Turn	0	0	0	0%	0.00	✓	✓				Y
	B1051 Chapel Hill	Left	151	145	-6	-4%	0.49	✓	✓				Y
		Ahead	17	16	-1	-6%	0.25	✓	✓				Y
		Right	110	114	4	4%	0.38	✓	✓				Y
		U-Turn	1	0	-1	-100%	1.41	✓	✓				Y
Station Rd / Church Rd	Church Rd N	Ahead	357	362	5	1%	0.26	✓	✓				Y
		Right	36	32	-4	-11%	0.69	✓	✓				Y
	Church Rd S	Left	16	14	-2	-13%	0.52	✓	✓				Y
		Ahead	377	351	-26	-7%	1.36	✓	✓				Y
	Station Rd	Left	24	19	-5	-21%	1.08	✓	✓				Y
		Right	13	12	-1	-8%	0.28	✓	✓				Y
Chapel Hill / St John's Rd	St John's Rd	Left	9	6	-3	-33%	1.10	✓	✓				Y
		Right	5	3	-2	-40%	1.00	✓	✓				Y
	Chapel Hill E	Ahead	335	320	-15	-4%	0.83	✓	✓				Y
		Right	29	26	-3	-10%	0.57	✓	✓				Y
	Chapel Hill W	Left	21	19	-2	-10%	0.45	✓	✓				Y
		Ahead	263	271	8	3%	0.49	✓	✓				Y
Chapel Hill / B1383	B1383 Cambridge Rd N	Left	58	60	2	3%	0.26	✓	✓				Y
		Ahead	535	502	-33	-6%	1.45	✓	✓				Y
		Right	16	16	0	0%	0.00	✓	✓				Y
	B1051 Chapel Hill	Left	254	242	-12	-5%	0.76	✓	✓				Y
		Ahead	57	52	-5	-9%	0.68	✓	✓				Y
		Right	45	39	-6	-13%	0.93	✓	✓				Y
	B1383 Cambridge Rd S	Left	62	63	1	2%	0.13	✓	✓				Y
		Ahead	368	367	-1	0%	0.05	✓	✓				Y
		Right	191	196	5	3%	0.36	✓	✓				Y
	Bentfield Rd	Left	23	21	-2	-9%	0.43	✓	✓				Y
		Ahead	39	41	2	5%	0.32	✓	✓				Y
		Right	72	68	-4	-6%	0.48	✓	✓				Y

AM Peak Summary	
Total number of counts considered	46
VISSIM model counts with GEH <3 (Critical Links only)	46
% of VISSIM counts with GEH <3	100.00%
VISSIM model counts with GEH <5	46
% of VISSIM counts with GEH <5	100.00%
VISSIM model counts with GEH <10	46
% of VISSIM counts with GEH <10	100.00%
VISSIM model counts meeting WebTAG Unit 3.1 criteria	46
% of VISSIM counts meeting WebTAG Unit 3.1 flow criteria	100.00%

AM Peak	07:45	to	08:45

JUNCTION / MOVEMENT			Vehicle Flow		DIFFERENCE		GEH Criteria Met?		FLOW				Critical Link
Junction	Approach	Turn	Lights		Diff.	% Diff.	GEH	GEH	FLOW	<700	700 – 2700	>2700	
			Observed	Modelled									
Lower St / B1051 Grove Hill	Lower Street N	Left	17	17	0	0%	0.00	✓	✓				Y
		Ahead	238	221	-17	-7%	1.12	✓	✓				Y
	B1051	Left	265	280	15	6%	0.91	✓	✓				Y
		Right	12	12	0	0%	0.00	✓	✓				Y
	Lower Street S	Ahead	200	187	-13	-7%	0.93	✓	✓				Y
		Right	183	179	-4	-2%	0.30	✓	✓				Y
Chapel Hill / Church Rd Mini R'bout	Lower Street	Left	23	24	1	4%	0.21	✓	✓				Y
		Ahead	262	261	-1	0%	0.06	✓	✓				Y
		Right	215	209	-6	-3%	0.41	✓	✓				Y
		U-Turn	3	3	0	0%	0.00	✓	✓				Y
	Mountfitchet Castle St	Left	14	13	-1	-7%	0.27	✓	✓				Y
		Ahead	4	3	-1	-25%	0.53	✓	✓				Y
		Right	12	11	-1	-8%	0.29	✓	✓				Y
		U-Turn	0	0	0	0%	0.00	✓	✓				Y
	Church Rd	Left	130	115	-15	-12%	1.36	✓	✓				Y
		Ahead	228	216	-12	-5%	0.81	✓	✓				Y
		Right	29	27	-2	-7%	0.38	✓	✓				Y
		U-Turn	0	0	0	0%	0.00	✓	✓				Y
	B1051 Chapel Hill	Left	145	139	-6	-4%	0.50	✓	✓				Y
		Ahead	16	15	-1	-6%	0.25	✓	✓				Y
		Right	108	109	1	1%	0.10	✓	✓				Y
		U-Turn	1	0	-1	-100%	1.41	✓	✓				Y
Station Rd / Church Rd	Church Rd N	Ahead	349	351	2	1%	0.11	✓	✓				Y
		Right	35	32	-3	-9%	0.52	✓	✓				Y
	Church Rd S	Left	15	13	-2	-13%	0.53	✓	✓				Y
		Ahead	363	340	-23	-6%	1.23	✓	✓				Y
	Station Rd	Left	22	18	-4	-18%	0.89	✓	✓				Y
		Right	13	12	-1	-8%	0.28	✓	✓				Y
Chapel Hill / St John's Rd	St John's Rd	Left	9	6	-3	-33%	1.10	✓	✓				Y
		Right	5	3	-2	-40%	1.00	✓	✓				Y
	Chapel Hill E	Ahead	314	303	-11	-4%	0.63	✓	✓				Y
		Right	29	26	-3	-10%	0.57	✓	✓				Y
	Chapel Hill W	Left	21	19	-2	-10%	0.45	✓	✓				Y
		Ahead	252	259	7	3%	0.44	✓	✓				Y
Chapel Hill / B1383	B1383 Cambridge Rd N	Left	56	57	1	2%	0.13	✓	✓				Y
		Ahead	514	483	-31	-6%	1.39	✓	✓				Y
		Right	16	16	0	0%	0.00	✓	✓				Y
	B1051 Chapel Hill	Left	237	229	-8	-3%	0.52	✓	✓				Y
		Ahead	54	49	-5	-9%	0.70	✓	✓				Y
		Right	43	38	-5	-12%	0.79	✓	✓				Y
	B1383 Cambridge Rd S	Left	59	60	1	2%	0.13	✓	✓				Y
		Ahead	346	347	1	0%	0.05	✓	✓				Y
		Right	182	186	4	2%	0.29	✓	✓				Y
	Bentfield Rd	Left	22	21	-1	-5%	0.22	✓	✓				Y
		Ahead	38	41	3	8%	0.48	✓	✓				Y
		Right	70	68	-2	-3%	0.24	✓	✓				Y

AM Peak Summary	
Total number of counts considered	46
VISSIM model counts with GEH <3 (Critical Links only)	46
% of VISSIM counts with GEH <3	100.00%
VISSIM model counts with GEH <5	46
% of VISSIM counts with GEH <5	100.00%
VISSIM model counts with GEH <10	46
% of VISSIM counts with GEH <10	100.00%
VISSIM model counts meeting WebTAG Unit 3.1 criteria	46
% of VISSIM counts meeting WebTAG Unit 3.1 flow criteria	100.00%

AM Peak 07:45 to 08:45

JUNCTION / MOVEMENT			Vehicle Flow		DIFFERENCE		GEH Criteria Met?		FLOW				Critical Link
Junction	Approach	Turn	Heavies Observed	Heavies Modelled	Diff.	% Diff.	GEH	GEH	FLOW	<700	700 – 2700	>2700	
Lower St / B1051 Grove Hill	Lower Street N	Left	0	0	0	0%	0.00	✓	✓				Y
		Ahead	7	9	2	29%	0.71	✓	✓				Y
	B1051	Left	17	14	-3	-18%	0.76	✓	✓				Y
		Right	0	0	0	0%	0.00	✓	✓				Y
	Lower Street S	Ahead	9	10	1	11%	0.32	✓	✓				Y
		Right	7	7	0	0%	0.00	✓	✓				Y
Chapel Hill / Church Rd Mini R'bout	Lower Street	Left	0	0	0	0%	0.00	✓	✓				Y
		Ahead	6	6	0	0%	0.00	✓	✓				Y
		Right	17	16	-1	-6%	0.25	✓	✓				Y
		U-Turn	0	0	0	0%	0.00	✓	✓				Y
	Mountfitchet Castle St	Left	1	0	-1	-100%	1.41	✓	✓				Y
		Ahead	1	0	-1	-100%	1.41	✓	✓				Y
		Right	0	0	0	0%	0.00	✓	✓				Y
		U-Turn	0	0	0	0%	0.00	✓	✓				Y
	Church Rd	Left	4	1	-3	-75%	1.90	✓	✓				Y
		Ahead	11	10	-1	-9%	0.31	✓	✓				Y
		Right	1	1	0	0%	0.00	✓	✓				Y
		U-Turn	0	0	0	0%	0.00	✓	✓				Y
	B1051 Chapel Hill	Left	6	7	1	17%	0.39	✓	✓				Y
		Ahead	1	1	0	0%	0.00	✓	✓				Y
		Right	2	5	3	150%	1.60	✓	✓				Y
		U-Turn	0	0	0	0%	0.00	✓	✓				Y
Station Rd / Church Rd	Church Rd N	Ahead	8	12	4	50%	1.26	✓	✓				Y
		Right	1	0	-1	-100%	1.41	✓	✓				Y
	Church Rd S	Left	1	1	0	0%	0.00	✓	✓				Y
		Ahead	14	11	-3	-21%	0.85	✓	✓				Y
	Station Rd	Left	2	1	-1	-50%	0.82	✓	✓				Y
		Right	0	0	0	0%	0.00	✓	✓				Y
Chapel Hill / St John's Rd	St John's Rd	Left	0	0	0	0%	0.00	✓	✓				Y
		Right	0	0	0	0%	0.00	✓	✓				Y
	Chapel Hill E	Ahead	21	17	-4	-19%	0.92	✓	✓				Y
		Right	0	0	0	0%	0.00	✓	✓				Y
	Chapel Hill W	Left	0	0	0	0%	0.00	✓	✓				Y
		Ahead	11	13	2	18%	0.58	✓	✓				Y
Chapel Hill / B1383	B1383 Cambridge Rd N	Left	2	3	1	50%	0.63	✓	✓				Y
		Ahead	21	19	-2	-10%	0.45	✓	✓				Y
		Right	0	0	0	0%	0.00	✓	✓				Y
	B1051 Chapel Hill	Left	17	13	-4	-24%	1.03	✓	✓				Y
		Ahead	3	3	0	0%	0.00	✓	✓				Y
		Right	2	1	-1	-50%	0.82	✓	✓				Y
	B1383 Cambridge Rd S	Left	3	3	0	0%	0.00	✓	✓				Y
		Ahead	22	20	-2	-9%	0.44	✓	✓				Y
		Right	9	10	1	11%	0.32	✓	✓				Y
	Bentfield Rd	Left	1	0	-1	-100%	1.41	✓	✓				Y
		Ahead	1	0	-1	-100%	1.41	✓	✓				Y
		Right	2	1	-1	-50%	0.82	✓	✓				Y

PM Peak Summary	
Total number of counts considered	46
VISSIM model counts with GEH <3 (Critical Links only)	46
% of VISSIM counts with GEH <3	100.00%
VISSIM model counts with GEH <5	46
% of VISSIM counts with GEH <5	100.00%
VISSIM model counts with GEH <10	46
% of VISSIM counts with GEH <10	100.00%
VISSIM model counts meeting WebTAG Unit 3.1 criteria	46
% of VISSIM counts meeting WebTAG Unit 3.1 flow criteria	100.00%

PM Peak	17:00	to	18:00

JUNCTION / MOVEMENT			Vehicle Flow		DIFFERENCE		GEH Criteria Met?		FLOW				Critical Link
Junction	Approach	Turn	All		Diff.	% Diff.	GEH	GEH	FLOW	<700	700 – 2700	>2700	
			Observed	Modelled									
Lower St / B1051 Grove Hill	Lower Street N	Left	17	16	-1	-6%	0.25	✓	✓				Y
		Ahead	142	135	-7	-5%	0.59	✓	✓				Y
	B1051	Left	194	198	4	2%	0.29	✓	✓				Y
		Right	14	13	-1	-7%	0.27	✓	✓				Y
	Lower Street S	Ahead	265	234	-31	-12%	1.96	✓	✓				Y
		Right	308	303	-5	-2%	0.29	✓	✓				Y
Chapel Hill / Church Rd Mini R'bout	Lower Street	Left	27	25	-2	-7%	0.39	✓	✓				Y
		Ahead	174	162	-12	-7%	0.93	✓	✓				Y
		Right	135	144	9	7%	0.76	✓	✓				Y
		U-Turn	3	3	0	0%	0.00	✓	✓				Y
	Mountfitchet Castle St	Left	59	49	-10	-17%	1.36	✓	✓				Y
		Ahead	26	26	0	0%	0.00	✓	✓				Y
		Right	39	36	-3	-8%	0.49	✓	✓				Y
		U-Turn	0	0	0	0%	0.00	✓	✓				Y
	Church Rd	Left	128	121	-7	-5%	0.63	✓	✓				Y
		Ahead	274	264	-10	-4%	0.61	✓	✓				Y
		Right	44	40	-4	-9%	0.62	✓	✓				Y
		U-Turn	1	0	-1	-100%	1.41	✓	✓				Y
	B1051 Chapel Hill	Left	251	236	-15	-6%	0.96	✓	✓				Y
		Ahead	44	41	-3	-7%	0.46	✓	✓				Y
		Right	113	103	-10	-9%	0.96	✓	✓				Y
		U-Turn	1	0	-1	-100%	1.41	✓	✓				Y
Station Rd / Church Rd	Church Rd N	Ahead	310	278	-32	-10%	1.87	✓	✓				Y
		Right	38	36	-2	-5%	0.33	✓	✓				Y
	Church Rd S	Left	20	21	1	5%	0.22	✓	✓				Y
		Ahead	399	382	-17	-4%	0.86	✓	✓				Y
	Station Rd	Left	49	44	-5	-10%	0.73	✓	✓				Y
		Right	25	23	-2	-8%	0.41	✓	✓				Y
Chapel Hill / St John's Rd	St John's Rd	Left	12	8	-4	-33%	1.26	✓	✓				Y
		Right	11	9	-2	-18%	0.63	✓	✓				Y
	Chapel Hill E	Ahead	268	280	12	4%	0.72	✓	✓				Y
		Right	8	6	-2	-25%	0.76	✓	✓				Y
	Chapel Hill W	Left	6	6	0	0%	0.00	✓	✓				Y
		Ahead	390	372	-18	-5%	0.92	✓	✓				Y
Chapel Hill / B1383	B1383 Cambridge Rd N	Left	80	79	-1	-1%	0.11	✓	✓				Y
		Ahead	423	416	-7	-2%	0.34	✓	✓				Y
		Right	21	20	-1	-5%	0.22	✓	✓				Y
	B1051 Chapel Hill	Left	187	192	5	3%	0.36	✓	✓				Y
		Ahead	47	44	-3	-6%	0.44	✓	✓				Y
		Right	62	60	-2	-3%	0.26	✓	✓				Y
	B1383 Cambridge Rd S	Left	66	63	-3	-5%	0.37	✓	✓				Y
		Ahead	484	477	-7	-1%	0.32	✓	✓				Y
		Right	278	277	-1	0%	0.06	✓	✓				Y
	Bentfield Rd	Left	31	30	-1	-3%	0.18	✓	✓				Y
		Ahead	45	42	-3	-7%	0.45	✓	✓				Y
		Right	44	42	-2	-5%	0.30	✓	✓				Y