HEMEL HEMPSTEAD URBAN TRANSPORT MODEL

Local Model Validation Report

Report

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1. INTRODUCTION

Background

1.1 Hertfordshire Highways and Dacorum Borough Council are currently developing an Urban Transport Plan for Hemel Hempstead, and through that work, identified a need for a more detailed understanding of traffic and highway issues in the town.

1.2 Steer Davies Gleave (SDG) has therefore been commissioned by Hertfordshire Highways to build a PARAMICS micro-simulation model of the Hemel Hempstead area. A base year (2008) and two future year (2021 and 2031) models will be constructed using a variety of data sources held by the client.

1.3 In particular, the client needs the model for assessing the traffic impacts of a large number of potential future year housing development sites. Additionally, there is a desire to have a traffic model available to enable comparative assessment of developer's schemes.

Study Team

1.4 The study team consists of representatives from Hertfordshire Highways, Hertfordshire County Council, Dacorum Borough Council and Steer Davies Gleave.

Scope of Report

1.5 This report details the methodology and data sources used to build the 2008 base year PARAMICS model of Hemel Hempstead and assesses the adequacy of the resulting model in terms of calibration and validation statistics that compare modelled outputs to observed measurements of traffic flow, journey times and demand patterns.

Structure of Report

1.6 The remainder of this report is structured as follows:

- Chapter 2 describes the scope of the model;
- Chapter 3 details all data used in the study;
- Chapter 4 details the construction of the network;
- Chapter 5 details the construction of the demand matrices;
- Chapter 6 details the calibration of the model;
- Chapter 7 reports the validation of the model;
- Chapter 8 presents an executive summary of the study.

2. SCOPE OF MODEL

Model Requirements

2.1 The overall objective of the study is to develop a transport model of the Hemel Hempstead urban area that can be used to test the impact of key development sites and transport schemes around the town. This objective forms part of the Local Development Strategy being progressed by Dacorum Borough Council.

2.2 Additionally, the model may be presented to non-technical audiences, so there is a requirement for good visual representation of the traffic network and traffic conditions in Hemel Hempstead.

2.3 Traffic modelling projects vary widely in the level of detail of the final models and this variance is usually due to a combination of factors, including the end purpose of the model, timescales, and resources. In this study, the study team have agreed that the goal is not to build a 'traffic engineering' standard of micro-simulation model, useful for example, for detailed testing of complex highway schemes, but instead to build a more 'strategic' style of micro-simulation model that allows broad assessment and visual presentation of wider urban development options.

2.4 The study team therefore agreed that the model would be built using existing datasets held by the client, and that the modelling team would seek to build a model that achieves good calibration of turning flows at key junctions, and a realistic representation of traffic demand patterns across the wider area.

Extent of Model

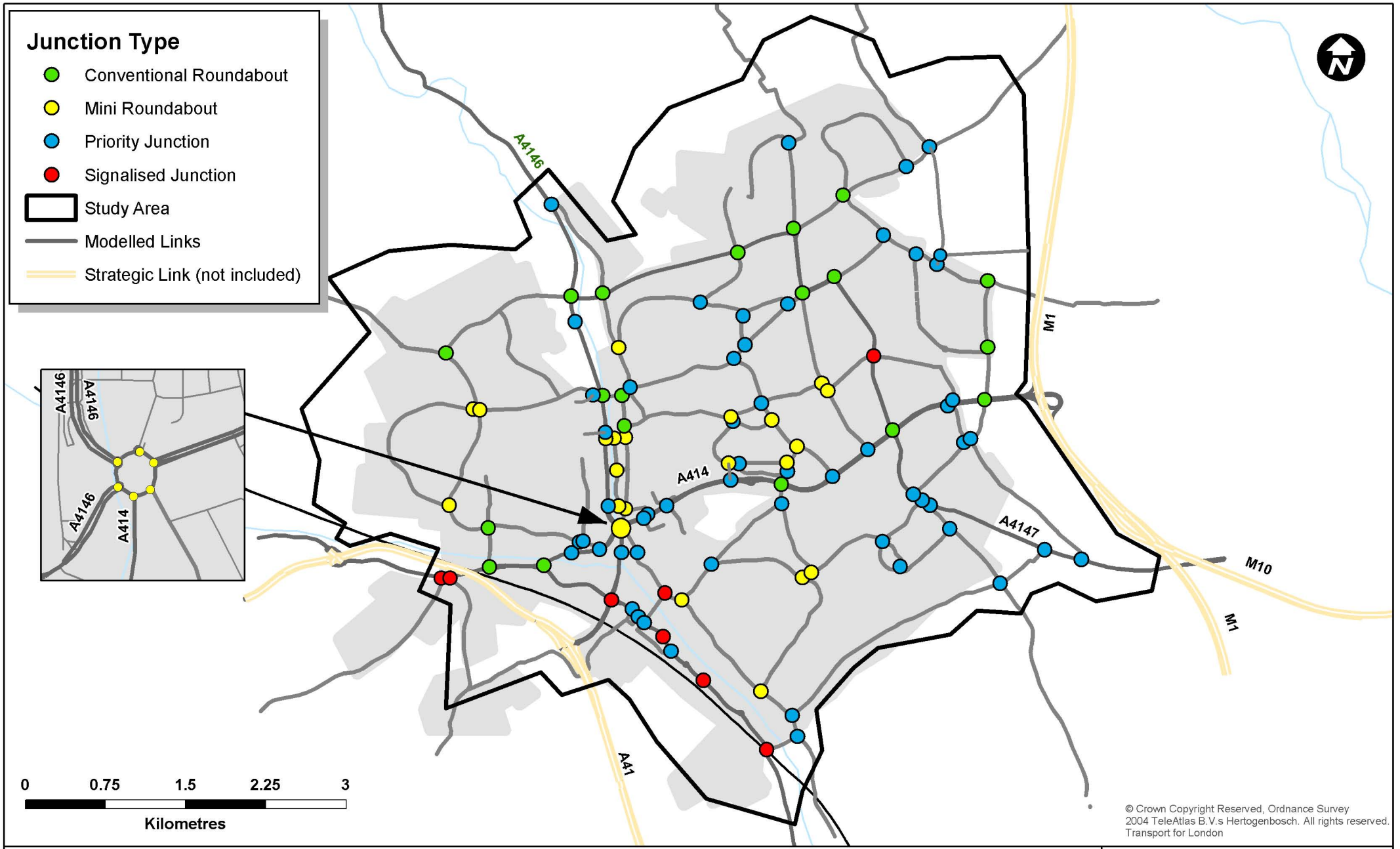
2.5 The study area is formed by the entire urban area of Hemel Hempstead and routes into and out of the town. The study team defined the elements of the road network to be included based upon local knowledge and the end purpose of the model. In particular it was decided that modelling of the A41, which runs through the south-western edge of the model area, and the M1, which runs parallel to the east of the model area, were not necessary for this study. Figure 2.1 shows the geographical extent of the model, and the included highway links and junction types.

Time Periods

2.6 Models were built of the following three time periods:

- AM Peak 0700-1000;
- PM Peak 1600-1900;
- Saturday Peak 1100-1400.

2.7 Micro-simulation guidelines (The Micro-simulation Consultancy Good Practice Guide by SIAS) suggest that where the peak modelled period includes additional hours before and after the peak hour, that it is not necessary to add separate, synthetic warm-up and cool-down periods to the model. Instead, the model warm-up and cool-down is achieved with the lower levels of demand before and after the peak hours.



Hemel Hempstead Urban Transport Model

Figure 2.1: Geographical Extent of Study Area

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3. DATA

Introduction

3.1 In this section, we describe all data used in the study and detail the methods used where adjustments were made to account, for example, for seasonality, year or missing elements.

3.2 All data used was provided by Hertfordshire Highways and Dacorum Borough Council except where specifically noted otherwise.

Schedule of Data Items

3.3 The data used in this study have been grouped into three categories, which relate to the primary use of each data item:

- Network Data – characteristics of the road network and physical features of the study area used to build the PARAMICS network model;
- Travel Demand Data – travel demand including origin-destination type surveys and other data describing travel patterns across the study area;
- Count Data – manual and automatic traffic counts of turns and links in the study area.

3.4 In the following sub-sections, the content of each data category is described.

Network Data

3.5 Table 3.1 lists each data item relating to the road network and physical features of the study area.

TABLE 3.1 DATA ITEMS: NETWORK

Data Item	Comment
DXF tiles	OS background mapping tiles used as background in PARAMICS for network build
ArcView GIS project	Layers showing: (i) Road network features; (ii) Junction details; (iii) Speed limits; (iv) Bus stop locations.
Signal plan data	Hard copy of 2008 timings information for each signalised junction.
Photography: Network features	Obtained during site visits in 2008 by Steer Davies Gleave.
Journey times	ITIS data for major network sections.
Bus service analysis	Spreadsheet of bus services and frequencies derived from HERMIS 2008 database.
Bus timetables	2008 operator timetables for each bus service.

Travel Demand Data

3.6 Table 3.2 lists each data item relating to travel demand in the study area.

TABLE 3.2 DATA ITEMS: TRAVEL DEMAND

Data Item	Comment
Census data	Travel to work and population data by output areas within study area.
County Travel Survey data	Household survey of movements between areas within the county.
School census data	Individual origin-destination data for school trips for each school in Hemel Hempstead.
ANPR data	Number plate matching survey at 5 points at edges of study area.
Travelwise	Occupancy surveys and counts for routes in/out of centre.

Count Data

3.7 Table 3.3 lists each data item relating to traffic counts in the study area. A map showing count locations is provided in Figure 3.1.

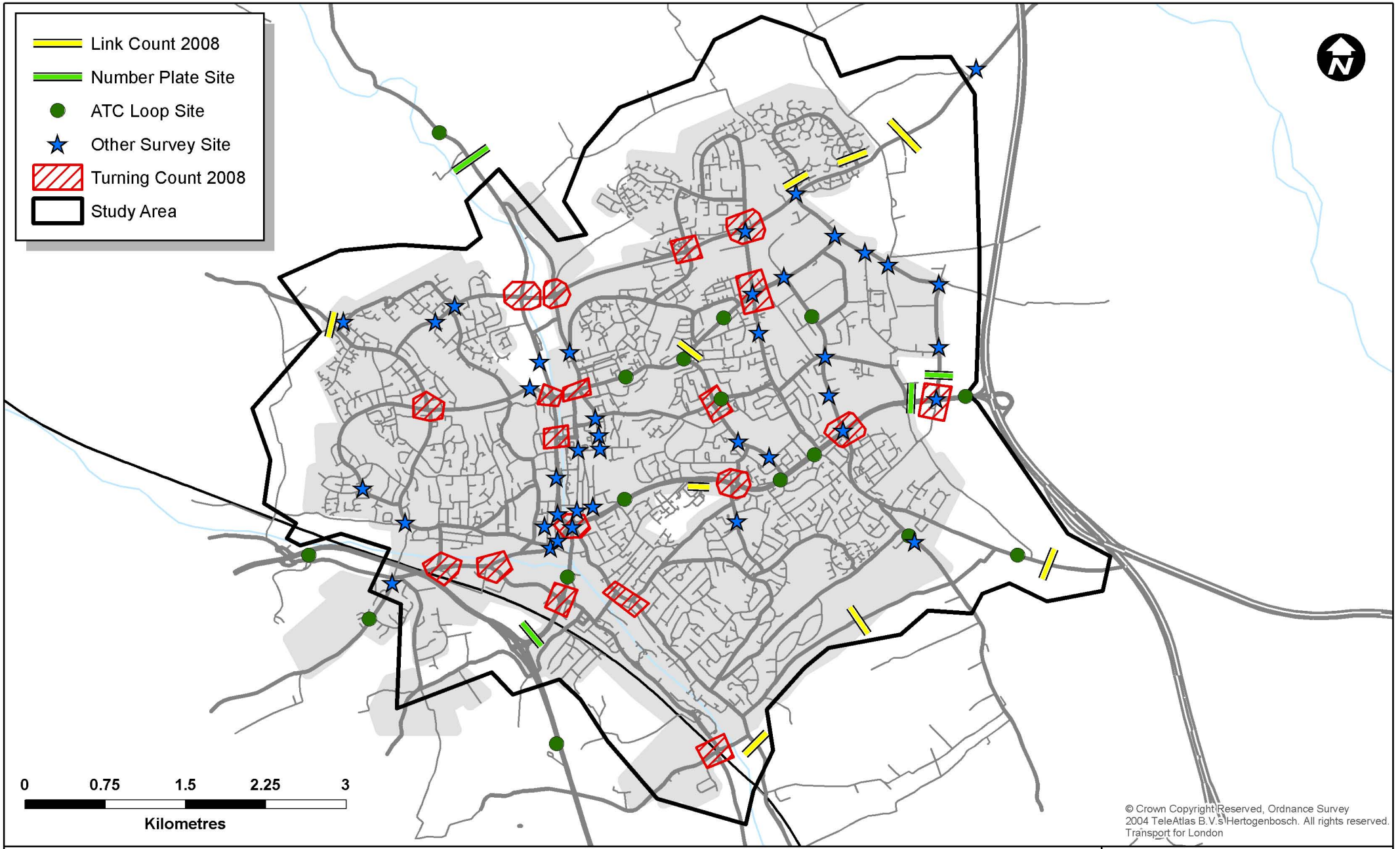
TABLE 3.3 DATA ITEMS: TRAFFIC COUNTS

Data Item	Year	Classified	AM	PM	SAT
New Turning Counts for Study (20)	2008	7 user classes	15 min 07:00 – 10:00	15 min 16:00 – 19:00	15 min 11:00 – 14:00
New Link ATCs for Study (10)	2008	'vehicles'	hourly	hourly	hourly
ATCs (7)	2007	'vehicles'	hourly	hourly	hourly
Adhoc Link Counts (5x2006, 2x2003)	2003/ 2006	'vehicles'	hourly	hourly	hourly
Plough Turning Count	2005	5 user classes	15 min 07:30 – 19:30	15 min 16:00 – 18:00	n/a
Adhoc Turning Counts (5)	2007 + 2006	14 user classes	hourly	hourly	hourly
Speed Monitoring Sites with Link Counts (2)	2003	'vehicles'	hourly	hourly	hourly

Data Model

3.8 A spreadsheet data model was constructed which displays the available count data on a schematic representation of the road network. This was used to check the consistency of counts between sites and also to synthesise missing count data.

3.9 In particular, full turning counts were not possible for the larger roundabouts in the study area – instead each approach arm was classified by 'first turn' and 'all other'. By using a pro-rata method based on input entry flows, and adjacent junction flows, the missing turning counts were synthesized.



Hemel Hempstead Urban Transport Model

Fig 3.1: Location of Counts

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Growth Rates

3.10 TEMPRO was used to derive growth rates for the study area that could be used to re-base any earlier counts to a 2008 base year. Local growth factors for Hemel Hempstead were used to adjust NRTF growth giving the factors to rebase to 2008 counts in Table 3.4.

TABLE 3.4 ADJUSTED LOCAL FACTORS TO REBASE COUNTS TO 2008

Year	AM	PM	SAT
1998	1.222	1.218	1.206
1999	1.203	1.198	1.187
2000	1.185	1.180	1.170
2001	1.168	1.162	1.153
2002	1.137	1.132	1.124
2003	1.107	1.104	1.072
2004	1.079	1.077	1.073
2005	1.053	1.051	1.048
2006	1.026	1.026	1.026
2007	1.014	1.013	1.013

4. NETWORK CONSTRUCTION

General

4.1 A three phase methodology was used to build the PARAMICS network.

4.2 Firstly, an initial network build was undertaken using the data supplied by the client and online resources. Secondly, a calibration of the individual junctions on the network against turning count data was performed. Finally, the full network and matrix were calibrated.

4.3 However, for convenience, all network build procedures, parameters and techniques are described in this section of the report.

Network Build

4.4 The Ordnance Survey base mapping tiles supplied by Hertfordshire Highways were used to create a single DXF file for input into PARAMICS as a background for the model build exercise.

Link and junction characteristics

4.5 The data items supplied by Hertfordshire Highways (see Table 3.1) were used to initially define network variables such as link speeds, number of lanes and bus routes.

4.6 Initial junction layouts were coded using aerial photography, from websites such as Live Maps (http://maps.live.com/) and Google Maps (http://maps.google.co.uk).

4.7 Most links in the model are coded as 'minor' – meaning that generally only familiar drivers would use them to divert around delays.

4.8 Signposted major strategic routes are coded as 'major'. These routes are used by all unfamiliar drivers. In Figure 4.1 the major/minor coding is shown – with major links in red.

4.9 In addition to signposted major routes into and out of Hemel Hempstead, High Street/Piccotts End was also coded as a major route providing north/south access between the A4147 and Queensway.

Vehicle Types

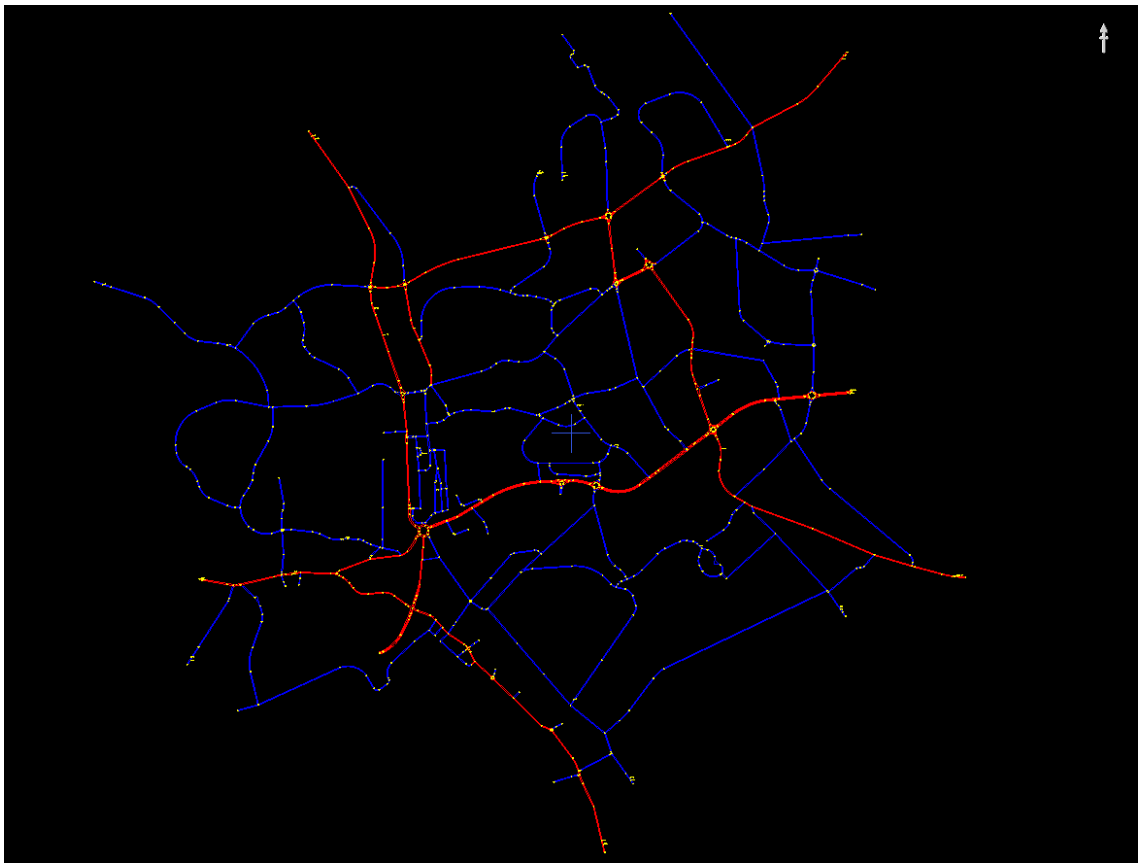
4.10 Demand matrices and count validation were considered in terms of two broad vehicle types: lights and HGVs.

4.11 The light vehicle class includes 80% cars and 20% light vans.

4.12 The HGV class includes 20% medium and 80% large goods vehicles.

4.13 Additionally, buses were coded separately as fixed transit routes based on timetable information and route maps.

FIGURE 4.1 LINKS BY CATEGORY (MAJOR = RED, MINOR = BLUE)



Zone system

4.14 A zoning system was developed based on the administrative structure of the study area. This structure was preserved to facilitate census analysis and data transfer. A zone plan is provided in Figure 4.2. Table 4.1 provides a description of the area represented by each zone.

4.15 Land uses in Hemel Hempstead are fairly well defined, with separation between the major employment, leisure/retail, and residential areas, as illustrated in Figure 4.3. Additionally it is worth noting:

- Zones 1-15 are external zones providing access/egress to the modelled area by inter-urban routes (eg. A41 and M1);
- Zones 16-62 are internal zones which broadly correspond to the ward/output area structure of the modelled area;
- Zone 52 includes the rail station and Zone 30 includes the hospital; however these zones do not solely represent those important trip attractors, but also the surrounding area;
- Zones 30 and 31 represent the town centre;
- Zones 49, 57 and 58 represent the Maylands industrial area;
- Zone 41 represents the Jarman Park leisure and retail centre.

4.16 Car parks were used to refine the zoning system further and control the entry and exit

of vehicles onto/from the network. Car parks, in the PARAMICS sense, do not necessarily relate to actual car parks, but as subdivisions of zones used to allow entry and exit of vehicles from particular links within zones.

TABLE 4.1 MODEL ZONES

Zone	Description	Zone	Description	Zone	Description
1	A4146 (N)	22	Woodhall	43	Leverstock Green
2	Cupid Green Lane	23	Highfield and St Pauls	44	Leverstock Green
3	Holtsmere End	24	Highfield and St Pauls/Central	45	Leverstock Green
4	B487 (E)	25	Boxmoor	46	Adeyfield West
5	Punch Bowl Lane/ Hogg End Lane	26	Highfield and St Pauls/Central	47	Adeyfield East
6	M1 (ALL)	27	Central	48	Adeyfield East
7	A4147 (SE)	28	Adeyfield West	49	Adeyfield East
8	Bedmond Road	29	Central	50	Central
9	Lower Road	30	Central	51	Central
10	A4251 (S)	31	Central	52	Apsley
11	A41 (ALL)	32	Central	53	Apsley
12	Featherbed Lane	33	Bovingdon, Flaunden & Chipperfield	54	Boxmoor
13	B4505 (SW)	34	Apsley	55	Apsley
14	A4251 (W)	35	Kings Langley	56	Apsley
15	Berkhamstead Road (NW)	36	Nash Mills	57	Adeyfield East
16	Chaulden and Warners End	37	Bennetts End	58	Adeyfield East
17	Warners End	38	Bennetts End	59	Adeyfield West
18	Gadebridge	39	Corner Hall	60	Adeyfield West
19	Central	40	Corner Hall	61	Grove Hill
20	Central	41	Corner Hall	62	Woodhall
21	Grove Hill	42	Corner Hall		

Hemel Hempstead Urban Transport Model

Figure 4.2: Zone Structure

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Land Features

- Golf Course
- Hospital
- Ski Centre
- Study Area

Land Cover Classification

- Business/Mixed Use
- Industrial
- Leisure/Entertainment
- Leisure/Recreation
- Retail/Centre
- Residential

A4146
M1
A414
A4147
M10
M1
A41

0 0.75 1.5 2.25 3

Kilometres

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Figure 4.3: Land Cover Classification

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Model Parameters

4.17 A number of network parameters were changed during the model calibration and validation process but are described in this section for convenience.

Link Speeds

4.18 Generally, link speeds have been coded as the speed limits in reality. However, in some situations coded speeds have been reduced to better reflect the road conditions/traffic behaviour:

- Peascroft Road and Chambersbury Road have been reduced to speed limits of 20mph to simulate the residential nature of the area and reduce the likelihood of rat-running between Bennetts End Road and Leverstock Green Road.
- A 20mph section has been added to link 254 – 255 in both directions to simulate the traffic calmed area on St John's Road.
- Speed limits on Westwick Row and sections of Green Lane have been reduced from 60mph to 50mph to reflect the relatively poor quality of the road.
- Speed limits on Felden Lane and Featherbed Lane have been reduced from 60mph to 45mph to reflect the relatively poor quality of the road.

Link Costs

4.19 Cost factors were applied to a very small number of links to minimise unusual routing behaviour:

- Cost of travel on Winifred Road and Storey Street was set to 2.0 to minimise unrealistic re-routing to avoid signals on London Road.
- Cost of travel on Westwick Row was set to 1.5 to reduce the attractiveness of this route relative to Leverstock Green Road.
- Free flow left turn lanes on roundabouts were set with low cost factors to minimise left turners using the main circulatory sections.

Assignment Parameters

4.20 A generalised cost equation of Cost = 1 xTime + 1 xDistance has been used to reflect the importance of distance (as a proxy for vehicle operating cost) in strategic models.

4.21 The dynamic feedback interval has been set at 2 minutes with a feedback factor of 0.30.

Driver Familiarity

4.22 Familiarity affects the cost calculation for alternative routes and is applied by vehicle class. A setting, for example, of 90% implies that 90% of the vehicles of that user class are familiar with the network and will re-route using minor roads to avoid delays. In contrast, unfamiliar drivers perceive the cost on minor links to be double that of major links, and are therefore much less likely to re-route. Familiarity settings are as follows:

- Cars 60% are familiar to reflect relatively high through-traffic levels.
- LGVs 85% are familiar. Mostly local traders etc so a high value is appropriate.
- MGVs 60% are familiar to reflect through-traffic.
- HGVs 0% are familiar to prevent HGV rat-running through minor roads.

Signal Timings

4.23 All signals are coded to reflect the timing and staging information supplied by Hertfordshire Highways. However, modifications were made to two of the signalised junctions.

Box Lane/London Road (S1a/b)

4.24 This two-stream junction currently works on SCOOT, which will continuously update green times based on the prevailing traffic conditions (from detector loops). Consequently, the maximum timings given in the specification are not necessarily those in use – these will only be used in the event of a loss in communication to the SCOOT UTC controller (as backup timings). Consequently, to make a simplification of SCOOT operation we have assumed:

- The pedestrians stages do not operate during the peaks – observations showed rare pedestrian crossing activity. Therefore, the loss in green time to traffic over an hour would be relatively insignificant, particularly as the junction generally operates with relatively little traffic delay.
- Green times have been chosen as a best estimate that would be implemented by SCOOT – as above, we do not have any "live" SCOOT output, and the maximum green times in the specs are also not necessarily appropriate estimates.

London Road/Rucklers Lane (S10)

4.25 As for the London Road/Box Lane junction, this site is served by a method of control that updates signal timings continuously based on the flows measured, in this case MOVA. Consequently, the max timings given in the specification are not necessarily those in use – these will only be used in the event of breakdown of the MOVA unit (as backup timings – the spec does give some MOVA max timings also, and these are significantly higher than the VA Maximums). Consequently, to make a simplification of MOVA operation we have applied green times that we consider a best estimate that would be implemented by MOVA (within the limits of the MOVA green time maximums) within a "realistic" cycle time (high enough to supply the necessary capacity, but not too high to result in sluggish" operation of the junction).

5. MATRIX CONSTRUCTION

General Approach

5.1 In agreement with the client team, no origin or destination traffic survey data was collected for this study. However, good quality journey to work (JTW) data and schools origin-destination data was made available by Hertfordshire Highways with which to construct a prior matrix for the morning peak period.

5.2 A comprehensive traffic survey programme of turning and link counts across the study area was undertaken by Hertfordshire Highways for use in developing and calibrating this prior matrix.

Morning Period Matrix Construction

5.3 The JTW data described work trips to and from wards in the study area. This included trips from Hemel Hempstead wards to other Hemel Hempstead wards (intra-Hemel trips), trips from Hemel Hempstead wards to external areas (out-commuting) and trips from external areas to Hemel Hempstead wards (in-commuting):

- JTW Intra-Hemel trips = 13157
- JTW Hemel to External = 14258
- JTW External to Hemel = 12253

5.4 This data was coded to the model zoning system to form the basis of the morning period prior matrix. All trips in the demand data that were to or from areas outside of the study area were assigned to one of the external zones in the PARAMICS model based on their location. For example, trips likely to have used the M1 on the way to the centre of Hemel were assigned to external zone 6 and trips likely to have used Leighton Buzzard Road from the north were assigned to zone 1.

5.5 Similarly, data describing school drop-off trips by ward in the study area was recoded to the model zoning system and added to the morning period prior matrix.

- School DropOff (Primary) = 2751
- School Dropoff (Secondary) = 1194
- School Dropoff (Special) = 136

5.6 Finally, the external to external trips identified by the ANPR survey were added to the prior matrix:

- ANPR External to External = 1381

5.7 The initial morning period prior matrix contained a total of 45130 trips representing the sum total of the seven trip types above. The ratio of lights to heavy vehicles in the external counts was found to be 5.39%: this value was applied to the full matrix to produce a prior HGV matrix.

5.8 Where available, counts were used to factor zone totals. In particular, it was possible to constrain zone totals at most external zones, and well-defined internal zones (such as Jarman Park) to count totals.

5.9 The prior matrix was then further modified through a manual process of matrix

estimation, taking into account land use types, turning data, and link counts across the study area resulting in a final AM matrix which has 53037 lights and 2743 heavies for a total of 55780 vehicles. The increase in trips reflects the addition of the unobserved trip types, such as retail, leisure and employers business, to the initial prior, which contained only work trips, school trips and external to external trips.

5.10 Origin and destination totals for the morning period matrix are in Table 5.1:

TABLE 5.1 ZONE TOTALS: MORNING PERIOD MATRIX

Zone	Os	Ds	Zone	Os	Ds	Zone	Os	Ds
1	3132	1251	22	971	410	43	1168	202
2	294	305	23	1277	1078	44	1139	400
3	83	68	24	999	750	45	1265	1663
4	2225	2390	25	465	140	46	216	264
5	228	349	26	303	526	47	1688	851
6	5338	4789	27	129	366	48	1016	1582
7	1788	1670	28	287	190	49	602	1730
8	1104	1388	29	441	591	50	613	111
9	669	1486	30	420	2421	51	590	564
10	1039	1398	31	370	1809	52	608	618
11	3133	2497	32	138	367	53	300	175
12	258	387	33	292	61	54	1455	697
13	358	573	34	754	473	55	295	438
14	1358	1607	35	563	155	56	154	1463
15	400	847	36	640	370	57	1057	3553
16	1470	897	37	1083	418	58	222	1401
17	975	730	38	1073	925	59	809	394
18	1864	1508	39	536	240	60	294	367
19	264	70	40	512	668	61	1510	657
20	238	326	41	884	1060	62	767	431
21	823	249	42	952	534			

5.11 Generally, for the internal zones, the number of origins is higher for residential zones, and the number of destinations higher for employment zones. Zones which contain retail, leisure and/or education areas may not necessarily fit this pattern however. In particular, Zones 18 (Gadebridge), 23 (Highfields), 45 (Leverstock Green) and 48 (Adeyfield) are residential zones with relatively high numbers of destination trips in the morning period.

5.12 It is worth noting that for the Maylands industrial area, although the demands for Zones 59, 57 and 58 have been calibrated to 2008 traffic count levels, the area is still operating significantly under its capacity in terms of commercial and industrial activity following the Buncefield Oil Depot accident.

Morning Period Profiles

5.13 The demand matrix covers the whole 3 hour morning period. A set of release profiles was developed to simulate the build up and dissipation of queuing over the 3 hour period.

5.14 PARAMICS provides the ability to apply different release profiles to individual origin-destination cells, whole rows and/or columns, or the entire matrix.

5.15 For external zones, counts were used to directly produce entry and exit profiles, which were applied by row and column respectively. For example, for all trips originating in zone 1 (the A4146), the entry flow profile from the A4146 count at the junction with Galley Hill was applied. Conversely, for all trips with destinations at zone 1, the A4146 exit flow profile from the same count was applied.

5.16 For external zones where no count data was available, the profile from a nearby external zone where data was available was used.

5.17 The average of all external profiles was used to create a profile for internal zones.

5.18 Figures 5.1 – 5.12 illustrate the profiles used in the morning period model.

FIGURE 5.1 MORNING PERIOD TRAFFIC PROFILE: ZONE 1

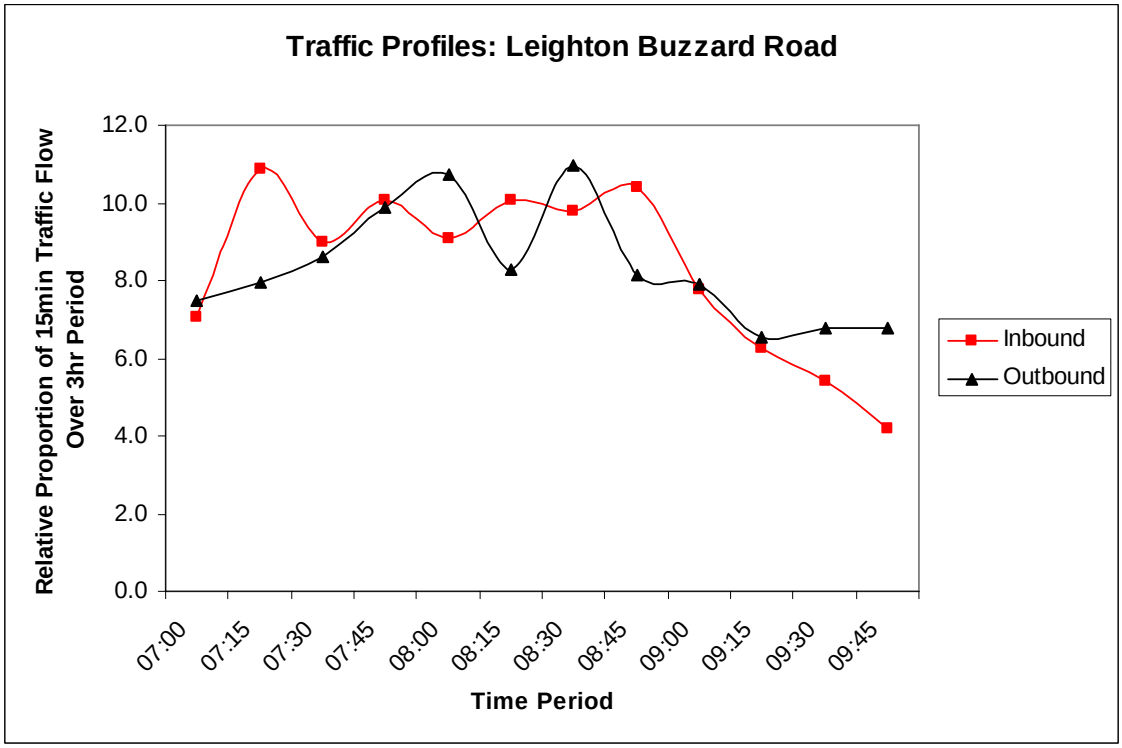


FIGURE 5.2 MORNING PERIOD TRAFFIC PROFILE: ZONE 2

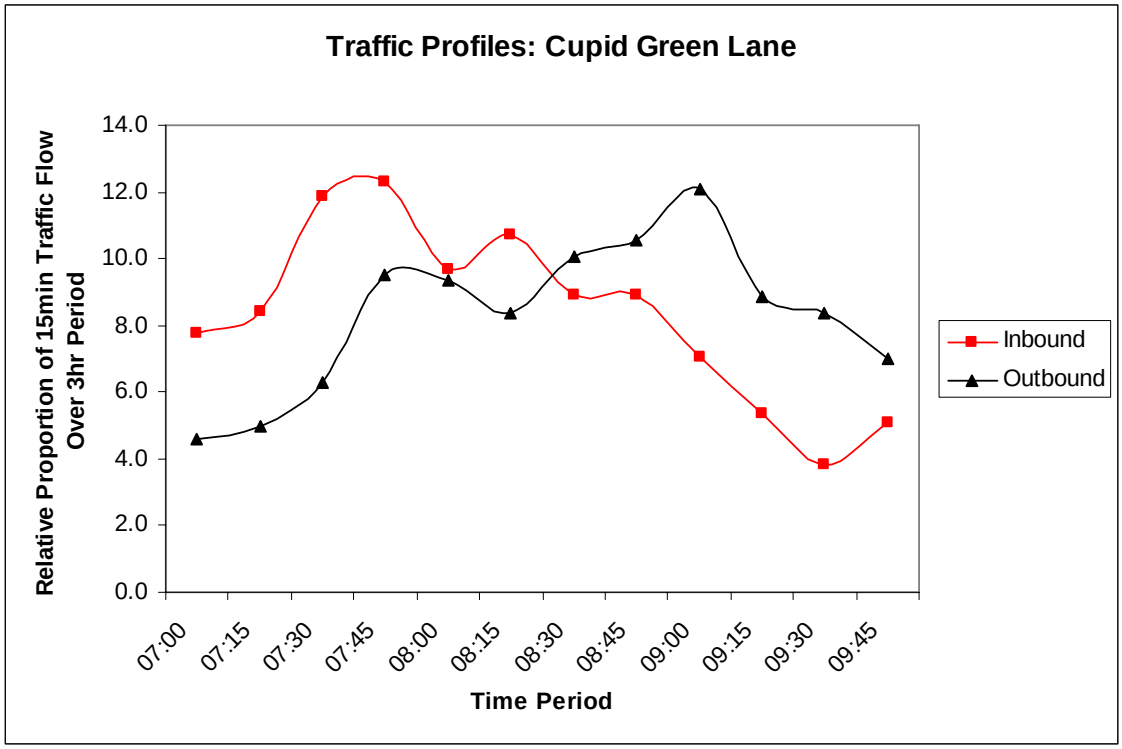


FIGURE 5.3 MORNING PERIOD TRAFFIC PROFILE: ZONES 3, 4 AND 5

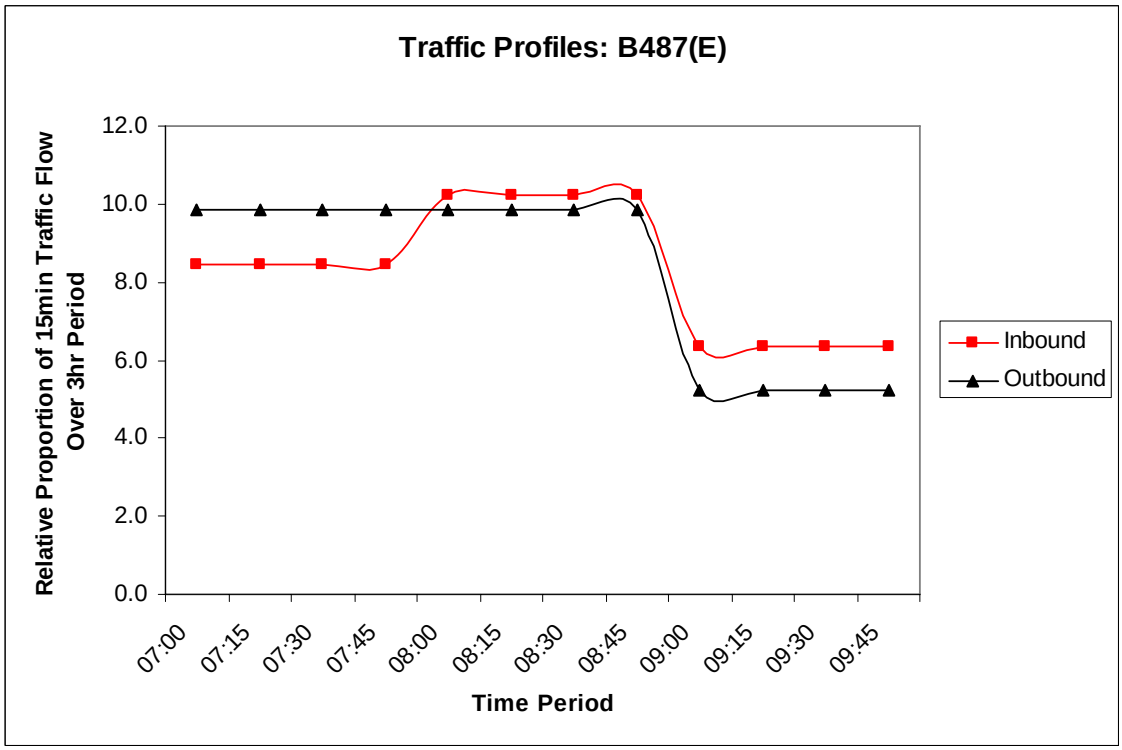


FIGURE 5.4 MORNING PERIOD TRAFFIC PROFILE: ZONE 6

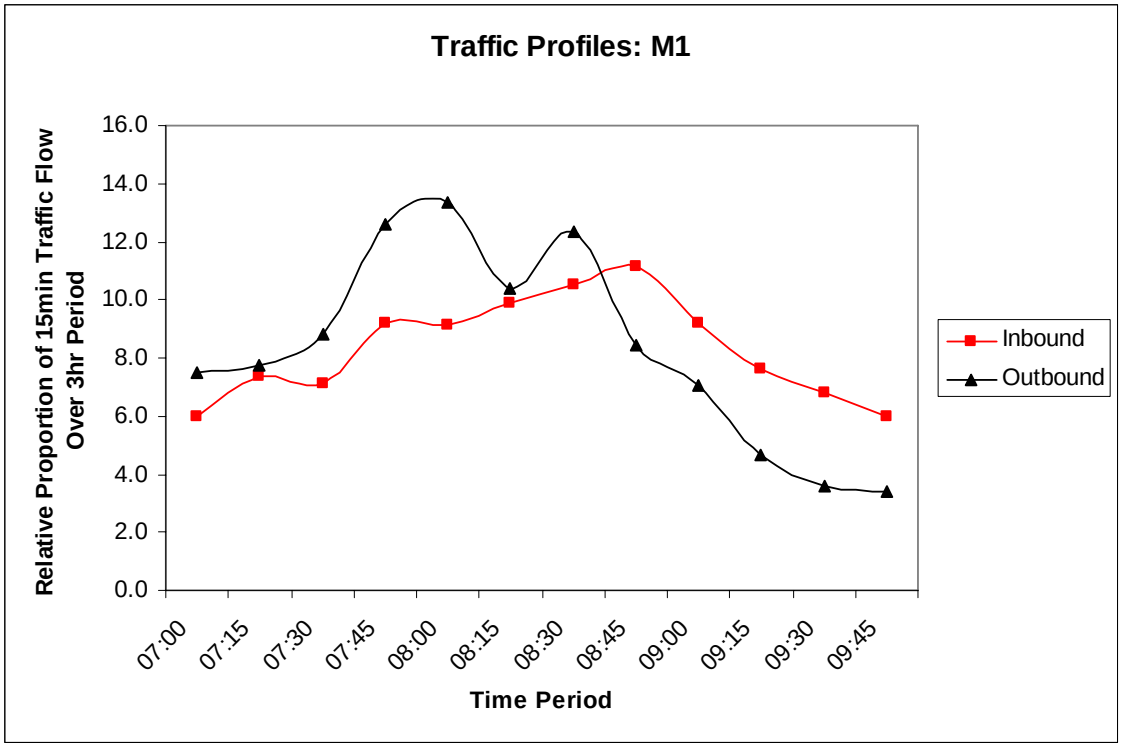


FIGURE 5.5 MORNING PERIOD TRAFFIC PROFILE: ZONE 7

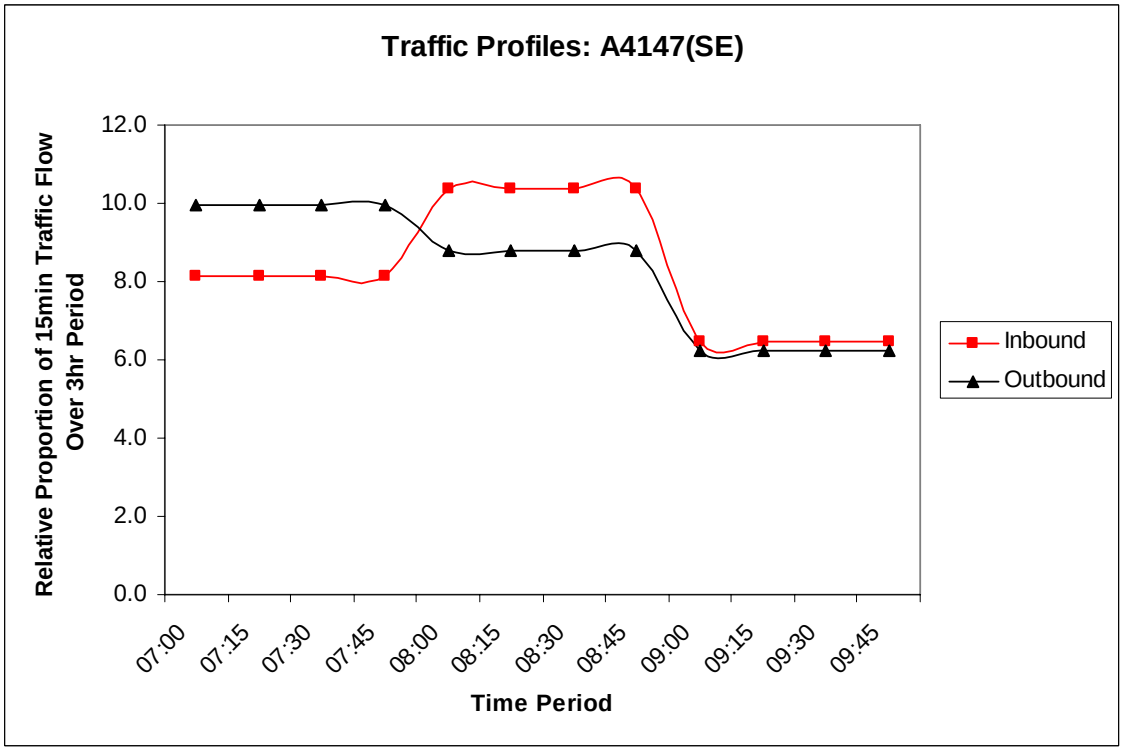


FIGURE 5.6 MORNING PERIOD TRAFFIC PROFILE: ZONE 8

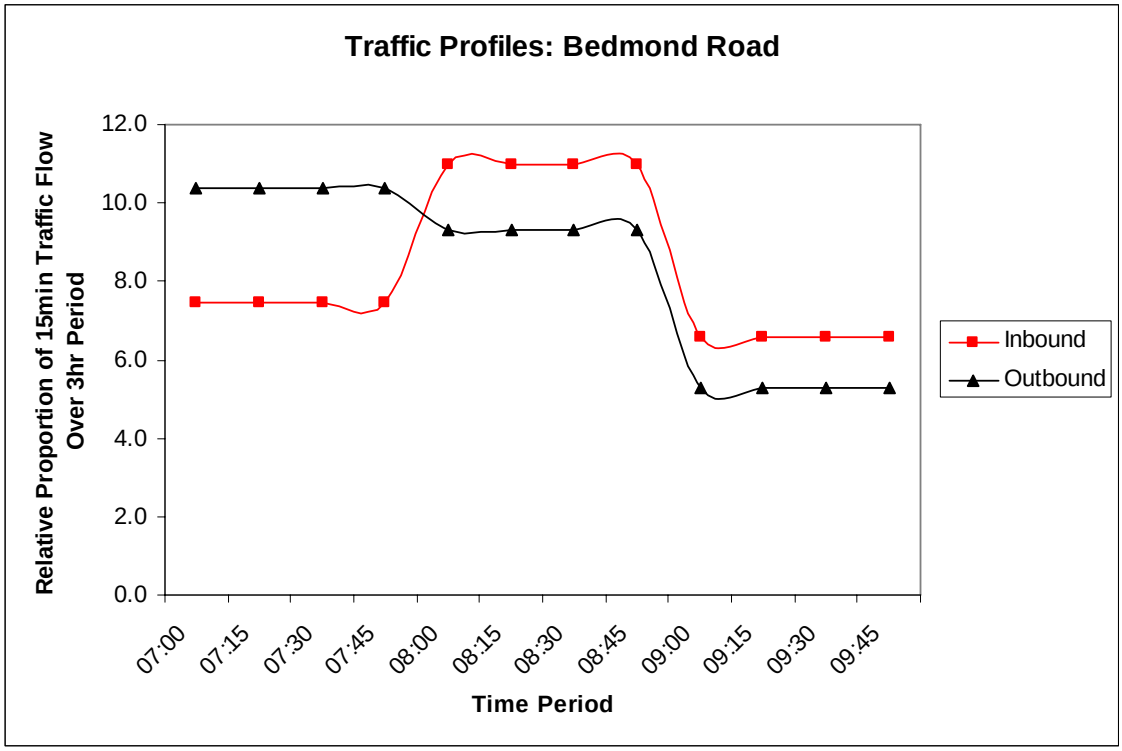


FIGURE 5.7 MORNING PERIOD TRAFFIC PROFILE: ZONE 9

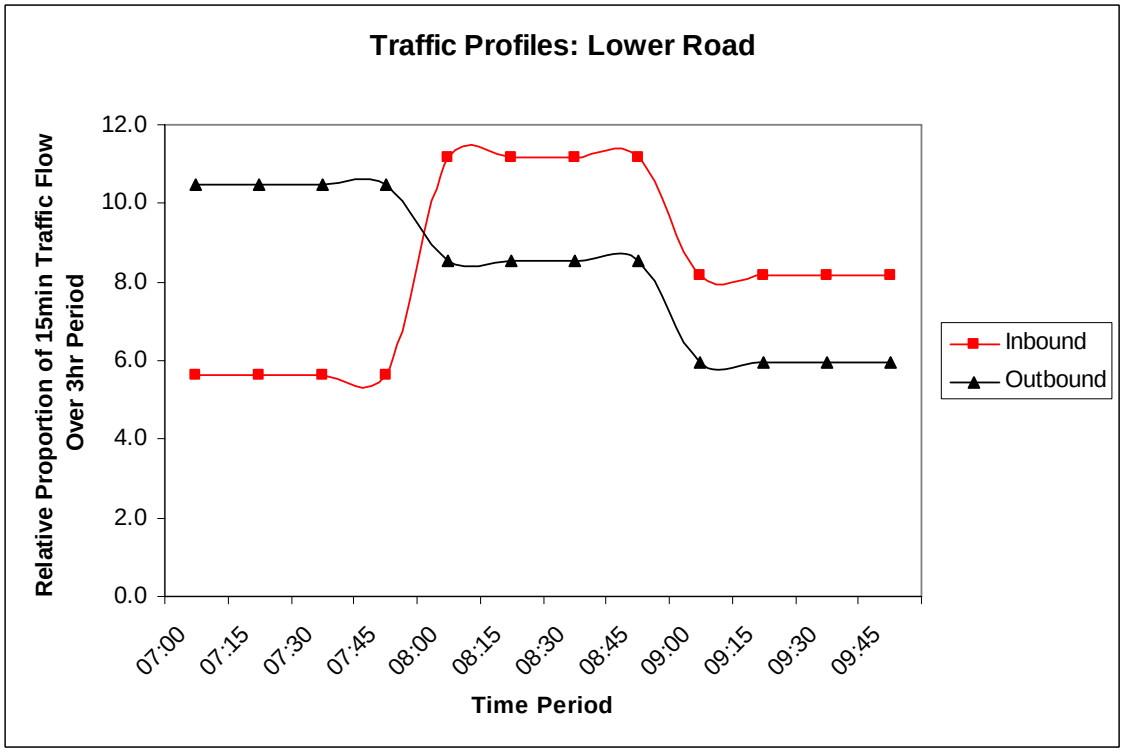


FIGURE 5.8 MORNING PERIOD TRAFFIC PROFILE: ZONE 10

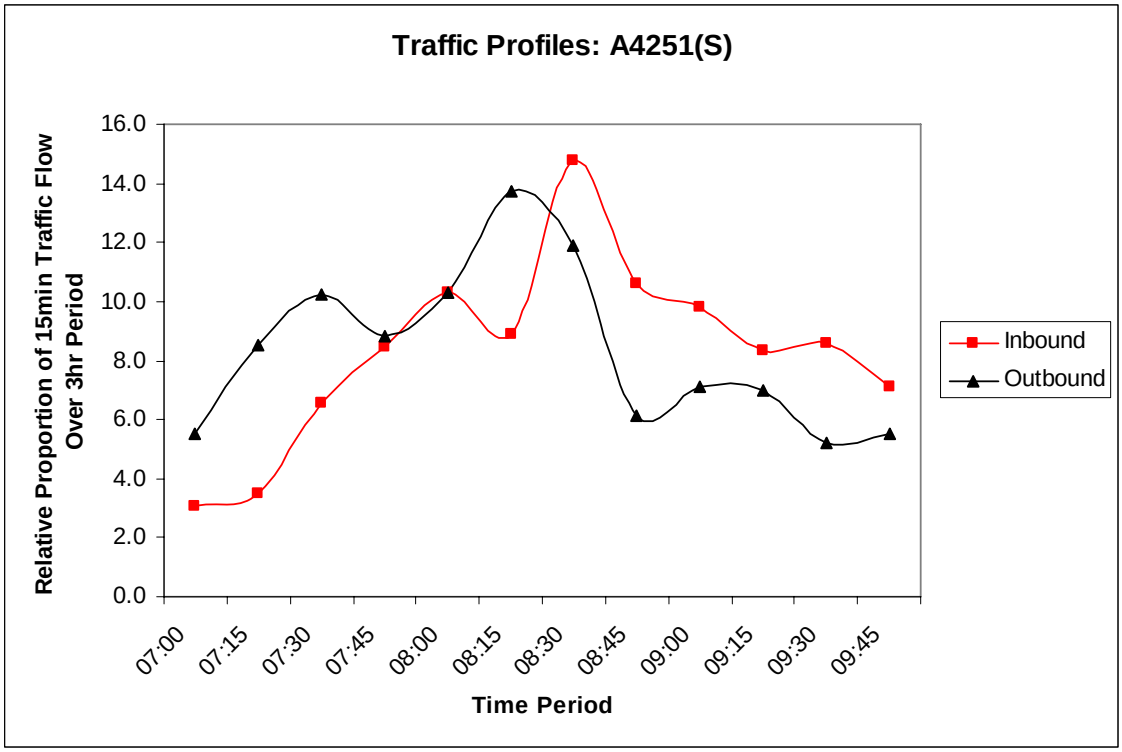


FIGURE 5.9 MORNING PERIOD TRAFFIC PROFILE: ZONES 11 AND 12

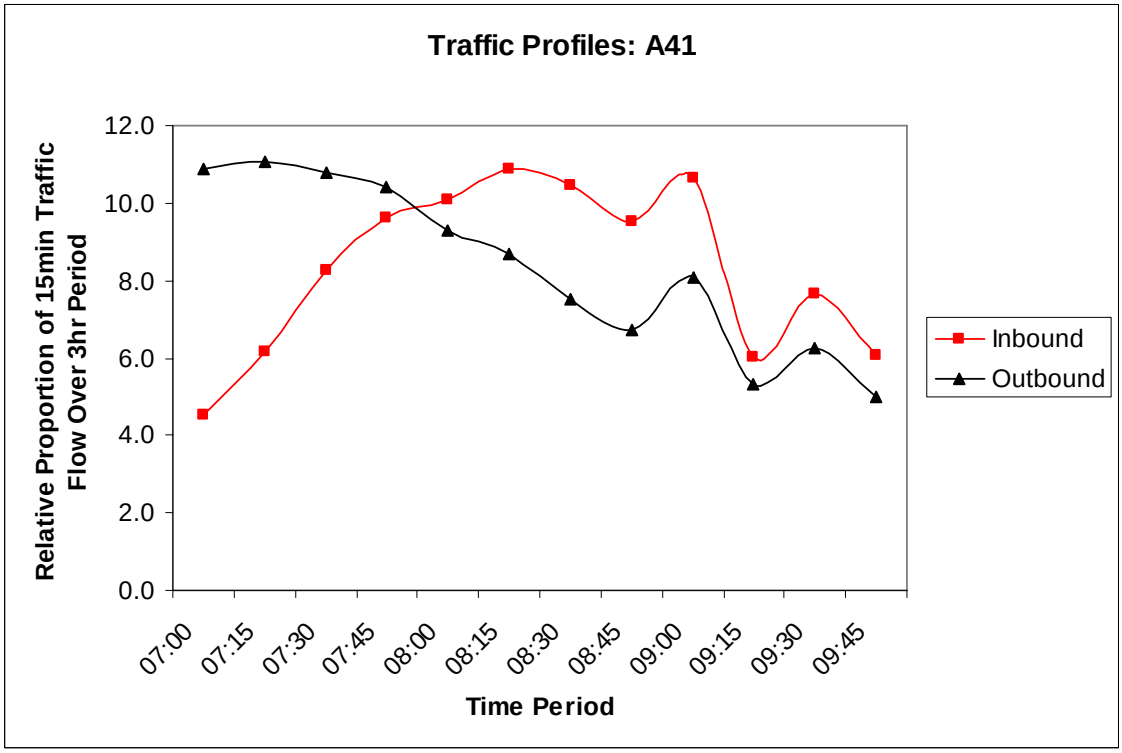


FIGURE 5.10 MORNING PERIOD TRAFFIC PROFILE: ZONES 13 AND 14

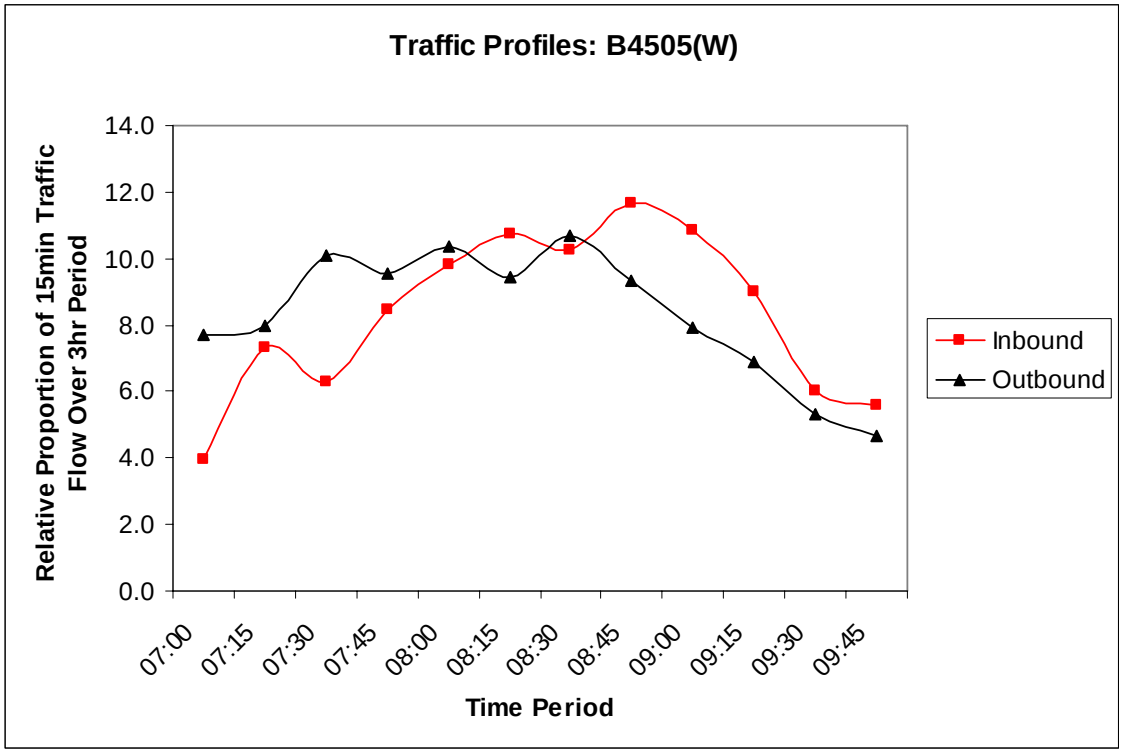


FIGURE 5.11 MORNING PERIOD TRAFFIC PROFILE: ZONE 15

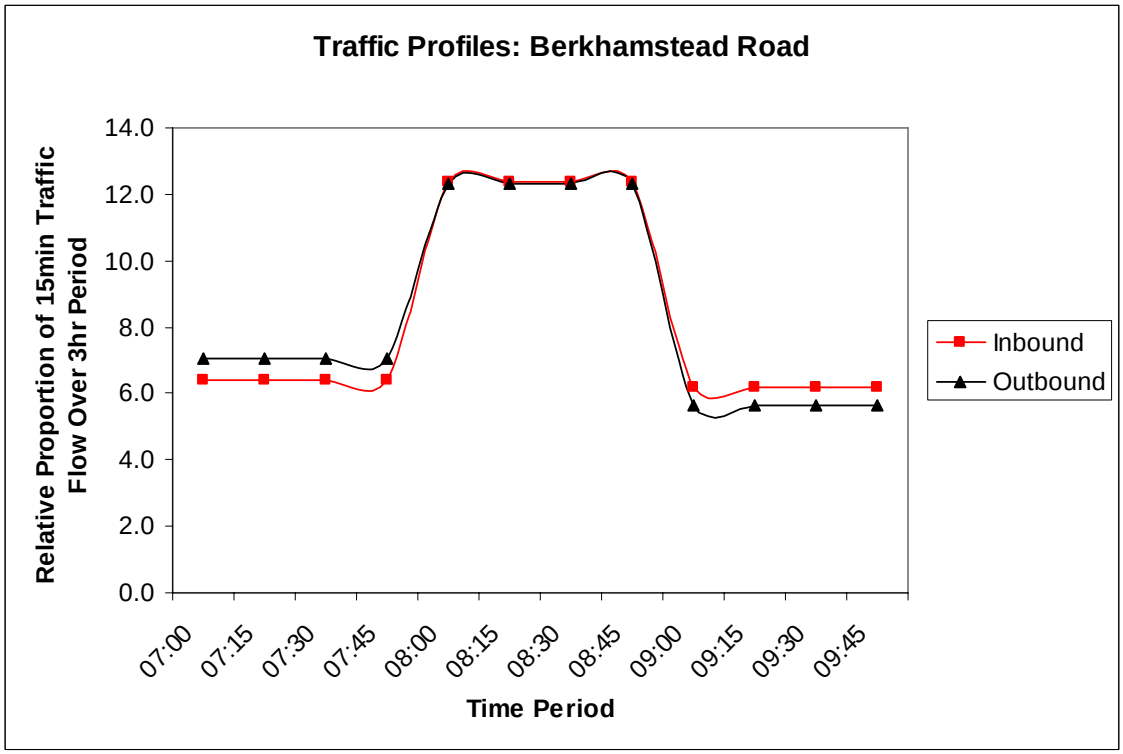
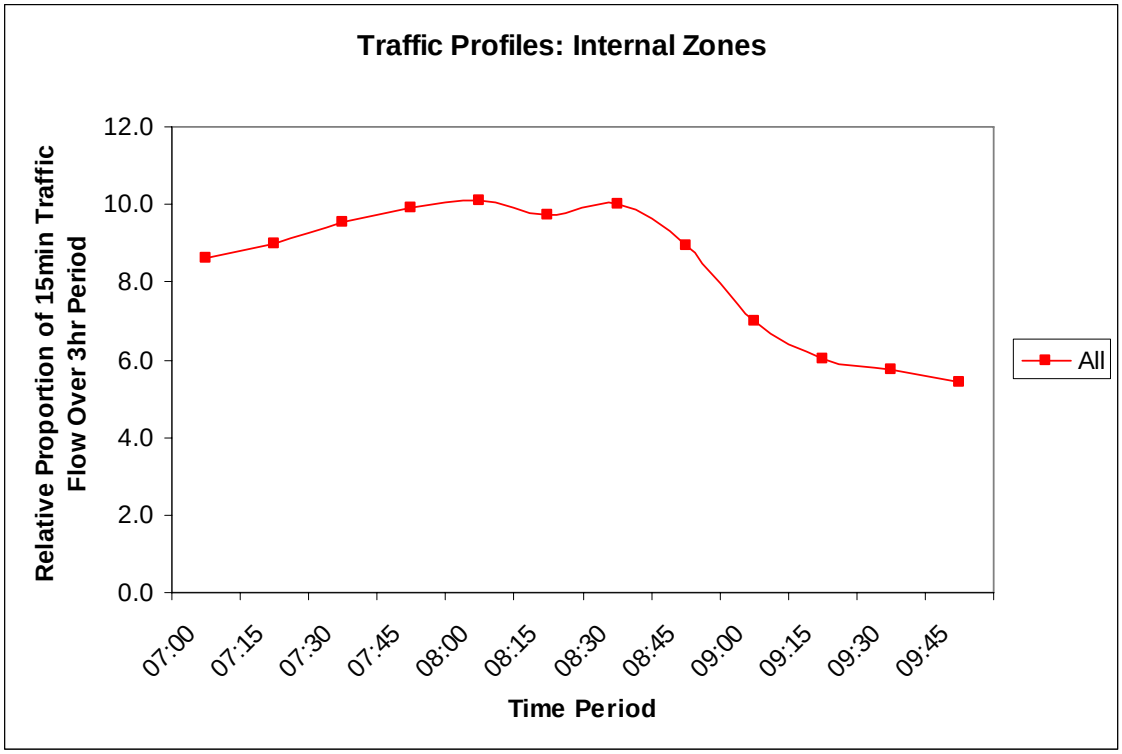


FIGURE 5.12 MORNING PERIOD TRAFFIC PROFILE: INTERNAL ZONES



Development of Evening Period Matrix

5.19 A transpose of the final validated morning period matrix was used as the basis for the evening period matrix, reflecting the tidal nature of journey-to-work trips between the morning and evening peaks.

5.20 Evening period external to external trips identified by the ANPR survey were over-written:

- ANPR External to External = 1474

5.21 The ratio of lights to heavy vehicles in the external counts was found to be 2.35%: this value was applied to the full matrix to produce a prior HGV matrix.

5.22 Where available, counts were used to factor zone totals. In particular, it was possible to constrain zone totals at most external zones, and well-defined internal zones (such as Jarman Park) to count totals.

5.23 The prior matrix was then further modified through a manual process of matrix estimation, taking into account land use types, turning data, and link counts across the study area resulting in a final PM matrix which has 58185 lights and 1368 heavies for a total of 59553 vehicles. The small increase in trips reflects changes in the balance of the unobserved trip types, such as retail, leisure and employers business, to the initial prior, which was formed by the transpose of the morning period matrix.

5.24 Origin and destination totals for the evening period matrix are in Table 5.2:

TABLE 5.2 ZONE TOTALS: EVENING PERIOD MATRIX

Zone	Os	Ds	Zone	Os	Ds	Zone	Os	Ds
1	1330	2511	22	756	1003	43	190	1558
2	408	454	23	1218	1421	44	333	1060
3	132	106	24	668	1065	45	1000	1507
4	2080	2218	25	362	698	46	274	289
5	309	140	26	640	219	47	1463	1535
6	5132	4342	27	677	132	48	1575	1132
7	1692	1227	28	108	586	49	2187	596
8	1577	981	29	638	552	50	394	988
9	1682	707	30	1165	677	51	745	562
10	1105	1014	31	1269	584	52	620	605
11	2798	3297	32	71	434	53	801	389
12	428	598	33	161	381	54	497	1498
13	608	384	34	498	696	55	559	395
14	2367	1044	35	104	491	56	1433	188
15	513	756	36	391	1108	57	2732	1408
16	1493	1582	37	637	922	58	1619	292
17	831	949	38	1103	1098	59	569	929
18	1508	1903	39	425	553	60	208	302
19	95	176	40	493	433	61	1050	1634
20	450	273	41	1858	2052	62	568	1037
21	325	1167	42	631	715			

5.25 Generally, for the internal zones, the zone totals show the reverse pattern to the morning period matrix. Residential zones tend to have more destinations than origins, and employment zones have significantly more origins than destinations.

Evening Period Profiles

5.26 Figures 5.13 – 5.24 illustrate the profiles used in the evening period model.

FIGURE 5.13 EVENING PERIOD TRAFFIC PROFILE: ZONE 1

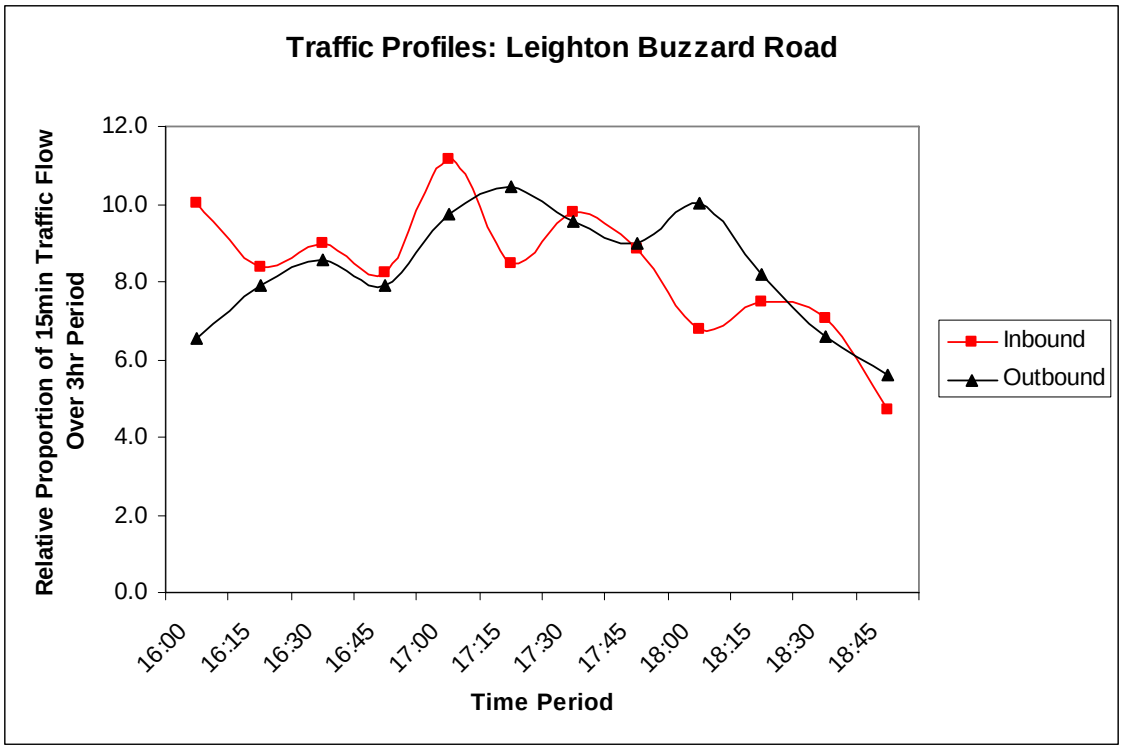


FIGURE 5.14 EVENING PERIOD TRAFFIC PROFILE: ZONE 2

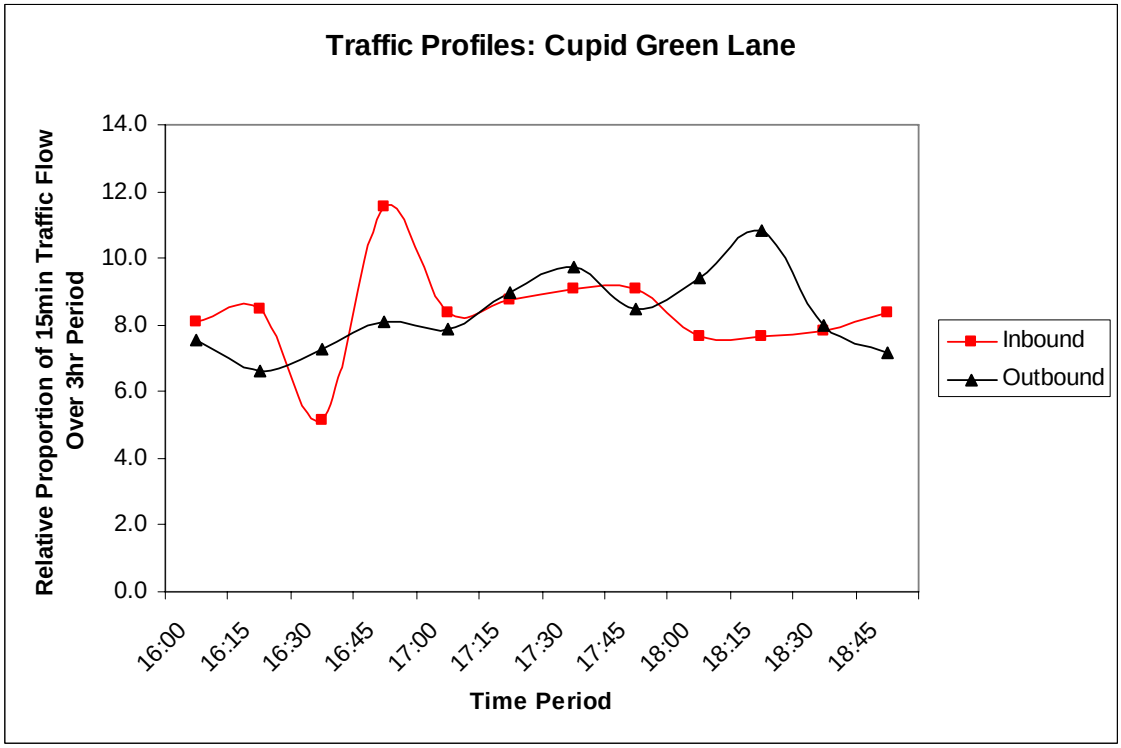


FIGURE 5.15 EVENING PERIOD TRAFFIC PROFILE: ZONES 3, 4 AND 5

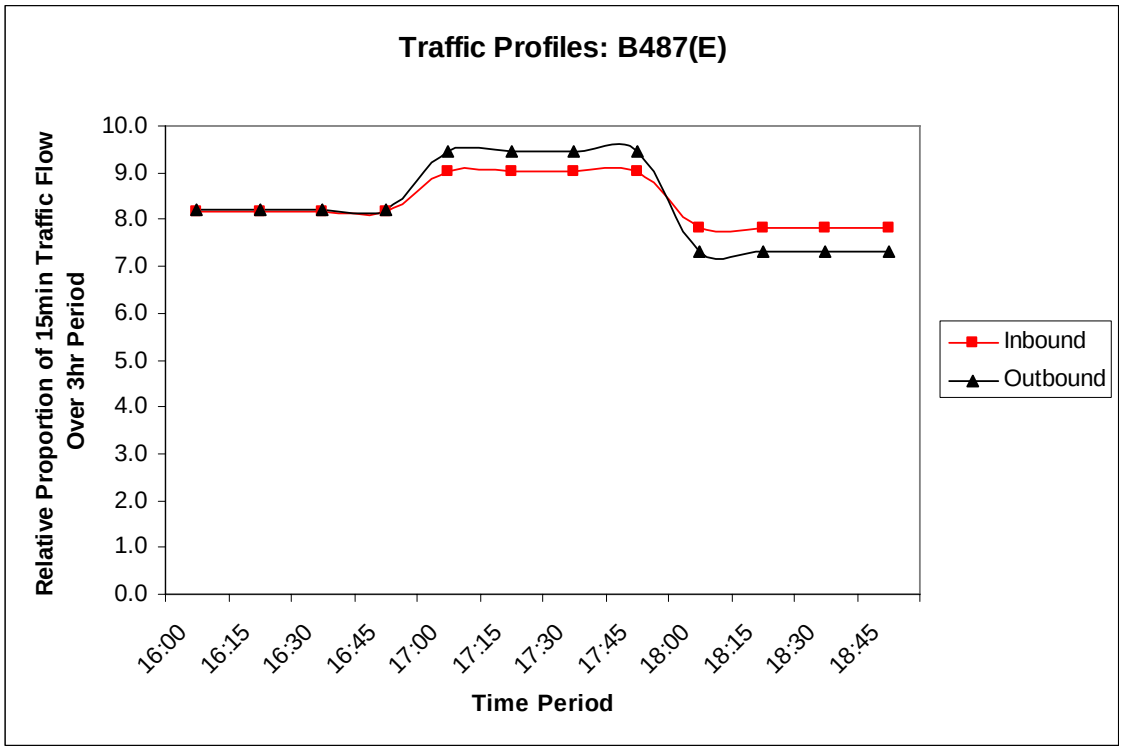


FIGURE 5.16 EVENING PERIOD TRAFFIC PROFILE: ZONE 6

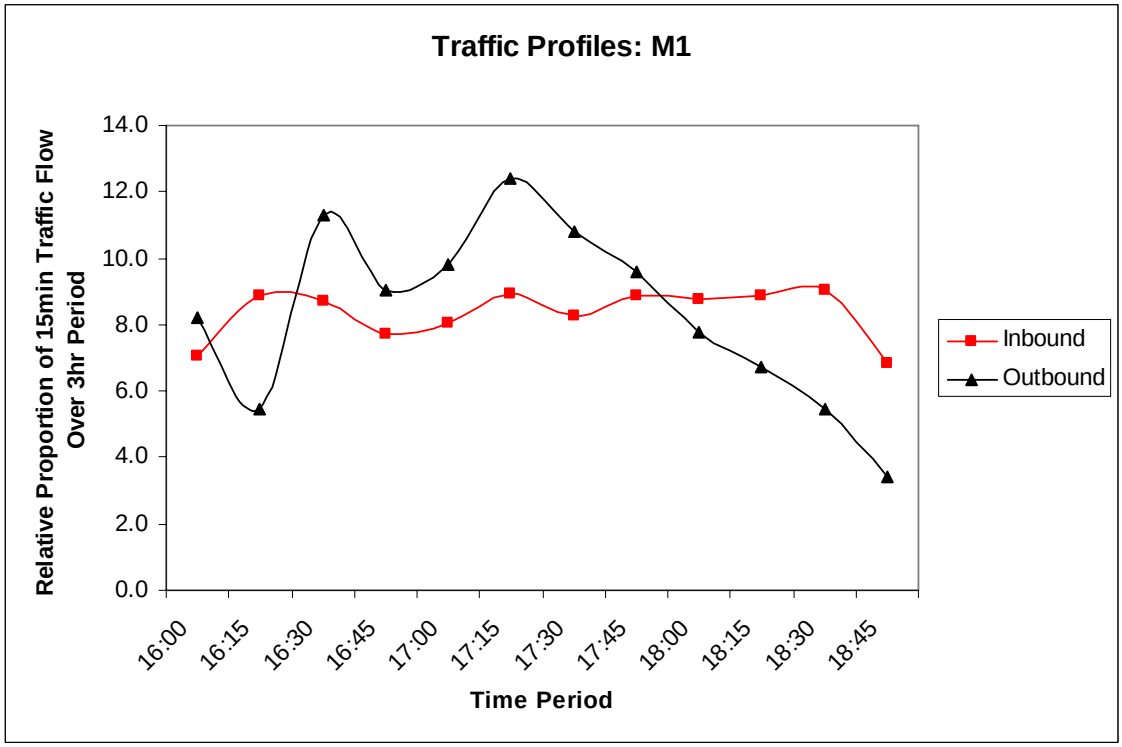


FIGURE 5.17 EVENING PERIOD TRAFFIC PROFILE: ZONE 7

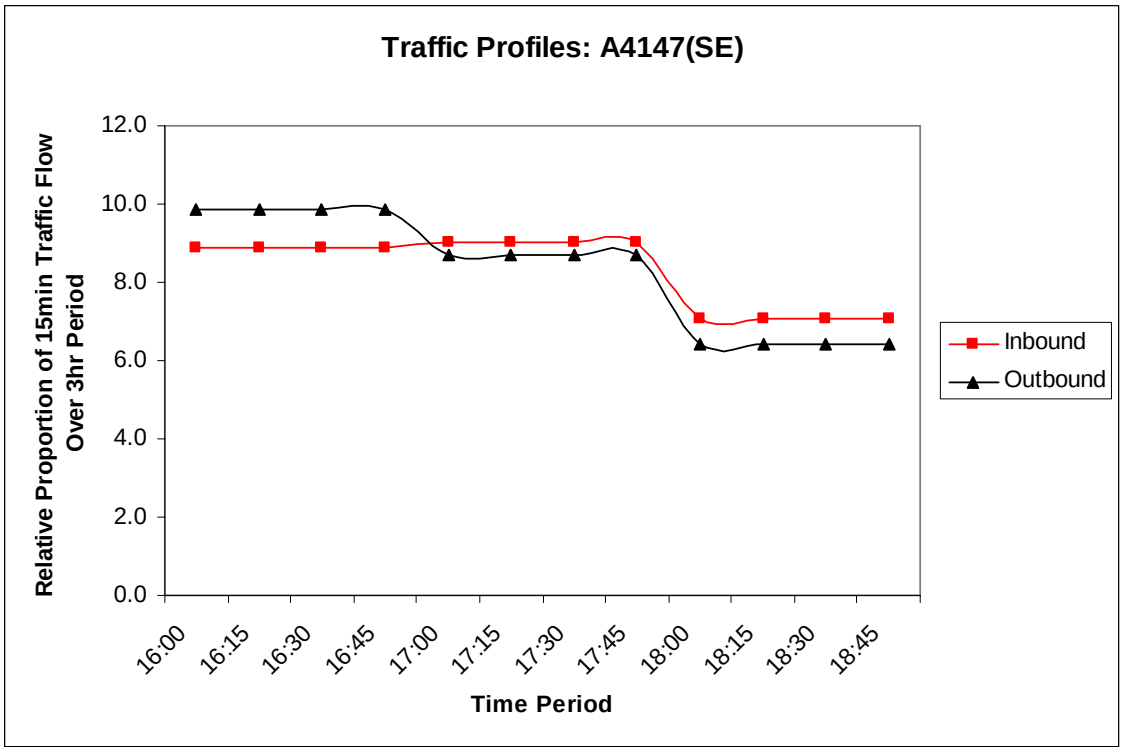


FIGURE 5.18 EVENING PERIOD TRAFFIC PROFILE: ZONE 8

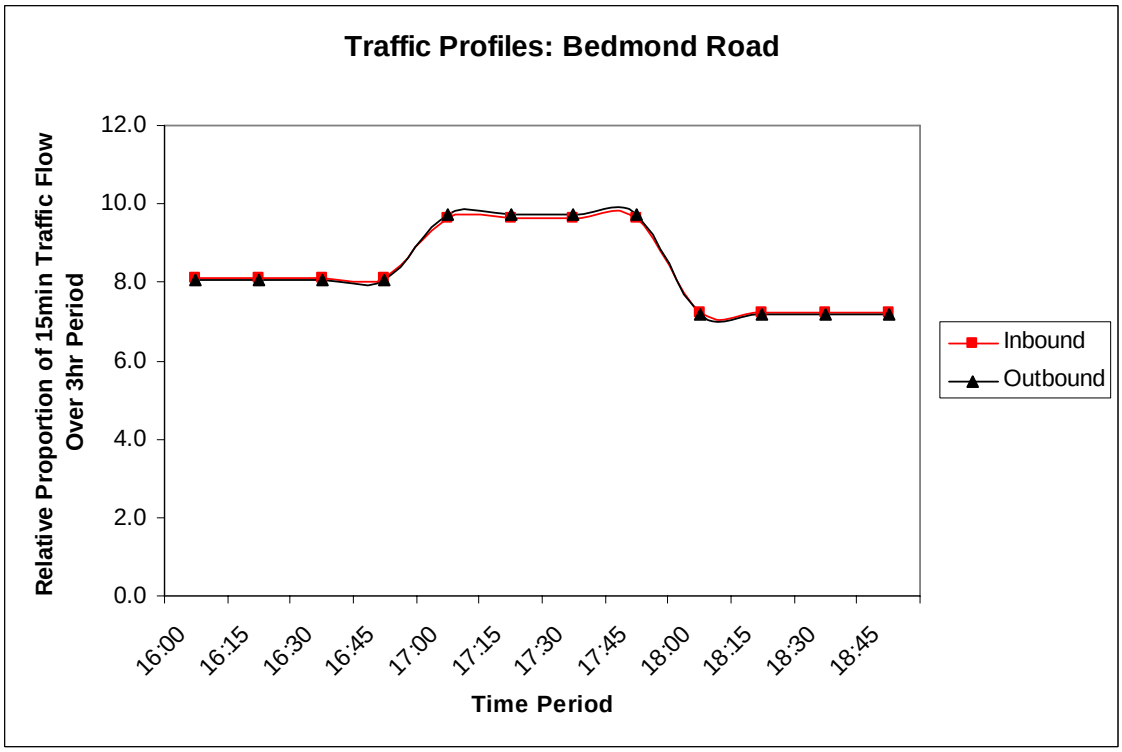


FIGURE 5.19 EVENING PERIOD TRAFFIC PROFILE: ZONE 9

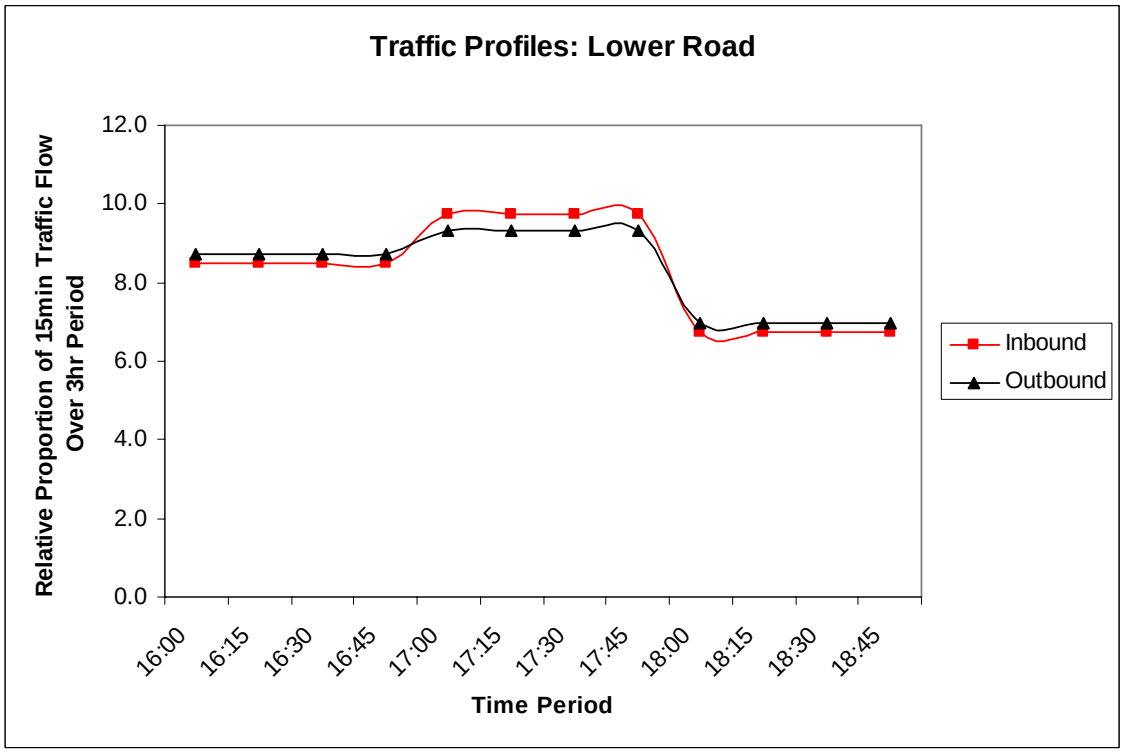


FIGURE 5.20 EVENING PERIOD TRAFFIC PROFILE: ZONE 10

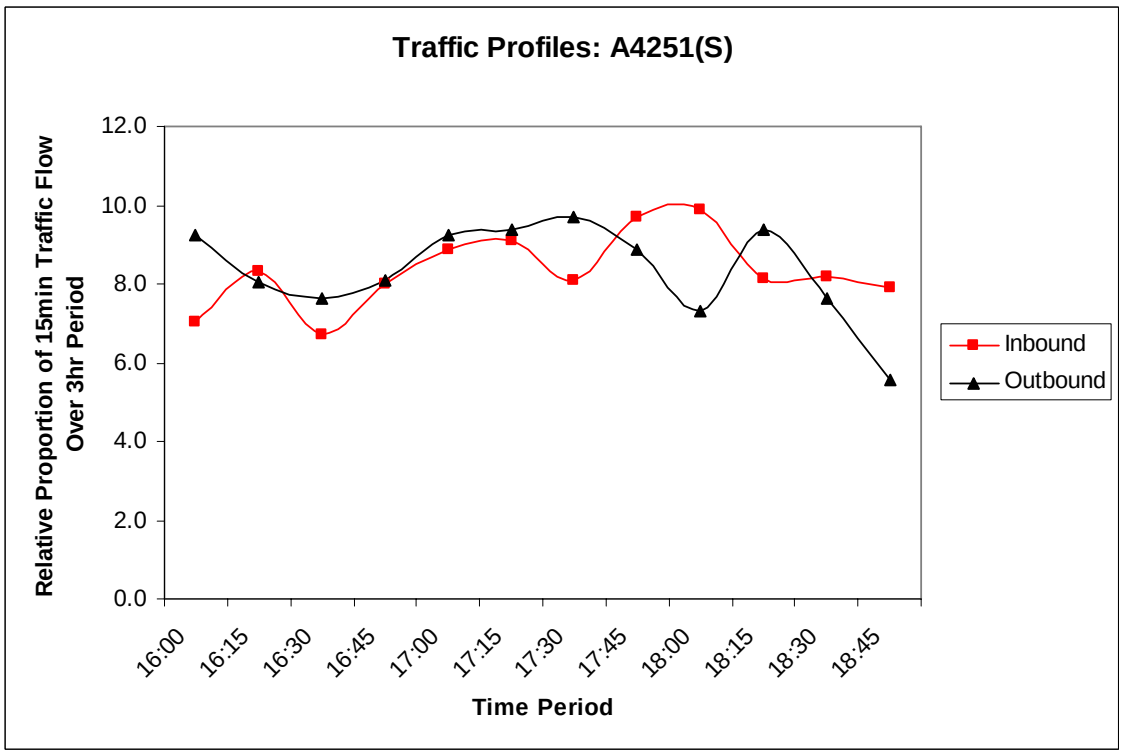


FIGURE 5.21 EVENING PERIOD TRAFFIC PROFILE: ZONES 11 AND 12

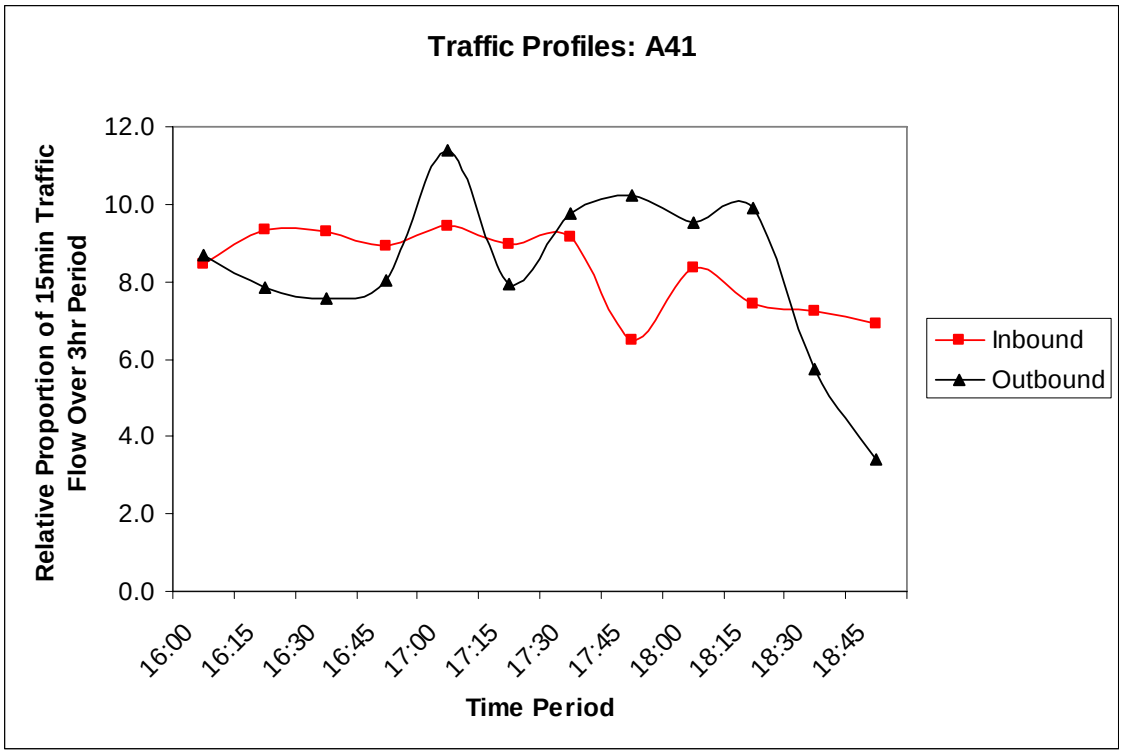


FIGURE 5.22 EVENING PERIOD TRAFFIC PROFILE: ZONES 13 AND 14

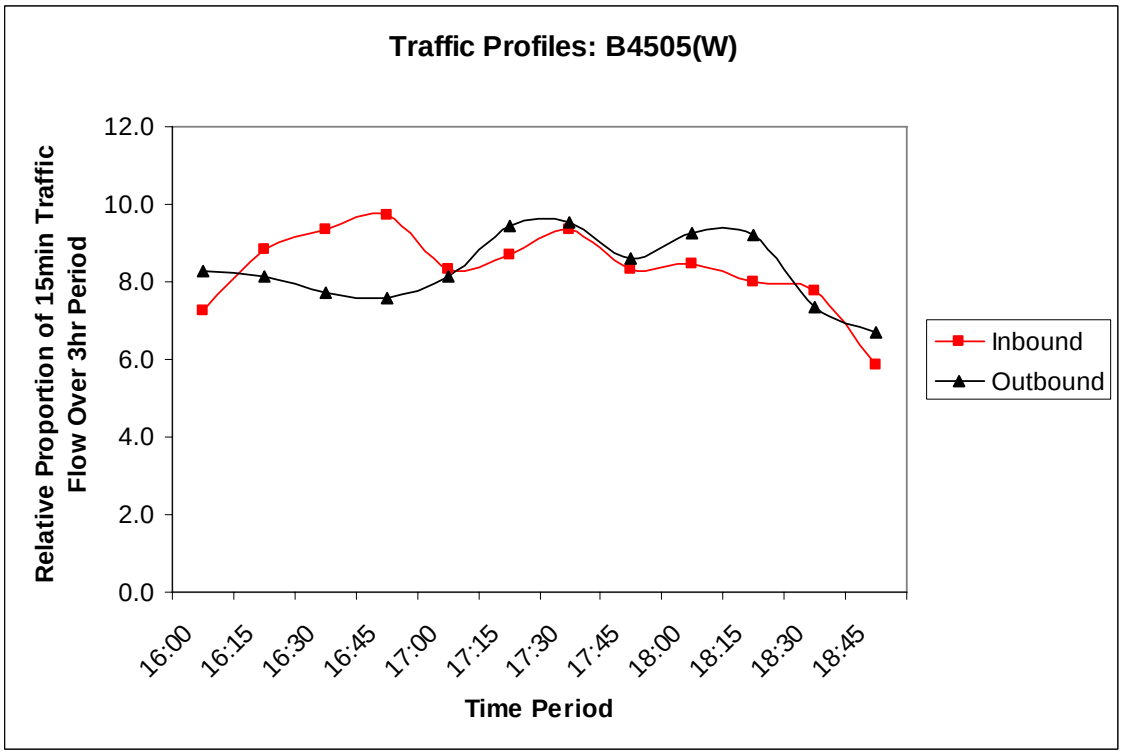


FIGURE 5.23 EVENING PERIOD TRAFFIC PROFILE: ZONE 15

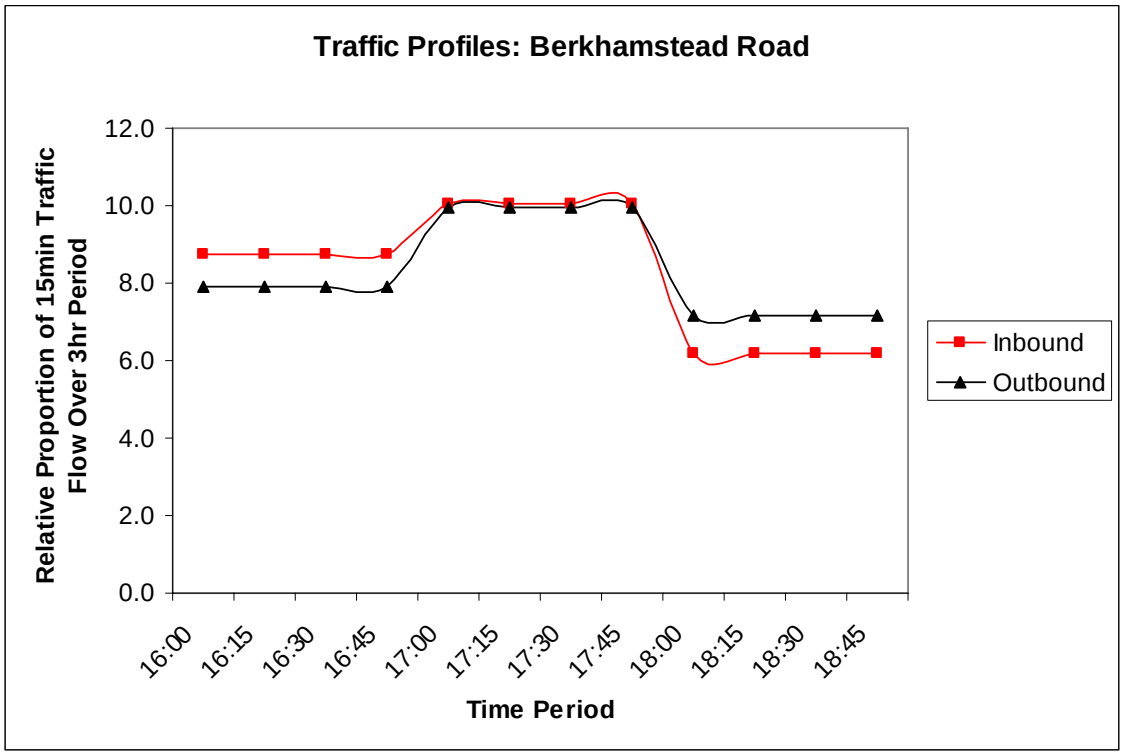
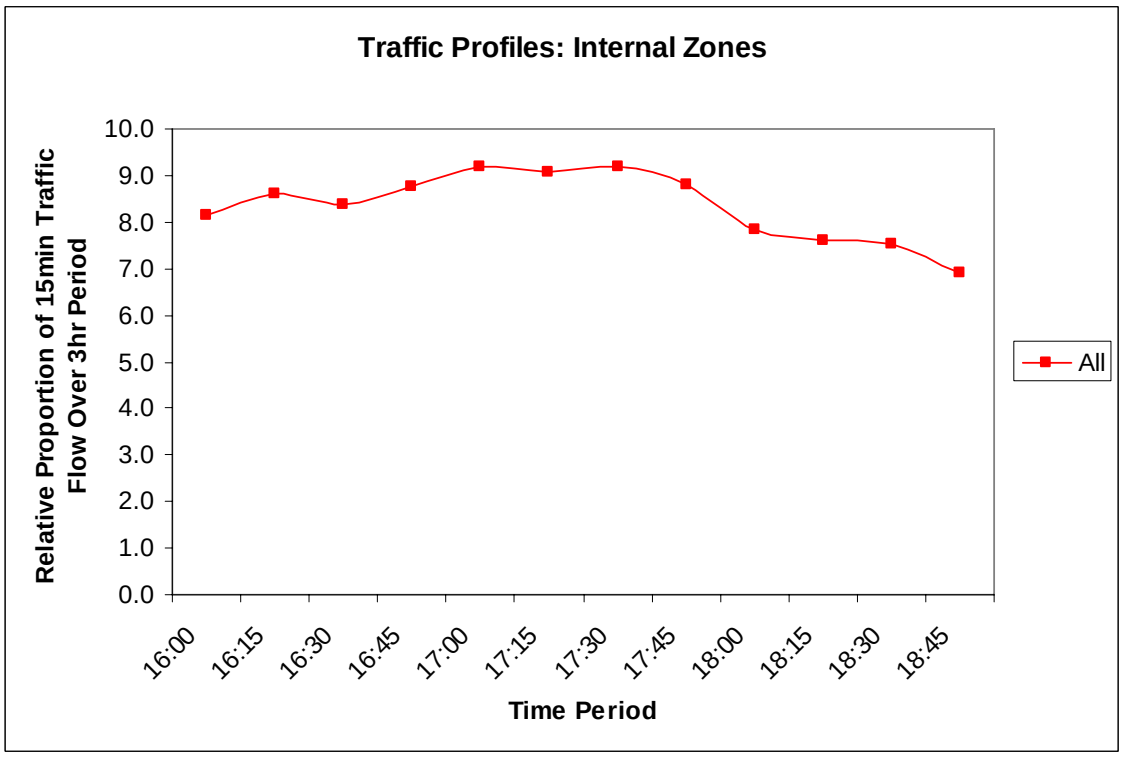


FIGURE 5.24 EVENING PERIOD TRAFFIC PROFILE: INTERNAL ZONES



Development of Saturday Period Matrix

5.27 50% of the morning period matrix and 50% of the evening period matrix were added to form the basis of the Saturday period prior matrix. Although this approach is relatively imprecise, it was considered to maximise the representation of likely Saturday trip patterns, for which no other information was available.

5.28 Saturday period external to external trips identified by the ANPR survey were over-written:

- ANPR External to External = 1757

5.29 The ratio of lights to heavy vehicles in the external counts was found to be 1.87%: this value was applied to the full matrix to produce a prior HGV matrix.

5.30 Where available, counts were used to factor zone totals. In particular, it was possible to constrain zone totals at most external zones, and well-defined internal zones (such as Jarman Park) to count totals.

5.31 The prior matrix was then further modified through a manual process of matrix estimation, taking into account land use types, turning data, and link counts across the study area resulting in a final Saturday matrix which has 53929 lights and 1008 heavies for a total of 54937 vehicles.

5.32 Origin and destination totals for the Saturday period matrix are in Table 5.3:

TABLE 5.3 ZONE TOTALS: SATURDAY PERIOD MATRIX

Zone	Os	Ds	Zone	Os	Ds	Zone	Os	Ds
1	1783	2021	22	774	571	43	712	668
2	330	370	23	1147	1169	44	738	735
3	117	97	24	788	705	45	888	883
4	1518	1433	25	545	424	46	270	276
5	278	252	26	518	362	47	1460	1044
6	3239	3897	27	408	251	48	1156	1065
7	1275	1173	28	212	389	49	1438	1130
8	882	828	29	552	551	50	458	639
9	999	1078	30	941	1633	51	680	555
10	1083	1152	31	1050	1326	52	606	668
11	3060	3087	32	114	361	53	551	292
12	348	508	33	237	288	54	1453	1091
13	491	442	34	731	683	55	494	436
14	2050	1720	35	338	334	56	900	849
15	382	772	36	532	744	57	1391	1398
16	1566	1444	37	883	611	58	823	603
17	505	883	38	1042	938	59	690	622
18	1599	1826	39	561	457	60	259	332

19	182	136	40	505	411	61	1225	1156
20	335	303	41	2782	2850	62	679	805
21	538	488	42	846	722			

5.33 Generally, for the internal zones, there is a balance between origins and destinations, as might be expected during a Saturday period.

Saturday Period Profiles

5.34 Figures 5.25 – 5.36 illustrate the profiles used in the Saturday period model.

FIGURE 5.25 SATURDAY PERIOD TRAFFIC PROFILE: ZONE 1

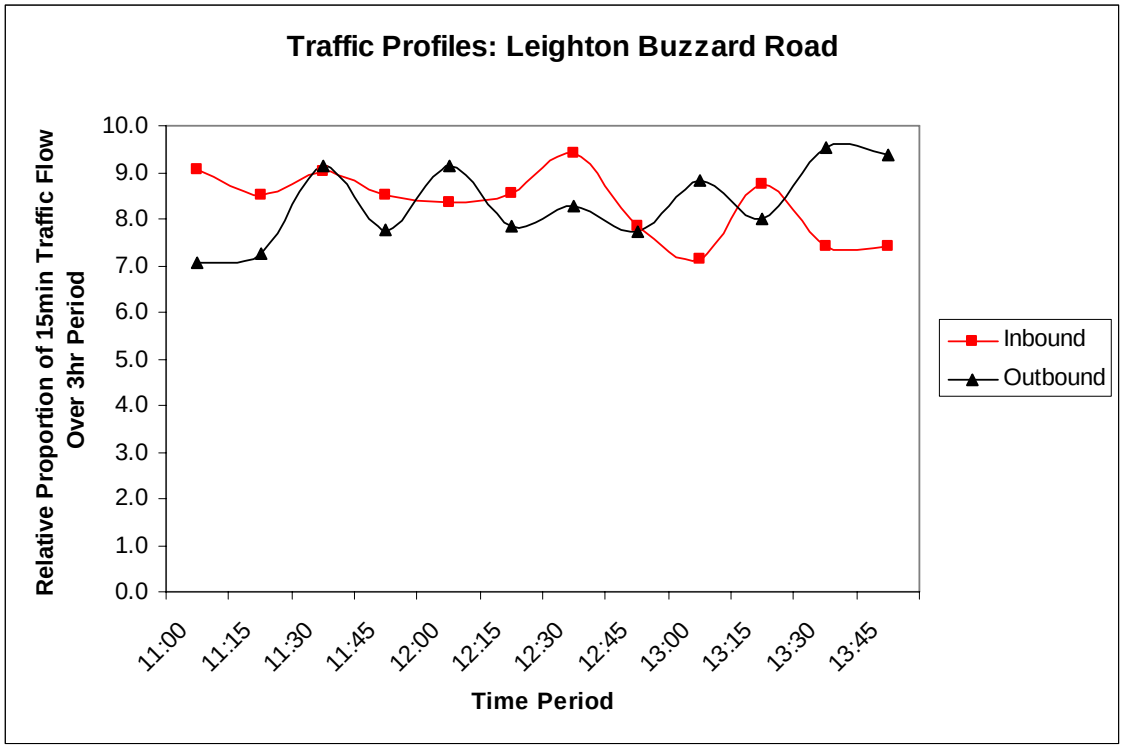


FIGURE 5.26 SATURDAY PERIOD TRAFFIC PROFILE: ZONE 2

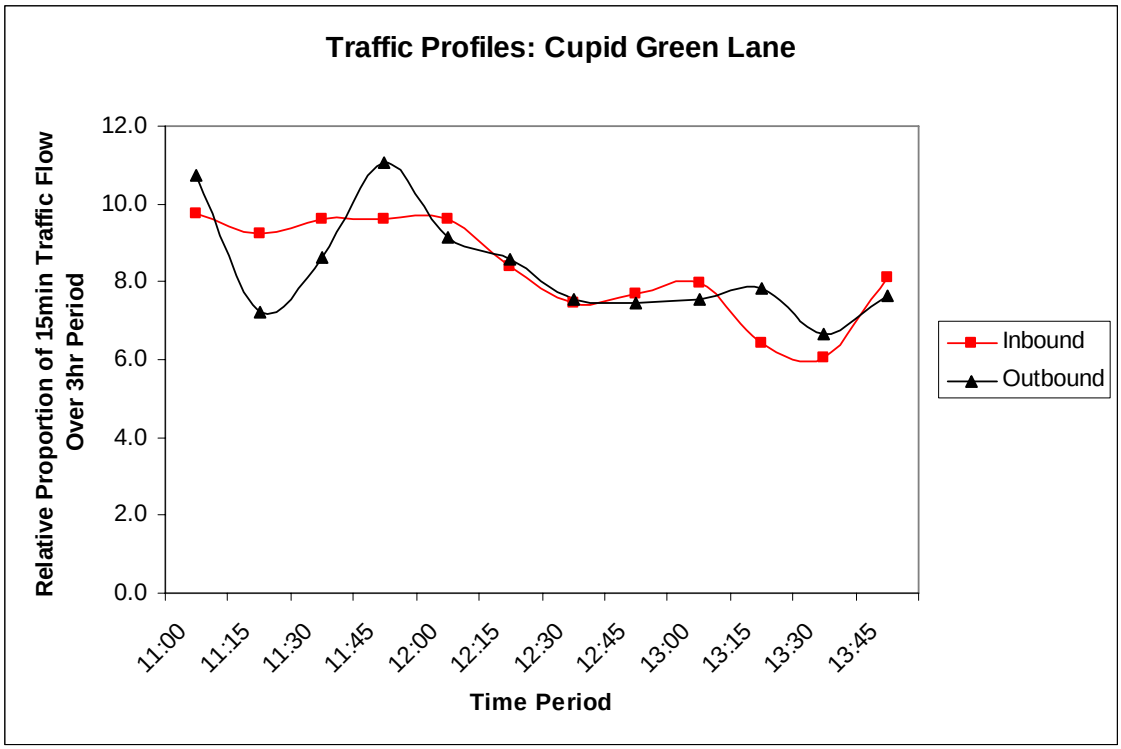


FIGURE 5.27 SATURDAY PERIOD TRAFFIC PROFILE: ZONES 3, 4 AND 5

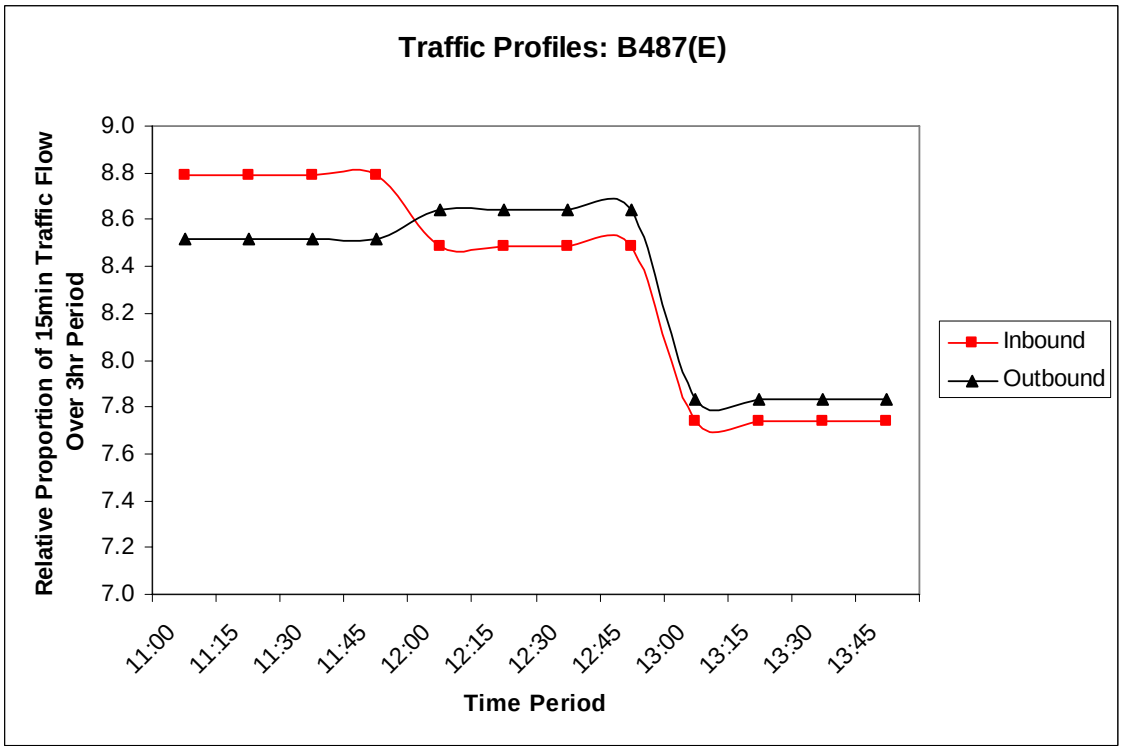


FIGURE 5.28 SATURDAY PERIOD TRAFFIC PROFILE: ZONE 6

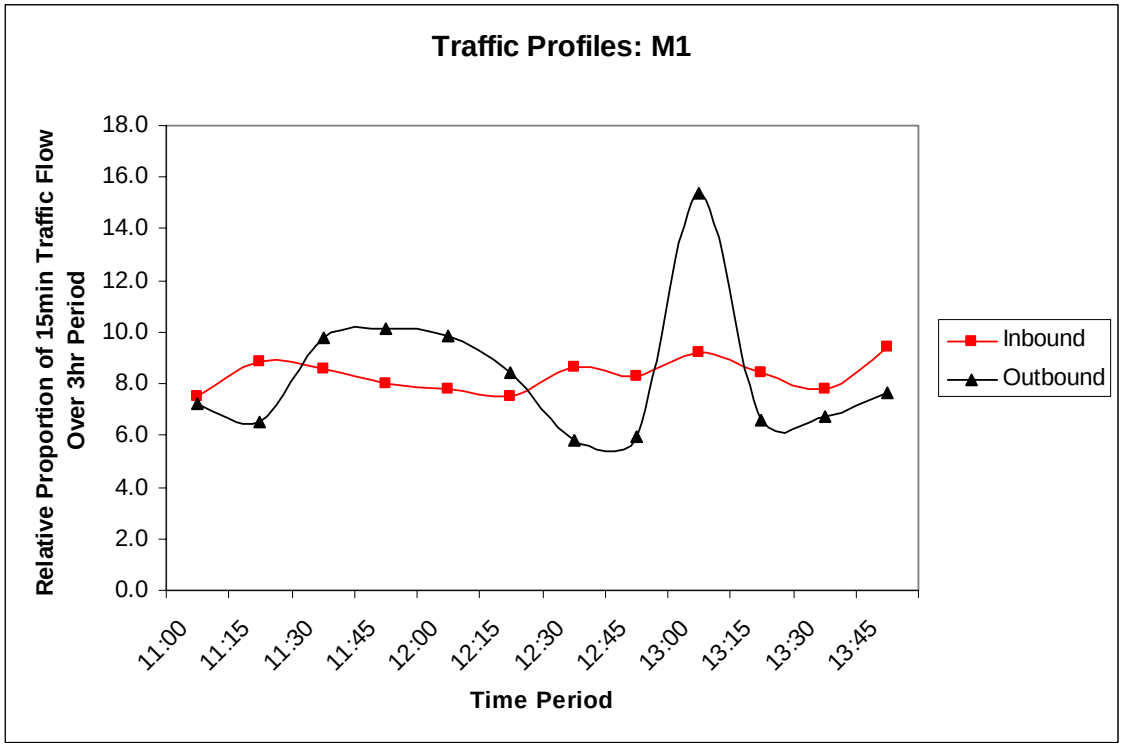


FIGURE 5.29 SATURDAY PERIOD TRAFFIC PROFILE: ZONE 7

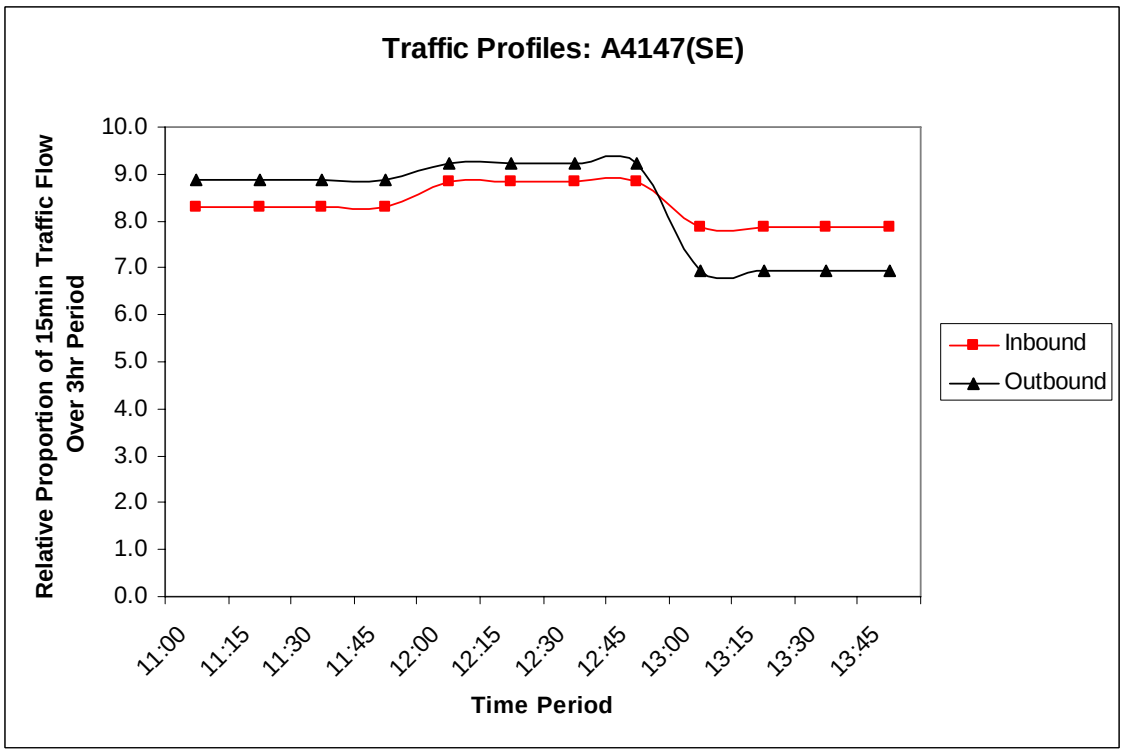


FIGURE 5.30 SATURDAY PERIOD TRAFFIC PROFILE: ZONE 8

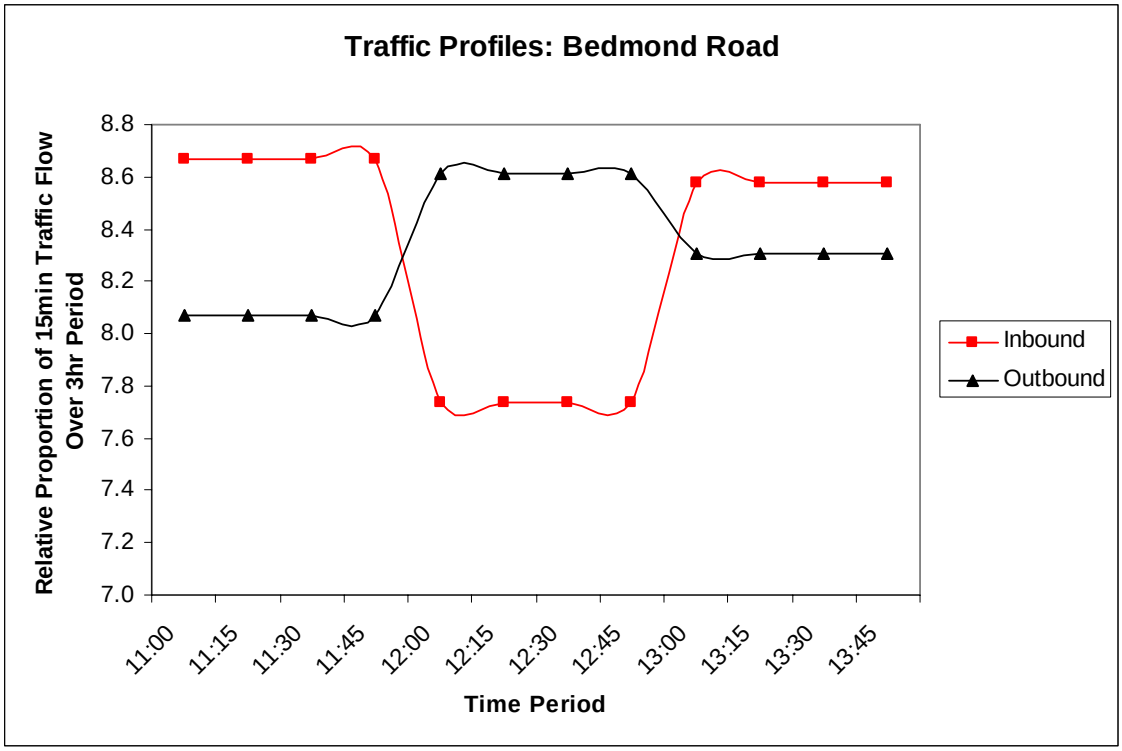


FIGURE 5.31 SATURDAY PERIOD TRAFFIC PROFILE: ZONE 9

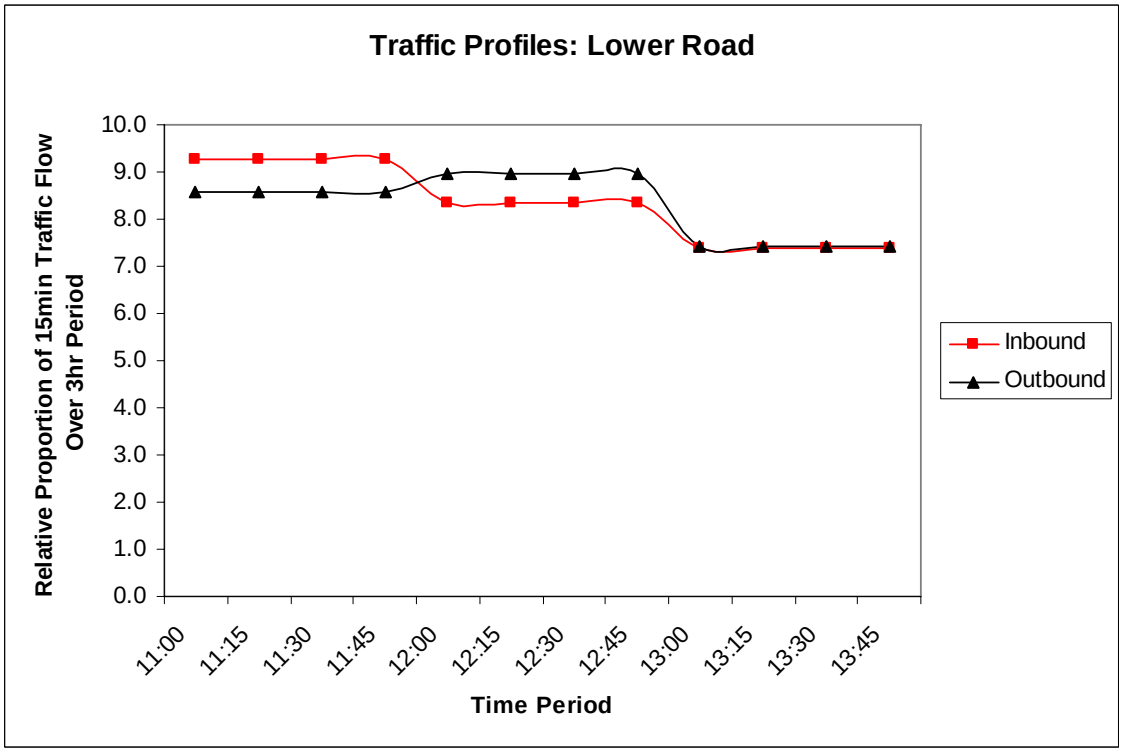


FIGURE 5.32 SATURDAY PERIOD TRAFFIC PROFILE: ZONE 10

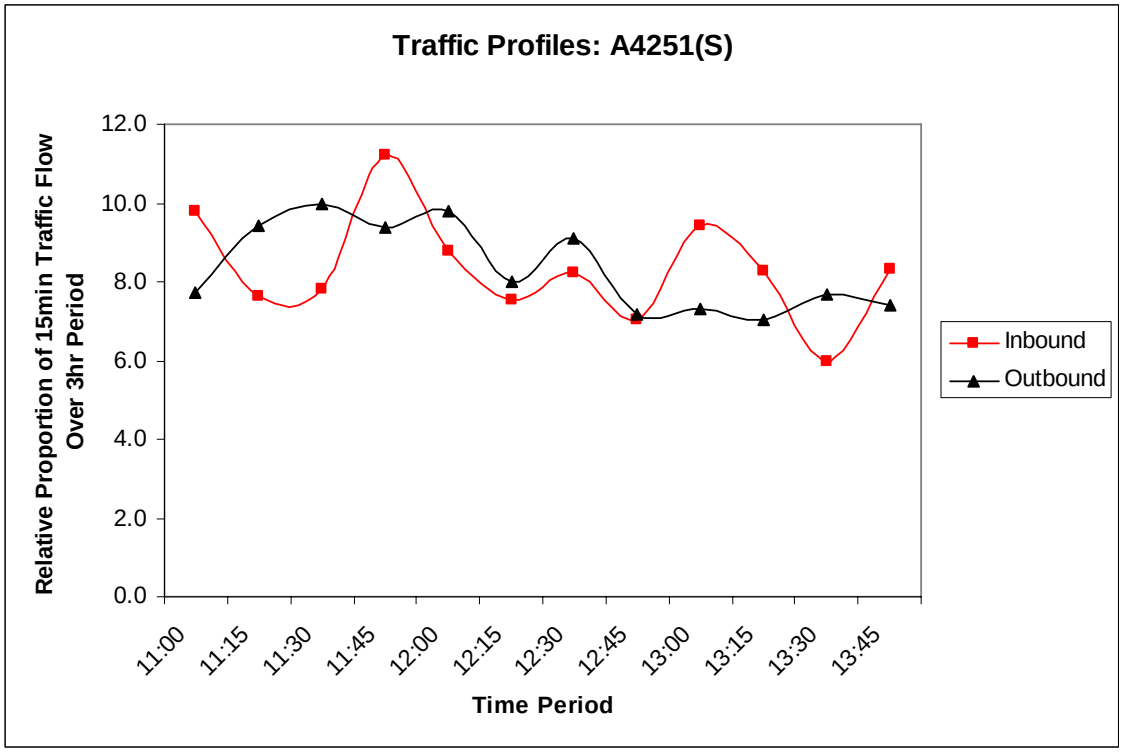


FIGURE 5.33 SATURDAY PERIOD TRAFFIC PROFILE: ZONES 11 AND 12

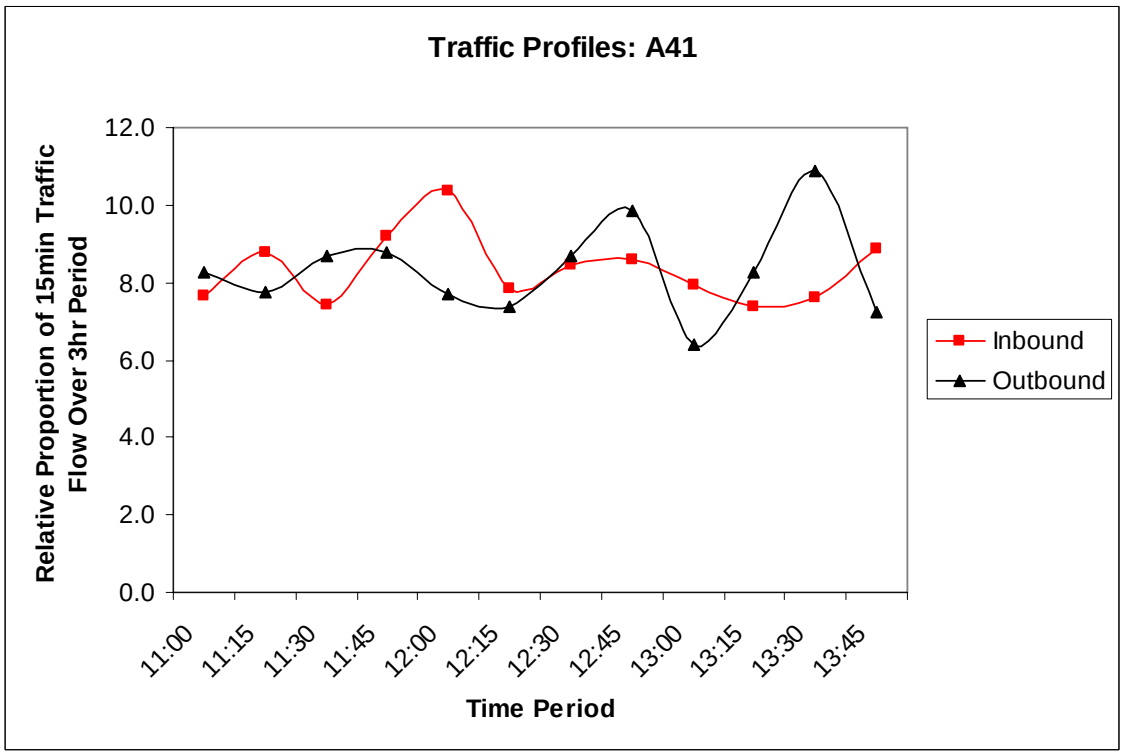


FIGURE 5.34 SATURDAY PERIOD TRAFFIC PROFILE: ZONES 13 AND 14

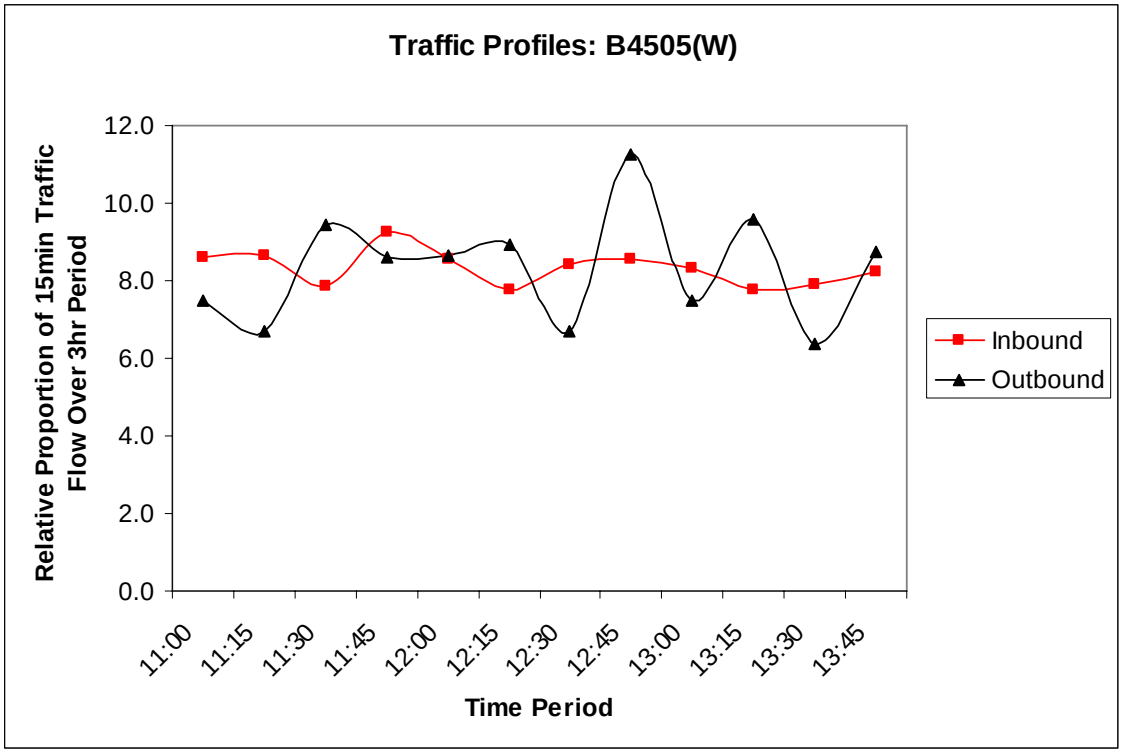


FIGURE 5.35 SATURDAY PERIOD TRAFFIC PROFILE: ZONE 15

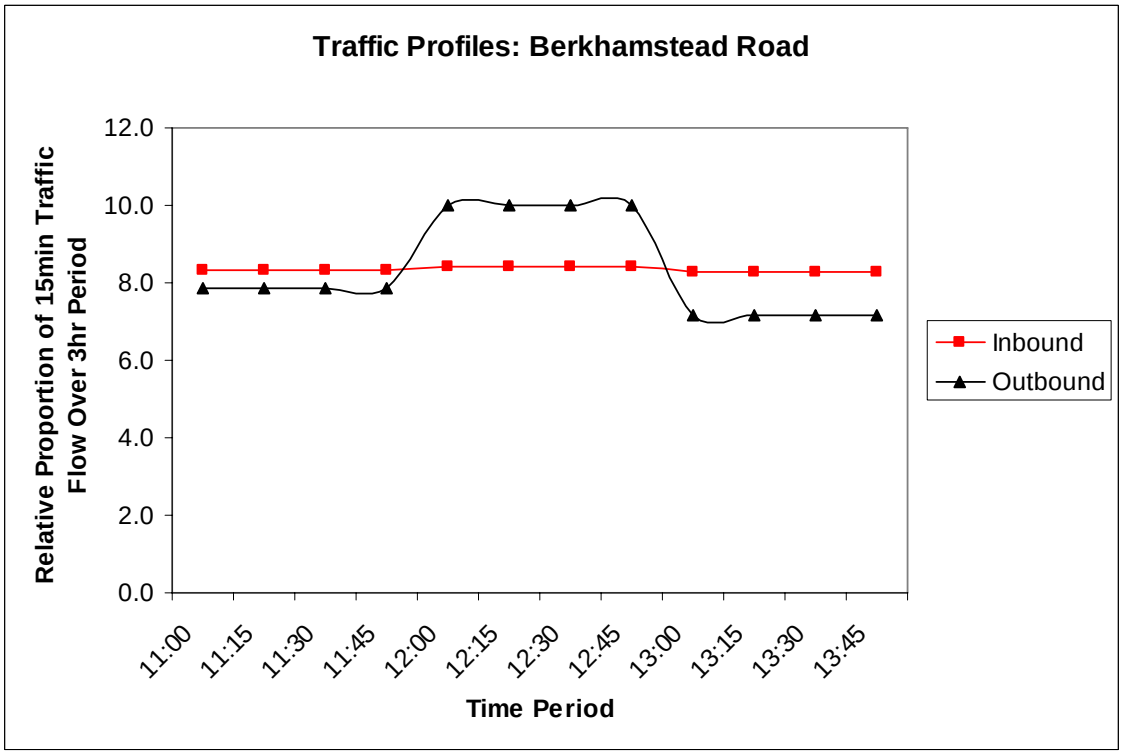
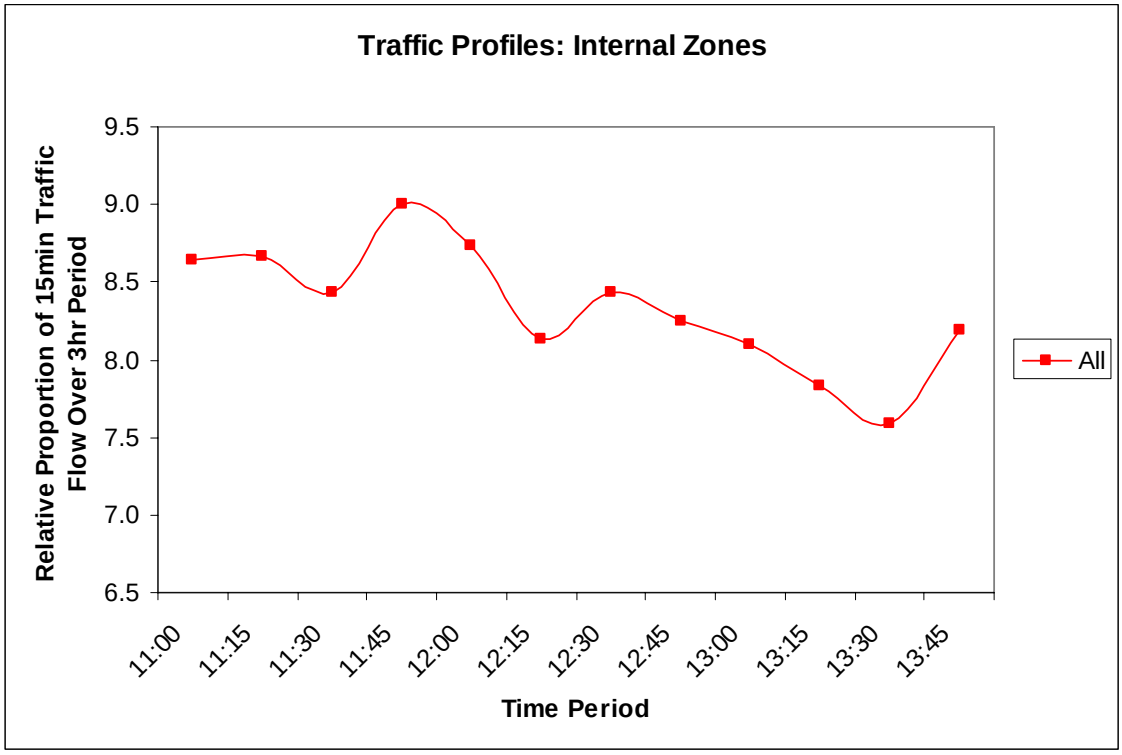


FIGURE 5.36 SATURDAY PERIOD TRAFFIC PROFILE: INTERNAL ZONES



6. MODEL CALIBRATION

Introduction

6.1 Model calibration was undertaken in two stages:

- Individual junction calibration;
- Network and demand calibration.

6.2 Recognising that in strategic models it is usually extremely difficult to calibrate to the kind of detailed data used in smaller scale micro-simulation models, the two stage approach was used.

6.3 In this approach, junctions for which high quality turning count data was available, were calibrated individually using the Junction Scoping capability of PARAMICS. This ensured that the operation of each junction was sufficient to replicate the observed flow, capacity and traffic behaviour.

6.4 After the isolated calibration of each junction, a more traditional network and demand calibration was conducted as reported in the matrix and network construction sections.

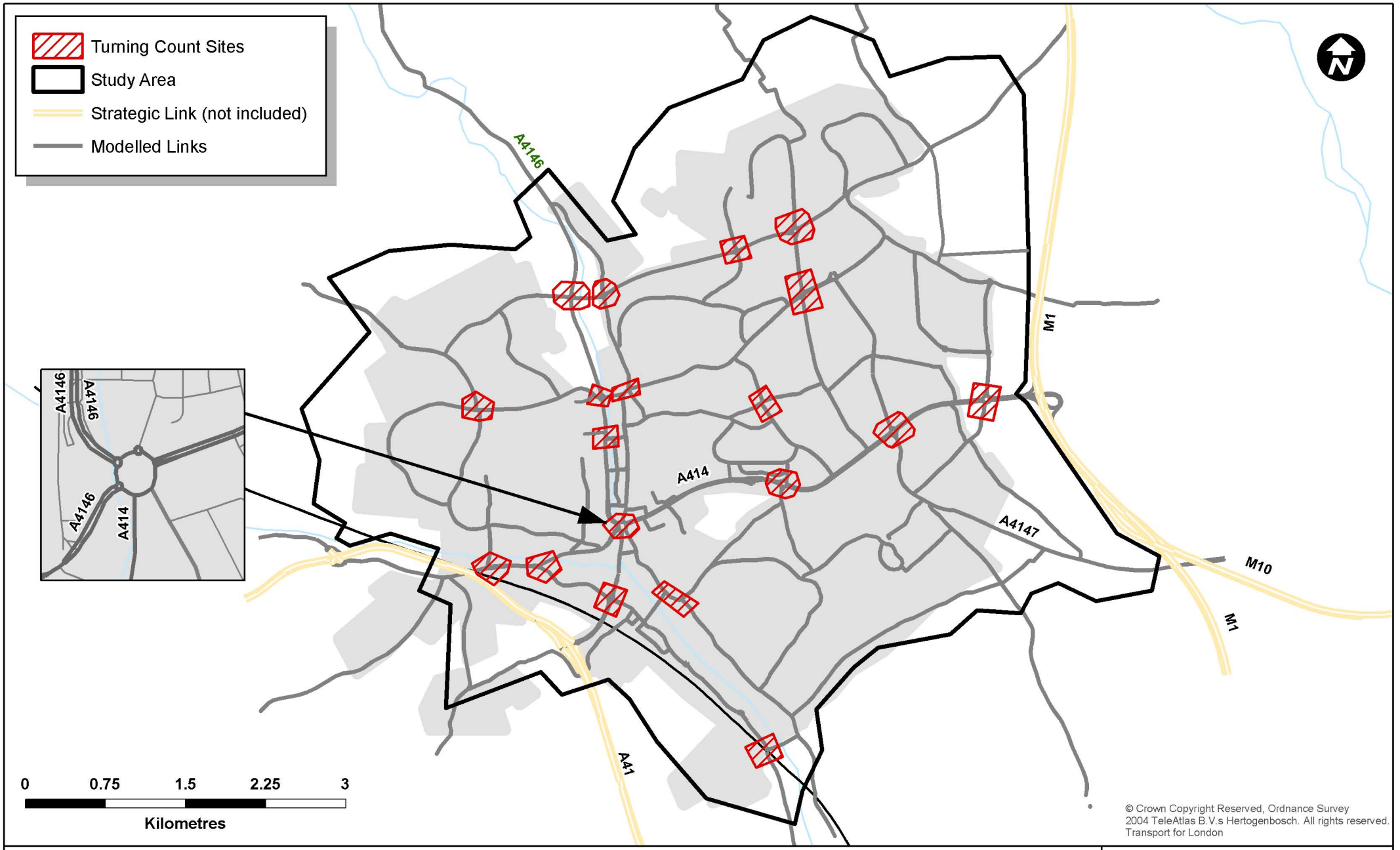
Individual Junction Calibration

6.5 High quality turning data from 2008 was collected by Hertsfordshire Highways for 20 key junctions summarised in Table 6.1 and illustrated in Figure 6.1.

TABLE 6.1 KEY JUNCTIONS

Junction Name	PARAMICS Annotation Code
Leighton Buzzard Road / Coombe Street	R1
St Albans Road / Jarman Way	R2
St Albans Road / Bennetts End Road	R3
Breakspear Way / Maylands Avenue	R4
Breakspear Way / Green Lane	R5
Queensway / High Street Green / Redbourn Road	R7
Redbourn Road / St Agnells Lane	R8
Aycliffe Drive / Cambrian Way	R9
Picotts End / A4147	R10
Leighton Buzzard Road / Galley Hill	R11
Leighton Buzzard Road / Queensway	R12
Queensway / Marlowes	R13
London Road / Fishery Road	R18
London Road / Station Road	R19
Adeyfield Road / Great Road / Longlands	P20P21
Long Chaulden / Boxted Road / Northridge Way	P36P37
Lawn Lane / St Albans Hill / Belswains Green	P51

The Plough	P88 – P93
Two Waters Way / London Road	S4
Lawn Lane / Deaconsfield Road	S7
Hempstead Road / Rucklers Lane	S10



Hemel Hempstead Urban Transport Model

Figure 6.1: Individually Calibrated Junctions

steer davies gleave

Drawn by:	Last Updated:	Revision:
EJB	09/01/2009	0

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Leighton Buzzard Road / Coombe Street (R1)

6.6 A three-arm roundabout with two entry lanes on each approach (shown in Figure 6.2).

FIGURE 6.2 LEIGHTON BUZZARD ROAD / COOMBE STREET (R1)

6.7 This junction was modelled using standard PARAMICS techniques:

- All approach links modelled as 30mph.
- 2 lanes used on Coombe Street exit to smooth exit movements. In reality, exit lane is large but not formally marked as 2 lanes.
- 20m visibility set on each entry link.
- Minor modifications to stopline and kerb positions were made during calibration to better replicate observed vehicle movements.

6.8 Table 6.2 details the calibration of observed against modelled turning flows for the evening time period which was the busiest.

TABLE 6.2 JUNCTION CALIBRATION: LEIGHTON BUZZARD ROAD / COOMBE STREET (R1)

From	To	Observed	Modelled	Diff.	GEH
LB Rd (n)	Coombe St	401	399	-2	0.11
LB Rd (n)	LB Rd (s)	2024	2017	-7	0.16

Coombe St	LB Rd (s)	918	918	0	0.00
Coombe St	LB Rd (n)	713	712	-1	0.04
LB Rd (s)	LB Rd (n)	2277	2266	-11	0.23
LB Rd (s)	Coombe St	674	674	0	0.00

6.9 Modelled turning flows replicate observed flows well, and show that the model is capable of reproducing the junction's normal peak operating capacities.

6.10 Visual operation of the modelled junction is similar to observations made by the modelling team.

6.11 Some turning movements are 'jerky' due to the small radius of the roundabout which requires the use of very short model links. This is unavoidable.

St Albans Road / Jarman Way (R2)

6.12 A three-arm roundabout with two/three entry lanes on each approach and a free flow lane from St Albans Road (w) to St Albans Road (e). Jarman Way is the main access route to a major retail and leisure development.

6.13 This junction was modelled using standard PARAMICS techniques:

- Approach and exit links on St Albans Road modelled as 40mph.
- Approach and exit links to Jarman Park modelled as 30mph.
- Lane usage coded as on ground.
- Sections of the circulatory carriageway were coded as 3 lanes, and then the extra lane was banned. This technique is used frequently at roundabouts when the number of entry, exit and circulatory lanes differs, to improve lane usage behaviour.
- 20m visibility set on each entry link.
- Minor modifications to stopline and kerb positions were made during calibration to better replicate observed vehicle movements.

6.14 Table 6.3 details the calibration of observed against modelled turning flows for the evening time period which was the busies.

TABLE 6.3 JUNCTION CALIBRATION: ST ALBANS ROAD / JARMAN WAY (R2)

From	To	Observed	Modelled	Diff.	GEH
St Albans Rd (w)	St Albans Rd (e)	2721	2715	-6	0.12
St Albans Rd (w)	Jarman Way	713	709	-4	0.15
St Albans Rd (e)	Jarman Way	1297	1299	2	0.06
St Albans Rd (e)	St Albans Rd (w)	3189	3181	-8	0.14
Jarman Way	St Albans Rd (w)	709	710	1	0.04
Jarman Way	St Albans Rd (e)	1226	1222	-4	0.11

6.15 Modelled turning flows replicate observed flows well, and show that the model is capable of reproducing the junction's normal peak operating capacities.

6.16 Visual operation of the modelled junction is similar to observations made by the

modelling team.

St Albans Road / Bennetts End (R3)

6.17 A large four-arm roundabout with two/three entry lanes on each approach.

6.18 This junction was modelled using standard PARAMICS techniques:

- Approach and exit links on St Albans Road modelled as 25-35mph because of link curvature and lane gains.
- Approach and exit links to Bennetts End and White Hart Road modelled as 30mph.
- Lane usage coded as on ground.
- Sections of the circulatory carriageway were coded as 3 lanes, and then the extra lane was banned. This technique is used frequently at roundabouts when the number of entry, exit and circulatory lanes differs, to improve lane usage behaviour.
- 20m visibility set on each entry link.
- Minor modifications to stopline and kerb positions were made during calibration to better replicate observed vehicle movements.

6.19 Table 6.4 details the calibration of observed against modelled turning flows for the evening time period which was the busiest.

TABLE 6.4 JUNCTION CALIBRATION: ST ALBANS ROAD / BENNETTS END (R3)

From	To	Observed	Modelled	Diff.	GEH
White Hart Road	St Albans Rd (e)	93	93	0	0.00
White Hart Road	Bennetts End Road	506	506	0	0.00
White Hart Road	St Albans Rd (w)	956	956	0	0.00
St Albans Rd (e)	Bennetts End Road	962	954	-8	0.26
St Albans Rd (e)	St Albans Rd (w)	2988	2980	-8	0.15
St Albans Rd (e)	White Hart Road	655	657	2	0.08
Bennetts End Road	St Albans Rd (w)	542	540	-2	0.09
Bennetts End Road	White Hart Road	320	314	-6	0.34
Bennetts End Road	St Albans Rd (e)	1469	1462	-7	0.18
St Albans Rd (w)	White Hart Road	588	588	0	0.00
St Albans Rd (w)	St Albans Rd (e)	2671	2666	-5	0.10
St Albans Rd (w)	Bennetts End Road	1401	1399	-2	0.05

6.20 Modelled turning flows replicate observed flows well, and show that the model is capable of reproducing the junction's normal peak operating capacities.

6.21 Visual operation of the modelled junction is similar to observations made by the modelling team.

Breakspear Way / Maylands Avenue (R4)

6.22 A large four-arm roundabout with two/three entry lanes on each approach and free

flow lanes from Maylands Avenue to Breakspear Way and from Leverstock Green Way to St Albans Road.

6.23 This junction was modelled using standard PARAMICS techniques:

- Approach and exit links modelled as 25-30mph because of link curvature and lane gains.
- Lane usage coded as on ground.
- Sections of the circulatory carriageway were coded as 3 lanes, and then the extra lane was banned. This technique is used frequently at roundabouts when the number of entry, exit and circulatory lanes differs, to improve lane usage behaviour.
- 20m visibility set on each entry link.
- Minor modifications to stopline and kerb positions were made during calibration to better replicate observed vehicle movements.

6.24 Table 6.5 details the calibration of observed against modelled turning flows for the evening time period which was the busiest.

TABLE 6.5 JUNCTION CALIBRATION: BREAKSPEAR WAY / MAYLANDS AVENUE (R4)

From	To	Observed	Modelled	Diff.	GEH
Maylands Avenue	Breakspear Way	1354	1349	-5	0.14
Maylands Avenue	Leverstock Green Way	749	749	0	0.00
Maylands Avenue	St Albans Rd (w)	1214	1209	-5	0.14
Breakspear Way	Leverstock Green Way	198	197	-1	0.07
Breakspear Way	St Albans Rd (w)	1856	1849	-7	0.16
Breakspear Way	Maylands Avenue	1178	1170	-8	0.23
Leverstock Green Way	St Albans Rd (w)	1648	1644	-4	0.10
Leverstock Green Way	Maylands Avenue	754	753	-1	0.04
Leverstock Green Way	Breakspear Way	431	431	0	0.00
St Albans Rd (w)	Maylands Avenue	533	528	-5	0.22
St Albans Rd (w)	Breakspear Way	2282	2274	-8	0.17
St Albans Rd (w)	Leverstock Green Way	1437	1426	-11	0.29

6.25 Modelled turning flows replicate observed flows well, and show that the model is capable of reproducing the junction's normal peak operating capacities.

6.26 Visual operation of the modelled junction is similar to observations made by the modelling team.

Breakspear Way / Green Lane (R5)

6.27 A large four-arm roundabout with two/three entry lanes on each approach. This junction provides access between Hemel Hempstead and the M1 (see Figure 6.3).

FIGURE 6.3 BREAKSPEAR WAY / GREEN LANE (R5)

6.28 This junction was modelled using standard PARAMICS techniques:

- Breakspear Way approach and exit links modelled at speed of connecting dual sections (70mph). Green Lane approach and exits modelled between 25-45mph depending on curvature.
- Lane usage coded as on ground.
- Sections of the circulatory carraigeway were coded as 3 lanes, and then the extra lane was banned. This technique is used frequently at roundabouts when the number of entry, exit and circulatory lanes differs, to improve lane usage behaviour.
- 20m visibility set on each entry link.
- Minor modifications to stopline and kerb positions were made during calibration to better replicate observed vehicle movements.

6.29 Table 6.6 details the calibration of observed against modelled turning flows for the morning time period which was the busiest.

TABLE 6.6 JUNCTION CALIBRATION: BREAKSPEAR WAY / GREEN LANE (R5)

From	To	Observed	Modelled	Diff.	GEH

Green Lane (n)	Breakspear Way (e)	1391	1389	-2	0.05
Green Lane (n)	Green Lane (s)	91	89	-2	0.21
Green Lane (n)	Breakspear Way (w)	50	51	1	0.14
Breakspear Way (e)	Green Lane (s)	397	396	-1	0.05
Breakspear Way (e)	Breakspear Way (w)	3378	3373	-5	0.09
Breakspear Way (e)	Green Lane (n)	1630	1627	-3	0.07
Green Lane (s)	Breakspear Way (w)	59	59	0	0.00
Green Lane (s)	Green Lane (n)	286	283	-3	0.18
Green Lane (s)	Breakspear Way (e)	771	767	-4	0.14
Breakspear Way (w)	Green Lane (n)	126	126	0	0.00
Breakspear Way (w)	Breakspear Way (e)	2671	2660	-11	0.21
Breakspear Way (w)	Green Lane (s)	217	215	-2	0.14

6.30 Modelled turning flows replicate observed flows well, and show that the model is capable of reproducing the junction's normal peak operating capacities.

6.31 Visual operation of the modelled junction is similar to observations made by the modelling team.

Queensway / Redbourn Road / High Street Green (R7)

6.32 A large four-arm roundabout with two/three entry lanes on each approach and free flow left turning lanes on all approaches.

6.33 This junction was modelled using standard PARAMICS techniques:

- Redbourn Road entry and exit links modelled as 40mph. Remaining entries and exits at 25-30mph.
- Lane usage coded as on ground.
- Circulatory coded as 2 lanes.
- 20m visibility set on each entry link.
- Minor modifications to stopline and kerb positions were made during calibration to better replicate observed vehicle movements.

6.34 Table 6.7 details the calibration of observed against modelled turning flows for the morning time period which was the busiest.

TABLE 6.7 JUNCTION CALIBRATION: QUEENSWAY / REDBOURN ROAD / HIGH STREEN GREEN (R7)

From	To	Observed	Modelled	Diff.	GEH
Redbourn Road	Swallowdale Lane	1821	1818	-3	0.07
Redbourn Road	High Street Green	440	439	-1	0.05
Redbourn Road	Queensway	850	849	-1	0.03
Swallowdale Lane	High Street Green	145	143	-2	0.17
Swallowdale Lane	Queensway	565	564	-1	0.04

Swallowdale Lane	Redbourn Road	281	282	1	0.06
High Street Green	Queensway	1080	1076	-4	0.12
High Street Green	Redbourn Road	39	37	-2	0.32
High Street Green	Swallowdale Lane	73	72	-1	0.12
Queensway	Redbourn Road	400	399	-1	0.05
Queensway	Swallowdale Lane	1177	1176	-1	0.03
Queensway	High Street Green	612	611	-1	0.04

6.35 Modelled turning flows replicate observed flows well, and show that the model is capable of reproducing the junction's normal peak operating capacities.

6.36 Visual operation of the modelled junction is similar to observations made by the modelling team.

Redbourn Road / St Agnells Lane (R8)

6.37 A large four arm roundabout with two entry lanes on each approach (see Figure 6.4).

6.38 This junction was modelled using standard PARAMICS techniques:

- All entry and exit links are set at 30mph.
- Lane usage coded as on ground.
- Circulatory coded as 2 lanes.
- 20m visibility set on each entry link.
- Minor modifications to stopline and kerb positions were made during calibration to better replicate observed vehicle movements.

6.39 Table 6.8 details the calibration of observed against modelled turning flows for the evening time period which was the busiest.

TABLE 6.8 JUNCTION CALIBRATION: REDBOURN ROAD / ST AGNELLS LANE (R8)

From	To	Observed	Modelled	Diff.	GEH
St Agnells Lane	Redbourn Road (e)	292	290	-2	0.12
St Agnells Lane	Redbourn Road (s)	190	191	1	0.07
St Agnells Lane	A4147 Link Road	247	248	1	0.06
Redbourn Road (e)	Redbourn Road (s)	1287	1281	-6	0.17
Redbourn Road (e)	A4147 Link Road	984	981	-3	0.10
Redbourn Road (e)	St Agnells Lane	740	738	-2	0.07
Redbourn Road (s)	A4147 Link Road	1318	1315	-3	0.08
Redbourn Road (s)	St Agnells Lane	610	610	0	0.00
Redbourn Road (s)	Redbourn Road (e)	1089	1088	-1	0.03
A4147 Link Road	St Agnells Lane	98	95	-3	0.31
A4147 Link Road	Redbourn Road (e)	925	926	1	0.03
A4147 Link Road	Redbourn Road (s)	713	711	-2	0.07

6.40 Modelled turning flows replicate observed flows well, and show that the model is capable of reproducing the junction's normal peak operating capacities.

6.41 Visual operation of the modelled junction is similar to observations made by the modelling team.

FIGURE 6.4 REDBOURN ROAD / ST AGNELLS LANE (R8)

Aycliffe Drive / Cambrian Way (R9)

6.42 A large four-arm roundabout with two entry lanes on each approach.

6.43 This junction was modelled using standard PARAMICS techniques:

- A4147 (e) entry and exit links are set as 50mph; A4147 (w) to 40mph, and Aycliffe Drive/Cambrian Way to 30mph.
- Lane usage coded as on ground.
- Circulatory coded as 2 lanes.
- 20m visibility set on each entry link.
- Minor modifications to stopline and kerb positions were made during calibration to better replicate observed vehicle movements.

6.44 Table 6.9 details the calibration of observed against modelled turning flows for the

evening time period which was the busiest.

TABLE 6.9 JUNCTION CALIBRATION: AYCLIFFE DRIVE / CAMBRIAN WAY (R9)

From	To	Observed	Modelled	Diff.	GEH
Aycliffe Drive	A4147 (e)	211	210	-1	0.07
Aycliffe Drive	Cambrian Way	290	291	1	0.06
Aycliffe Drive	A4147 (w)	501	499	-2	0.09
A4147 (e)	Cambrian Way	203	203	0	0.00
A4147 (e)	A4147 (w)	2361	2360	-1	0.02
A4147 (e)	Aycliffe Drive	376	374	-2	0.10
Cambrian Way	A4147 (w)	122	123	1	0.09
Cambrian Way	Aycliffe Drive	474	474	0	0.00
Cambrian Way	A4147 (e)	181	183	2	0.15
A4147 (w)	Aycliffe Drive	748	748	0	0.00
A4147 (w)	A4147 (e)	1377	1374	-3	0.08
A4147 (w)	Cambrian Way	178	175	-3	0.23

6.45 Modelled turning flows replicate observed flows well, and show that the model is capable of reproducing the junction's normal peak operating capacities.

6.46 Visual operation of the modelled junction is similar to observations made by the modelling team.

Piccotts End / A4147 (R10)

6.47 A four-arm roundabout with one entry lane on each approach. Although lanes are not formally marked, there is enough room for traffic to utilise the flare as two lanes at busy times (see Figure 6.5).

6.48 This junction was modelled using standard PARAMICS techniques:

- A4147 (e) entry and exit links are set as 60mph; A4147 (w) to 50mph, and Piccotts End to 30mph.
- Lane usage coded as on ground.
- Circulatory coded as 2 lanes.
- 20m visibility set on each entry link.
- Minor modifications to stopline and kerb positions were made during calibration to better replicate observed vehicle movements.

FIGURE 6.5 PICCOTTS END/ A4147 (R10)

6.49 Table 6.10 details the calibration of observed against modelled turning flows for the morning time period which was the busiest.

TABLE 6.10 JUNCTION CALIBRATION: PICCOTTS END / A4147 (R10)

From	To	Observed	Modelled	Diff.	GEH
Piccotts End (n)	A4147 (e)	78	78	0	0.00
Piccotts End (n)	Piccotts End (s)	61	60	-1	0.13
Piccotts End (n)	A4147 (w)	38	39	1	0.16
A4147 (e)	Piccotts End (s)	247	246	-1	0.06
A4147 (e)	A4147 (w)	1906	1902	-4	0.09
A4147 (e)	Piccotts End (n)	15	15	0	0.00
Piccotts End (s)	A4147 (w)	133	131	-2	0.17
Piccotts End (s)	Piccotts End (n)	12	12	0	0.00
Piccotts End (s)	A4147 (e)	68	69	1	0.12
A4147 (w)	Piccotts End (n)	28	27	-1	0.19
A4147 (w)	A4147 (e)	2737	2730	-7	0.13
A4147 (w)	Piccotts End (s)	413	414	1	0.05

6.50 Modelled turning flows replicate observed flows well, and show that the model is

capable of reproducing the junction's normal peak operating capacities.

6.51 Visual operation of the modelled junction is similar to observations made by the modelling team.

Leighton Buzzard Road / Galley Hill (R11)

6.52 A four-arm roundabout with one entry lane on each approach. Although lanes are not formally marked, there is enough room for traffic to utilise the flare as two lanes at busy times (see Figure 6.6).

FIGURE 6.6 LEIGHTON BUZZARD ROAD / GALLEY HILL (R11)

6.53 This junction was modelled using standard PARAMICS techniques:

- A4147 (e) entry and exit links are set as 60mph; Galley Hill to 30mph, and Leighton Buzzard Road to 50mph.
- Lane usage coded as on ground.
- Circulatory coded as 2 lanes.
- 20m visibility set on each entry link. 50m visibility set on exit from left turning free-flow lane.
- Minor modifications to stopline and kerb positions were made during calibration to better replicate observed vehicle movements.

6.54 Table 6.11 details the calibration of observed against modelled turning flows for the morning time period which was the busiest.

TABLE 6.11 JUNCTION CALIBRATION: LEIGHTON BUZZARD ROAD / GALLEY HILL (R11)

From	To	Observed	Modelled	Diff.	GEH
Leighton Buzzard Road (n)	A4147 (e)	1483	1477	-6	0.16
Leighton Buzzard Road (n)	Leighton Buzzard Road (s)	1673	1667	-6	0.15
Leighton Buzzard Road (n)	Galley Hill	104	104	0	0.00
A4147 (e)	Leighton Buzzard Road (s)	715	714	-1	0.04
A4147 (e)	Galley Hill	673	671	-2	0.08
A4147 (e)	Leighton Buzzard Road (n)	464	462	-2	0.09
Leighton Buzzard Road (s)	Galley Hill	287	287	0	0.00
Leighton Buzzard Road (s)	Leighton Buzzard Road (n)	747	747	0	0.00
Leighton Buzzard Road (s)	A4147 (e)	517	516	-1	0.04
Galley Hill	Leighton Buzzard Road (n)	125	125	0	0.00
Galley Hill	A4147 (e)	1250	1245	-5	0.14
Galley Hill	Leighton Buzzard Road (s)	336	336	0	0.00

6.55 Modelled turning flows replicate observed flows well, and show that the model is capable of reproducing the junction's normal peak operating capacities.

6.56 Visual operation of the modelled junction is similar to observations made by the modelling team.

6.57 The ahead movement from Leighton Buzzard Road (n) occasionally crosses with the ahead movement from Galley Hill due to roundabout lane coding between nodes 99a and 99b. The ahead from Galley Hill has been coded to use only lane 2 to smooth movement through the junction.

Leighton Buzzard Road / Queensway (R12)

6.58 A four-arm roundabout with three entry lanes on each approach.

6.59 This junction was modelled using standard PARAMICS techniques:

- All entries and exits are 30mph.
- Lane usage coded as on ground.
- Circulatory coded as 3 lanes.
- 20m visibility set on each entry link.
- Approachs on south and west arms widened in two stages (one to two, then two to three lanes) to improve lane usage on circulatory.

- Wide start flags set on exit links to improve lane usage.
- Minor modifications to stopline and kerb positions were made during calibration to better replicate observed vehicle movements.

6.60 Table 6.12 details the calibration of observed against modelled turning flows for the evening time period which was the busiest.

TABLE 6.12 JUNCTION CALIBRATION: LEIGHTON BUZZARD ROAD / QUEENSWAY (R12)

From	To	Observed	Modelled	Diff.	GEH
Leighton Buzzard Road (n)	Queensway	327	329	2	0.11
Leighton Buzzard Road (n)	Leighton Buzzard Road (s)	446	447	1	0.05
Leighton Buzzard Road (n)	Warners End Road	1094	1094	0	0.00
Queensway	Leighton Buzzard Road (s)	573	573	0	0.00
Queensway	Warners End Road	1005	1003	-2	0.06
Queensway	Leighton Buzzard Road (n)	988	993	5	0.16
Leighton Buzzard Road (s)	Warners End Road	582	581	-1	0.04
Leighton Buzzard Road (s)	Leighton Buzzard Road (n)	1117	1114	-3	0.09
Leighton Buzzard Road (s)	Queensway	1133	1131	-2	0.06
Warners End Road	Leighton Buzzard Road (n)	240	240	0	0.00
Warners End Road	Queensway	503	503	0	0.00
Warners End Road	Leighton Buzzard Road (s)	706	707	1	0.04

6.61 Modelled turning flows replicate observed flows well, and show that the model is capable of reproducing the junction's normal peak operating capacities.

6.62 Visual operation of the modelled junction is similar to observations made by the modelling team.

Queensway / Marlowes (R13)

6.63 A three-arm roundabout with one/two entry lanes on each approach. Although lanes on the eastern approach are not formally marked, there is enough room for traffic to utilise the flare as two lanes at busy times (see Figure 6.7).

FIGURE 6.7 QUEENSWAY / MARLOWES (R13)

6.64 This junction was modelled using standard PARAMICS techniques:

- All entries and exits are 30mph.
- Lane usage coded as on ground.
- Circulatory coded as 2 lanes. Some short links used for circulatory – unavoidable because of small roundabout diameter.
- 20m visibility set on each entry link. (18.5m on south arm because of short link length).
- Minor modifications to stopline and kerb positions were made during calibration to better replicate observed vehicle movements.

6.65 Table 6.13 details the calibration of observed against modelled turning flows for the evening time period which was the busiest.

TABLE 6.13 JUNCTION CALIBRATION: QUEENSWAY / MARLOWES (R13)

From	To	Observed	Modelled	Diff.	GEH
Queensway (w)	Queensway (e)	1169	1170	1	0.03
Queensway (w)	Marlowes	595	597	2	0.08
Queensway (e)	Marlowes	635	636	1	0.04
Queensway (e)	Queensway (w)	1621	1620	-1	0.02
Marlowes	Queensway (w)	1003	1006	3	0.09
Marlowes	Queensway (e)	1191	1193	2	0.06

6.66 Modelled turning flows replicate observed flows well, and show that the model is capable of reproducing the junction's normal peak operating capacities.

6.67 Visual operation of the modelled junction is similar to observations made by the

modelling team.

London Road / Fishery Road (R18)

6.68 A four-arm roundabout with one/two entry lanes on each approach. Provides an exit – only from the station.

6.69 This junction was modelled using standard PARAMICS techniques:

- All entries and exits are 30mph.
- Lane usage coded as on ground.
- Circulatory coded as 2 lanes. Some short links used for circulatory – unavoidable because of small roundabout diameter.
- 20m visibility set on each entry link. (19m on north arm because of short link length).
- 2 lanes coded on eastern and western entry links. Although these are not marked on the ground in busy times there is enough room for vehicles to queue in the flare as 2 short lanes.
- Minor modifications to stopline and kerb positions were made during calibration to better replicate observed vehicle movements.

6.70 Table 6.14 details the calibration of observed against modelled turning flows for the busiest modelled time period.

TABLE 6.14 JUNCTION CALIBRATION: LONDON ROAD / FISHERY ROAD (R18)

From	To	Observed	Modelled	Diff.	GEH
Fishery Road	London Road (e)	663	662	-1	0.04
Fishery Road	London Road (w)	636	636	0	0.00
London Road (e)	London Road (w)	1647	1651	4	0.10
London Road (e)	Fishery Road	944	942	-2	0.07
Station exit	London Road (w)	130	129	-1	0.09
Station exit	Fishery Road	201	201	0	0.00
Station exit	London Road (e)	356	357	1	0.05
London Road (w)	Fishery Road	919	919	0	0.00
London Road (w)	London Road (e)	1646	1644	-2	0.05

6.71 Modelled turning flows replicate observed flows well, and show that the model is capable of reproducing the junction's normal peak operating capacities.

6.72 Visual operation of the modelled junction is similar to observations made by the modelling team.

London Road / Station Road (R19)

6.73 A three-arm mini-roundabout with one/two entry lanes on each approach.

6.74 This junction was modelled using standard PARAMICS techniques:

- All entries and exits are 30mph.

- Lane usage coded as on ground.
- Circulatory coded as 2 lanes. Some short links used for circulatory – unavoidable because of small roundabout diameter.
- 20m visibility set on each entry link. (19m on north arm because of short link length).
- 2 lanes coded on eastern entry link. Although this is not marked on the ground in busy times there is enough room for vehicles to queue in the flare as 2 short lanes.
- Minor modifications to stopline and kerb positions were made during calibration to better replicate observed vehicle movements.

6.75 Table 6.15 details the calibration of observed against modelled turning flows for the evening time period which was the busiest.

TABLE 6.15 JUNCTION CALIBRATION: LONDON ROAD / STATION ROAD (R19)

From	To	Observed	Modelled	Diff.	GEH
London Road (w)	Station Road	1708	1712	4	0.10
London Road (w)	London Road (e)	637	634	-3	0.12
Station Road	London Road (e)	106	108	2	0.19
Station Road	London Road (w)	1369	1378	9	0.24
London Road (e)	London Road (w)	1432	1432	0	0.00
London Road (e)	Station Road	689	690	1	0.04

6.76 Modelled turning flows replicate observed flows well, and show that the model is capable of reproducing the junction's normal peak operating capacities.

6.77 Visual operation of the modelled junction is similar to observations made by the modelling team. Some movements on the circulatory are a bit jerky due to the short circulatory links.

Adeyfield Road / Great Road / Longlands (P20P21)

6.78 Two priority junctions on Adeyfield Road operating in close proximity.

6.79 This junction was modelled using standard PARAMICS techniques:

- All entries and exits are 30mph.
- Lane usage coded as two entry lanes from north, south and west arms. There is enough room on each of these approaches that in busy periods traffic uses the junction with right turners queued separately.
- 20m visibility set on each entry link.
- Minor modifications to stopline and kerb positions were made during calibration to better replicate observed vehicle movements.

6.80 Table 6.16 details the calibration of observed against modelled turning flows for the evening time period which was the busiest.

TABLE 6.16 JUNCTION CALIBRATION: ADEYFIELD ROAD / GREAT ROAD / LONGLANDS (P20P21)

From	To	Observed	Modelled	Diff.	GEH
Great Road	Adeyfield Road (e)	74	71	-3	0.35
Great Road	Longlands	511	510	-1	0.04
Great Road	Adeyfield Road (w)	35	33	-2	0.34
Adeyfield Road (e)	Longlands	861	854	-7	0.24
Adeyfield Road (e)	Adeyfield Road (w)	721	717	-4	0.15
Adeyfield Road (e)	Great Road	155	152	-3	0.24
Longlands	Adeyfield Road (w)	352	351	-1	0.05
Longlands	Great Road	510	509	-1	0.04
Longlands	Adeyfield Road (e)	151	149	-2	0.16
Adeyfield Road (w)	Great Road	122	120	-2	0.18
Adeyfield Road (w)	Adeyfield Road (e)	595	594	-1	0.04
Adeyfield Road (w)	Longlands	457	459	2	0.09

6.81 Modelled turning flows replicate observed flows well, and show that the model is capable of reproducing the junction's normal peak operating capacities.

6.82 Visual operation of the modelled junction is similar to observations made by the modelling team.

Long Chaulden / Boxted Road / Northridge Way (P36P37)

6.83 Two mini roundabout junctions on Long Chaulden/Warners End Road operating in close proximity.

6.84 This junction was modelled using standard PARAMICS techniques:

- All entries and exits are 30mph.
- Lane usage coded as on ground.
- Coded as two separate priority junctions with turning priorities set as medium to simulate mini-roundabout behaviour.
- 20m visibility set on each entry link.
- Minor modifications to stopline and kerb positions were made during calibration to better replicate observed vehicle movements.

6.85 Table 6.17 details the calibration of observed against modelled turning flows for the evening time period which was the busiest.

TABLE 6.17 JUNCTION CALIBRATION: LONG CHAULDEN / BOXTED ROAD / NORTHRIDGE WAY (P36P37)

From	To	Observed	Modelled	Diff.	GEH
Boxted Road	Warners End Road	386	384	-2	0.10
Boxted Road	Northridge Way	495	491	-4	0.18
Boxted Road	Long Chaulden	217	216	-1	0.07

Warners End Road	Northridge Way	484	483	-1	0.05
Warners End Road	Long Chaulden	516	510	-6	0.26
Warners End Road	Boxted Road	404	399	-5	0.25
Northridge Way	Long Chaulden	188	189	1	0.07
Northridge Way	Boxted Road	699	692	-7	0.27
Northridge Way	Warners End Road	453	450	-3	0.14
Long Chaulden	Boxted Road	154	153	-1	0.08
Long Chaulden	Warners End Road	416	413	-3	0.15
Long Chaulden	Northridge Way	96	96	0	0.00

6.86 Modelled turning flows replicate observed flows well, and show that the model is capable of reproducing the junction's normal peak operating capacities.

6.87 Visual operation of the modelled junction is similar to observations made by the modelling team.

Lawn Lane / St Albans Hill / Belswains Green (P51)

6.88 A three-arm mini roundabout with one lane on each approach.

6.89 This junction was modelled using standard PARAMICS techniques:

- All entries and exits are 30mph.
- Lane usage coded as on ground.
- Coded as a priority junction with turning priorities set as medium to simulate mini-roundabout behaviour.
- 30m visibility set on each entry link (16.5m on western approach because of short link length).
- Minor modifications to stopline and kerb positions were made during calibration to better replicate observed vehicle movements.

6.90 Table 6.18 details the calibration of observed against modelled turning flows for the evening time period which was the busiest.

TABLE 6.18 JUNCTION CALIBRATION: LAWN LANE / ST ALBANS HILL / BELSWAINS GREEN (P51)

From	To	Observed	Modelled	Diff.	GEH
Lawn Lane	St Albans Hill	1094	1094	0	0.00
Lawn Lane	Belswaines Green	1082	1080	-2	0.06
St Albans Hill	Belswaines Green	286	288	2	0.12
St Albans Hill	Lawn Lane	780	778	-2	0.07
Belswaines Green	Lawn Lane	988	988	0	0.00
Belswaines Green	St Albans Hill	200	201	1	0.07

6.91 Modelled turning flows replicate observed flows well, and show that the model is capable of reproducing the junction's normal peak operating capacities.

6.92 Visual operation of the modelled junction is similar to observations made by the modelling team.

The Plough (P88 - 93)

6.93 The Plough is a very unusual junction, formed of six mini-roundabouts linked as a circulatory which allows both clockwise and anti-clockwise movements (see Figure 6.8.

6.94 This junction was modelled using non-standard PARAMICS techniques because of its unusual nature:

- All entries and exits are 30mph.
- Lane usage coded as on ground.
- Each mini-roundabout is coded as a priority junction. All turning priorities are set as major (instead of medium – which is normal for mini roundabouts). This is because operation of the model under standard coding for mini roundabouts produced significantly less junction capacity than occurs in reality.
- Observation of traffic behaviour suggests that traffic moves through the set of mini-roundabouts much more efficiently than in the model under standard coding. By coding the roundabout turns as major priority, we can simulate increased capacity at the junction – however with a concomitant loss in realism of the traffic behaviour (in some instances vehicle 'drive-through' events are visible, whereby vehicles making opposing movements do not correctly give-way because all turns are coded as major).
- 20m visibility set on each entry link.
- Section of circulatory between nodes 653 and 753z set as 3 lanes with 1 lane closed to traffic to improve lane behaviour on southbound vehicles.
- Minor modifications to stopline and kerb positions were made during calibration to better replicate observed vehicle movements.

6.95 Modelled turning flows replicate observed flows well, and show that the model is capable of reproducing the junction's normal peak operating capacities.

6.96 Visual operation of the modelled junction is reasonable, but on close inspection problems with vehicle 'drive-through' are evident. This is due to the priority coding discussed in paragraph 6.94.

FIGURE 6.8 THE PLOUGH (P88-93)

6.97 Table 6.19 details the calibration of observed against modelled turning flows for the evening time period which was the busiest. (2 hour counts – most other junctions are 3hr).

TABLE 6.19 JUNCTION CALIBRATION: THE PLOUGH (P88-93)

From	To	Observed	Modelled	Diff.	GEH
Marlowes	St Albans Road	4	4	0	0.00
	Lawn Lane	2	2	0	0.00
	Two Waters Road	3	3	0	0.00
	Station Road	0	0	0	0.00
	Leighton Buzzard Road	0	0	0	0.00
St Albans Road	Lawn Lane	223	222	-1	0.07
	Two Waters Road	802	799	-3	0.11
	Station Road	912	909	-3	0.10
	Leighton Buzzard Road	692	691	-1	0.04
	Marlowes	1	2	1	0.82
Lawn Lane	Two Waters Road	33	34	1	0.17

	Station Road	294	294	0	0.00
	Leighton Buzzard Road	315	314	-1	0.06
	Marlowes	0	0	0	0.00
	St Albans Road	337	338	1	0.05
Two Waters Road	Station Road	186	185	-1	0.07
	Leighton Buzzard Road	924	921	-3	0.10
	Marlowes	0	0	0	0.00
	St Albans Road	956	951	-5	0.16
	Lawn Lane	77	76	-1	0.11
Station Road	Leighton Buzzard Road	513	513	0	0.00
	Marlowes	0	0	0	0.00
	St Albans Road	940	933	-7	0.23
	Lawn Lane	301	298	-3	0.17
	Two Waters Road	299	298	-1	0.06
Leighton Buzzard Road	Marlowes	1	2	1	0.82
	St Albans Road	838	830	-8	0.28
	Lawn Lane	224	223	-1	0.07
	Two Waters Road	1048	1040	-8	0.25
	Station Road	708	706	-2	0.08

London Road / Two Waters Way (S4)

6.98 The largest signalised junction in the study area with three/four entry lanes including separately signalled left turn lanes on each approach.

6.99 This junction was modelled using standard PARAMICS techniques:

- All entries and exits are 30mph.
- Lane usage coded as on ground. However to reduce the amount of short links in the model, the geometry of the left turning lanes has been simplified.
- Minor modifications to stopline and kerb positions were made during calibration to better replicate observed vehicle movements.

6.100 Table 6.20 details the calibration of observed against modelled turning flows for the evening time period which was the busiest.

TABLE 6.20 JUNCTION CALIBRATION: LONDON ROAD / TWO WATERS WAY (S4)

From	To	Observed	Modelled	Diff.	GEH
Two Waters Way (n)	London Road (e)	794	793	-1	0.04
Two Waters Way (n)	Two Waters Way (s)	2339	2328	-11	0.23

Two Waters Way (n)	London Road (w)	150	149	-1	0.08
London Road (e)	Two Waters Way (s)	576	573	-3	0.13
London Road (e)	London Road (w)	823	819	-4	0.14
London Road (e)	Two Waters Way (n)	601	601	0	0.00
Tfwo Waters Way (s)	London Road (w)	691	681	-10	0.38
Two Waters Way (s)	Two Waters Way (n)	2191	2154	-37	0.79
Two Waters Way (s)	London Road (e)	970	948	-22	0.71
London Road (w)	Two Waters Way (n)	36	35	-1	0.17
London Road (w)	London Road (e)	571	567	-4	0.17
London Road (w)	Two Waters Way (s)	310	309	-1	0.06

6.101 Modelled turning flows replicate observed flows reasonably well except on London Road (e), and show that the model is capable of reproducing the junction's normal peak operating capacities.

6.102 Visual operation of the modelled junction is similar to observations made by the modelling team.

Lawn Lane / Deaconsfield Road (S7)

6.103 A four arm signalised junction with single lane entries on each approach.

6.104 This junction was modelled using standard PARAMICS techniques:

- All entries and exits are 30mph.
- Although the lanes are coded as single lane approaches on each arm, the junction has a large central turning area in which right turning vehicles can be bypassed by vehicles moving ahead from each arm. Therefore a small two lane section has been added after the stopline on each arm.
- 20m visibility set on each entry link (50m on western approach).
- Minor modifications to stopline and kerb positions were made during calibration to better replicate observed vehicle movements.

6.105 Table 6.21 details the calibration of observed against modelled turning flows for the evening time period which was the busiest.

TABLE 6.21 JUNCTION CALIBRATION: LAWN LANE / DEACONSFIELD ROAD (S7)

From	To	Observed	Modelled	Diff.	GEH
Lawn Lane (n)	Deaconsfield Road	24	24	0	0.00
Lawn Lane (n)	Lawn Lane (s)	1249	1247	-2	0.06
Lawn Lane (n)	Durrants Hill Road	234	234	0	0.00
Deaconsfield Road	Lawn Lane (s)	24	24	0	0.00
Deaconsfield Road	Durrants Hill Road	32	30	-2	0.36
Deaconsfield Road	Lawn Lane (n)	41	42	1	0.16
Lawn Lane (s)	Durrants Hill Road	515	515	0	0.00
Lawn Lane (s)	Lawn Lane (n)	987	993	6	0.19

Lawn Lane (s)	Deaconsfield Road	28	27	-1	0.19
Durrants Hill Road	Lawn Lane (n)	266	265	-1	0.06
Durrants Hill Road	Deaconsfield Road	70	72	2	0.24
Durrants Hill Road	Lawn Lane (s)	942	940	-2	0.07

6.106 Modelled turning flows replicate observed flows well, and show that the model is capable of reproducing the junction's normal peak operating capacities.

6.107 Visual operation of the modelled junction is similar to observations made by the modelling team.

Hempstead Road / Rucklers Lane (S10)

6.108 A four arm signalised junction where the minor arms are staggered.

6.109 This junction was modelled using standard PARAMICS techniques:

- All entries and exits are 30mph.
- Although the lanes are coded as single lane approaches on the east and west arms, there is room after each stopline for vehicles turning left or right to bypass each other . Therefore a small two lane section has been added after the stopline on those arms. Similarly, right turners from London Road to either of the minor arms can utilise the relatively large area after the signal stoplines to queue to make right turns, and this has been reflected by coding this middle section as two lanes in each direction.
- Minor modifications to stopline and kerb positions were made during calibration to better replicate observed vehicle movements.

6.110 Table 6.22 details the calibration of observed against modelled turning flows for the evening time period which was the busiest.

TABLE 6.22 JUNCTION CALIBRATION: HEMPSTEAD ROAD / RUCKLERS LANE (S10)

From	To	Observed	Modelled	Diff.	GEH
London Road (n)	Nash Mills Lane	641	599	-42	1.69
London Road (n)	London Road (s)	1111	1050	-61	1.86
London Road (n)	Rucklers Lane	129	120	-9	0.81
Nash Mills Lane	London Road (s)	502	497	-5	0.22
Nash Mills Lane	Rucklers Lane	105	105	0	0.00
Nash Mills Lane	London Road (n)	547	548	1	0.04
London Road (s)	Rucklers Lane	100	99	-1	0.10
London Road (s)	London Road (n)	1003	999	-4	0.13
London Road (s)	Nash Mills Lane	488	483	-5	0.23
Rucklers Lane	London Road (n)	58	56	-2	0.26
Rucklers Lane	Nash Mills Lane	66	65	-1	0.12
Rucklers Lane	London Road (s)	93	92	-1	0.10

6.111 Modelled turning flows replicate observed flows well, and show that the model is

capable of reproducing the junction's normal peak operating capacities.

6.112 Visual operation of the modelled junction is similar to observations made by the modelling team.

7. MODEL VALIDATION

Morning Period Model

7.1 Design Manual for Roads and Bridges (DMRB) Volume 12a includes 'assignment validation acceptability guidelines' for highway traffic models. This is summarised in Table 7.1 below.

TABLE 7.1 DMRB VOL12A MODEL VALIDATION GUIDELINES

Criteria and Measures	Acceptability Guideline
Assigned hourly flows compared with observed flows	
1. Individual flows within 100 for flows <700vph	> 85%
2. Individual flows within 15% for flows 700-2,700vph	> 85%
3. Individual flows within 400 for flows >2,700vph	> 85%
4. Total screenline flows (normally >5 links) to be within 5%	All (or nearly all) screenlines
GEH statistic:	
(i) individual flows: GEH < 5	> 85% of cases
(ii) screenline totals : GEH < 4	All (or nearly all) screenlines

7.2 We have adopted the validation guidelines in Table 7.1 as the criteria for comparing individual and screenline flows both in terms of absolute flow differences and GEH.

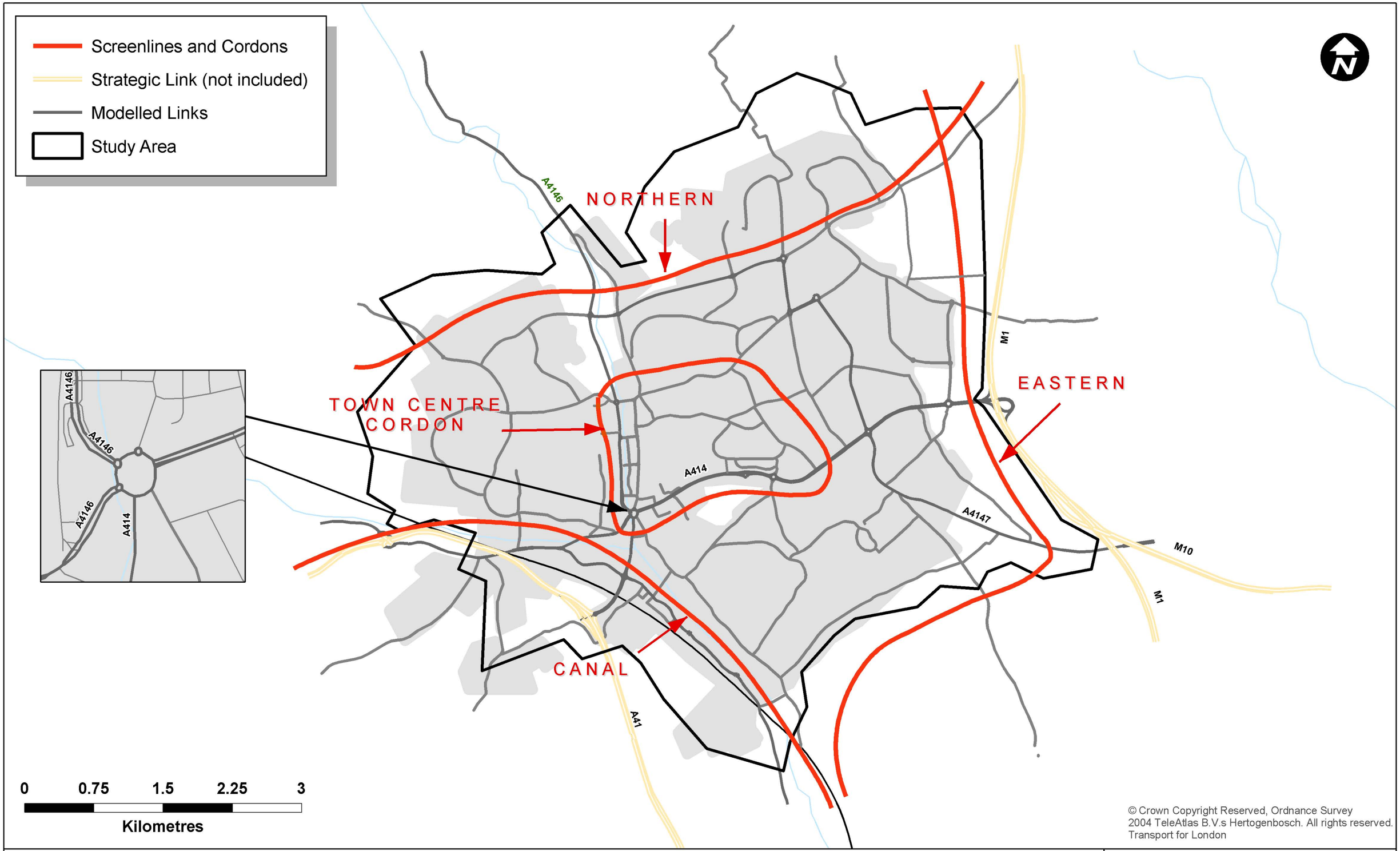
7.3 In discussion with the client group, a set of screenlines was chosen that covers the inputs and outputs to the model from external areas. Additionally, a town centre cordon was defined from available count data which covers all inputs and outputs to the town centre area (see Figure 7.1).

7.4 The rationale behind the town centre cordon was to demonstrate that the model would be able to test the impacts of development proposals on town centre flows, and particularly to test the impacts of potential developments of important radial routes such as St Albans Road, London Road and Leighton Buzzard Road.

7.5 Similarly, each of the outer screenline locations were selected to demonstrate that total traffic levels entering and leaving the town on the major routes were sufficiently close to observed flows.

7.6 In accordance with micro-simulation guidelines the model was run with five random 'seeds' to simulate variability in traffic profiles and behaviour. All quoted results are mean averages across the five runs. Generally, the differences between overall model behaviour between each run was small; all individual runs exhibit similar link, screenline and cordon flow validation to the average.

7.7 Tables 7.2-7.5 provide a summary comparison of observed link flows for the 3 hour morning period and the corresponding modelled flows, details of the absolute and percentage differences, and the value of the GEH statistic for the northern, east/south and canal screenlines, and the town centre cordon respectively.



Hemel Hempstead Urban Transport Model

Figure 7.1: Validation Screenlines

steer davies gleave

Drawn by:	Last Updated:	Revision:
EJB	09/01/2009	0

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TABLE 7.2 MORNING PERIOD MODEL: OBSERVED VS MODELLED FLOWS: NORTHERN SCREENLINE

Link	A-Node	B-Node	Count	Model	Abs. Diff.	% Diff.	GEH
Northern Screenline							
Inbound							
Berkhamsted Road / Boxted Road	124	106	868	988	120	14%	3.94
Leighton Buzzard Road	90	676z	3260	3254	-6	0%	0.11
Piccotts End	95	689	177	131	-46	-26%	3.71
Aycliffe Drive	681	83d	1530	1523	-7	0%	0.18
St Agnells Lane	72	607	1143	1122	-21	-2%	0.62
Shenley Road west	291z	63d	1072	877	-195	-18%	6.25
Shenley Road east	291	284	739	855	116	16%	4.11
Total Inbound			8789	8750	-39	0%	0.42
Outbound							
Berkhamsted Road / Boxted Road	106	124	897	831	-66	-7%	2.25
Leighton Buzzard Road	676z	90	1336	1232	-104	-8%	2.90
Piccotts End	689	95	51	65	14	27%	1.84
Aycliffe Drive	83d	681	689	662	-27	-4%	1.04
St Agnells Lane	608	72	587	554	-33	-6%	1.38
Shenley Road west	63d	291z	409	388	-21	-5%	1.05
Shenley Road east	284	291	426	434	8	2%	0.39
Total Outbound			4395	4166	-229	-5%	3.50

TABLE 7.3 MORNING PERIOD MODEL: OBSERVED VS MODELLED FLOWS: EAST/SOUTH SCREENLINE

Link	A-Node	B-Node	Count	Model	Abs. Diff.	% Diff.	GEH
East/South Screenline							
Inbound							
Hemel Hempstead Road	498	55	2219	2225	6	0%	0.13
Breakspear Way	8	533	5405	5334	-71	-1%	0.97
Hemel Hempstead Road	777	327	1788	1809	21	1%	0.50
Bedmond Road / Bedmond Hill	340	329	995	1102	107	11%	3.30
Lower Road	741	347	798	674	-124	-16%	4.57
Total Inbound			11205	11144	-61	-1%	0.58
Outbound							
Hemel Hempstead Road	55	498	2251	2353	102	5%	2.13
Breakspear Way	532	7	4833	4746	-87	-2%	1.26
Hemel Hempstead Road	327	777	1670	1653	-17	-1%	0.42
Bedmond Road / Bedmond Hill	329	340	1521	1363	-158	-10%	4.16
Lower Road	347	741	1544	1453	-91	-6%	2.35
Total Outbound			11819	11568	-251	-2%	2.32

TABLE 7.4 MORNING PERIOD MODEL: OBSERVED VS MODELLED FLOWS: CANAL SCREENLINE

Link	A-Node	B-Node	Count	Model	Abs. Diff.	% Diff.	GEH
Canal Screenline							
Inbound							
Fishery Road	735	418	885	824	-61	-7%	2.09
Station Road	542a	474	2140	2332	192	9%	4.06
Two Waters Way	646z	465	3034	2807	-227	-7%	4.20
Durrants Hill Road	728z	727z	824	665	-159	-19%	5.83
Nash Mills Lane / Red Lion Lane	748	744	988	1126	138	14%	4.24
Total Inbound			7871	7754	-117	-1%	1.32
Outbound							
Fishery Road	418	735	1792	1846	54	3%	1.27
Station Road	474	542a	1511	1571	60	4%	1.53
Two Waters Way	465	650z	2796	2992	196	7%	3.64
Durrants Hill Road	727z	728z	910	699	-211	-23%	7.44
Nash Mills Lane / Red Lion Lane	744	748	1262	1181	-81	-6%	2.32
Total Outbound			8271	8289	18	0%	0.20

TABLE 7.5 MORNING PERIOD MODEL: OBSERVED VS MODELLED FLOWS: TOWN CENTRE CORDON

Link	A-Node	B-Node	Count	Model	Abs. Diff.	% Diff.	GEH
Town Centre Cordon							
Inbound							
Section: North							
Leighton Buzzard Road	710	163d	2656	2888	232	9%	4.41
Queensway	196	197	1110	1328	218	20%	6.24
Section: East							
Adeyfield Road	221	222	1256	1120	-136	-11%	3.95
St Albans Road	781	667	3619	3823	204	6%	3.34
Section: South							
Bennetts End Road	370	625	2160	2041	-119	-6%	2.60
Jarman Way	658x	666	846	882	36	4%	1.22
Lawn Lane	461	655	1050	1027	-23	-2%	0.71
Two Waters Road	464	656	2729	2809	80	3%	1.52
Section: West							
Station Road	658z	657	3062	2779	-283	-9%	5.24
Warners End Road	493	163c	2204	1985	-219	-10%	4.79
Total Inbound			20692	20682	-10	0%	0.07
Outbound							
Section: North							
Leighton Buzzard Road	163d	710	1195	1303	108	9%	3.06
Queensway	197	196	1675	1556	-119	-7%	2.96
Section: East							
Adeyfield Road	222	221	975	924	-51	-5%	1.66
St Albans Road	666x	780	4312	4509	197	5%	2.97
Section: South							
Bennetts End Road	624	370	2161	1953	-208	-10%	4.59
Jarman Way	665	659	1086	1030	-56	-5%	1.72
Lawn Lane	655	461	1053	1045	-8	-1%	0.25
Two Waters Road	656	464	2941	2977	36	1%	0.66
Section: West							
Station Road	657	658z	1887	1778	-109	-6%	2.55
Warners End Road	163c	493	1164	1122	-42	-4%	1.24
Total Outbound			18449	18197	-252	-1%	1.86

7.8 Generally, modelled link and screenline flows are acceptably close to the observed values over the 3 hour period. Table 7.6 demonstrates the compliance of the morning period model with the DMRB guidelines. All DMRB criteria are met.

TABLE 7.6 MORNING PERIOD MODEL COMPLIANCE WITH DMRB GUIDELINES

Criteria and Measures	Number/% Satisfying Guideline	Compliance
Assigned hourly flows compared with observed flows:		
1. Individual flows within 100 for flows <700vph	100% (6/6)	Yes
2. Individual flows within 15% for flows 700-2,700vph	100% (38/38)	Yes
3. Individual flows within 400 for flows >2,700vph	100% (10/10)	Yes
4. Total screenline flows (normally >5 links) to be within 5%	Nearly all (7/8)	Yes
GEH statistic:		
(i) individual flows: GEH < 5	91% (49/54)	Yes
(ii) screenline totals : GEH < 4	All (8/8)	Yes

7.9 Tables 7.7-7.10 provide a summary comparison of observed link flows for the first hour of the morning period (07:00 – 08:00) and the corresponding modelled flows, details of the absolute and percentage differences, and the value of the GEH statistic for the northern, east/south and canal screenlines, and the town centre cordon respectively.

TABLE 7.7 MORNING PERIOD MODEL (07:00 – 08:00): OBSERVED VS MODELLED FLOWS: NORTHERN SCREENLINE

Link	A-Node	B-Node	Count	Model	Abs. Diff.	% Diff.	GEH
Northern Screenline							
Inbound							
Berkhamsted Road / Boxted Road	124	106	222	313	91	41%	5.56
Leighton Buzzard Road	90	676z	1198	1189	-9	-1%	0.26
Piccotts End	95	689	49	49	0	0%	0.00
Aycliffe Drive	681	83d	497	547	50	10%	2.19
St Agnells Lane	72	607	458	403	-55	-12%	2.65
Shenley Road west	291z	63d	379	309	-70	-18%	3.77
Shenley Road east	291	284	266	310	44	17%	2.59
Total Inbound			3069	3120	51	2%	0.92
Outbound							
Berkhamsted Road / Boxted Road	106	124	254	215	-39	-15%	2.55
Leighton Buzzard Road	676z	90	441	382	-59	-13%	2.91
Piccotts End	689	95	14	21	7	50%	1.67
Aycliffe Drive	83d	681	156	214	58	37%	4.26
St Agnells Lane	608	72	149	149	0	0%	0.00
Shenley Road west	63d	291z	67	111	44	66%	4.66
Shenley Road east	284	291	104	121	17	16%	1.60
Total Outbound			1185	1213	28	2%	0.81

TABLE 7.8 MORNING PERIOD MODEL (07:00 – 08:00): OBSERVED VS MODELLED FLOWS: EAST/SOUTH SCREENLINE

Link	A-Node	B-Node	Count	Model	Abs. Diff.	% Diff.	GEH
East/South Screenline							
Inbound							
Hemel Hempstead Road	498	55	748	742	-6	-1%	0.22
Breakspear Way	8	533	1612	1630	18	1%	0.45
Hemel Hempstead Road	777	327	584	585	1	0%	0.04
Bedmond Road / Bedmond Hill	340	329	296	325	29	10%	1.65
Lower Road	741	347	180	152	-28	-16%	2.17
Total Inbound			3420	3434	14	0%	0.24
Outbound							
Hemel Hempstead Road	55	498	889	845	-44	-5%	1.49
Breakspear Way	532	7	1617	1585	-32	-2%	0.80
Hemel Hempstead Road	327	777	666	587	-79	-12%	3.16
Bedmond Road / Bedmond Hill	329	340	632	503	-129	-20%	5.42
Lower Road	347	741	648	552	-96	-15%	3.92
Total Outbound			4452	4072	-380	-9%	5.82

TABLE 7.9 MORNING PERIOD MODEL (07:00 – 08:00): OBSERVED VS MODELLED FLOWS: CANAL SCREENLINE

Link	A-Node	B-Node	Count	Model	Abs. Diff.	% Diff.	GEH
Canal Screenline							
Inbound							
Fishery Road	735	418	205	227	22	11%	1.50
Station Road	542a	474	571	631	60	11%	2.45
Two Waters Way	646z	465	790	790	0	0%	0.00
Durrants Hill Road	728z	727z	230	213	-17	-7%	1.14
Nash Mills Lane / Red Lion Lane	748	744	340	341	1	0%	0.05
Total Inbound			2136	2202	66	3%	1.42
Outbound							
Fishery Road	418	735	653	582	-71	-11%	2.86
Station Road	474	542a	644	518	-126	-20%	5.23
Two Waters Way	465	650z	1067	1109	42	4%	1.27
Durrants Hill Road	727z	728z	283	225	-58	-20%	3.64
Nash Mills Lane / Red Lion Lane	744	748	331	340	9	3%	0.49
Total Outbound			2978	2774	-204	-7%	3.80

TABLE 7.10 MORNING PERIOD MODEL (07:00 – 08:00): OBSERVED VS MODELLED FLOWS: TOWN CENTRE CORDON

Link	A-Node	B-Node	Count	Model	Abs. Diff.	% Diff.	GEH
Town Centre Cordon							
Inbound							
Section: North							
Leighton Buzzard Road	710	163d	1024	1038	14	1%	0.44
Queensway	196	197	275	447	172	63%	9.05
Section: East							
Adeyfield Road	221	222	319	372	53	17%	2.85
St Albans Road	781	667	1074	1188	114	11%	3.39
Section: South							
Bennetts End Road	370	625	658	717	59	9%	2.25
Jarman Way	658x	666	208	211	3	1%	0.21
Lawn Lane	461	655	378	304	-74	-20%	4.01
Two Waters Road	464	656	795	780	-15	-2%	0.53
Section: West							
Station Road	658z	657	892	851	-41	-5%	1.39
Warners End Road	493	163c	583	679	96	16%	3.82
Total Inbound			6206	6587	381	6%	4.76
Outbound							
Section: North							
Leighton Buzzard Road	163d	710	400	404	4	1%	0.20
Queensway	197	196	506	483	-23	-5%	1.03
Section: East							
Adeyfield Road	222	221	319	252	-67	-21%	3.97
St Albans Road	666x	780	1444	1633	189	13%	4.82
Section: South							
Bennetts End Road	624	370	625	612	-13	-2%	0.52
Jarman Way	665	659	250	220	-30	-12%	1.96
Lawn Lane	655	461	379	331	-48	-13%	2.55
Two Waters Road	656	464	1059	1107	48	5%	1.46
Section: West							
Station Road	657	658z	680	593	-87	-13%	3.45
Warners End Road	163c	493	390	338	-52	-13%	2.73
Total Outbound			6052	5973	-79	-1%	1.02

7.10 Generally, modelled link and screenline flows are acceptably close to the observed values over the 07:00 – 08:00 period. Table 7.11 demonstrates the compliance of this modelled hour in the morning period model with the DMRB guidelines. All DMRB criteria are met.

TABLE 7.11 MORNING PERIOD MODEL (07:00 – 08:00 HR) COMPLIANCE WITH DMRB GUIDELINES

Criteria and Measures	Number/% Satisfying Guideline	Compliance
Assigned hourly flows compared with observed flows:		
1. Individual flows within 100 for flows <700vph	93% (38/41)	Yes
2. Individual flows within 15% for flows 700-2,700vph	100% (13/13)	Yes
3. Individual flows within 400 for flows >2,700vph	N/A	Yes
4. Total screenline flows (normally >5 links) to be within 5%	Nearly all (5/8)	Yes
GEH statistic:		
(i) individual flows: GEH < 5	93% (50/54)	Yes
(ii) screenline totals : GEH < 4	Nearly all (6/8)	Yes

7.11 Tables 7.12-7.15 provide a summary comparison of observed link flows for the second hour of the morning period (08:00 – 09:00) and the corresponding modelled flows, details of the absolute and percentage differences, and the value of the GEH statistic for the northern, east/south and canal screenlines, and the town centre cordon respectively.

TABLE 7.12 MORNING PERIOD MODEL (08:00 – 09:00): OBSERVED VS MODELLED FLOWS: NORTHERN SCREENLINE

Link	A-Node	B-Node	Count	Model	Abs. Diff.	% Diff.	GEH
Northern Screenline							
Inbound							
Berkhamsted Road / Boxted Road	124	106	430	416	-14	-3%	0.68
Leighton Buzzard Road	90	676z	1281	1244	-37	-3%	1.04
Piccotts End	95	689	97	51	-46	-47%	5.35
Aycliffe Drive	681	83d	646	590	-56	-9%	2.25
St Agnells Lane	72	607	437	442	5	1%	0.24
Shenley Road west	291z	63d	448	325	-123	-27%	6.26
Shenley Road east	291	284	306	293	-13	-4%	0.75
Total Inbound			3645	3361	-284	-8%	4.80
Outbound							
Berkhamsted Road / Boxted Road	106	124	441	388	-53	-12%	2.60
Leighton Buzzard Road	676z	90	508	480	-28	-6%	1.26
Piccotts End	689	95	15	25	10	67%	2.24
Aycliffe Drive	83d	681	316	261	-55	-17%	3.24
St Agnells Lane	608	72	225	217	-8	-4%	0.54
Shenley Road west	63d	291z	226	153	-73	-32%	5.30
Shenley Road east	284	291	162	169	7	4%	0.54
Total Outbound			1893	1693	-200	-11%	4.72

TABLE 7.13 MORNING PERIOD MODEL (08:00 – 09:00): OBSERVED VS MODELLED FLOWS: EAST/SOUTH SCREENLINE

Link	A-Node	B-Node	Count	Model	Abs. Diff.	% Diff.	GEH
East/South Screenline							
Inbound							
Hemel Hempstead Road	498	55	908	897	-11	-1%	0.37
Breakspear Way	8	533	2152	2092	-60	-3%	1.30
Hemel Hempstead Road	777	327	743	736	-7	-1%	0.26
Bedmond Road / Bedmond Hill	340	329	437	474	37	8%	1.73
Lower Road	741	347	357	296	-61	-17%	3.38
Total Inbound			4597	4495	-102	-2%	1.51
Outbound							
Hemel Hempstead Road	55	498	888	865	-23	-3%	0.78
Breakspear Way	532	7	1747	1942	195	11%	4.54
Hemel Hempstead Road	327	777	587	594	7	1%	0.29
Bedmond Road / Bedmond Hill	329	340	568	510	-58	-10%	2.50
Lower Road	347	741	528	508	-20	-4%	0.88
Total Outbound			4318	4419	101	2%	1.53

TABLE 7.14 MORNING PERIOD MODEL (08:00 – 09:00): OBSERVED VS MODELLED FLOWS: CANAL SCREENLINE

Link	A-Node	B-Node	Count	Model	Abs. Diff.	% Diff.	GEH
Canal Screenline							
Inbound							
Fishery Road	735	418	405	343	-62	-15%	3.21
Station Road	542a	474	884	994	110	12%	3.59
Two Waters Way	646z	465	1221	1150	-71	-6%	2.06
Durrants Hill Road	728z	727z	332	263	-69	-21%	4.00
Nash Mills Lane / Red Lion Lane	748	744	430	432	2	0%	0.10
Total Inbound			3272	3182	-90	-3%	1.58
Outbound							
Fishery Road	418	735	729	789	60	8%	2.18
Station Road	474	542a	528	599	71	13%	2.99
Two Waters Way	465	650z	909	1065	156	17%	4.97
Durrants Hill Road	727z	728z	337	295	-42	-12%	2.36
Nash Mills Lane / Red Lion Lane	744	748	575	487	-88	-15%	3.82
Total Outbound			3078	3235	157	5%	2.79

TABLE 7.15 MORNING PERIOD MODEL (08:00 – 09:00): OBSERVED VS MODELLED FLOWS: TOWN CENTRE CORDON

Link	A-Node	B-Node	Count	Model	Abs. Diff.	% Diff.	GEH
Town Centre Cordon							
Inbound							
Section: North							
Leighton Buzzard Road	710	163d	831	1079	248	30%	8.03
Queensway	196	197	484	514	30	6%	1.34
Section: East							
Adeyfield Road	221	222	524	477	-47	-9%	2.10
St Albans Road	781	667	1325	1462	137	10%	3.67
Section: South							
Bennetts End Road	370	625	859	742	-117	-14%	4.14
Jarman Way	658x	666	277	292	15	5%	0.89
Lawn Lane	461	655	358	415	57	16%	2.90
Two Waters Road	464	656	1007	1138	131	13%	4.00
Section: West							
Station Road	658z	657	1130	1078	-52	-5%	1.57
Warners End Road	493	163c	1074	768	-306	-28%	10.08
Total Inbound			7869	7965	96	1%	1.08
Outbound							
Section: North							
Leighton Buzzard Road	163d	710	431	530	99	23%	4.52
Queensway	197	196	756	633	-123	-16%	4.67
Section: East							
Adeyfield Road	222	221	404	474	70	17%	3.34
St Albans Road	666x	780	1556	1505	-51	-3%	1.30
Section: South							
Bennetts End Road	624	370	888	767	-121	-14%	4.21
Jarman Way	665	659	381	357	-24	-6%	1.25
Lawn Lane	655	461	359	453	94	26%	4.67
Two Waters Road	656	464	1003	1054	51	5%	1.59
Section: West							
Station Road	657	658z	643	662	19	3%	0.74
Warners End Road	163c	493	420	472	52	12%	2.46
Total Outbound			6841	6907	66	1%	0.80

7.12 Generally, modelled link and screenline flows are acceptably close to the observed values over the 08:00 – 09:00 period. Table 7.16 demonstrates the compliance of this modelled hour in the morning period model with the DMRB guidelines. All DMRB criteria are met.

TABLE 7.16 MORNING PERIOD MODEL (08:00 – 09:00 HR) COMPLIANCE WITH DMRB GUIDELINES

Criteria and Measures	Number/% Satisfying Guideline	Compliance
Assigned hourly flows compared with observed flows:		
1. Individual flows within 100 for flows <700vph	97% (33/34)	Yes
2. Individual flows within 15% for flows 700-2,700vph	100% (20/20)	Yes
3. Individual flows within 400 for flows >2,700vph	N/A	Yes
4. Total screenline flows (normally >5 links) to be within 5%	Nearly all (6/8)	Yes
GEH statistic:		
(i) individual flows: GEH < 5	91% (49/54)	Yes
(ii) screenline totals : GEH < 4	Nearly all (6/8)	Yes

7.13 Tables 7.17-7.20 provide a summary comparison of observed link flows for the second

hour of the morning period (09:00 – 10:00) and the corresponding modelled flows, details of the absolute and percentage differences, and the value of the GEH statistic for the northern, east/south and canal screenlines, and the town centre cordon respectively.

TABLE 7.17 MORNING PERIOD MODEL (09:00 –10:00): OBSERVED VS MODELLED FLOWS: NORTHERN SCREENLINE

Link	A-Node	B-Node	Count	Model	Abs. Diff.	% Diff.	GEH
Northern Screenline							
Inbound							
Berkhamsted Road / Boxted Road	124	106	216	259	43	20%	2.79
Leighton Buzzard Road	90	676z	781	821	40	5%	1.41
Piccotts End	95	689	31	31	0	0%	0.00
Aycliffe Drive	681	83d	387	386	-1	0%	0.05
St Agnells Lane	72	607	248	277	29	12%	1.79
Shenley Road west	291z	63d	245	243	-2	-1%	0.13
Shenley Road east	291	284	167	252	85	51%	5.87
Total Inbound			2075	2269	194	9%	4.16
Outbound							
Berkhamsted Road / Boxted Road	106	124	202	228	26	13%	1.77
Leighton Buzzard Road	676z	90	387	369	-18	-5%	0.93
Piccotts End	689	95	22	18	-4	-18%	0.89
Aycliffe Drive	83d	681	217	187	-30	-14%	2.11
St Agnells Lane	608	72	213	188	-25	-12%	1.77
Shenley Road west	63d	291z	116	125	9	8%	0.82
Shenley Road east	284	291	160	144	-16	-10%	1.30
Total Outbound			1317	1259	-58	-4%	1.62

TABLE 7.18 MORNING PERIOD MODEL (09:00 - 10:00): OBSERVED VS MODELLED FLOWS: EAST/SOUTH SCREENLINE

Link	A-Node	B-Node	Count	Model	Abs. Diff.	% Diff.	GEH
East/South Screenline							
Inbound							
Hemel Hempstead Road	498	55	563	586	23	4%	0.96
Breakspear Way	8	533	1641	1613	-28	-2%	0.69
Hemel Hempstead Road	777	327	461	488	27	6%	1.24
Bedmond Road / Bedmond Hill	340	329	262	303	41	16%	2.44
Lower Road	741	347	261	226	-35	-13%	2.24
Total Inbound			3188	3216	28	1%	0.49
Outbound							
Hemel Hempstead Road	55	498	474	643	169	36%	7.15
Breakspear Way	532	7	1469	1220	-249	-17%	6.79
Hemel Hempstead Road	327	777	417	472	55	13%	2.61
Bedmond Road / Bedmond Hill	329	340	321	350	29	9%	1.58
Lower Road	347	741	368	393	25	7%	1.28
Total Outbound			3049	3078	29	1%	0.52

TABLE 7.19 MORNING PERIOD MODEL (09:00 – 10:00): OBSERVED VS MODELLED FLOWS: CANAL SCREENLINE

Link	A-Node	B-Node	Count	Model	Abs. Diff.	% Diff.	GEH
Canal Screenline							
Inbound							
Fishery Road	735	418	275	254	-21	-8%	1.29
Station Road	542a	474	685	708	23	3%	0.87
Two Waters Way	646z	465	1023	868	-155	-15%	5.04
Durrants Hill Road	728z	727z	262	188	-74	-28%	4.93
Nash Mills Lane / Red Lion Lane	748	744	218	353	135	62%	7.99
Total Inbound			2463	2371	-92	-4%	1.87
Outbound							
Fishery Road	418	735	410	475	65	16%	3.09
Station Road	474	542a	339	454	115	34%	5.78
Two Waters Way	465	650z	820	819	-1	0%	0.03
Durrants Hill Road	727z	728z	290	180	-110	-38%	7.18
Nash Mills Lane / Red Lion Lane	744	748	356	354	-2	-1%	0.11
Total Outbound			2215	2282	67	3%	1.41

TABLE 7.20 MORNING PERIOD MODEL (09:00 – 10:00): OBSERVED VS MODELLED FLOWS: TOWN CENTRE CORDON

Link	A-Node	B-Node	Count	Model	Abs. Diff.	% Diff.	GEH
Town Centre Cordon							
Inbound							
Section: North							
Leighton Buzzard Road	710	163d	801	771	-30	-4%	1.07
Queensway	196	197	351	366	15	4%	0.79
Section: East							
Adeyfield Road	221	222	413	271	-142	-34%	7.68
St Albans Road	781	667	1220	1173	-47	-4%	1.36
Section: South							
Bennetts End Road	370	625	643	582	-61	-9%	2.46
Jarman Way	658x	666	361	380	19	5%	0.99
Lawn Lane	461	655	314	308	-6	-2%	0.34
Two Waters Road	464	656	927	892	-35	-4%	1.16
Section: West							
Station Road	658z	657	1040	850	-190	-18%	6.18
Warners End Road	493	163c	547	537	-10	-2%	0.43
Total Inbound			6617	6130	-487	-7%	6.10
Outbound							
Section: North							
Leighton Buzzard Road	163d	710	364	369	5	1%	0.26
Queensway	197	196	413	441	28	7%	1.36
Section: East							
Adeyfield Road	222	221	252	197	-55	-22%	3.67
St Albans Road	666x	780	1312	1370	58	4%	1.58
Section: South							
Bennetts End Road	624	370	648	574	-74	-11%	2.99
Jarman Way	665	659	455	452	-3	-1%	0.14
Lawn Lane	655	461	315	261	-54	-17%	3.18
Two Waters Road	656	464	879	817	-62	-7%	2.13
Section: West							
Station Road	657	658z	564	523	-41	-7%	1.76
Warners End Road	163c	493	354	312	-42	-12%	2.30
Total Outbound			5556	5316	-240	-4%	3.26

7.14 Generally, modelled link and screenline flows are acceptably close to the observed values over the 09:00 – 10:00 period. Table 7.21 demonstrates the compliance of this modelled hour in the morning period model with the DMRB guidelines. All DMRB criteria are met.

TABLE 7.21 MORNING PERIOD MODEL (09:00 –10:00 HR) COMPLIANCE WITH DMRB GUIDELINES

Criteria and Measures	Number/% Satisfying Guideline	Compliance
Assigned hourly flows compared with observed flows:		
1. Individual flows within 100 for flows <700vph	88% (38/43)	Yes
2. Individual flows within 15% for flows 700-2,700vph	100% (11/11)	Yes
3. Individual flows within 400 for flows >2,700vph	N/A	Yes
4. Total screenline flows (normally >5 links) to be within 5%	Nearly all (6/8)	Yes
GEH statistic:		
(i) individual flows: GEH < 5	83% (45/54)	No
(ii) screenline totals : GEH < 4	Nearly all (6/8)	Yes

7.15 Only 83% of modelled links flows give a GEH of less than 5.0 when compared to observed flows, meaning that the third modelled hour narrowly fails one of the DMRB criteria. However, this final modelled hour out of the three hour period is effectively acting as a model cooldown, as recommended in the micro-simulation good practice guide. More importantly, the three hour period and peak hour statistics all meet the DMRB criteria.

Evening Period Model

7.16 Tables 7.22-7.25 provide a summary comparison of observed link flows for the 3 hour evening period and the corresponding modelled flows, details of the absolute and percentage differences, and the value of the GEH statistic for the northern, east/south and canal screenlines, and the town centre cordon respectively.

TABLE 7.22 EVENING PERIOD MODEL: OBSERVED VS MODELLED FLOWS: NORTHERN SCREENLINE

Link	A-Node	B-Node	Count	Model	Abs. Diff.	% Diff.	GEH
Northern Screenline							
Inbound							
Berkhamsted Road / Boxted Road	124	106	860	1038	178	21%	5.78
Leighton Buzzard Road	90	676z	1347	1373	26	2%	0.71
Piccotts End	95	689	89	48	-41	-46%	4.95
Aycliffe Drive	681	83d	1002	1048	46	5%	1.44
St Agnells Lane	72	607	729	720	-9	-1%	0.33
Shenley Road west	291z	63d	739	636	-103	-14%	3.93
Shenley Road east	291	284	537	654	117	22%	4.79
Total Inbound			5303	5517	214	4%	2.91
Outbound							
Berkhamsted Road / Boxted Road	106	124	819	732	-87	-11%	3.12
Leighton Buzzard Road	676z	90	2682	2509	-173	-6%	3.40
Piccotts End	689	95	160	133	-27	-17%	2.23
Aycliffe Drive	83d	681	1598	1598	0	0%	0.00
St Agnells Lane	608	72	1448	1580	132	9%	3.39
Shenley Road west	63d	291z	922	938	16	2%	0.52
Shenley Road east	284	291	1148	1021	-127	-11%	3.86
Total Outbound			8777	8511	-266	-3%	2.86

TABLE 7.23 EVENING PERIOD MODEL: OBSERVED VS MODELLED FLOWS: EAST/SOUTH SCREENLINE

Link	A-Node	B-Node	Count	Model	Abs. Diff.	% Diff.	GEH
East/South Screenline							
Inbound							
Hemel Hempstead Road	498	55	2070	2075	5	0%	0.11
Breakspear Way	8	533	5020	5131	111	2%	1.56
Hemel Hempstead Road	777	327	1689	1689	0	0%	0.00
Bedmond Road / Bedmond Hill	340	329	1536	1575	39	3%	0.99
Lower Road	741	347	1654	1686	32	2%	0.78
Total Inbound			11969	12156	187	2%	1.70
Outbound							
Hemel Hempstead Road	55	498	2223	2156	-67	-3%	1.43
Breakspear Way	532	7	4240	4297	57	1%	0.87
Hemel Hempstead Road	327	777	1214	1190	-24	-2%	0.69
Bedmond Road / Bedmond Hill	329	340	1009	956	-53	-5%	1.69
Lower Road	347	741	727	682	-45	-6%	1.70
Total Outbound			9413	9281	-132	-1%	1.37

TABLE 7.24 EVENING PERIOD MODEL: OBSERVED VS MODELLED FLOWS: CANAL SCREENLINE

Link	A-Node	B-Node	Count	Model	Abs. Diff.	% Diff.	GEH
Canal Screenline							
Inbound							
Fishery Road	735	418	2064	1967	-97	-5%	2.16
Station Road	542a	474	2397	2516	119	5%	2.40
Two Waters Way	646z	465	2828	2962	134	5%	2.49
Durrants Hill Road	728z	727z	1278	1057	-221	-17%	6.47
Nash Mills Lane / Red Lion Lane	748	744	1195	1112	-83	-7%	2.44
Total Inbound			9762	9614	-148	-2%	1.50
Outbound							
Fishery Road	418	735	1299	1130	-169	-13%	4.85
Station Road	474	542a	1475	1632	157	11%	3.98
Two Waters Way	465	650z	3283	3325	42	1%	0.73
Durrants Hill Road	727z	728z	781	521	-260	-33%	10.19
Nash Mills Lane / Red Lion Lane	744	748	1154	1192	38	3%	1.11
Total Outbound			7992	7800	-192	-2%	2.16

TABLE 7.25 EVENING PERIOD MODEL: OBSERVED VS MODELLED FLOWS: TOWN CENTRE CORDON

Link	A-Node	B-Node	Count	Model	Abs. Diff.	% Diff.	GEH
Town Centre Cordon							
Inbound							
Section: North							
Leighton Buzzard Road	710	163d	1867	1887	20	1%	0.46
Queensway	196	197	1673	1933	260	16%	6.12
Section: East							
Adeyfield Road	221	222	1737	1842	105	6%	2.48
St Albans Road	781	667	4814	4764	-50	-1%	0.72
Section: South							
Bennetts End Road	370	625	2331	2141	-190	-8%	4.02
Jarman Way	658x	666	1935	1856	-79	-4%	1.81
Lawn Lane	461	655	1003	1052	49	5%	1.53
Two Waters Road	464	656	2802	2954	152	5%	2.83
Section: West							
Station Road	658z	657	2924	2619	-305	-10%	5.79
Warners End Road	493	163c	1449	1565	116	8%	2.99
Total Inbound			22535	22613	78	0%	0.52
Outbound							
Section: North							
Leighton Buzzard Road	163d	710	2469	2586	117	5%	2.33
Queensway	197	196	1182	1074	-108	-9%	3.22
Section: East							
Adeyfield Road	222	221	820	1023	203	25%	6.69
St Albans Road	666x	780	4108	4136	28	1%	0.44
Section: South							
Bennetts End Road	624	370	2869	2845	-24	-1%	0.45
Jarman Way	665	659	2010	2016	6	0%	0.13
Lawn Lane	655	461	963	867	-96	-10%	3.17
Two Waters Road	656	464	3100	3142	42	1%	0.75
Section: West							
Station Road	657	658z	1727	2005	278	16%	6.44
Warners End Road	163c	493	2823	2696	-127	-4%	2.42
Total Outbound			22071	22390	319	1%	2.14

7.17 Generally, modelled link and screenline flows are acceptably close to the observed values over the 3 hour period. Table 7.26 demonstrates the compliance of the evening period model with the DMRB guidelines. All but one DMRB criteria are met. For individual flows less than 700 only 2 out of 3 links are within 100. However, this applies to a small number of low-flow links of relative insignificance over a 3hr model period

TABLE 7.26 EVENING PERIOD MODEL COMPLIANCE WITH DMRB GUIDELINES

Criteria and Measures	Number/% Satisfying Guideline	Compliance
Assigned hourly flows compared with observed flows:		
1. Individual flows within 100 for flows <700vph	67% (2/3)	No
2. Individual flows within 15% for flows 700-2,700vph	100% (40/40)	Yes
3. Individual flows within 400 for flows >2,700vph	100% (11/11)	Yes
4. Total screenline flows (normally >5 links) to be within 5%	All (8/8)	Yes
GEH statistic:		
(i) individual flows: GEH < 5	87% (47/54)	Yes
(ii) screenline totals : GEH < 4	All (8/8)	Yes

7.18 Tables 7.27-7.30 provide a summary comparison of observed link flows for the first hour of the evening period (16:00 – 17:00) and the corresponding modelled flows, details of the absolute and percentage differences, and the value of the GEH statistic for the northern, east/south and canal screenlines, and the town centre cordon respectively.

TABLE 7.27 EVENING PERIOD MODEL (16:00 – 17:00): OBSERVED VS MODELLED FLOWS: NORTHERN SCREENLINE

Link	A-Node	B-Node	Count	Model	Abs. Diff.	% Diff.	GEH
Northern Screenline							
Inbound							
Berkhamsted Road / Boxted Road	124	106	331	347	16	5%	0.87
Leighton Buzzard Road	90	676z	490	471	-19	-4%	0.87
Piccotts End	95	689	27	15	-12	-44%	2.62
Aycliffe Drive	681	83d	350	340	-10	-3%	0.54
St Agnells Lane	72	607	244	233	-11	-5%	0.71
Shenley Road west	291z	63d	228	204	-24	-11%	1.63
Shenley Road east	291	284	179	213	34	19%	2.43
Total Inbound			1849	1823	-26	-1%	0.61
Outbound							
Berkhamsted Road / Boxted Road	106	124	258	214	-44	-17%	2.86
Leighton Buzzard Road	676z	90	826	723	-103	-12%	3.70
Piccotts End	689	95	36	39	3	8%	0.49
Aycliffe Drive	83d	681	494	503	9	2%	0.40
St Agnells Lane	608	72	427	474	47	11%	2.21
Shenley Road west	63d	291z	242	287	45	19%	2.77
Shenley Road east	284	291	339	308	-31	-9%	1.72
Total Outbound			2622	2548	-74	-3%	1.46

TABLE 7.28 EVENING PERIOD MODEL (16:00 – 17:00): OBSERVED VS MODELLED FLOWS: EAST/SOUTH SCREENLINE

Link	A-Node	B-Node	Count	Model	Abs. Diff.	% Diff.	GEH
East/South Screenline							
Inbound							
Hemel Hempstead Road	498	55	675	667	-8	-1%	0.31
Breakspear Way	8	533	1669	1650	-19	-1%	0.47
Hemel Hempstead Road	777	327	600	591	-9	-2%	0.37
Bedmond Road / Bedmond Hill	340	329	500	510	10	2%	0.44
Lower Road	741	347	562	566	4	1%	0.17
Total Inbound			4006	3984	-22	-1%	0.35
Outbound							
Hemel Hempstead Road	55	498	731	656	-75	-10%	2.85
Breakspear Way	532	7	1290	1301	11	1%	0.31
Hemel Hempstead Road	327	777	408	364	-44	-11%	2.24
Bedmond Road / Bedmond Hill	329	340	326	282	-44	-13%	2.52
Lower Road	347	741	254	216	-38	-15%	2.48
Total Outbound			3009	2819	-190	-6%	3.52

TABLE 7.29 EVENING PERIOD MODEL (16:00 – 17:00): OBSERVED VS MODELLED FLOWS: CANAL SCREENLINE

Link	A-Node	B-Node	Count	Model	Abs. Diff.	% Diff.	GEH
Canal Screenline							
Inbound							
Fishery Road	735	418	655	661	6	1%	0.23
Station Road	542a	474	775	830	55	7%	1.94
Two Waters Way	646z	465	1046	983	-63	-6%	1.98
Durrants Hill Road	728z	727z	405	340	-65	-16%	3.37
Nash Mills Lane / Red Lion Lane	748	744	403	330	-73	-18%	3.81
Total Inbound			3284	3144	-140	-4%	2.47
Outbound							
Fishery Road	418	735	393	356	-37	-9%	1.91
Station Road	474	542a	415	467	52	13%	2.48
Two Waters Way	465	650z	1093	1005	-88	-8%	2.72
Durrants Hill Road	727z	728z	249	174	-75	-30%	5.16
Nash Mills Lane / Red Lion Lane	744	748	404	387	-17	-4%	0.85
Total Outbound			2554	2389	-165	-6%	3.32

TABLE 7.30 EVENING PERIOD MODEL (16:00 – 17:00): OBSERVED VS MODELLED FLOWS: TOWN CENTRE CORDON

Link	A-Node	B-Node	Count	Model	Abs. Diff.	% Diff.	GEH
Town Centre Cordon							
Inbound							
Section: North							
Leighton Buzzard Road	710	163d	611	622	11	2%	0.44
Queensway	196	197	511	566	55	11%	2.37
Section: East							
Adeyfield Road	221	222	515	573	58	11%	2.49
St Albans Road	781	667	1573	1490	-83	-5%	2.12
Section: South							
Bennetts End Road	370	625	770	662	-108	-14%	4.04
Jarman Way	658x	666	548	523	-25	-5%	1.08
Lawn Lane	461	655	345	309	-36	-10%	1.99
Two Waters Road	464	656	965	976	11	1%	0.35
Section: West							
Station Road	658z	657	1007	848	-159	-16%	5.22
Warners End Road	493	163c	515	459	-56	-11%	2.54
Total Inbound			7360	7028	-332	-5%	3.91
Outbound							
Section: North							
Leighton Buzzard Road	163d	710	850	790	-60	-7%	2.10
Queensway	197	196	407	344	-63	-15%	3.25
Section: East							
Adeyfield Road	222	221	280	311	31	11%	1.80
St Albans Road	666x	780	1414	1285	-129	-9%	3.51
Section: South							
Bennetts End Road	624	370	926	904	-22	-2%	0.73
Jarman Way	665	659	598	558	-40	-7%	1.66
Lawn Lane	655	461	319	272	-47	-15%	2.73
Two Waters Road	656	464	1027	966	-61	-6%	1.93
Section: West							
Station Road	657	658z	573	592	19	3%	0.79
Warners End Road	163c	493	972	832	-140	-14%	4.66
Total Outbound			7366	6854	-512	-7%	6.07

7.19 Generally, modelled link and screenline flows are acceptably close to the observed values over the 16:00 – 17:00 period. Table 7.31 demonstrates the compliance of this modelled hour in the evening period model with the DMRB guidelines. All DMRB criteria are met.

TABLE 7.31 EVENING PERIOD MODEL (16:00 – 17:00) COMPLIANCE WITH DMRB GUIDELINES

Criteria and Measures	Number/% Satisfying Guideline	Compliance
Assigned hourly flows compared with observed flows:		
1. Individual flows within 100 for flows <700vph	100% (38/38)	Yes
2. Individual flows within 15% for flows 700-2,700vph	100% (16/16)	Yes
3. Individual flows within 400 for flows >2,700vph	N/A	Yes
4. Total screenline flows (normally >5 links) to be within 5%	Nearly all (6/8)	Yes
GEH statistic:		
(i) individual flows: GEH < 5	96% (52/54)	Yes
(ii) screenline totals : GEH < 4	Nearly all (7/8)	Yes

7.20 Tables 7.32-7.35 provide a summary comparison of observed link flows for the second hour of the evening period (17:00 – 18:00) and the corresponding modelled flows, details of the absolute and percentage differences, and the value of the GEH statistic for the northern, east/south and canal screenlines, and the town centre cordon respectively.

TABLE 7.32 EVENING PERIOD MODEL (17:00 – 18:00): OBSERVED VS MODELLED FLOWS: NORTHERN SCREENLINE

Link	A-Node	B-Node	Count	Model	Abs. Diff.	% Diff.	GEH
Northern Screenline							
Inbound							
Berkhamsted Road / Boxted Road	124	106	380	396	16	4%	0.81
Leighton Buzzard Road	90	676z	508	532	24	5%	1.05
Piccotts End	95	689	32	19	-13	-41%	2.57
Aycliffe Drive	681	83d	332	390	58	17%	3.05
St Agnells Lane	72	607	256	263	7	3%	0.43
Shenley Road west	291z	63d	259	255	-4	-2%	0.25
Shenley Road east	291	284	168	239	71	42%	4.98
Total Inbound			1935	2094	159	8%	3.54
Outbound							
Berkhamsted Road / Boxted Road	106	124	326	286	-40	-12%	2.29
Leighton Buzzard Road	676z	90	1020	959	-61	-6%	1.94
Piccotts End	689	95	64	51	-13	-20%	1.71
Aycliffe Drive	83d	681	602	586	-16	-3%	0.66
St Agnells Lane	608	72	508	568	60	12%	2.59
Shenley Road west	63d	291z	358	332	-26	-7%	1.40
Shenley Road east	284	291	437	370	-67	-15%	3.34
Total Outbound			3315	3152	-163	-5%	2.87

TABLE 7.33 EVENING PERIOD MODEL (17:00 – 18:00): OBSERVED VS MODELLED FLOWS: EAST/SOUTH SCREENLINE

Link	A-Node	B-Node	Count	Model	Abs. Diff.	% Diff.	GEH
East/South Screenline							
Inbound							
Hemel Hempstead Road	498	55	747	753	6	1%	0.22
Breakspear Way	8	533	1695	1776	81	5%	1.94
Hemel Hempstead Road	777	327	611	617	6	1%	0.24
Bedmond Road / Bedmond Hill	340	329	591	605	14	2%	0.57
Lower Road	741	347	646	651	5	1%	0.20
Total Inbound			4290	4402	112	3%	1.70
Outbound							
Hemel Hempstead Road	55	498	840	806	-34	-4%	1.19
Breakspear Way	532	7	1806	1749	-57	-3%	1.35
Hemel Hempstead Road	327	777	451	439	-12	-3%	0.57
Bedmond Road / Bedmond Hill	329	340	392	363	-29	-7%	1.49
Lower Road	347	741	271	252	-19	-7%	1.17
Total Outbound			3760	3609	-151	-4%	2.49

TABLE 7.34 EVENING PERIOD MODEL (17:00 – 18:00): OBSERVED VS MODELLED FLOWS: CANAL SCREENLINE

Link	A-Node	B-Node	Count	Model	Abs. Diff.	% Diff.	GEH
Canal Screenline							
Inbound							
Fishery Road	735	418	776	701	-75	-10%	2.76
Station Road	542a	474	822	917	95	12%	3.22
Two Waters Way	646z	465	964	1090	126	13%	3.93
Durrants Hill Road	728z	727z	505	361	-144	-29%	6.92
Nash Mills Lane / Red Lion Lane	748	744	431	403	-28	-6%	1.37
Total Inbound			3498	3472	-26	-1%	0.44
Outbound							
Fishery Road	418	735	450	415	-35	-8%	1.68
Station Road	474	542a	543	610	67	12%	2.79
Two Waters Way	465	650z	1199	1267	68	6%	1.94
Durrants Hill Road	727z	728z	263	196	-67	-25%	4.42
Nash Mills Lane / Red Lion Lane	744	748	385	452	67	17%	3.28
Total Outbound			2840	2940	100	4%	1.86

TABLE 7.35 EVENING PERIOD MODEL (17:00 – 18:00): OBSERVED VS MODELLED FLOWS: TOWN CENTRE CORDON

Link	A-Node	B-Node	Count	Model	Abs. Diff.	% Diff.	GEH
Town Centre Cordon							
Inbound							
Section: North							
Leighton Buzzard Road	710	163d	636	691	55	9%	2.14
Queensway	196	197	706	733	27	4%	1.01
Section: East							
Adeyfield Road	221	222	727	707	-20	-3%	0.75
St Albans Road	781	667	1692	1701	9	1%	0.22
Section: South							
Bennetts End Road	370	625	830	810	-20	-2%	0.70
Jarman Way	658x	666	671	643	-28	-4%	1.09
Lawn Lane	461	655	331	398	67	20%	3.51
Two Waters Road	464	656	924	1095	171	19%	5.38
Section: West							
Station Road	658z	657	964	959	-5	-1%	0.16
Warners End Road	493	163c	512	627	115	22%	4.82
Total Inbound			7993	8364	371	5%	4.10
Outbound							
Section: North							
Leighton Buzzard Road	163d	710	814	947	133	16%	4.48
Queensway	197	196	430	380	-50	-12%	2.48
Section: East							
Adeyfield Road	222	221	289	390	101	35%	5.48
St Albans Road	666x	780	1441	1555	114	8%	2.95
Section: South							
Bennetts End Road	624	370	1145	1017	-128	-11%	3.89
Jarman Way	665	659	721	735	14	2%	0.52
Lawn Lane	655	461	352	345	-7	-2%	0.37
Two Waters Road	656	464	1133	1194	61	5%	1.79
Section: West							
Station Road	657	658z	631	742	111	18%	4.24
Warners End Road	163c	493	990	1000	10	1%	0.32
Total Outbound			7946	8305	359	5%	3.98

7.21 Generally, modelled link and screenline flows are acceptably close to the observed values over the 17:00 – 18:00 period. Table 7.36 demonstrates the compliance of this modelled hour in the evening period model with the DMRB guidelines. All DMRB criteria are met.

TABLE 7.36 EVENING PERIOD MODEL (17:00 – 18:00) COMPLIANCE WITH DMRB GUIDELINES

Criteria and Measures	Number/% Satisfying Guideline	Compliance
Assigned hourly flows compared with observed flows:		
1. Individual flows within 100 for flows <700vph	88% (29/33)	Yes
2. Individual flows within 15% for flows 700-2,700vph	100% (21/21)	Yes
3. Individual flows within 400 for flows >2,700vph	N/A	Yes
4. Total screenline flows (normally >5 links) to be within 5%	Nearly all (7/8)	Yes
GEH statistic:		
(i) individual flows: GEH < 5	94% (51/54)	Yes
(ii) screenline totals : GEH < 4	Nearly all (7/8)	Yes

7.22 Tables 7.37-7.40 provide a summary comparison of observed link flows for the third

hour of the evening period (18:00 – 19:00) and the corresponding modelled flows, details of the absolute and percentage differences, and the value of the GEH statistic for the northern, east/south and canal screenlines, and the town centre cordon respectively.

TABLE 7.37 EVENING PERIOD MODEL (18:00 –19:00): OBSERVED VS MODELLED FLOWS: NORTHERN SCREENLINE

Link	A-Node	B-Node	Count	Model	Abs. Diff.	% Diff.	GEH
Northern Screenline							
Inbound							
Berkhamsted Road / Boxted Road	124	106	149	295	146	98%	9.80
Leighton Buzzard Road	90	676z	349	370	21	6%	1.11
Piccotts End	95	689	30	15	-15	-50%	3.16
Aycliffe Drive	681	83d	320	317	-3	-1%	0.17
St Agnells Lane	72	607	229	224	-5	-2%	0.33
Shenley Road west	291z	63d	252	177	-75	-30%	5.12
Shenley Road east	291	284	190	202	12	6%	0.86
Total Inbound			1519	1600	81	5%	2.05
Outbound							
Berkhamsted Road / Boxted Road	106	124	235	232	-3	-1%	0.20
Leighton Buzzard Road	676z	90	836	827	-9	-1%	0.31
Piccotts End	689	95	60	43	-17	-28%	2.37
Aycliffe Drive	83d	681	502	508	6	1%	0.27
St Agnells Lane	608	72	513	537	24	5%	1.05
Shenley Road west	63d	291z	322	320	-2	-1%	0.11
Shenley Road east	284	291	372	344	-28	-8%	1.48
Total Outbound			2840	2811	-29	-1%	0.55

TABLE 7.38 EVENING PERIOD MODEL (18:00 –19:00): OBSERVED VS MODELLED FLOWS: EAST/SOUTH SCREENLINE

Link	A-Node	B-Node	Count	Model	Abs. Diff.	% Diff.	GEH
East/South Screenline							
Inbound							
Hemel Hempstead Road	498	55	648	655	7	1%	0.27
Breakspear Way	8	533	1656	1705	49	3%	1.20
Hemel Hempstead Road	777	327	478	481	3	1%	0.14
Bedmond Road / Bedmond Hill	340	329	445	460	15	3%	0.71
Lower Road	741	347	446	469	23	5%	1.08
Total Inbound			3673	3770	97	3%	1.59
Outbound							
Hemel Hempstead Road	55	498	652	694	42	6%	1.62
Breakspear Way	532	7	1144	1247	103	9%	2.98
Hemel Hempstead Road	327	777	355	387	32	9%	1.66
Bedmond Road / Bedmond Hill	329	340	291	310	19	7%	1.10
Lower Road	347	741	202	215	13	6%	0.90
Total Outbound			2644	2853	209	8%	3.99

TABLE 7.39 EVENING PERIOD MODEL (18:00 –19:00): OBSERVED VS MODELLED FLOWS: CANAL SCREENLINE

Link	A-Node	B-Node	Count	Model	Abs. Diff.	% Diff.	GEH
Canal Screenline							
Inbound							
Fishery Road	735	418	633	605	-28	-4%	1.13
Station Road	542a	474	800	769	-31	-4%	1.11
Two Waters Way	646z	465	818	890	72	9%	2.46
Durrants Hill Road	728z	727z	368	356	-12	-3%	0.63
Nash Mills Lane / Red Lion Lane	748	744	361	379	18	5%	0.94
Total Inbound			2980	2999	19	1%	0.35
Outbound							
Fishery Road	418	735	456	359	-97	-21%	4.81
Station Road	474	542a	517	555	38	7%	1.64
Two Waters Way	465	650z	991	1052	61	6%	1.91
Durrants Hill Road	727z	728z	269	152	-117	-43%	8.06
Nash Mills Lane / Red Lion Lane	744	748	365	353	-12	-3%	0.63
Total Outbound			2598	2471	-127	-5%	2.52

TABLE 7.40 EVENING PERIOD MODEL (18:00 –19:00): OBSERVED VS MODELLED FLOWS: TOWN CENTRE CORDON

Link	A-Node	B-Node	Count	Model	Abs. Diff.	% Diff.	GEH
Town Centre Cordon							
Inbound							
Section: North							
Leighton Buzzard Road	710	163d	620	574	-46	-7%	1.88
Queensway	196	197	456	634	178	39%	7.62
Section: East							
Adeyfield Road	221	222	495	562	67	14%	2.91
St Albans Road	781	667	1549	1572	23	1%	0.58
Section: South							
Bennetts End Road	370	625	731	669	-62	-8%	2.34
Jarman Way	658x	666	716	690	-26	-4%	0.98
Lawn Lane	461	655	327	345	18	6%	0.98
Two Waters Road	464	656	913	883	-30	-3%	1.00
Section: West							
Station Road	658z	657	953	813	-140	-15%	4.71
Warners End Road	493	163c	422	479	57	14%	2.69
Total Inbound			7182	7221	39	1%	0.46
Outbound							
Section: North							
Leighton Buzzard Road	163d	710	805	849	44	5%	1.53
Queensway	197	196	345	350	5	1%	0.27
Section: East							
Adeyfield Road	222	221	251	321	70	28%	4.14
St Albans Road	666x	780	1253	1295	42	3%	1.18
Section: South							
Bennetts End Road	624	370	798	924	126	16%	4.29
Jarman Way	665	659	691	724	33	5%	1.24
Lawn Lane	655	461	292	251	-41	-14%	2.49
Two Waters Road	656	464	940	982	42	4%	1.35
Section: West							
Station Road	657	658z	523	671	148	28%	6.06
Warners End Road	163c	493	861	864	3	0%	0.10
Total Outbound			6759	7231	472	7%	5.64

7.23 Generally, modelled link and screenline flows are acceptably close to the observed values over the 18:00 – 19:00 period. Table 7.41 demonstrates the compliance of this modelled hour in the evening period model with the DMRB guidelines. All DMRB criteria are met.

TABLE 7.41 EVENING PERIOD MODEL (18:00 –19:00) COMPLIANCE WITH DMRB GUIDELINES

Criteria and Measures	Number/% Satisfying Guideline	Compliance
Assigned hourly flows compared with observed flows:		
1. Individual flows within 100 for flows <700vph	89% (34/38)	Yes
2. Individual flows within 15% for flows 700-2,700vph	100% (16/16)	Yes
3. Individual flows within 400 for flows >2,700vph	N/A	Yes
4. Total screenline flows (normally >5 links) to be within 5%	Nearly all (6/8)	Yes
GEH statistic:		
(i) individual flows: GEH < 5	91% (49/54)	No
(ii) screenline totals : GEH < 4	Nearly all (7/8)	Yes

Saturday Period Model

7.24 Tables 7.42-7.45 provide a summary comparison of observed link flows for the 3 hour Saturday period and the corresponding modelled flows, details of the absolute and percentage differences, and the value of the GEH statistic for the northern, east/south and canal screenlines, and the town centre cordon respectively.

TABLE 7.42 SATURDAY PERIOD MODEL: OBSERVED VS MODELLED FLOWS: NORTHERN SCREENLINE

Link	A-Node	B-Node	Count	Model	Abs. Diff.	% Diff.	GEH
Northern Screenline							
Inbound							
Berkhamsted Road / Boxted Road	124	106	708	678	-30	-4%	1.14
Leighton Buzzard Road	90	676z	1908	1865	-43	-2%	0.99
Piccotts End	95	689	101	90	-11	-11%	1.13
Aycliffe Drive	681	83d	1238	1222	-16	-1%	0.46
St Agnells Lane	72	607	844	849	5	1%	0.17
Shenley Road west	291z	63d	747	700	-47	-6%	1.75
Shenley Road east	291	284	793	711	-82	-10%	2.99
Total Inbound			6339	6115	-224	-4%	2.84
Outbound							
Berkhamsted Road / Boxted Road	106	124	697	748	51	7%	1.90
Leighton Buzzard Road	676z	90	1885	1992	107	6%	2.43
Piccotts End	689	95	140	107	-33	-24%	2.97
Aycliffe Drive	83d	681	1230	1130	-100	-8%	2.91
St Agnells Lane	608	72	885	831	-54	-6%	1.84
Shenley Road west	63d	291z	567	542	-25	-4%	1.06
Shenley Road east	284	291	926	765	-161	-17%	5.54
Total Outbound			6330	6115	-215	-3%	2.73

TABLE 7.43 SATURDAY PERIOD MODEL: OBSERVED VS MODELLED FLOWS: EAST/SOUTH SCREENLINE

Link	A-Node	B-Node	Count	Model	Abs. Diff.	% Diff.	GEH
East/South Screenline							
Inbound							
Hemel Hempstead Road	498	55	1483	1513	30	2%	0.78
Breakspear Way	8	533	3309	3237	-72	-2%	1.26
Hemel Hempstead Road	777	327	1221	1272	51	4%	1.44
Bedmond Road / Bedmond Hill	340	329	840	881	41	5%	1.40
Lower Road	741	347	1000	1003	3	0%	0.09
Total Inbound			7853	7906	53	1%	0.60
Outbound							
Hemel Hempstead Road	55	498	1424	1392	-32	-2%	0.85
Breakspear Way	532	7	4096	3820	-276	-7%	4.39
Hemel Hempstead Road	327	777	1178	1143	-35	-3%	1.03
Bedmond Road / Bedmond Hill	329	340	819	804	-15	-2%	0.53
Lower Road	347	741	948	1047	99	10%	3.13
Total Outbound			8465	8206	-259	-3%	2.84

TABLE 7.44 SATURDAY PERIOD MODEL: OBSERVED VS MODELLED FLOWS: CANAL SCREENLINE

Link	A-Node	B-Node	Count	Model	Abs. Diff.	% Diff.	GEH
Canal Screenline							
Inbound							
Fishery Road	735	418	1516	1467	-49	-3%	1.27
Station Road	542a	474	1922	2363	441	23%	9.53
Two Waters Way	646z	465	3148	2940	-208	-7%	3.77
Durrants Hill Road	728z	727z	1000	985	-15	-2%	0.48
Nash Mills Lane / Red Lion Lane	748	744	1171	1115	-56	-5%	1.66
Total Inbound			8757	8870	113	1%	1.20
Outbound							
Fishery Road	418	735	1566	1415	-151	-10%	3.91
Station Road	474	542a	2044	1913	-131	-6%	2.95
Two Waters Way	465	650z	3611	3351	-260	-7%	4.41
Durrants Hill Road	727z	728z	966	706	-260	-27%	8.99
Nash Mills Lane / Red Lion Lane	744	748	1165	1048	-117	-10%	3.52
Total Outbound			9352	8433	-919	-10%	9.75

TABLE 7.45 SATURDAY PERIOD MODEL: OBSERVED VS MODELLED FLOWS: TOWN CENTRE CORDON

Link	A-Node	B-Node	Count	Model	Abs. Diff.	% Diff.	GEH
Town Centre Cordon							
Inbound							
Section: North							
Leighton Buzzard Road	710	163d	2303	2312	9	0%	0.19
Queensway	196	197	1302	1375	73	6%	2.00
Section: East							
Adeyfield Road	221	222	1289	1287	-2	0%	0.06
St Albans Road	781	667	3948	3852	-96	-2%	1.54
Section: South							
Bennetts End Road	370	625	2252	2224	-28	-1%	0.59
Jarman Way	658x	666	2746	2778	32	1%	0.61
Lawn Lane	461	655	1076	1061	-15	-1%	0.46
Two Waters Road	464	656	2765	2940	175	6%	3.28
Section: West							
Station Road	658z	657	3135	2941	-194	-6%	3.52
Warners End Road	493	163c	1639	1638	-1	0%	0.02
Total Inbound			22455	22408	-47	0%	0.31
Outbound							
Section: North							
Leighton Buzzard Road	163d	710	2544	1998	-546	-21%	11.46
Queensway	197	196	1179	1466	287	24%	7.89
Section: East							
Adeyfield Road	222	221	724	711	-13	-2%	0.49
St Albans Road	666x	780	3988	3966	-22	-1%	0.35
Section: South							
Bennetts End Road	624	370	2771	2401	-370	-13%	7.28
Jarman Way	665	659	2982	2801	-181	-6%	3.37
Lawn Lane	655	461	1086	923	-163	-15%	5.14
Two Waters Road	656	464	2995	3227	232	8%	4.16
Section: West							
Station Road	657	658z	1949	2150	201	10%	4.44
Warners End Road	163c	493	2423	2215	-208	-9%	4.32
Total Outbound			22641	21858	-783	-3%	5.25

7.25 Generally, modelled link and screenline flows are acceptably close to the observed values over the 3 hour period. Table 7.46 demonstrates the compliance of the Saturday period model with the DMRB guidelines. All but one DMRB criteria are met. For individual flows less than 700 only 2 out of 3 links are within 100. However, this applies to a small number of low-flow links of relative insignificance over a 3hr model period

TABLE 7.46 SATURDAY PERIOD MODEL COMPLIANCE WITH DMRB GUIDELINES

Criteria and Measures	Number/% Satisfying Guideline	Compliance
Assigned hourly flows compared with observed flows:		
1. Individual flows within 100 for flows <700vph	100% (4/4)	No
2. Individual flows within 15% for flows 700-2,700vph	100% (38/38)	Yes
3. Individual flows within 400 for flows >2,700vph	100% (12/12)	Yes
4. Total screenline flows (normally >5 links) to be within 5%	Nearly all (7/8)	Yes
GEH statistic:		
(i) individual flows: GEH < 5	87% (47/54)	Yes
(ii) screenline totals : GEH < 4	Nearly all (6/8)	Yes

7.26 Tables 7.47-7.50 provide a summary comparison of observed link flows for the first hour of the Saturday period (11:00 – 12:00) and the corresponding modelled flows, details of the absolute and percentage differences, and the value of the GEH statistic for the northern, east/south and canal screenlines, and the town centre cordon respectively.

TABLE 7.47 SATURDAY PERIOD MODEL (11:00 – 12:00): OBSERVED VS MODELLED FLOWS: NORTHERN SCREENLINE

Link	A-Node	B-Node	Count	Model	Abs. Diff.	% Diff.	GEH
Northern Screenline							
Inbound							
Berkhamsted Road / Boxted Road	124	106	223	227	4	2%	0.27
Leighton Buzzard Road	90	676z	639	638	-1	0%	0.04
Piccotts End	95	689	34	33	-1	-3%	0.17
Aycliffe Drive	681	83d	447	412	-35	-8%	1.69
St Agnells Lane	72	607	310	295	-15	-5%	0.86
Shenley Road west	291z	63d	271	236	-35	-13%	2.20
Shenley Road east	291	284	273	237	-36	-13%	2.25
Total Inbound			2197	2078	-119	-5%	2.57
Outbound							
Berkhamsted Road / Boxted Road	106	124	200	220	20	10%	1.38
Leighton Buzzard Road	676z	90	554	593	39	7%	1.63
Piccotts End	689	95	50	34	-16	-32%	2.47
Aycliffe Drive	83d	681	389	368	-21	-5%	1.08
St Agnells Lane	608	72	319	281	-38	-12%	2.19
Shenley Road west	63d	291z	189	178	-11	-6%	0.81
Shenley Road east	284	291	292	241	-51	-17%	3.12
Total Outbound			1993	1915	-78	-4%	1.76

TABLE 7.48 SATURDAY PERIOD MODEL (11:00 – 12:00): OBSERVED VS MODELLED FLOWS: EAST/SOUTH SCREENLINE

Link	A-Node	B-Node	Count	Model	Abs. Diff.	% Diff.	GEH
East/South Screenline							
Inbound							
Hemel Hempstead Road	498	55	496	528	32	6%	1.41
Breakspear Way	8	533	1029	1070	41	4%	1.27
Hemel Hempstead Road	777	327	386	422	36	9%	1.79
Bedmond Road / Bedmond Hill	340	329	300	304	4	1%	0.23
Lower Road	741	347	355	366	11	3%	0.58
Total Inbound			2566	2690	124	5%	2.42
Outbound							
Hemel Hempstead Road	55	498	462	446	-16	-3%	0.75
Breakspear Way	532	7	1351	1198	-153	-11%	4.29
Hemel Hempstead Road	327	777	401	372	-29	-7%	1.48
Bedmond Road / Bedmond Hill	329	340	250	240	-10	-4%	0.64
Lower Road	347	741	311	331	20	6%	1.12
Total Outbound			2775	2587	-188	-7%	3.63

TABLE 7.49 SATURDAY PERIOD MODEL (11:00 – 12:00): OBSERVED VS MODELLED FLOWS: CANAL SCREENLINE

Link	A-Node	B-Node	Count	Model	Abs. Diff.	% Diff.	GEH
Canal Screenline							
Inbound							
Fishery Road	735	418	465	484	19	4%	0.87
Station Road	542a	474	644	783	139	22%	5.20
Two Waters Way	646z	465	1061	968	-93	-9%	2.92
Durrants Hill Road	728z	727z	342	331	-11	-3%	0.60
Nash Mills Lane / Red Lion Lane	748	744	425	378	-47	-11%	2.35
Total Inbound			2937	2944	7	0%	0.13
Outbound							
Fishery Road	418	735	491	457	-34	-7%	1.56
Station Road	474	542a	624	599	-25	-4%	1.01
Two Waters Way	465	650z	1188	1069	-119	-10%	3.54
Durrants Hill Road	727z	728z	328	230	-98	-30%	5.87
Nash Mills Lane / Red Lion Lane	744	748	412	359	-53	-13%	2.70
Total Outbound			3043	2714	-329	-11%	6.13

TABLE 7.50 SATURDAY PERIOD MODEL (11:00 – 12:00): OBSERVED VS MODELLED FLOWS: TOWN CENTRE CORDON

Link	A-Node	B-Node	Count	Model	Abs. Diff.	% Diff.	GEH
Town Centre Cordon							
Inbound							
Section: North							
Leighton Buzzard Road	710	163d	796	772	-24	-3%	0.86
Queensway	196	197	444	461	17	4%	0.80
Section: East							
Adeyfield Road	221	222	486	439	-47	-10%	2.19
St Albans Road	781	667	1354	1265	-89	-7%	2.46
Section: South							
Bennetts End Road	370	625	775	741	-34	-4%	1.23
Jarman Way	658x	666	788	847	59	7%	2.06
Lawn Lane	461	655	341	352	11	3%	0.59
Two Waters Road	464	656	877	947	70	8%	2.32
Section: West							
Station Road	658z	657	995	964	-31	-3%	0.99
Warners End Road	493	163c	560	557	-3	-1%	0.13
Total Inbound			7416	7345	-71	-1%	0.83
Outbound							
Section: North							
Leighton Buzzard Road	163d	710	807	640	-167	-21%	6.21
Queensway	197	196	328	478	150	46%	7.47
Section: East							
Adeyfield Road	222	221	245	240	-5	-2%	0.32
St Albans Road	666x	780	1315	1270	-45	-3%	1.25
Section: South							
Bennetts End Road	624	370	843	775	-68	-8%	2.39
Jarman Way	665	659	975	911	-64	-7%	2.08
Lawn Lane	655	461	346	290	-56	-16%	3.14
Two Waters Road	656	464	954	1038	84	9%	2.66
Section: West							
Station Road	657	658z	621	690	69	11%	2.70
Warners End Road	163c	493	799	731	-68	-9%	2.46
Total Outbound			7233	7063	-170	-2%	2.01

7.27 Generally, modelled link and screenline flows are acceptably close to the observed values over the 11:00 – 12:00 period. Table 7.51 demonstrates the compliance of this modelled hour in the Saturday period model with the DMRB guidelines. All DMRB criteria are met.

TABLE 7.51 SATURDAY PERIOD MODEL (11:00 – 12:00) COMPLIANCE WITH DMRB GUIDELINES

Criteria and Measures	Number/% Satisfying Guideline	Compliance
Assigned hourly flows compared with observed flows:		
1. Individual flows within 100 for flows <700vph	95% (36/38)	Yes
2. Individual flows within 15% for flows 700-2,700vph	100% (16/16)	Yes
3. Individual flows within 400 for flows >2,700vph	N/A	Yes
4. Total screenline flows (normally >5 links) to be within 5%	Nearly all (6/8)	Yes
GEH statistic:		
(i) individual flows: GEH < 5	93% (50/54)	Yes
(ii) screenline totals : GEH < 4	Nearly all (7/8)	Yes

7.28 Tables 7.52-7.55 provide a summary comparison of observed link flows for the second hour of the Saturday period (12:00 – 13:00) and the corresponding modelled flows, details of the absolute and percentage differences, and the value of the GEH statistic for the northern, east/south and canal screenlines, and the town centre cordon respectively.

TABLE 7.52 SATURDAY PERIOD MODEL (12:00 – 13:00): OBSERVED VS MODELLED FLOWS: NORTHERN SCREENLINE

Link	A-Node	B-Node	Count	Model	Abs. Diff.	% Diff.	GEH
Northern Screenline							
Inbound							
Berkhamsted Road / Boxted Road	124	106	238	228	-10	-4%	0.66
Leighton Buzzard Road	90	676z	652	641	-11	-2%	0.43
Piccotts End	95	689	39	28	-11	-28%	1.90
Aycliffe Drive	681	83d	426	415	-11	-3%	0.54
St Agnells Lane	72	607	280	295	15	5%	0.88
Shenley Road west	291z	63d	250	239	-11	-4%	0.70
Shenley Road east	291	284	276	238	-38	-14%	2.37
Total Inbound			2161	2084	-77	-4%	1.67
Outbound							
Berkhamsted Road / Boxted Road	106	124	268	300	32	12%	1.90
Leighton Buzzard Road	676z	90	622	682	60	10%	2.35
Piccotts End	689	95	41	36	-5	-12%	0.81
Aycliffe Drive	83d	681	426	392	-34	-8%	1.68
St Agnells Lane	608	72	290	284	-6	-2%	0.35
Shenley Road west	63d	291z	205	186	-19	-9%	1.36
Shenley Road east	284	291	318	270	-48	-15%	2.80
Total Outbound			2170	2150	-20	-1%	0.43

TABLE 7.53 SATURDAY PERIOD MODEL (12:00 – 13:00): OBSERVED VS MODELLED FLOWS: EAST/SOUTH SCREENLINE

Link	A-Node	B-Node	Count	Model	Abs. Diff.	% Diff.	GEH
East/South Screenline							
Inbound							
Hemel Hempstead Road	498	55	503	515	12	2%	0.53
Breakspear Way	8	533	1066	1069	3	0%	0.09
Hemel Hempstead Road	777	327	431	439	8	2%	0.38
Bedmond Road / Bedmond Hill	340	329	283	272	-11	-4%	0.66
Lower Road	741	347	334	337	3	1%	0.16
Total Inbound			2617	2632	15	1%	0.29
Outbound							
Hemel Hempstead Road	55	498	492	494	2	0%	0.09
Breakspear Way	532	7	1416	1222	-194	-14%	5.34
Hemel Hempstead Road	327	777	434	431	-3	-1%	0.14
Bedmond Road / Bedmond Hill	329	340	282	286	4	1%	0.24
Lower Road	347	741	340	387	47	14%	2.47
Total Outbound			2964	2820	-144	-5%	2.68

TABLE 7.54 SATURDAY PERIOD MODEL (12:00 – 13:00): OBSERVED VS MODELLED FLOWS: CANAL SCREENLINE

Link	A-Node	B-Node	Count	Model	Abs. Diff.	% Diff.	GEH
Canal Screenline							
Inbound							
Fishery Road	735	418	554	512	-42	-8%	1.82
Station Road	542a	474	606	796	190	31%	7.18
Two Waters Way	646z	465	1083	1034	-49	-5%	1.51
Durrants Hill Road	728z	727z	339	330	-9	-3%	0.49
Nash Mills Lane / Red Lion Lane	748	744	402	381	-21	-5%	1.06
Total Inbound			2984	3053	69	2%	1.26
Outbound							
Fishery Road	418	735	535	489	-46	-9%	2.03
Station Road	474	542a	726	667	-59	-8%	2.24
Two Waters Way	465	650z	1277	1151	-126	-10%	3.62
Durrants Hill Road	727z	728z	318	243	-75	-24%	4.48
Nash Mills Lane / Red Lion Lane	744	748	389	372	-17	-4%	0.87
Total Outbound			3245	2922	-323	-10%	5.82

TABLE 7.55 SATURDAY PERIOD MODEL (12:00 – 13:00): OBSERVED VS MODELLED FLOWS: TOWN CENTRE CORDON

Link	A-Node	B-Node	Count	Model	Abs. Diff.	% Diff.	GEH
Town Centre Cordon							
Inbound							
Section: North							
Leighton Buzzard Road	710	163d	803	789	-14	-2%	0.50
Queensway	196	197	452	465	13	3%	0.61
Section: East							
Adeyfield Road	221	222	419	438	19	5%	0.92
St Albans Road	781	667	1256	1330	74	6%	2.06
Section: South							
Bennetts End Road	370	625	711	751	40	6%	1.48
Jarman Way	658x	666	970	980	10	1%	0.32
Lawn Lane	461	655	370	367	-3	-1%	0.16
Two Waters Road	464	656	950	1041	91	10%	2.88
Section: West							
Station Road	658z	657	1077	1006	-71	-7%	2.20
Warners End Road	493	163c	569	557	-12	-2%	0.51
Total Inbound			7577	7724	147	2%	1.68
Outbound							
Section: North							
Leighton Buzzard Road	163d	710	874	690	-184	-21%	6.58
Queensway	197	196	420	500	80	19%	3.73
Section: East							
Adeyfield Road	222	221	252	240	-12	-5%	0.77
St Albans Road	666x	780	1379	1359	-20	-1%	0.54
Section: South							
Bennetts End Road	624	370	1031	835	-196	-19%	6.42
Jarman Way	665	659	1026	983	-43	-4%	1.36
Lawn Lane	655	461	374	342	-32	-9%	1.69
Two Waters Road	656	464	1031	1105	74	7%	2.26
Section: West							
Station Road	657	658z	671	752	81	12%	3.04
Warners End Road	163c	493	838	764	-74	-9%	2.61
Total Outbound			7896	7570	-326	-4%	3.71

7.29 Generally, modelled link and screenline flows are acceptably close to the observed values over the 12:00 – 13:00 period. Table 7.56 demonstrates the compliance of this modelled hour in the Saturday period model with the DMRB guidelines. All DMRB criteria are met.

TABLE 7.56 SATURDAY PERIOD MODEL (12:00 – 13:00) COMPLIANCE WITH DMRB GUIDELINES

Criteria and Measures	Number/% Satisfying Guideline	Compliance
Assigned hourly flows compared with observed flows:		
1. Individual flows within 100 for flows <700vph	97% (36/37)	Yes
2. Individual flows within 15% for flows 700-2,700vph	100% (17/17)	Yes
3. Individual flows within 400 for flows >2,700vph	N/A	Yes
4. Total screenline flows (normally >5 links) to be within 5%	Nearly all (7/8)	Yes
GEH statistic:		
(i) individual flows: GEH < 5	93% (50/54)	Yes
(ii) screenline totals : GEH < 4	Nearly all (7/8)	Yes

7.30 Tables 7.57-7.60 provide a summary comparison of observed link flows for the third

hour of the Saturday period (13:00 – 14:00) and the corresponding modelled flows, details of the absolute and percentage differences, and the value of the GEH statistic for the northern, east/south and canal screenlines, and the town centre cordon respectively.

TABLE 7.57 SATURDAY PERIOD MODEL (13:00 –14:00): OBSERVED VS MODELLED FLOWS: NORTHERN SCREENLINE

Link	A-Node	B-Node	Count	Model	Abs. Diff.	% Diff.	GEH
Northern Screenline							
Inbound							
Berkhamsted Road / Boxted Road	124	106	247	223	-24	-10%	1.57
Leighton Buzzard Road	90	676z	617	585	-32	-5%	1.31
Piccotts End	95	689	28	29	1	4%	0.19
Aycliffe Drive	681	83d	365	395	30	8%	1.54
St Agnells Lane	72	607	254	259	5	2%	0.31
Shenley Road west	291z	63d	226	224	-2	-1%	0.13
Shenley Road east	291	284	244	235	-9	-4%	0.58
Total Inbound			1981	1950	-31	-2%	0.70
Outbound							
Berkhamsted Road / Boxted Road	106	124	229	228	-1	0%	0.07
Leighton Buzzard Road	676z	90	709	717	8	1%	0.30
Piccotts End	689	95	49	36	-13	-27%	1.99
Aycliffe Drive	83d	681	415	370	-45	-11%	2.27
St Agnells Lane	608	72	276	266	-10	-4%	0.61
Shenley Road west	63d	291z	173	178	5	3%	0.38
Shenley Road east	284	291	316	253	-63	-20%	3.74
Total Outbound			2167	2048	-119	-5%	2.59

TABLE 7.58 SATURDAY PERIOD MODEL (13:00 –14:00): OBSERVED VS MODELLED FLOWS: EAST/SOUTH SCREENLINE

Link	A-Node	B-Node	Count	Model	Abs. Diff.	% Diff.	GEH
East/South Screenline							
Inbound							
Hemel Hempstead Road	498	55	484	470	-14	-3%	0.64
Breakspear Way	8	533	1214	1098	-116	-10%	3.41
Hemel Hempstead Road	777	327	404	411	7	2%	0.35
Bedmond Road / Bedmond Hill	340	329	257	305	48	19%	2.86
Lower Road	741	347	311	300	-11	-4%	0.63
Total Inbound			2670	2584	-86	-3%	1.68
Outbound							
Hemel Hempstead Road	55	498	470	452	-18	-4%	0.84
Breakspear Way	532	7	1329	1400	71	5%	1.92
Hemel Hempstead Road	327	777	343	339	-4	-1%	0.22
Bedmond Road / Bedmond Hill	329	340	287	277	-10	-3%	0.60
Lower Road	347	741	297	329	32	11%	1.81
Total Outbound			2726	2797	71	3%	1.35

TABLE 7.59 SATURDAY PERIOD MODEL (13:00 –14:00): OBSERVED VS MODELLED FLOWS: CANAL SCREENLINE

Link	A-Node	B-Node	Count	Model	Abs. Diff.	% Diff.	GEH
Canal Screenline							
Inbound							
Fishery Road	735	418	497	471	-26	-5%	1.18
Station Road	542a	474	672	784	112	17%	4.15
Two Waters Way	646z	465	1004	938	-66	-7%	2.12
Durrants Hill Road	728z	727z	319	324	5	2%	0.28
Nash Mills Lane / Red Lion Lane	748	744	344	357	13	4%	0.69
Total Inbound			2836	2874	38	1%	0.71
Outbound							
Fishery Road	418	735	540	470	-70	-13%	3.11
Station Road	474	542a	694	646	-48	-7%	1.85
Two Waters Way	465	650z	1146	1131	-15	-1%	0.44
Durrants Hill Road	727z	728z	320	234	-86	-27%	5.17
Nash Mills Lane / Red Lion Lane	744	748	364	317	-47	-13%	2.55
Total Outbound			3064	2798	-266	-9%	4.91

TABLE 7.60 SATURDAY PERIOD MODEL (13:00 –14:00): OBSERVED VS MODELLED FLOWS: TOWN CENTRE CORDON

Link	A-Node	B-Node	Count	Model	Abs. Diff.	% Diff.	GEH
Town Centre Cordon							
Inbound							
Section: North							
Leighton Buzzard Road	710	163d	704	750	46	7%	1.71
Queensway	196	197	406	449	43	11%	2.08
Section: East							
Adeyfield Road	221	222	384	410	26	7%	1.30
St Albans Road	781	667	1338	1257	-81	-6%	2.25
Section: South							
Bennetts End Road	370	625	766	732	-34	-4%	1.24
Jarman Way	658x	666	988	951	-37	-4%	1.19
Lawn Lane	461	655	365	342	-23	-6%	1.22
Two Waters Road	464	656	938	951	13	1%	0.42
Section: West							
Station Road	658z	657	1063	970	-93	-9%	2.92
Warners End Road	493	163c	510	524	14	3%	0.62
Total Inbound			7462	7336	-126	-2%	1.46
Outbound							
Section: North							
Leighton Buzzard Road	163d	710	863	668	-195	-23%	7.05
Queensway	197	196	431	489	58	13%	2.70
Section: East							
Adeyfield Road	222	221	227	231	4	2%	0.26
St Albans Road	666x	780	1294	1337	43	3%	1.19
Section: South							
Bennetts End Road	624	370	897	791	-106	-12%	3.65
Jarman Way	665	659	981	907	-74	-8%	2.41
Lawn Lane	655	461	366	292	-74	-20%	4.08
Two Waters Road	656	464	1010	1084	74	7%	2.29
Section: West							
Station Road	657	658z	657	708	51	8%	1.95
Warners End Road	163c	493	786	720	-66	-8%	2.41
Total Outbound			7512	7227	-285	-4%	3.32

7.31 Generally, modelled link and screenline flows are acceptably close to the observed values over the 13:00 – 14:00 period. Table 7.61 demonstrates the compliance of this modelled hour in the Saturday period model with the DMRB guidelines. All DMRB criteria are met.

TABLE 7.61 SATURDAY PERIOD MODEL (13:00 –14:00) COMPLIANCE WITH DMRB GUIDELINES

Criteria and Measures	Number/% Satisfying Guideline	Compliance
Assigned hourly flows compared with observed flows:		
1. Individual flows within 100 for flows <700vph	97% (36/37)	Yes
2. Individual flows within 15% for flows 700-2,700vph	100% (17/17)	Yes
3. Individual flows within 400 for flows >2,700vph	N/A	Yes
4. Total screenline flows (normally >5 links) to be within 5%	Nearly all (7/8)	Yes
GEH statistic:		
(i) individual flows: GEH < 5	96% (52/54)	No
(ii) screenline totals : GEH < 4	Nearly all (7/8)	Yes

8. SUMMARY

Introduction

8.1 Steer Davies Gleave has been commissioned to build a PARAMICS micro-simulation model of the Hemel Hempstead urban area which can be used, in particular, to assess the traffic impacts of a number of potential future year development sites in the town. Additionally, the model will enable comparative assessment of potentially competing schemes.

8.2 The study area is formed by the entire urban area of Hemel Hempstead and routes into and out of the town, as shown in Figure 2.1.

8.3 Models are required for the following 3 time periods:

- AM Peak 0700-1000
- PM Peak 1600-1900
- Saturday peak 1100-1400

8.4 It was agreed that the model be built using existing datasets held by the client, and that the modelling team would seek to build a model that achieves good calibration of turning flows at key junctions, and a realistic representation of traffic demand patterns across the wider area.

Data Availability

8.5 All data used in the study has been provided by Hertfordshire Highways and Dacorum Borough Council, supplemented with information relating to network features collected on site.

8.6 The data used in this study have been grouped into three categories, which relate to the primary use of each data item:

- Network Data – characteristics of the road network and physical features of the study area used to build the PARAMICS network model;
- Travel Demand Data – travel demand including origin-destination type surveys and other data describing travel patterns across the study area;
- Count Data – manual and automatic traffic counts of turns and links in the study area.

8.7 At some of the larger roundabouts, full turning counts were not available and in such cases data for missing turns have been synthesised using a pro-rata method based on total entry flows and flows at adjacent junctions.

Network Construction

8.8 Ordnance Survey base mapping tiles have been used to create the background for creating the model network. The client also supplied details of network variables such as link speeds, number of lanes and bus route information.

8.9 Most links in the model are coded as ‘minor’ – meaning that generally only familiar drivers would use them to divert around delays. Signposted major strategic routes are coded as ‘major’. These routes are used by all unfamiliar drivers.

8.10 Vehicles in the model are classified under two broad vehicle types: lights and HGVs. The light vehicle class includes 80% cars and 20% light vans. The HGV class includes 20% medium and 80% large goods vehicles. Buses are treated separately as fixed routes based on timetable information and route maps.

8.11 Driver familiarity is applied by vehicle class and, linked with the 'minor' and 'major' link types defined above, dictates the amount of re-routing to avoid delays will occur. Familiarity settings have been set to the following values:

- Cars 60% are familiar to reflect relatively high through-traffic levels.
- LGVs 85% are familiar. Mostly local traders etc so a high value is appropriate.
- MGVs 60% are familiar to reflect through-traffic.
- HGVs 0% are familiar to prevent HGV rat-running through minor roads.

8.12 Generally links speeds are coded as the speed limits in reality.

Matrix Construction

8.13 Good quality journey to work data and schools origin-destination data was made available with which to construct a prior matrix.

8.14 The initial morning period prior matrix contained a total of 47028 trips representing the sum total of the seven trip types above. The ratio of lights to heavy vehicles in the external counts was found to be 5.39%: this value was applied to the full matrix to produce a prior HGV matrix.

8.15 The prior matrix was then further modified through a manual process of matrix estimation, taking into account land use types, turning data, and link counts across the study area resulting in a final AM matrix which has 52073 lights and 2837 heavies for a total of 54910 vehicles. The increase in trips reflects the addition of the unobserved trip types, such as retail, leisure and employers business, to the initial prior, which contained only work trips, school trips and external to external trips.

8.16 The demand matrix covers the whole 3 hour morning period. A set of release profiles was developed to simulate the build up and dissipation of queuing over the 3 hour period. For external zones, counts were used to directly produce entry and exit profiles, which were applied by row and column respectively. For external zones where no count data was available, the profile from a nearby external zone where data was available was used.

8.17 The average of all external profiles was used to create a profile for internal zones..

Model Calibration

8.18 Model calibration was undertaken in two stages:

- Individual junction calibration;
- Network and demand calibration.

8.19 Junctions for which high quality turning count data are available have been calibrated individually using the Junction Scoping Capability of PARAMICS. This methodology was applied to a total of 20 junctions spread evenly around the town and, with minor alterations described in Section 6, it is demonstrated that the operation of each junction was sufficient to replicate the observed flow, capacity and traffic behaviour.

8.20 After the isolated calibration of each junction, a more traditional network and demand calibration was conducted.

Model Validation

8.21 Validation guidelines as set out in Design Manula for Roads and Bridges (DMRB) Volume 12a have been adopted as the criteria for comparing individual and screenline flows both in terms of absolute flow differences and GEH.

8.22 All modelled link and screenline flows are acceptably close to observed values and, as demonstrated in Table 8.1 the DMRB criteria in nearly all individual modelled hours and overall 3 hour time periods. The 9-10 hour in the morning period model narrowly misses one DMRB criteria, however in the context of the more important morning peak hour validating sufficiently well, we do not consider this to be a problem.

TABLE 8.1 MODEL VALIDATION SUMMARY

DMRB Validation criteria	AM Peak				PM Peak				Saturday Peak			
	7-8am	8-9am	9-10am	7-10am	4-5pm	5-6pm	6-7pm	4-7pm	11-12:00	12-13:00	13-14:00	11-14:00
Individual flows within 100 for flows <700	93	97	88	100	100	88	89	87	95	97	97	100
Individual flows within 15% for flows 700-2700	100	100	100	100	100	100	100	100	100	100	100	100
Individual flows within 400 for flows >2700 GEH:	n/a	n/a	n/a	100	n/a	n/a	n/a	100	n/a	n/a	n/a	n/a
Individual flows: geh<5 for >85% of cases	93	91	83	91	96	94	91	87	93	93	96	87
Screenline totals: geh<4 for (nearly) all cases	6/8	6/8	6/8	all	7/8	7/8	7/8	all	7/8	7/8	7/8	6/8

Use of Model

8.23 The 2008 base year PARAMICS model of Hemel Hempstead has been built using the best available data, and provides a good representation of key junction operations, and strategic traffic flows across the town. The model replicates build up and dissipation of traffic levels over each of the three modelled periods well.

8.24 The model has been developed to assess broad strategic effects of development in Hemel Hempstead and is suitable for that purpose.

8.25 The 2008 model will be used as a base from which future year models will be constructed. In the immediate future, it has been agreed that models representing growth in demand and changes in infrastructure to 2021 and 2031 will be produced. The future year models will be specifically used to evaluate strategic differences between Core Strategy options as part of the ongoing Local Development Framework process.

8.26 More traditionally, micro-simulation models are used to test detailed effects of development on much smaller areas of network. This strategic model provides an excellent base for such detailed work; however, for that purpose, we would recommend using a sub-section of the model and developing bespoke demands and profiles for that sub-section.

8.27 Alternatively, for detailed assessment work, the whole model could be used and a

local re-calibration of the demand patterns and profiles could be undertaken for the area of interest.

CONTROL SHEET

Project/Proposal Name:	HEMEL HEMPSTEAD URBAN TRANSPORT MODEL
Document Title:	Local Model Validation Report
Client Contract/Project Number:	
SDG Project/Proposal Number:	

ISSUE HISTORY

Issue No.	Date	Details
Draft June	**13th June 2008**	**Ongoing Draft**
Draft Nov	**12th Nov 2008**	**Pre-Draft on Junction Parameters**
Final Draft	**15th Jan 2009**	**Final Draft of AM version**
Final	**11th May 2009**	**Final All Time Periods**

REVIEW

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