



Bedford Town Centre Transport Modelling

Local Model Validation Report (LMVR)

Final Draft



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Contents

1	INTRODUCTION	1
	Study Background	1
	Purpose of Report	1
	Structure of Report	1
	Mapping License	1
2	MODEL OVERVIEW AND KEY FEATURES	2
	Existing Model Platform and Software Selection.....	2
	Study Area	2
	Zoning System.....	2
	Sector Plan	5
	Network Structure	7
	Time Periods.....	7
	User Classes	7
	Generalised Cost Formulations and Parameter Values	7
3	DATA COLLECTION	9
	Introduction	9
	Existing Data.....	9
	Additional Data	11
4	MODEL DEVELOPMENT	14
	Introduction	14
	Network Structure	14
	Prior Matrix	16
5	MODEL ASSIGNMENT, CALIBRATION AND VALIDATION.....	18
	Model Assignment	18
	Model Calibration/Validation	19
	Matrix Estimation	20
	Link Flow Calibration	27
	Link Flow Validation.....	28
	Journey Time Validation	29
6	SUMMARY AND CONCLUSIONS	32
	Summary	32
	Conclusion	33

Tables and Figures

Table 2.1 Generalised Cost Parameter Values	8
Table 5.1 Model Convergence Statistics.....	18
Table 5.2 DMRB Calibration and Validation Criteria	19
Table 5.3 Comparison of Matrix Totals - Prior vs. Post Matrix Estimation.....	20
Figure 2-1 Study Area	3
Figure 2-3 Bedford Zone Plan – Town Centre	5
Figure 3-1 Traffic Counts from Bedford Borough Council	10
Figure 3-2 Cordons and Screenlines	11
Figure 3-3 MCC Site Locations	12
Figure 3-4 Journey Time Routes.....	13
Figure 4.1 Final Network - Whole Model.....	15
Figure 4.2 Final Network – Town Centre	16
Figure 5-1 AM Lights Trip Length Distribution	21
Figure 5-2 AM Heavies Trip Length Distribution	21
Figure 5-3 IP Lights Trip Length Distribution	22
Figure 5-4 IP Heavies Trip Length Distribution	22
Figure 5-5 PM Lights Trip Length Distribution	22
Figure 5-6 PM Heavies Trip Length Distribution	23

Appendices

Route Choice Demonstration
 Sector to Sector Movement Analysis
 Flow Calibration
 Flow Validation
 Journey Time Validation

1 Introduction

Study Background

- 1.1 JMP Consultants Ltd (JMP) has been commissioned by Bedford Borough Council, to develop a SATURN model of Bedford.
- 1.2 The aim of the model is to provide a tool which supports development of a town centre transport strategy and can be used for activities including strategic planning, strategy testing and the development of highway schemes.
- 1.3 The Bedford SATURN model has been developed from a previous model established by Atkins which covers the Bedford Town centre, A421 Corridor and M1 Jn13 to Jn14. This model was considered to provide a suitably robust basis for the development of the Bedford model. The model development has considered amendments to a 2011 base model, reflecting 2011 Census data and additional traffic count and journey time information.
- 1.4 Further details on the model development are provided later in the report. A database of the Travel to work (TtW) trips between all output areas within England and Wales by mode from the 2011 Census has been required by Bedford Borough Council to use for this study.

Purpose of Report

- 1.5 This report gives a detailed description of the development of the Bedford highway assignment model and also presents details of the calibration and validation of the model.

Structure of Report

- 1.6 Following this introduction, this report contains the following chapters:
 - Chapter 2 gives an overview of the model and its key features;
 - Chapter 3 outlines the data collection exercise undertaken for the study including collation of data from other sources;
 - Chapter 4 describes development of the network and prior matrix for the base models;
 - Chapter 5 presents the results of the model assignment, and the base year calibration and validation; and
 - Chapter 6 provides a summary of the model development, standards achieved and fitness for purpose.

Mapping License

- 1.7 Use of OS Open Data is subject to the terms at www.ordnancesurvey.co.uk/opendata/licence
- 1.8 Unless specifically stated, all map extracts are taken from Ordnance Survey data © Crown copyright and database 2006.

2 Model Overview and Key Features

Existing Model Platform and Software Selection

Previous SATURN model from Atkins

- 2.1 The previous 2011 Bedford Base Year SATURN model from Atkins was developed and validated in 2012 and covered the urban area of Bedford and the rural area in the north of the Borough. The matrices were created using the existing A421 forecast year 2011 model matrix, St. Neots base year model matrix, the 2001 Census and RSI data.
- 2.2 The base year model from Atkins was validated against 2011 observed traffic flow and journey time data. Thus the main methodology is using this model as a basis, undertaking further refinement to the network and zoning system of the model and recreating the matrices using 2011 Census data.

Software Selection

- 2.3 The version of the software used for this study is SATURN 11.2.05.

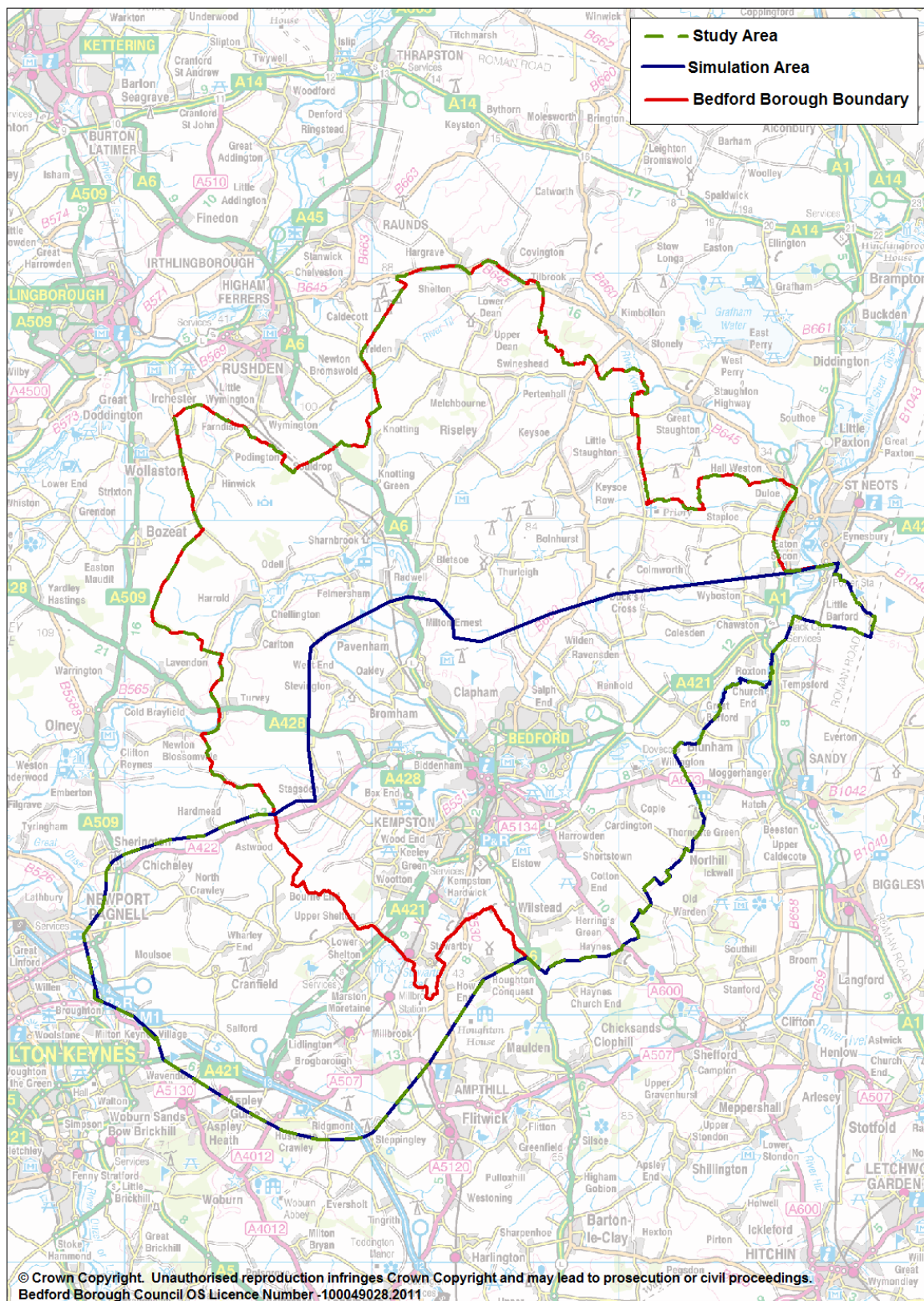
Study Area

- 2.4 The study area has been outlined and agreed with Bedford Borough Council and covers the area designated as Bedford for this study. The A422 route to M1 Junction 14 is included in simulation area to enable a better representation of the route choice to reach the M1 from Bedford. A1/A421 Black Cat roundabout is coded within detailed simulation of the model. The A1/A428 junction and A428/Bedford Road junction in St Neots are within the buffer area. The study area is shown in Figure 2-1.

Zoning System

- 2.5 The zoning system was been revised as appropriate by disaggregating the large zones within the study area to yield a finer zoning system suitable for testing proposed schemes and developments, within the context of the town centre transport strategy.
- 2.6 The disaggregation of the zone boundaries was performed in a manner which ensures consistency with the 2011 census output areas as much as possible, as well as the existing zone boundaries. This is in accordance with common practice and the guidance provided in WebTAG (the Department of Transport's Web-based Transport Analysis Guidance on the conduct of transport studies) and the Design Manual for Roads and Bridges (DMRB). This ensures compatibility with the TEMPRO zones for the region and to enable growth forecasts to be applied more easily for any future year testing that may subsequently be performed using the model. It also relates the model to the planning data so that updates to the base matrix may be performed if required.
- 2.7 In disaggregating the zones, consideration was given as far as possible to achieve homogeneity in terms of land-use. Zones have also been defined to enable an accurate reflection of loading points of traffic onto the network.
- 2.8 The final model has 240 zones in total, with 43 empty "Dummy" zones for forecasting purposes in relation to potential development locations. Figures 2.2 and 2.3 illustrate the overall model and town centre zone plan respectively after the disaggregation.

Figure 2-1 Study Area



- 2.9
- 2.10
- 2.11
- 2.12

Figure 2-2 Bedford Zone Plan - Overview

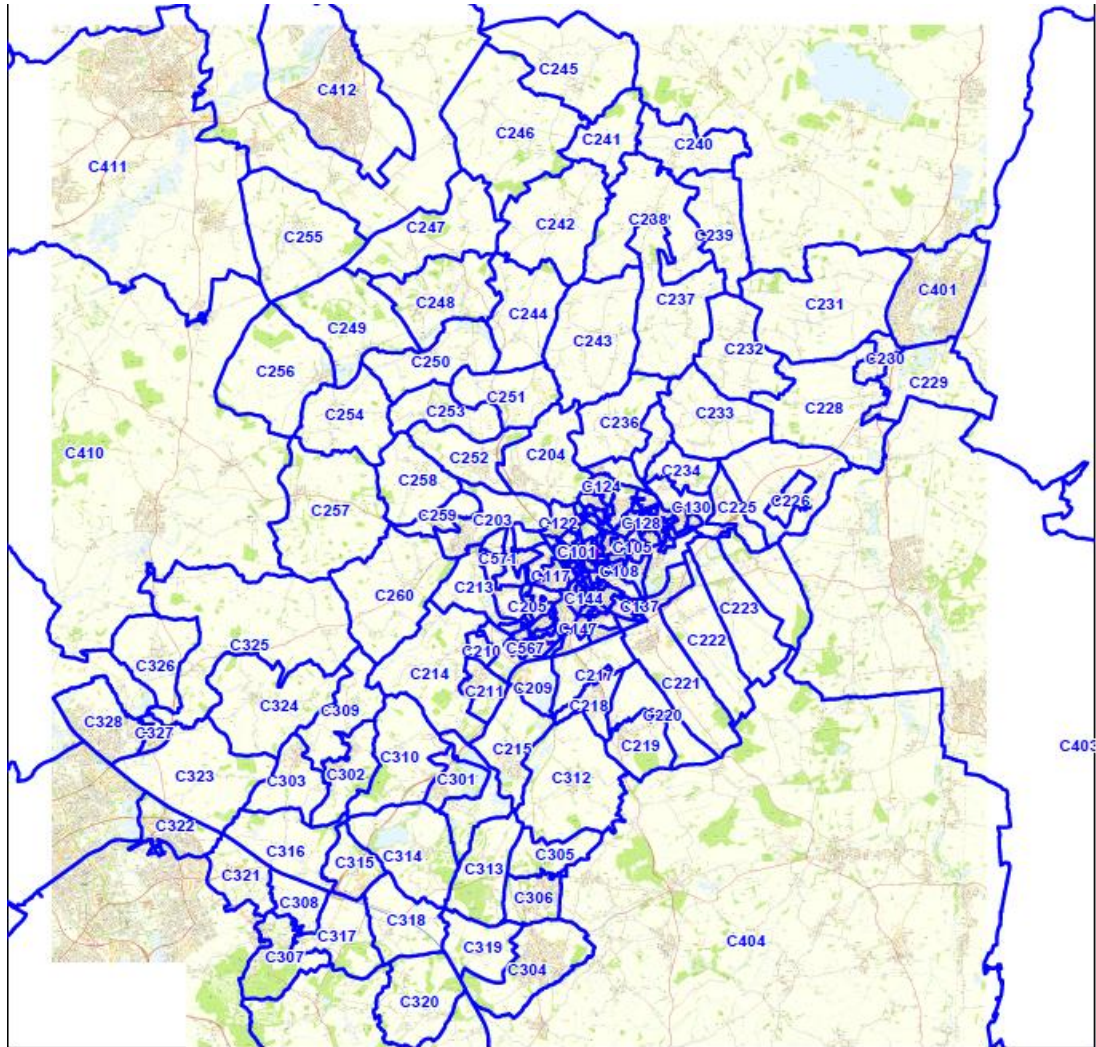
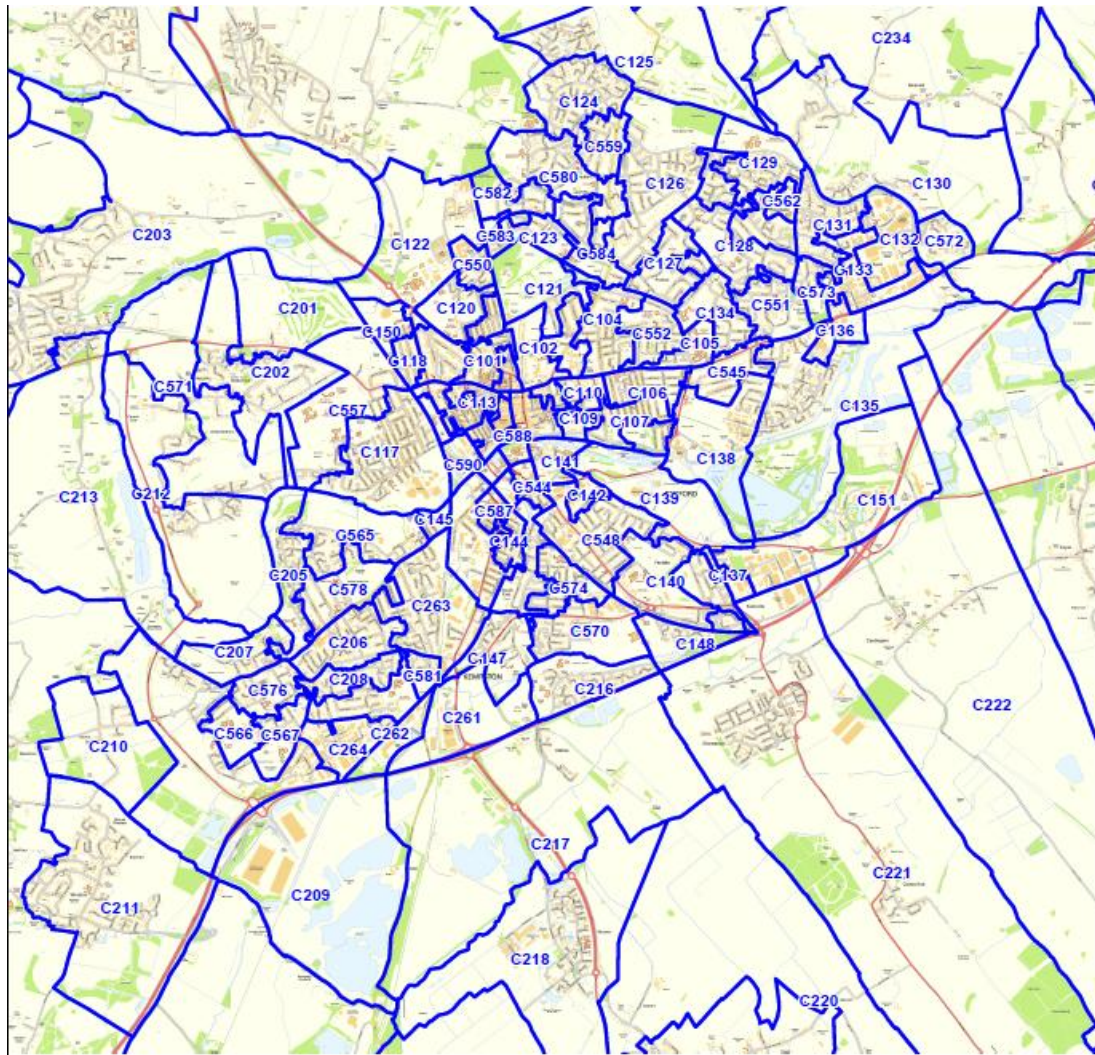


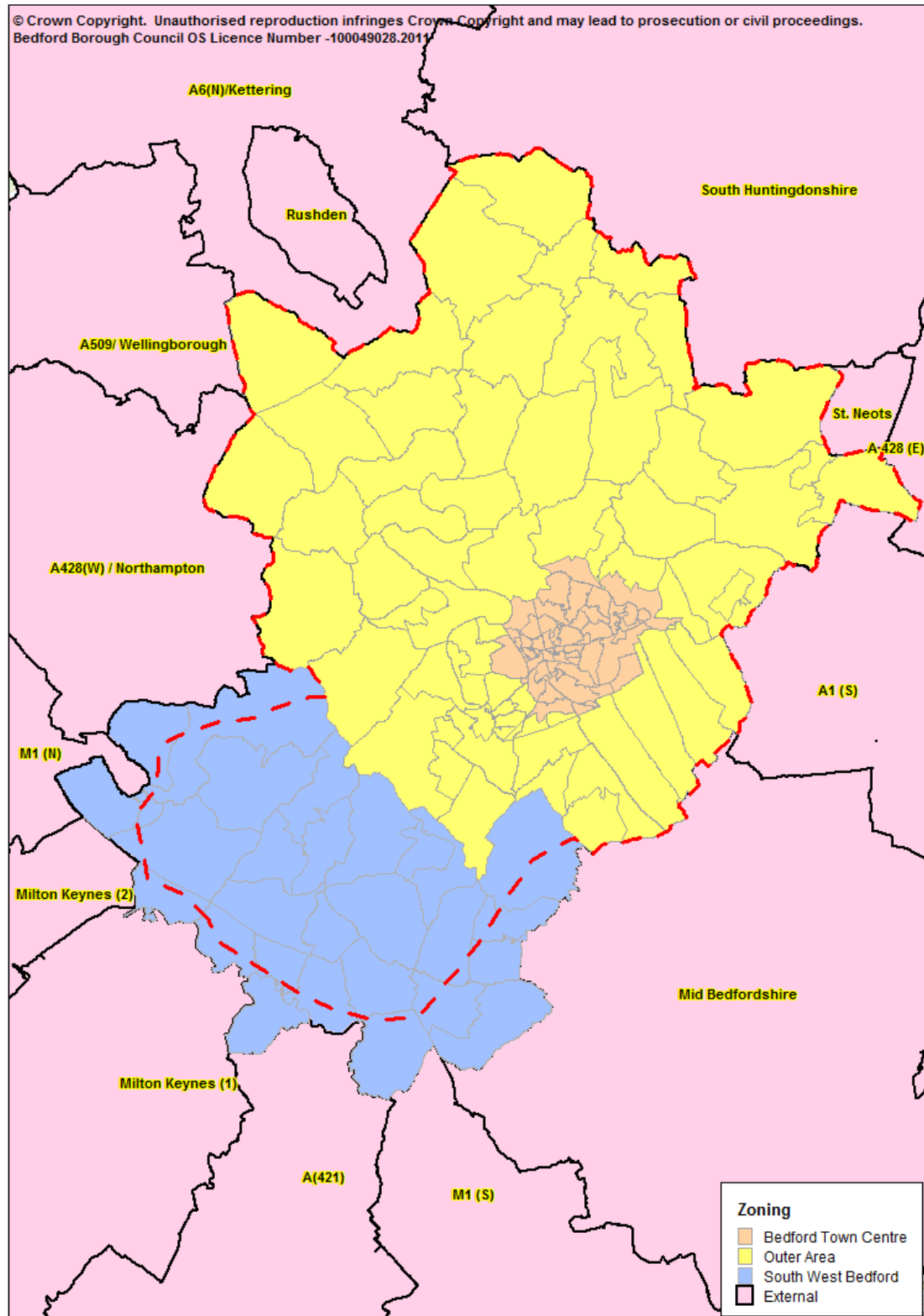
Figure 2-3 Bedford Zone Plan – Town Centre



Sector Plan

- 2.13 The 4 sector plan is consistent with the previous model, and shown as Figure 2.4. This will mainly be used for traffic movement analysis. The 4 sectors are Bedford town centre, rest of Bedford Borough, south-west Bedford and external area.

Figure 2-4 Bedford Sector Plan



Network Structure

- 2.14 The network for the Bedford model was based on the previous model, with the majority of the structure retained. Refinements to coding of some junctions and links have been made, either to reflect conditions on site in 2011, improve the accuracy of the set parameters or as part of the supplementation of the additional network to the model. Additional zone connectors are added to ensure the access points are accurate for the disaggregated zones. Examples of changes include:
- A6/B530/A5134: a roundabout shown in Google Earth rather than a priority junction in the network coding;
 - The results of the comparison also suggest potential differences in coding for the junctions below:
 - A421/A428 Roundabout: Lane allocation;
 - A421/A603 Roundabout: Lane allocation;
 - Castle Rd/ George St junction is a mini-roundabout rather than a four-arm priority junction;
 - Cauldwell St/St. Mary's St/Cardington Road: two lane approach from Cauldwell St; and
 - revision of the coding of Britannia Road to include representation of car parks to the north accessed via Kings Place.

Time Periods

- 2.15 The model represents the AM peak hour (0730-0830), Inter Peak hour (1000-1600 average) and PM peak hour (1700-1800). These peak hours are consistent with the previous model.
- 2.16 The Bedford model has a base year of 2011.

User Classes

- 2.17 The existing user classes from the previous model were used in the Bedford model. There are two user classes:
- light vehicles (cars and light goods vehicles); and
 - heavy goods vehicles

Passenger Car Unit (PCU) Factors

- 2.18 It should also be noted that the SATURN model assigns passenger car units (PCUs) rather than vehicles. Lights have a PCU value of 1.0, meaning that they equate to an average car. Heavies are given a PCU value of 1.9.

Generalised Cost Formulations and Parameter Values

Value of Time and Vehicle Operating Cost

- 2.19 Values of time and vehicle operating costs were recalculated for the Bedford model, to reflect information derived from WEBTAG November 2014. The calculated values as used in the model are set out in Table 2.1.

Table 2.1 Generalised Cost Parameter Values

2011	Vehicle Operating Cost (pence per kilometre)			Values of time per vehicle (pence per minute)		
	AM	IP	PM	AM	IP	PM
Lights	0.46	0.40	0.45	1.00	1.00	1.00
HGV	2.12	2.15	2.18	1.00	1.00	1.00

3 Data Collection

Introduction

- 3.1 The Bedford model maintained the previous model's 2011 base year, and hence the previous model data formed the majority of the dataset. This information was expanded through the collection of further 2011 data, and specific surveys required to disaggregate some of the town centre zones.

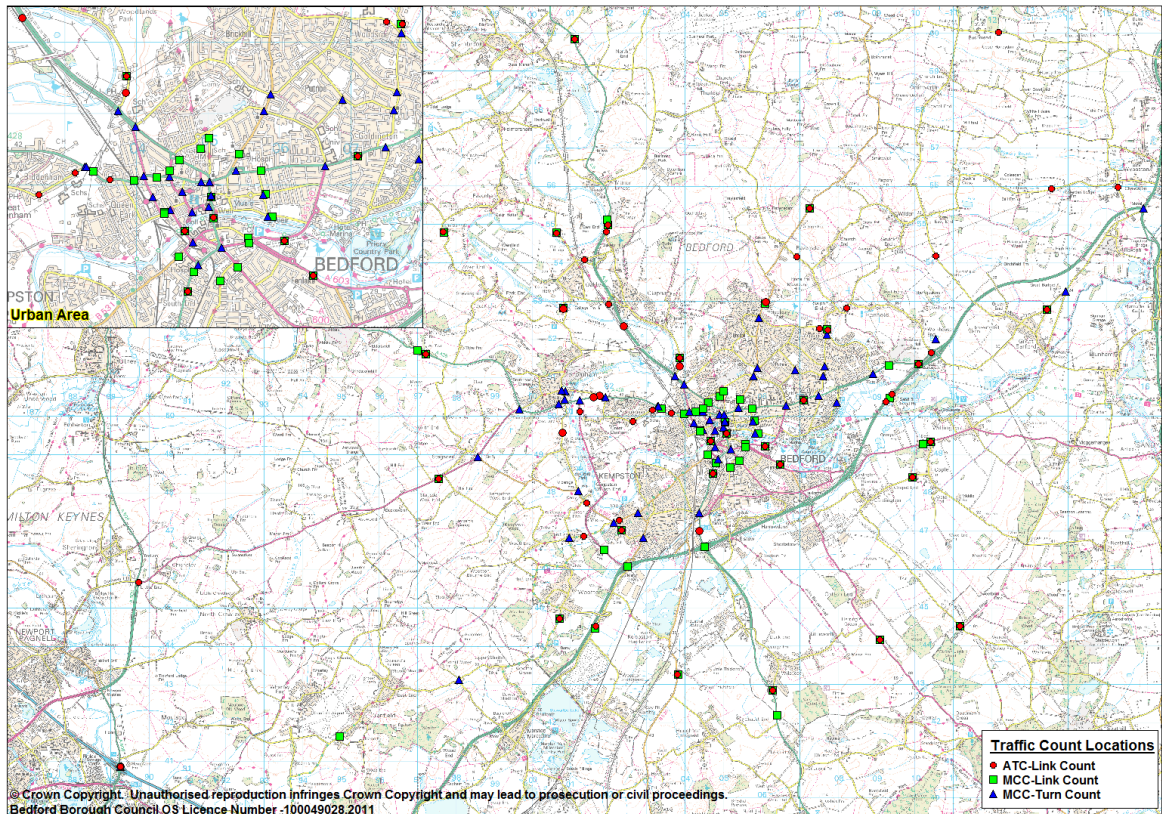
Existing Data

- 3.2 In order to define any additional survey requirements necessary to provide a suitably comprehensive dataset for the calibration and validation of the SATURN model, it was first necessary to identify and review existing data sources.
- 3.3 The list of data used in the previous model was reviewed:
- Automatic Traffic Counts (ATC)
 - Manual Classified Counts (MCC)
 - Manual Classified Turning Counts (MCTC)
 - Signal data

Traffic Counts

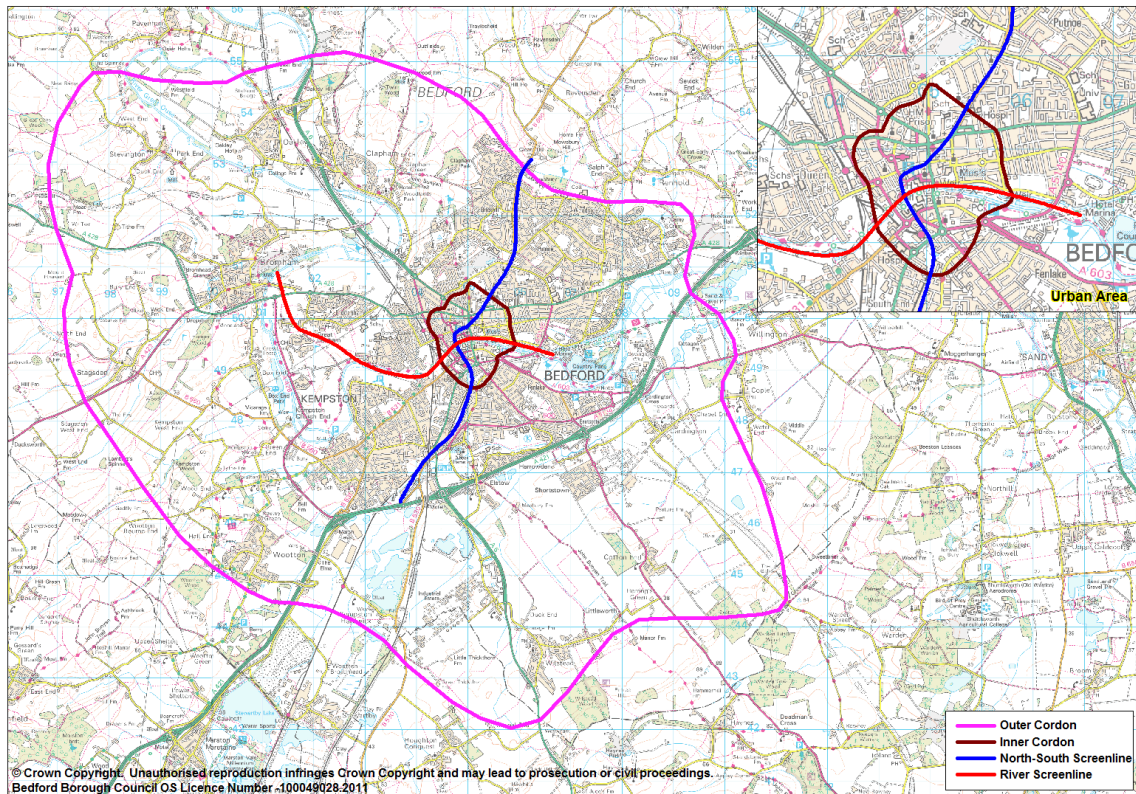
- 3.4 Traffic count surveys undertaken at strategic highway links and junctions have been obtained from Bedford Borough Council. Seasonality factors were used to convert all survey data into figures representing an average year, and growth factors to convert 2009-2010 traffic flow data to current 2011 levels. The traffic count data were used in the calibration and validation stages of the model building. Figure 3.1 shows the locations of these counts.

Figure 3-1 Traffic Counts from Bedford Borough Council



- 3.5 These traffic counts were used to form screenlines and cordons based on which the model is calibrated and validated. Two calibration cordons, inner cordon and outer cordon are formed to ensure that the model is well calibrated both within and outside the urban area. In addition, links along A421 are also formed to ensure the A421 calibrated well. Two validation screenlines cutting the urban area North-South and East-West were also established to validate the model. The location of the calibration cordons and the validation screenlines are shown in Figure 3.2.

Figure 3-2 Cordons and Screenlines



Signal Data

- 3.6 Bedford Borough Council provided 2011 traffic signal data taken from their records.

Additional Data

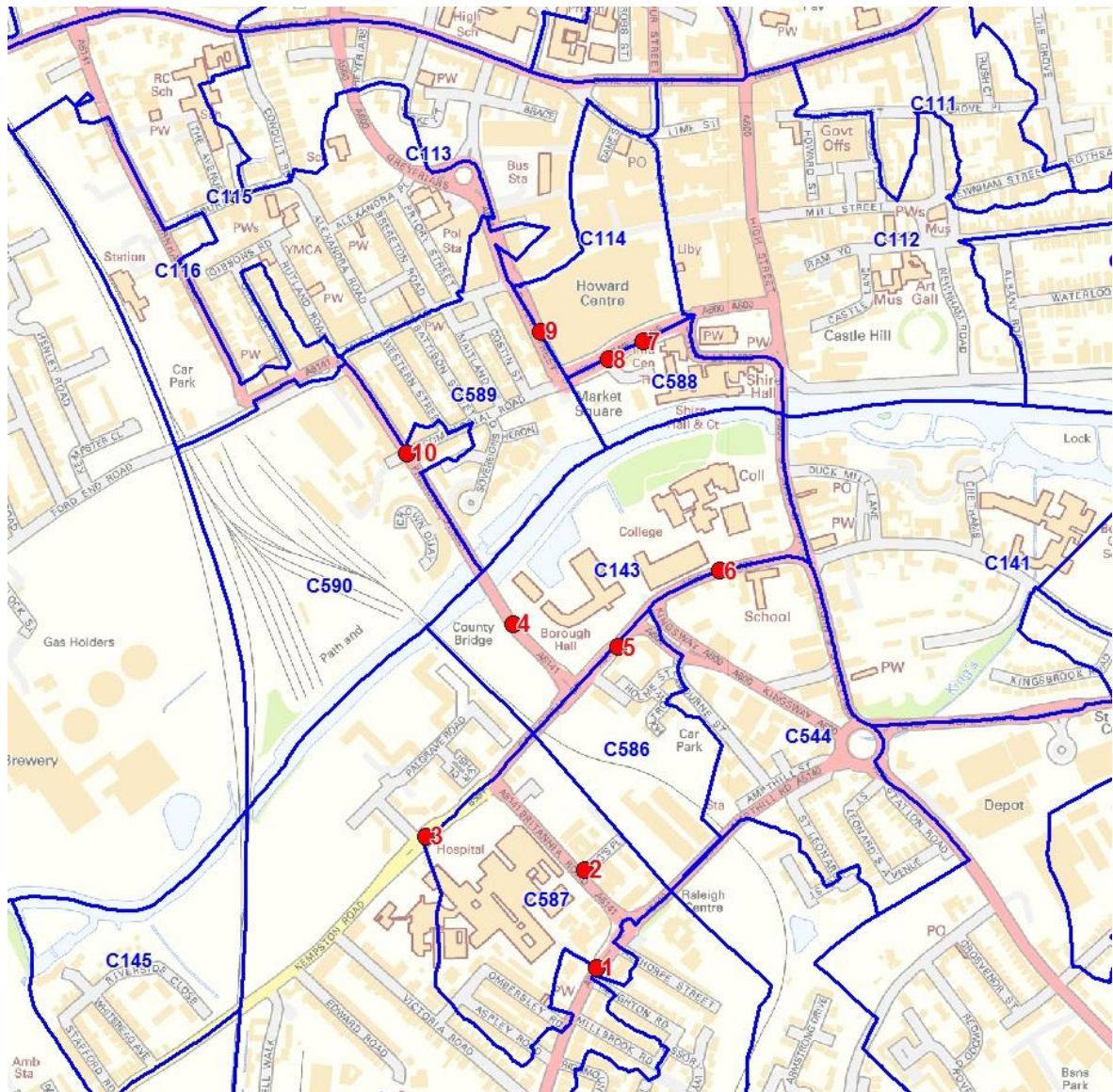
- 3.7 Upon review of the available data, the following additional have been collected for the development of the model:

- Manual Classified counts (MCCs) for zone split in town centre;
- Highway Agency's Traffic Flow Data System (TRADS) along A421 and M1;
- Traffic Master Journey Time survey data;
- 2011 National Census Journey to Work (JTW) data
- Bus route and timetable information

Manual Classified Counts (MCCs)

- 3.8 A series of MCCs were undertaken across the area shown in Figure 3.3, collecting all turning movements at the defined 10 junctions for a 12-hour period to disaggregate the large town centre zones to smaller zones based on the land use. The surveys were undertaken on Thursday 9th October 2014. The counts were then factored back to 2011 levels. These survey counts data has been also used in the calibration process to improve the Bedford town centre model validation.

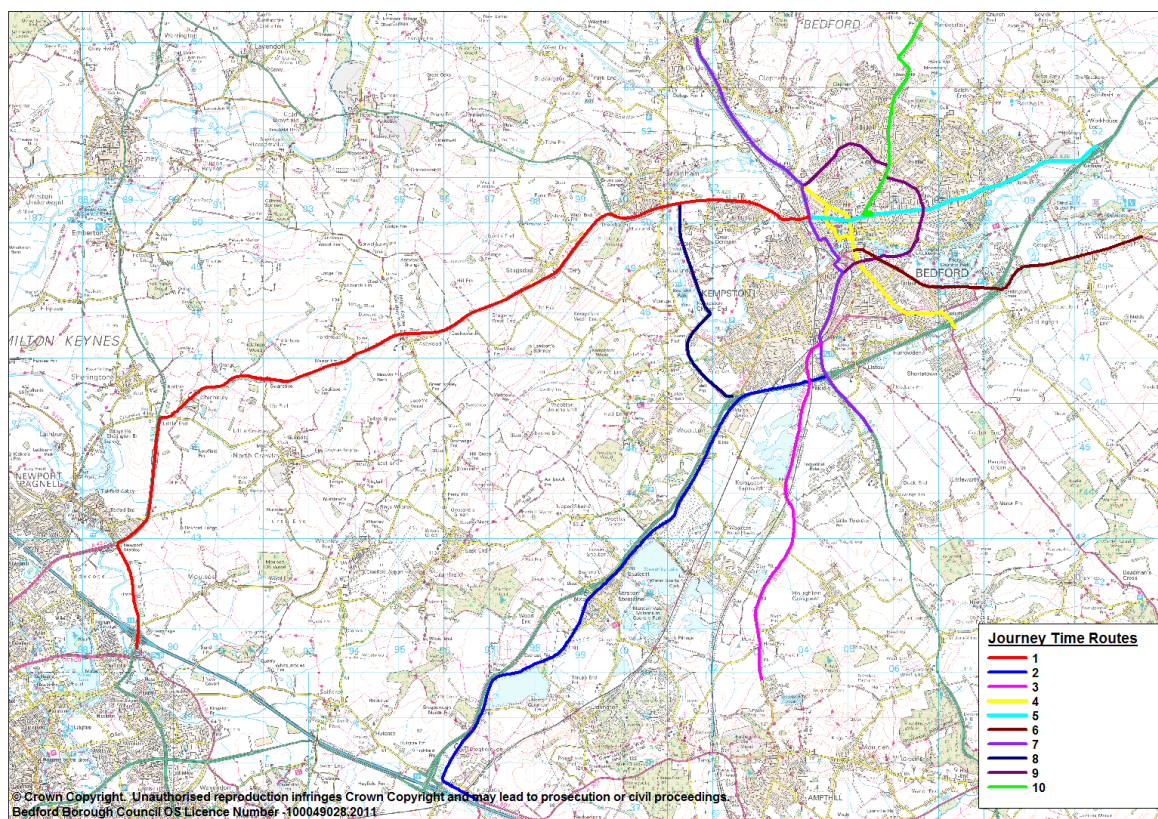
Figure 3-3 MCC Site Locations



Traffic Master Journey Time Data

- 3.9 In order to determine journey times, data was obtained from the Trafficmaster system and analysed by JMP.
- 3.10 Figure 3.4 shows the routes used for model validation.

Figure 3-4 Journey Time Routes



National Census Journey to Work Data

- 3.11 A database of the Travel to Work (TtW) trips between all output areas within England and Wales by mode from the 2011 Census has been made available for this study.
- 3.12 Graphical Information System (GIS) software Manifold were used to identify the 2011 Census zones, known as output areas, that are within each individual traffic model zone. A matrix based on the 2011 Census TtW Data was produced to assist the demand rebuild process. As data from the 2011 Census is only available to Middle Layer Super Output Area (MSOA), data from the 2001 Census was used to disaggregate into Census Output Areas (COA).

Bus Route and Timetable Information

- 3.13 Bus routes and timetable information was obtained from the Bedford Borough Council website. The bus routes are coded into the Bedford Model and the timetable allowed the service frequency to be calculated per modelled hour to reflect the traffic loading effect of these bus routes on the model network.

4 Model Development

Introduction

- 4.1 The development of the Bedford highway model can be split into distinct stages as follows:
- Review and refinement of the existing network from Atkins;
 - Rebuild the matrix based on the 2011 census data
 - Model calibration including matrix estimation; and
 - Model validation
- 4.2 This chapter details the development of the model network and prior matrix. The model calibration and validation stages are covered in chapter 5.

Network Structure

- 4.3 During the development of the network, the existing model network from Atkins was reviewed and updated for the following key network elements within the simulation Area and the final network structure shown in Figures 4.1 and 4.2 :
- node type;
 - capacities;
 - link distances and speed;
 - signal timings; and
 - zone connectors

Junction Layout

- 4.4 The junction layout for the major junctions in the simulation area have been revised against the 2011 Google Maps to make sure the SATURN network represents the correct situation. The following coding errors have been noticed and fixed in this study:
- Incorrect number of circulatory lanes for A421 roundabouts;
 - Missing signals for M1 Jn14;
 - Incorrect number of approaching lanes/arms for town centre junctions; and
 - Incorrect junction type for town centre junctions.

Capacities

- 4.5 Saturation flows in the simulation area have been revised for the specific junction types; a capacity and circulatory capacity and traffic signal timings for roundabouts and signalised junctions respectively. The saturation flows for some major roundabouts on the A421 were too high in the previous model and have been updated to lower values to represent existing junction capacity in Bedford area.

Link distance and speed

- 4.6 In the Bedford Modelled Area the link distances for the major roads have been revised against the Google Maps and link speeds have been revised to match cruise speeds for the specific link type characteristic by road type (urban/rural, distributor/residential/minor road). The network error messages have been also revised to make sure two-way links have the same distance and speed for two directions.

Signal Timings

- 4.7 Signal timings were checked against observed data supplied by Bedford Borough Council and optimised in the assignment stage.

Zone connectors

- 4.8 The access point for all zone within the study area have been revised against the Google Maps. Additional zone connectors have been identified for the disaggregated zones with the assistance from the Bedford Borough Council.

Figure 4.1 Final Network - Whole Model

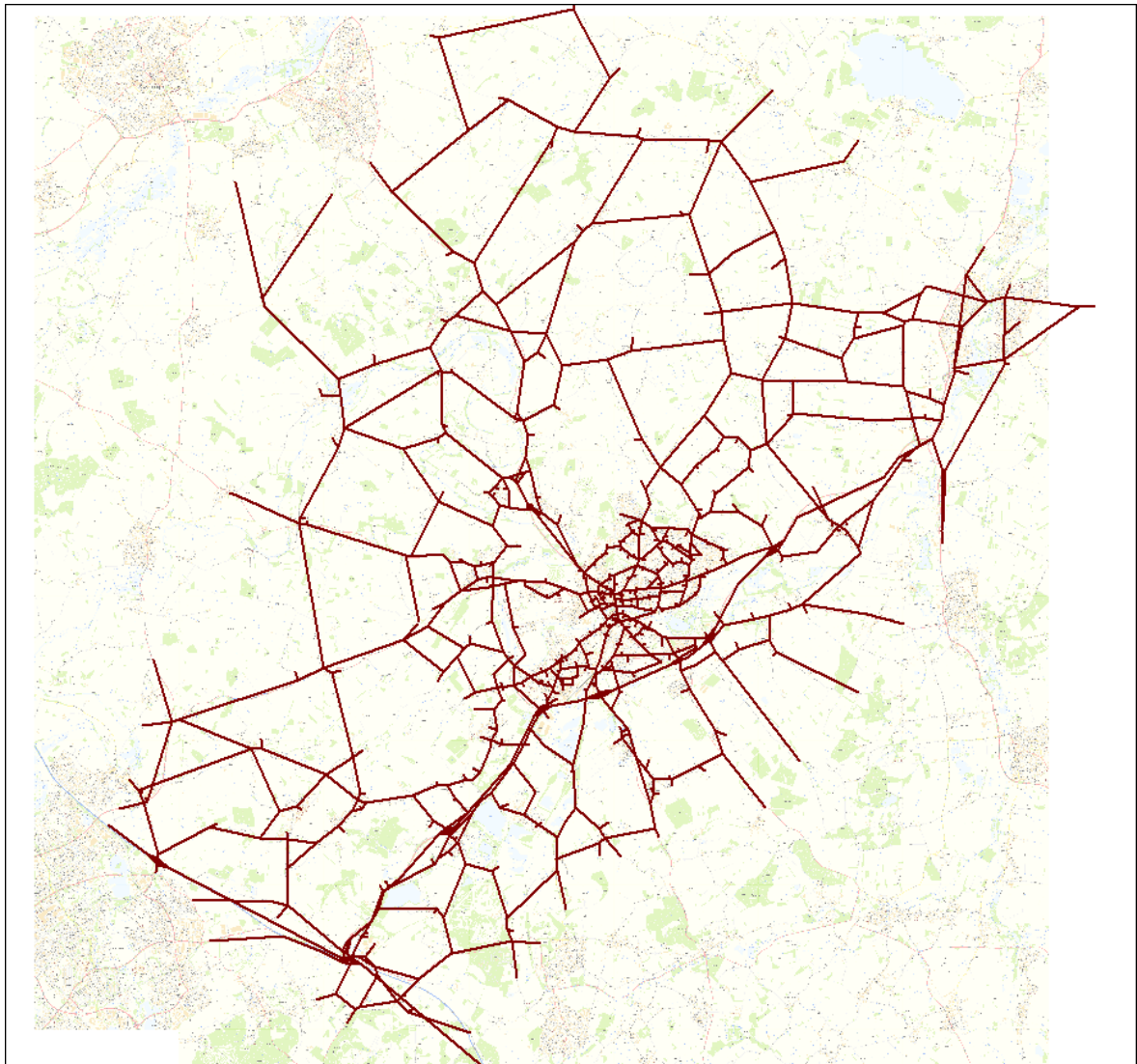
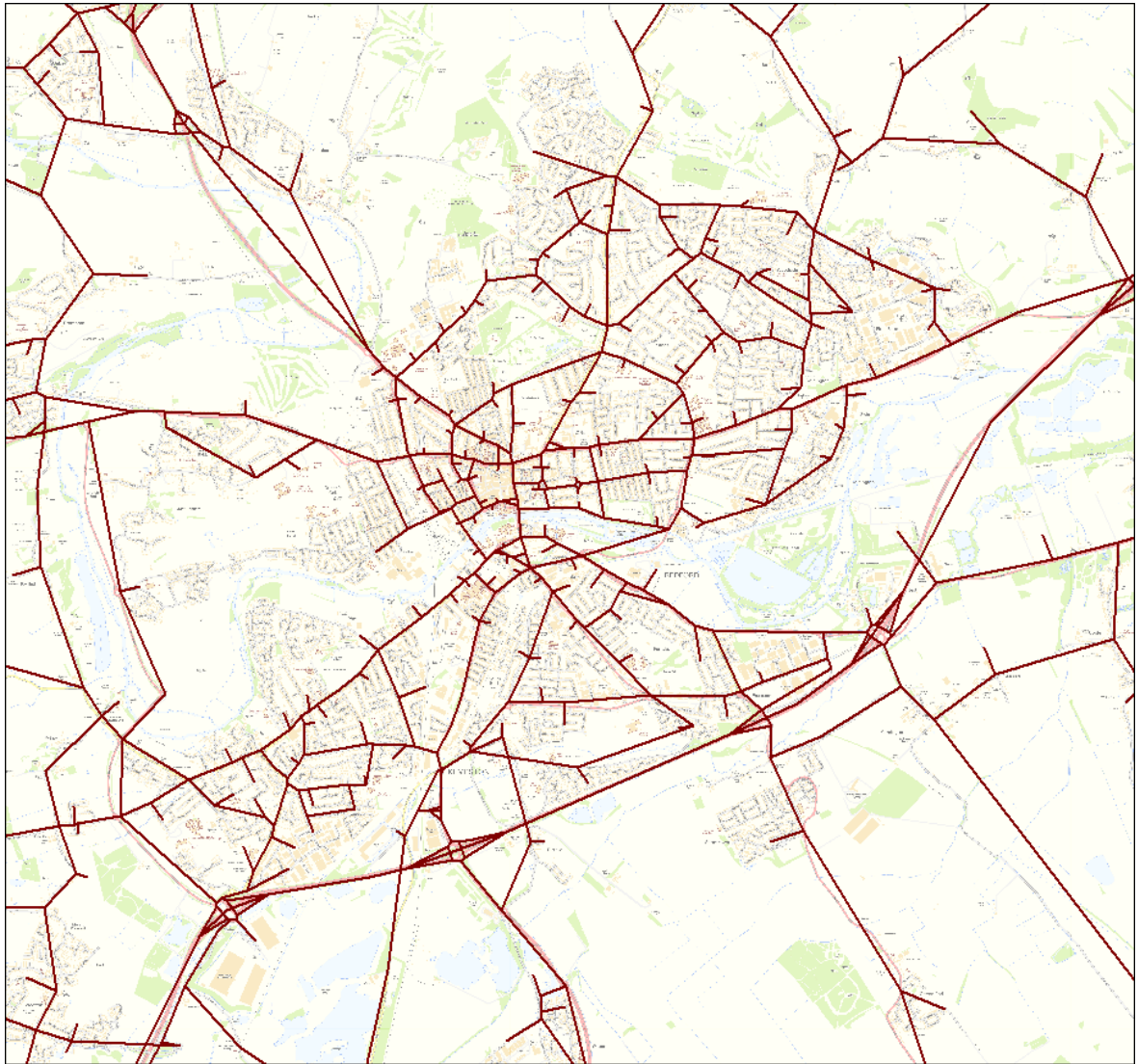


Figure 4.2 Final Network – Town Centre



Prior Matrix

- 4.9 The matrix building process sought to utilise available data to develop a set of prior matrices. This provides an initial estimate of the traffic movements within the study area. These matrices were subsequently updated using matrix estimation (ME), a process that yields a “best fit” to observed traffic count data used for the calibration process.
- 4.10 Prior matrices for the two peak hours were developed using the 2011 Census Travel to Work (TtW) for internal trips and additionally, the prior matrix of the previous model for the external-external trips was incorporated in this stage.
- 4.11 2011 Middle Layer Super Output Area (MSOA) Travel to Work (TtW) data was disaggregated to Census Output Area (COA) level using 2001 TtW data. This was then transposed to allow for returning trips, factored to allow for variable travel time and disaggregated at key locations within the model using recent surveys.
- 4.12 The prior matrix also has included the school element which was determined by using 2011 census data. 2011 school children at MSOA level was split into 2011 COA level, using 2001 COA level of

school children. These were then routed from COA to COA according to the closest available school.

4.13 The inter peak prior matrix was built using the average of the AM and PM matrices.

5 Model Assignment, Calibration and Validation

Model Assignment

Assignment Procedures

- 5.1 The Wardrop User Equilibrium approach was used for assignment of trips to the highway network. This method seeks to minimise travel costs for all vehicles in the network and is based on the following assumptions:
- 5.2 'Traffic arranges itself on congested networks such that the cost of travel on all routes used between each O-D pair is equal to the minimum cost of travel and all unused routes have equal or greater cost.' (SATURN manual, Chapter 7)
- 5.3 The assignment utilised the generalised cost functions expressed in terms of travel time and distance. The parameters used in the generalised cost function are summarised in Chapter 2.

Model Convergence

- 5.4 This is a measure of how stable the model network is. Acceptable stability and convergence means that if the model was to be run through further iterations, then the outputs would not change significantly, in terms of assigned flows, route journey times, congestion and travel costs.
- 5.5 The two criteria for acceptable model convergence used are defined in DMRB and are as follows:
- 'Delta' – less than 1% or at least stable, with convergence fully documented and all other criteria met; and
 - Gap value – less than 0.5% for four consecutive iterations.
- 5.6 The convergence statistics for the two peak models have been extracted after running the trip assignment. A summary of the convergence statistics is given in Table 5.1.

Table 5.1 Model Convergence Statistics

Time Period	Assignment Loop	Delta (%)	Flow Change Stability (%)	Gap (%)
AM	24	0.0247	98.6	0.053
	25	0.0217	97.9	0.049
	26	0.0106	98.9	0.043
	27	0.0097	99.1	0.051
IP	13	0.0057	97.5	0.011
	14	0.0048	97.6	0.010
	15	0.0043	98.5	0.007
	16	0.0040	98.9	0.008
PM	66	0.0302	98.0	0.070
	67	0.0683	97.9	0.090
	68	0.0503	97.6	0.052
	69	0.0071	99.1	0.066

- 5.7 The convergence statistics demonstrate that the base models converge in accordance with DMRB criteria.

Model Calibration/Validation

- 5.8 Calibration and validation of the network and matrices was undertaken to ensure that the model provides a sufficiently robust representation of observed traffic patterns within the study area. The calibration process involves the refinement of the network detail and characteristics to ensure assignment and route choice is well represented. It also involves adjustment of trip matrices to achieve a reasonable distribution of trip origins and destinations and to replicate observed flows within the model at the survey sites, to the degree of accuracy specified within required calibration/validation criteria.
- 5.9 The calibration/validation of the model has been performed in accordance with the Design Manual for Roads and Bridges (DMRB) and WebTAG.

Route Choice

- 5.10 As part of the network calibration process, routings were checked between following corridors:
- A428 Cambridge to Bedford Borough Council Offices in AM and Bedford Borough Council Offices to A428 Cambridge in PM – to check East West routeing;
 - Milton Keynes to Bedford town centre – to check A422, A421 routeing; and
 - Select link analysis on Western Bypass – to understand its routeing pattern.
- 5.11 The route choice plots are shown in Appendix A. It is considered the routing shown in these plots to be a reasonable representation of existing patterns.

Calibration/Validation Criteria

- 5.12 According to the standards specified in the Design Manual for Roads and Bridges (DMRB) Volume 12a Part 1 'Traffic Appraisal in Urban Areas', the criteria outlined in Table 5.2 need to be met for the model to be deemed calibrated and validated.

Table 5.2 DMRB Calibration and Validation Criteria

Criteria and Measures	Acceptability Guidelines
GEH statistics: individual flows: GEH<5	>85% of cases
GEH statistics: screenlines: GEH<4	All (or nearly all) screenlines
Individual flows within 100 vph for flows < 700vph	>85% of cases
Individual flows within 15% for flows <700-2700vph	
Individual flows within 400 vph for flows > 2700vph	
Total screenline flows to be within 5%	All (or nearly all) screenlines
Journey times within 15% (or 1 minute, if higher)	>85% of cases

Note: vph – vehicles per hour

- 5.13 The principal measures to gauge model accuracy are through comparisons with surveyed traffic flows. The guidelines contain two different measures that can be used to compare modelled and observed traffic flows. However each of these different measures has their shortcomings. Using a percentage difference can accentuate small differences when the flows are small. Using absolute differences can cause the differences in high flow links to overshadow major inconsistencies in lower flow links.

- 5.14 A measure that has been devised to overcome this problem is the GEH error statistic. The GEH statistic is a form of the Chi-squared statistic and compares two values and weights the difference according to the average of the two flows.
- 5.15 The weighting is not linear but takes the form of a square root function:

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

Where:

M = Modelled Flow
C = Observed Flow

- 5.16 The other method is based on differences in flow volume, as shown in Table 5.2. Both measures effectively measure the same aspect of the model and are presented in this report. It should be noted that WebTAG unit M3.1 states in paragraph 3.2.7 that comparisons that meet either the GEH or the flow criteria should be deemed satisfactory.
- 5.17 The criteria also provide guidelines for the comparison of screenlines. Again, both volumetric comparisons and the GEH statistic may be applied, but with different degrees of accuracy required compared to individual count comparisons.

Matrix Estimation

- 5.18 To improve the fit of the modelled flows against observed counts as part of the calibration process, matrix estimation was performed using the SATME2 module of SATURN. This method takes the prior trip matrix and traffic counts to estimate the most likely trip matrix consistent with the information contained in the counts.
- 5.19 When applying matrix estimation to adjust the prior matrices, care must be taken to ensure that the quality and consistency of the input count data is high. Checks were undertaken to ensure that this was the case, and a number of counts were consequently discarded due to quality reasons, inconsistencies with counts on adjacent links or overlapping of sites.
- 5.20 The calibration dataset comprises all the traffic count were included in the estimation process. As less information was available for the Inter peak counts, an Inter peak factor applied based on the MCC counts across the town centre. Model validation was performed using journey time comparisons, as discussed later in this section.
- 5.21 Six iterations of matrix estimation were performed with the 2 user classes grouped into vehicle types (Lights and Heavies).
- 5.22 Table 5.3 below shows a comparison of the total matrix size before and after estimation for the cordon model. This indicates the limited impact of the estimation process on the prior matrix.

Table 5.3 Comparison of Matrix Totals - Prior vs. Post Matrix Estimation

Time Period	Prior Matrix	Post-ME Matrix	% Change
AM	85252.11	77550.05	-9%
IP	50929.66	57687.61	13%
PM	82256.45	76490.77	-7%

Trip Length Distribution

- 5.23 The comparisons of the trip length distributions for the pre and post matrix estimation matrices are shown in Figures 5.1 to 5.6 below for the different time periods and vehicle types.
- 5.24 The figures show that the trip length patterns for each vehicle type are maintained following the application of matrix estimation for all of the time periods.

Figure 5-1 AM Lights Trip Length Distribution

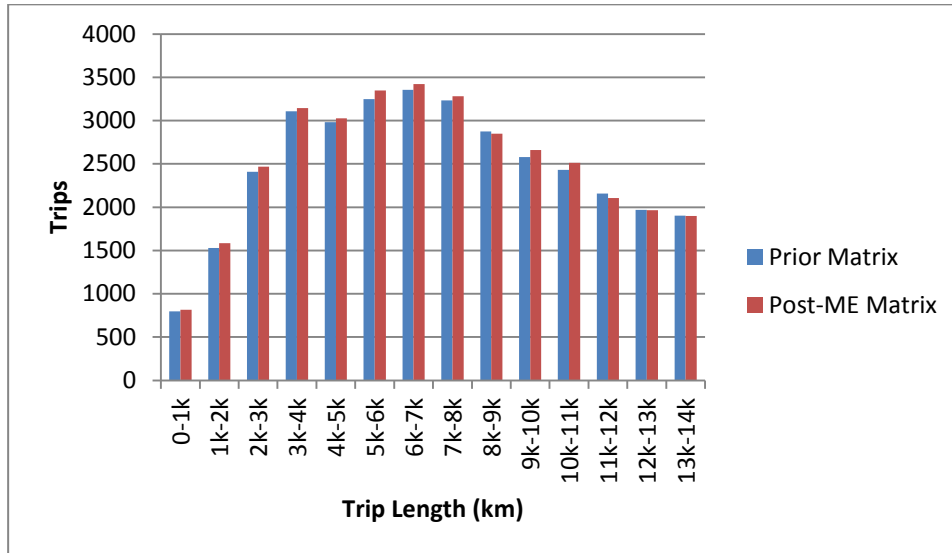


Figure 5-2 AM Heavies Trip Length Distribution

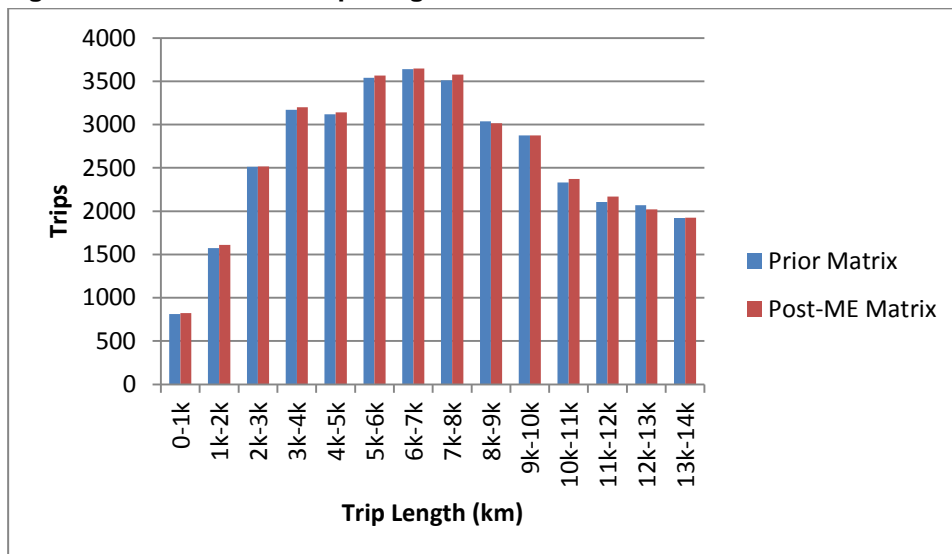


Figure 5-3 IP Lights Trip Length Distribution

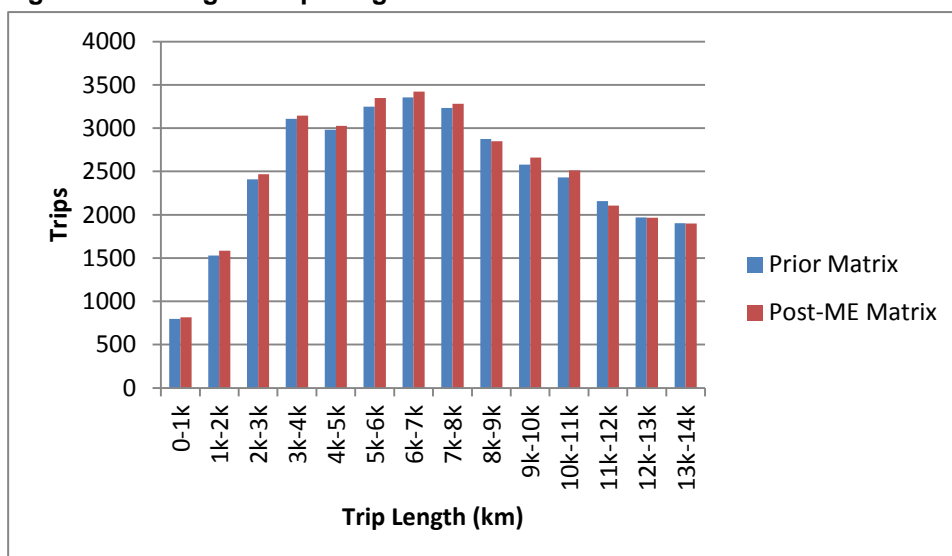


Figure 5-4 IP Heavies Trip Length Distribution

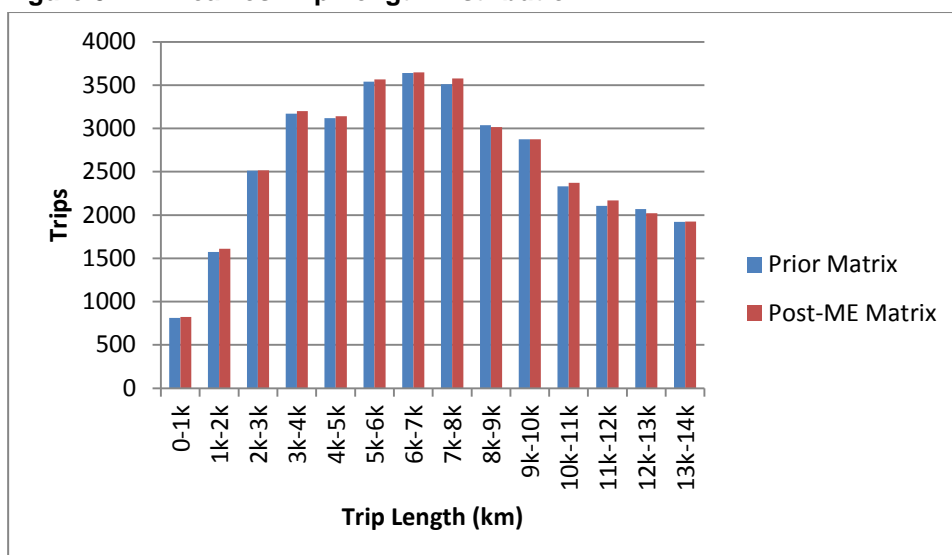


Figure 5-5 PM Lights Trip Length Distribution

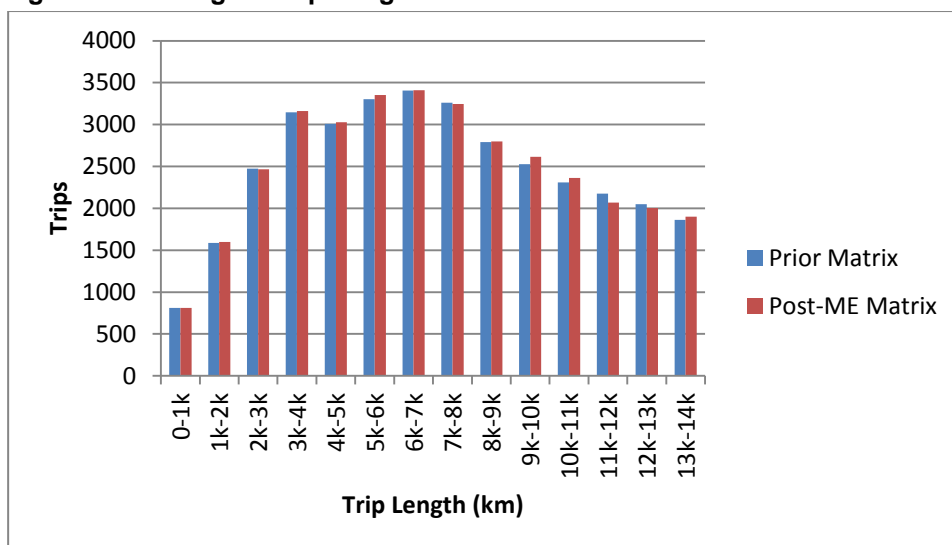
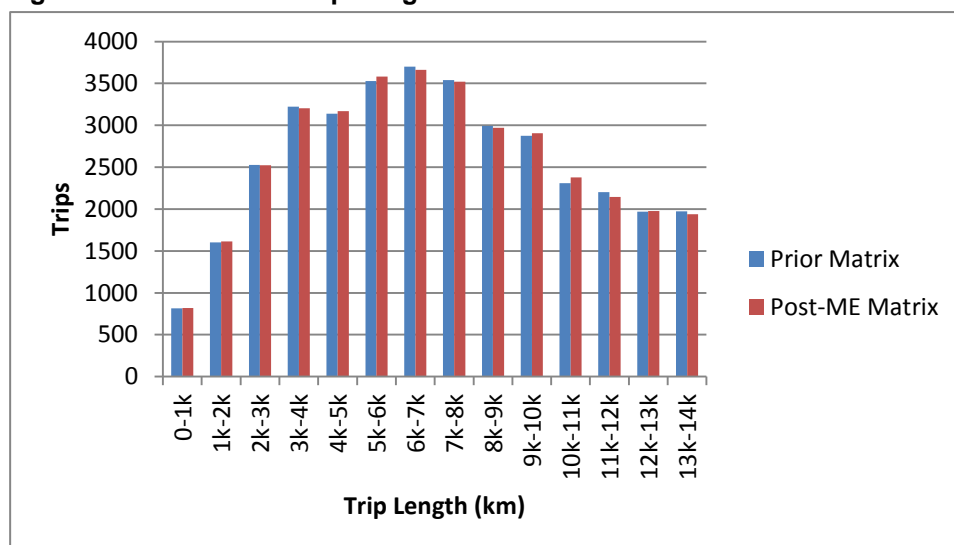


Figure 5-6 PM Heavies Trip Length Distribution



Regression Analysis

5.25 The Regression Analysis for the prior and post matrix estimation comparison are provided in Figures 5.7 to 5.12, with Table 5.4 showing a summary of various prior and post matrix statistics. It should be noted that WebTAG 3.19 Table 5 Significance of Matrix Estimation Changes states that cell to cell Regression Analysis that meet the following criteria:

- Slope within 0.98 and 1.02;
- Intercept near zero; and
- R2 in excess of 0.95.

Figure 5-7 Matrix Scatter Plot – Lights (AM)

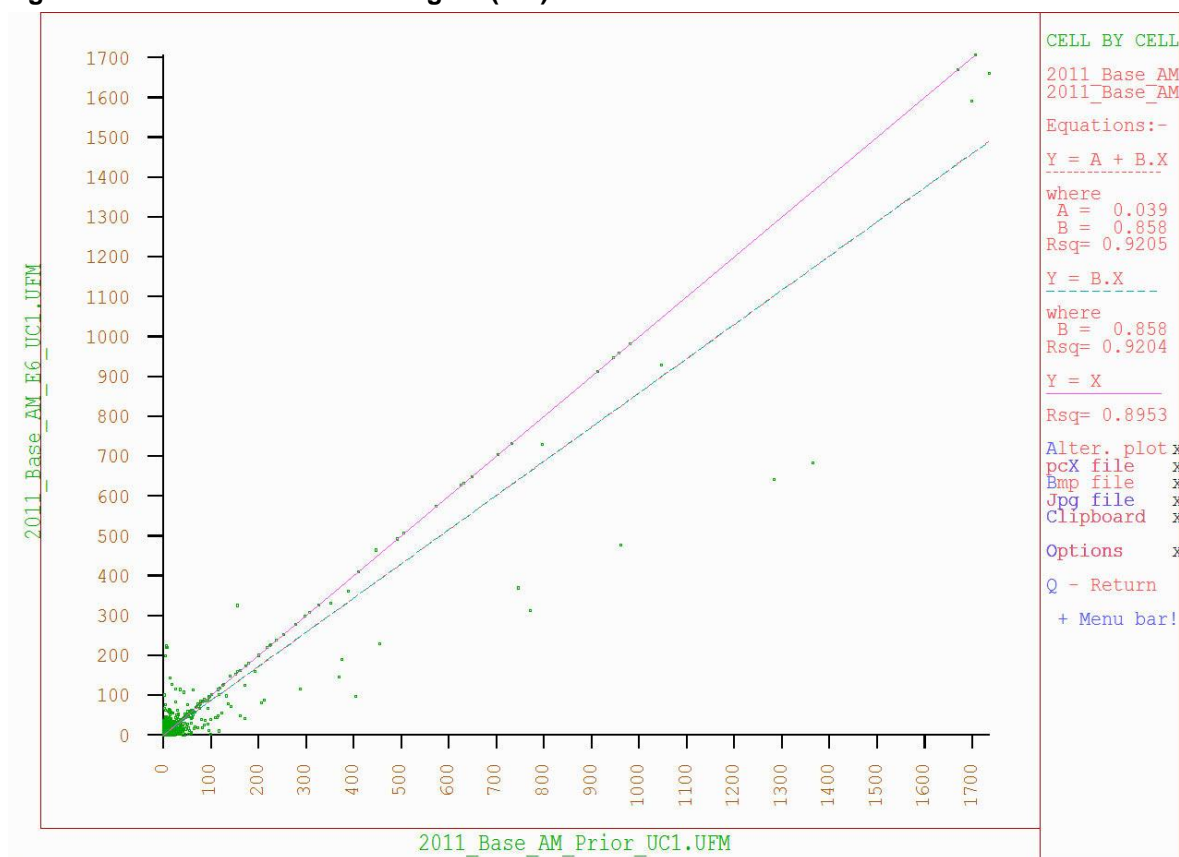


Figure 5-8 Matrix Scatter Plot – Heavies (AM)

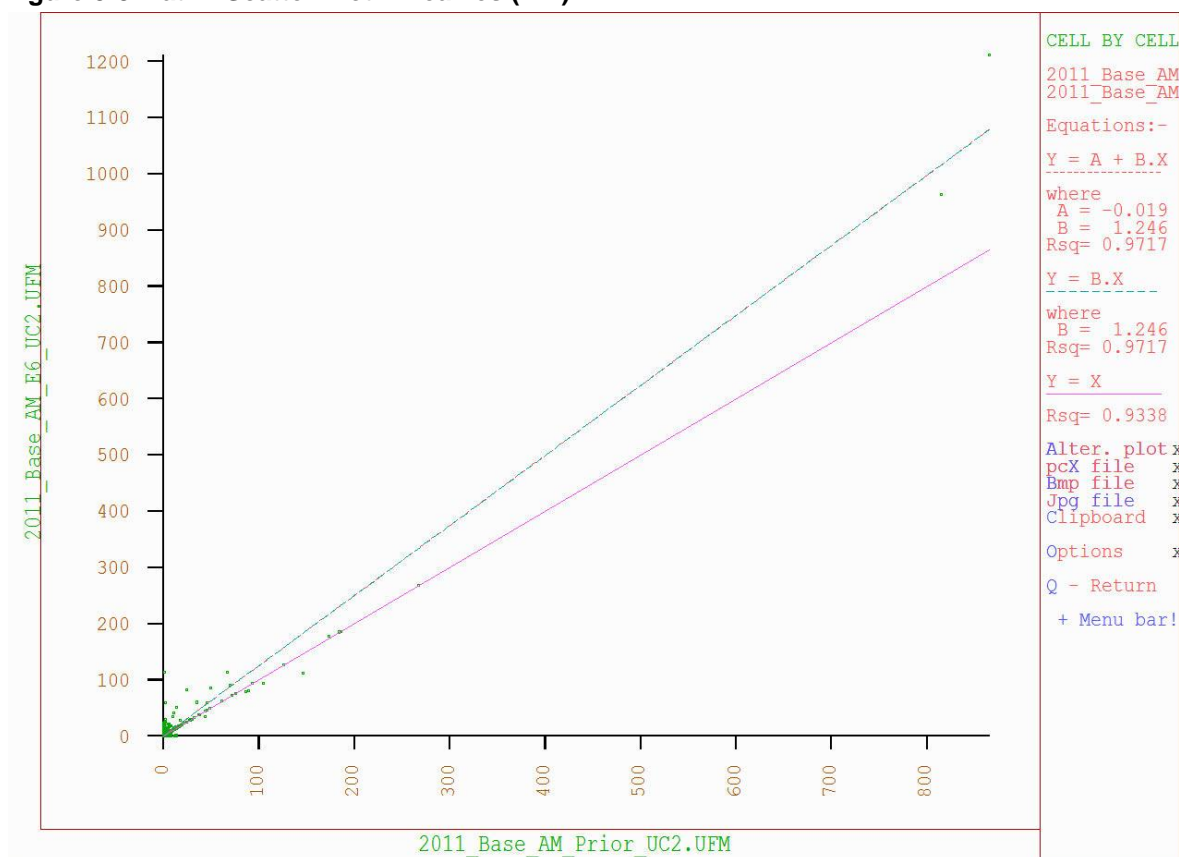


Figure 5-9 Matrix Scatter Plot – Lights (IP)

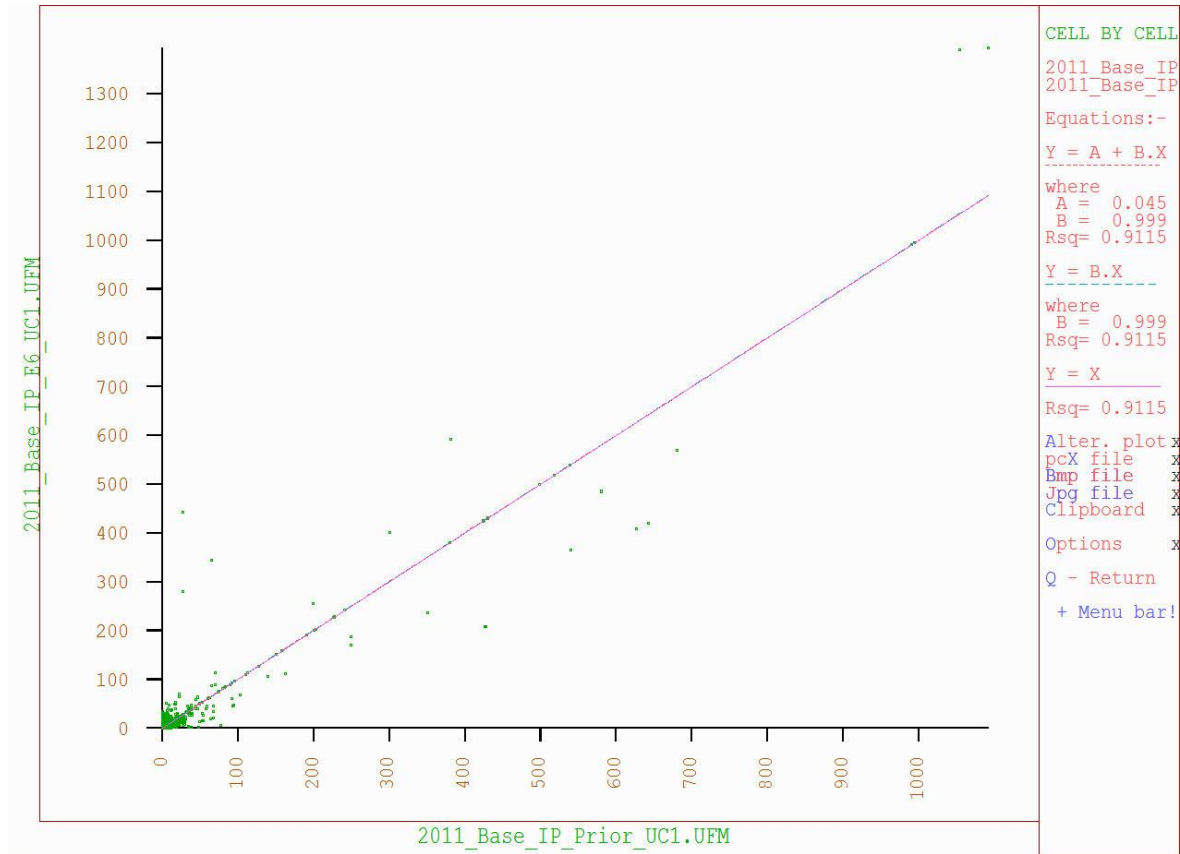


Figure 5-10 Matrix Scatter Plot – Heavies (IP)

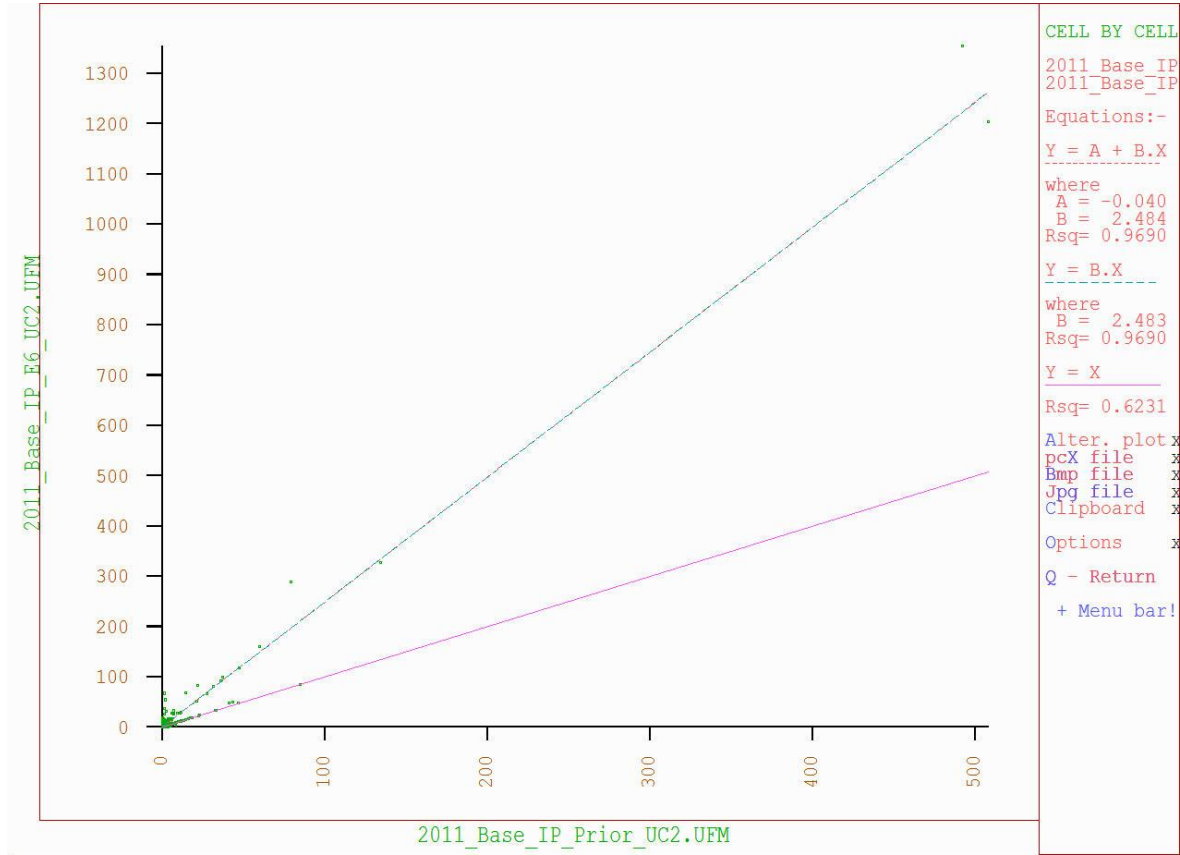


Figure 5-11 Matrix Scatter Plot – Lights (PM)

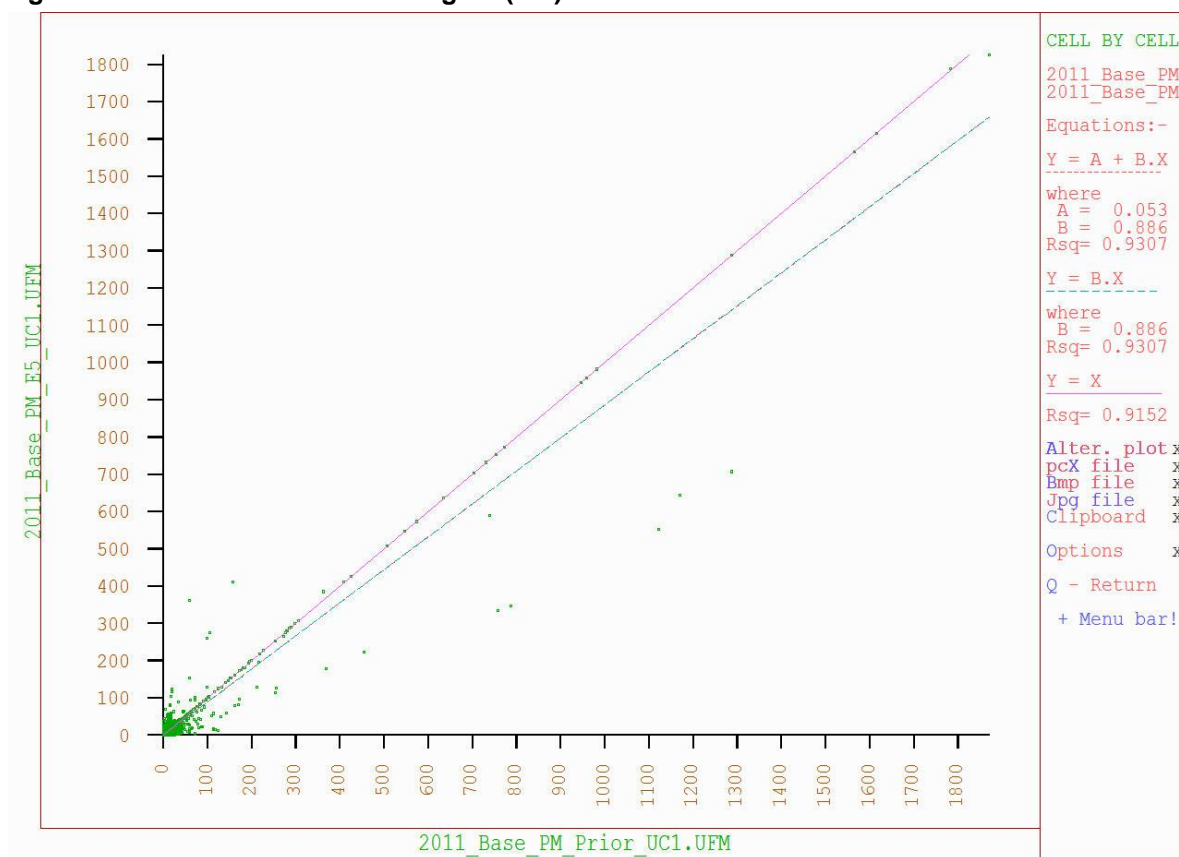


Figure 5-12 Matrix Scatter Plot – Heavies (PM)

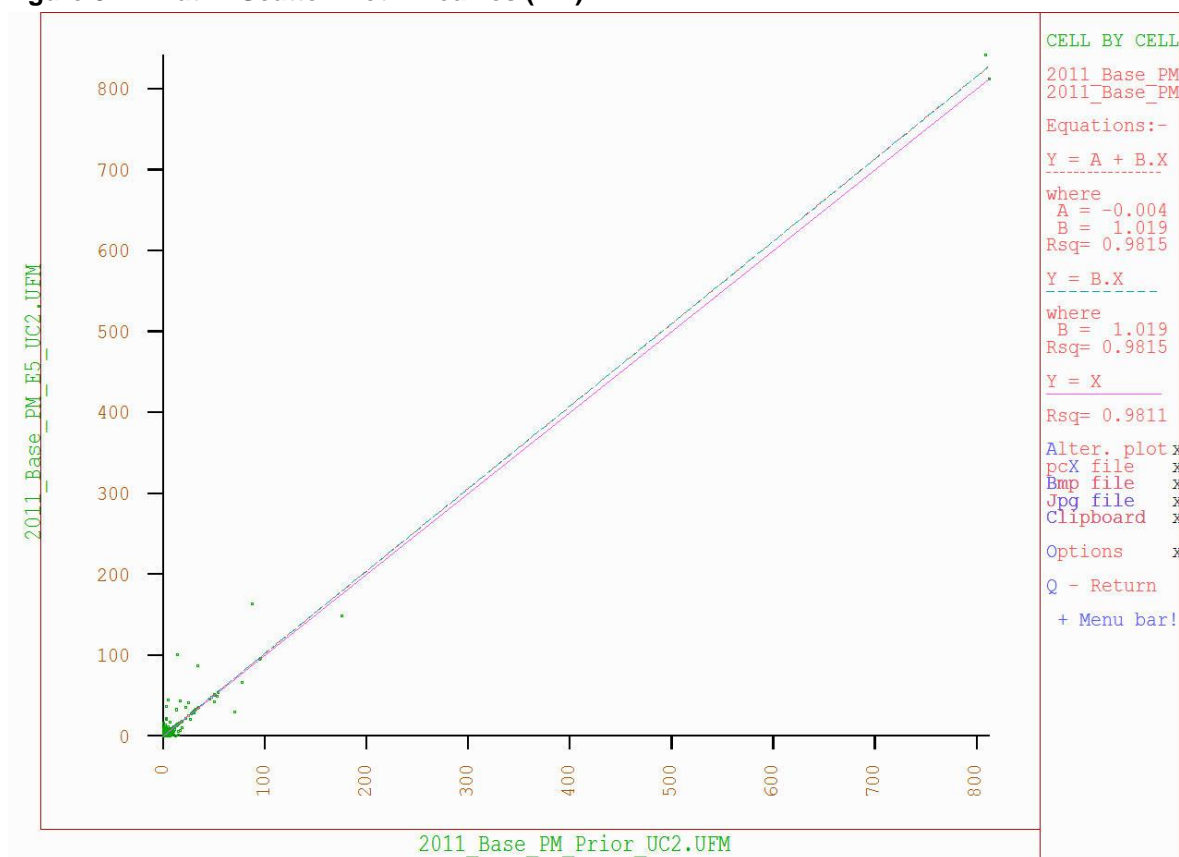


Table 5.4 Comparison of Matrix Statistics - Prior vs. Post Matrix Estimation

UC	AM			IP			PM		
	Intercept	Slope	R ²	Intercept	Slope	R ²	Intercept	Slope	R ²
Lights	0.04	0.86	0.92	0.05	1.00	0.91	0.05	0.89	0.93
Heavies	-0.02	1.25	0.97	-0.04	2.48	0.97	0.00	1.02	0.98

Sector to Sector Movement Analysis

- 5.26 The sector to sector movement analysis was carried out to capture the movement changes between sectors for prior and post ME models. There are 4 sectors. The 4 sectors are Bedford town centre, rest of Bedford Borough, south-west Bedford and external area. The sector plan was shown in Chapter 2.
- 5.27 Table 5.5 shows a summary of the entry/exit trips total for each sector between the prior matrix and the post matrix estimation matrix. The sector to sector movement comparison between the prior matrix and the post matrix estimation matrix are shown in Appendix B.

Table 5.5 Comparison of Sector Trips Total - Prior vs. Post Matrix Estimation

Sector	Location	Prior ME - In	Prior ME - Out	Post ME - In	Post ME - Out	Dif - In	Dif - Out	%Dif - In	%Dif - Out
1	Bedford Town Centre	12694	13946	14669	14135	1975	190	16%	1%
2	Outer Area	10558	9527	9419	9707	-1138	179	-11%	2%
3	Southwest Bedford	12505	12031	10826	10633	-1678	-1397	-13%	-12%
4	External	49496	49748	42635	43075	-6860	-6674	-14%	-13%
Total		85252		77550		-7702		-9%	

Link Flow Calibration

- 5.28 The traffic counts used for calibration were compared against traffic flows from the model. These counts are spread throughout the study area to help ensure an acceptable degree of robustness across the model.
- 5.29 Table 5.6 summarises the calibration results, with all the observed counts used in ME and modelled flows compared in accordance with the DMRB criteria set out in Table 5.2 above.

Table 5.6 Summary of Flow Calibration – All Counts

Time Period	Total No. of Counts	No. of counts with GEH < 5	% of counts with GEH < 5	No. of Counts Satisfying DMRB	% Satisfying DMRB Flow
AM	438	369	84%	393	90%
IP	420	374	89%	392	93%
PM	376	334	89%	343	91%

- 5.30 Two cordons were used for model flow calibration. In addition, links along A421 are also formed to ensure the A421 calibrated well. The summary of cordon and A421 calibration results are shown in Tables 5.7 to 5.9 respectively for the three model periods. Detailed link performance is shown in Appendix C.

Table 5.7 Summary of AM Peak Flow Calibration

BOUNDARY	DIRECTION	Obs.	Mod.	Obs - Mod	% Diff.	GEH	DMRB	
							Flow	GEH
Cordon 1 - Outer Cordon	IN	8924	8742	-182	-2%	2	✓	✓
	OUT	8133	8218	84	1%	1	✓	✓
Cordon 2 - Inner Cordon	IN	8813	8516	-296	-3%	3	✓	✓
	OUT	7310	6988	-322	-4%	4	✓	✓
A421	NB	13533	13571	37	0%	0	✓	✓
	SB	14358	14706	348	2%	3	✓	✓
NUMBER OF SCREENLINES COMPLYING WITH DMRB				POST ME2			6 / 6	6 / 6
PERCENTAGE OF SCREENLINES COMPLYING WITH DMRB							100%	100%
PERCENTAGE OF INDIVIDUAL LINKS COMPLYING WITH DMRB							96%	91%

Table 5.8 Summary of IP Peak Flow Calibration

BOUNDARY	DIRECTION	Obs.	Mod.	Obs - Mod	% Diff.	GEH	DMRB	
							Flow	GEH
Cordon 1 - Outer Cordon	IN	6095	6240	145	2%	2	✓	✓
	OUT	6005	6250	245	4%	3	✓	✓
Cordon 2 - Inner Cordon	IN	7087	6802	-284	-4%	3	✓	✓
	OUT	7326	6903	-424	-6%	5	x	x
A421	NB	10857	10805	-52	0%	1	✓	✓
	SB	10237	10093	-144	-1%	1	✓	✓
NUMBER OF SCREENLINES COMPLYING WITH DMRB				POST ME2			5 / 6	5 / 6
PERCENTAGE OF SCREENLINES COMPLYING WITH DMRB							83%	83%
PERCENTAGE OF INDIVIDUAL LINKS COMPLYING WITH DMRB							91%	86%

Table 5.9 Summary of PM Peak Flow Calibration

BOUNDARY	DIRECTION	Obs.	Post	Obs - Mod	% Diff.	GEH	DMRB	
							Flow	GEH
Cordon 1 - Outer Cordon	IN	7484	7424	-59	-1%	1	✓	✓
	OUT	7976	7948	-28	0%	0	✓	✓
Cordon 2 - Inner Cordon	IN	7559	7644	85	1%	1	✓	✓
	OUT	9251	8828	-422	-5%	4	✓	x
A421	NB	14112	14189	77	1%	1	✓	✓
	SB	11358	11254	-104	-1%	1	✓	✓
NUMBER OF SCREENLINES COMPLYING WITH DMRB				POST ME2			6 / 6	5 / 6
PERCENTAGE OF SCREENLINES COMPLYING WITH DMRB							100%	83%
PERCENTAGE OF INDIVIDUAL LINKS COMPLYING WITH DMRB							95%	95%

- 5.31 The AM peak calibration shows that the matrix estimation ensured that the post ME matrix met the DMRB criteria for both the cordons/A421 and individual links.
- 5.32 The Inter peak and PM peak calibration shows that the matrix estimation ensured that the post ME matrix met the DMRB criteria for individual links. The total of the cordons/A421 is just below the 85% criteria, noting that this equates to one of the six values not quite meeting the criteria.

Link Flow Validation

- 5.33 Screenline validation checks were undertaken against an independent set of screenlines, as identified in Figure 3.2. The results of the validation assessment are summarised in Tables 5.10 to 5.12, with detailed link performance contained in Appendix D.

Table 5.10 Summary of AM Peak Flow Validation

BOUNDARY	DIRECTION	Obs.	Mod.	Obs - Mod	% Diff.	GEH	DMRB	
							Flow	GEH
Screenline 1-River Screenline	NB	3535	3345	-190	-5%	3	✖	✓
	SB	4330	4494	164	4%	2	✓	✓
Screenline 2 - NS Screenline	EB	7564	7537	-27	0%	0	✓	✓
	WB	7967	7764	-203	-3%	2	✓	✓
NUMBER OF SCREENLINES COMPLYING WITH DMRB							3 / 4	4 / 4
PERCENTAGE OF SCREENLINES COMPLYING WITH DMRB							75%	100%
PERCENTAGE OF INDIVIDUAL LINKS COMPLYING WITH DMRB							87%	83%

Table 5.11 Summary of IP Peak Flow Validation

BOUNDARY	DIRECTION	Obs.	Mod.	Obs - Mod	% Diff.	GEH	DMRB	
							Flow	GEH
Screenline 1-River Screenline	NB	3340	3023	-317	-9%	6	✖	✖
	SB	3370	3447	77	2%	1	✓	✓
Screenline 2 - NS Screenline	EB	6770	6044	-727	-11%	9	✖	✖
	WB	6565	6384	-181	-3%	2	✓	✓
NUMBER OF SCREENLINES COMPLYING WITH DMRB							2 / 4	2 / 4
PERCENTAGE OF SCREENLINES COMPLYING WITH DMRB							50%	50%
PERCENTAGE OF INDIVIDUAL LINKS COMPLYING WITH DMRB							77%	73%

Table 5.12 Summary of PM Peak Flow Validation

BOUNDARY	DIRECTION	Obs.	Post	Obs - Mod	% Diff.	GEH	DMRB	
							Flow	GEH
Screenline 1-River Screenline	NB	4260	4218	-42	-1%	1	✓	✓
	SB	3902	4136	234	6%	4	✖	✓
Screenline 2 - NS Screenline	EB	8129	7774	-355	-4%	4	✓	✓
	WB	7243	7244	1	0%	0	✓	✓
NUMBER OF SCREENLINES COMPLYING WITH DMRB							3 / 4	4 / 4
PERCENTAGE OF SCREENLINES COMPLYING WITH DMRB							75%	100%
PERCENTAGE OF INDIVIDUAL LINKS COMPLYING WITH DMRB							87%	87%

- 5.34 The AM peak validation results shows that the model meets the GEH criteria overall, almost meeting the criteria for individual links. Conversely the model meets flow criteria for individual links, however the river screenline northbound falls just short of the 5% criteria. Overall it is considered that the AM peak model validates satisfactorily.
- 5.35 The PM peak validation results shows that the model has achieved DMRB flow and GEH criteria for individual links. GEH criteria are satisfied for all screenlines, however the river screenline does not quite meet the 5% flow criteria. Overall it is considered that the PM peak model validates satisfactorily.
- 5.36 The Inter peak validation results show that the model does not perform as well as the AM and PM models. This is considered to be due to the prior matrix construction as an average of AM and PM models, and the reduced traffic data available to inform the model. As such it is recommended that more weight be given to the AM and PM models.

Journey Time Validation

- 5.37 Journey time information was provided by Bedford Borough Council from the Trafficmaster database and yielded 10 routes in both directions as shown in Figure 3-4.
- 5.38 The Trafficmaster dataset contains GPS journey time data for all links on the ITN network derived from data obtained from vehicles fitted with GPS devices.

- 5.39 The Trafficmaster database references the surveyed information to directional flow along individual links by defining the start and end node of each section. The frequency, speed, congestion and journey time is available for each direction along each link.
- 5.40 A list of links involved in each journey time route was defined using the nodes within the model and these node pairs used to export the journey time along each route.
- 5.41 Modelled journey times were compared with the observed journey time data across the 10 routes. Summaries of the overall modelled and observed journey time comparisons for each route are provided in Tables 5.13 to 5.15 for all the time periods. The results are summarised as
- in the AM peak 19 out of 20 routes (95%) satisfy the DMRB journey time validation criteria;
 - in the Inter peak all the routes (100%) satisfy the DRMB criteria for journey time validation; and
 - in the PM peak 17 out of 20 routes (85%) satisfy the DMRB journey time validation criteria.
- 5.42 The time distance plots for the journey times are shown in Appendix E.

Table 5.13 AM Journey Time Validation Summary

Route No.	Route Description	Direction	Route Journey Time				
			Obs.	Mod.	Dif.	% Dif.	Within 15%
Route 1	M1 / A509 to A428 / A5141	NB	1624	1321	303	19%	x
	A428 / A5141 to M1 / A509	SB	1394	1297	97	7%	✓
Route 2	A4012 / A507 to A6 / A421	NB	969	1033	-64	-7%	✓
	A6 / A421 to A4012 / A507	SB	811	906	-95	-12%	✓
Route 3	B530 / Millbrook Road to Ampthill Road / A6 Junction	NB	411	436	-25	-6%	✓
	Ampthill Road / A6 Junction to B530 / Millbrook Road	SB	405	391	14	3%	✓
Route 4	A600 The High Roundabout to A6 / Clapham Road	NB	824	744	80	10%	✓
	A6 / Clapham Road to A600 The High Roundabout	SB	694	637	57	8%	✓
Route 5	A5141 / A428 to A4280 West of A421	EB	767	726	41	5%	✓
	A4280 West of A421 to A5141 / A428	WB	782	727	55	7%	✓
Route 6	A603 Cardington Road / A6 to A603 Bedford Road / Sandy Road	EB	570	496	74	13%	✓
	A603 Bedford Road / Sandy Road to A603 Cardington Road / A6	WB	559	511	48	9%	✓
Route 7	A6 / Causeway Roundabout to A6 / Highfield Road Junction	NB	1171	1098	73	6%	✓
	A6 / Highfield Road Junction to A6 / Causeway Roundabout	SB	1322	1184	138	10%	✓
Route 8	A421 / A428 Western Bypass Road Exit to A428 Western Bypass End	NB	301	257	44	15%	✓
	A428 Western Bypass End to A421 / A428 Western Bypass Road Exit	SB	345	350	-5	-1%	✓
Route 9	A6 / Britannia Road to A6 / Brickhill Drive	NB	1017	887	130	13%	✓
	A6 / Brickhill Drive to A6 / Britannia Road	SB	827	902	-75	-9%	✓
Route 10	A428 - Rothsay Gardens to B660 - Oldways Road	NB	498	523	-25	-5%	✓
	B660 - Oldways Road to A428 - Rothsay Gardens	SB	465	488	-23	-5%	✓
% Routes Meeting Criteria							95%

Table 5.14 Inter peak Journey Time Validation Summary

Route No.	Route Description	Direction	Route Journey Time				
			Obs.	Mod.	Dif.	% Dif.	Within 15%
Route 1	M1 / A509 to A428 / A5141	NB	1167	1267	-100	-9%	✓
	A428 / A5141 to M1 / A509	SB	1141	1281	-140	-12%	✓
Route 2	A4012 / A507 to A6 / A421	NB	799	922	-123	-15%	✓
	A6 / A421 to A4012 / A507	SB	807	903	-96	-12%	✓
Route 3	B530 / Millbrook Road to Ampthill Road / A6 Junction	NB	385	429	-44	-12%	✓
	Ampthill Road / A6 Junction to B530 / Millbrook Road	SB	439	387	52	12%	✓
Route 4	A600 The High Roundabout to A6 / Clapham Road	NB	807	724	83	10%	✓
	A6 / Clapham Road to A600 The High Roundabout	SB	705	613	92	13%	✓
Route 5	A5141 / A428 to A4280 West of A421	EB	777	711	66	8%	✓
	A4280 West of A421 to A5141 / A428	WB	810	715	95	12%	✓
Route 6	A603 Cardington Road / A6 to A603 Bedford Road / Sandy Road	EB	425	490	-65	-15%	✓
	A603 Bedford Road / Sandy Road to A603 Cardington Road / A6	WB	474	504	-30	-6%	✓
Route 7	A6 / Causeway Roundabout to A6 / Highfield Road Junction	NB	1058	1058	0	0%	✓
	A6 / Highfield Road Junction to A6 / Causeway Roundabout	SB	1108	1078	30	3%	✓
Route 8	A421 / A428 Western Bypass Road Exit to A428 Western Bypass End	NB	281	257	24	8%	✓
	A428 Western Bypass End to A421 / A428 Western Bypass Road Exit	SB	285	249	36	13%	✓
Route 9	A6 / Britannia Road to A6 / Brickhill Drive	NB	810	828	-18	-2%	✓
	A6 / Brickhill Drive to A6 / Britannia Road	SB	793	858	-65	-8%	✓
Route 10	A428 - Rothsay Gardens to B660 - Oldways Road	NB	532	498	34	6%	✓
	B660 - Oldways Road to A428 - Rothsay Gardens	SB	480	481	-1	0%	✓
% Routes Meeting Criteria							100%

Table 5.15 PM Journey Time Validation Summary

Route No.	Route Description	Direction	Route Journey Time				
			Obs.	Mod.	Dif.	% Dif.	Within 15%
Route 1	M1 / A509 to A428 / A5141	NB	1315	1368	-53	-4%	✓
	A428 / A5141 to M1 / A509	SB	1225	1328	-103	-8%	✓
Route 2	A4012 / A507 to A6 / A421	NB	786	922	-136	-17%	✓
	A6 / A421 to A4012 / A507	SB	1205	918	287	24%	✗
Route 3	B530 / Millbrook Road to Ampthill Road / A6 Junction	NB	500	441	59	12%	✓
	Ampthill Road / A6 Junction to B530 / Millbrook Road	SB	449	390	59	13%	✓
Route 4	A600 The High Roundabout to A6 / Clapham Road	NB	954	815	139	15%	✓
	A6 / Clapham Road to A600 The High Roundabout	SB	781	629	152	19%	✗
Route 5	A5141 / A428 to A4280 West of A421	EB	768	735	33	4%	✓
	A4280 West of A421 to A5141 / A428	WB	885	746	139	16%	✗
Route 6	A603 Cardington Road / A6 to A603 Bedford Road / Sandy Road	EB	481	499	-18	-4%	✓
	A603 Bedford Road / Sandy Road to A603 Cardington Road / A6	WB	486	514	-28	-6%	✓
Route 7	A6 / Causeway Roundabout to A6 / Highfield Road Junction	NB	1287	1175	112	9%	✓
	A6 / Highfield Road Junction to A6 / Causeway Roundabout	SB	1309	1133	176	13%	✓
Route 8	A421 / A428 Western Bypass Road Exit to A428 Western Bypass End	NB	300	259	41	14%	✓
	A428 Western Bypass End to A421 / A428 Western Bypass Road Exit	SB	292	249	43	15%	✓
Route 9	A6 / Britannia Road to A6 / Brickhill Drive	NB	888	881	7	1%	✓
	A6 / Brickhill Drive to A6 / Britannia Road	SB	832	883	-51	-6%	✓
Route 10	A428 - Rothsay Gardens to B660 - Oldways Road	NB	559	492	67	12%	✓
	B660 - Oldways Road to A428 - Rothsay Gardens	SB	480	503	-23	-5%	✓
% Routes Meeting Criteria							85%

5.43 Overall there is a good level of validation achieved for the model in all time periods.

6 Summary and Conclusions

Summary

- 6.1 JMP was commissioned by Bedford Borough Council, to develop a SATURN model of the region of Bedford area.
- 6.2 The aim of the model is to support the Bedford Borough Council across a variety of activities including strategic planning, strategy testing and the development of highway schemes.
- 6.3 The Bedford SATURN model has been developed from a previous model established by Atkins which covers the Bedford Town centre, A421 Corridor and M1 Jn13 to Jn14. This model was considered to provide a reasonable basis for the development of the Bedford model. The model development has considered amendments to a 2011 base model, reflecting 2011 Census data and additional traffic count and journey time information.
- 6.4 The model is designed to replicate travelling conditions during a neutral month in the following time periods:
- AM Peak Hour (0730 to 0830)
 - Inter Peak Hour (1000 to 1600)
 - PM Peak Hour (1700 to 1800)
- 6.5 The final prior matrices were determined using a combination of Census Data (both 2011 and 2001) and the prior matrices used in the development of the previous SATURN model. 2011 MSOA TtW data was disaggregated to COA level using 2001 TtW data. This was then transposed to allow for returning trips, factored to allow for variable travel time and disaggregated at key locations within the model using recent surveys. These matrices include broad approximations of the COA data for TtW and school trips.
- 6.6 The model was tested against the DMRB calibration/validation criteria for:
- Link flow; and
 - Journey time.
- 6.7 The model shows a good calibration against observed flows for all screenlines and individual links, with the level of correspondence between observed and modelled flows presented in Chapter 5 of the report.
- 6.8 The journey times validate very well for all the time periods and have achieved the criteria.
- 6.9 In terms of flow validation, the AM and PM peak models perform well against DMRB flow and GEH criteria across screenlines and individual links. The Inter peak flow validation results shows that the model does not achieve the DMRB flow and GEH criteria across screenlines and individual links. This is considered to be due to the prior matrix construction as an average of AM and PM models, and the reduced traffic data available to inform the Inter Peak model.
- 6.10
- 6.11 Overall it can be argued that a robust level of validation has been achieved for the AM and PM models. Whilst the Inter Peak model performs well against most criteria, it is recommended that more weight be given to the AM and PM models.

Conclusion

- 6.12 Overall, the model is deemed fit for the purposes for testing the local plan given its complexity and size. It is therefore considered to provide an acceptable basis for assessing the impact of the Local Plan. For detailed planning applications, individual link or junction models may be required to supplement the strategic level of analysis in this model.
- 6.13 It is important that any conclusions drawn from interpreting model results should be considered with reference to the model calibration/validation.

Appendix A

Route Choice Demonstration

Job No	Report No	Issue no	Report Name	Page
ST15239	1	1	Bedford Town Centre LMVR	1

Figure A-1 – AM Peak – Cambridge to Bedford Borough Office

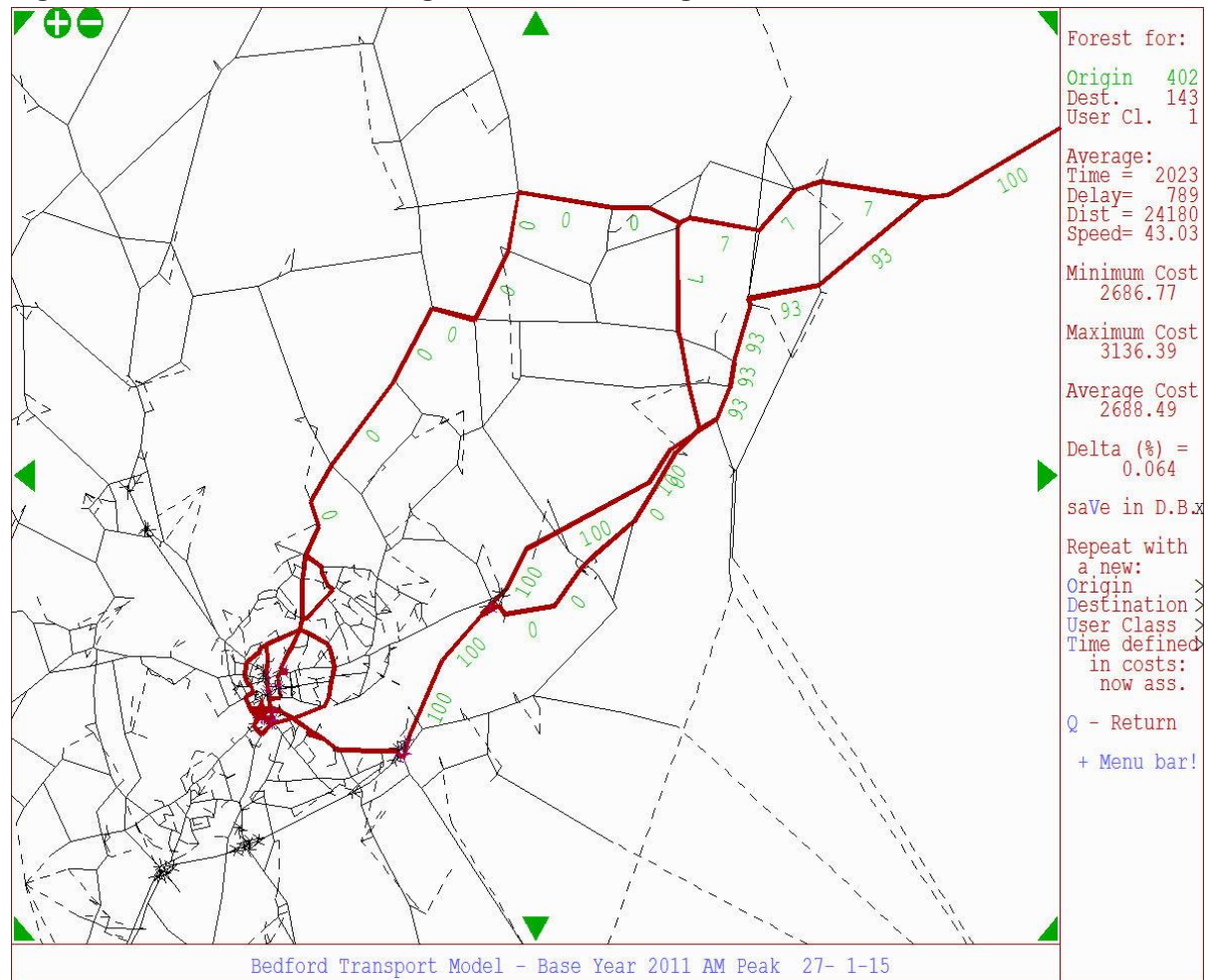


Figure A-2 – PM Peak – Bedford Borough Office to Cambridge

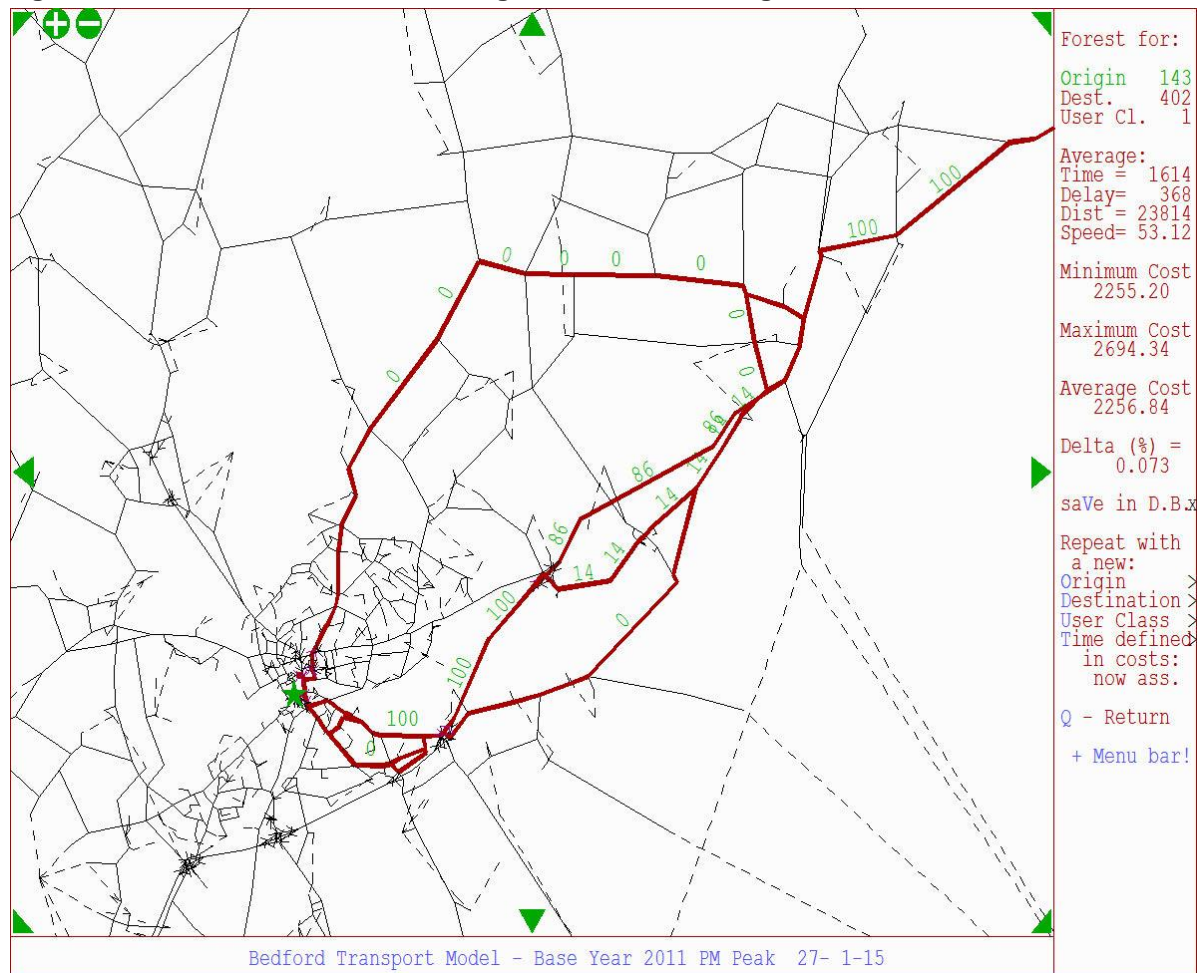


Figure A-3 – AM Peak – East of Milton Keynes to Bedford Town Centre

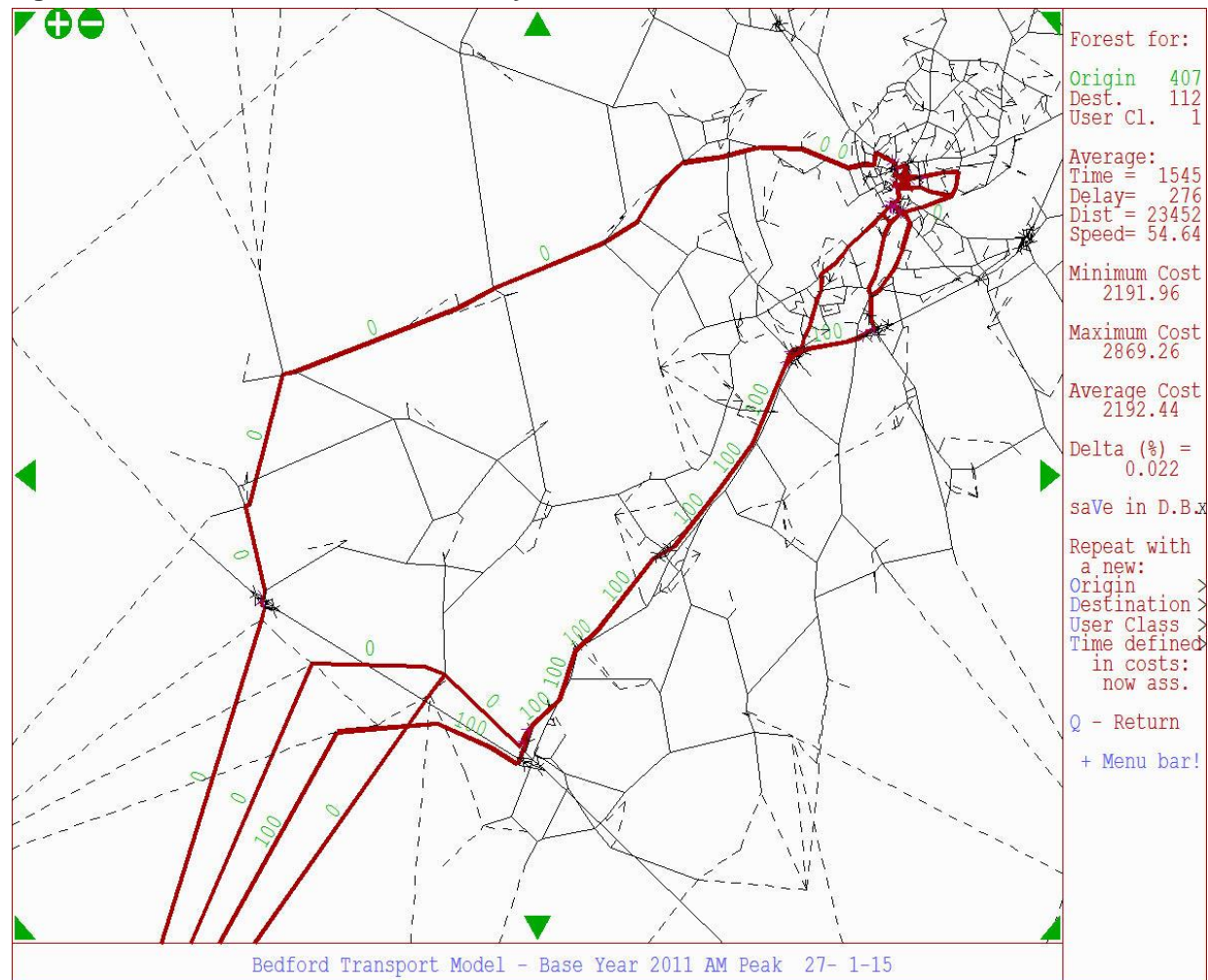


Figure A-4 – PM Peak – Bedford Town Centre to East of Milton Keynes

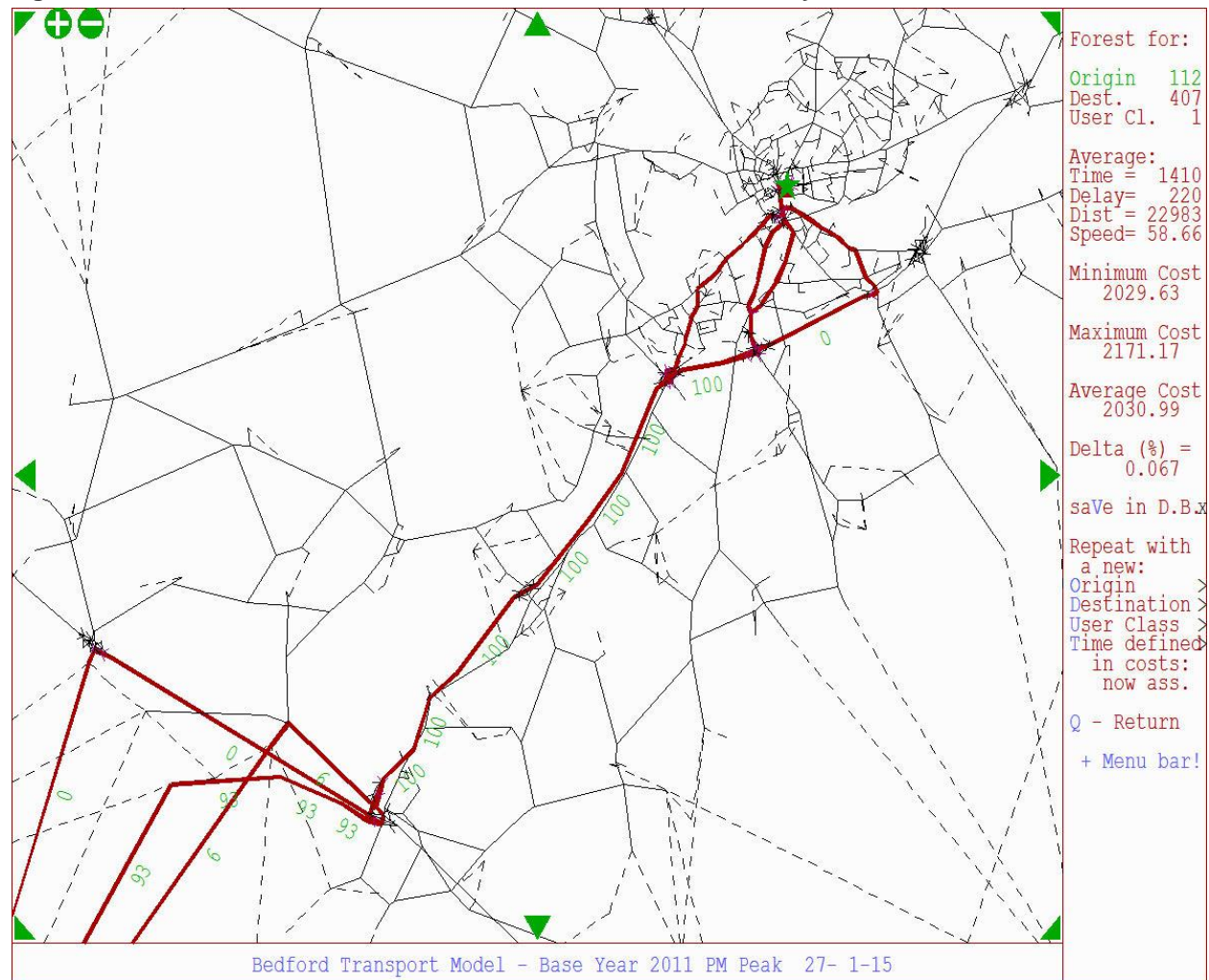
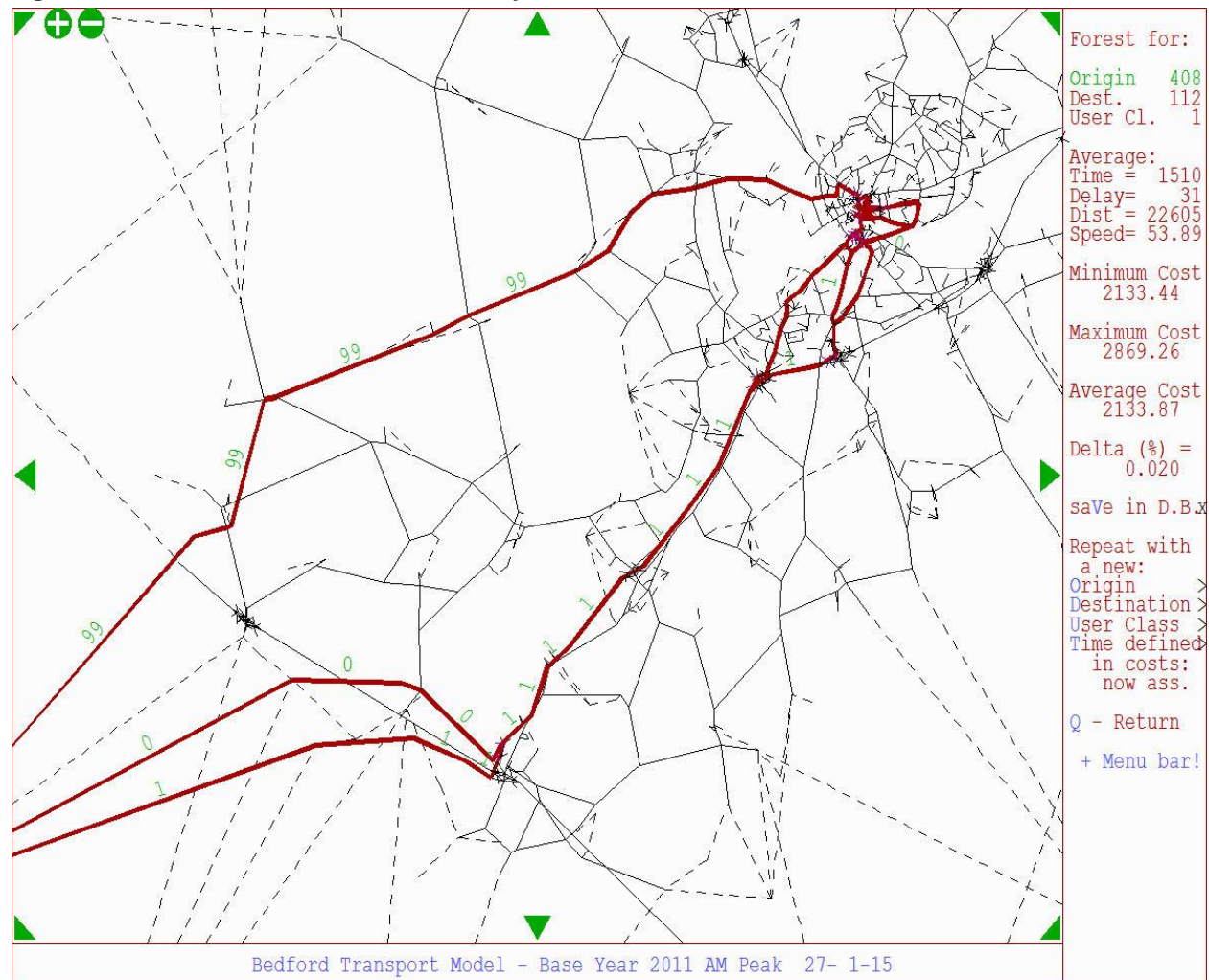


Figure A-5 – AM Peak – West of Milton Keynes to Bedford Town Centre



Forest for:

Origin 112
Dest. 408
User Cl. 1

Average:
Time = 1406
Delay = 215
Dist = 23113
Speed = 59.17

Minimum Cost
2029.63

Maximum Cost
2171.17

Average Cost
2030.20

Delta (%) =
0.028

saVe in D.B.x

Repeat with
a new:
Origin >
Destination >
User Class >
Time defined
in costs:
now ass.

Q - Return
+ Menu bar!

Bedford Transport Model - Base Year 2011 PM Peak 27- 1-15

Figure A-7 – AM Peak – Western Bypass Northbound

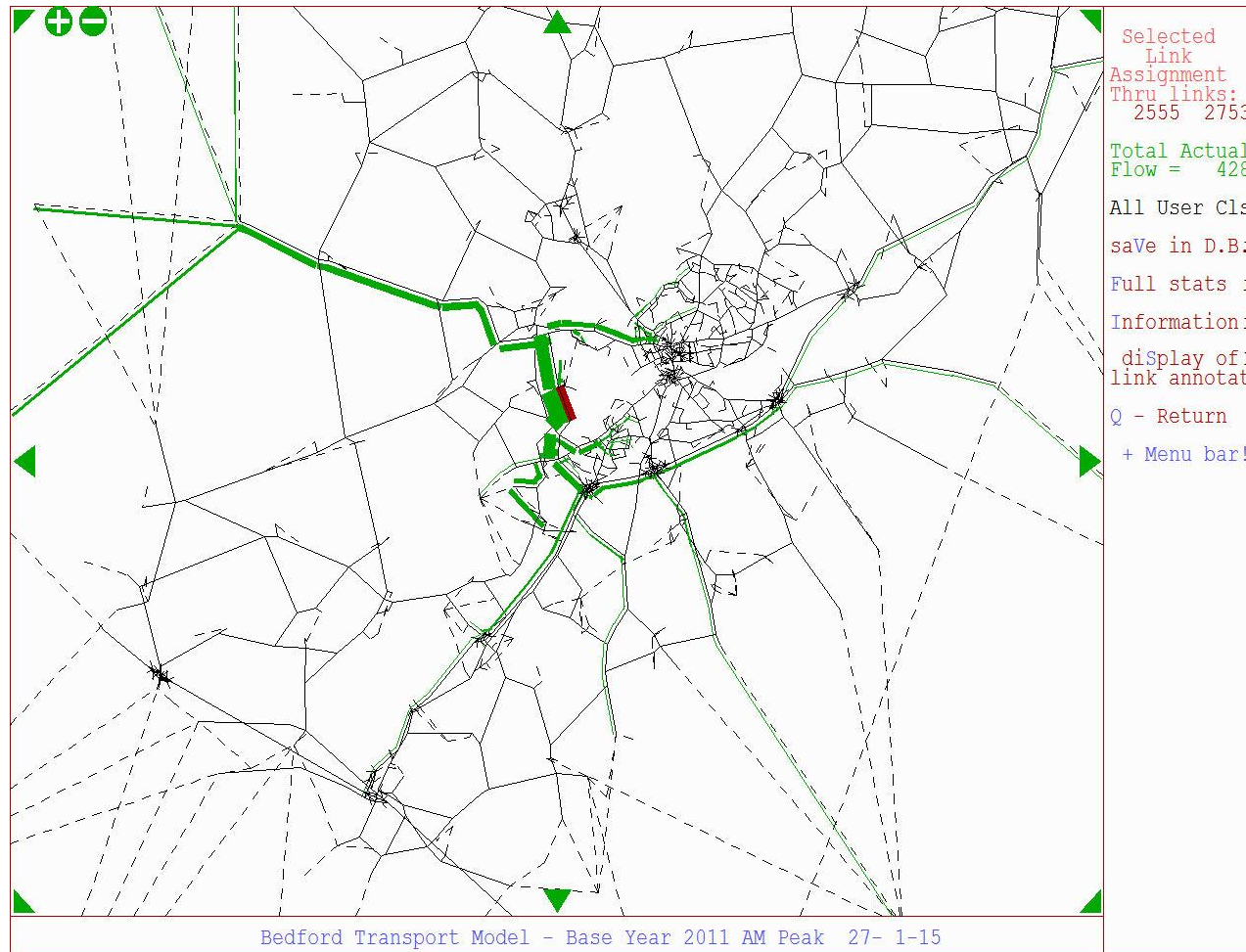


Figure A-8 – PM Peak – Western Bypass Northbound

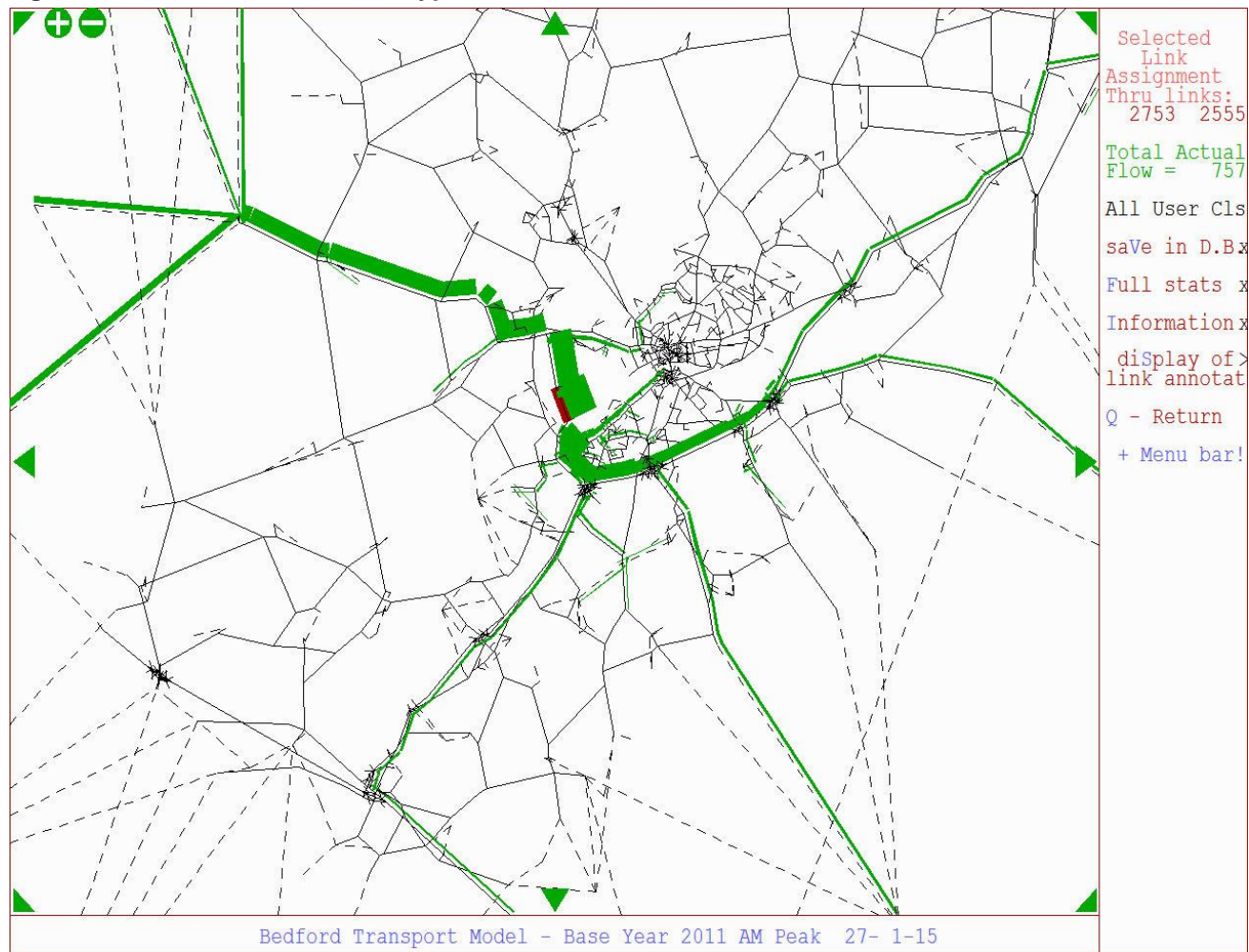


Figure A-9 – AM Peak – Western Bypass Southbound

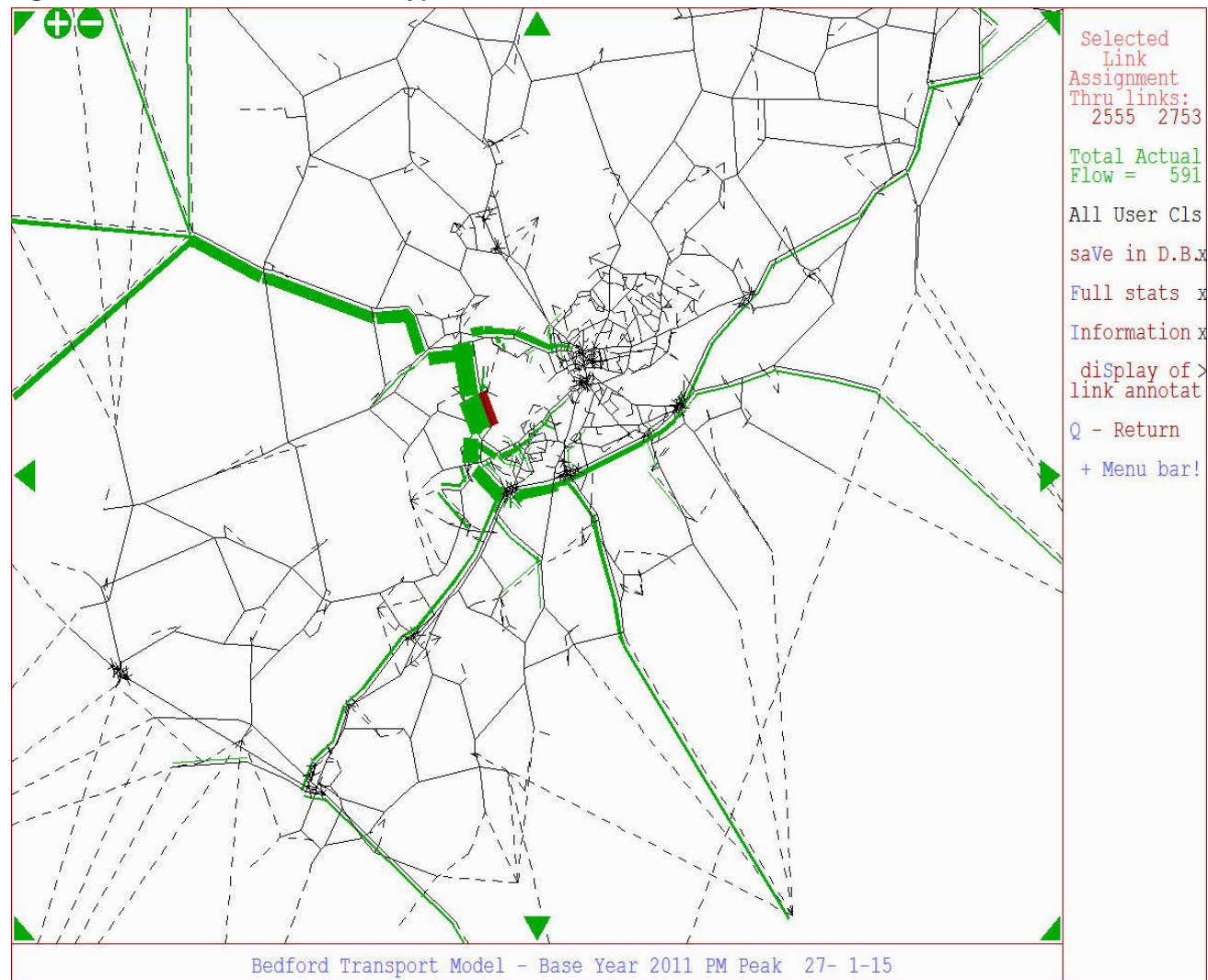
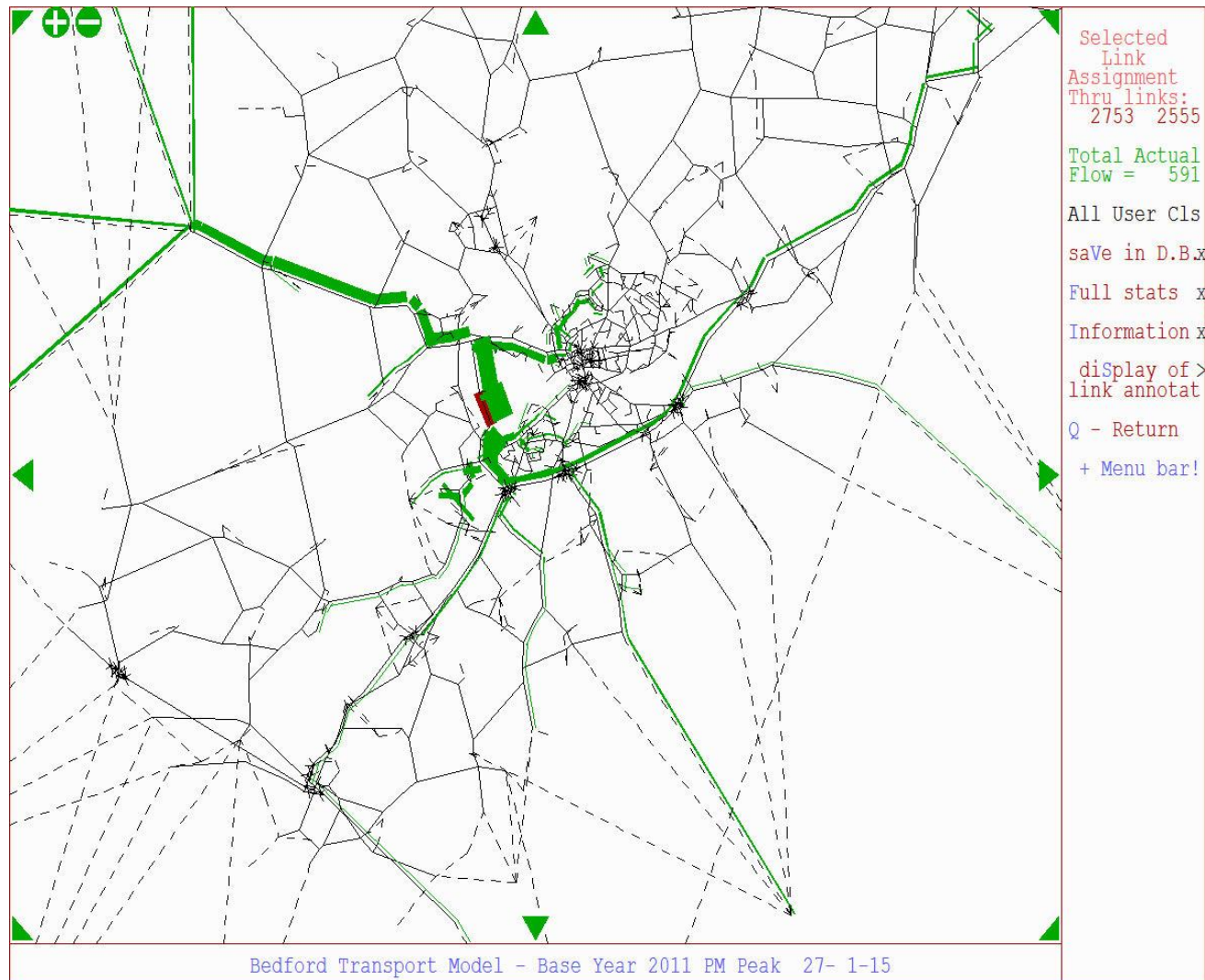


Figure A-10 – PM Peak – Western Bypass Southbound



Appendix B

Sector to Sector Movement Analysis

Job No	Report No	Issue no	Report Name	Page
ST15239	1	1	Bedford Town Centre LMVR	1

Figure B-1 – AM Peak – Sector to Sector Movements for Lights

Prior Sector Matrix		Lights			
	1	2	3	4	T
1	4686	3224	1514	3660	13083
2	1773	1798	960	3790	8321
3	856	976	1807	7275	10915
4	4388	3349	7078	29651	44466
T	11703	9347	11359	44375	76784
Post ME Matrix					
	1	2	3	4	T
1	6952	2719	1289	2518	13478
2	2780	2022	1008	2894	8705
3	1025	1028	1507	5859	9419
4	3243	2436	5750	25087	36516
T	14001	8205	9554	36358	68118
Difference					
	1	2	3	4	T
1	2266	-505	-225	-1142	395
2	1007	224	49	-896	384
3	169	51	-300	-1416	-1496
4	-1145	-913	-1328	-4564	-7949
T	2297	-1142	-1805	-8017	-8667
% Difference					
	1	2	3	4	T
1	48%	-16%	-15%	-31%	3%
2	57%	12%	5%	-24%	5%
3	20%	5%	-17%	-19%	-14%
4	-26%	-27%	-19%	-15%	-18%
T	20%	-12%	-16%	-18%	-11%

Figure B-2 – AM Peak – Sector to Sector Movements for Heavies

Prior Sector Matrix		Heavies			
	1	2	3	4	T
1	369	228	147	120	863
2	320	311	218	357	1207
3	185	245	271	415	1116
4	116	427	510	4229	5282
T	991	1211	1146	5121	8468
Post ME Matrix					
	1	2	3	4	T
1	259	139	98	162	658
2	161	238	208	395	1002
3	110	256	268	580	1215
4	139	581	698	5140	6558
T	668	1215	1272	6277	9432
Difference					
	1	2	3	4	T
1	-110	-89	-49	42	-205
2	-159	-73	-10	37	-205
3	-75	11	-3	166	99
4	22	154	188	911	1276
T	-322	4	126	1156	965
% Difference					
	1	2	3	4	T
1	-30%	-39%	-33%	36%	-24%
2	-50%	-23%	-5%	10%	-17%
3	-41%	4%	-1%	40%	9%
4	19%	36%	37%	22%	24%
T	-33%	0%	11%	23%	11%

Figure B-3 – AM Peak – Sector to Sector Movements for All UCs

Prior Sector Matrix		All			
	1	2	3	4	T
1	5054	3452	1661	3779	13946
2	2094	2109	1178	4147	9527
3	1041	1222	2078	7690	12031
4	4505	3776	7588	33880	49748
T	12694	10558	12505	49496	85252
Post ME Matrix					
	1	2	3	4	T
1	7211	2858	1386	2680	14135
2	2942	2260	1216	3289	9707
3	1135	1284	1775	6439	10633
4	3382	3017	6448	30227	43075
T	14669	9419	10826	42635	77550
Difference					
	1	2	3	4	T
1	2156	-593	-274	-1099	190
2	848	151	39	-858	179
3	94	62	-303	-1250	-1397
4	-1123	-759	-1140	-3653	-6674
T	1975	-1138	-1678	-6860	-7702
% Difference					
	1	2	3	4	T
1	43%	-17%	-17%	-29%	1%
2	40%	7%	3%	-21%	2%
3	9%	5%	-15%	-16%	-12%
4	-25%	-20%	-15%	-11%	-13%
T	16%	-11%	-13%	-14%	-9%

Figure B-4 – Inter Peak – Sector to Sector Movements for Lights

Prior Sector Matrix		Lights			
	1	2	3	4	T
1	2824	1495	715	2410	7444
2	1516	1088	586	2161	5352
3	718	586	1094	4346	6744
4	2438	2161	4346	18059	27005
T	7496	5331	6742	26977	46545
Post ME Matrix					
	1	2	3	4	T
1	5469	2171	1089	1941	10670
2	2097	1502	821	1831	6251
3	968	817	1061	3897	6743
4	2053	1865	4189	17340	25447
T	10586	6355	7161	25010	49111
Difference					
	1	2	3	4	T
1	2644	676	374	-469	3226
2	581	413	235	-330	899
3	250	231	-33	-449	-1
4	-386	-297	-157	-718	-1558
T	3090	1024	419	-1967	2566
% Difference					
	1	2	3	4	T
1	94%	45%	52%	-19%	43%
2	38%	38%	40%	-15%	17%
3	35%	39%	-3%	-10%	0%
4	-16%	-14%	-4%	-4%	-6%
T	41%	19%	6%	-7%	6%

Figure B-5 – Inter Peak – Sector to Sector Movements for Heavies

Prior Sector Matrix		Heavies			
	1	2	3	4	T
1	163	133	76	60	432
2	136	157	106	194	593
3	79	115	131	253	578
4	53	199	270	2259	2781
T	432	604	583	2765	4384
Post ME Matrix					
	1	2	3	4	T
1	222	116	108	128	574
2	119	181	184	344	829
3	126	209	215	506	1055
4	138	477	527	4977	6119
T	605	983	1034	5955	8577
Difference					
	1	2	3	4	T
1	59	-17	32	68	141
2	-17	24	79	150	235
3	47	94	84	253	478
4	85	278	257	2718	3338
T	173	379	451	3190	4192
% Difference					
	1	2	3	4	T
1	36%	-13%	42%	114%	33%
2	-13%	15%	74%	77%	40%
3	59%	82%	64%	100%	83%
4	159%	139%	95%	120%	120%
T	40%	63%	77%	115%	96%

Figure B-6 – Inter Peak – Sector to Sector Movements for All UCs

Prior Sector Matrix		All			
	1	2	3	4	T
1	2988	1628	791	2470	7877
2	1652	1246	692	2355	5945
3	797	701	1225	4599	7322
4	2492	2361	4616	20318	29786
T	7928	5935	7325	29742	50930
Post ME Matrix					
	1	2	3	4	T
1	5691	2287	1197	2069	11244
2	2216	1683	1005	2175	7079
3	1094	1026	1276	4403	7799
4	2191	2342	4716	22317	31566
T	11191	7338	8195	30964	57688
Difference					
	1	2	3	4	T
1	2703	659	406	-401	3367
2	564	438	313	-180	1135
3	297	325	51	-196	476
4	-301	-19	100	2000	1780
T	3263	1402	870	1223	6758
% Difference					
	1	2	3	4	T
1	90%	40%	51%	-16%	43%
2	34%	35%	45%	-8%	19%
3	37%	46%	4%	-4%	7%
4	-12%	-1%	2%	10%	6%
T	41%	24%	12%	4%	13%

Figure B-7 – PM Peak – Sector to Sector Movements for Lights

Prior Sector Matrix		Lights			
	1	2	3	4	T
1	4643	1715	848	4299	11506
2	3234	1798	976	3349	9357
3	1515	960	1807	7078	11360
4	3664	3790	7275	29345	44074
T	13056	8263	10907	44072	76297
Post ME Matrix					
	1	2	3	4	T
1	7668	2780	1148	2928	14525
2	3106	2424	957	2485	8972
3	1377	1243	1625	5896	10141
4	2320	2652	5621	26428	37021
T	14471	9099	9351	37738	70659
Difference					
	1	2	3	4	T
1	3025	1065	300	-1371	3019
2	-127	626	-20	-863	-384
3	-138	283	-182	-1183	-1219
4	-1344	-1137	-1655	-2917	-7053
T	1416	836	-1556	-6334	-5638
% Difference					
	1	2	3	4	T
1	65%	62%	35%	-32%	26%
2	-4%	35%	-2%	-26%	-4%
3	-9%	29%	-10%	-17%	-11%
4	-37%	-30%	-23%	-10%	-16%
T	11%	10%	-14%	-14%	-7%

Figure B-8 – PM Peak – Sector to Sector Movements for Heavies

Prior Sector Matrix		Heavies			
	1	2	3	4	T
1	171	211	104	78	564
2	130	209	132	283	754
3	78	134	162	420	793
4	59	230	382	3177	3849
T	438	785	779	3958	5960
Post ME Matrix					
	1	2	3	4	T
1	84	94	51	54	283
2	69	126	99	253	547
3	48	134	118	463	763
4	89	305	329	3515	4239
T	290	659	598	4286	5832
Difference					
	1	2	3	4	T
1	-87	-118	-52	-23	-281
2	-62	-83	-33	-29	-207
3	-30	0	-43	43	-30
4	30	75	-53	338	390
T	-148	-126	-181	328	-128
% Difference					
	1	2	3	4	T
1	-51%	-56%	-51%	-30%	-50%
2	-47%	-40%	-25%	-10%	-27%
3	-38%	0%	-27%	10%	-4%
4	51%	33%	-14%	11%	10%
T	-34%	-16%	-23%	8%	-2%

Figure B-9 – PM Peak – Sector to Sector Movements for All UCs

Prior Sector Matrix		All			
	1	2	3	4	T
1	4814	1927	952	4377	12069
2	3364	2007	1108	3631	10111
3	1592	1094	1969	7498	12153
4	3724	4020	7657	32522	47923
T	13494	9048	11686	48029	82256
Post ME Matrix					
	1	2	3	4	T
1	7752	2874	1199	2983	14808
2	3175	2550	1055	2739	9519
3	1425	1377	1744	6359	10904
4	2409	2958	5950	29944	41260
T	14761	9758	9948	42024	76491
Difference					
	1	2	3	4	T
1	2938	947	248	-1394	2738
2	-189	543	-53	-892	-591
3	-168	283	-225	-1140	-1250
4	-1314	-1062	-1707	-2579	-6663
T	1267	710	-1738	-6005	-5766
% Difference					
	1	2	3	4	T
1	61%	49%	26%	-32%	23%
2	-6%	27%	-5%	-25%	-6%
3	-11%	26%	-11%	-15%	-10%
4	-35%	-26%	-22%	-8%	-14%
T	9%	8%	-15%	-13%	-7%

Appendix C

Flow Calibration

Job No	Report No	Issue no	Report Name	Page
St15239	1	2	Bedford Town Centre LMVR	1

Figure C-1 – AM Peak – Flow Calibration – Outer Cordon

Table 1 : Outer Cordon				Observed			Post (Total - Actual)					DMRB	
Location	Dir	Saturn Link		Count (LV)	Count (HV)	Count (Total)	Post	Diff	% Diff	GEH		Flow	GEH
South of Wilstead,A6	IN	9146-371	1	778	56	834	991	157	19%	5.2		✗	✗
North west of Houghton Conquest,B530	IN	601-6001	1	284	29	313	308	-6	-2%	0.3		✓	✓
Between the Wootton and Stewartby turns,Old A421	IN	604-8040	1	173	45	218	140	-78	-36%	5.8		✓	✗
South of Wootton,C70	IN	9002-7043	1	117	5	121	122	1	1%	0.1		✓	✓
South west of Stagsden,A422	IN	7041-9023	1	356	34	389	416	27	7%	1.3		✓	✓
Between Turvey and Bromham,A428	IN	7200-2751	2	489	66	555	644	89	16%	3.7		✓	✓
North west of Stevington,C45	IN	9050-9029	1	2	0	2	31	29	1474%	7.1		✓	✗
Oakley,C15	IN	9051-9263	1	103	0	103	107	4	4%	0.4		✓	✓
South of Milton Ernest,A6	IN	2781-9264	2	942	239	1181	1068	-113	-10%	3.4		✓	✓
Near the Bedford Borough Boundary,B660	IN	2576-9229	3	388	12	400	398	-1	0%	0.1		✓	✓
SW of Renhold,C40	IN	9366-9227	2	215	32	247	225	-21	-9%	1.4		✓	✓
East of Norse Road, Bedford,A428	IN	9809-9213	2	899	104	1003	973	-29	-3%	0.9		✓	✓
Bedford Southern Bypass (east of the A603 junction),A603	IN	9214-714	6	1782	320	2102	1842	-260	-12%	5.9		✓	✗
Cople,A603	IN	9207-2688	1	698	84	782	783	1	0%	0.0		✓	✓
Cople,C156	IN	9208-2693	1	55	2	57	62	5	9%	0.7		✓	✓
North west of Old Warden,U147	IN	2692-9249	1	83	2	86	90	4	5%	0.4		✓	✓
North of Haynes,A600	IN	9168-9172	1	495	37	532	541	10	2%	0.4		✓	✓
South of Wilstead,A6	OUT	371-9146	1	917	75	992	993	1	0%	0.0		✓	✓
North west of Houghton Conquest,B530	OUT	6001-601	1	377	34	411	416	5	1%	0.3		✓	✓
Between the Wootton and Stewartby turns,Old A421	OUT	8040-604	1	218	90	308	336	28	9%	1.6		✓	✓
South of Wootton,C70	OUT	7043-9002	1	179	9	188	182	-6	-3%	0.4		✓	✓
South west of Stagsden,A422	OUT	9023-7041	1	743	32	775	912	137	18%	4.7		✗	✓
Between Turvey and Bromham,A428	OUT	2751-7200	2	381	54	435	435	-1	0%	0.0		✓	✓
North west of Stevington,C45	OUT	9029-9050	1	2	2	4	15	11	258%	3.5		✓	✓
Oakley,C15	OUT	9263-9051	1	76	0	76	121	45	60%	4.6		✓	✓
South of Milton Ernest,A6	OUT	9264-2781	2	393	41	433	503	70	16%	3.2		✓	✓
Near the Bedford Borough Boundary,B660	OUT	9229-2576	3	194	14	208	210	2	1%	0.1		✓	✓
SW of Renhold,C40	OUT	9227-9366	2	118	34	152	117	-35	-23%	3.0		✓	✓
East of Norse Road, Bedford,A428	OUT	9213-9809	2	1087	56	1144	1087	-56	-5%	1.7		✓	✓
Bedford Southern Bypass (east of the A603 junction),A603	OUT	714-9214	6	1392	293	1685	1568	-117	-7%	2.9		✓	✓
Cople,A603	OUT	2688-9207	1	475	131	606	623	17	3%	0.7		✓	✓
Cople,C156	OUT	2693-9208	1	101	0	101	105	3	3%	0.3		✓	✓
North west of Old Warden,U147	OUT	9249-2692	1	62	6	68	68	0	0%	0.0		✓	✓
North of Haynes,A600	OUT	9172-9168	1	495	52	547	527	-20	-4%	0.9		✓	✓
Individual Links	IN	17										94%	76%
	OUT	17										94%	100%
	Both Directions	34										94%	88%
Screenlines	IN	17		7857	1066	8924	8742	-182	-2%	1.9		✓	✓
	OUT	17		7211	922	8133	8218	84	1%	0.9		✓	✓

Figure C-2 – AM Peak – Flow Calibration – Inner Cordon

			Observed			Post (Total - Actual)						
Table 2 : Inner Cordon												
Location	Dir	Saturn Link		Count (LV)	Count (HV)	Count (Total)	Post	Diff	% Diff	GEH	DMRB	
											Flow	GEH
London Road	IN	2660-9190	3	891	26	917	921	4	0%	0.1	✓	✓
Amphthill Road	IN	9194-2659	1	470	33	503	526	23	5%	1.0	✓	✓
Couldwell Street	IN	9195-9193	1	1000	52	1052	1009	-43	-4%	1.3	✓	✓
Ford End Road	IN	2020-9378	2	364	19	383	385	2	0%	0.1	✓	✓
A428 Bromham Road	IN	202-9232	2	950	17	966	761	-205	-21%	7.0	✗	✗
A5141 Shakespeare Road	IN	2547-2972	1	487	14	501	484	-17	-3%	0.7	✓	✓
A6 Calpham Road	IN	9231-2546	1	1023	66	1089	1115	26	2%	0.8	✓	✓
Park Avenue	IN	9216-9373	1	601	7	609	644	36	6%	1.4	✓	✓
B660 Kimbolton Road	IN	2515-9268	2	453	7	460	380	-79	-17%	3.9	✓	✓
Goldington Road	IN	2534-9269	1	601	62	663	653	-10	-1%	0.4	✓	✓
Castle Road	IN	2015-2228	1	211	0	211	214	3	1%	0.2	✓	✓
The Embankment	IN	2017-2523	1	539	5	544	523	-20	-4%	0.9	✓	✓
Rope walk	IN	2643-9190	3	855	59	914	899	-16	-2%	0.5	✓	✓
London Road	OUT	9190-2660	3	689	31	720	725	5	1%	0.2	✓	✓
Amphthill Road	OUT	2659-9194	1	876	45	921	918	-3	0%	0.1	✓	✓
Couldwell Street	OUT	9193-9195	1	890	33	923	947	23	3%	0.8	✓	✓
Ford End Road	OUT	9378-2020	1	306	24	329	326	-3	-1%	0.2	✓	✓
A428 Bromham Road	OUT	9232-202	2	1032	48	1080	1079	-1	0%	0.0	✓	✓
A5141 Shakespeare Road	OUT	2972-2547	1	576	20	597	196	-400	-67%	20.1	✗	✗
A6 Calpham Road	OUT	2546-9231	1	515	59	574	639	65	11%	2.6	✓	✓
Park Avenue	OUT	9373-9216	1	283	10	292	319	27	9%	1.5	✓	✓
B660 Kimbolton Road	OUT	9268-2515	1	278	17	294	300	6	2%	0.3	✓	✓
Goldington Road	OUT	9269-2534	1	529	54	583	597	13	2%	0.5	✓	✓
Castle Road	OUT	2228-2015	1	49	0	49	40	-8	-17%	1.3	✓	✓
The Embankment	OUT	2523-2017	1	101	2	103	64	-40	-38%	4.3	✓	✓
Rope walk	OUT	9190-2643	3	782	62	844	839	-5	-1%	0.2	✓	✓
Individual Links	IN	13									92%	92%
	OUT	13									92%	92%
	Both Directions	26									92%	92%
Screenlines	IN	13		8446	367	8813	8516	-296	-3%	3.2	✓	✓
Screenlines	OUT	13		6906	404	7310	6988	-322	-4%	3.8	✓	✓

Figure C-3 – AM Peak – Flow Calibration – A421

			Observed			Post (Total - Actual)						
Table 6 : A421 Screenline												
Location	Dir	Saturn Link		Count (LV)	Count (HV)	Count (Total)	Post	Diff	% Diff	GEH	DMRB	
											Flow	GEH
Between Beancroft Road and A428, A421	NB	9819-9814	1	1539	391	1930	1910	-20	-1%	0.5	✓	✓
Junction with A428, A421	NB	9815-9816	1	1227	314	1541	1526	-14	-1%	0.4	✓	✓
Junction with A5141, A421	NB	721-9178	1	1535	343	1878	1974	95	5%	2.2	✓	✓
Between A5141 and A600, A421	NB	9178-9247	1	2284	427	2711	2852	141	5%	2.7	✓	✓
Between A600 and A603, A421	NB	9179-9180	#	1868	376	2244	2237	-6	0%	0.1	✓	✓
Bedford Southern Bypass (east of the A603 junction), A421	NB	714-9214	6	1392	293	1685	1568	-117	-7%	2.9	✓	✓
Between Water End and A1, A421	NB	9812-9813	#	1277	268	1545	1503	-42	-3%	1.1	✓	✓
Between Beancroft Road and A428	SB	9814-9819	1	2098	350	2448	2470	22	1%	0.4	✓	✓
Junction with A428, A421	SB	9816-9815	1	1735	289	2024	2078	53	3%	1.2	✓	✓
Junction with A5141, A422	SB	9178-721	1	1514	334	1849	2043	195	11%	4.4	✓	✓
Between A5141 and A600, A421	SB	9247-9178	1	2125	436	2561	2918	357	14%	6.8	✓	✗
Between A600 and A603, A421	SB	9180-9179	#	1932	373	2304	2273	-31	-1%	0.6	✓	✓
Bedford Southern Bypass (east of the A603 junction), A421	SB	9214-714	6	1782	320	2102	1842	-260	-12%	5.9	✓	✗
Junction with Water End, A421	SB	9806-9214	#	788	282	1070	1083	12	1%	0.4	✓	✓
Individual Links	NB	7									100%	100%
	SB	7									100%	71%
	Both Directions	14									100%	86%
Screenlines	NB	7		11121	2412	13533	13571	37	0%	0.3	✓	✓
	SB	7		11974	2384	14358	14706	348	2%	2.9	✓	✓

Figure C-4 – Inter Peak – Flow Calibration – Outer Cordon

Table 1 : Outer Cordon			Observed			Post (Total - Actual)						
Location	Dir	Saturn Link		Count (LV)	Count (HV)	Count (Total)	Post	Diff	% Diff	GEH	DMRB	
											Flow	GEH
South of Wilstead,A6	IN	9146-371	1	569	117	686	733	47	7%	1.8	✓	✓
North west of Houghton Conquest,B530	IN	601-6001	1	199	21	220	220	-1	0%	0.0	✓	✓
Between the Wootton and Stewartby turns,Old A421	IN	604-8040	1	126	51	178	153	-24	-14%	1.9	✓	✓
South of Wootton,C70	IN	9002-7043	1	81	3	84	84	0	0%	0.0	✓	✓
South west of Stagsden,A422	IN	7041-9023	1	423	38	461	470	10	2%	0.5	✓	✓
Between Turvey and Bromham,A428	IN	7200-2751	2	327	59	386	430	43	11%	2.2	✓	✓
North west of Stevington,C45	IN	9050-9029	1	3	0	3	30	27	820%	6.6	✓	✗
Oakley,C15	IN	9051-9263	1	64	0	64	67	3	4%	0.3	✓	✓
South of Milton Ernest,A6	IN	2781-9264	2	475	278	754	592	-162	-22%	6.2	✗	✗
Near the Bedford Borough Boundary,B660	IN	2576-9229	3	145	4	149	147	-2	-1%	0.2	✓	✓
SW of Renhold,C40	IN	9366-9227	2	135	4	139	143	4	3%	0.4	✓	✓
East of Norse Road, Bedford,A428	IN	9809-9213	2	534	84	617	847	229	37%	8.5	✗	✗
Bedford Southern Bypass (east of the A603 junction),A603	IN	9214-714	6	1221	385	1606	1565	-41	-3%	1.0	✓	✓
Cople,A603	IN	9207-2688	1	382	34	416	424	8	2%	0.4	✓	✓
Cople,C156	IN	9208-2693	1	48	0	49	49	0	1%	0.0	✓	✓
North west of Old Warden,U147	IN	2692-9249	1	37	0	37	61	24	64%	3.4	✓	✓
North of Haynes,A600	IN	9168-9172	1	204	42	246	225	-20	-8%	1.3	✓	✓
South of Wilstead,A6	OUT	371-9146	1	629	83	712	735	23	3%	0.9	✓	✓
North west of Houghton Conquest,B530	OUT	6001-601	1	262	19	281	280	-1	0%	0.0	✓	✓
Between the Wootton and Stewartby turns,Old A421	OUT	8040-604	1	159	55	214	212	-1	0%	0.1	✓	✓
South of Wootton,C70	OUT	7043-9002	1	77	5	83	82	-1	-1%	0.1	✓	✓
South west of Stagsden,A422	OUT	9023-7041	1	435	34	469	499	30	6%	1.4	✓	✓
Between Turvey and Bromham,A428	OUT	2751-7200	2	372	61	434	433	-1	0%	0.0	✓	✓
North west of Stevington,C45	OUT	9029-9050	1	2	1	4	21	17	490%	5.0	✓	✓
Oakley,C15	OUT	9263-9051	1	88	0	88	114	26	30%	2.6	✓	✓
South of Milton Ernest,A6	OUT	9264-2781	2	365	42	407	458	51	13%	2.4	✓	✓
Near the Bedford Borough Boundary,B660	OUT	9229-2576	3	138	27	165	155	-10	-6%	0.8	✓	✓
SW of Renhold,C40	OUT	9227-9366	2	123	38	161	150	-11	-7%	0.9	✓	✓
East of Norse Road, Bedford,A428	OUT	9213-9809	2	455	41	496	722	226	46%	9.2	✗	✗
Bedford Southern Bypass (east of the A603 junction),A603	OUT	714-9214	6	1342	383	1725	1603	-122	-7%	3.0	✓	✓
Cople,A603	OUT	2688-9207	1	328	53	382	381	-1	0%	0.1	✓	✓
Cople,C156	OUT	2693-9208	1	60	0	60	62	2	3%	0.2	✓	✓
North west of Old Warden,U147	OUT	9249-2692	1	39	2	41	58	18	44%	2.5	✓	✓
North of Haynes,A600	OUT	9172-9168	1	262	23	285	285	0	0%	0.0	✓	✓
Individual Links	IN	17									88%	82%
	OUT	17									94%	94%
	Both Directions	34									91%	88%
Screenlines	IN	17		4974	1121	6095	6240	145	2%	1.8	✓	✓
	OUT	17		5138	867	6005	6250	245	4%	3.1	✓	✓

Figure C-5 – Inter Peak – Flow Calibration – Inner Cordon

			Observed			Post (Total - Actual)						
Table 2 : Inner Cordon												
Location	Dir	Saturn Link		Count (LV)	Count (HV)	Count (Total)	Post	Diff	% Diff	GEH	DMRB	
											Flow	GEH
London Road	IN	2660-9190	3	765	58	823	807	-16	-2%	0.6	✓	✓
Amphill Road	IN	9194-2659	1	416	32	449	451	3	1%	0.1	✓	✓
Couldwell Street	IN	9195-9193	1	895	46	941	946	5	1%	0.2	✓	✓
Ford End Road	IN	2020-9378	2	357	26	384	383	0	0%	0.0	✓	✓
A428 Bromham Road	IN	202-9232	2	717	47	764	762	-2	0%	0.1	✓	✓
A5141 Shakespeare Road	IN	2547-2972	1	490	18	508	369	-139	-27%	6.6	✗	✗
A6 Calpham Road	IN	9231-2546	1	692	74	766	765	-1	0%	0.0	✓	✓
Park Avenue	IN	9216-9373	1	349	8	358	356	-2	0%	0.1	✓	✓
B660 Kimbolton Road	IN	2515-9268	2	285	6	291	301	11	4%	0.6	✓	✓
Goldington Road	IN	2534-9269	1	464	43	507	513	6	1%	0.3	✓	✓
Castle Road	IN	2015-2228	1	132	0	132	133	1	1%	0.1	✓	✓
The Embankment	IN	2017-2523	1	313	4	317	278	-39	-12%	2.3	✓	✓
Rope walk	IN	2643-9190	3	778	72	849	738	-111	-13%	3.9	✓	✓
London Road	OUT	9190-2660	3	786	42	828	821	-7	-1%	0.2	✓	✓
Amphill Road	OUT	2659-9194	1	540	47	587	623	36	6%	1.5	✓	✓
Couldwell Street	OUT	9193-9195	1	846	34	881	880	0	0%	0.0	✓	✓
Ford End Road	OUT	9378-2020	1	320	22	342	341	0	0%	0.0	✓	✓
A428 Bromham Road	OUT	9232-202	2	779	50	829	836	7	1%	0.3	✓	✓
A5141 Shakespeare Road	OUT	2972-2547	1	572	24	596	424	-172	-29%	7.6	✗	✗
A6 Calpham Road	OUT	2546-9231	1	603	62	665	676	11	2%	0.4	✓	✓
Park Avenue	OUT	9373-9216	1	333	4	337	297	-40	-12%	2.2	✓	✓
B660 Kimbolton Road	OUT	9268-2515	1	291	15	306	310	4	1%	0.2	✓	✓
Goldington Road	OUT	9269-2534	1	547	59	605	614	8	1%	0.3	✓	✓
Castle Road	OUT	2228-2015	1	96	0	96	96	0	0%	0.0	✓	✓
The Embankment	OUT	2523-2017	1	159	4	163	98	-65	-40%	5.7	✓	✗
Rope walk	OUT	9190-2643	3	1011	80	1091	885	-206	-19%	6.6	✗	✗
Individual Links	IN	13									92%	92%
	OUT	13									85%	77%
	Both Directions	26									88%	85%
Screenlines	IN	13		6654	433	7087	6802	-284	-4%	3.4	✓	✓
Screenlines	OUT	13		6882	444	7326	6903	-424	-6%	5.0	✗	✗

Figure C-6 – Inter Peak – Flow Calibration – A421

			Observed			Post (Total - Actual)						
Table 6 : A421 Screenline												
Location	Dir	Saturn Link		Count (LV)	Count (HV)	Count (Total)	Post	Diff	% Diff	GEH	DMRB	
											Flow	GEH
Between Beacroft Road and A428, A421	NB	9819-9814	1	1384	454	1838	1850	12	1%	0.3	✓	✓
Junction with A428, A421	NB	9815-9816	1	1102	379	1481	1486	5	0%	0.1	✓	✓
Junction with A5141, A421	NB	721-9178	1	1289	418	1708	1488	-219	-13%	5.5	✓	✗
Between A5141 and A600, A421	NB	9178-9247	1	1234	448	1682	1692	10	1%	0.2	✓	✓
Between A600 and A603, A421	NB	9179-9180	#	969	368	1337	1340	3	0%	0.1	✓	✓
Bedford Southern Bypass (east of the A603 junction), A421	NB	714-9214	6	1342	383	1725	1603	-122	-7%	3.0	✓	✓
Between Water End and A1, A421	NB	9812-9813	#	791	296	1087	1346	259	24%	7.4	✗	✗
Between Beacroft Road and A428	SB	9814-9819	1	1430	429	1859	1859	0	0%	0.0	✓	✓
Junction with A428, A421	SB	9816-9815	1	1178	361	1539	1539	0	0%	0.0	✓	✓
Junction with A5141, A422	SB	9178-721	1	1161	400	1562	1372	-189	-12%	4.9	✓	✓
Between A5141 and A600, A421	SB	9247-9178	1	1197	393	1590	1590	0	0%	0.0	✓	✓
Between A600 and A603, A421	SB	9180-9179	#	962	340	1301	1301	0	0%	0.0	✓	✓
Bedford Southern Bypass (east of the A603 junction), A421	SB	9214-714	6	1221	385	1606	1565	-41	-3%	1.0	✓	✓
Junction with Water End, A421	SB	9806-9214	#	527	254	781	866	85	11%	3.0	✓	✓
Individual Links	NB	7									86%	71%
	SB	7									100%	100%
	Both Directions	14									93%	86%
Screenlines	NB	7		8111	2746	10857	10805	-52	0%	0.5	✓	✓
	SB	7		7676	2561	10237	10093	-144	-1%	1.4	✓	✓

Figure C-7 – PM Peak – Flow Calibration – Outer Cordon

Table 1 : Outer Cordon			Observed			Post (Total - Actual)						
Location	Dir	Saturn Link		Count (LV)	Count (HV)	Count (Total)	Post	Diff	% Diff	GEH	DMRB	
											Flow	GEH
South of Wilstead,A6	IN	9146-371	1	660	90	750	798	48	6%	1.7	✓	✓
North west of Houghton Conquest,B530	IN	601-6001	1	344	9	353	353	0	0%	0.0	✓	✓
Between the Wootton and Stewartby turns,Old A421	IN	604-8040	1	166	31	197	181	-16	-8%	1.2	✓	✓
South of Wootton,C70	IN	9002-7043	1	166	2	168	167	-1	-1%	0.1	✓	✓
South west of Stagsden,A422	IN	7041-9023	1	712	14	726	684	-42	-6%	1.6	✓	✓
Between Turvey and Bromham,A428	IN	7200-2751	2	336	9	345	420	75	22%	3.8	✓	✓
North west of Stevington,C45	IN	9050-9029	1	12	0	12	30	18	154%	4.0	✓	✓
Oakley,C15	IN	9051-9263	1	74	0	74	104	30	41%	3.2	✓	✓
South of Milton Ernest,A6	IN	2781-9264	2	507	120	626	594	-32	-5%	1.3	✓	✓
Near the Bedford Borough Boundary,B660	IN	2576-9229	3	196	2	198	200	2	1%	0.1	✓	✓
SW of Renhold,C40	IN	9366-9227	2	195	7	202	197	-5	-3%	0.4	✓	✓
East of Norse Road, Bedford,A428	IN	9809-9213	2	1027	199	1226	1067	-159	-13%	4.7	✓	✓
Bedford Southern Bypass (east of the A603 junction),A603	IN	9214-714	6	1302	162	1464	1498	33	2%	0.9	✓	✓
Cople,A603	IN	9207-2688	1	524	25	549	549	0	0%	0.0	✓	✓
Cople,C156	IN	9208-2693	1	87	0	87	96	9	11%	1.0	✓	✓
North west of Old Warden,U147	IN	2692-9249	1	57	0	57	58	1	3%	0.2	✓	✓
North of Haynes,A600	IN	9168-9172	1	409	41	449	428	-22	-5%	1.0	✓	✓
South of Wilstead,A6	Out	371-9146	1	672	29	701	805	104	15%	3.8	✓	✓
North west of Houghton Conquest,B530	OUT	6001-601	1	379	36	415	426	11	3%	0.5	✓	✓
Between the Wootton and Stewartby turns,Old A421	OUT	8040-604	1	200	27	227	180	-47	-21%	3.3	✓	✓
South of Wootton,C70	OUT	7043-9002	1	89	7	96	92	-4	-5%	0.5	✓	✓
South west of Stagsden,A422	OUT	9023-7041	1	356	11	366	369	3	1%	0.2	✓	✓
Between Turvey and Bromham,A428	OUT	2751-7200	2	560	23	582	629	47	8%	1.9	✓	✓
North west of Stevington,C45	OUT	9029-9050	1	6	0	6	9	3	45%	1.0	✓	✓
Oakley,C15	OUT	9263-9051	1	173	0	173	175	2	1%	0.2	✓	✓
South of Milton Ernest,A6	OUT	9264-2781	2	817	23	840	846	6	1%	0.2	✓	✓
Near the Bedford Borough Boundary,B660	OUT	9229-2576	3	236	12	248	247	0	0%	0.0	✓	✓
SW of Renhold,C40	OUT	9227-9366	2	188	3	190	246	55	29%	3.7	✓	✓
East of Norse Road, Bedford,A428	OUT	9213-9809	2	579	95	674	615	-59	-9%	2.3	✓	✓
Bedford Southern Bypass (east of the A603 junction),A603	OUT	714-9214	6	1998	187	2185	1963	-221	-10%	4.9	✓	✓
Cople,A603	OUT	2688-9207	1	568	38	606	660	54	9%	2.1	✓	✓
Cople,C156	OUT	2693-9208	1	105	0	105	107	2	2%	0.2	✓	✓
North west of Old Warden,U147	OUT	9249-2692	1	93	0	93	111	18	19%	1.8	✓	✓
North of Haynes,A600	OUT	9172-9168	1	462	7	468	468	0	0%	0.0	✓	✓
Individual Links	IN	17									100%	100%
	OUT	17									100%	100%
	Both Directions	34									100%	100%
Screenlines	IN	17		6773	711	7484	7424	-59	-1%	0.7	✓	✓
	OUT	17		7480	496	7976	7948	-28	0%	0.3	✓	✓

Figure C-8 – PM Peak – Flow Calibration – Inner Cordon

			Observed			Post (Total - Actual)						
Table 2 : Inner Cordon												
Location	Dir	Saturn Link		Count (LV)	Count (HV)	Count (Total)	Post	Diff	% Diff	GEH	DMRB	
											Flow	GEH
London Road	IN	2660-9190	3	776	7	783	756	-27	-3%	1.0	✓	✓
Amphthill Road	IN	9194-2659	1	581	7	589	613	24	4%	1.0	✓	✓
Couldwell Street	IN	9195-9193	1	936	7	944	927	-17	-2%	0.6	✓	✓
Ford End Road	IN	2020-9378	2	427	5	432	478	46	11%	2.2	✓	✓
A428 Bromham Road	IN	202-9232	2	996	24	1020	988	-32	-3%	1.0	✓	✓
A5141 Shakespeare Road	IN	2547-2972	1	455	2	457	450	-6	-1%	0.3	✓	✓
A6 Calpham Road	IN	9231-2546	1	725	26	752	906	155	21%	5.4	✗	✗
Park Avenue	IN	9216-9373	1	437	0	437	415	-22	-5%	1.1	✓	✓
B660 Kimbolton Road	IN	2515-9268	2	268	0	268	277	9	3%	0.6	✓	✓
Goldington Road	IN	2534-9269	1	527	9	536	583	47	9%	2.0	✓	✓
Castle Road	IN	2015-2228	1	166	0	166	170	4	3%	0.3	✓	✓
The Embankment	IN	2017-2523	1	411	0	411	299	-113	-27%	6.0	✗	✗
Rope walk	IN	2643-9190	3	747	19	766	783	17	2%	0.6	✓	✓
London Road	OUT	9190-2660	3	1131	7	1138	1137	-1	0%	0.0	✓	✓
Amphthill Road	OUT	2659-9194	1	489	14	503	512	9	2%	0.4	✓	✓
Couldwell Street	OUT	9193-9195	1	918	5	923	947	25	3%	0.8	✓	✓
Ford End Road	OUT	9378-2020	1	536	5	541	377	-163	-30%	7.6	✗	✗
A428 Bromham Road	OUT	9232-202	2	1281	17	1297	1204	-93	-7%	2.6	✓	✓
A5141 Shakespeare Road	OUT	2972-2547	1	545	9	554	487	-67	-12%	2.9	✓	✓
A6 Calpham Road	OUT	2546-9231	1	1007	19	1026	1085	58	6%	1.8	✓	✓
Park Avenue	OUT	9373-9216	1	489	0	489	474	-15	-3%	0.7	✓	✓
B660 Kimbolton Road	OUT	9268-2515	1	457	2	459	451	-8	-2%	0.4	✓	✓
Goldington Road	OUT	9269-2534	1	770	9	779	809	30	4%	1.1	✓	✓
Castle Road	OUT	2228-2015	1	139	0	139	139	0	0%	0.0	✓	✓
The Embankment	OUT	2523-2017	1	299	5	303	117	-186	-61%	12.9	✗	✗
Rope walk	OUT	9190-2643	3	1087	12	1099	1089	-10	-1%	0.3	✓	✓
Individual Links	IN	13									85%	85%
	OUT	13									85%	85%
	Both Directions	26									85%	85%
Screenlines	IN	13		7452	107	7559	7644	85	1%	1.0	✓	✓
Screenlines	OUT	13		9147	104	9251	8828	-422	-5%	4.4	✓	✗

Figure C-9 – PM Peak – Flow Calibration – A421

			Observed			Post (Total - Actual)						
Table 6 : A421 Screenline												
Location	Dir	Saturn Link		Count (LV)	Count (HV)	Count (Total)	Post	Diff	% Diff	GEH	DMRB	
											Flow	GEH
Between Beancroft Road and A428, A421	NB	9819-9814	1	1956	178	2135	2187	53	2%	1.1	✓	✓
Junction with A428, A421	NB	9815-9816	1	1557	160	1717	1739	22	1%	0.5	✓	✓
Junction with A5141, A421	NB	721-9178	1	1722	181	1902	1923	21	1%	0.5	✓	✓
Between A5141 and A600, A421	NB	9178-9247	1	2455	224	2679	2823	144	5%	2.8	✓	✓
Between A600 and A603, A421	NB	9179-9180	#	1971	192	2163	2174	11	1%	0.2	✓	✓
Bedford Southern Bypass (east of the A603 junction), A421	NB	714-9214	6	1998	187	2185	1963	-221	-10%	4.9	✓	✓
Between Water End and A1, A421	NB	9812-9813	#	1189	142	1331	1378	47	3%	1.3	✓	✓
Between Beancroft Road and A428	SB	9814-9819	1	1513	187	1701	1674	-27	-2%	0.6	✓	✓
Junction with A428, A421	SB	9816-9815	1	1240	163	1403	1365	-38	-3%	1.0	✓	✓
Junction with A5141, A422	SB	9178-721	1	1419	167	1586	1527	-60	-4%	1.5	✓	✓
Between A5141 and A600, A421	SB	9247-9178	1	2177	187	2365	2433	68	3%	1.4	✓	✓
Between A600 and A603, A421	SB	9180-9179	#	1746	186	1932	1897	-35	-2%	0.8	✓	✓
Bedford Southern Bypass (east of the A603 junction), A421	SB	9214-714	6	1302	162	1464	1498	33	2%	0.9	✓	✓
Junction with Water End, A421	SB	9806-9214	#	758	149	907	860	-47	-5%	1.6	✓	✓
Individual Links	NB	7									100%	100%
	SB	7									100%	100%
	Both Directions	14									100%	100%
Screenlines	NB	7		12848	1264	14112	14189	77	1%	0.6	✓	✓
	SB	7		10156	1202	11358	11254	-104	-1%	1.0	✓	✓

Appendix D

Flow Validation

Job No	Report No	Issue no	Report Name
ST15239	1	1	Bedford Town Centre LMVR

Figure D-1 – AM Peak – Flow Calibration – River Screenline

			Observed			Post (Total - Actual)						
Table 3 : River Screenline												
Location	Dir	Saturn Link	Count (LV)	Count (HV)	Count (Total)	Post	Diff	% Diff	GEH	DMRB		
										Flow	GEH	
The Green, Bromham	NB	324-3223	1	205	2	208	169	-38	-18%	2.8	✓	✓
A428 / Bedford Western Bypass	NB	8033-3223	1	544	47	592	554	-38	-6%	1.6	✓	✓
Prebend Street,A5141	NB	2225-2974	1	847	50	897	820	-76	-9%	2.6	✓	✓
Town Bridge, St Marys Street,A6	NB	9191-2012	2	634	27	661	612	-50	-8%	2.0	✓	✓
Longholme Bridge,A5140	NB	9188-9376	1	1149	30	1178	1190	12	1%	0.3	✓	✓
The Green, Bromham	SB	3223-324	1	123	5	127	104	-23	-18%	2.2	✓	✓
A428 / Bedford Western Bypass	SB	3223-8033	1	809	45	854	862	7	1%	0.3	✓	✓
Prebend Street,A5141	SB	2974-2225	1	885	38	923	953	30	3%	1.0	✓	✓
Town Bridge, St Marys Street,A6	SB	2012-9191	2	1144	52	1196	1362	166	14%	4.6	✓	✓
Longholme Bridge,A5140	SB	9376-9188	1	1206	23	1229	1213	-16	-1%	0.5	✓	✓
Individual Links	NB	5									100%	100%
	SB	5									100%	100%
	Both Directions	10									100%	100%
Screenlines	NB	5		3379	157	3535	3345	-190	-5%	3.2	✗	✓
	SB	5		4167	163	4330	4494	164	4%	2.5	✓	✓

Figure D-2 – AM Peak – Flow Calibration – NS Screenline

			Observed			Post (Total - Actual)						
Table 4 : NS Screenline												
Location	Dir	Saturn Link		Count (LV)	Count (HV)	Count (Total)	Post	Diff	% Diff	GEH	DMRB	
											Flow	GEH
A421	EB	9816-362	1	2212	463	2675	2765	91	3%	1.7	✓	✓
Elstow Road	EB	385-316	1	608	25	633	650	17	3%	0.7	✓	✓
Britannia Road	EB	2657-9194	1	357	28	385	451	66	17%	3.2	✓	✓
Cauldwell Steet	EB	9193-9273	1	676	26	702	680	-22	-3%	0.8	✓	✓
Horne Lane	EB	2086-2085	1	25	7	32	6	-26	-80%	5.9	✓	✗
A6 Tavistock Street	EB	2024-9218	1	1527	115	1642	1679	37	2%	0.9	✓	✓
B660 Kimbolton Road	EB	9374-9216	1	182	20	201	154	-48	-24%	3.6	✓	✓
Polhill Avenue	EB	9216-9375	1	466	22	488	357	-132	-27%	6.4	✗	✗
Putnoe Lane	EB	9221-2584	1	236	10	246	239	-7	-3%	0.5	✓	✓
Wentworth Drive	EB	9229-2579	1	545	15	560	556	-4	-1%	0.2	✓	✓
A421	WB	362-9816	1	2391	431	2823	2904	82	3%	1.5	✓	✓
Elstow Road	WB	316-385	1	485	11	496	534	37	8%	1.6	✓	✓
Britannia Road	WB	9194-2657	1	540	28	569	791	223	39%	8.5	✗	✗
Cauldwell Steet	WB	9273-9193	1	654	21	676	681	6	1%	0.2	✓	✓
Horne Lane	WB	2085-2086	1	628	52	680	624	-56	-8%	2.2	✓	✓
A428 Bromham Road	WB	9218-9270	2	792	68	859	748	-111	-13%	3.9	✓	✓
B660 Kimbolton Road	WB	9216-9374	1	455	10	464	334	-131	-28%	6.5	✗	✗
Pothill Avenue	WB	9375-9216	1	510	20	530	347	-183	-35%	8.7	✗	✗
Putnoe Lane	WB	2584-9221	1	456	0	456	388	-68	-15%	3.3	✓	✓
Wentworth Drive	WB	2579-9229	1	392	22	414	412	-2	0%	0.1	✓	✓
Individual Links	EB	10									90%	80%
	WB	10									70%	70%
	Both Directions	20									80%	75%
Screenlines	EB	10		6833	731	7564	7537	-27	0%	0.3	✓	✓
	WB	10		7303	664	7967	7764	-203	-3%	2.3	✓	✓

Figure D-3 – Inter Peak – Flow Calibration – River Screenline

			Observed			Post (Total - Actual)						
Table 3 : River Screenline												
Location	Dir	Saturn Link		Count (LV)	Count (HV)	Count (Total)	Post	Diff	% Diff	GEH	DMRB	
											Flow	GEH
The Green, Bromham	NB	324-3223	1	143	4	147	128	-19	-13%	1.6	✓	✓
A428 / Bedford Western Bypass	NB	8033-3223	1	555	58	613	592	-21	-3%	0.8	✓	✓
Prebend Street,A5141	NB	2225-2974	2	771	29	800	719	-81	-10%	3.0	✓	✓
Town Bridge, St Marys Street,A6	NB	9191-2012	2	632	19	651	564	-88	-13%	3.6	✓	✓
Longholme Bridge,A5140	NB	9188-9376	1	1111	19	1129	1021	-109	-10%	3.3	✓	✓
The Green, Bromham	SB	3223-324	1	142	4	146	130	-16	-11%	1.4	✓	✓
A428 / Bedford Western Bypass	SB	3223-8033	1	601	52	653	704	50	8%	1.9	✓	✓
Prebend Street,A5141	SB	2974-2225	2	777	28	804	791	-13	-2%	0.5	✓	✓
Town Bridge, St Marys Street,A6	SB	2012-9191	2	878	30	907	1019	111	12%	3.6	✓	✓
Longholme Bridge,A5140	SB	9376-9188	1	846	13	859	804	-56	-6%	1.9	✓	✓
Individual Links	NB	5									100%	100%
	SB	5									100%	100%
	Both Directions	10									100%	100%
Screenlines	NB	5		3212	129	3340	3023	-317	-9%	5.6	x	*
	SB	5		3244	126	3370	3447	77	2%	1.3	✓	✓

Figure D-4 – Inter Peak – Flow Calibration – NS Screenline

			Observed			Post (Total - Actual)						
Table 4 : NS Screenline												
Location	Dir	Saturn Link		Count (LV)	Count (HV)	Count (Total)	Post	Diff	% Diff	GEH	DMRB	
											Flow	GEH
A421	EB	9816-362	1	1860	563	2422	2304	-118	-5%	2.4	✓	✓
Elstow Road	EB	385-316	1	509	15	523	480	-43	-8%	1.9	✓	✓
Britannia Road	EB	2657-9194	1	410	40	450	364	-86	-19%	4.3	✓	✓
Cauldwell Steet	EB	9193-9273	1	668	30	698	505	-193	-28%	7.9	x	x
Horne Lane	EB	2086-2085	1	66	5	71	27	-44	-62%	6.3	✓	x
A6 Tavistock Street	EB	2024-9218	1	1215	121	1336	1393	57	4%	1.5	✓	✓
B660 Kimbolton Road	EB	9374-9216	1	247	9	256	161	-95	-37%	6.6	✓	x
Polhill Avenue	EB	9216-9375	1	392	18	411	295	-116	-28%	6.2	x	x
Putnoe Lane	EB	9221-2584	1	323	7	330	177	-152	-46%	9.6	x	x
Wentworth Drive	EB	9229-2579	1	249	24	273	337	64	23%	3.7	✓	✓
A421	WB	362-9816	1	1756	530	2286	2188	-98	-4%	2.1	✓	✓
Elstow Road	WB	316-385	1	553	17	570	529	-41	-7%	1.7	✓	✓
Britannia Road	WB	9194-2657	1	355	30	386	542	156	41%	7.3	x	x
Cauldwell Steet	WB	9273-9193	1	612	29	641	530	-110	-17%	4.6	x	✓
Horne Lane	WB	2085-2086	1	658	55	712	569	-143	-20%	5.7	x	x
A428 Bromham Road	WB	9218-9270	2	619	69	687	669	-18	-3%	0.7	✓	✓
B660 Kimbolton Road	WB	9216-9374	1	242	8	250	270	20	8%	1.2	✓	✓
Polhill Avenue	WB	9375-9216	1	371	17	387	314	-73	-19%	3.9	✓	✓
Putnoe Lane	WB	2584-9221	1	329	0	329	306	-23	-7%	1.3	✓	✓
Wentworth Drive	WB	2579-9229	1	291	26	317	466	149	47%	7.5	x	x
Individual Links	EB	10									70%	50%
	WB	10									60%	70%
	Both Directions	20									65%	60%
Screenlines	EB	10		5940	831	6770	6044	-727	-11%	9.1	x	*
	WB	10		5785	780	6565	6384	-181	-3%	2.3	✓	✓

Figure D-5 – PM Peak – Flow Calibration – River Screenline

			Observed			Post (Total - Actual)						
Table 3 : River Screenline												
Location	Dir	Saturn Link		Count (LV)	Count (HV)	Count (Total)	Post	Diff	% Diff	GEH	DMRB	
											Flow	GEH
The Green, Bromham	NB	324-3223	1	156	2	158	144	-15	-9%	1.2	✓	✓
A428 / Bedford Western Bypass	NB	8033-3223	1	857	25	882	832	-51	-6%	1.7	✓	✓
Prebend Street,A5141	NB	2225-2974	2	821	14	835	840	5	1%	0.2	✓	✓
Town Bridge, St Marys Street,A6	NB	9191-2012	2	777	16	793	703	-90	-11%	3.3	✓	✓
Longholme Bridge,A5140	NB	9188-9376	1	1575	16	1591	1699	108	7%	2.7	✓	✓
The Green, Bromham	SB	3223-324	1	237	0	237	210	-26	-11%	1.8	✓	✓
A428 / Bedford Western Bypass	SB	3223-8033	1	709	20	729	725	-4	-1%	0.2	✓	✓
Prebend Street,A5141	SB	2974-2225	2	817	18	836	1016	180	22%	5.9	✗	✗
Town Bridge, St Marys Street,A6	SB	2012-9191	2	1089	23	1112	1135	23	2%	0.7	✓	✓
Longholme Bridge,A5140	SB	9376-9188	1	977	11	989	1049	61	6%	1.9	✓	✓
Individual Links	NB	5									100%	100%
	SB	5									80%	80%
	Both Directions	10									90%	90%
Screenlines	NB	5		4187	73	4260	4218	-42	-1%	0.6	✓	✓
	SB	5		3830	73	3902	4136	234	6%	3.7	✗	✓

Figure D-6 – PM Peak – Flow Calibration – NS Screenline

						Observed			Post (Total - Actual)				
Table 4 : NS Screenline													
Location	Dir	Saturn Link		Count (LV)	Count (HV)	Count (Total)	Post	Diff	% Diff	GEH	DMRB		
											Flow	GEH	
A421	EB	9816-362	1	2486	242	2727	2752	24	1%	0.5	✓	✓	
Elstow Road	EB	385-316	1	559	9	568	583	16	3%	0.6	✓	✓	
Britannia Road	EB	2657-9194	1	534	2	536	598	62	12%	2.6	✓	✓	
Cauldwell Steet	EB	9193-9273	1	731	5	735	659	-76	-10%	2.9	✓	✓	
Horne Lane	EB	2086-2085	1	105	2	107	108	1	1%	0.1	✓	✓	
A6 Tavistock Street	EB	2024-9218	1	1543	36	1579	1645	66	4%	1.7	✓	✓	
B660 Kimbolton Road	EB	9374-9216	1	446	0	446	372	-75	-17%	3.7	✓	✓	
Polhill Avenue	EB	9216-9375	1	588	5	592	421	-172	-29%	7.6	x	x	
Putnoe Lane	EB	9221-2584	1	460	0	460	385	-75	-16%	3.7	✓	✓	
Wentworth Drive	EB	9229-2579	1	375	2	377	251	-126	-33%	7.1	x	x	
A421	WB	362-9816	1	2043	233	2275	2354	79	3%	1.6	✓	✓	
Elstow Road	WB	316-385	1	816	2	818	803	-16	-2%	0.5	✓	✓	
Britannia Road	WB	9194-2657	1	338	5	342	382	40	12%	2.1	✓	✓	
Cauldwell Steet	WB	9273-9193	1	605	7	612	517	-95	-16%	4.0	✓	✓	
Horne Lane	WB	2085-2086	1	784	24	808	844	36	4%	1.3	✓	✓	
A428 Bromham Road	WB	9218-9270	2	771	18	789	870	81	10%	2.8	✓	✓	
B660 Kimbolton Road	WB	9216-9374	1	157	2	160	212	52	33%	3.8	✓	✓	
Polhill Avenue	WB	9375-9216	1	449	0	449	389	-61	-13%	3.0	✓	✓	
Putnoe Lane	WB	2584-9221	1	336	0	336	407	71	21%	3.7	✓	✓	
Wentworth Drive	WB	2579-9229	1	648	5	653	467	-186	-28%	7.9	x	x	
Individual Links	EB	10									80%	80%	
	WB	10									90%	90%	
	Both Directions	20									85%	85%	
Screenlines	EB	10		7826	304	8129	7774	-355	-4%	4.0	✓	✓	
	WB	10		6947	296	7243	7244	1	0%	0.0	✓	✓	

Appendix E

Journey Time Validation

Job No	Report No	Issue no	Report Name
ST15239	1	1	Bedford Town Centre LMVR

Figure E-1 – AM Peak – Journey Time Calibration – Route 1 Northbound

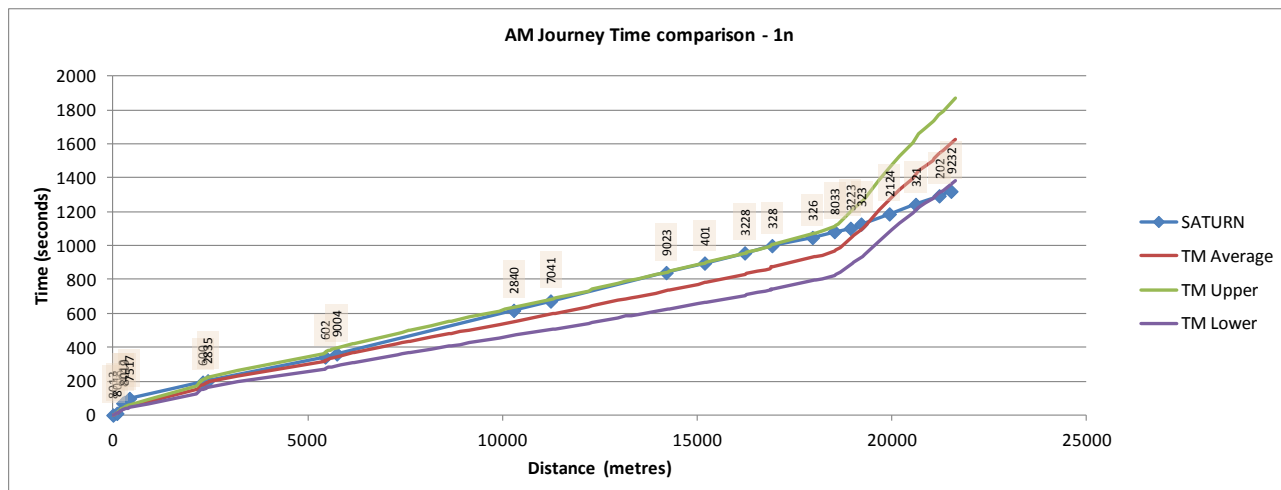


Figure E-2 – Inter Peak – Journey Time Calibration – Route 1 Northbound

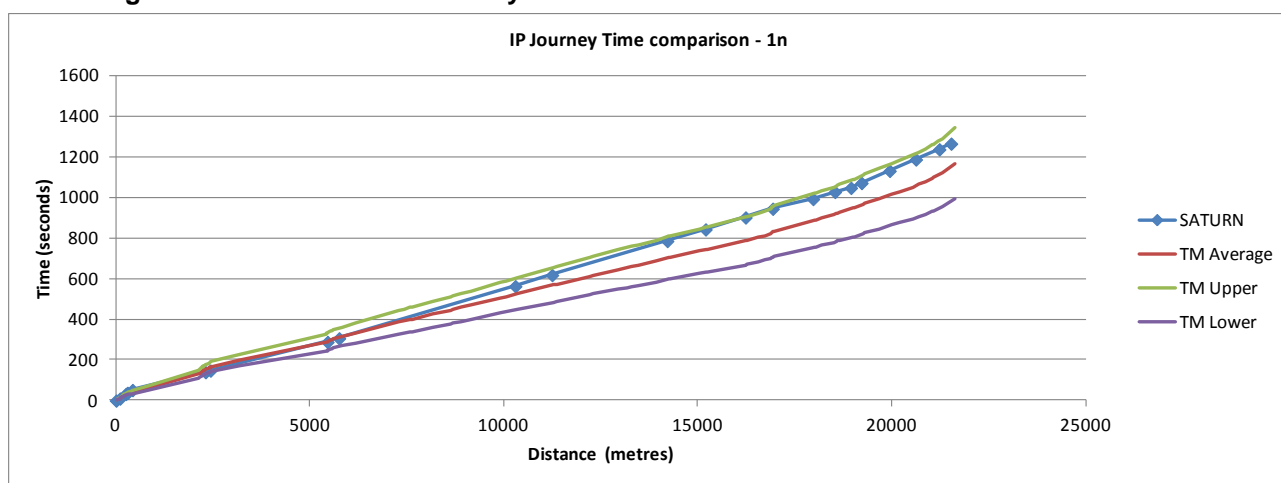


Figure E-3 – PM Peak – Journey Time Calibration – Route 1 Northbound

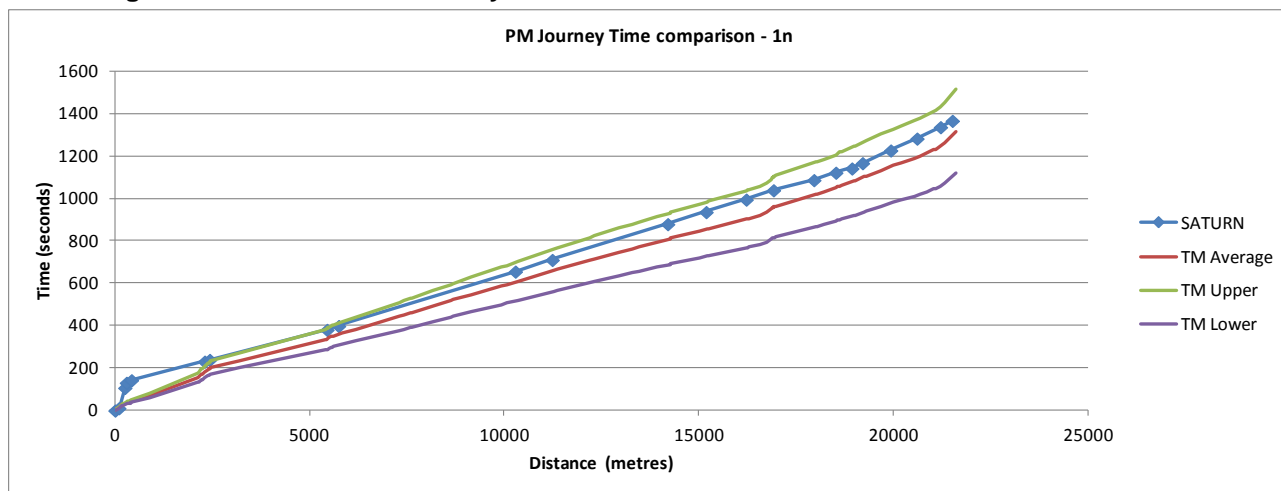


Figure E-4 – AM Peak – Journey Time Calibration – Route 1 Southbound

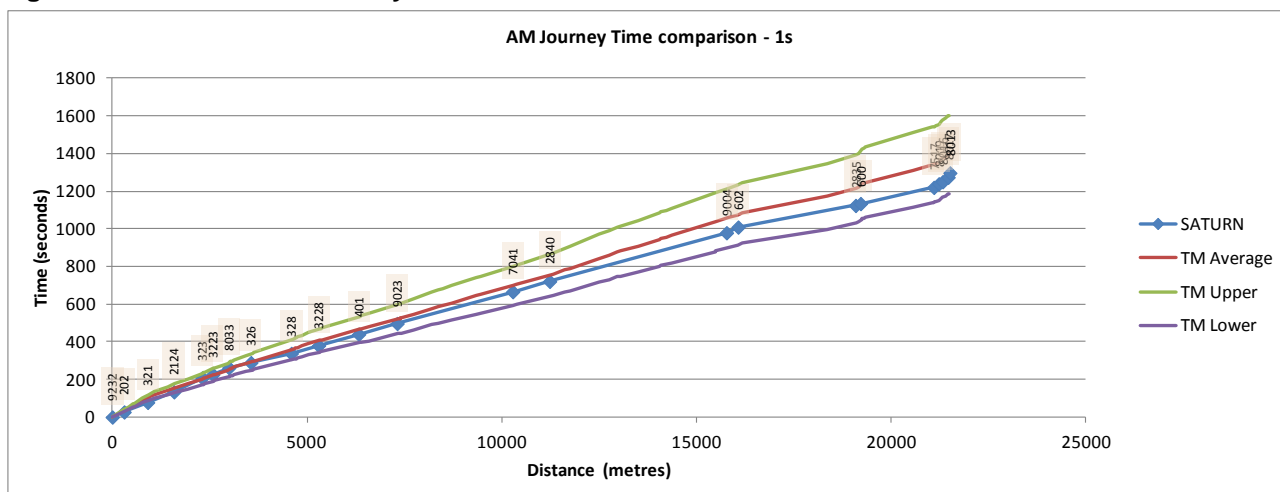


Figure E-5 – Inter Peak – Journey Time Calibration – Route 1 Southbound

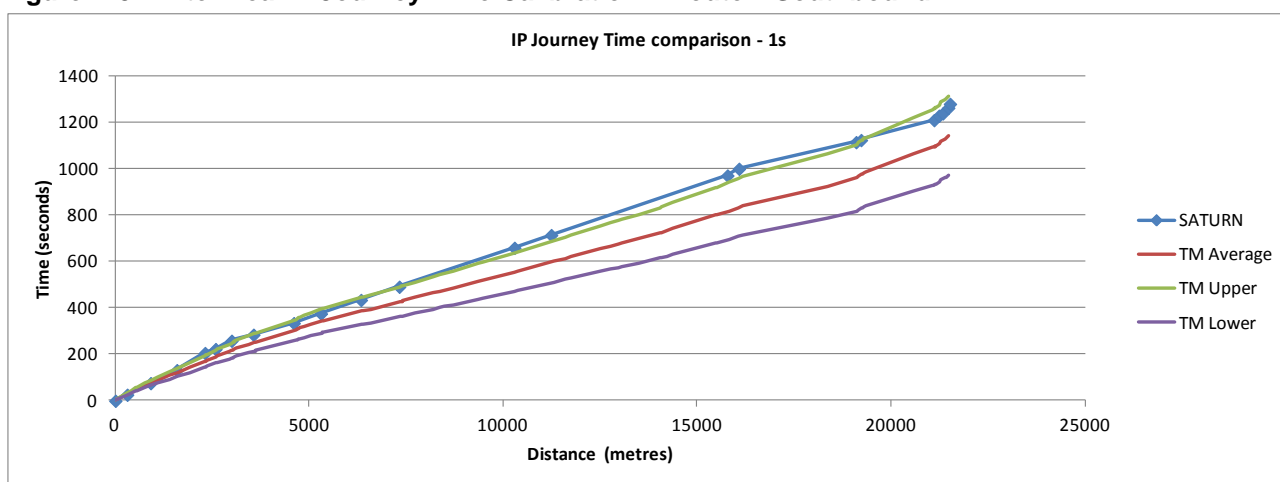


Figure E-6 – PM Peak – Journey Time Calibration – Route 1 Southbound

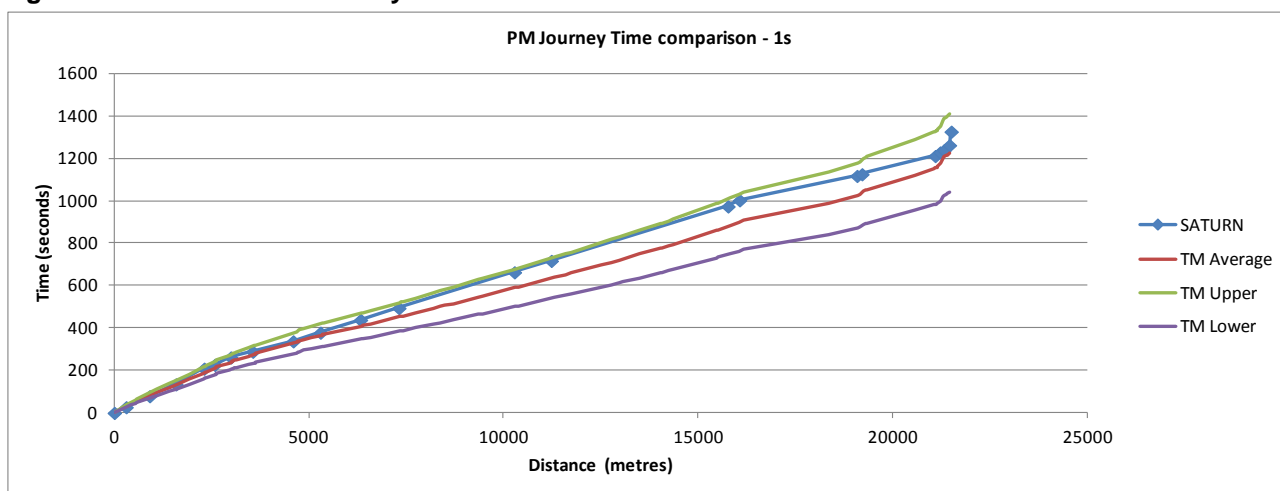


Figure E-7 – AM Peak – Journey Time Calibration – Route 2 Northbound

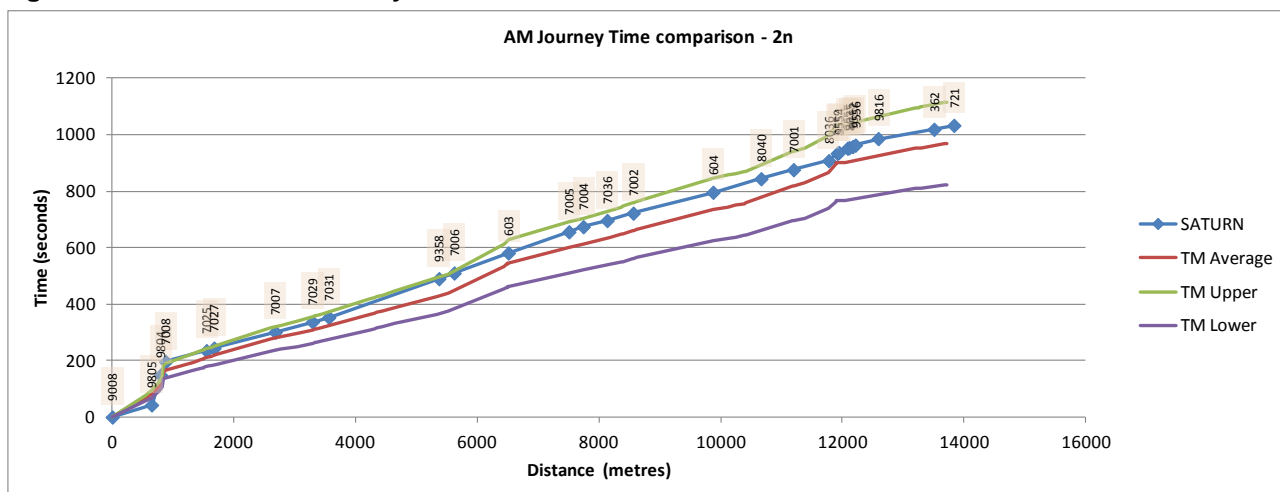


Figure E-8 – Inter Peak – Journey Time Calibration – Route 2 Northbound

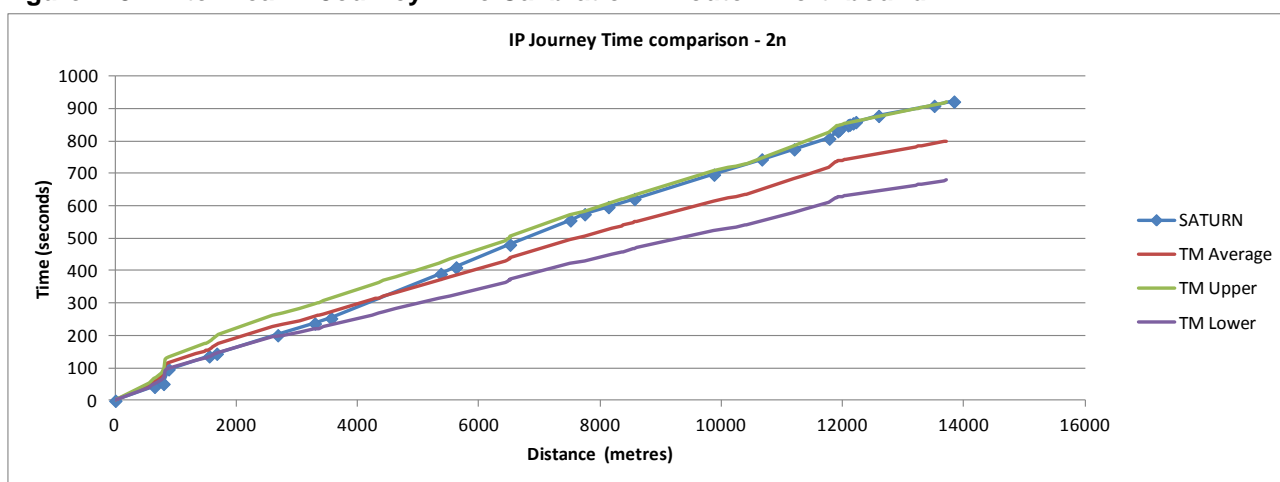


Figure E-9 – PM Peak – Journey Time Calibration – Route 2 Northbound

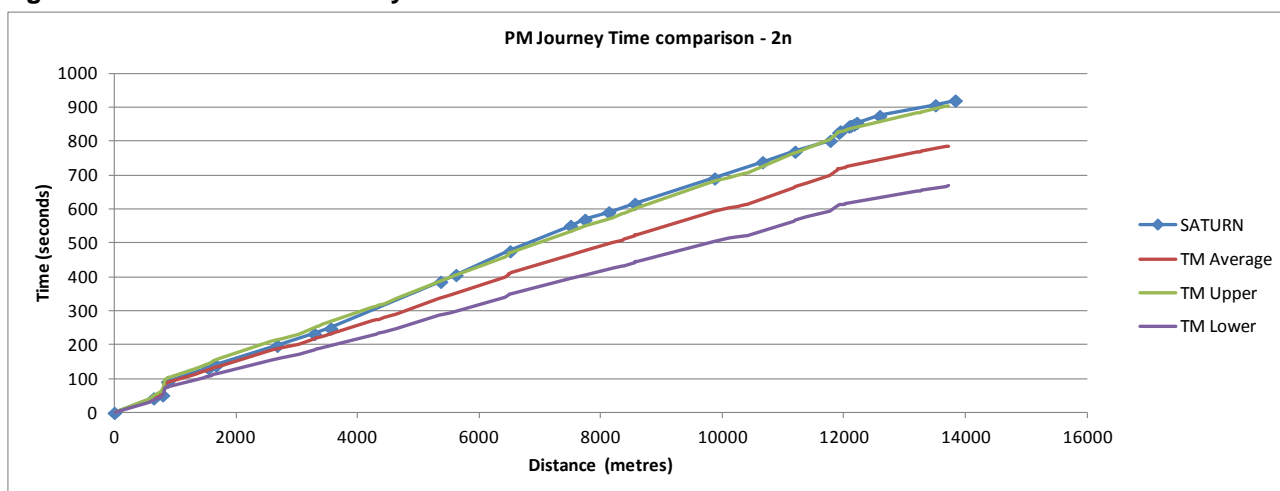


Figure E-10 – AM Peak – Journey Time Calibration – Route 2 Southbound

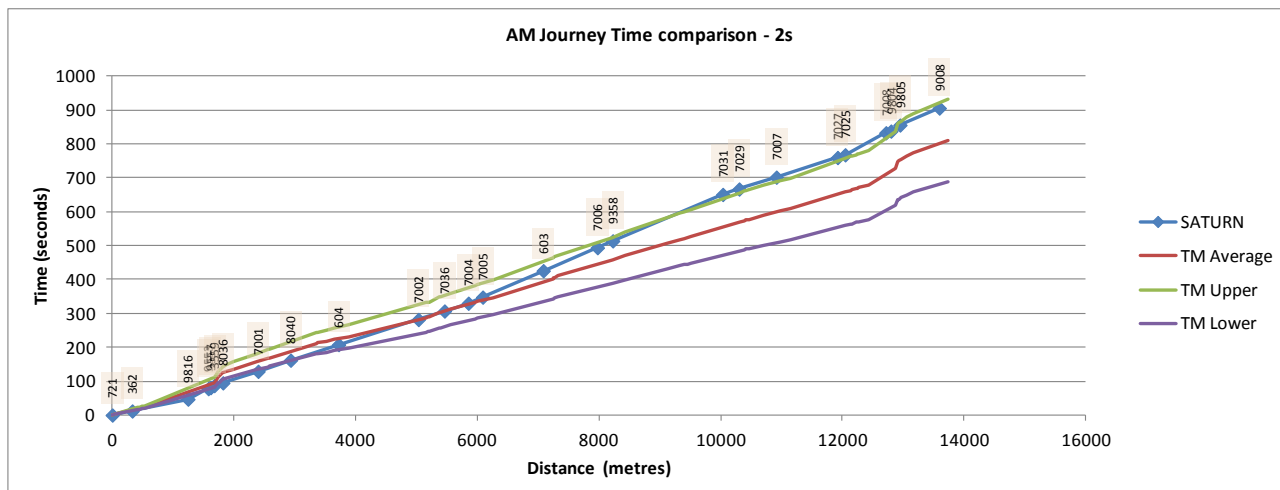


Figure E-11 – Inter Peak – Journey Time Calibration – Route 2 Southbound

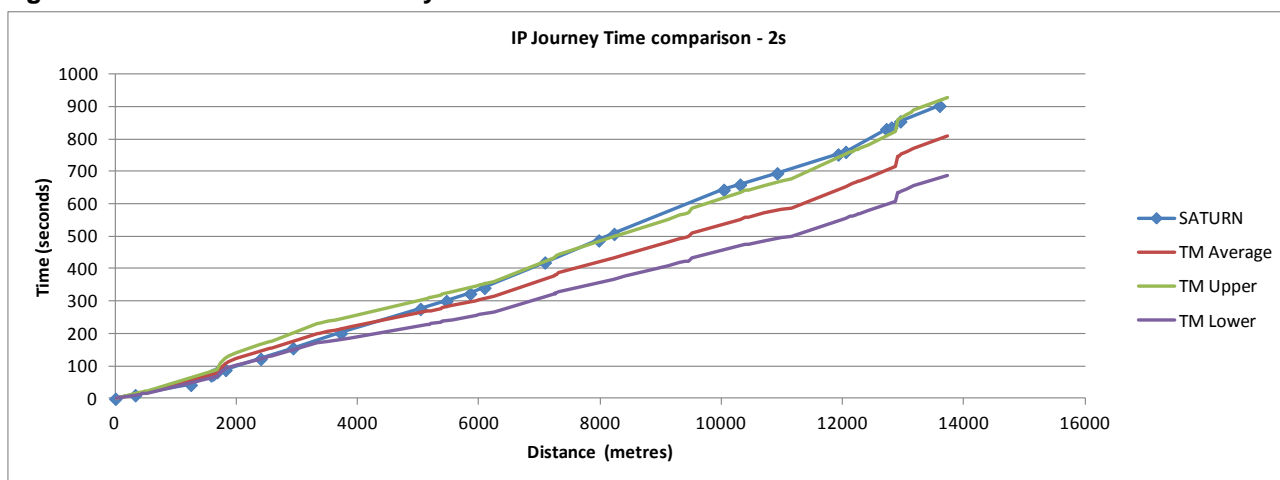


Figure E-12 – PM Peak – Journey Time Calibration – Route 2 Southbound

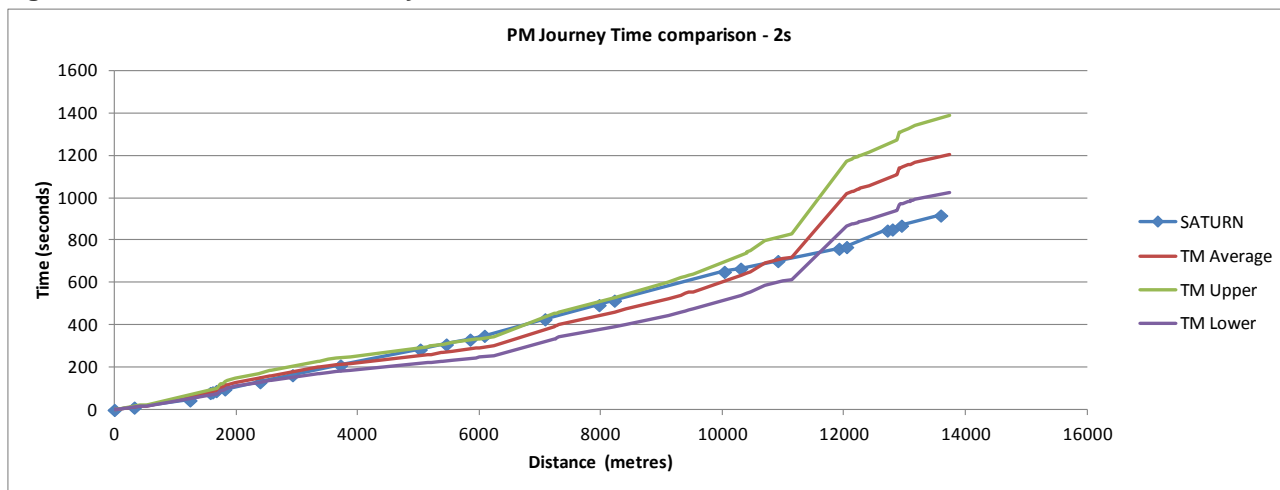


Figure E-13 – AM Peak – Journey Time Calibration – Route 3 Northbound

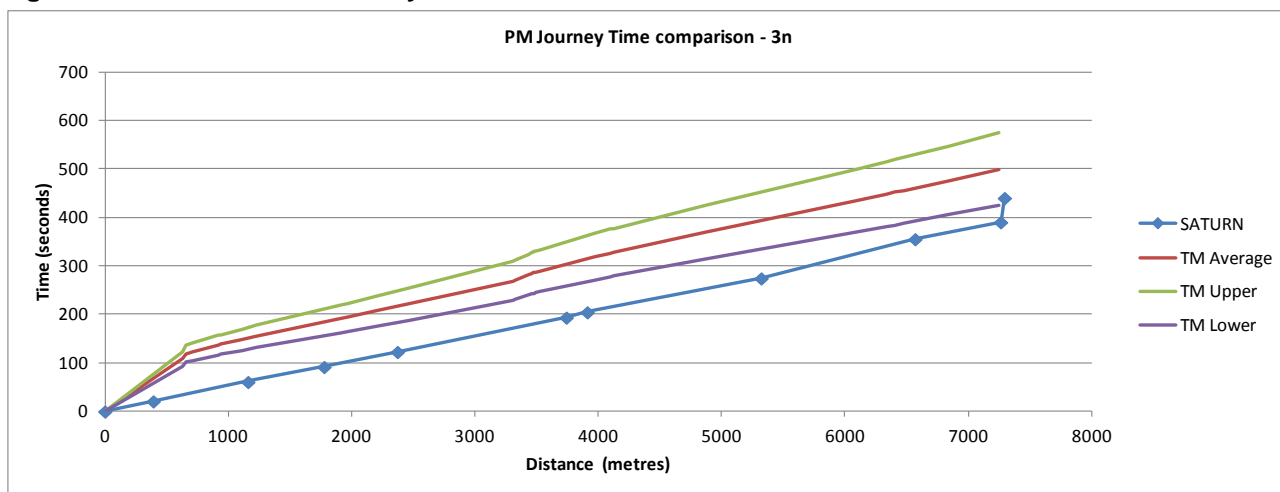


Figure E-14 – Inter Peak – Journey Time Calibration – Route 3 Northbound

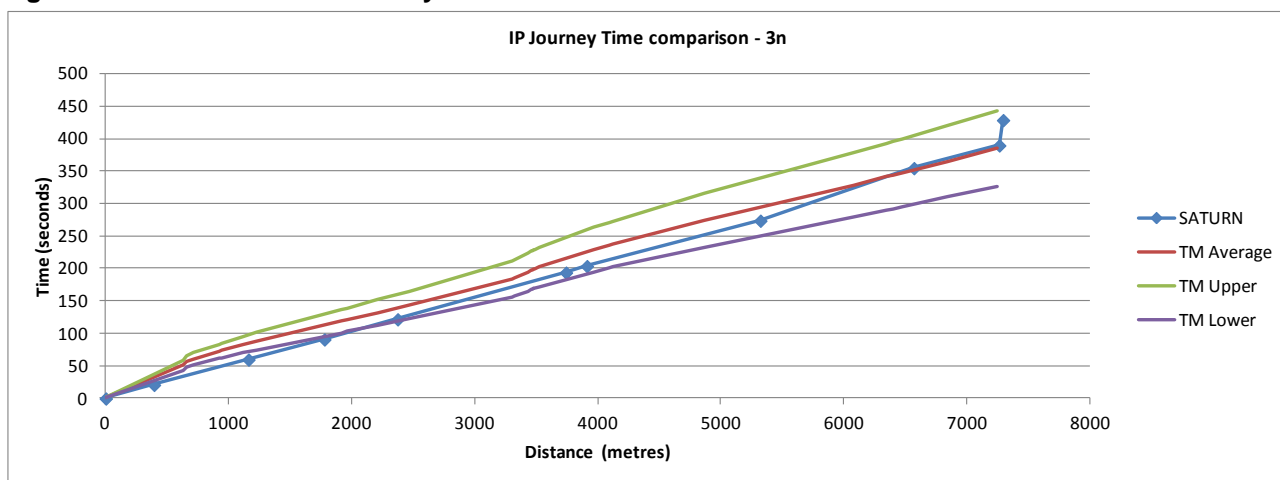


Figure E-15 – PM Peak – Journey Time Calibration – Route 3 Northbound

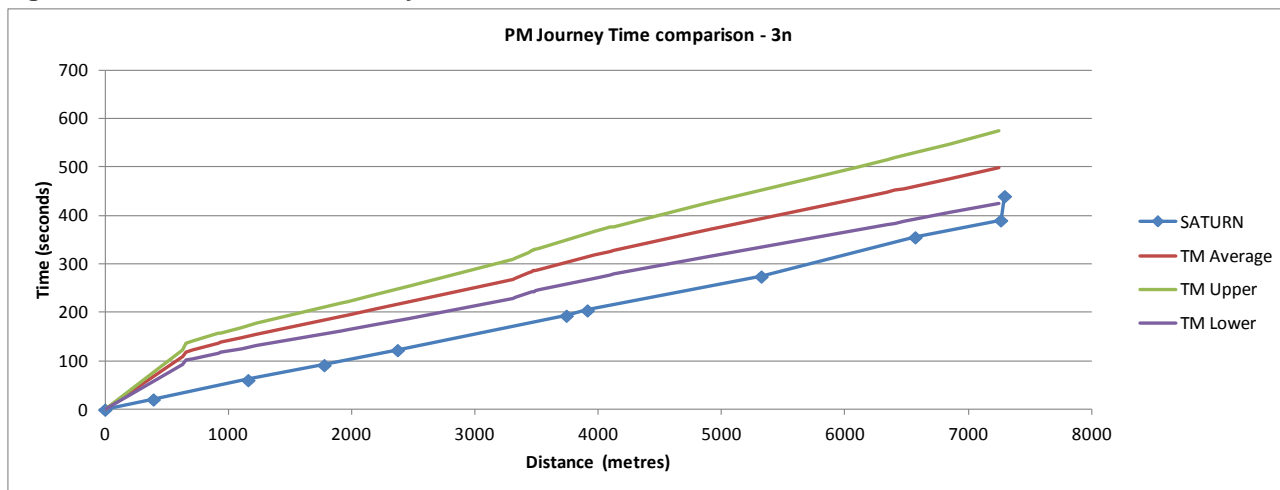


Figure E-16 – AM Peak – Journey Time Calibration – Route 3 Southbound

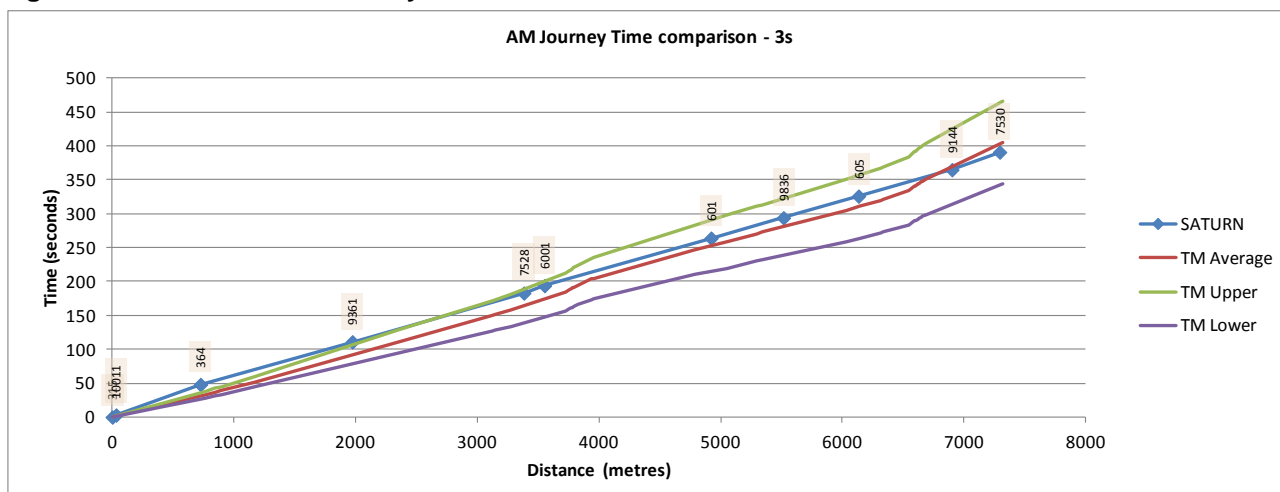


Figure E-17 – Inter Peak – Journey Time Calibration – Route 3 Southbound

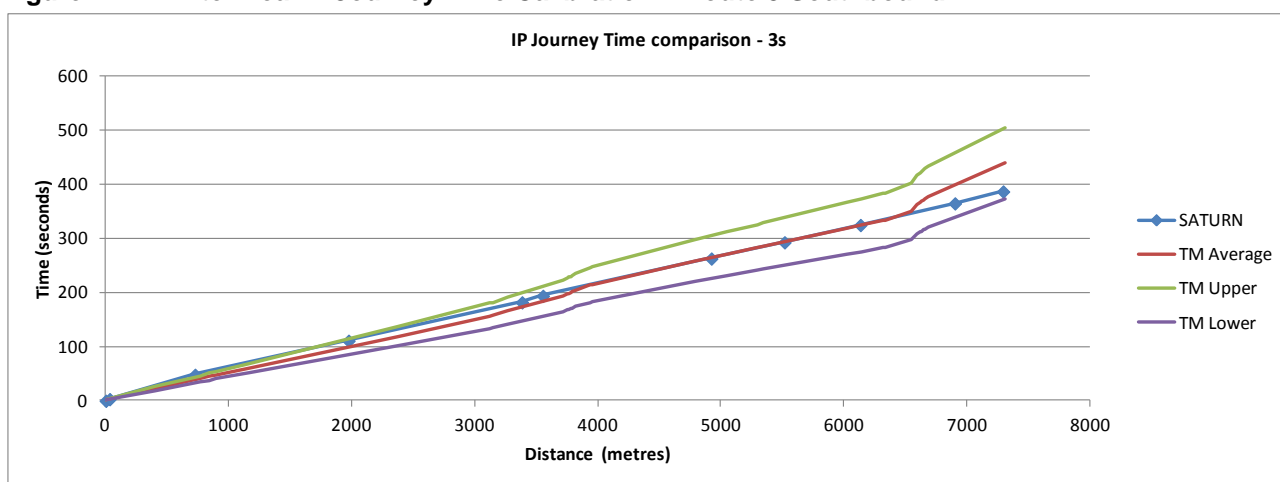


Figure E-18 – PM Peak – Journey Time Calibration – Route 3 Southbound

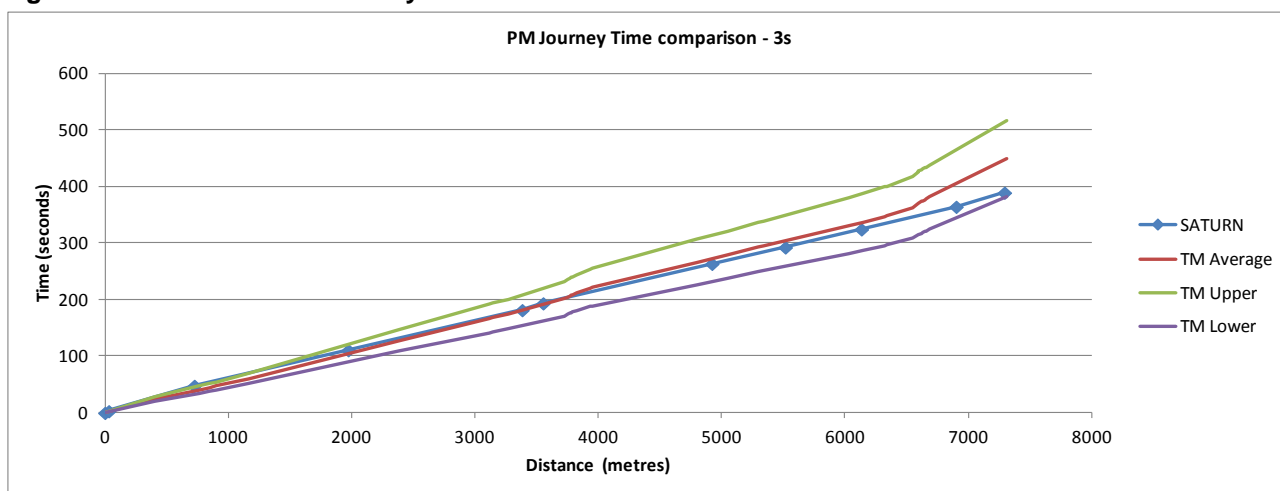


Figure E-19 – AM Peak – Journey Time Calibration – Route 4 Northbound

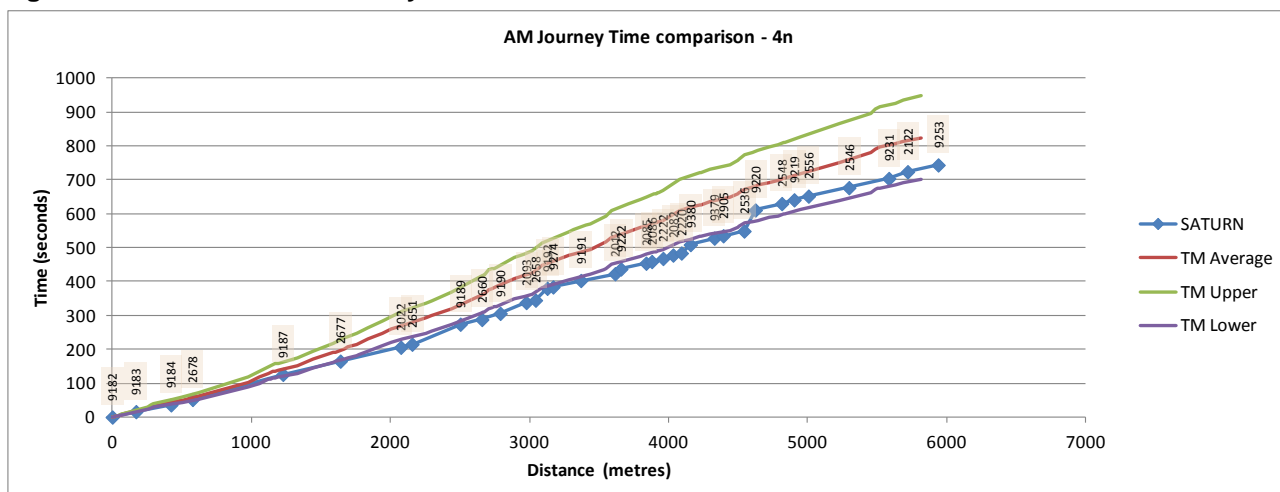


Figure E-20 – Inter Peak – Journey Time Calibration – Route 4 Northbound

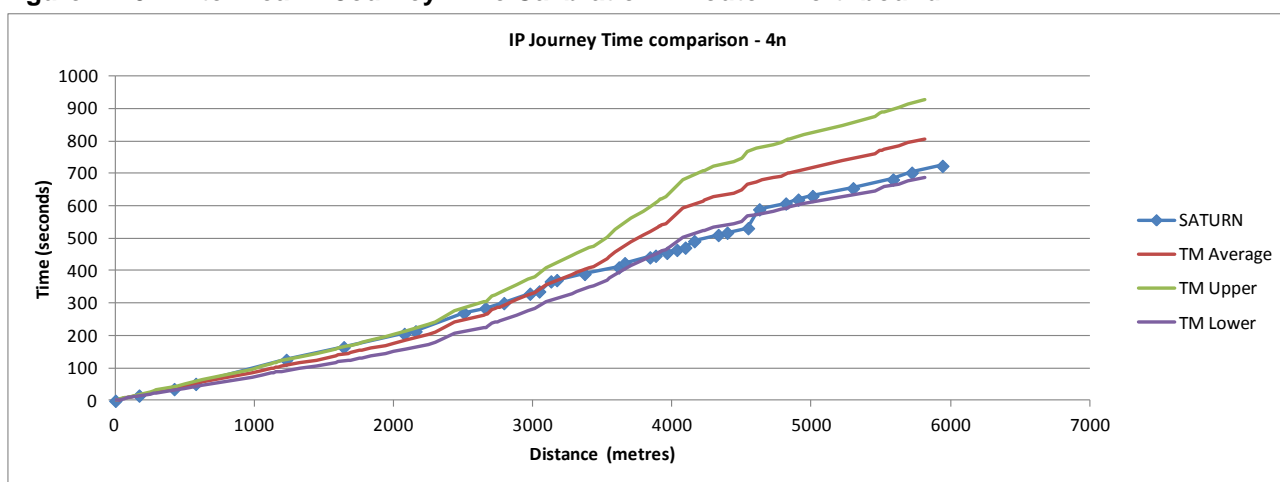


Figure E-21 – PM Peak – Journey Time Calibration – Route 4 Northbound

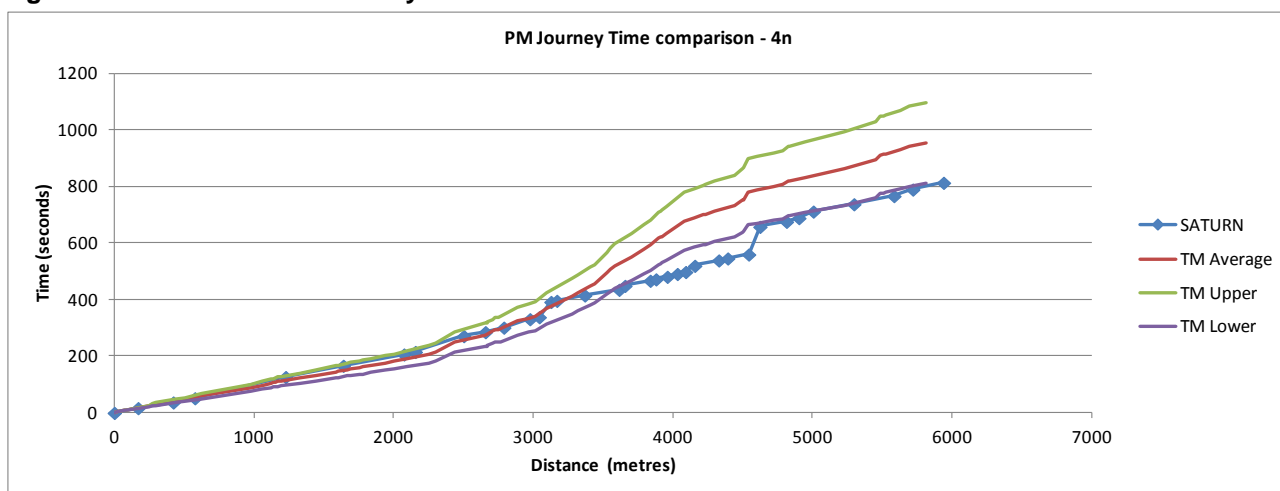


Figure E-22 – AM Peak – Journey Time Calibration – Route 4 Southbound

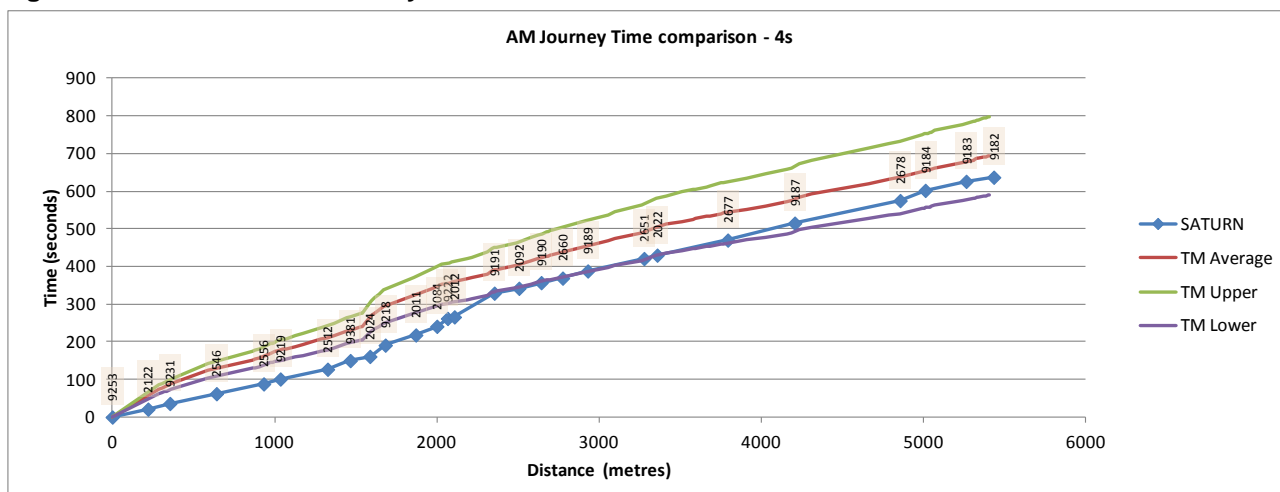


Figure E-23 – Inter Peak – Journey Time Calibration – Route 4 Southbound

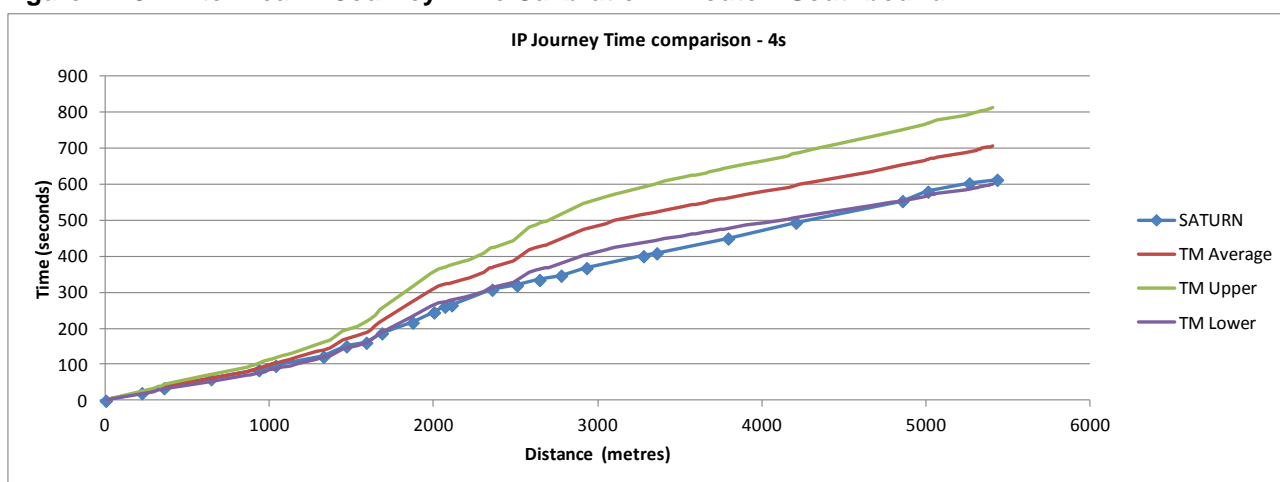


Figure E-24 – PM Peak – Journey Time Calibration – Route 4 Southbound

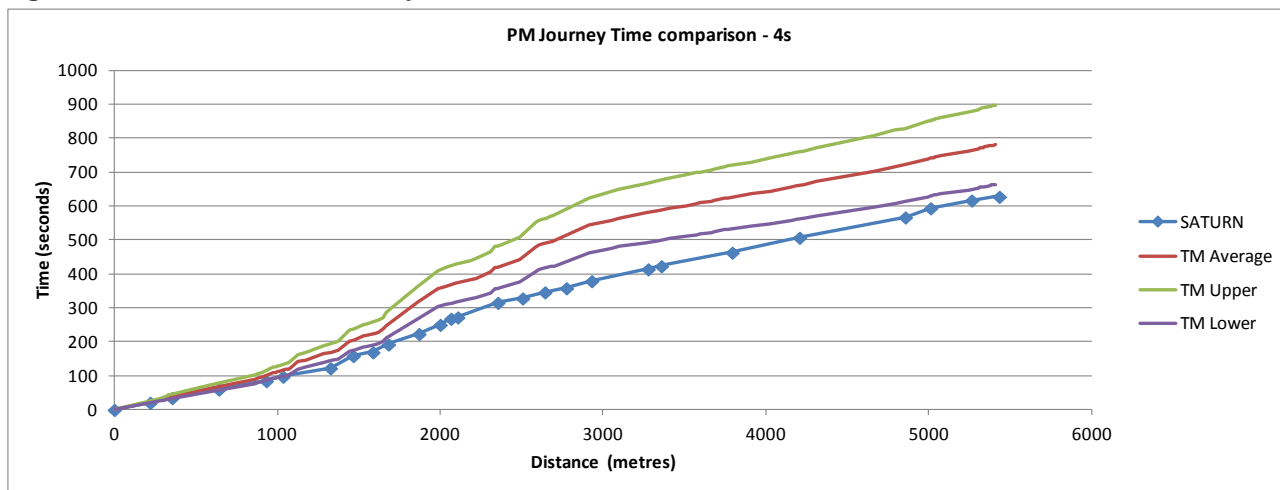


Figure E-25 – AM Peak – Journey Time Calibration – Route 5 Eastbound

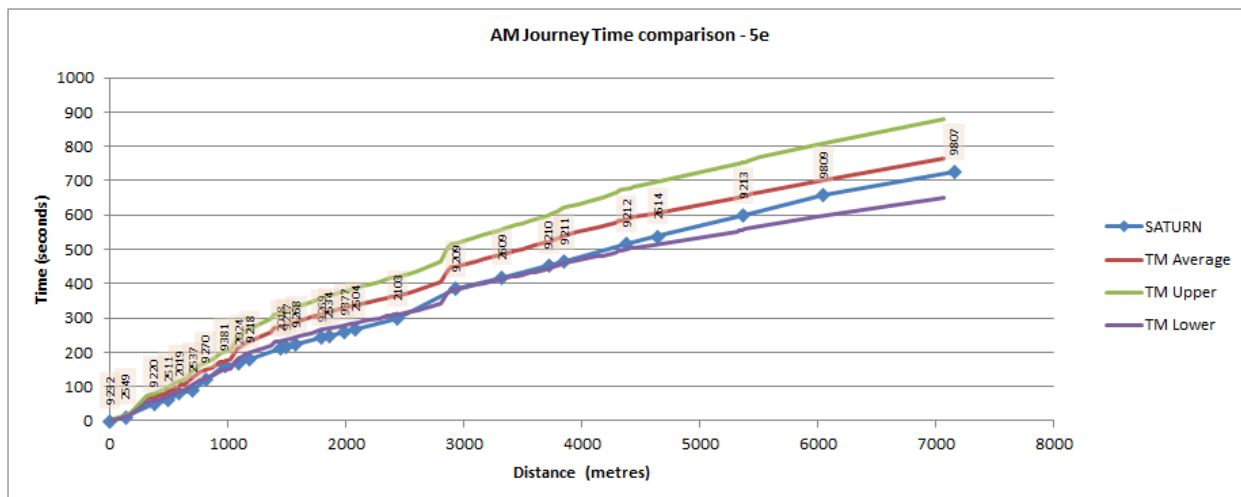


Figure E-26 – Inter Peak – Journey Time Calibration – Route 5 Eastbound

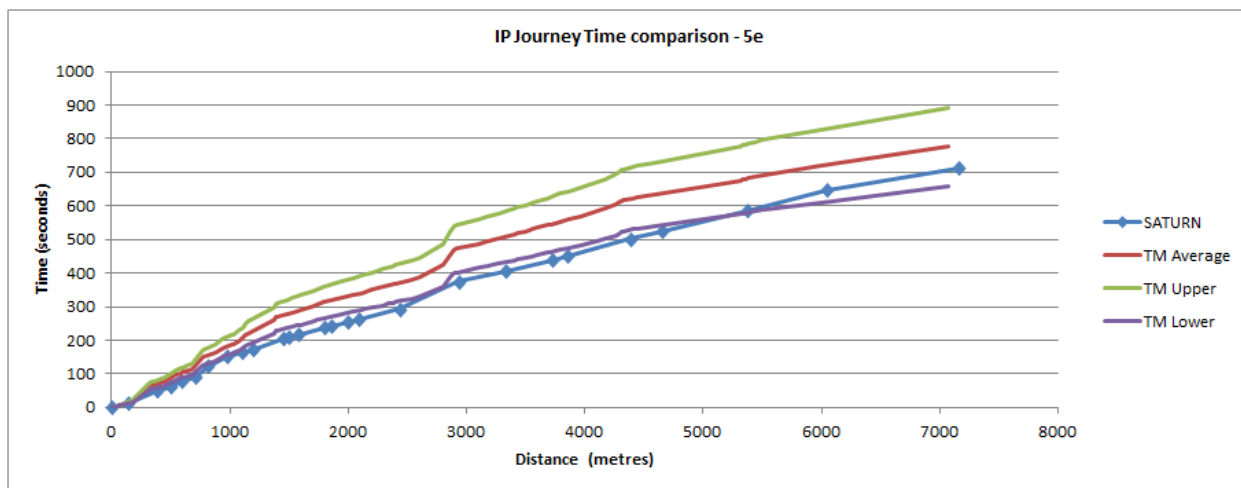


Figure E-27 – PM Peak – Journey Time Calibration – Route 5 Eastbound

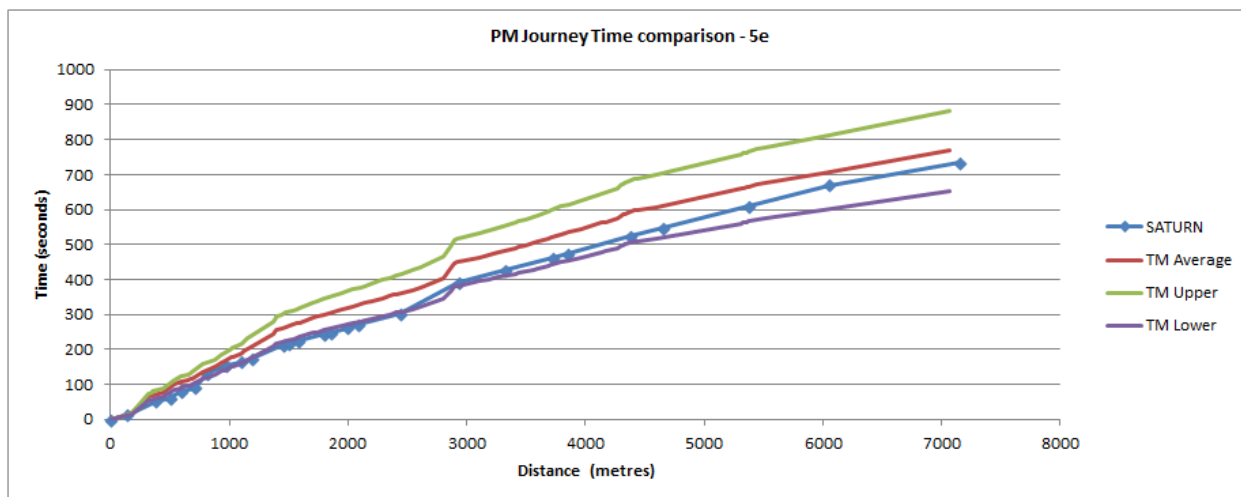


Figure E-28 – AM Peak – Journey Time Calibration – Route 5 Westbound

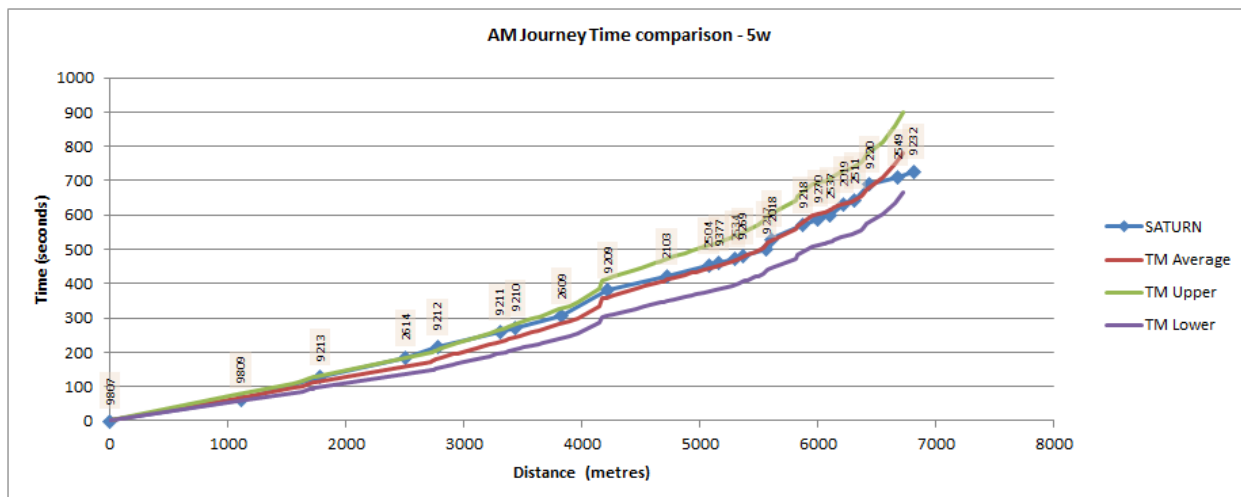


Figure E-29 – Inter Peak – Journey Time Calibration – Route 5 Westbound

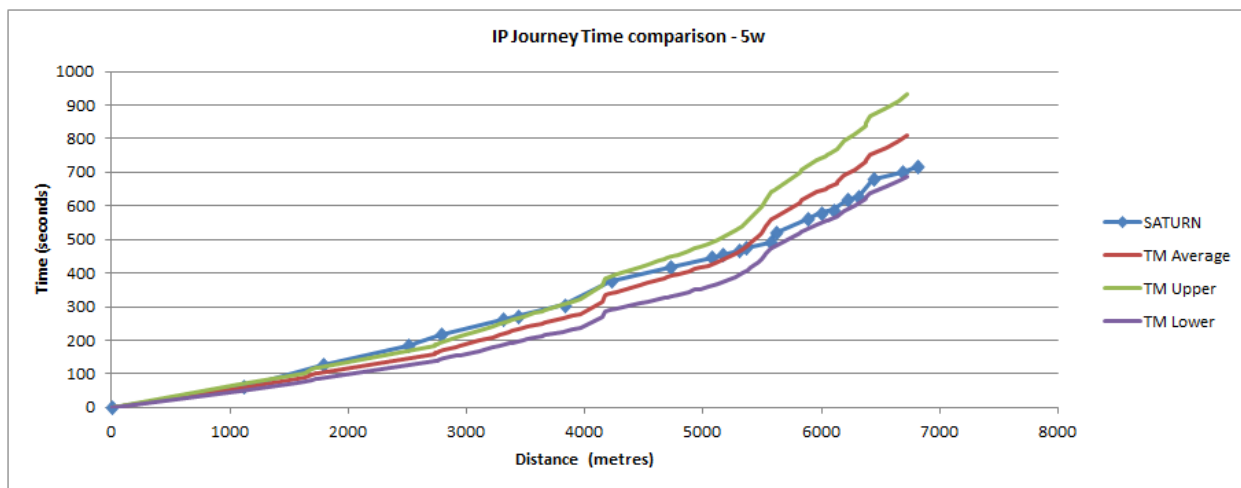


Figure E-30 – PM Peak – Journey Time Calibration – Route 5 Westbound

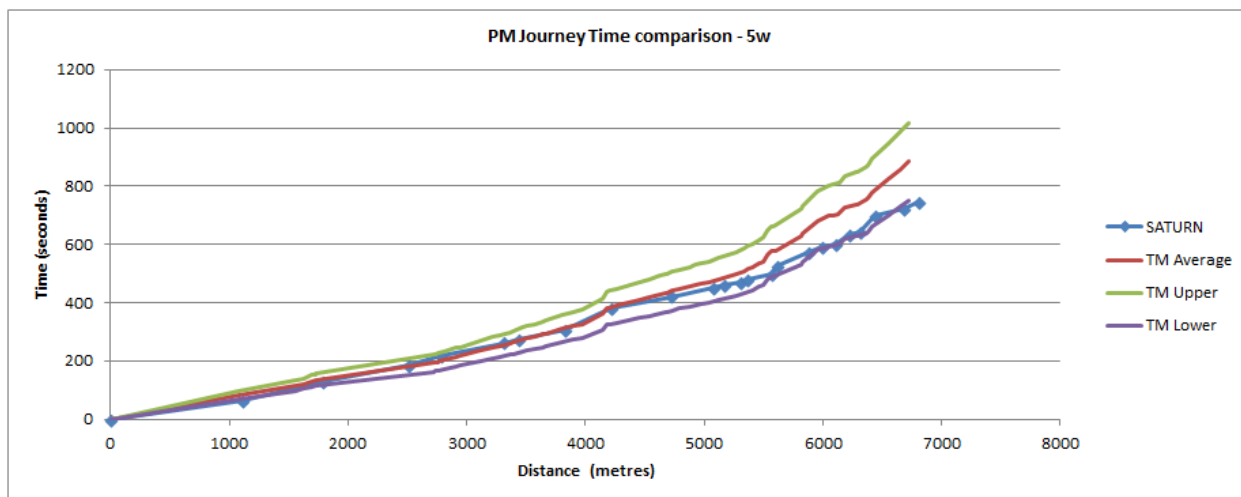


Figure E-31 – AM Peak – Journey Time Calibration – Route 6 Eastbound

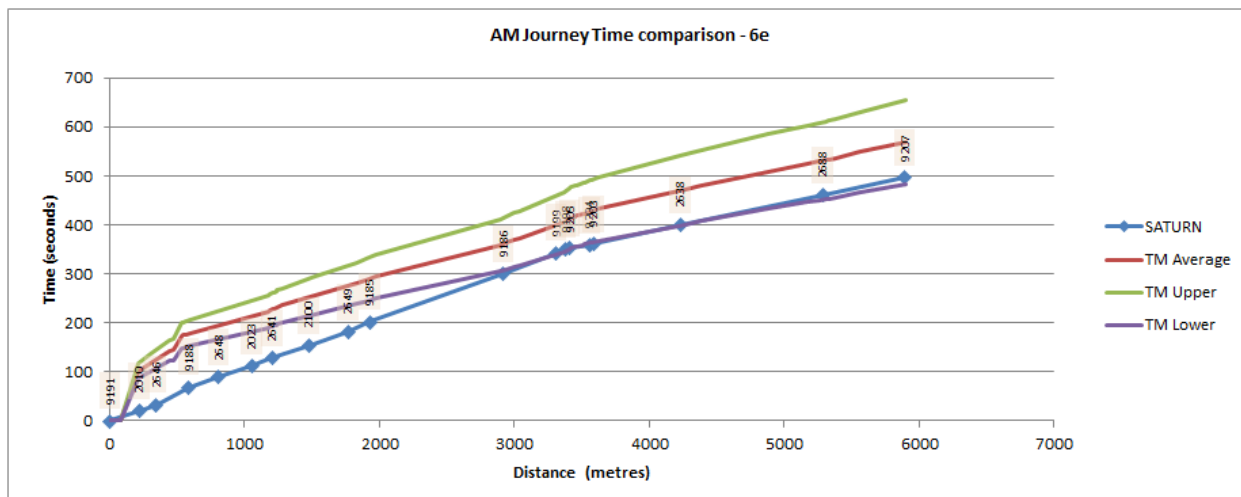


Figure E-32 – Inter Peak – Journey Time Calibration – Route 6 Eastbound

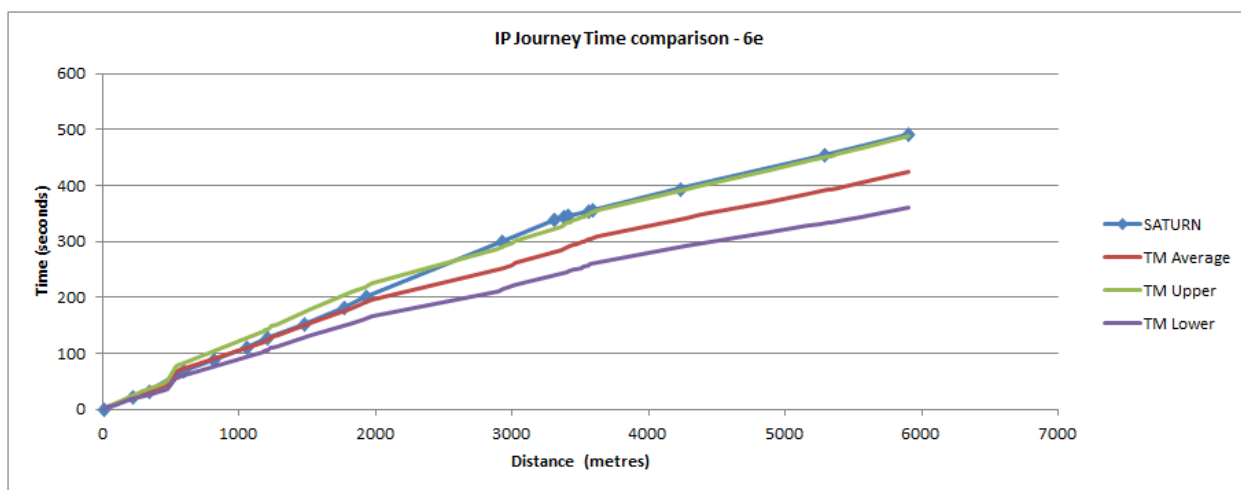


Figure E-33 – PM Peak – Journey Time Calibration – Route 6 Eastbound

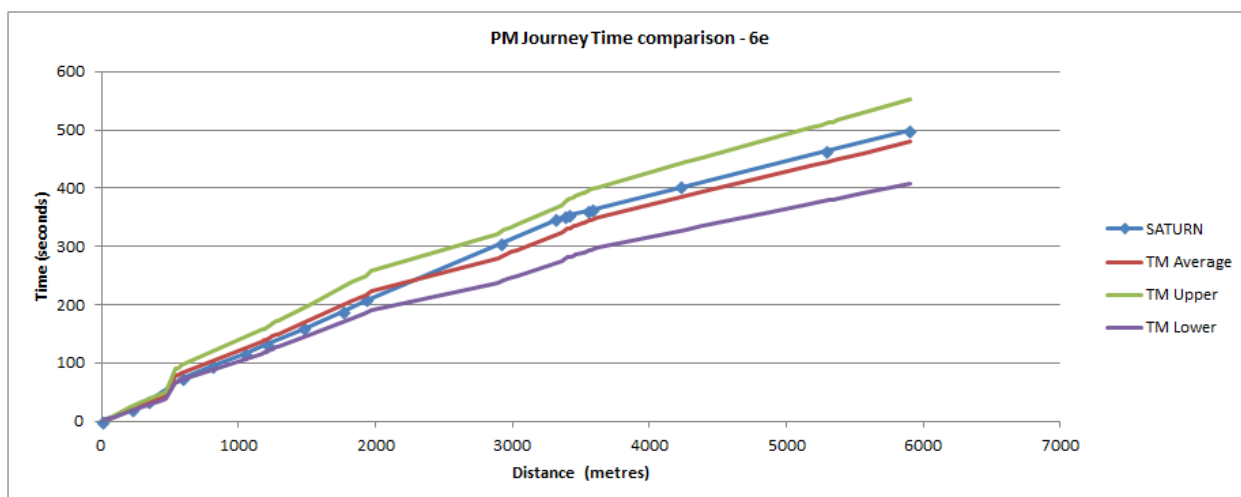


Figure E-34 – AM Peak – Journey Time Calibration – Route 6 Westbound

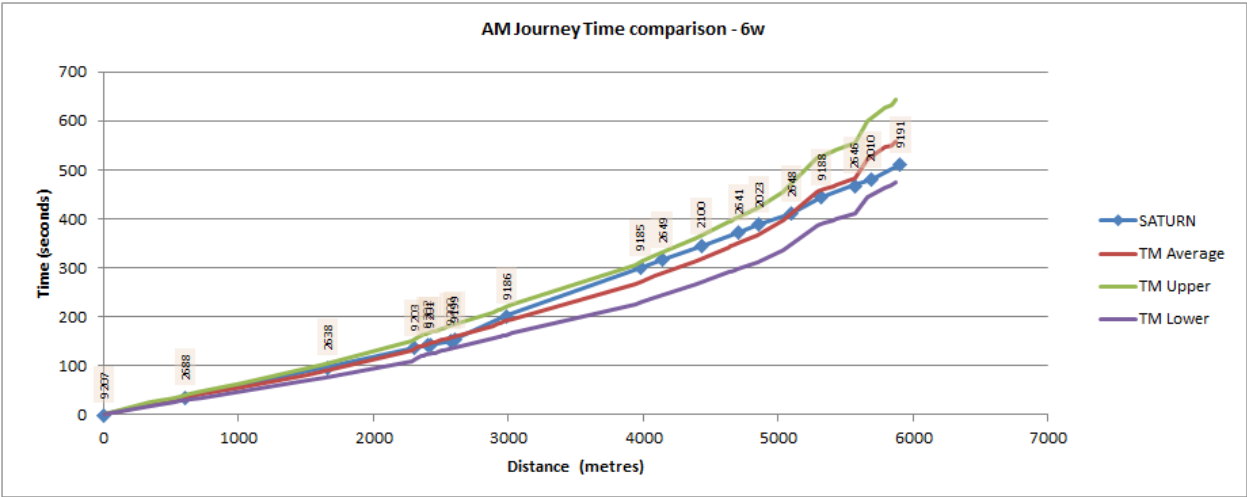


Figure E-35 – Inter Peak – Journey Time Calibration – Route 6 Westbound

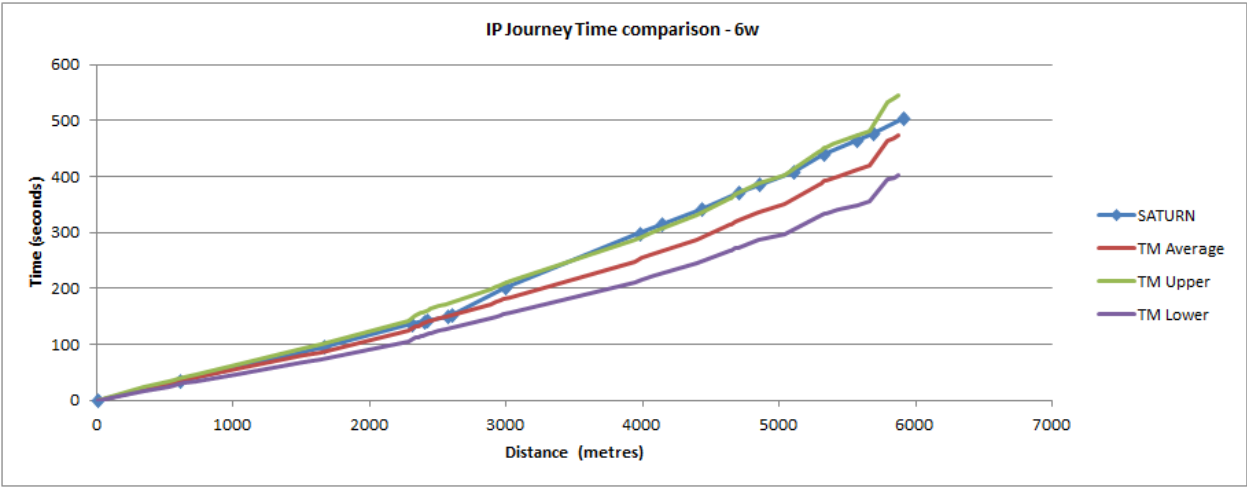


Figure E-36 – PM Peak – Journey Time Calibration – Route 6 Westbound

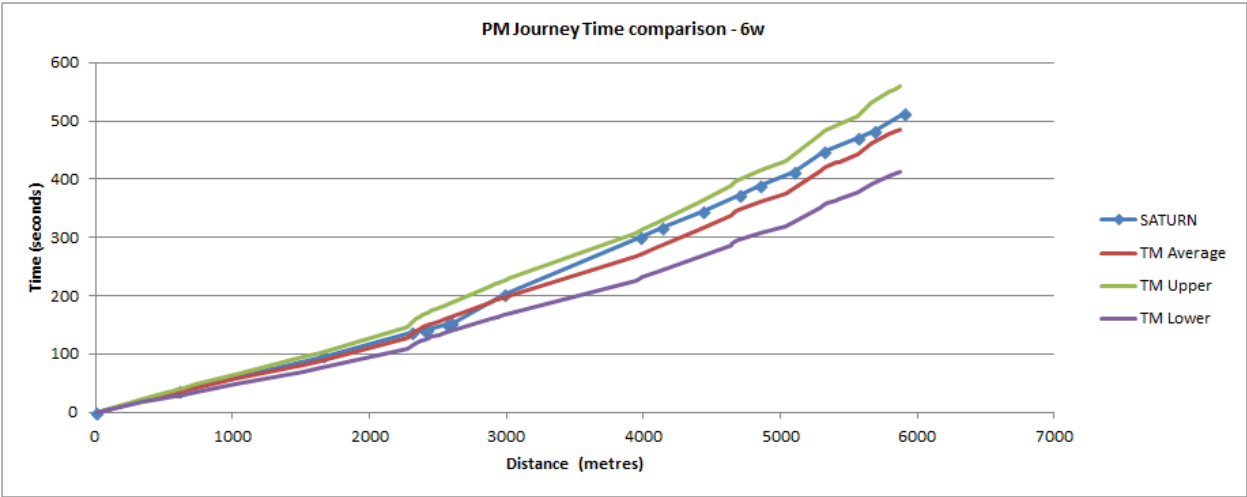


Figure E-37 – AM Peak – Journey Time Calibration – Route 7 Northbound

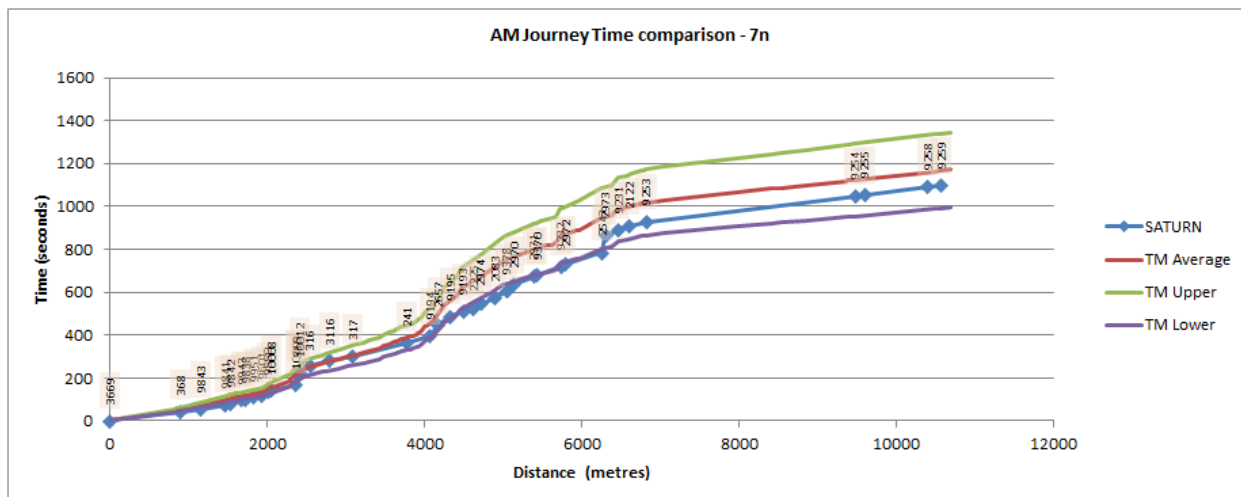


Figure E-38 – Inter Peak – Journey Time Calibration – Route 7 Northbound

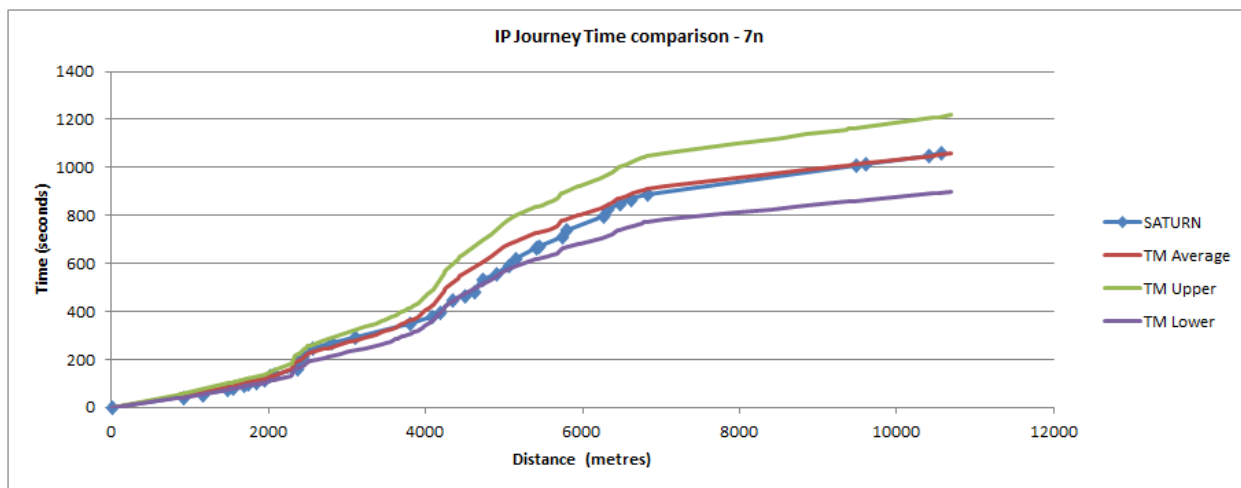


Figure E-39 – PM Peak – Journey Time Calibration – Route 7 Northbound

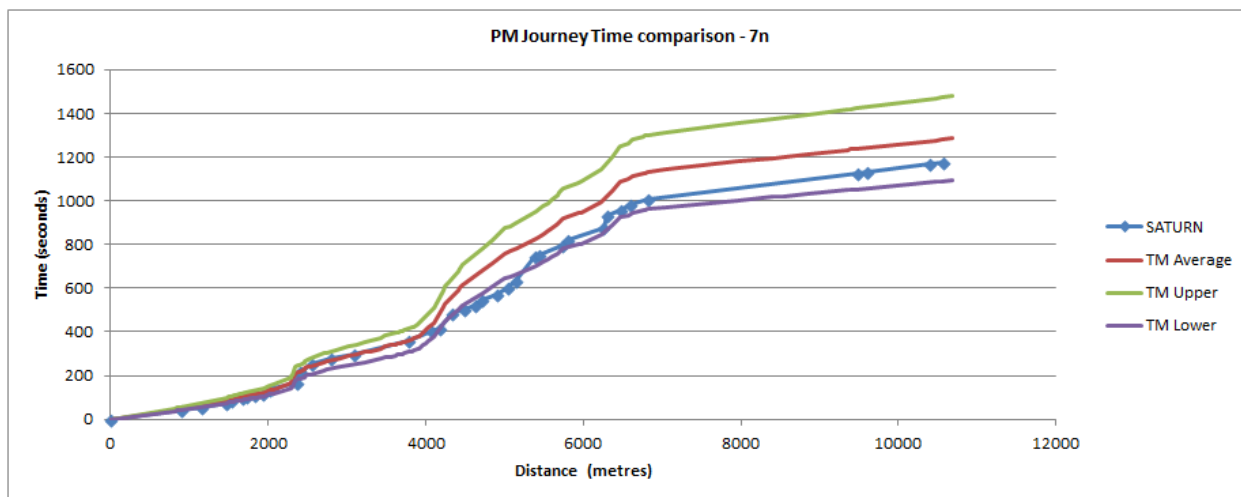


Figure E-40 – AM Peak – Journey Time Calibration – Route 7 Southbound

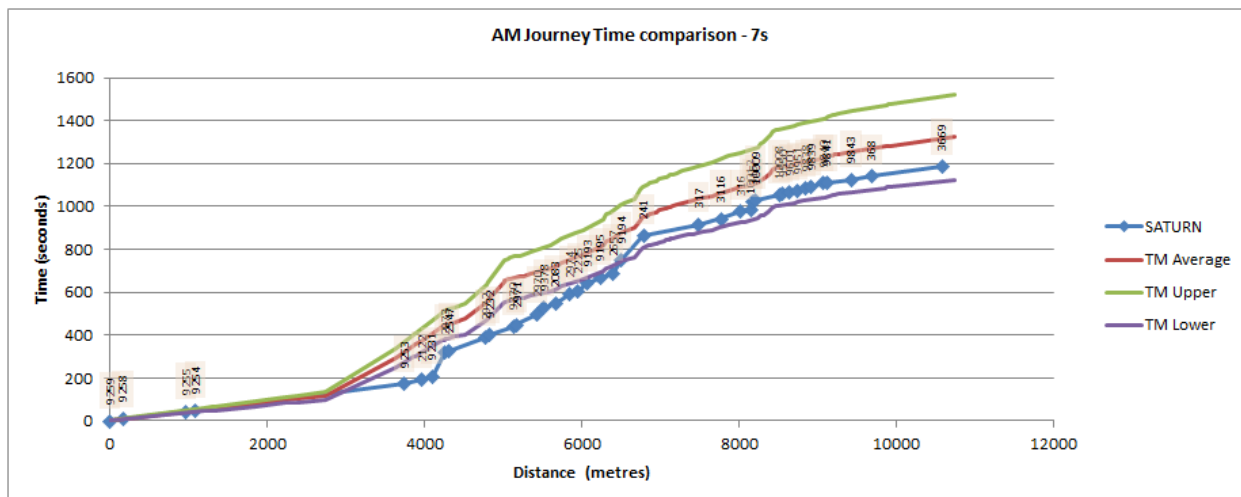


Figure E-41 – Inter Peak – Journey Time Calibration – Route 7 Southbound

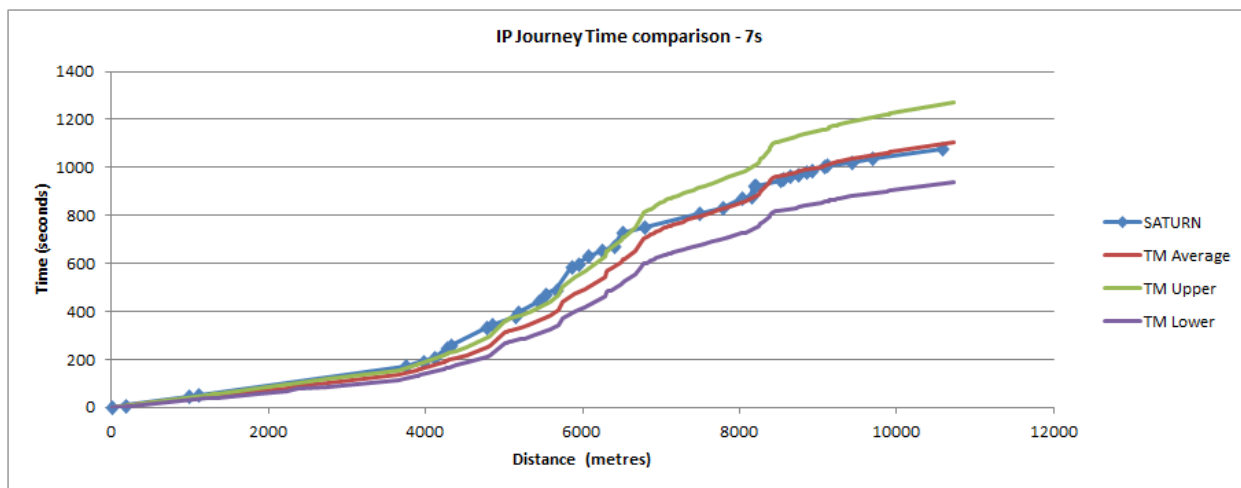


Figure E-42 – PM Peak – Journey Time Calibration – Route 7 Southbound

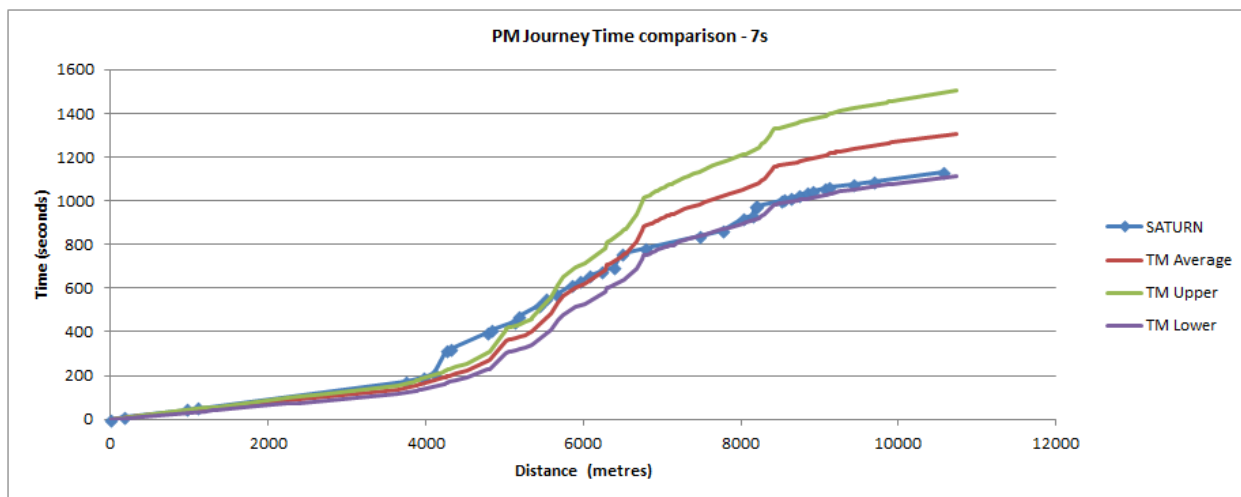


Figure E-43 – AM Peak – Journey Time Calibration – Route 8 Northbound

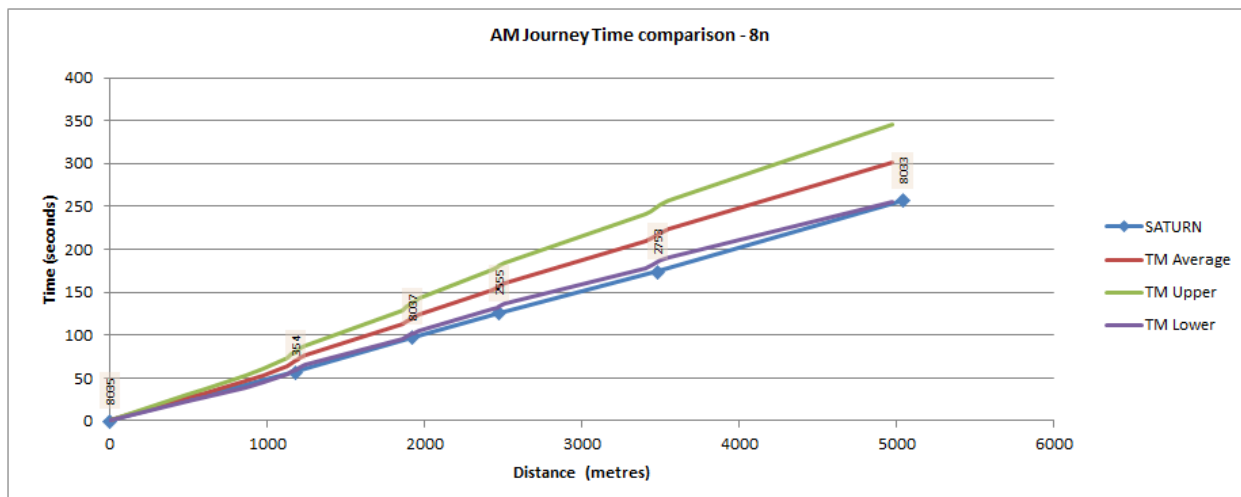


Figure E-44 – Inter Peak – Journey Time Calibration – Route 8 Northbound

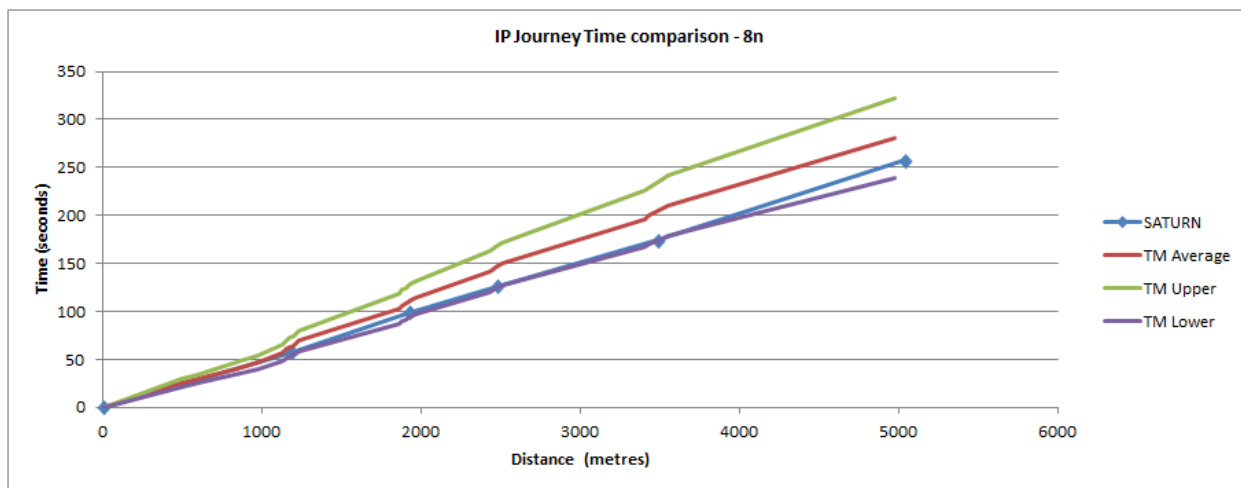


Figure E-45 – PM Peak – Journey Time Calibration – Route 8 Northbound

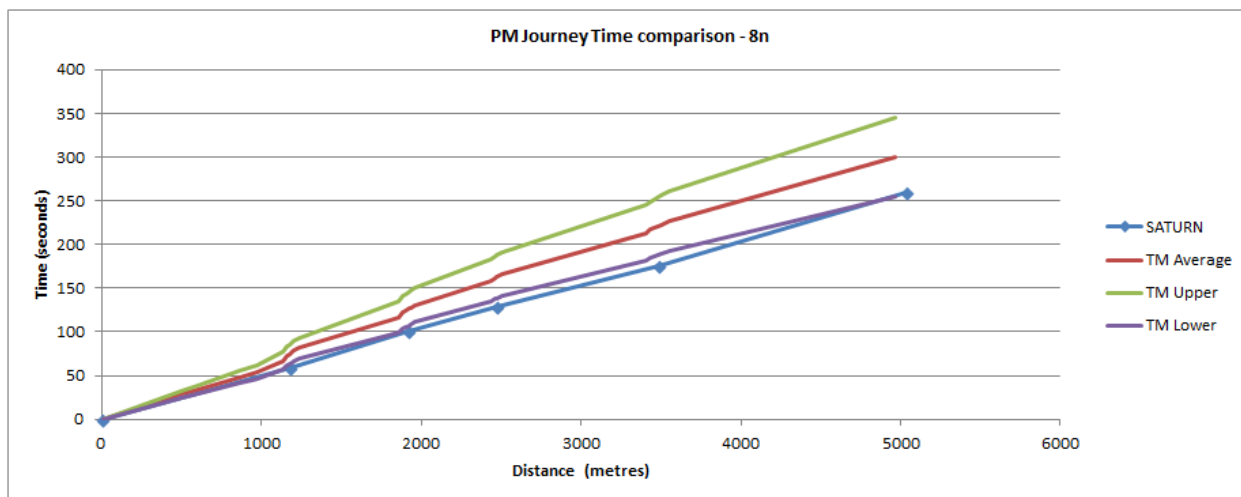


Figure E-46 – AM Peak – Journey Time Calibration – Route 8 Southbound

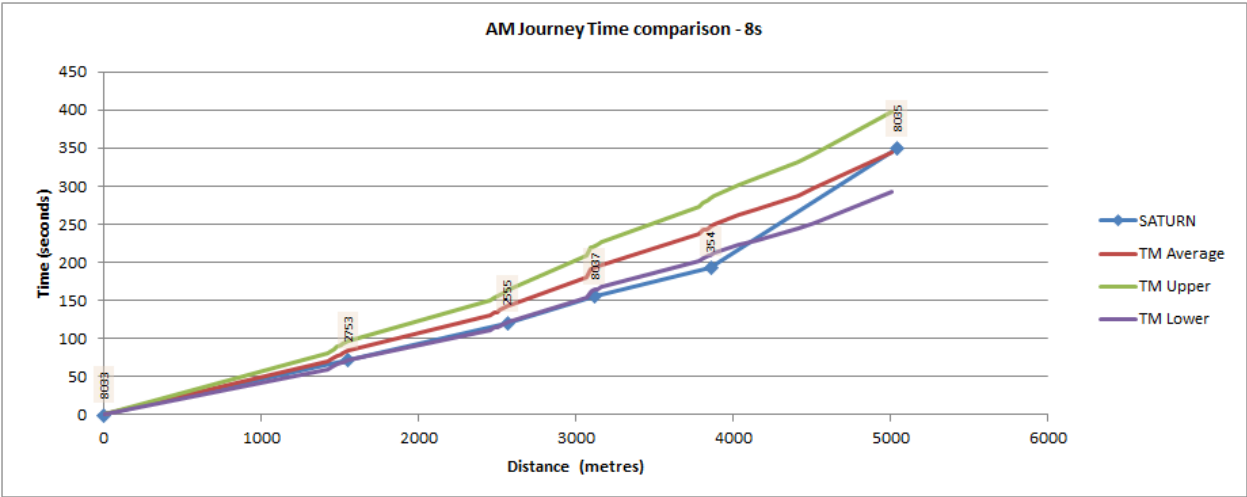


Figure E-47 – Inter Peak – Journey Time Calibration – Route 8 Southbound

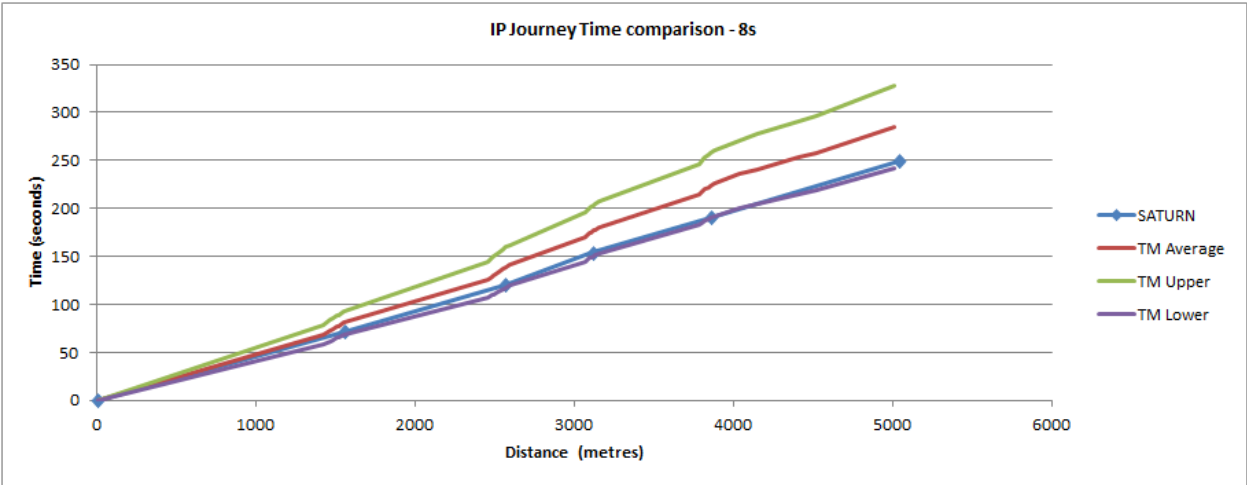


Figure E-48 – PM Peak – Journey Time Calibration – Route 8 Southbound

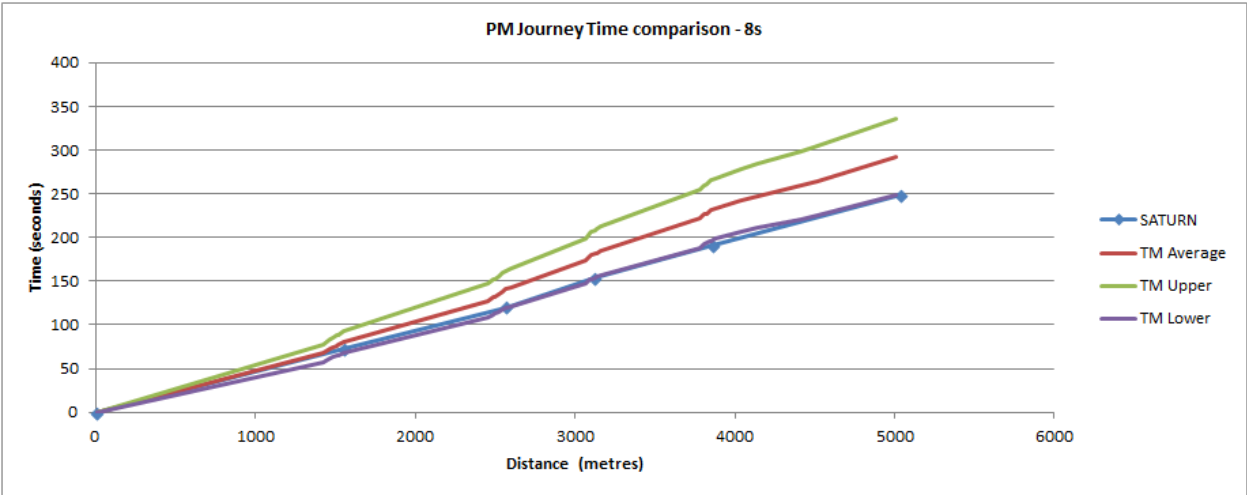


Figure E-49 – AM Peak – Journey Time Calibration – Route 9 Northbound

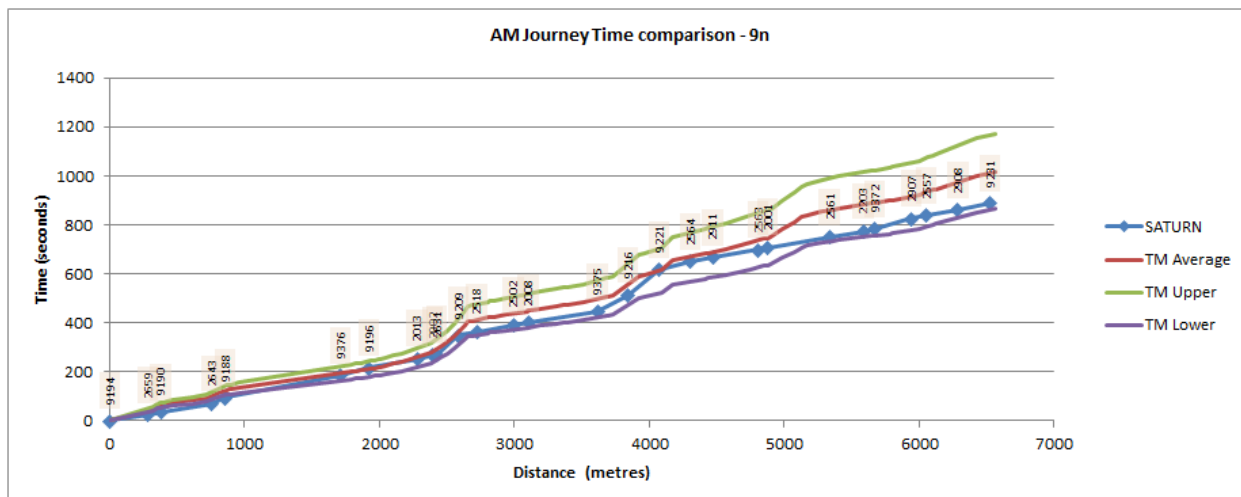


Figure E-50 – Inter Peak – Journey Time Calibration – Route 9 Northbound

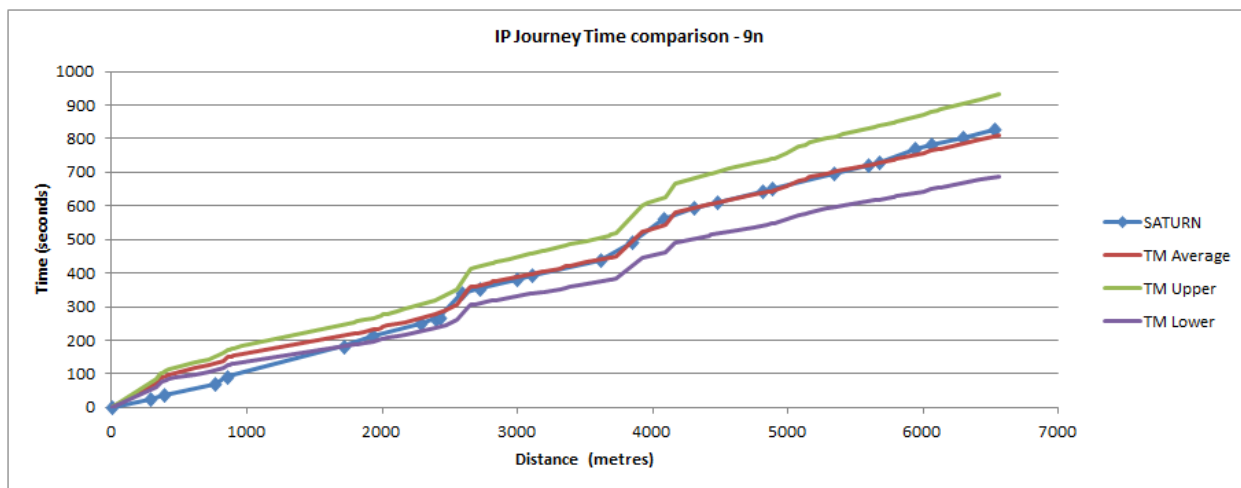


Figure E-51 – PM Peak – Journey Time Calibration – Route 9 Northbound

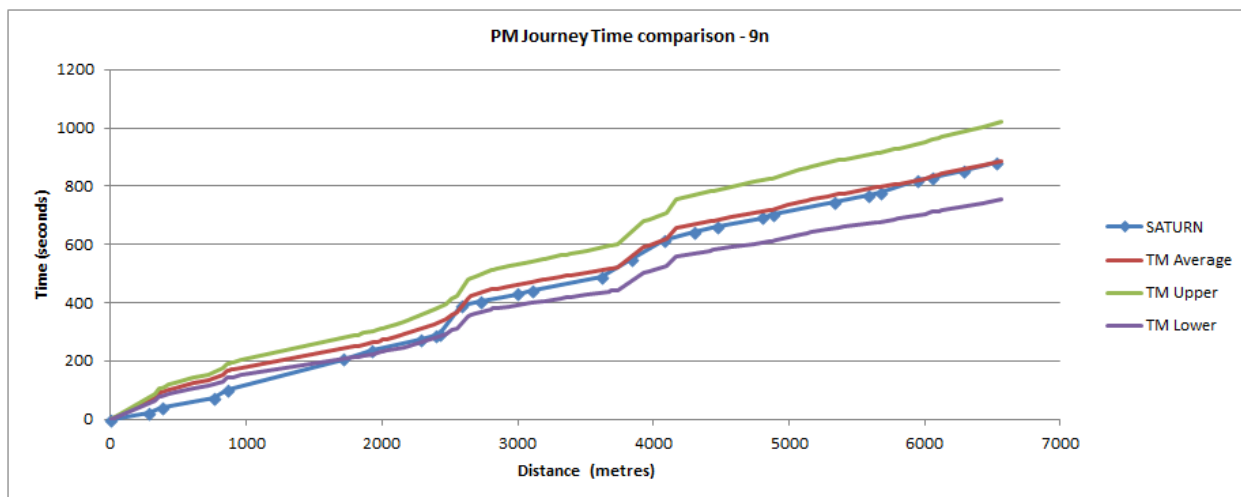


Figure E-52 – AM Peak – Journey Time Calibration – Route 9 Southbound

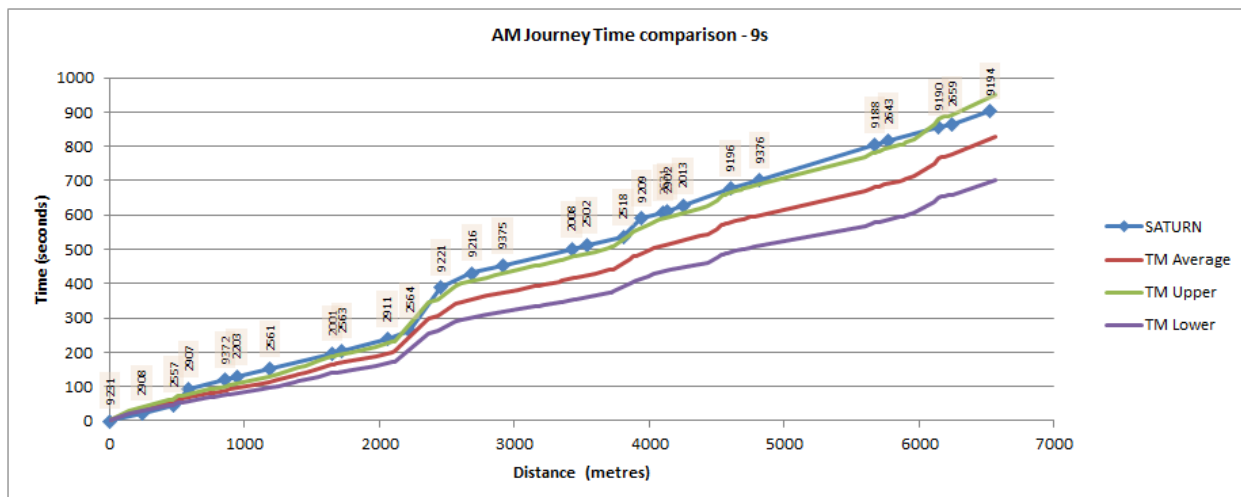


Figure E-53 – Inter Peak – Journey Time Calibration – Route 9 Southbound

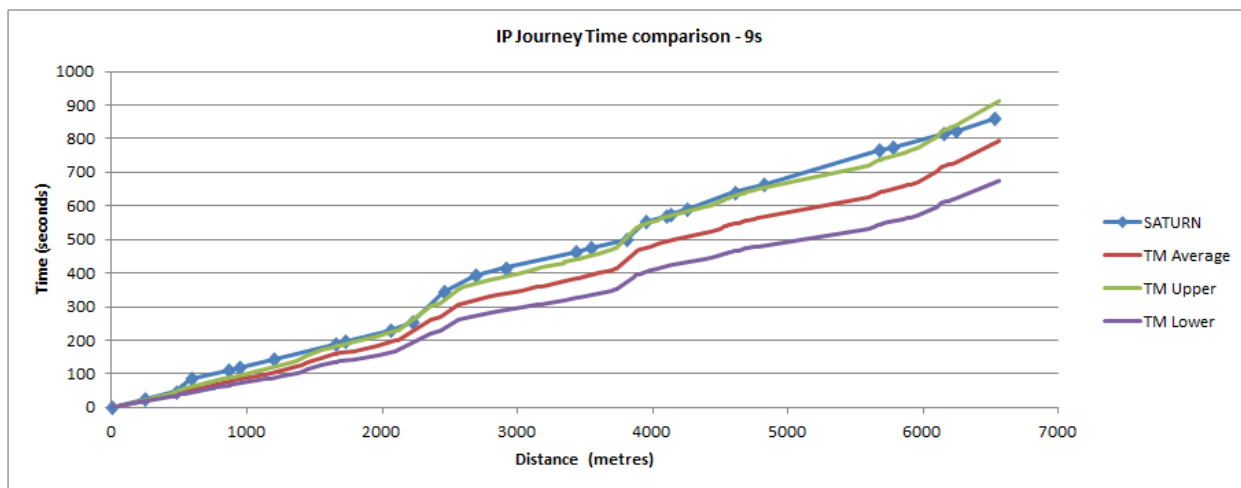


Figure E-54 – PM Peak – Journey Time Calibration – Route 9 Southbound

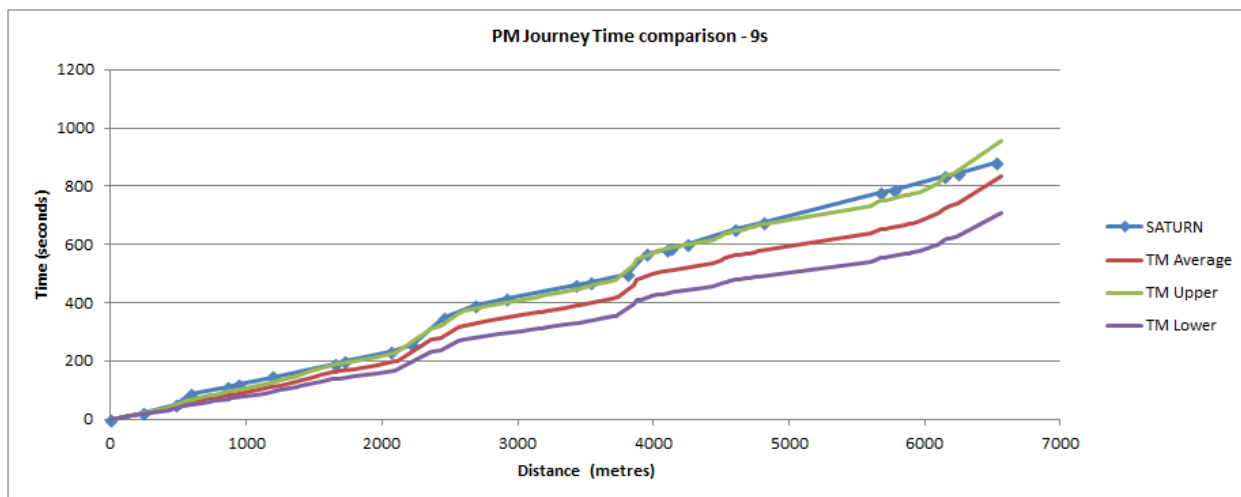


Figure E-55 – AM Peak – Journey Time Calibration – Route 10 Northbound

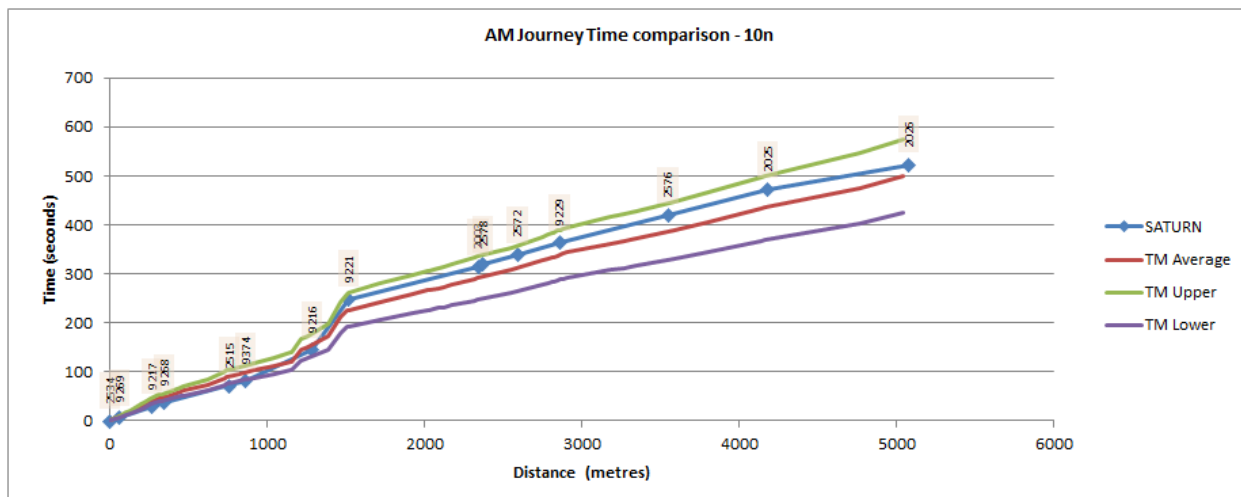


Figure E-56 – Inter Peak – Journey Time Calibration – Route 10 Northbound

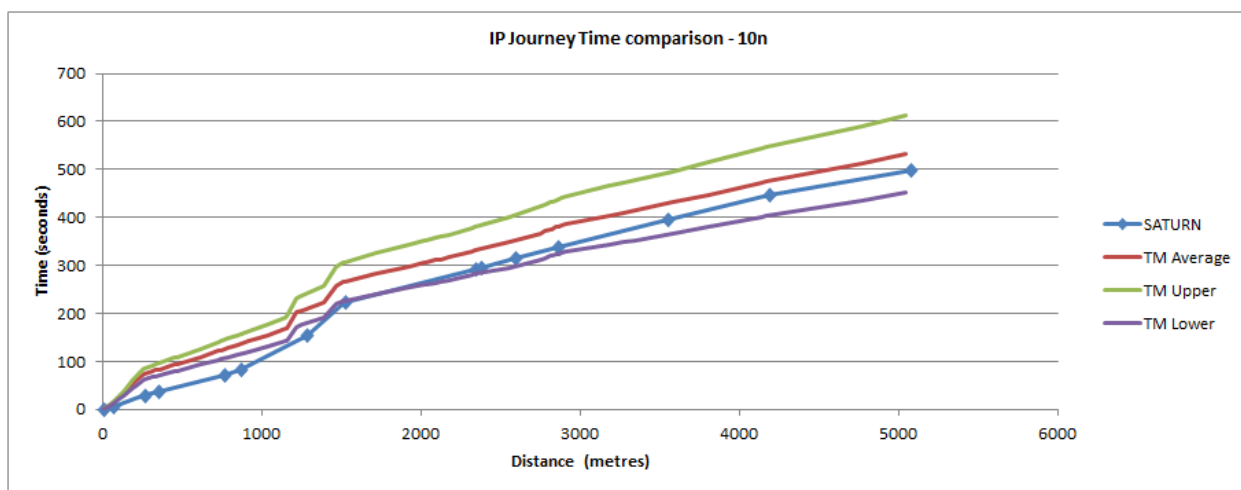


Figure E-57 – PM Peak – Journey Time Calibration – Route 10 Northbound

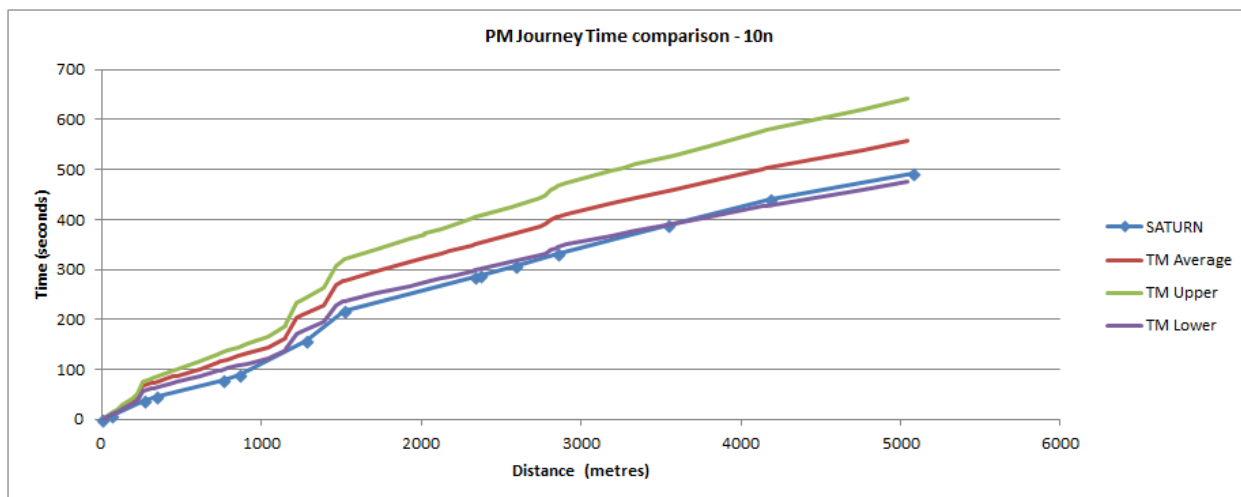


Figure E-58 – AM Peak – Journey Time Calibration – Route 10 Southbound

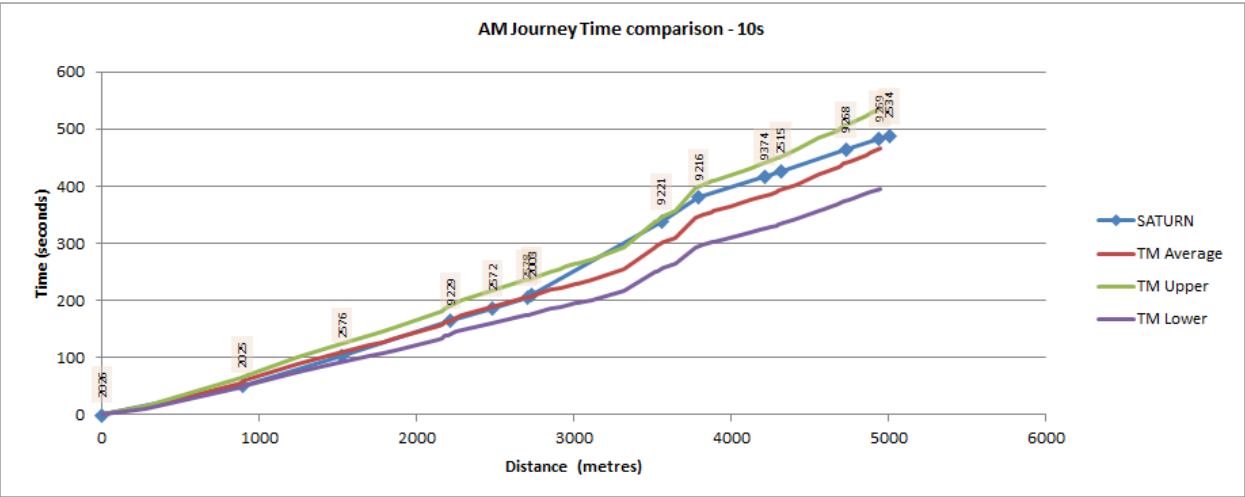


Figure E-59 – Inter Peak – Journey Time Calibration – Route 10 Southbound

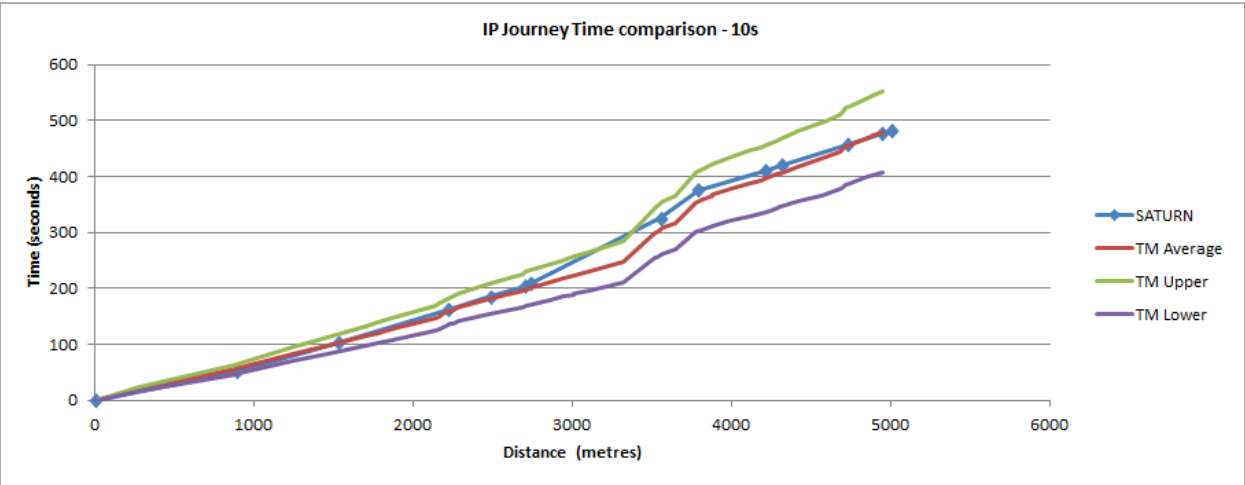
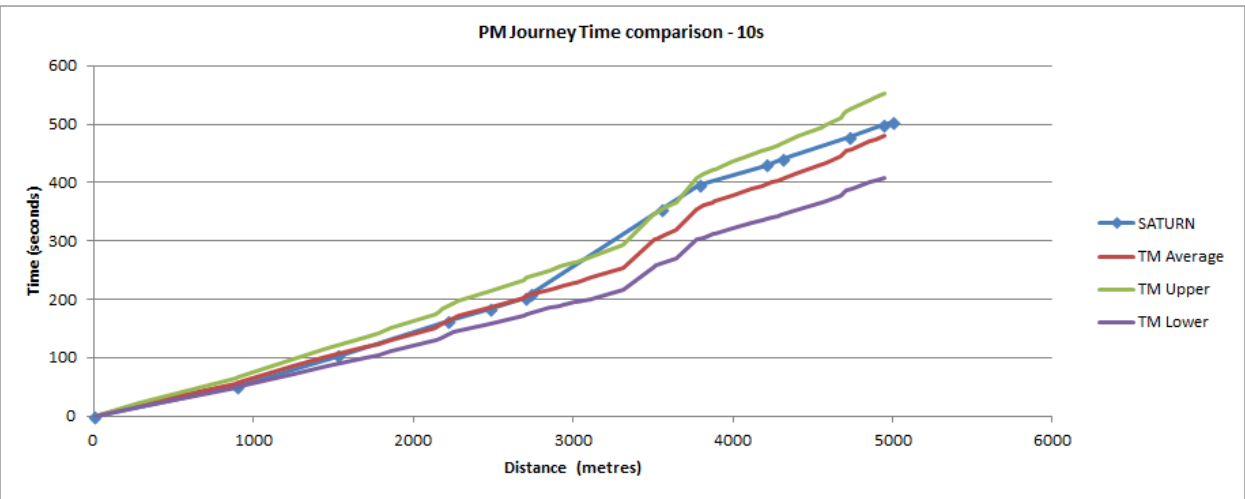


Figure E-60 – PM Peak – Journey Time Calibration – Route 10 Southbound





Job No	Report No	Issue no	Report Name
ST15239	1	1	Bedford Town Centre LMVR