M4 J17 VISSIM Model

Local Model Validation Report (LMVR)

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Highways England

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Project Manager:	Lee Templeman
Author:	Asier Inclan Conde
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Jacobs Consultancy Ltd.

1 The Square, Temple Quay
2nd Floor
Bristol, BS1 6DG
United Kingdom
T +44 (0)117 910 2580
F +44 (0)117 910 2581
www.jacobs.com

Contents

1. Introduction

1.1 Background

Jacobs has been commissioned by Highways England to develop a model of M4 J17. This interchange is expected to experience significant growth from land use development in future years and Highways England wishes to have a robust assessment tool which can be used to test the impact of this growth and prove the benefits of improvement works.

1.2 Purpose

The purpose of this report is to set out the process involved in the creation of an M4 J17 VISSIM model, and to present the results of the model calibration and validation checks carried out in order to ensure the model meets the relevant calibration and validation criteria.

1.3 Report Structure

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

- **Section 2**: Model Development, including software specification, model parameters, coverage and durations and network coding;
- **Section 3**: Model Calibration, including traffic data used, matrix development and results of observed and modelled turning count comparisons;
- **Section 4**: Model Validation, including results of the observed and modelled journey time comparisons which seek to demonstrate that the model is simulating operational conditions on the network;
- **Section 5**: Summary, concludes the report including an assessment of the overall fit of the model and compliance with technical acceptability standards.

2. Model Development

2.1 Software Specification

The M4 J17 VISSIM model has been developed using VISSIM 2020. This was the latest version of the software available at the time of model development.

PCMOVA 3 software has been used to control traffic signals in the junctions of the model. PCMOVA is the implementation of MOVA within a PC environment that allows connection to micro-simulation models.

2.2 Network Coverage

The model network covers the M5 J17 interchange and its approaches as shown in **Figure 2.1**. The model also includes simulation of the M4 mainline carriageway.

Figure 2.1: M4 J17 model extents

2.3 Model Periods

The model has been developed to simulate traffic observed during the following peak periods: (**AM**) weekday morning peak period from 7:00 to 10:00am; and (**PM**) weekday evening peak period from 4:00 to 7:00pm.

The model network is small enough that the initial 15 minutes of each period can be considered sufficient to provide the 'warm-up' period needed to populate the network with vehicles prior to the collection of output statistics. This provides a degree of flexibility in the periods used for any subsequent assessment.

An examination of the TomTom mean journey time data (October-November 2019) collected for model validation (see 4.1) suggests that J17 suffers most from congestion during the weekday AM period on the

A350 arm between 7:00 and 8:00am. As such, any use of the model for assessment ought to consider the period commencing 7:15am onwards, allowing 15 minutes warm-up period.

2.4 Model Assignment

The model has been set up as 'dynamic'. This is because it is easier to include development growth for forecast scenarios. For this purpose, origin-destination matrices have been developed from available traffic count data for the model area.

2.5 Model Parameters

The simulation resolution was set to 10 time-steps per simulation second. In addition to this, all link types that have been used include modifications to the default driver behaviour parameters as detailed in **Table 2.1**.

Table 2.1: Driver behaviour parameter changes

Parameter	Value	Comments
Average Standstill Distance	1.5m	This determines the spacing of vehicles when queuing. A value of 1.5m is in-line with Highway England guidelines on micro-simulation modelling.
Number of Observed Vehicles	10	The number of observed vehicles determines how well drivers predict the movement of others and react accordingly. The default value of 4 allows an accurate modelling of network operation.
Reaction to Red/Amber at Signals	Stop	To account for the fact that VISSIM treats the red-amber periods at signal as green time, an adjustment to the default has been made. Doing so ensures that vehicle behaviour will more accurately reflect actual reaction times of drivers as they receive red-amber followed by green.

A 'Weaving' link type has been applied to links where merging behaviour is required, such as the on-slip merge lengths. The link type includes modifications to the default driver behaviour parameters: a reduction in the Safety distance factor to 0.20 and an increase in maximum deceleration to -0.6m/s2.

2.6 Network Coding

2.6.1 Highway Layout

Digital Ordnance Survey (OS) landline mapping was obtained for the purposes of coding the mode network. This gave details of the highway alignment and approximate intersection layouts.

This information was supplemented with detailed information on the highway layout obtained through aerial photography, as well as available as-built drawings. These provided an indication of various highway features, such as:

- The position of stop lines and give-way lines;
- The number of lanes throughout the network (and approximate widths), including roundabout circulatory lanes, and their designated (or informal) utilisation by vehicles;

- The lengths of flared approaches and the points at which widening occurs;
- The presence of right turn ghost islands or, where these are not provided, whether right turning vehicles block the mainline ahead flow of traffic at junctions;
- The location, layout and type of pedestrian crossings, and
- Any other highway features, such as turning/lane restrictions (one-way streets, bus lanes, HOV lanes and so on), and their location.

2.6.2 Modelled Speeds

Modelled speed distributions are based on DfT 2013 Speed Surveys with the relevant speed distribution chosen based on the road type or signed speed limit. As such 'Motorway' speeds have been applied to the M4, with 'Single Carriageway' speeds used on the A429 and B4122. Since the A350 is a dual carriageway, 'Motorway' (70mph) speeds have been applied, although modelled speeds on the approach to J17 are reduced because of the yellow bar markings (see below).

The A350 northbound approach to J17 has traverse yellow bar markings which commence some 400m upstream of the entry to the roundabout. An examination of TomTom inter-peak (10:00am-4:00pm) mean speeds (October-November 2019) suggests that from this point drop from circa 60mph to 40mph. To replicate this, a Desired Speed Decision for 40pmh is coded o the A350 on the approach to J17.

Elsewhere, Desired Speed Decisions were coded roughly halfway along the M4 off-slips to slow vehicles to circa 40mph to simulate slowing down on the approach to the J17 roundabout. Desired Speed Decisions for 30mph speeds were then also coded on the entry to the roundabout to ensure that circulatory speeds remained within the roundabout.

Reduced Speed Areas have also been applied to simulate vehicles slowing on bends within the modelled network. A consistent approach has been taken to this with 30mph used on bends, which in this network are all roughly similar in terms of radii.

2.6.3 Traffic Signals

The traffic signal installations controlling the M4 slip road approaches operate under MOVA. Details regarding the controller and MOVA set-up were supplied by Highways England and used to configure the PCMOVA linker and operate signals in the model using PCMOVA. Detector positions in the model were coded in accordance with as-built signals layout information provided by Highways England.

3. Model Calibration

3.1 Traffic Data

The M4 J17 model was commissioned during the COVID-19 pandemic so it was not possible to collect new data to develop the model matrices. Instead, the model was calibrated from a combination of existing available sources, namely a turning count carried out on Thursday 10th May 2018 and WebTRIS data from May 2018 and November 2019.

To bring the traffic flows in the model up to the most recent 'typical' year possible and to match the 2019 journey time data for model validation, the May 2018 turning count was growthed based on the difference between the May 2018 and November 2019 WebTRIS data. M4 mainline flows were taken directly from November 2019 WebTRIS data.

Table 3.1 compares the May 2018 and November 2019 WebTRIS data for the M4 J17 off and on-slips sites. The data represents the Monday to Thursday mean for the modelled hours of 7:00-8:00am, 8:00-9:00am, 9:00-10:00am, 4:00-5:00pm, 5:00-6:00pm and 6:00-7:00pm.

Table 3.1: WebTRIS May 2018 and November 2019 (Mon-Thurs) comparison and growth factors

Hour	Eastbound Off-Slip			Eastbound On-Slip			Eastbound Off-Slip			Eastbound On-Slip		
	2018	2019	%	2018	2019	%	2018	2019	%	2018	2019	%
7am	918	1034	13%	1001	1004	0%	723	754	4%	954	1005	5%
8am	775	862	11%	888	1006	13%	629	664	6%	728	759	4%
9am	512	580	13%	568	597	5%	471	482	2%	555	562	1%
4pm	727	761	5%	668	739	11%	745	825	11%	821	912	11%
5pm	821	827	1%	696	702	1%	867	926	7%	735	836	14%
6pm	612	660	8%	433	409	-6%	661	690	4%	468	490	5%

Table 3.1 also shows the percentage growth factors derived from the comparison which was used to derive factors to uplift the May 2018 turning count. For the slip road approaches, the relevant slip road growth was applied, but for the local road network arms, an average of the eastbound and westbound on-slips was applied.

3.2 Matrix Development

Since it is a single junction model, trip matrices could be derived directly from the adjusted turning count data. Matrices at 15-minute intervals were taken directly from the May 2018 MCC, which were then factored-up using the growth in **Table 3.1**. Traffic volumes for the M4 mainline carriageway 'through-movement' were derived from WebTRIS November 2019 data.

Matrices were calculated for light vehicles (LVs), comprising cars, taxis and LGVs, and heavy vehicles (HVs) comprising OGV1, OGV2 and buses/coaches. The modelled composition within each of these for the AM and PM periods was also taken from the May 2018 classified turning count with an overall percentage split calculated across all arms. The resulting modelled vehicle type splits are shown in **Table 3.2**.

Table 3.2: Modelled traffic compositions

Period	Light Vehicles		Heavy Vehicles		
	Cars	LGVs	OGV1	OGV2	Buses/Coaches
AM	84%	16%	36%	60%	4%
PM	89&	11%	34%	60%	6%

3.3 Calibration Results

3.3.1 Calibration Criteria

Model calibration is the process by which observed data used in model development is checked in terms of model output with adjustment to the model to improve the fit between the two datasets. For the M4 J17, this has been carried out through the comparison of observed (adjusted May 2018) and modelled turning movements at each junction within the model network for every hour modelled.

The calibration checks have been based on 10 seed runs in each modelled period. This has sought to achieve the acceptability criteria set out in the TAG Unit M3.1 'Highway Assignment Modelling' (Table 2). This specifies an acceptable range of error for both traffic flow and journey time results. These criteria are reproduced in **Table 3.3**.

Table 3.3: TAG link flow and turning movement validation criteria (from Unit M3.1, Table 2)

Criteria and Measures	Acceptability Guideline
Assigned hourly flows compared with observed flows	
Individual flows within 15% for flows 700-2,700 vph	>85% of flows
Individual flows within 100 vph for flows < 700 vph	>85% of flows
Individual flows within 400 vph for flows > 2,700 vph	>85% of flows
Total screenline flows (>5 links) to be within 5%	All (nearly all) screenlines
GEH statistic	
Individual flows: GEH < 5	>85% of cases

The GEH statistic has been adopted as the indicator of the extent to which modelled flows match the corresponding observed values. This is often referred to as 'goodness-of-fit'. TAG advocates seeking a GEH of five or less for greater than 85% of comparison. TfL guidelines on micro-simulation promotes stricter criteria of achieving a GEH of three or less for important or critical turning movements within the model area.

3.3.2 Turning Count Comparisons

Tables 3.4, 3.5 and **3.6** summarise the results of the turning count calibration checks for the AM and PM periods for cars, LGVs and HGVs, respectively. Full calibration results can be found in **Appendix A.** The results indicate a good level of fit within each hour modelled satisfying the requirement for 85 per cent, or more, of turning movements to have a GEH of three or less.

Table 3.4: M4 J17 VISSIM model, turning count calibration summary results (cars)

GEH	7:00-8:00am	8:00-9:00am	9:00-10:00am	4:00-5:00pm	5:00-6:00pm	6:00-7:00pm
% < 3	100%	100%	100%	100%	100%	100%
% < 5	100%	100%	100%	100%	100%	100%

Table 3.5: M4 J17 VISSIM model, turning count calibration summary results (LGVs)

GEH	7:00-8:00am	8:00-9:00am	9:00-10:00am	4:00-5:00pm	5:00-6:00pm	6:00-7:00pm
% < 3	100%	100%	100%	100%	100%	100%
% < 5	100%	100%	100%	100%	100%	100%

Table 3.6: M4 J17 VISSIM model, turning count calibration summary results (HGVs)

GEH	7:00-8:00am	8:00-9:00am	9:00-10:00am	4:00-5:00pm	5:00-6:00pm	6:00-7:00pm
% < 3	100%	100%	100%	100%	100%	95%
% < 5	100%	100%	100%	100%	100%	100%

4. Model Validation

Model validation involves comparing modelled data with observed data that is independent from that used in calibration where adjustments are carried out to improve the fit between the two. For this model, validation has been carried out through a comparison of observed and modelled journey times. This also ensures that operational conditions in the model, in terms of congestion and delay, broadly reflect typical conditions on street.

4.1 Observed Data

Observed journey time data used for model validation was derived from TomTom data from Streetwise Services. The benefits of using TomTom data are that it provides a high sample size, usually hundreds of observations compared to several that might be obtained using a floating car survey.

Mean TomTom journey time data was supplied by Streetwise Services for the date range between the 21st October and 28th November 2019, Mondays to Thursdays with hourly mean journey times provided for 7:00-8:00am, 8:00-9:00am, 9:00-10:00am, 10:00am-4:00pm, 4:00-5:00pm, 5:00-6:00pm and 6:00-7:00pm.

4.2 Journey Time Routes

Journey time validation has been carried out along a series of routes through the modelled network. TomTom journey time data was extracted for these routes, with the journey time sections in VISSIM matched to the available TomTom link lengths. The routes used for model validation were as follows:

- **Route 1**: M4 eastbound off-slip (length = 1,706m);
- **Route 2**: M4 westbound off-slip (length = 1,792m);
- **Route 3**: A429 to A350 southbound exit (length = 1,998m);
- **Route 4**: B4122 approach arm (length = 747m);
- **Route 5**: A350 to A429 northbound exit (length = 1,722m);
- **Route 6**: M4 mainline eastbound – network entry to J17 diverge (length = 1,673m);
- **Route 7**: M4 mainline eastbound – diverge to merge (length = 1,137m);
- **Route 8**: M4 mainline eastbound – merge to network exit (length = 2,657m);
- **Route 9**: M4 mainline westbound – network entry to J17 diverge (length = 2,885m);
- **Route 10**: M4 mainline westbound – diverge to merge (length = 1,230m); and
- **Route 11**: M4 mainline westbound – merge to network exit (length = 1,587m).

4.3 Mean-Median Analysis

To ensure that were no incidents or notable outlier days affecting the observed TomTom mean journey times, **Table 4.1** compares the mean and median output from the TomTom data. Since the mean is influenced more by outlier values, a large difference between the mean and median could suggest a problematic day occurring within the date range for the TomTom data.

Table 4.1: TomTom Mean and Median Journey Time Comparison

Route	7:00-8:00am		8:00-9:00am		9:00-10:00am		4:00-5:00pm		5:00-6:00pm		6:00-7:00pm	
	Mean	Med	Mean	Med	Mean	Med	Mean	Med	Mean	Med	Mean	Med
1	94	91	90	84	80	77	86	81	92	84	78	74
2	88	85	87	82	84	80	92	88	99	92	85	81
3	191	138	218	141	146	122	203	141	236	153	166	128
4	75	55	60	48	52	47	75	50	59	49	51	47
5	292	254	192	115	100	90	134	107	149	119	107	94
6	56	54	55	53	56	53	57	54	56	54	56	54
7	36	35	36	35	36	35	37	36	38	36	36	35
8	86	84	85	83	86	83	87	85	87	85	85	83
9	95	92	93	90	95	91	98	95	97	95	94	92
10	40	39	39	38	40	38	44	40	41	40	40	39
11	53	51	52	50	52	50	56	53	54	52	52	51

The comparison in **Table 4.1** shows that for most routes the mean and median journey time values are very close. There are some notable differences for Routes 3 and 5, but these routes are long and reflect give-way entries to J17 and so will be subject to variation. Overall the comparison suggests that there were no incidents during the TomTom date range and that the use of mean journey times is acceptable.

4.4 Validation Results

4.4.1 Acceptability Criteria

Acceptability criteria set out by Transport for London (TfL) in their latest micro-simulation best-practice guidelines recommend that average modelled travel times be within 15 per cent of the observed values on 85 per cent of routes. Further guidance provided in TAG Unit M3.1 (Table 3), reproduced in **Table 4.2**, suggests a suitable overall fit to have been achieved once 85 per cent of routes validate to within 15 per cent or one minute (if higher). Since many of the routes used for validation in the M4 J17 model are short, routes are deemed to fit if within 15 seconds of the observed (or 15%) rather than 60 seconds.

Table 4.2: TAG journey time validation criteria (from Unit M3.1, Table 3)

Criteria and Measures	Acceptability Guideline
Modelled journey times compared with observed times	
Journey times within 15% (or 1 minute, if higher)	>85% of routes

4.4.2 Journey Time Comparisons

Model validation has been undertaken using 10 simulation seed runs. The journey time validation results are shown in **Tables 4.2** and **4.3** for the AM (7:00-10:00am) and PM (4:00-7:00pm) peak periods,

respectively. Since the observed TomTom data could be biased to cars, the modelled journey time outputs reflect those obtained for car vehicle types only.

Table 4.3: Journey time validation results (in seconds), AM

Route	7:00-8:00am					8:00-9:00am					9:00-10:00am				
	Obs	Mod	Abs	%	OK	Obs	Mod	Abs	%	OK	Obs	Mod	Abs	%	OK
1	94	96	2	3%	✓	90	92	2	2%	✓	80	85	5	6%	✓
2	88	95	7	8%	✓	87	97	10	12%	✓	84	89	5	6%	✓
3	191	171	-20	-10%	✓	218	194	-24	-11%	✓	146	155	9	6%	✓
4	75	85	10	14%	✓	60	71	11	18%	✓	52	50	-2	-5%	✓
5	292	259	-33	-11%	✓	192	187	-5	-3%	✓	100	109	9	9%	✓
6	56	60	4	8%	✓	55	59	4	8%	✓	56	59	3	6%	✓
7	36	40	4	12%	✓	36	40	4	11%	✓	36	40	4	11%	✓
8	86	96	10	12%	✓	85	95	10	11%	✓	86	95	9	10%	✓
9	95	107	12	13%	✓	93	106	13	14%	✓	95	104	9	9%	✓
10	40	45	5	13%	✓	39	45	6	16%	✓	40	44	4	11%	✓
11	53	59	6	12%	✓	52	59	7	14%	✓	52	58	6	11%	✓
-	Percentage fit			100%		Percentage fit			100%		Percentage fit			100%	

Table 4.4: Journey time validation results (in seconds), PM

Route	4:00-5:00pm					5:00-6:00pm					6:00-7:00pm				
	Obs	Mod	Abs	%	OK	Obs	Mod	Abs	%	OK	Obs	Mod	Abs	%	OK
1	86	90	4	4%	✓	92	92	0	0%	✓	78	85	7	9%	✓
2	92	100	8	8%	✓	99	102	3	3%	✓	85	92	7	8%	✓
3	203	192	-11	-6%	✓	236	228	-8	-3%	✓	166	162	-4	-3%	✓
4	75	72	-3	-4%	✓	59	68	9	15%	✓	51	50	-1	-2%	✓
5	134	123	-11	-8%	✓	149	128	-21	-14%	✓	107	109	2	1%	✓
6	57	62	5	9%	✓	56	62	6	11%	✓	56	60	4	7%	✓
7	37	42	5	13%	✓	38	41	3	9%	✓	36	40	4	12%	✓
8	87	100	13	15%	✓	87	99	12	13%	✓	85	96	11	13%	✓
9	98	105	7	7%	✓	97	104	7	7%	✓	94	102	8	9%	✓
10	44	44	0	1%	✓	41	44	3	7%	✓	40	43	3	8%	✓
11	56	58	2	4%	✓	54	57	3	6%	✓	52	56	4	8%	✓
-	Percentage fit			100%		Percentage fit			100%		Percentage fit			100%	

The validation results in **Tables 4.3** and **4.4** show that there is an excellent fit between observed and modelled journey times in both the AM and PM modelled periods with both the TfL and TAG (or 15 second minimum absolute difference) acceptability criteria satisfied in every hour modelled.

5. Summary

This report has presented the methodology employed in the development of a base (2019) VISSIM model of the M4 J17 interchange. The report has detailed the general model parameters and set out the traffic data used to calibrate the weekday AM (7:00-10:00am) and PM (4:00-7:00pm) period models. It has also presented the results of calibration and validation checks which seek to ensure that observed traffic volumes and operational conditions within the modelled network replicate typical conditions.

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

The model has also been validated through comparison of observed (TomTom) mean journey times (October-November 2019) and modelled journey times on every approach to J17 for every hour modelled. These checks show that the models are replicating these observed operational conditions within the network throughout the simulated periods. These checks confirm that the model meets TAG and TfL modelling acceptability criteria in terms of the fit between observed and modelled journey times.

Appendix A. Detailed Calibration Results

Cars

From	To	Observed			Modelled			Diff			GEH		
		7-8am	8-9am	9-10am	7-8am	8-9am	9-10am	7-8am	8-9am	9-10am	7-8am	8-9am	9-10am
A429	M4 East	97	115	69	93	115	71	-3	0	1	0.35	0.02	0.16
A429	B4122	51	62	46	48	61	45	-3	-2	-1	0.44	0.20	0.11
A429	A350	200	240	179	194	242	176	-7	1	-3	0.49	0.08	0.23
A429	M4 West	212	259	189	207	264	186	-5	5	-3	0.31	0.33	0.19
M4 East	A429	84	74	55	82	72	53	-2	-1	-2	0.27	0.16	0.32
M4 East	B4122	32	36	12	30	36	12	-3	-1	0	0.47	0.11	0.01
M4 East	A350	433	375	281	415	385	279	-18	10	-2	0.88	0.53	0.13
M4 East	M4 West	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
B4122	A429	133	91	50	132	94	51	-1	3	1	0.09	0.27	0.14
B4122	M4 East	155	102	61	157	105	61	1	3	1	0.11	0.25	0.09
B4122	A350	3	16	12	3	16	12	0	-1	-1	0.08	0.19	0.18
B4122	M4 West	86	61	31	86	62	30	1	1	-1	0.09	0.07	0.14
A350	A429	396	347	285	377	359	281	-19	12	-4	0.96	0.64	0.25
A350	M4 East	337	285	249	335	287	242	-2	2	-7	0.14	0.12	0.44
A350	B4122	183	189	133	183	188	132	-1	-1	-1	0.04	0.08	0.10
A350	M4 West	450	320	243	430	340	242	-20	19	0	0.95	1.07	0.02
M4 West	A429	415	212	106	406	217	103	-10	4	-2	0.48	0.30	0.22
M4 West	M4 East	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
M4 West	B4122	149	180	121	144	181	117	-6	0	-4	0.46	0.04	0.38
M4 West	A350	257	318	206	244	319	207	-14	1	1	0.87	0.05	0.04
M4 West	M4 East	1536	1286	1297	1493	1300	1288	-42	14	-9	1.09	0.40	0.24
M4 East	M4 West	2218	2124	1625	2133	2124	1646	-85	-1	22	1.82	0.02	0.54
% GEH < 3											100%	100%	100%
% GEH < 5											100%	100%	100%

LGVs

From	To	Observed			Modelled			Diff			GEH		
		7-8am	8-9am	9-10am	7-8am	8-9am	9-10am	7-8am	8-9am	9-10am	7-8am	8-9am	9-10am
A429	M4 East	18	22	13	19	23	13	1	1	0	0.16	0.21	0.03
A429	B4122	10	12	9	9	12	8	-1	1	-1	0.20	0.16	0.37
A429	A350	38	46	34	37	47	37	-1	1	3	0.16	0.15	0.52
A429	M4 West	40	49	36	36	48	36	-4	-1	0	0.68	0.14	0.07
M4 East	A429	16	14	10	15	16	11	-1	2	0	0.36	0.49	0.13
M4 East	B4122	6	7	2	7	7	3	1	0	0	0.32	0.03	0.26
M4 East	A350	82	71	54	81	66	56	-2	-6	3	0.21	0.67	0.37
M4 East	M4 West	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
B4122	A429	25	17	10	24	17	9	-1	0	-1	0.19	0.10	0.22
B4122	M4 East	30	19	12	25	18	11	-5	-1	0	0.90	0.30	0.14
B4122	A350	1	3	2	1	3	2	0	0	0	0.05	0.04	0.01
B4122	M4 West	16	12	6	15	12	6	-1	0	0	0.35	0.04	0.06
A350	A429	75	66	54	72	68	57	-4	2	2	0.44	0.19	0.29

A350	M4 East	64	54	47	62	51	50	-2	-3	3	0.23	0.39	0.43
A350	B4122	35	36	25	33	37	23	-2	1	-2	0.31	0.13	0.50
A350	M4 West	86	61	46	82	60	45	-4	-1	-1	0.47	0.10	0.12
M4 West	A429	79	40	20	78	42	22	-1	2	2	0.13	0.31	0.45
M4 West	M4 East	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
M4 West	B4122	28	34	23	27	32	28	-1	-2	4	0.20	0.34	0.89
M4 West	A350	49	61	39	51	61	39	2	1	-1	0.29	0.10	0.13
M4 West	M4 East	292	245	247	289	238	250	-3	-7	2	0.18	0.47	0.16
M4 East	M4 West	422	405	309	407	413	304	-15	8	-5	0.75	0.39	0.30
% GEH < 3											100%	100%	100%
% GEH < 5											100%	100%	100%

HGVs

From	To	Observed			Modelled			Diff			GEH		
		7-8am	8-9am	9-10am	7-8am	8-9am	9-10am	7-8am	8-9am	9-10am	7-8am	8-9am	9-10am
A429	M4 East	3	3	9	3	3	8	0	-1	-1	0.11	0.33	0.30
A429	B4122	2	0	3	2	0	3	0	0	-1	0.26	0.00	0.36
A429	A350	14	20	13	13	17	13	-1	-3	0	0.35	0.68	0.11
A429	M4 West	12	11	18	11	9	15	-1	-2	-3	0.27	0.50	0.63
M4 East	A429	6	8	3	5	7	3	-1	-1	0	0.40	0.41	0.22
M4 East	B4122	10	5	9	9	5	8	-1	0	-1	0.43	0.17	0.34
M4 East	A350	38	26	36	35	26	32	-3	0	-4	0.42	0.08	0.71
M4 East	M4 West	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
B4122	A429	4	8	2	4	7	2	0	-1	0	0.16	0.34	0.12
B4122	M4 East	13	10	8	12	9	7	-1	-1	-1	0.33	0.32	0.42
B4122	A350	12	11	10	12	10	9	-1	0	-1	0.18	0.15	0.33
B4122	M4 West	21	24	10	19	24	10	-1	0	-1	0.28	0.07	0.23
A350	A429	22	23	18	20	22	16	-2	-1	-1	0.46	0.26	0.30
A350	M4 East	20	28	18	17	28	16	-2	0	-2	0.50	0.05	0.40
A350	B4122	10	9	7	9	8	7	-1	-1	-1	0.28	0.24	0.20
A350	M4 West	31	49	35	27	48	32	-3	-1	-3	0.64	0.11	0.46
M4 West	A429	17	18	25	16	16	25	-1	-2	0	0.25	0.39	0.02
M4 West	M4 East	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
M4 West	B4122	32	28	31	31	28	29	-1	0	-1	0.10	0.04	0.25
M4 West	A350	47	40	45	44	39	42	-3	-2	-3	0.46	0.25	0.50
M4 West	M4 East	224	160	173	210	155	164	-14	-5	-9	0.92	0.41	0.70
M4 East	M4 West	170	166	213	157	158	203	-13	-8	-10	1.04	0.60	0.69
% GEH < 3											100%	100%	100%
% GEH < 5											100%	100%	100%

Cars

From	To	Observed			Modelled			Diff			GEH		
		4-5pm	5-6pm	6-7pm	4-5pm	5-6pm	6-7pm	4-5pm	5-6pm	6-7pm	4-5pm	5-6pm	6-7pm
A429	M4 East	72	77	39	72	79	40	0	2	1	0.04	0.19	0.19
A429	B4122	80	76	56	78	77	56	-2	1	0	0.26	0.13	0.05
A429	A350	324	308	216	312	315	213	-12	8	-3	0.68	0.43	0.21
A429	M4 West	344	326	235	328	335	236	-16	9	1	0.87	0.51	0.06
M4 East	A429	104	108	99	101	110	97	-3	2	-3	0.34	0.15	0.28
M4 East	B4122	47	37	34	46	37	34	-2	0	0	0.27	0.02	0.00
M4 East	A350	520	567	494	496	570	494	-24	3	0	1.06	0.13	0.00
M4 East	M4 West	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
B4122	A429	78	62	47	78	61	47	0	-1	0	0.01	0.14	0.05
B4122	M4 East	92	72	54	93	73	54	1	0	0	0.15	0.04	0.02
B4122	A350	8	26	6	8	26	6	1	0	0	0.18	0.01	0.08
B4122	M4 West	49	40	27	48	41	27	-1	1	0	0.21	0.23	0.07
A350	A429	341	403	267	332	404	272	-9	1	5	0.51	0.05	0.30
A350	M4 East	302	350	230	294	347	230	-8	-3	-1	0.44	0.16	0.03
A350	B4122	165	186	124	163	192	125	-2	5	1	0.19	0.38	0.07
A350	M4 West	343	318	220	337	316	222	-6	-2	2	0.33	0.12	0.16
M4 West	A429	171	181	116	167	177	119	-4	-4	3	0.31	0.30	0.29
M4 West	M4 East	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
M4 West	B4122	206	238	167	200	236	171	-5	-3	4	0.39	0.17	0.30
M4 West	A350	365	422	288	348	422	294	-17	0	6	0.91	0.01	0.37
M4 West	M4 East	2507	2325	1817	2434	2327	1827	-73	2	10	1.48	0.04	0.23
M4 East	M4 West	1838	1566	1303	1774	1568	1306	-64	2	3	1.50	0.05	0.07
% GEH < 3											100%	100%	100%
% GEH < 5											100%	100%	100%

LGVs

From	To	Observed			Modelled			Diff			GEH		
		4-5pm	5-6pm	6-7pm	4-5pm	5-6pm	6-7pm	4-5pm	5-6pm	6-7pm	4-5pm	5-6pm	6-7pm
A429	M4 East	9	10	5	7	8	5	-2	-1	1	0.73	0.38	0.26
A429	B4122	10	9	7	10	9	6	0	0	-1	0.11	0.03	0.23
A429	A350	40	38	27	37	40	27	-3	2	1	0.50	0.31	0.13
A429	M4 West	43	40	29	40	43	28	-3	3	-1	0.43	0.40	0.27
M4 East	A429	13	13	12	11	13	13	-2	-1	1	0.52	0.16	0.20
M4 East	B4122	6	5	4	6	5	4	0	0	0	0.15	0.19	0.07
M4 East	A350	64	70	61	62	69	64	-2	-1	3	0.27	0.11	0.33
M4 East	M4 West	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
B4122	A429	10	8	6	9	8	6	-1	0	0	0.34	0.05	0.04
B4122	M4 East	11	9	7	8	10	6	-3	1	-1	1.04	0.19	0.31
B4122	A350	1	3	1	1	3	1	0	-1	0	0.55	0.36	0.15
B4122	M4 West	6	5	3	6	4	4	0	-1	0	0.08	0.27	0.11
A350	A429	42	50	33	43	48	32	1	-2	-1	0.12	0.24	0.24

A350	M4 East	37	43	28	38	45	31	1	2	2	0.15	0.30	0.43
A350	B4122	20	23	15	19	19	15	-1	-4	0	0.30	0.88	0.01
A350	M4 West	42	39	27	40	44	26	-2	4	-2	0.32	0.65	0.30
M4 West	A429	21	22	14	20	24	15	-1	1	1	0.33	0.27	0.19
M4 West	M4 East	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
M4 West	B4122	25	29	21	22	32	19	-3	2	-1	0.62	0.37	0.28
M4 West	A350	45	52	36	45	58	33	0	5	-2	0.02	0.72	0.37
M4 West	M4 East	310	287	225	307	292	229	-3	5	4	0.17	0.27	0.26
M4 East	M4 West	227	194	161	221	198	165	-7	4	4	0.44	0.30	0.28
% GEH < 3											100%	100%	100%
% GEH < 5											100%	100%	100%

HGVs

From	To	Observed			Modelled			Diff			GEH		
		4-5pm	5-6pm	6-7pm	4-5pm	5-6pm	6-7pm	4-5pm	5-6pm	6-7pm	4-5pm	5-6pm	6-7pm
A429	M4 East	3	4	0	3	3	5	0	-1	5	0.01	0.45	0.00
A429	B4122	2	4	1	2	1	1	-1	-3	0	0.45	1.71	0.37
A429	A350	17	9	3	13	14	9	-4	6	6	1.05	1.64	2.36
A429	M4 West	19	6	8	12	8	12	-7	2	4	1.69	0.58	1.25
M4 East	A429	6	2	3	4	5	2	-2	3	-1	0.75	1.56	0.50
M4 East	B4122	22	21	19	14	11	13	-8	-11	-5	2.00	2.72	1.34
M4 East	A350	39	16	16	35	22	21	-4	6	5	0.62	1.41	1.27
M4 East	M4 West	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
B4122	A429	7	1	1	4	4	2	-3	3	1	1.25	1.84	0.82
B4122	M4 East	17	8	5	13	7	5	-3	-1	0	0.83	0.19	0.04
B4122	A350	6	1	4	11	7	6	5	5	2	1.75	2.79	0.98
B4122	M4 West	16	12	8	16	19	9	1	7	1	0.15	1.90	0.45
A350	A429	20	14	17	19	19	15	-1	5	-2	0.26	1.18	0.43
A350	M4 East	16	14	15	16	21	15	1	7	0	0.17	1.67	0.09
A350	B4122	7	6	4	8	7	5	1	0	1	0.36	0.10	0.65
A350	M4 West	41	43	20	30	46	28	-11	3	8	1.89	0.43	1.71
M4 West	A429	10	7	6	12	13	17	1	6	10	0.31	1.93	3.03
M4 West	M4 East	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
M4 West	B4122	24	26	14	27	28	24	3	2	10	0.58	0.33	2.31
M4 West	A350	32	35	18	37	37	32	5	1	14	0.77	0.24	2.74
M4 West	M4 East	199	150	117	203	147	143	4	-3	26	0.30	0.21	2.25
M4 East	M4 West	202	176	168	166	160	181	-36	-17	13	2.66	1.27	0.98
% GEH < 3											100%	100%	95%
% GEH < 5											100%	100%	100%