Crawley Transport Model

Highway Assignment Model

Local Model Validation Report

On behalf of **West Sussex County Council**

Project Ref: 35981/R02 | Rev: AA | Date: August 2016

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Document Control Sheet

Project Name: Crawley Transport Model

Project Ref: 35981

Report Title: Highway Assignment Model – Local Model Validation Report

Doc Ref: CTM-35981-R002

Date: 16 August 2016

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Revision	Date	Description	Prepared	Reviewed	Approved
A	26/09/2016	Amendments due to client comments	NM	PG	SM

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1 Introduction

1.1 Background

1.1.1 Peter Brett Associates LLP (PBA) was commissioned by West Sussex County Council (WSCC) to update the Crawley Transport Model (CTM). This report summarises the methodology which has been adopted and agreed with WSCC in order to build and validate a base year SATURN model of Crawley. The purpose of this model is to assist in assessing the relative effects of different transport schemes to alleviate transport issues in and around Crawley.

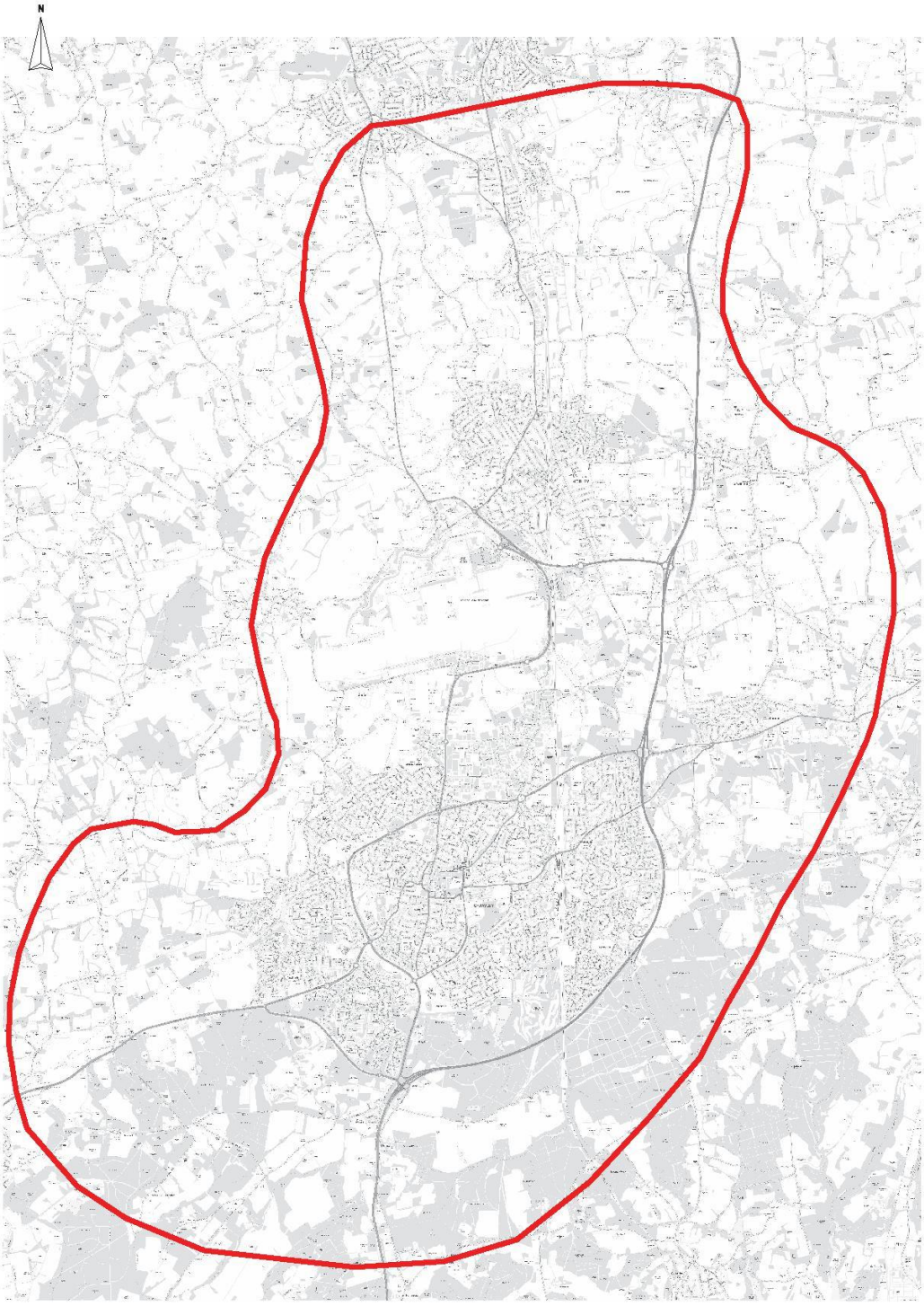
1.1.2 The aim of the project is to develop a traffic model with a base year of 2015 that will be used to test the relative effects of transport infrastructure schemes and development proposals within the Crawley area. The immediate need for the CTM is to support a local growth fund bid to the Coast to Capital Local Enterprise Partnership (CtC LEP) for the Crawley Area Transport Package Phase Two schemes, which are included in the Strategic Infrastructure Package, Infrastructure Delivery Plan and Crawley Town Centre feasibility study.

1.2 Model Area

1.2.1 The area covered by the model is shown in Figure 1-1. The model includes the whole of the Crawley urban area and Gatwick Airport, in order for the model to be capable of assessing local access improvements to the airport, which is located in the Borough.

1.2.2 The CTM is a highway network model being developed using the established SATURN software. The model will consist of an AM peak hour model (08:00 to 09:00), an average Inter Peak hour model (10:00 to 16:00) and a PM peak hour model (17:00 to 18:00). The model will consist of five user classes comprising car commute, car employer business, car other, Light Goods Vehicles (LGV) and Heavy Goods Vehicles.

Figure 1-1: Crawley Transport Model – Study Area



1.3 Spreadsheet Demand Model

1.3.1 The SATURN model is a highway assignment model, however it is recognised that modelling of specific interventions may need to assess mode share relative to public transport (PT) and active modes. To address these considerations, the SATURN traffic assignment model will be supported by a spreadsheet-based trip end and mode choice model.

1.3.2 The spreadsheet model will enable the preparation of consistent scenario forecasts and will include committed development information, data taken from local plans, along with growth predictions from Department for Transports (DfT) National Trip End Model (NTEM).

1.3.3 At this stage other demand responses, such as time period choice are not considered, but the approach taken to developing, the model allows flexibility for this to be considered at a later stage with the addition of DIADEM or similar.

1.3.4 The development of the spreadsheet demand model will be reported separately from this LMVR.

1.4 Local Context

1.4.1 Crawley is located in the north of the County of West Sussex, bordering Surrey just to the north of the town. Crawley is bounded by the M23 to the east and south, which links to the M25 approximately 10 miles north. To the south of Crawley, the M23 becomes the A23 to Brighton and the south coast. Gatwick Airport is located directly to the north of Crawley.

1.4.2 The M23 accommodates strategic traffic movements, which bypass Crawley and also allows access to/from Crawley and Gatwick Airport via four junctions.

1.4.3 There are a number of A-Roads which provide connections to the local area. These include the A217 which links Crawley to Reigate in the north and the A264 which provide a link to East Grinstead, and Copthorne to the east, and Horsham to the south west. Areas to the south east and west/north west of Crawley are more rural in character, with B roads and minor roads from local villages such as Rusper, Charlwood and Balcombe.

1.4.4 Within Crawley itself, Crawley Avenue forms an inner ring road to the north and west, which is crossed by a number or arterial roads allowing access to the town centre. . Manor Royal is a major employment area within Crawley covering an area of 240 hectares and home to approximately 500 businesses generating 30,000 jobs[1]. This is located to the north of Crawley Avenue and south of Gatwick Airport.

1.4.5 There are some unique challenges/characteristics inherent in the Crawley network, not least the impact of Gatwick Airport. This includes:

- Parking choices for the general public and employees at Gatwick, which may influence route choice for example between Gatwick Road and London Road.
- The nature of day to day variability of route choice such as between the A264 Horsham Road, A2220 Horsham Road and A23 Brighton Road to access the town centre from the west and south. Access to the Crawley from the west and south east is also characterised by the more minor routes such as Ifield Drive, Rusper Road, Turners Hill and Balcombe Road.
- The rail level crossings and shuttle working under rail bridges (St Marys' Drive), the influence of signalised junctions in corridors such as Haslett Avenue/Worth Park Avenue all of which influence day to day basis variations in journey times and hence route choice.
- Given the proximity of Gatwick Airport and the importance that the Highways England (HE) network, namely the A23 Trunk Road and in particular the M23 plays in enabling long distance traffic to bypass Crawley to access and egress Gatwick Airport, considerable effort has been made to calibrate flows and journey times on the M23 including the M23 Gatwick spur at M23 Junction 9. Locally, emphasis has

[1] http://www.manorroyal.org/pages/index.cfm

been placed in calibrating and validating key areas of future proposed development in Crawley including Manor Royal employment area, North East sector development area, Copthorne area development east of M23 Junction 10 and that access to the town centre from the south is well represented.

1.5 Future Model Applications

1.5.1 When considering the use of the CTM for future work the following should be considered:

1) Although it is desirable for the models reflect these day to day variations, in practice models are tools with limited ability to capture all the intricate sensitivities inherent in a network like Crawley. The model represents average weekday conditions, and therefore it is not possible to replicate the day to day variability and sensitivities accurately. The model has been created to consider the availability of route choices even though it may not be possible to match in every case, actual flows and journey times for specific competing routes. The model has therefore validated to replicate directional cordon and screen line flows as priority over individual link flows for example. The stability of the model is demonstrated through achieving acceptable convergence criteria demonstrating its robustness.

2) In considering the compliance of the CTM with WebTAG validation criteria and guidelines, it is important to understand the purpose for which the model is required. Guidance notes on validation acceptability are provided in TAG Unit M3.1. As stated in the guidance, this does not guarantee that a model is 'fit for purpose' and likewise a failure to meet the specified validation standards, does not mean that a model is not 'fit for purpose'. A model that meets the specified validation standards may not be fit for the particular purposes and conversely, a model that fails to meet to some degree the validation standards maybe useable for certain applications. On this basis, the validation of the CTM prioritises areas of the network at which interventions and development are proposed. The use matrix estimation has been minimised to alter the prior matrices in an effort to meet calibration and validation standards. It should be noted that the model has been created to test scheme that are currently known and consideration to the suitability of testing all future schemes should be taken at the time. The model may need to be updated and/or therefore be subject to local area reviews before testing each scheme and/or development proposal.

1.6 Report Structure

1.6.1 Following this introduction, this report is presented with the following structure:

- Section 2 provides an overview of the highway assignment model
- Section 3 summarises the traffic data used in the model development
- Section 4 details the matrix development
- Section 5 outlines the assignment, calibration and validation procedures
- Section 6 Outlines the calibration results
- Section 7 Outlines the model validation results
- Section 8 provides an overall summary

2 Highway Model Overview

2.1 Introduction

2.1.1 The CTM has been developed using SATURN version 11.3.12F. This software is suitable for developing the network and assignment of the matrix. The matrix building process has been carried out in Excel, with the final matrices output to SATURN format for assignment to the network.

2.1.2 One of the main benefits of using SATURN for the assignment process is that it is applicable to both urban and rural networks and can model peak hour congestion in sufficient detail. As a combined simulation and assignment model, SATURN also has the advantage that it enables detailed junction modelling.

2.1.3 The model in question is a highway assignment model only and does not include any multimodal or demand modelling.

2.1.1 The assignment model predicts routes that drivers will choose and the way that traffic demand interacts with the available road capacity. The underlying principle used in the adopted assignment algorithm is Wardrop's First Principle of Traffic Equilibrium. Wardrop's First Principle states that:

"*Traffic arranges itself on networks such that the cost of travel on all routes used between each OD pair is equal to the minimum cost of travel and all unused routes have equal or greater cost".*

2.1.2 The aim of the assignment model is to reach equilibrium such that costs and flows are in balance under the assumption that individual users will seek to minimise their costs of travel through the network.

2.2 Previous Models

2.2.1 The existing CTM was originally developed in 2006 to assess the transport and development needs of the town. Over the intervening years, there have been a range of geographical expansions and model updates.

2.2.2 The most recent update was undertaken in 2008 by PBA on behalf of Crest Nicholson Ltd for a development site at West of Bewbush. This used 2006 Roadside Interview (RSI) and traffic count data to inform the matrix development, calibration and validation. The model now requires a more comprehensive update to be used to support the preparation of full business cases.

2.2.3 The existing model covers an area including Crawley Borough and minor roads to the west as far as Faygate/Rusper. The overall study area has been agreed with WSCC and extended in all directions, so that the wider re-routing effects of proposed scheme interventions can be captured. The detailed study area includes the urban area of Crawley and Gatwick Airport to allow the assessment of local access improvements to Gatwick Airport.

2.3 Model Year and Time Periods

2.3.1 The model has been developed with a base year of 2015 as the majority of the data used in the model development was collected in November 2015.

2.3.2 Three time periods have been represented within the model:

- AM Peak hour (0800-0900);
- Inter Peak (1000-1600 average hour); and
- PM Peak hour (1700-1800).

2.3.3 The choice of these periods was confirmed using count data.

2.4 Vehicle Types and Travel Purposes

2.4.1 The following vehicle types have been included within the model:

- Car;
- Light Goods Vehicles;
- Heavy Goods Vehicles comprising OGV1 and OGV2 combined.

2.4.2 Cars are further classified by travel or trip purpose resulting in five user classes in the model:

- Car commuting (carcom)
- Car other (caroth)
- Car employer business (careb)
- Light Goods Vehicles;
- Heavy Goods Vehicles comprising OGV1 and OGV2 combined.

PCU Factors

2.4.3 Passenger Car Units (PCU) is used as the standard unit for demand and capacity within the model. This allows for the impact of large vehicles which take up more road space and take longer to clear junctions to be accounted for. The factors used within the CTM are:

- Car - 1.0
- LGV – 1.0
- HGV – 2.3
- PSV/Bus – 2.5

2.5 Network Development

Network Extent

2.5.1 The extent of the detailed highway network is shown in Figure 2-1 and the wider modelled network is shown in Figure 2-2.

Figure 2-1: Detailed Modelled Network Area

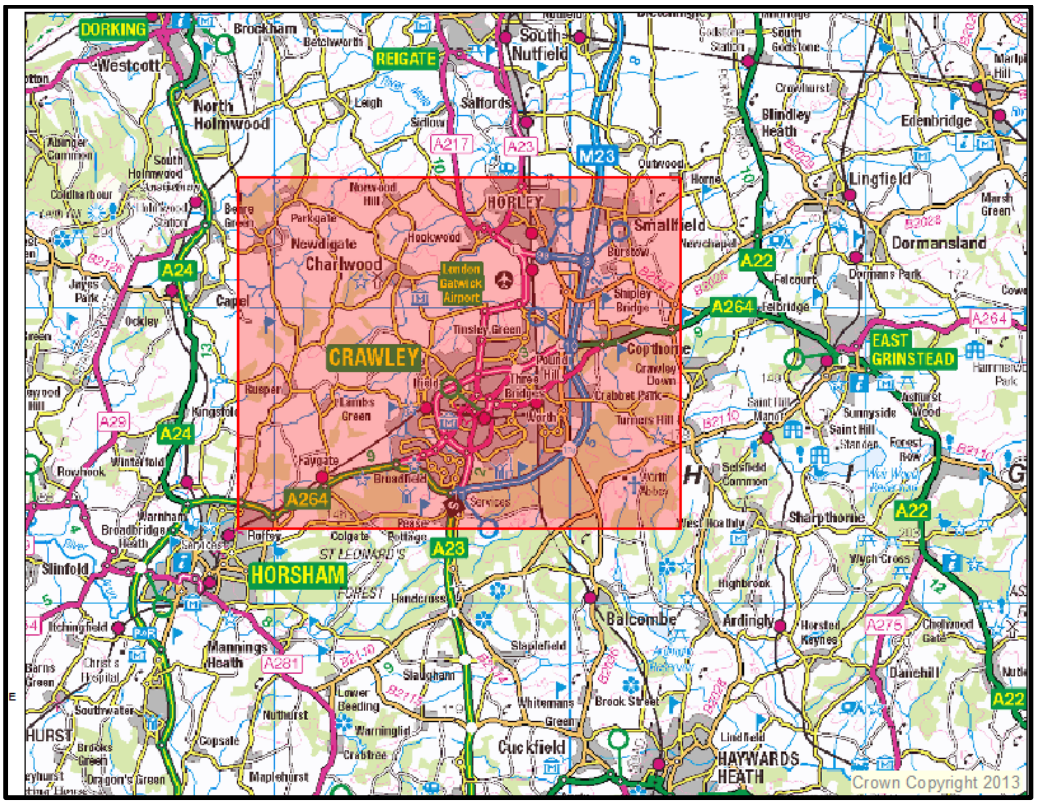
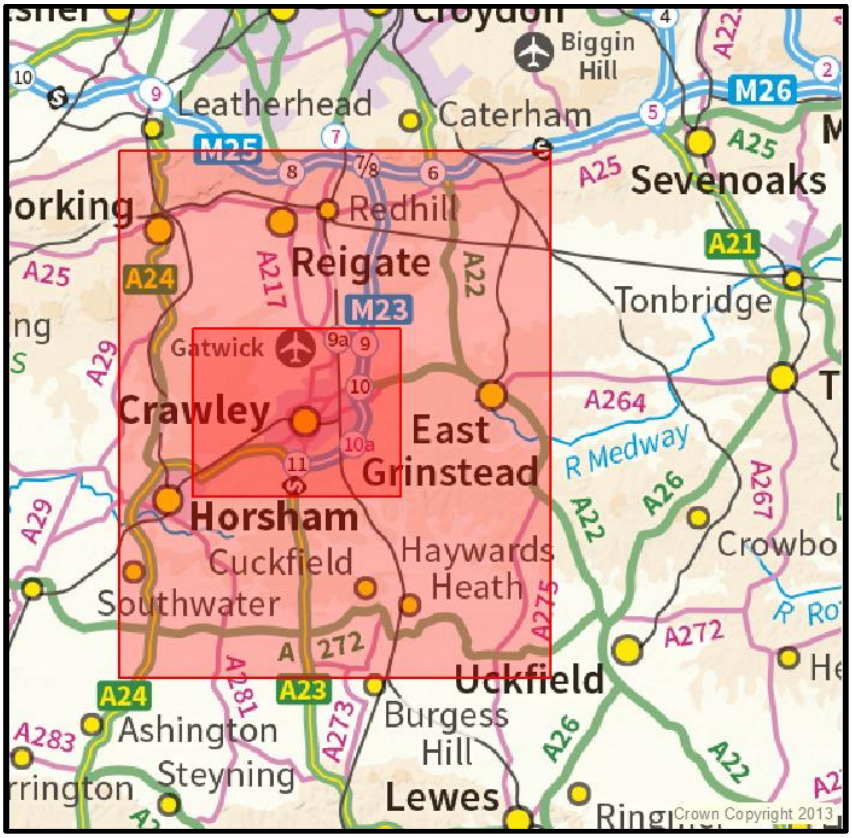


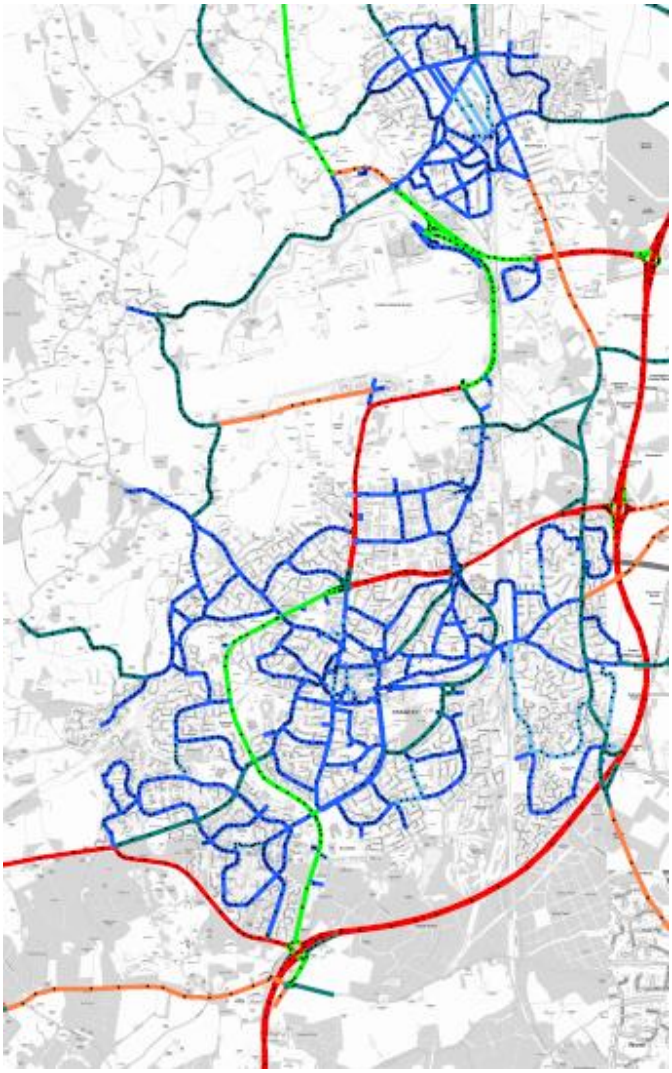
Figure 2-2: Wider Modelled Network Area



Network Structure

2.5.2 The network within the detailed modelled area was coded in simulation, while the area covered by the wider model was coded in buffer. The extent of the buffer network and the specific roads included was agreed with WSCC. The detailed simulation network is shown in Figure 2-3.

Figure 2-3: SATURN Network Structure



2.5.3 In the simulation area, junctions are modelled in detail and this allows the effects of junction delays to be represented more realistically. In the buffer area, junctions are not explicitly modelled. Routeings and assignment of trips in the buffer network are determined by link based attributes and speed/flow relationships.

2.5.4 In developing the highway network, key highway link characteristics were included in the network coding. This included attributes such as:

- Link length - Measured by reshaping the network using MapInfo;
- Link type;
- Link capacity;

- Link cruise speed in kilometres per hour (kph) initial coded as speed limits before being modified as necessary during the calibration/validation process;
- Speed/flow relationship in the buffer network and on highway links such as the Highway England network and Crawley Avenue;
- One way or two way link operation as appropriate;
- Bus lanes;
- Bus routes and frequencies – using scheduled bus timetables for local services

Junction Types and Saturation Flows

2.5.5 The Crawley model consists of various types of junctions including priority junctions, roundabouts and signal controlled junctions. Table 2-1 summarise the default turn saturation flows that have been assumed in the CTM subject to amendment as part of the calibration process.

2.5.6 Within the simulated urban area, the main delays to a journey predominantly result from traffic interaction at junctions. In between junctions within the simulation network, traffic is assumed to travel at uniform speeds.

Table 2-1: Default Turn Saturation Flows assumed (PCU/hr)

Junction Type	Movement	Saturation Flow
Priority	Major-Straight ahead	1,825
	Major-minor left turn	1,725
	Major-minor right turn	1,650
	Minor-major left turn	1,200
	Minor-major right turn	875
	Minor-major ahead	950
Roundabout	One lane	1,620
	Two lanes	3,200
	Three lanes	4,500
Signals	Left turn	1,750
	Straight ahead	1,900
	Right turn	1,700

Speed Flow Curves

2.5.7 Speed/flow curves were used in the wider model area particularly in the buffer area to model the flow delay relationships. In the buffer arear, journey times including delays were determined using speed/flow curves. The speed/flow relationships were derived from DMRB Volume 13 COBA manual.

Level Crossings

2.5.8 There are two level crossings located within the detailed model area as follows;

- A2220 Horsham Road between Springfield Road and Albany Road/Spencers Road
- A2219 Brighton Road between Springfield Road and Station Way.

2.5.9 The level crossings have been coded into the model using a two-stage traffic signal. The rail timetable has been used to determine the number of services on the line. The timetable indicates the following level of passenger services;

- AM Peak – 5 trains towards London and 3 trains towards Horsham
- Inter Peak – 4 trains in each direction per hour
- PM Peak – 4 trains towards London and 5 trains towards Horsham

2.5.10 It has been assumed that the level crossing gates will be closed for 3 minutes when activated. The following signal settings have been input at the level crossings at each highway link;

- AM and Inter Peak – Green Time = 270 Seconds Red Time = 180 seconds
- PM Peak - Green Time = 220 Seconds Red Time = 180 Seconds

Zone Centroid Connectors

2.5.11 Centroid connectors enable the zones to be linked to the highway network. These are coded as follows as far as possible using specific entry / exit junctions from local access roads onto the main road network from self-contained residential areas, business parks, retail areas and car parks for example.

2.5.12 Judgement is used to determine the number of centroid connectors required from each zone to represent locations where the traffic from the zones was likely to load in reality.

2.6 Zoning System

2.6.1 The zoning system used for the Crawley model is based on 2011 census output areas. The benefit of using these as the zoning structure is ease of use and comparison with planning data, such as population and employment estimates in both the development of the base model and for model forecasting going forward.

2.6.2 The zoning system comprises 292 zones in total of which the first 146 are internal zones representing the detailed Crawley Urban area. The rest of the zones are external zones, which represent the entire UK. These are more refined in the areas immediately outside the detailed modelled area and become more coarse further out.

2.6.3 For ease of analysis and understanding of the trip making patterns, the zoning system is divided into twenty one (21) sectors. As with the zoning system itself, the sectors are more

refined within the detailed modelled area, again, becoming more coarse further out from the detailed area.

2.6.4 The zoning system is shown in Figures 2-4 and 2-5.

Figure 2-4: Crawley Simulation Area Model Zones

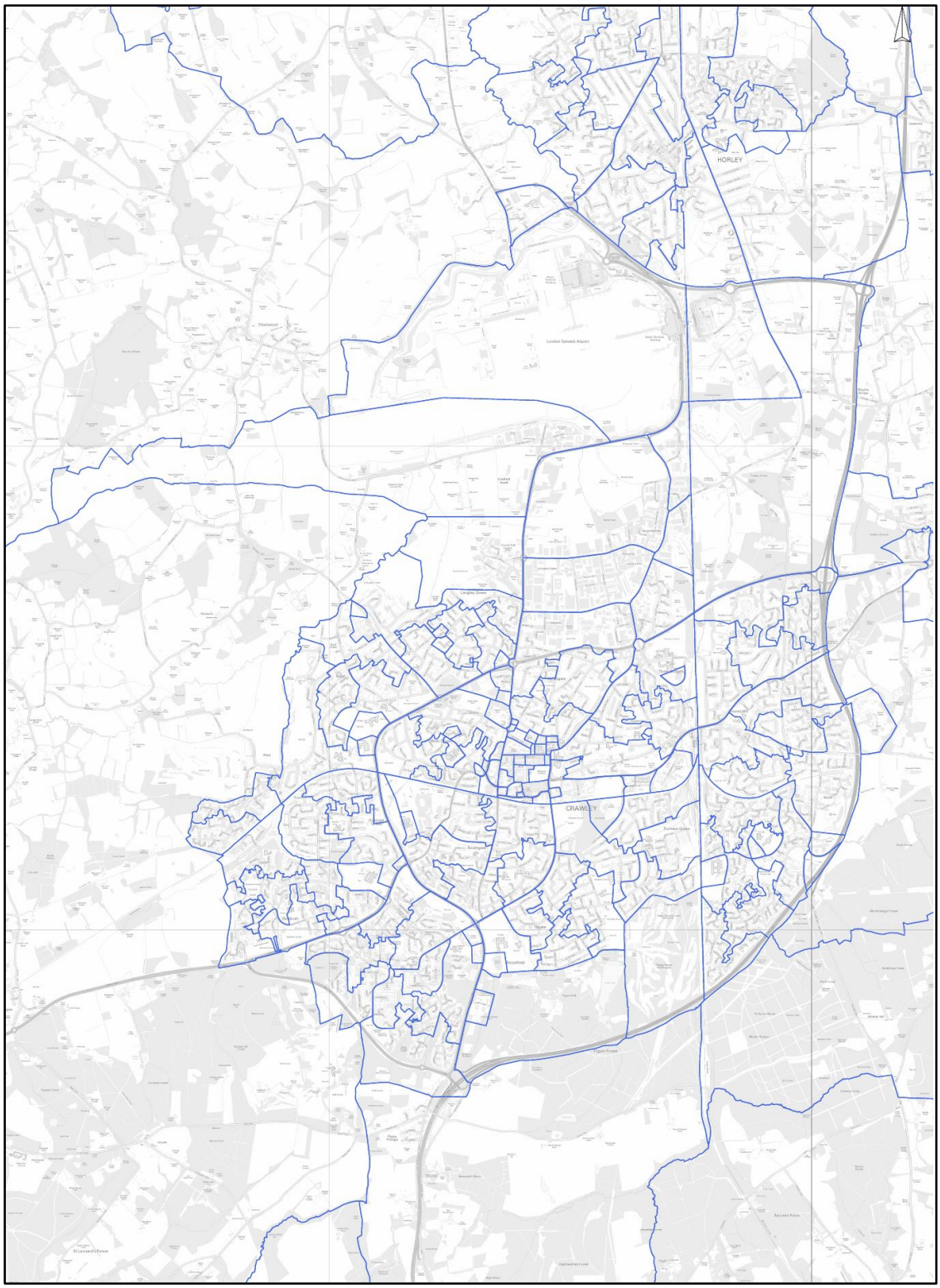
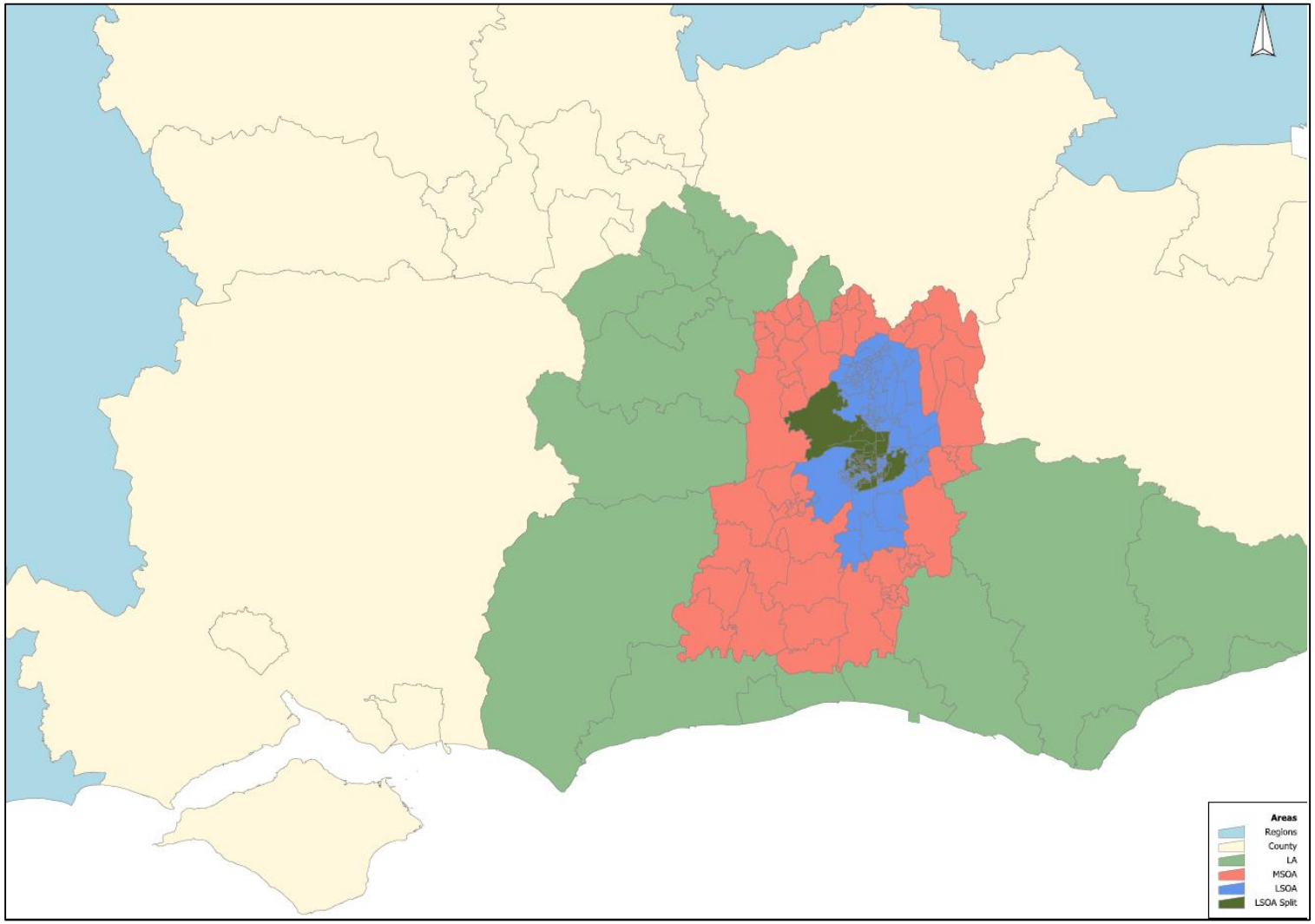


Figure 2-5: Wider Area Model Zones



3 Survey Data

3.1 Overview

3.1.1 This section summarises the data that has been used to update the Crawley model and includes both existing data and new data that has recently been collected. The types of existing and new collected data comprise:

- Automatic Traffic Counts (ATC)
- Manual Classified Turning Counts (MCTC)
- On-street Travel Interview Survey
- Journey Time data
- Mobile Phone data for matrix building
- Bus Ticket Data
- Traffic Signal Data

3.1.2 More detail analysis of the data that has been used in developing the CTM is reported in the Crawley Transport Data Report (35981/R1 dated 25th April 2016). The sections that follow outline the key data that has been used in developing the highway model.

3.2 Existing Data

3.2.1 In line with WebTAG guidance, existing data has been used where ever possible in order to keep data costs to a minimum while not compromising the integrity of the model. The following existing data has been used:

- WSCC Data
- Highways England Data

3.2.2 The existing WSCC ATC survey locations used in the model validation process are summarised in Table 3-1 and shown in Figure 3-1. The flows at these sites are total flows and are not classified by vehicle type. The data was downloaded for the same dates as that collected for the newly collected ATC surveys i.e. Saturday 14th November to 28 November 2015. The flows will predominantly be used to inform the flow validation on an outer cordon within the Crawley network.

Table 3-1: Existing WSCC ATC locations

ATC Reference	Location
1	A2220 Horsham Road east of roundabout with A264
2	A23 London Road north of roundabout with Fleming Way
3	A23_Crawley Avenue south of Horsham Road
4	A23 Crawley Avenue west of Ifield Avenue
5	A23 London Road west of Gatwick Road
6	A264 Crawley Road east of Faygate Lane
7	A2011 Crawley Avenue west of Balcombe Slip Road
8	A23 Brighton Road, Pease Cottage
9	Horsham Road, north of Barn Close, Pease Cottage
10	B2036 Balcombe Road (Just South of M23 J10A)
11	C319 Turners Hill Road (east of motorway bridge)
12	A2220 Copthorne Road west of Old Hollow
13	B2036 Balcombe Road 50 yards south of B2037 roundabout
14	C207 Gatwick Road just south of A23 London Road
15	C33 Ifield Avenue west of Town Barn Road

3.2.3 24 hour flow profiles were plotted for a number of selected WSCC maintained ATC sites and compared against the newly collected data. The flows for Tuesday to Thursday were analysed and shows that traffic levels are generally 08:00 to 09:00 in the morning and 17:00 to 18:00 in the afternoon.

3.2.4 Count data was obtained from HE's open data source website to inform flow calibration and validation on the Highways England (HE) network within the Crawley model area. The data was downloaded for November 2015 and analysed for the two week period Saturday 14th November to Saturday 28th November 2015.

3.2.5 The data covered the M23 around Crawley as well as the A23 in the jurisdiction of HE. The locations of the data collected is listed in Table 3-2 and shown in Figure 3-2. The data is classified by vehicle length in metres making it possible to discern vehicle classes into car (<5.2m), LGV (5.21-6.6m), OGV1 (6.61-11.6m) and OGV2 (above 11.6m).

Figure 3-1: Existing WSCC ATC data Locations and External Cordon

Figure 3-2: Highways England ATC data Locations

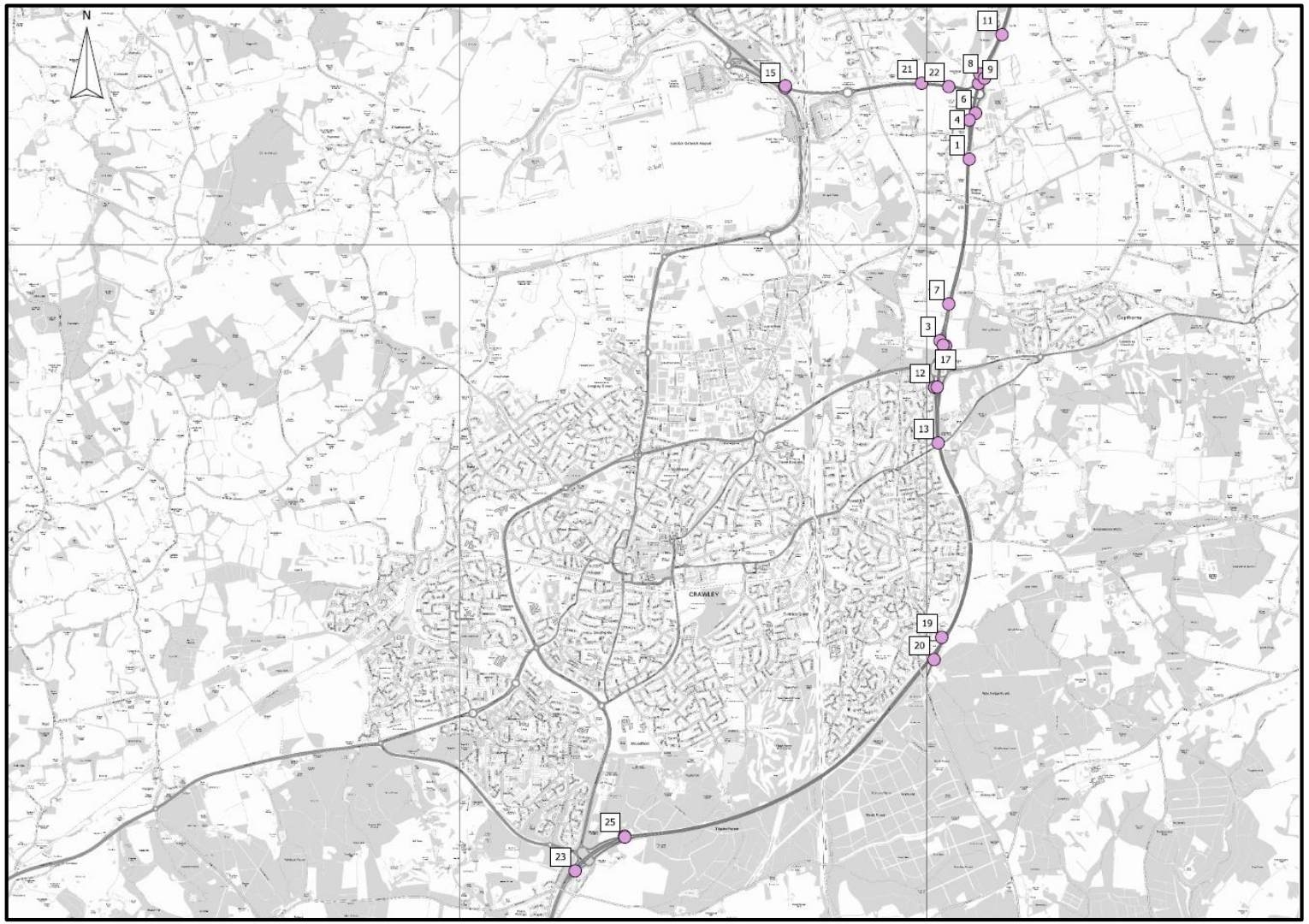


Table 3-2: Highways England ATC Count Locations

Count No.	HE Reference	Location	X coordinate	Y coordinate
1	MIDAS Site - 10007	M23 southbound between J9 and J10	530460	140916
2	MIDAS Site - 10022	M23 northbound within J10	530117	138475
3	MIDAS Site - 10313	M23 J10 northbound access	530147	138971
4	MIDAS Site - 2595	M23 J9 northbound exit	530460	141335
5	MIDAS Site - 2896	M23 J9 southbound exit	530623	141783
6	MIDAS Site - 3100	M23 J9 southbound access	530528	141409
7	MIDAS Site - 3385	M23 northbound between J10 and J9	530240	139364
8	MIDAS Site - 3675	M23 southbound within J9	530601	141791
9	MIDAS Site - 4199	M23 northbound within J9	530559	141726
10	MIDAS Site - 4693	M23 J9 northbound access	530573	141829
11	MIDAS Site - 5208	M23 southbound between J8 and J9	530811	142249
12	MIDAS Site - 9669	M23 J10 northbound exit	530088	138473
13	MIDAS Site - 9905	M23 northbound between J10A and J10	530127	137875
14	TAME Site 30360493	A23 southbound between A217 and M23 J9A	528490	141701
15	TAME Site 30360494	A23 southbound between A217 and M23 J9A	528485	141690
16	TAME Site 30360495	A23 northbound between M23 J9A and A217	528485	141680
17	TMU Site 5874-1	M23 J10 southbound exit	530206	138917
18	TMU Site 5874-2	M23 southbound within J10	530180	138924
19	TMU Site 5886-1	M23 J10A northbound access	530165	135793
20	TMU Site 5887-1	M23 J10A southbound exit	530083	135555
21	TMU Site 5980-1	M23 spur (Gatwick) eastbound between J9A and M23	529950	141730
22	TMU Site 5981-1	M23 J11 northbound access	530240	141693
23	TMU Site 5996-1	M23 southbound within J11	526237	133291
24	TMU Site 5997-1	A23 northbound between B2110 and M23-A264	525863	131502
25	TMU Site 5998-1	M23 J11 northbound access	526767	133663
26	TMU Site 5998-2	M23 northbound within J11	526770	133654

3.3 New Data Collection

3.3.1 New ATC and MCTC data was collected by Advanced Transport Research (ATR) who was commissioned by PBA.

3.3.2 The locations of the new ATC surveys are set out in Table 3-3 and shown in Figure 3-3. The data was collected at nine locations.

Table 3-3: New ATC locations

ATC Reference	Location	OSGR
1	Radford Road	TQ 28753 39666
2	St Mary's Drive	TQ 28797 37821
3	Haslett Avenue	TQ 28808 37079
4	Hawth Avenue	TQ 28051 36386
5	Southgate Avenue	TQ 27305 36301
6	Brighton Road	TQ 26750 36368
7	Horsham Road	TQ 26312 36460
8	Crawley Avenue	TQ 25502 36633
9	Ifield Avenue	TQ 25178 38448

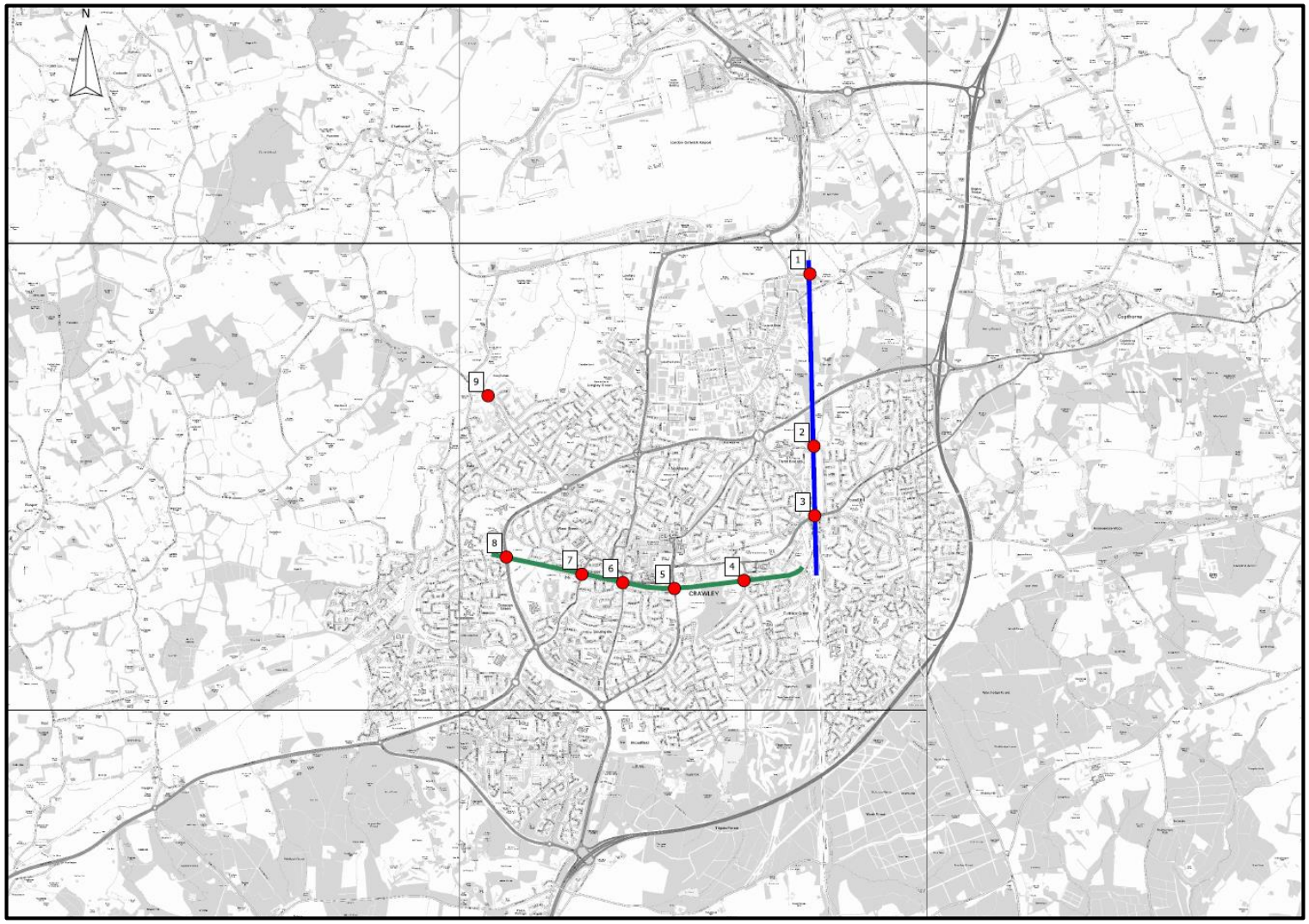
3.3.3 The ATC surveys were undertaken over a two week period (14 days) from Saturday 14 November 2015 to Saturday 28th November 2015. The data complemented existing WSCC ATC data collected as part of their permanent and periodic monitoring sites. The ATC data was classified into cars, LGV, OGV1 and OGV2.

3.3.4 The primary purpose of the new ATC data, used in conjunction with existing ATC data, is to provide independent data for validation on a cordon (shown in purple on Figure 3-1) and a North-South and East-West railway screen lines in Crawley (green and blue respectively on Figure 3-3). It has also enabled checks to understand day to day weekday flows to enable the model to be developed on representative weekday in a neutral month.

3.3.5 Two sites experienced some issues with the counters, these issues being identified as part of the mid-week checks during the ATC collection.

- **Site 5 Southgate Avenue** – Data is missing for the period between 20th November at 02:00 and 24th November at 06:00. To compensate for this, extra data was collected up until 6th December 2015.
- **Site 8 Crawley Avenue Northbound** – Data is missing for the period between 20th November at 02:00 and 24th November at 21:00. To compensate for this extra data was collected up until 6th December 2015.

Figure 3-3: New ATC Survey data Locations and Railway Screenlines



3.3.6 The locations of the MCTC surveys undertaken are set out in Table 3-4 and shown in Figure 3-4. The surveys were undertaken on Tuesday the 24th of November 2015 being within the two week period within which the new ATC surveys were undertaken.

3.3.7 The main purpose of the MCTC data is to inform the matrix estimation process as part of the matrix development and calibration process.

Table 3-4: Manual Classified Turning Count locations

MCC Reference	Location	OSGR
1	Copthorne Common Road / Copthorne Road / Copthorne way	TQ 31226 38802
2	Copthorne Road / Worth park Avenue / Balcombe Road	TQ 29707 37604
3	Balcombe Road / Lucerne Drive	TQ 29958 35839
4	Southgate Roundabout	TQ 26521 35063
5	Breezehurst Roundabout	TQ 25138 34988
6	Cheals Roundabout	TQ 25823 35686
7	Crawley Avenue / Gossops Drive	TQ 25536 36405
8	Ifield Roundabout	TQ 26142 37402
9	Crawley Avenue / London Road	TQ 26911 37761
10	Hazelwick Roundabout	TQ 28213 37960
11	Northgate Avenue / College Road / Exchange Road	TQ 27273 36833
12	Ifield Road Roundabout	TQ 26628 36621

3.3.8 Surveys were undertaken for a 12-hour period (0700 to 1900) on Tuesday 24th November 2015. There were no reports on the WSCC system of any major events or road works that could distort the data.

3.3.9 The data was fully classified into car, LGV, OGV1, OGV2, PSV, Motorcycles and cycles and was collected in 15 minute intervals.

Figure 3-4: Manual Classified Turning Count Locations

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3.4 Journey Time Data

3.4.1 Journey time data for model update was sourced from Traffic Master Data via the Department for Transport (DfT) covering the period October and November 2015. The data is GPS sourced and centrally purchased by the Department for Transport (DfT) and contains millions of GPS links broken down into 15 minute segments throughout the day (http://www.basemap.co.uk/trafficmaster-data/). The data is made up of a mixture of vehicles from fleet vehicles, LGVs, HGVs, buses, in car GPS devices and trackers fitted to high end luxury cars. As of 2015, Traffic Master polled over 110,000 vehicles every 1 to 10 seconds giving an extremely accurate dataset.

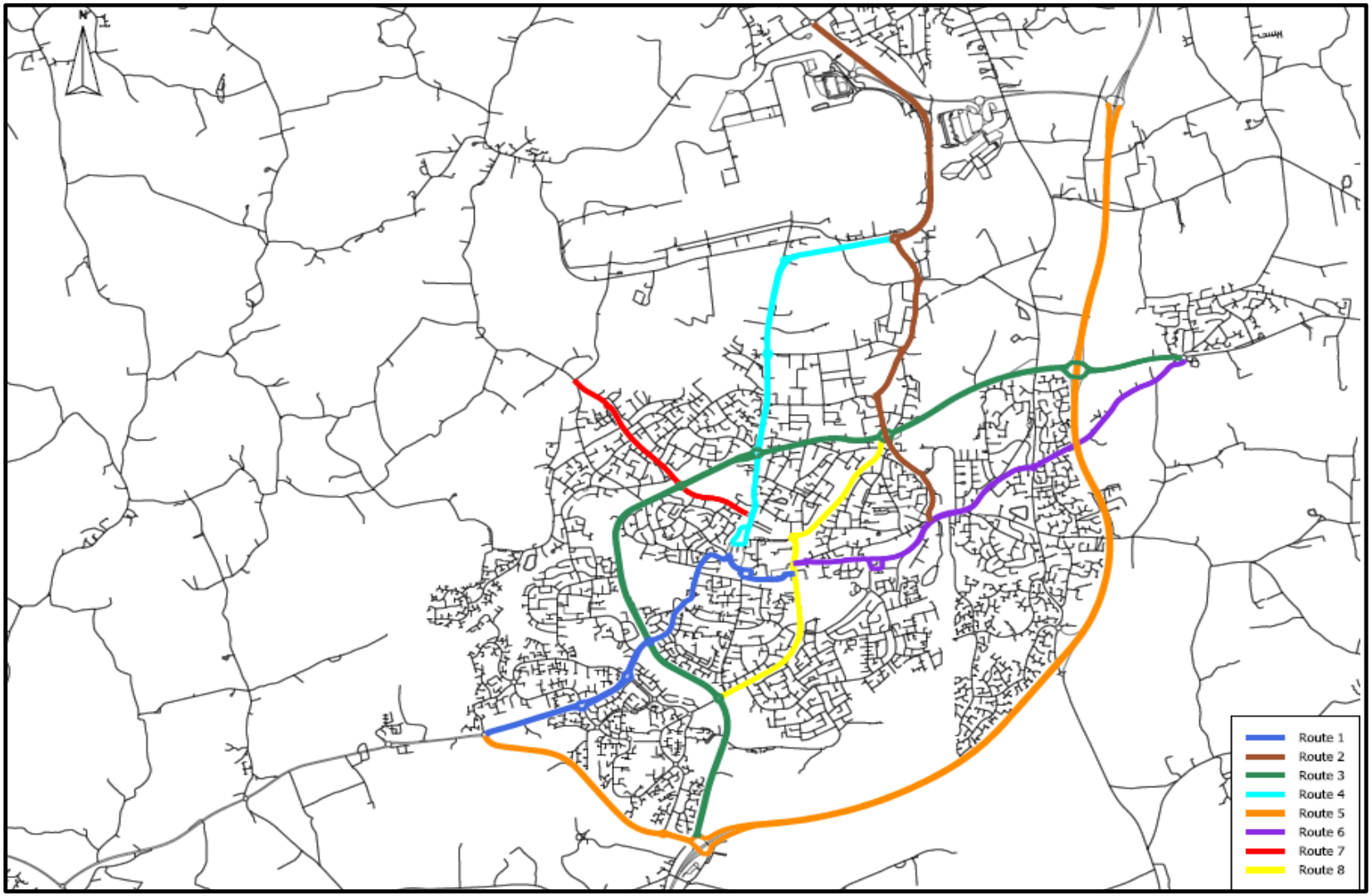
3.4.2 Journey time routes for validation were defined and the relevant journey time data for the AM peak hour (08:00 to 09:00), Inter Peak average hour (10:00 to 16:00) and PM peak hour (17:00 to 18:00) extracted from the full data for the study area. The data used was for the neutral weekdays Tuesday to Thursday.

3.4.3 The journey time routes are described in Table 3-5 and can be seen in Figure 3-5.

Table 3-5: Journey Time Routes

Route Number	Description	From	To
1	Horsham Road/Peglar Way/Station Way	A264	Southgate Avenue
2	London Road/Gatwick Road/Hazelwick Avenue	Horley	Haslett Avenue
3	A2011/A23	Copthorne	M23/A264 Roundabout
4	A23/A2219 London Road	Gatwick Road Roundabout	Peglar Way
5	M23	Gatwick Spur	M23/A264 Roundabout
6	A2220	Copthorne	Southgate Avenue
7	Ifield Avenue	Bonnetts Lane	London Road
8	A2004 Northgate Avenue/College Road/Southgate Avenue	A2011	A23

Figure 3-5: Journey Time Routes



3.5 Mobile Network Data

3.5.1 The mobile network data (MND) was used as the main source of data to develop origin destination matrices for the CTM. This was in preference to undertaking Roadside Interview Surveys (RSI) which has been the traditional method of developing matrices for transport models in the UK for a long time. However, RSI surveys are disruptive to travellers and sample rates can be low leading to less robust matrices. Use of mobile phone data is increasingly seen as a credible alternative although understanding and experience of using this data for matrix development is still limited. The use of the MND data in the matrix development is discussed further in Section 4.

4 Prior Matrix Development

4.1 Introduction

4.1.1 This section explains the methods used to develop the origin destination demand matrices prior to them being assigned to the network. The development of the highway matrices consists of three broad stages:

- Development of 'observed' matrices from mobile network data (MND)
- Development of synthesised matrices to complement MND data for short distance or internal to internal trips
- Merging the synthesised and MND matrices.

4.2 Mobile Network Data Matrices

4.2.1 As explained in Section 3.5, mobile network data was used as the main source of data to develop origin destination matrices for the CTM.

4.2.2 The mobile data has been provided by Telefonica (O2 in the UK) for the West Sussex region for six neutral weeks in April and May 2015. The data as provided was separated into different modes (road, rail and HGV). The data had also been split by purpose into the following categories:

- Non Home Based (NHB) Trips
- Outbound Home Based Work (OB_HBW) Trips
- Outbound Home Based Other (OB_HBO) Trips
- Inbound Home Based Work (IB_HBW) Trips
- Inbound Home Based Other (IB_HBO) Trips

4.2.3 As mobile data is known to possess some bias, the data for the Crawley model area has been validated for purpose of the intended uses as set out in section 1.0. Validation has been carried out to demonstrate that the mobile phone data is consistent with known sources of trip making data such as census journey to work data and National Travel Survey (NTS) data.

4.3 Initial Validation by Telefonica

4.3.1 Telefonica undertook some initial validation of the mobile phone data prior to releasing it to WSCC for use in the CTM. The initial validation is reported in 'West Sussex OD from Mobile Phone Data, Project Report', issued 25/02/2016.

4.3.2 This validation looked at the dataset for the whole of West Sussex therefore PBA has carried out similar validation tests to those undertaken by Telefonica, on the data for the Crawley model area only.

4.3.3 Telefonica compared a number of different factors in the data to the Census data (including journey to work data) and the National Travel Survey (NTS). These tests included:

- Comparison of home based origins with zone home population
- Comparison of work based origins with zone work population
- Analysis of trip purpose split
- Comparison of trips starting and ending per zone (trip symmetry)
- Trip length distribution against the census journey to work and NTS data
- Comparison of travel start time with NTS data
- Comparison of rail mode share with the census journey to work data

4.3.4 Telefonica used these tests to verify that there is a strong correlation and good fit between the mobile data and the census/NTS data and therefore considered suitable for use. Their results also highlighted some known bias in the mobile data such as the under-representation in short trips up to about 5 miles.

4.4 Additional Validation

4.4.1 The Crawley Transport Model only covers the areas in and around Crawley Borough. This means that a lot of the mobile data (which was for all of West Sussex) will be irrelevant.

4.4.2 The Telefonica data has been divided into approximately 650 zones whereas the Crawley model only requires data from around 70 of these zones which are at LSOA level. Some data from other zones outside of the Crawley model area has been included if journeys either start or end within the Crawley model area.

4.4.3 The validation tests undertaken by Telefonica have been repeated for only the zones relevant to the Crawley Transport Model (which is a subset of the original mobile data set).

4.4.4 It was considered and agreed with WSCC that the validation tests undertaken by PBA demonstrated that the mobile phone data was adequate for the purposes of developing prior matrices for the CTM when used along with complementary data sources such as Census data, in line with currently accepted practice, NTEM/TEMPRO was used to build synthetic matrices for short distance trips which mobile phone technology generally underestimates.

4.4.5 PBA has produced a technical note setting out the methodology for the validation undertaken as well as the results of the validation tests. This Technical Note is provided as Appendix E of the Data Report.

4.5 MND Matrix Development

4.5.1 Once the initial MND validation checks had been undertaken, the data was used to develop initial matrices. The data was as received from Telefonica, was already split by the required three model time periods. The OD movements were translated as necessary to match CTM zoning system. The MND trip purpose matrices were merged as necessary to create the three model assignment purpose splits of car commute, car other and car employer business.

4.5.2 A key challenge of creating matrices from MND was how to determine those through trips or external to external movements that were relevant to the Crawley model given that MND data covered the whole of West Sussex. A sector system was derived to make it easier to understand the Crawley and wider trip making patterns. Judgement was applied to decide which sector movements were relevant to the CTM including those sector movements that would form the external to external movements.

4.6 Development of Synthetic Matrices

4.6.1 The MND was used to inform ‘observed’ trip matrices. Internal to internal matrices have been synthesised using a gravity model. While the MPD contains external to internal, internal to external and internal to internal movements, the latter being short distance trips, were not well represented in the MPD hence the decision to synthesise.

4.6.2 Trip Length Distribution of the MPD when compared against known established sources of trip making data such as NTEM, National Travel Statistics (NTS) and census, showed that short distance trips of up to 5 kilometres were lacking in the data., The trip matrices were therefore synthesised using NTEM (dataset 62 available and current at the time the model was developed and calibrated) to better represent these short distance trips Other data sources used were the NTS and census journey to work data. The synthetic matrices were developed

for the 146 internal zones for car matrices. The LGV and HGV matrices were retained from the MPD.

4.6.3 The processes used to develop the synthetic matrices for the internal CTM zones are outlined and involved:

- Deriving population data from 2011 Census and NTEM dataset 62;
- Generation of production trip ends by trip purpose derived by running population estimates and using NTEM trip rates to create trip ends by purpose and mode;
- Deriving employment data from 2011 Census data and applying NTEM trip rates to employment data to create attraction trip ends by purpose
- Balancing the Productions and Attractions whereby the total attractions match the total productions for each purpose and mode;
- The trip ends were then distributed to create synthetic production/attraction (P/A) matrices. The distribution model assumed a negative exponential cost function which was based on zone to zone distances. This means that zones which are further apart have less trips travelling between them than zones which are closer. The gravity model was applied separately for each trip purpose;
- As the P/A matrices derived were 24 hour matrices, it was necessary to convert them to time period AM Peak hour, average Inter Peak hour and PM Peak hour matrices. This was done using factors derived from NTS data.
- The next step was to convert the time period P/A matrices to Origin/Destination matrices that can be assigned to the network. This was done by using scaling factors derived from NTS data and checked against factors for similar work from the literature.
- As the matrices had been derived assuming internal to internal zoning, this would have overestimated the internal - internal trips because the trips also included those trips with a trip end outside Crawley. Factors were derived from NTS to scale back the synthesised matrices and remove external to internal and internal to external trips thereby only retaining internal to internal trip numbers.
- Finally the purpose matrices were merged resulting to create the assignment trip purposes of commuting, employer business and other.
- The above processes were undertaken in Excel using macros as appropriate.

4.7 Merging MND and Synthesised Matrices

4.7.1 The MND matrices included some internal to internal or short distance trips although these were underestimated. It was decided to factor all internal to internal car trips from the MND matrices and replace them with the synthesised internal to internal matrices. These processes were undertaken using SATURN's matrix building module MX. The merged MND and synthesised matrices formed the initial prior matrices and were assigned to the network as part of the calibration process.

5 Model Assignment, Calibration and Validation Procedures

5.1 Introduction

5.1.1 Calibration of the network and matrices was undertaken to demonstrate that the model outputs provides a reasonable representation of observed traffic flows and behaviours in the updated model. The calibration process involved the refinement of the network detail to check that link lengths, link speeds and junction behaviour/operation are well represented. Junction parameters reviewed and amended as part of the calibration process include turn saturation flows and signal timings as appropriate.

5.2 Generalised Cost Parameters

5.2.1 Generalised cost parameters are used in the model network to determine the minimum cost routes by which traffic is assigned onto the network. Within SATURN, generalised cost coefficients are input by user class. The two parameters required are pence per minute (PPM) and pence per kilometre. The values of time and values of distance for 2010 and 2015 used to calculate the PPM and PPK coefficients were determined using TAG Data book Autumn 2015 release v1.4b. The coefficients are shown in Table 5-1.

Table 5-1: Generalised Cost Coefficients

User Class	Class Type	AM		IP		PM	
		PPM	PPK	PPM	PPK	PPM	PPK
1	Commute	1.00	0.42	1.00	0.41	1.00	0.42
2	Employer business	1.00	0.17	1.00	0.16	1.00	0.17
3	Other	1.00	0.33	1.00	0.32	1.00	0.33
4	LGV	1.00	0.51	1.00	0.51	1.00	0.51
5	HGV	1.00	1.55	1.00	1.50	1.00	1.55

5.3 Network Calibration

5.3.1 In order to verify that the modelled network correctly represents the existing situation, a number of checks were undertaken as part of the calibration process. These include the following:

- Checks to verify that loading of zone connectors was reasonable;
- Link lengths checks including verifying that directional distances were matched and where different, that the differences were reasonable;
- Routeing checks through the network by using SATURN's 'built trees' facility
- Verifying that lane designations at junctions were correctly coded;
- Verifying of turn saturation flows at key junctions;
- Routeing checks through the network by using SATURN's 'built trees' facility

5.3.2 A thorough examination of the SATURN network has confirmed that each zone centroid has been loaded onto the appropriate link and link length checks confirmed that link lengths had been coded correctly.

5.3.3 The modelled routeing of traffic throughout the network has been checked. Appendices A to C show P1X plots of the routeing calibration checks for all three modelled time periods.

5.3.4 The routeings have been checked using the 'forest trees' option within SATURN's P1X module. Routes between a wide range of Origin and Destination pairs across the whole network were checked to verify that route choice in the model was reasonable. This included checks for north to south and south to north key movements; checks for east to west and west to east movements. The routes encompassed both long distance cross Crawley movements and shorter distance trips within Crawley. Up to 20 directional routes have been checked for plausibility of routeing in the model.

5.3.5 The routeing checks indicated that the model was in main replicating the complex route choice in the CTM. This includes observed route choice for west to town centre movements such as between Horsham and the town centre which involves some traffic turning right at the Horsham Road/Crawley Avenue junction to then head into Crawley using the A23 Brighton Road for example.

5.4 Matrix Calibration

5.4.1 The matrix calibration involved assigning the initial or prior matrices onto the network and checking that observed flows were reasonably replicated. The prior matrix was developed from the MND data and synthesised matrices as described in Section 4.

5.4.2 Initial assignment indicated that HGV flows were considerably lower than observed counts suggested. Further analysis suggested that to replicate the order of HGV flows from observed counts, it was necessary to undertake factoring of the HGV matrix all three time periods. The HGV matrix had been informed by the MND and it appears that the MND considerably underestimated HGV demands. HGV matrix factoring was informed by reference to traffic counts and these indicated that in general HGV's were underestimated by a factor of around 10.

5.4.3 Where necessary, selective factoring of light vehicle matrices was also undertaken so that modelled flows were more consistent with observed flows. These matrix processes were only undertaken after thorough network checks had been made. They were also undertaken prior to carrying out the matrix estimation process. This process was undertaken in locations where it was noticeable that flows derived from the mobile phone data were low. This was particularly true of trips to Gatwick Airport from the north and the HE data on the M23 was used to factor the flows. The process was undertaken, such that trip distribution was not changed.

5.4.4 While matrix estimation generally improves flow calibration and validation, it should only be undertaken once network issues have been resolved and only when trip matrices are reasonably close to the expected demands, otherwise the matrix estimation process amplifies the network and demand errors. The results of the flow calibration following the matrix estimation process are reported in the next section.

6 Model Calibration Results

6.1 Introduction

6.1.1 This section reports on the flow calibration. As noted in Section 5, calibration of the network and matrices was undertaken to seek to achieve an accurate representation of observed traffic flows and behaviours in the updated corridor model. This section reports on the results of the flow calibration in the CTM for all three time periods.

6.1.2 The flow calibration was undertaken for key junctions in Crawley. Given the importance of the HE network, flow calibration has also been undertaken on the M23, A23 and the Gatwick Spur.

6.1.3 The Crawley flow calibration consists of up to 156 records while the HE calibration consists of up to 26 flow records in each time period. This underlines the extensive coverage of the calibration with a view to developing a model that is reasonably robust across the Crawley and HE network.

6.2 Flow Calibration Results

6.2.1 The GEH (Geoffrey Edward Havers) statistic has been used to summarise the flow calibration results. This summary is shown in Tables 6-1 and 6-2 for the Crawley and HE flows respectively. The actual flow calibration records are shown in Appendix D for Crawley counts and Appendix E for HE counts.

6.2.2 The GEH Statistic is a formula used in traffic modelling to compare two sets of traffic volumes and assess the fit between the observed and modelled flows. It takes account of the fact that when traffic flows are low, the percentage difference between observed and modelled flows may be high but the significance of this difference is small.

6.2.3 A GEH of less than 5.0 is considered to represent a good match between the modelled and observed hourly flows. A GEH value greater than 10 indicates that the match between observed and modelled flows is poor and closer attention is required. The guideline is to aim for 85% of counts with a GEH below 5.

Table 6-1: GEH Flow Calibration (PCU/hr) by Time Period – Crawley Calibration

Location Link No.	AM Peak	Inter Peak	PM Peak
No of Observed Turn Counts	156	156	156
No of Modelled flows with GEH<5	120	139	136
% of Modelled flows with GEH < 5	77	89	87
No of Modelled flows with GEH< 10	149	154	153
% of Modelled flows with GEH < 10	96	99	98

Table 6-2: GEH Flow Calibration (PCU/hr) by Time Period – Highways England Calibration

Location Link No.	AM Peak	Inter Peak	PM Peak
No of Observed Turn Counts	26	26	26
No of Modelled flows with GEH<5	25	24	24
% of Modelled flows with GEH < 5	96	92	92
No of Modelled flows with GEH< 10	26	24	26
% of Modelled flows with GEH < 10	100	100	100

6.2.4 In respect of the Crawley flow calibration, Table 6-1 shows that 77% of flows achieve a GEH value of less than 5 in the AM peak, increasing to 96% for flows with GEH of less than 10. In the Inter Peak, 89% achieve a GEH value of less than 5 and this increase to 99% for flows with a GEH value of less than 10. In the PM peak, 87% of flows achieve a GEH value of less than 5, increasing to 98% when a GEH value of 10 is analysed.

6.2.5 It is evident from Table 6-1 that the Inter Peak and PM peak models achieve the guideline requirements in achieving GEH values of less than 5 in at least 85% of cases. Given the sensitivities and complexities of the CTM, the achievement of 77% in the AM peak model is considered a good outcome. This is further verified by all three time periods achieving GEH values of less than 10 in at least 96% of the flows across all three time periods.

6.2.6 In respect of the HE flow calibration Table 6-2 shows that in all time periods, the model achieves a GEH value of less than 5 in excess of 85% of all counts. In the AM peak, 96% of the modelled flows have a GEH less than 5, while this figure is 92% in both the Inter Peak and PM Peak models. All time periods have 100% flows achieving a GEH of less than 10. It is evident that the CTM achieves flow calibration in excess of the guidelines on the HE network.

6.3 Trip Length Calibration Results

6.3.1 Trip length distribution pre and post matrix estimation has been checked. This is to check that the matrix estimation process does not materially alter the trip making patterns in the prior matrices. Matrix estimation can have the tendency to increase short distance trips at the expense of long distance trips, which needs to be kept to a minimum.

6.3.2 The results of the trip length distribution checks are shown in Figures 6-1 to 6-3 for each of the AM, Inter Peak and PM peaks respectively. The results show that the trip length distribution does not change too greatly pre and post matrix estimation.

Figure 6-1: AM Peak TLD comparison

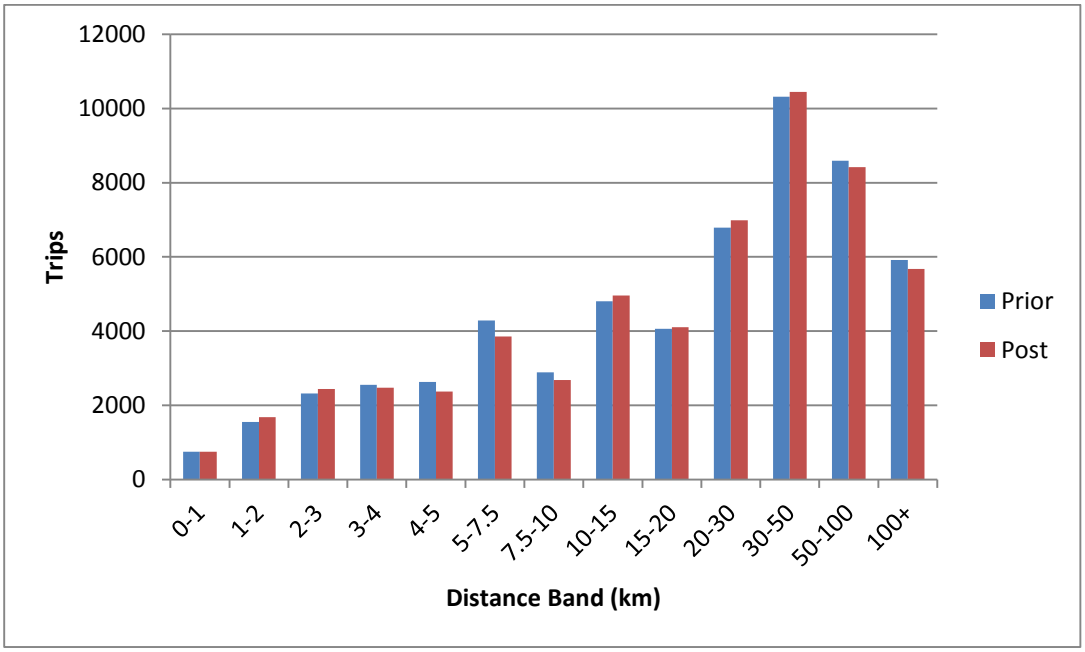


Figure 6-2: Inter Peak TLD comparison

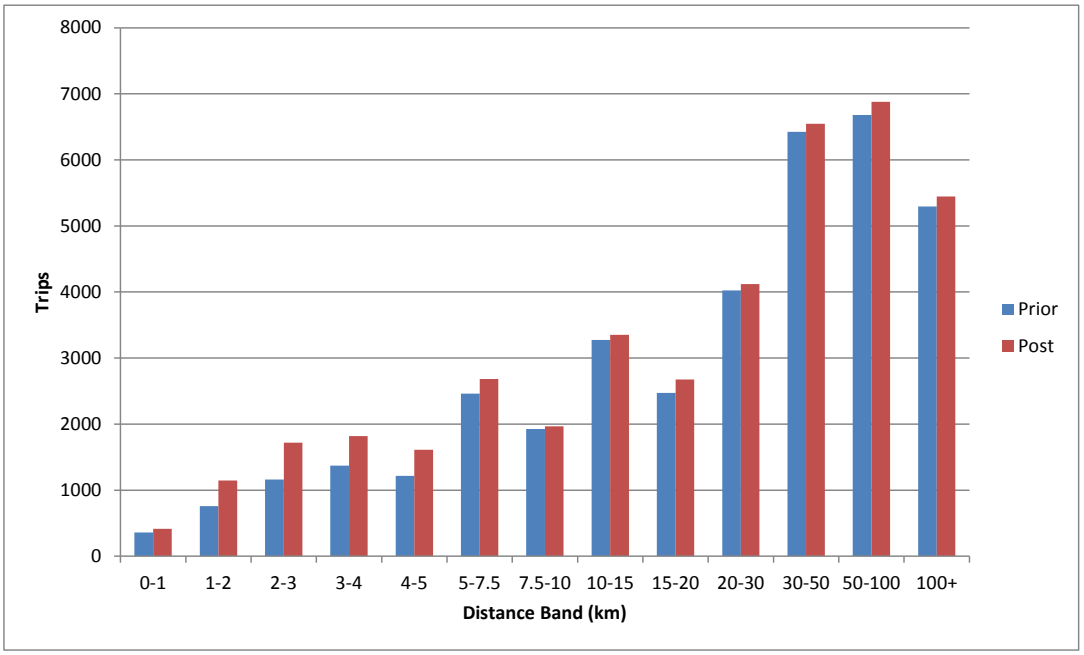
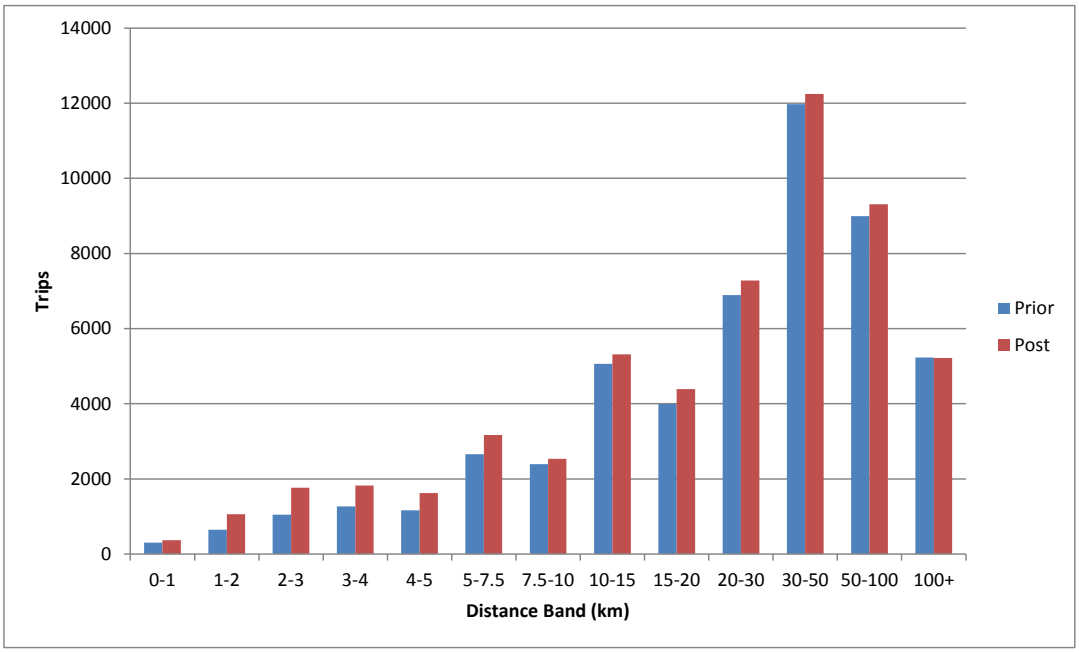


Figure 6-3: PM Peak TLD comparison



7 Model Validation Results

7.1 Introduction

7.1.1 This section reports on the flow and journey time validation achieved by the CTM. The results have been considered with respect to validation criteria and acceptability guidelines contained in Section 3 of TAG Unit M3.1 (Highway Assignment Modelling). The guidance notes that any adjustments to the model intended to reduce the differences between the modelled and observed data should be regarded as calibration. Validation simply involves comparing modelled and observed data that is independent from that used in the calibration.

7.1.2 The main comparisons required for the validation of a highway assignment model as noted in the guidance are listed below:

- A check on the quality of the trip matrices – this requires a comparison of assigned flows and counts totalled for each screenline or cordon.
- A check on the quality of the assignment – this is demonstrated by comparing flows and counts on individual links and turning movements at junctions;
- A check on the quality of the network and assignment – this is demonstrated by comparing modelled and observed journey times along routes.

7.2 Flow and Journey Time Validation Criteria and Acceptability Guidelines

7.2.1 The criteria and guidelines apply to models created both for general purposes and those created to address or assess specific interventions. In respect of the latter, it is expected that greater attention should be paid to validation quality in the vicinity of the interventions (para 3.1.2).

7.2.2 Table 7-1 provides a summary of WebTAG flow validation criteria and acceptability guidelines. It also includes journey time validation criteria and acceptability guidelines.

7.2.3 Criterion 1 relates directly to the flows, criterion 2 relates to the GEH statistic, which was explained in Section 6.2. Criterion 3 relates to screenlines and cordons and Criterion 4 relates to journey time validation.

Table 7-1: Validation Criteria and Acceptability Guidelines

Link Flow and Turning Movement Validation Criteria and Acceptability Guidelines		
Criteria	Description of Criteria	Acceptability Guideline
	Individual flows within 100 vph of counts for flows less than 700 vph	>85% of cases
1	Individual flows within 15% of counts for flows from 700 to 2,700 vph	>85% of cases
	Individual flows within 400 vph of counts for flows more than 2,700 vph	>85% of cases
2	GEH < 5 for individual flows	>85% of cases
	Screenline Flow Validation and Acceptability Guideline	Acceptability Guideline
3	Differences between modelled flows and observed counts should be less than 5% of the observed counts	All or nearly all screenlines
4	Journey Time Validation Criterion and Acceptability Guideline	Acceptability Guideline
4	Modelled Times along routes should be within 15% of surveyed times (or 1 minute, if higher than 15%)	>85% of routes

7.3 Flow Validation Results

7.3.1 Flow validation has been undertaken at an external cordon and two railway screenlines within the model. These are shown on Figure 7-1. The results of the flow validation are presented by time period and discussed in the sections that follow.

AM Peak hour (0800-0900) Flow Validation

7.3.2 Tables 7-2 and 7-3 show the AM Peak hour flow validation results for the external cordon (shown in purple in Figure 3.1) in the Inbound and Outbound directions respectively. This shows that in the inbound direction, the total modelled cordon flow is within 1% of the observed flow which is well within the 5% WebTAG threshold. In the outbound direction, the modelled cordon flow is within 4% of the observed flow which is also within the required threshold.

Table 7-2: AM Peak Flow Validation (PCU/hr) – External Cordon - Inbound

Link No.	Location	Count	Model	Diff.	% Diff.	GEH	Pass/Fail	
							Flow	GEH
1	A220 Horsham Road	740	763	24	3	0.87	✓	✓
2	Ifield Avenue	308	328	20	6	1.11	✓	✓
3	A23 London Road	1308	1323	15	1	0.42	✓	✓
4	Gatwick Road	735	884	149	20	5.23	×	×
5	Balcombe Road North	939	848	-91	-10	3.04	✓	×
6	M23 Southbound between j9 and J10	4041	4104	63	2	0.99	✓	✓
7	Copthorne Way	1447	1363	-84	-6	2.23	✓	✓
8	Copthorne Road	610	570	-40	-7	1.66	✓	✓
9	Turners Hill Road	596	497	-99	-17	4.23	✓	✓
10	Balcombe Road South	718	760	42	6	1.55	✓	✓
11	M23 Nbnd J11 to J10A	3824	3961	136	4	2.18	✓	✓
12	A23 Brighton Road	1808	1579	-229	-13	5.56	✓	×
All	Total	17073	16980	-93	-1	0.72	✓	✓

Table 7-3: AM Peak Flow Validation (PCU/hr) – External Cordon - Outbound

Link No.	Location	Count	Model	Diff.	% Diff.	GEH	Pass/Fail	
							Flow	GEH
1	A220 Horsham Road	853	749	-104	-12	3.66	✓	✓
2	Ifield Avenue	331	250	-81	-24	4.75	✓	✓
3	A23 London Road	820	790	-30	-4	1.05	✓	✓
4	Gatwick Road	835	945	110	13	3.70	✓	✓
5	Balcombe Road North	654	610	-45	-7	1.77	✓	✓
6	M23 Northbound between J10 and J9	4394	4234	-160	-4	2.43	✓	✓
7	Copthorne Way	973	1043	70	7	2.22	✓	✓
8	Copthorne Road	541	411	-130	-24	5.96	×	×
9	Turners Hill Road	439	382	-57	-13	2.83	✓	✓
10	Balcombe Road South	623	595	-27	-4	1.10	✓	✓
11	M23 Sbnd J10A to J11	n/a	n/a	n/a	n/a	n/a	n/a	n/a
12	A23 Brighton Road	711	762	51	7	1.87	✓	✓
All	Total	11172	10770	-402	-4	3.84	×	✓

7.3.3 Tables 7-4 and 7-5 show that the AM Peak hour flow validation results for the East – West Railway screenline (shown in green in Figure 3.2) in the Eastbound and Westbound directions respectively. This shows that in the eastbound direction, the total modelled cordon flow is within 3% of the observed flow which is well within the 5% WebTAG threshold. In the westbound direction, the modelled cordon flow is within 4% of the observed flow and is therefore also within the required threshold.

Table 7-4: AM Peak Flow Validation (PCU/hr) – East-West Rail Screenline - Eastbound

Link No.	Location	Count	Model	Diff.	% Diff.	GEH	Pass/Fail	
							Flow	GEH
1	Radford Road	266	244	-21	-8	1.34	✓	✓
2	Crawley Avenue	1090	940	-150	-14	4.70	✓	✓
3	St Marys Drive	226	154	-71	-32	5.16	✓	×
4	Haslett Avenue	965	1124	160	17	4.94	×	✓
All	Total	2546	2463	-83	-3	1.65	✓	✓

Table 7-5: AM Peak Flow Validation (PCU/hr) – East-West Rail Screenline - Westbound

Link No.	Location	Count	Model	Diff.	% Diff.	GEH	Pass/Fail	
							Flow	GEH
1	Radford Road	1126	881	-244	-22	7.71	×	×
2	Crawley Avenue	2406	2573	167	7	3.35	✓	✓
3	St Marys Drive	575	541	-33	-6	1.42	✓	✓
4	Haslett Avenue	1446	1359	-88	-6	2.34	✓	✓
All	Total	5553	5354	-198	-4	2.69	✓	✓

7.3.4 Tables 7-6 and 7-7 show the AM Peak hour flow validation results for the North – South Railway screenline (shown in blue on Figure 3.2) in the Northbound and Southbound directions respectively. The tables show that in the eastbound direction, the total modelled cordon flow matches the observed flows and is within 0 % of the observed flow. In the southbound direction, the modelled cordon flow is within 8% of the observed flow and is therefore outside the required threshold.

Table 7-6: AM Peak Flow Validation (PCU/hr) – North-South Rail Screenline - Northbound

Link No.	Location	Count	Model	Diff.	% Diff.	GEH	Pass/Fail	
							Flow	GEH
1	Hawth Avenue	995	1118	124	12	3.80	✓	✓
2	Southgate Avenue	950	882	-68	-7	2.25	✓	✓
3	Brighton Road	364	528	163	45	7.74	×	×
4	Horsham Road	435	461	25	6	1.20	✓	✓
5	Crawley Avenue	1654	1431	-224	-14	5.69	✓	×
All	Total	4399	4420	21	0	0.32	✓	✓

Table 7-7: AM Peak Flow Validation (PCU/hr) – North-South Rail Screenline - Southbound

Link No.	Location	Count	Model	Diff.	% Diff.	GEH	Pass/Fail	
							Flow	GEH
1	Hawth Avenue	775	1005	82	11	2.88	✓	✓
2	Southgate Avenue	488	567	-4	-1	0.20	✓	✓
3	Brighton Road	133	173	39	29	3.17	✓	✓
4	Horsham Road	210	284	32	15	2.15	✓	✓
5	Crawley Avenue	995	947	64	6	1.99	✓	✓
All	Total	2600	2976	213	8	4.09	✓	✓

7.3.5 WebTAG guidelines require that all or nearly all screenline total flows are modelled within 5% of observed flows. In the case of the CTM in the AM Peak, it has been shown that when the six directional flows are compared to the observed flows at the external and two railway screenlines, five of the total counts are well within the WebTAG threshold, and one is a few percentage points out at 8% of the observed flows. It should be noted that all but one of the screenline/cordon total flows achieve flow validation criteria. It is therefore concluded following the above discussion, that the CTM model reasonably reflects observed screenline/cordon flows in the AM Peak and hence that the quality of the matrix validation in this time period is good and suggests robust matrices.

7.3.6 In terms of the link flow validation, the results for the AM Peak hour are summarised in Table 7-8. The results show that of the 41 links in the validation, 34 (83%) achieve a GEH of less than 5. When links with GEH of less than 10 are considered, it is shown that all 41 links or 100% achieve a GEH of less than 10. Given the sensitivities and complexities of the CTM, it is considered that the flow validation is acceptable.

Table 7-8: AM Peak Flow Validation – Summary of Validation Results.

Parameter	AM Peak
No of Observed Turn Counts	41
No of Modelled flows with GEH<5	34
% of Modelled flows with GEH < 5	83
No of Modelled flows with GEH< 10	41
% of Modelled flows with GEH < 10	100

Inter Peak Average hour (1100-1200) Validation

7.3.7 Tables 7-9 and 7-10 show the Inter Peak hour flow validation results for the external cordon in the Inbound and Outbound directions respectively. It can be seen that in the inbound direction, the total modelled cordon flow is within 3% of the observed flow which is within the 5% WebTAG threshold. In the outbound direction, the modelled cordon flow is within 1% of the observed flow and is also within the required threshold.

Table 7-9: Inter Peak Flow Validation (PCU/hr) – External Cordon - Inbound

Link No.	Location	Count	Model	Diff.	% Diff.	GEH	Pass/Fail	
							Flow	GEH
1	A220 Horsham Road	679	691	11	1.7	0.43	✓	✓
2	Ifield Avenue	209	202	-7	-3.6	0.52	✓	✓
3	A23 London Road	759	746	-13	-1.7	0.48	✓	✓
4	Gatwick Road	434	569	134	31.0	6.00	×	×
5	Balcombe Road North	498	489	-9	-1.8	0.42	✓	✓
6	M23 Southbound between j9 and J10	3239	3214	-25	-0.8	0.44	✓	✓
7	Copthorne Way	971	956	-15	-1.6	0.50	✓	✓
8	Copthorne Road	347	328	-19	-5.6	1.06	✓	✓
9	Turners Hill Road	277	257	-20	-7.3	1.23	✓	✓
10	Balcombe Road South	303	314	11	3.5	0.60	✓	✓
11	M23 Nbnd J11 to J10A	2337	2535	199	8.5	4.02	✓	✓
12	A23 Brighton Road	642	767	125	19.4	4.70	✓	✓
All	Total	10698	11067	369	3.0	3.54	✓	✓

Table 7-10: Inter Peak Flow Validation (PCU/hr) – External Cordon - Outbound

Link No.	Location	Count	Model	Diff.	% Diff.	GEH	Pass/Fail	
							Flow	GEH
1	A220 Horsham Road	676	667	-9	-1.3	0.34	✓	✓
2	Ifield Avenue	195	176	-19	-9.8	1.40	✓	✓
3	A23 London Road	717	723	5	0.8	0.20	✓	✓
4	Gatwick Road	499	560	61	12.1	2.63	✓	✓
5	Balcombe Road North	506	430	-76	-15.0	3.54	✓	✓
6	M23 Northbound between J10 and J9	3300	3231	-69	-2.1	1.21	✓	✓
7	Copthorne Way	944	955	11	1.2	0.35	✓	✓
8	Copthorne Road	356	335	-21	-5.9	1.13	✓	✓
9	Turners Hill Road	246	244	-2	-0.7	0.11	✓	✓
10	Balcombe Road South	338	376	38	11.4	2.03	✓	✓
11	M23 Sbnd J10A to J11	n/a	n/a	n/a	n/a	n/a	n/a	n/a
12	A23 Brighton Road	635	662	27	4.3	1.08	✓	✓
All	Total	8414	8360	-54	-1.0	0.58	✓	✓

7.3.8 Tables 7-11 and 7-12 show the Inter Peak hour flow validation results for the East – West Railway screenline in the Eastbound and Westbound directions respectively. The tables show that in the eastbound direction, the total modelled cordon flow is within 9.8% of the observed flow which is outside the 5% WebTAG threshold. In the westbound direction, the modelled cordon flow is within 0.2% of the observed flows which is well within the required threshold.

Table 7-11: Inter Peak Flow Validation (PCU/hr) – East-West Rail Screenline - Eastbound

Link No.	Location	Count	Model	Diff.	% Diff.	GEH	Pass/Fail	
							Flow	GEH
1	Radford Road	314	231	-83	-26.3	5.01	✓	×
2	Crawley Avenue	1331	1377	46	3.4	1.25	✓	✓
3	St Marys Drive	273	108	-164	-60.3	11.90	×	×
4	Haslett Avenue	983	901	-82	-8.3	2.67	✓	✓
All	Total	2900	2617	-283	-9.8	5.39	✓	×

Table 7-12: Inter Peak Flow Validation (PCU/hr) – East-West Rail Screenline - Westbound

Link No.	Location	Count	Model	Diff.	% Diff.	GEH	Pass/Fail	
							Flow	GEH
1	Radford Road	310	349	39	12.7	2.16	✓	✓
2	Crawley Avenue	1315	1390	75	5.7	2.03	✓	✓
3	St Marys Drive	216	128	-88	-40.7	6.70	✓	×
4	Haslett Avenue	945	912	-32	-3.4	1.06	✓	✓
All	Total	2786	2780	-6	-0.2	0.12	✓	✓

7.3.9 Tables 7-13 and 7-14 show the Inter Peak hour flow validation results for the North – South Railway screenline in the Northbound and Southbound directions respectively. The tables show that in the northbound direction, the total modelled cordon flow is within 11.9 % of the observed flow and is outside the required threshold. In the southbound direction, the modelled cordon flow is within 4.6% of the observed flow and is therefore inside the required threshold.

Table 7-13: Inter Peak Flow Validation (PCU/hr) – North-South Rail Screenline - Northbound

Link No.	Location	Count	Model	Diff.	% Diff.	GEH	Pass/Fail	
							Flow	GEH
1	Hawth Avenue	677	783	107	15.8	3.95	×	✓
2	Southgate Avenue	534	485	-49	-9.3	2.19	✓	✓
3	Brighton Road	225	397	172	76.5	9.76	×	×
4	Horsham Road	274	228	-46	-16.6	2.87	✓	✓
5	Crawley Avenue	996	1134	138	13.9	4.23	✓	✓
All	Total	2705	3027	322	11.9	6.01	×	✓

Table 7-14: Inter Peak Flow Validation (PCU/hr) – North-South Rail Screenline - Southbound

Link No.	Location	Count	Model	Diff.	% Diff.	GEH	Pass/Fail	
							Flow	GEH
1	Hawth Avenue	667	772	105	15.8	3.93	✓	✓
2	Southgate Avenue	568	539	-29	-5.2	1.25	✓	✓
3	Brighton Road	181	199	18	10.0	1.31	✓	✓
4	Horsham Road	251	306	55	22.1	3.32	✓	✓
5	Crawley Avenue	1157	1136	-21	-1.8	0.62	✓	✓
All	Total	2824	2953	129	4.6	2.39	✓	✓

7.3.10 In the Inter Peak, it has been shown that when the six directional flows are compared to the observed flows at the external cordon and two railway screenlines, four of the total counts are well within the WebTAG threshold; two are outside the threshold at 9.8% and 11.9% of the observed flows. It can therefore be concluded that the CTM model reasonably reflects observed screenline/cordon flows in the inter peak and hence that the quality of the matrix validation in this time period is good and suggests robust matrices.

7.3.11 In terms of the link flow validation, the results for the Inter Peak hour are summarised as follows. The results show that of the 41 links in the validation, 36 (87%) achieve a GEH of less than 5. When links with GEH of less than 10 are considered, 40 links or 98% achieve a GEH of less than 10 and only 1 having a value greater than 10. Given the sensitivities and complexities of the CTM, it is considered that the flow validation is of an acceptable quality.

Table 7-15: Inter Peak Flow Validation – Summary of Validation Results.

Parameter	Inter Peak
No of Observed Turn Counts	41
No of Modelled flows with GEH<5	36
% of Modelled flows with GEH < 5	87
No of Modelled flows with GEH< 10	40
% of Modelled flows with GEH < 10	98

PM Peak hour (1700-1800) Validation

7.3.12 Tables 7-16 and 7-17 show the PM Peak hour flow validation results for the external cordon in the Inbound and Outbound directions respectively. The tables show that in the inbound direction, the total modelled cordon flow is within 0% of the observed flow which is well within the 5% WebTAG threshold. In the outbound direction, the modelled cordon flow is within 3% of the observed flow which is also within the required threshold.

Table 7-16: PM Peak Flow Validation (PCU/hr) – External Cordon - Inbound

Link No.	Location	Count	Model	Diff.	% Diff.	GEH	Pass/Fail	
							Flow	GEH
1	A220 Horsham Road	945	974	29	3	0.92	✓	✓
2	Ifield Avenue	408	323	-85	-21	4.42	✓	✓
3	A23 London Road	970	952	-17	-2	0.56	✓	✓
4	Gatwick Road	506	679	172	34	7.08	×	×
5	Balcombe Road North	584	628	44	8	1.80	✓	✓
6	M23 Southbound between j9 and J10	4898	4816	-82	-2	1.18	✓	✓
7	Copthorne Way	1111	1082	-29	-3	0.88	✓	✓
8	Copthorne Road	537	553	16	3	0.69	✓	✓
9	Turners Hill Road	449	302	-147	-33	7.59	×	×
10	Balcombe Road South	494	566	72	14	3.11	✓	✓
11	M23 Nbnd J11 to J10A	2433	2416	-18	-1	0.36	✓	✓
12	A23 Brighton Road	949	991	42	4	1.36	✓	✓
All	Total	14284	14281	-3	0	0.02	✓	✓

Table 7-17: PM Peak Flow Validation (PCU/hr) – External Cordon - Outbound

Link No.	Location	Count	Model	Diff.	% Diff.	GEH	Pass/Fail	
							Flow	GEH
1	A220 Horsham Road	1102	1008	-94	-9	2.90	✓	✓
2	Ifield Avenue	290	215	-75	-26	4.75	✓	✓
3	A23 London Road	1315	1169	-146	-11	4.14	✓	✓
4	Gatwick Road	942	805	-137	-15	4.62	✓	✓
5	Balcombe Road North	945	860	-85	-9	2.84	✓	✓
6	M23 Northbound between J10 and J9	3464	3317	-146	-4	2.52	✓	✓
7	Copthorne Way	1104	933	-170	-15	5.34	×	×
8	Copthorne Road	645	544	-101	-16	4.14	×	✓
9	Turners Hill Road	518	801	283	55	11.02	×	×
10	Balcombe Road South	822	929	106	13	3.60	✓	✓
11	M23 Sbnd J10A to J11	n/a	n/a	n/a	n/a	n/a	n/a	n/a
12	A23 Brighton Road	1079	1251	172	16	5.03	×	×
All	Total	12226	11832	-394	-3	3.59	✓	✓

7.3.13 Tables 7-18 and 7-19 show the PM Peak hour flow validation results for the East – West Railway screenline in the Eastbound and Westbound directions respectively. The tables show that in the eastbound direction, the total modelled cordon flow is within 12% of the observed flow which is outside the 5% WebTAG threshold. In the westbound direction, the modelled cordon flow is within 8% of the observed flow and is therefore a few percentage points outside the required threshold.

Table 7-18: PM Peak Flow Validation (PCU/hr) – East-West Rail Screenline - Eastbound

Link No.	Location	Count	Model	Diff.	% Diff.	GEH	Pass/Fail	
							Flow	GEH
1	Radford Road	965	715	-251	-26	8.65	×	×
2	Crawley Avenue	2279	2318	39	2	0.81	✓	✓
3	St Marys Drive	583	284	-299	-51	14.35	×	×
4	Haslett Avenue	1639	1474	-165	-10	4.18	✓	✓
All	Total	5467	4791	-676	-12	9.43	×	×

Table 7-19: PM Peak Flow Validation (PCU/hr) – East-West Rail Screenline - Westbound

Link No.	Location	Count	Model	Diff.	% Diff.	GEH	Pass/Fail	
							Flow	GEH
1	Radford Road	313	299	-14	-4	0.79	✓	✓
2	Crawley Avenue	1378	1469	91	7	2.41	✓	✓
3	St Marys Drive	212	93	-120	-56	9.68	×	×
4	Haslett Avenue	1026	827	-199	-19	6.53	×	×
All	Total	2929	2688	-241	-8	4.55	✓	✓

7.3.14 Tables 7-20 and 7-21 show the PM Peak hour flow validation results for the North – South Railway screenline in the Northbound and Southbound directions respectively. In the northbound direction, the total modelled cordon flow is within 8% of the observed flows which is a few percentage points outside the 5% required threshold. In the southbound direction, the modelled cordon flow is within 10% of the observed flow and is therefore outside the required threshold.

Table 7-20: PM Peak Flow Validation (PCU/hr) – North-South Rail Screenline - Northbound

Link No.	Location	Count	Model	Diff.	% Diff.	GEH	Pass/Fail	
							Flow	GEH
1	Hawth Avenue	770	680	-90	-12	3.34	✓	✓
2	Southgate Avenue	494	471	-23	-5	1.04	✓	✓
3	Brighton Road	221	372	151	68	8.76	×	×
4	Horsham Road	258	244	-14	-5	0.88	✓	✓
5	Crawley Avenue	1017	1203	186	18	5.58	×	×
All	Total	2759	2969	210	8	3.92	✓	✓

Table 7-21: PM Peak Flow Validation (PCU/hr) – North-South Rail Screenline - Southbound

Link No.	Location	Count	Model	Diff.	% Diff.	GEH	Pass/Fail	
							Flow	GEH
1	Hawth Avenue	1119	1005	-114	-10	3.50	✓	✓
2	Southgate Avenue	810	691	-119	-15	4.34	✓	✓
3	Brighton Road	344	370	26	8	1.38	✓	✓
4	Horsham Road	396	498	103	26	4.85	×	✓
5	Crawley Avenue	1559	1247	-311	-20	8.31	×	×
All	Total	4226	3811	-415	-10	6.55	×	×

7.3.15 In the PM Peak, it has been shown that when the six directional flows are compared to the observed flows at the external and two railway screenlines, two of the total counts are well within the WebTAG threshold, two at 8% each, are a few percentage points outside the threshold while the other two are within 10% and 12% of the observed flows. It should be noted that four of the screenline/cordon total flows achieve flow validation criteria implying that the flows are within acceptable limits of a link with equivalent flows. It can therefore be concluded that the CTM model reasonably reflects observed screenline/cordon flows in the PM Peak, and hence that the quality of the matrix validation in this time period is of an acceptable quality and suggests robust matrices.

7.3.16 In terms of the link flow validation, the results for the PM Peak hour are summarised in Table 7-22. The results show that of the 41 links in the validation list, 29 (71%) achieve a GEH of less than 5. When links with GEH of less than 10 are considered, 39 links or 95% achieve a GEH of less than 10 and only 2 have values greater than 10. The poor validation of Turners Hill Road outbound on the external cordon and St Mary's Drive particularly eastbound on the East-West Rail screenline are noted. It is noted that these are both a relatively minor part of the model network and unlikely to impact on fitness for purpose of the model. They are not key to impacts of any known development proposals. Given the sensitivities and complexities of the CTM, it is considered that the flow validation is of an acceptable quality.

Table 7-22: PM Peak Flow Validation – Summary of Validation Results.

Parameter	PM Peak
No of Observed Turn Counts	41
No of Modelled flows with GEH<5	29
% of Modelled flows with GEH < 5	71
No of Modelled flows with GEH< 10	39
% of Modelled flows with GEH < 10	95

7.4 Model Convergence

7.4.1 WebTAG guidance notes that before the results of any traffic assignment are used to influence decisions, the stability or degree of convergence of the assignment must be confirmed at the appropriate level (para 3.3 of TAG M3.1).

7.4.2 The importance of achieving convergence at an appropriate level is related to the need to provide stable, consistent and robust model results. This is especially so when model outputs are used to compare 'with' and 'without' scheme scenarios in cost benefit analysis. It is important to be able to distinguish differences due to the scheme from those associated with different degrees of convergence.

7.4.3 Table 7-23 summarises the most appropriate convergence measures of proximity and stability given in WebTAG Unit M3.1 Table 4 for model convergence.

Table 7-23: Summary of Convergence Measures and Base Model Acceptable Values.

Measure of Convergence	Base Model Acceptable Values
Delta and % Gap	Less than 0.1% or at least stable with convergence fully documented and all other criteria met
Percentage of links with flow change (P) < 1%	Four consecutive iterations greater than 98%
Percentage of links with cost change (P2) < 1%	Four consecutive iterations greater than 98%
Percentage change in total user costs (V)	Four consecutive iterations less than 0.1% (SUE only)

7.4.4 The results of convergence statistics achieved for all three time periods of the CTM are shown in Table 7-24. This shows that all three time period models exceed the convergence criteria required and there demonstrate that the models are stable and robust.

Table 7-24: CTM Convergence Statistics

AM				IP				PM			
Iteration	% Gap/ Delta	% Flow	%Cost Delays	Iteration	% Gap/ Delta	% % Flow ow	%Cost Delays	Iteration	% Gap/ Delta	% Flow	% Cost Delay
29	0.0055	99.2	99.6	13	0.0034	98.9	99.9	19	0.0058	98.6	99.4
30	0.0062	99.4	99.4	14	0.0023	99.0	99.8	20	0.0072	98.8	99.6
31	0.0077	98.9	99.5	15	0.0016	99.4	99.8	21	0.0045	98.5	99.4
32	0.0032	98.8	99.4	16	0.0015	99.4	99.9	22	0.0033	99.1	99.5

7.5 Journey Time Validation

7.5.1 Observed journey times were informed by Traffic Master Data. Eight journey time routes on key routes have been checked for journey time validation. Each route has been checked for validation in both directions. The validation routes were previously shown in Figure 3-5.

7.5.2 Tables 7-25 to 7-27 gives a summary of the AM peak, Inter Peak and PM peak journey time validation respectively. Appendix F gives graphical presentation of the journey time validation.

Table 7-25: AM Peak Journey Time Validation Results

Route Description	Distance (km)	Obs (min:sec)	Lower 15%	Upper 15%	Modelled Journey Time (min:sec)	Difference (Seconds)	% Diff.	Pass/ Fail
1 Westbound	4.358	07:57	06:45	09:08	07:04	-53	-11.1	✓
1 Eastbound	4.393	12:40	10:46	14:34	09:25	-195	-25.7	×
2 Northbound	6.647	11:07	09:27	12:47	09:13	-114	-17.1	×
2 Southbound	6.521	10:16	08:44	11:48	08:30	-106	-17.2	×
3 Northbound	10.198	16:27	13:59	18:55	14:52	-95	-9.6	✓
3 Southbound	10.198	16:06	13:41	18:31	13:19	-167	-17.3	×
4 Northbound	4.598	08:52	07:32	10:11	07:14	-98	-18.4	×
4 Southbound	4.332	08:13	06:59	09:26	06:11	-122	-24.7	×
5 Northbound	13.248	11:16	09:34	12:57	08:25	-171	-25.3	×
5 Southbound	13.393	09:10	07:47	10:32	08:34	-36	-6.5	✓
6 Westbound	4.972	10:10	08:39	11:42	08:58	-72	-11.8	✓
6 Eastbound	4.797	08:40	07:22	09:58	07:25	-75	-14.4	✓
7 Northbound	2.427	03:48	03:13	04:22	03:32	-16	-7.0	✓
7 Southbound	2.403	04:42	03:59	05:24	03:50	-52	-18.4	×
8 Northbound	3.683	08:50	07:31	10:10	07:41	-69	-13.0	✓
8 Southbound	3.611	08:02	06:50	09:15	07:09	-53	-11.0	✓

Table 7-26: Inter Peak Journey Time Validation Results

Route Description	Distance (km)	Obs (min:sec)	Lower 15%	Upper 15%	Modelled Journey Time (min:sec)	Difference (Seconds)	% Difference	Pass/ Fail
1 Westbound	4.358	08:58	07:38	10:19	06:52	-126	-23.4	×
1 Eastbound	4.393	09:32	08:07	10:58	07:45	-107	-18.7	×
2 Northbound	6.647	08:38	07:20	09:55	07:54	-44	-8.5	✓
2 Southbound	6.521	08:51	07:31	10:10	08:11	-40	-7.5	✓
3 Northbound	10.198	12:05	10:16	13:54	11:00	-65	-9.0	✓
3 Southbound	10.198	12:08	10:19	13:57	11:05	-63	-8.7	✓
4 Northbound	4.598	07:42	06:33	08:51	06:07	-95	-20.6	×
4 Southbound	4.332	07:39	06:31	08:48	07:04	-35	-7.6	✓
5 Northbound	13.248	08:28	07:12	09:44	07:41	-47	-9.3	✓
5 Southbound	13.393	08:36	07:18	09:53	08:15	-21	-4.1	✓
6 Westbound	4.972	08:12	06:58	09:25	07:26	-46	-9.3	✓
6 Eastbound	4.797	07:03	05:59	08:06	07:10	7	1.7	✓
7 Northbound	2.427	03:40	03:07	04:13	03:28	-12	-5.5	✓
7 Southbound	2.403	03:37	03:05	04:10	03:38	1	0.5	✓

8 Northbound	3.683	07:04	06:00	08:08	06:57	-7	-1.7	✓
8 Southbound	3.611	06:39	05:39	07:39	07:08	29	7.3	✓

Table 7-27: PM Peak Journey Time Validation Results

Route Description	Distance (km)	Obs (min:sec)	Lower 15%	Upper 15%	Modelled Journey Time (min:sec)	Difference (Seconds)	% Difference	Pass/ Fail
1 Westbound	4.358	12:54	10:58	14:50	14:05	71	9.2	✓
1 Eastbound	4.393	10:06	08:35	11:37	09:27	-39	-6.4	✓
2 Northbound	6.647	10:45	09:08	12:22	09:33	-72	-11.2	✓
2 Southbound	6.521	14:04	11:58	16:11	10:01	-243	-28.8	×
3 Northbound	10.198	19:35	16:39	22:31	15:55	-220	-18.7	×
3 Southbound	10.198	22:22	19:01	25:43	13:18	-544	-40.5	×
4 Northbound	4.598	09:23	07:58	10:47	07:00	-143	-25.4	×
4 Southbound	4.332	10:24	08:51	11:58	07:26	-178	-28.5	×
5 Northbound	13.248	09:16	07:53	10:39	09:00	-16	-2.9	✓
5 Southbound	13.393	09:22	07:58	10:46	09:36	14	2.5	✓
6 Westbound	4.972	09:45	08:17	11:13	08:37	-68	-11.6	✓
6 Eastbound	4.797	09:02	07:41	10:24	08:49	-13	-2.4	✓
7 Northbound	2.427	04:20	03:41	04:59	05:16	56	21.5	×
7 Southbound	2.403	04:10	03:32	04:47	04:22	12	4.8	✓
8 Northbound	3.683	07:53	06:42	09:04	08:11	18	3.8	✓
8 Southbound	3.611	10:56	09:18	12:35	08:55	-121	-18.4	×

7.5.3 The results show that in the AM peak, 8 out of the 16 routes or 50% achieve WebTAG guidelines of modelled routes being within 15% of observed journey times. Of the 8 routes not meeting this threshold, 5 routes are within 20% of observed times at 17.1%, 17.2%, 17.3%, 18.4% and 18.4% of observed times and are therefore narrowly outside the required threshold. The other 3 routes have modelled journey times within 24.7%, 25.3% and 25.7% of observed times respectively.

7.5.4 In the Inter Peak, 13 routes or 81% achieve required WebTAG guidelines. Of the three routes that do not, one route is within 18.7% of the observed journey time, one is within 20.6% and a third is within 23.4% of the observed journey time.

7.5.5 In the PM peak, 9 routes or 56% achieve the required WebTAG guidelines. Of the 7 that do not meet this guideline, two at 18.4% and 18.7% are within 20% of observed journey time, four at 21.5%, 25.4%, 28.5% and 28.8% respectively are within 30% of observed times and only one is in excess of 30% of observed journey times.

7.5.6 It is noticed that for all three time periods, the model journey times are quicker than the Trafficmaster data. One key explanation for this is that the Trafficmaster data is able to pick up the effects of mid link disruptions such as pick-ups, drop-offs, parked vehicles, slower vehicles, incidents and impacts on journey times of driver behaviour such as “courtesy give ways” for example. These issues are not readily represented within SATURN and hence the model is likely to be quicker than the Trafficmaster data suggests.

7.6 Summary

7.6.1 This chapter has presented and discussed the flow validation and Journey time validation of the CTM model. It has also presented convergence statistics achieved by the model. It has been concluded that the model achieves adequate validation to be considered a robust tool that can be relied upon for the purposes for which the model was commissioned such as informing business cases to support infrastructure schemes. Considerable effort has been made to improve validation on key links likely to be critical to assessing schemes and development in the vicinity of these links.

8 Summary

8.1 Overview

8.1.1 This report has summarised the methodology which has been adopted in order to build and validate a base year 2015 SATURN model of Crawley.

8.1.2 The purpose of this model is to assist in assessing the relative effects of different transport schemes to alleviate transport issues in and around Crawley.

8.1.3 The aim of the project is to develop a traffic model with a base year of 2015 that will be used to test the effects of transport infrastructure schemes and development proposals within the Crawley area. The immediate need for the CTM is to support a local growth fund bid to the Coast to Capital Local Enterprise Partnership (CtC LEP) for the Crawley Area Transport Package Phase Two schemes which are included in the Strategic Infrastructure Package, Infrastructure Delivery Plan and Crawley Town Centre feasibility study.

8.2 Conclusions

8.2.1 The calibration and validation results for the three modelled peak hours have shown a good and acceptable fit between observed and modelled flows and journey times. The model has been validated against independent counts and shows an acceptable fit when measured against the Acceptability Guidelines in WebTAG Unit M3.1 (Highway Assignment Modelling).

8.2.2 Journey times in the model time periods have been validated against DfT Traffic Master Data. The majority of the modelled routes are an acceptable fit to observed journey times and within the WebTAG validation criteria. Of those that do not, the majority are within 20% to 30% of observed journey times.

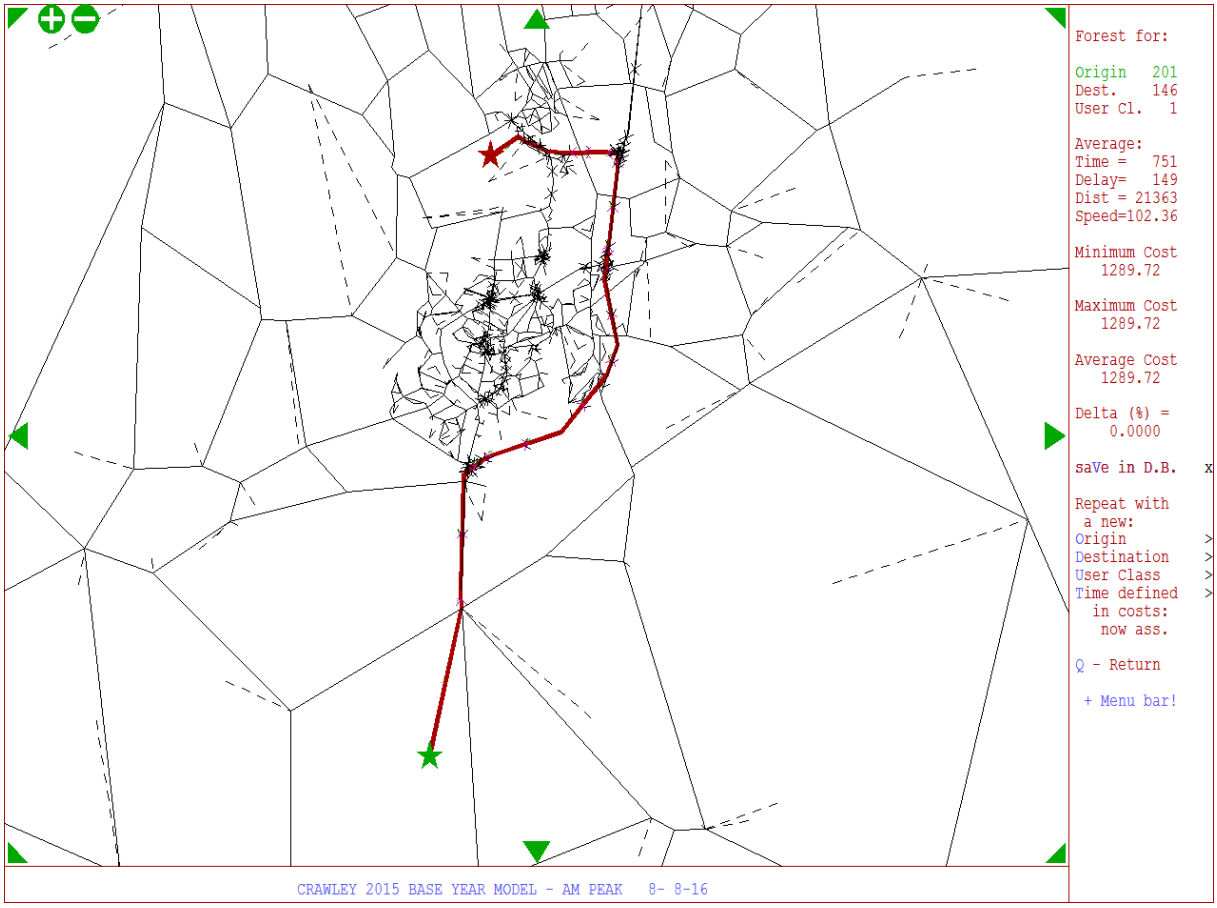
8.2.3 Crucially, all three time period models have been shown to meet convergence criteria guidelines demonstrating the stability and suitability of the models to discern scheme impact differences from impacts that may be due to other factors in the model were convergence of the model not good.

8.2.4 From the analysis of the results presented in this report, it is concluded that the base model is a robust tool for the agreed scope (set out in Section 1) and forms a good and acceptable platform from which to develop future forecasts. The model validation results are considered to be reasonably robust and therefore the model is considered suitable to measure the impacts on the network for the known schemes and future developments as outlined in Section 1.

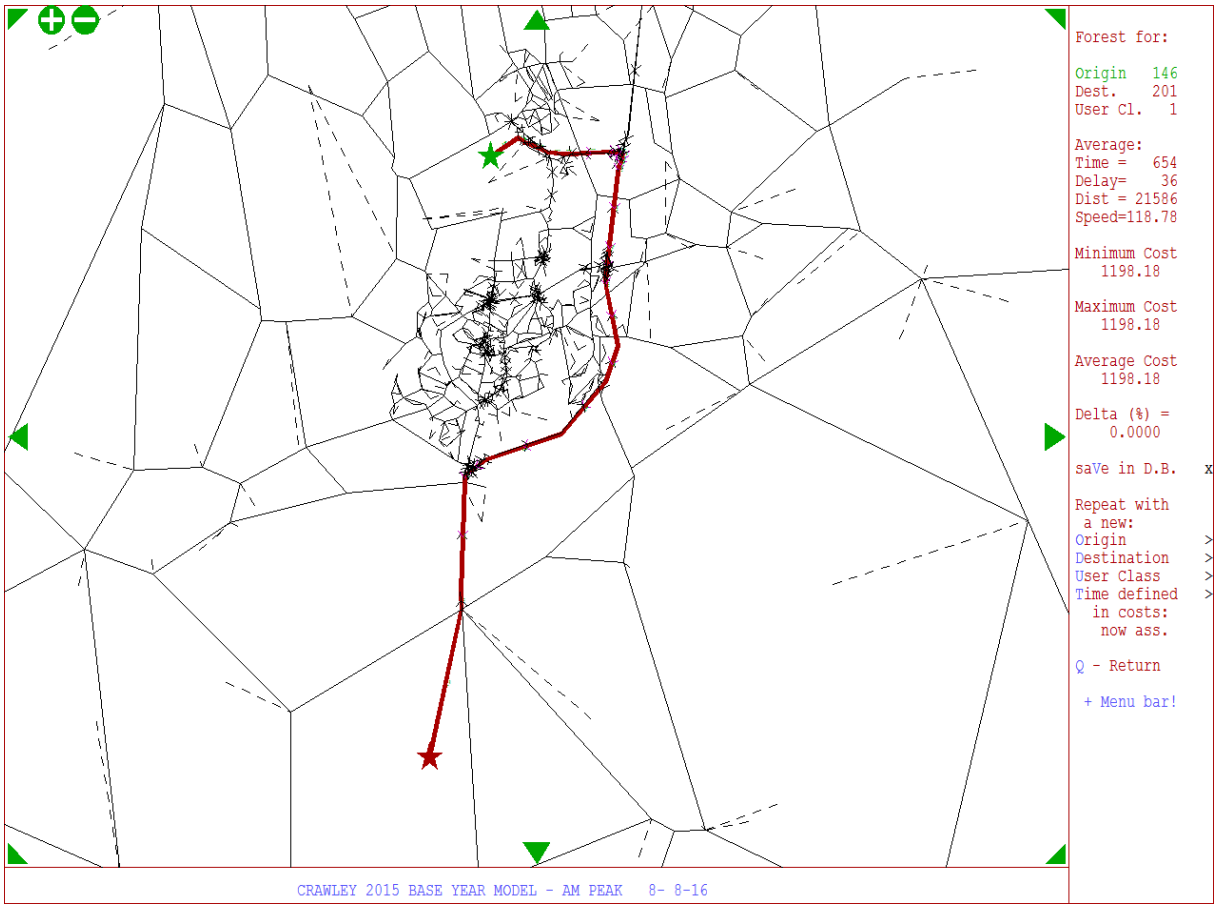
Appendix A AM Peak Route Checks

Job Name:	Crawley Transport Model
Job No:	35981
Note No:	N001
Date:	8 August 2016
Prepared By:	Carlos Ferrando
Subject:	**AM Routes**

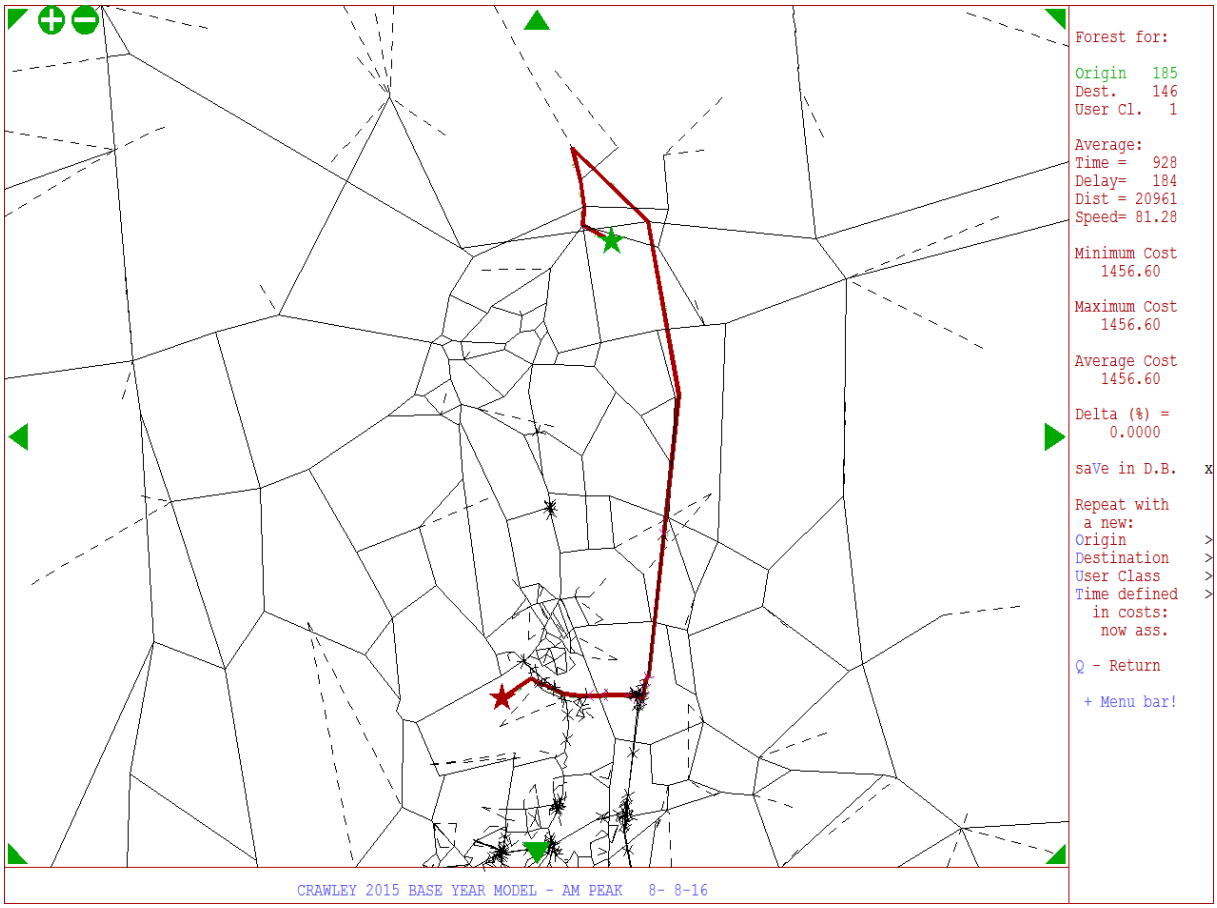
Route 1 – Zone 201 (A23) to Zone 146 (Gatwick Airport) – Northbound



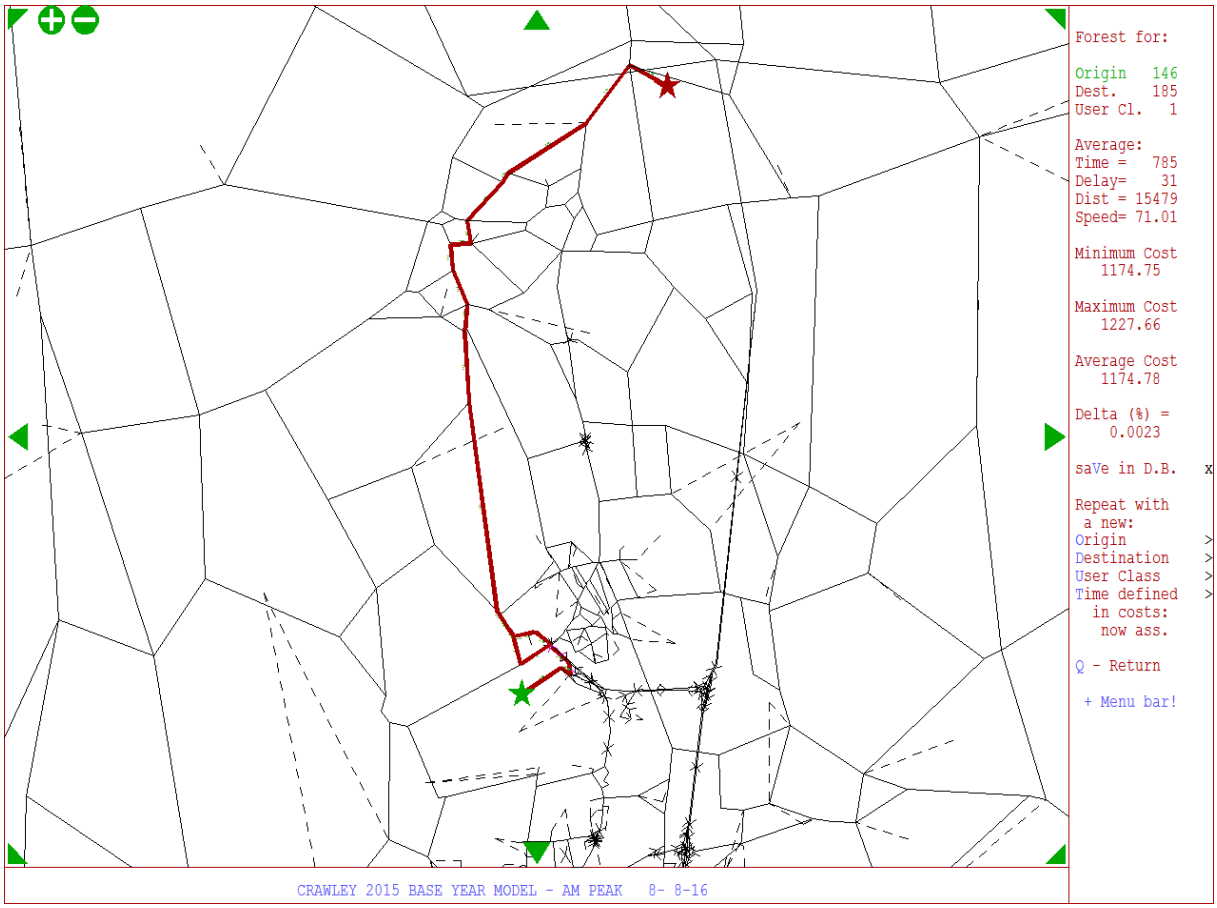
Route 1 – Zone 146 (Gatwick Airport) to Zone 201 (A23) - Southbound



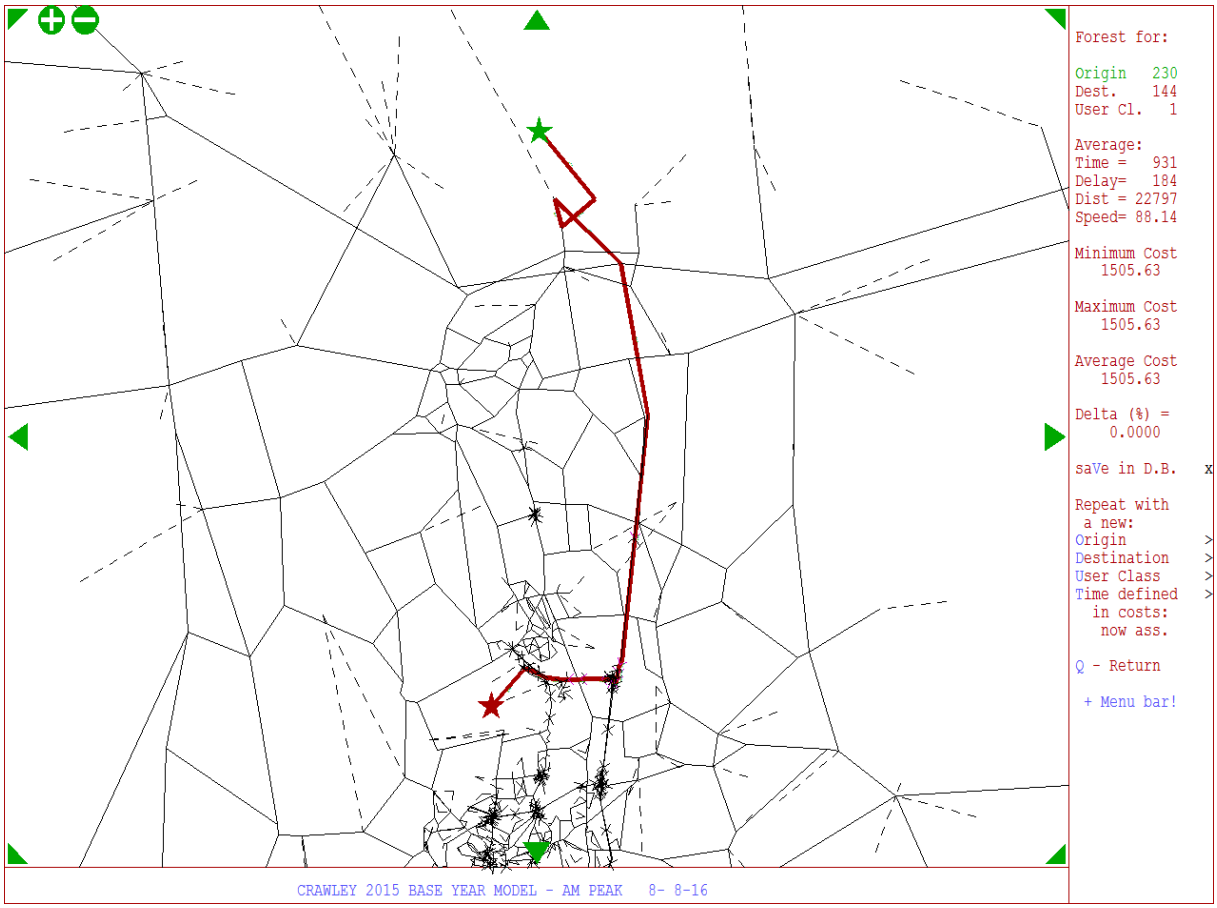
Route 2 – Zone 185 (M25N) to Zone 146 (Gatwick Airport) - Southbound



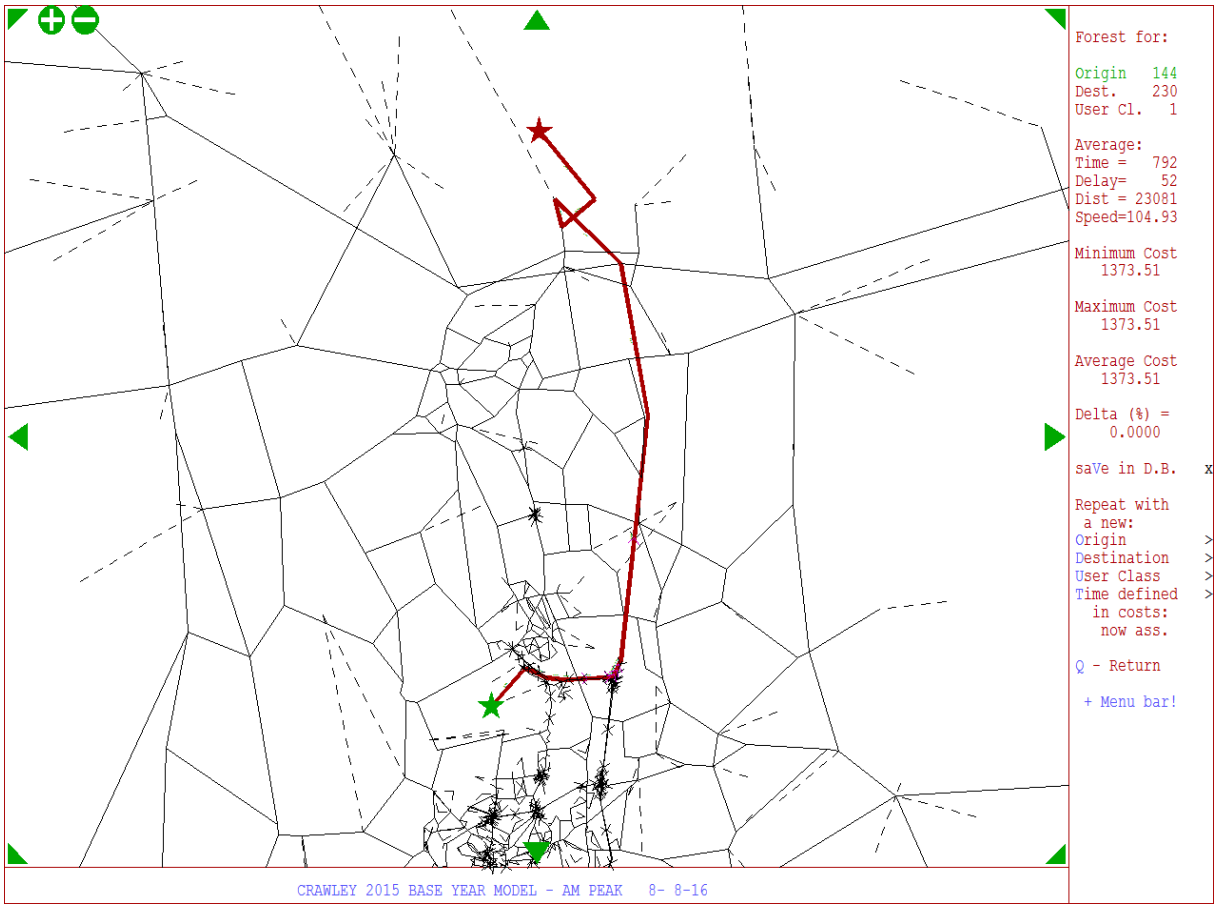
Route 2 – Zone 146 (Gatwick Airport) to Zone 185 (M25N) - Northbound



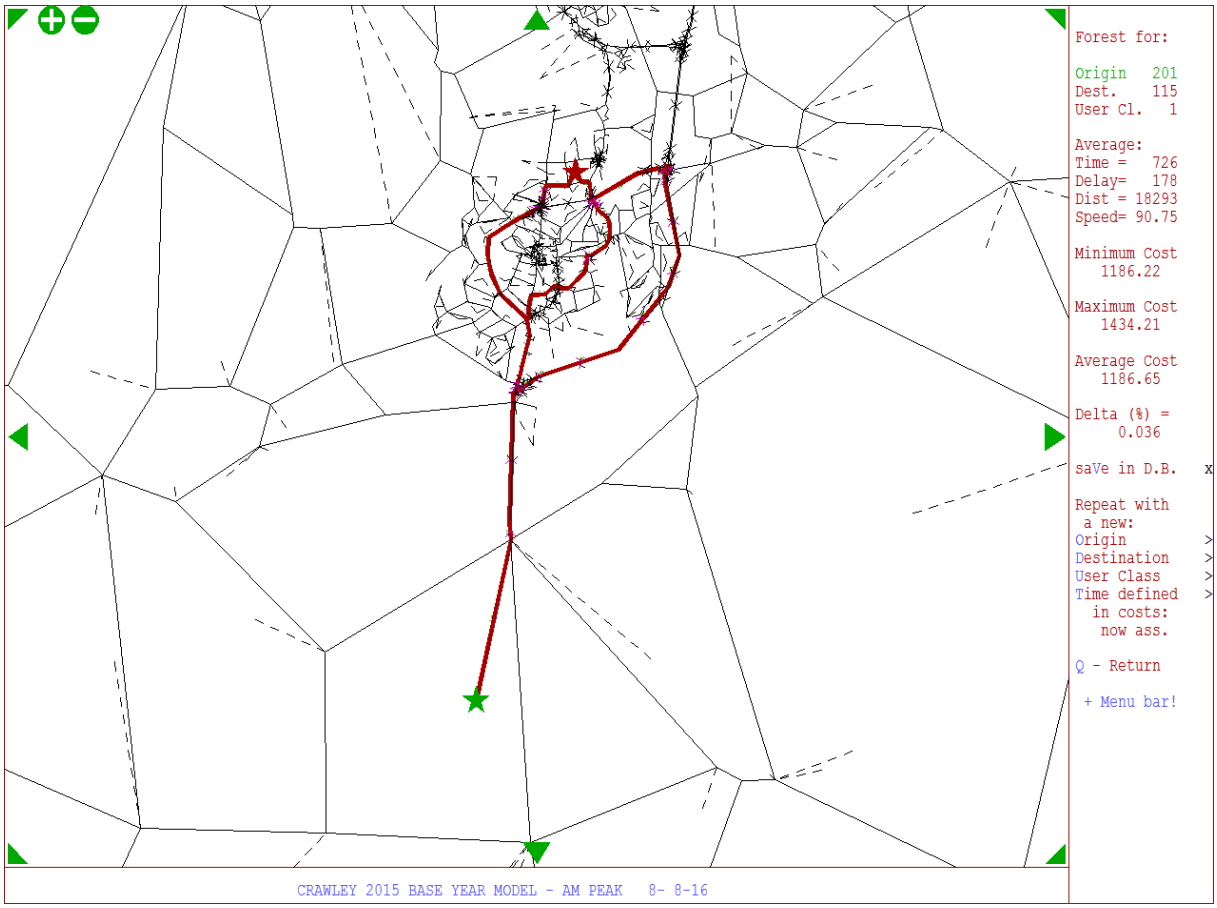
Route 3 – Zone 230 (M25N) to Zone 144 (Gatwick Airport) – Southbound



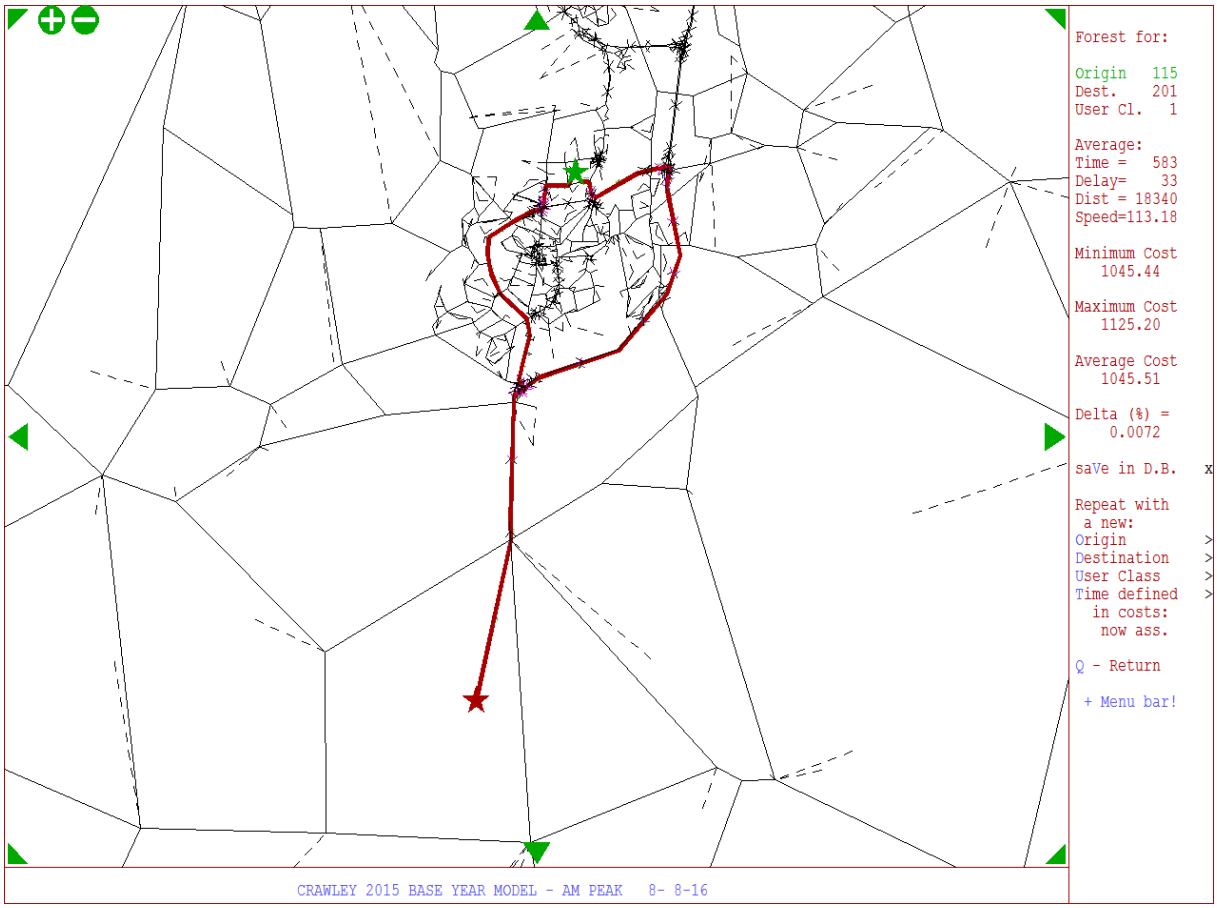
Route 3 – Zone 144 (Gatwick Airport) to Zone 230 (MN25N) – Northbound



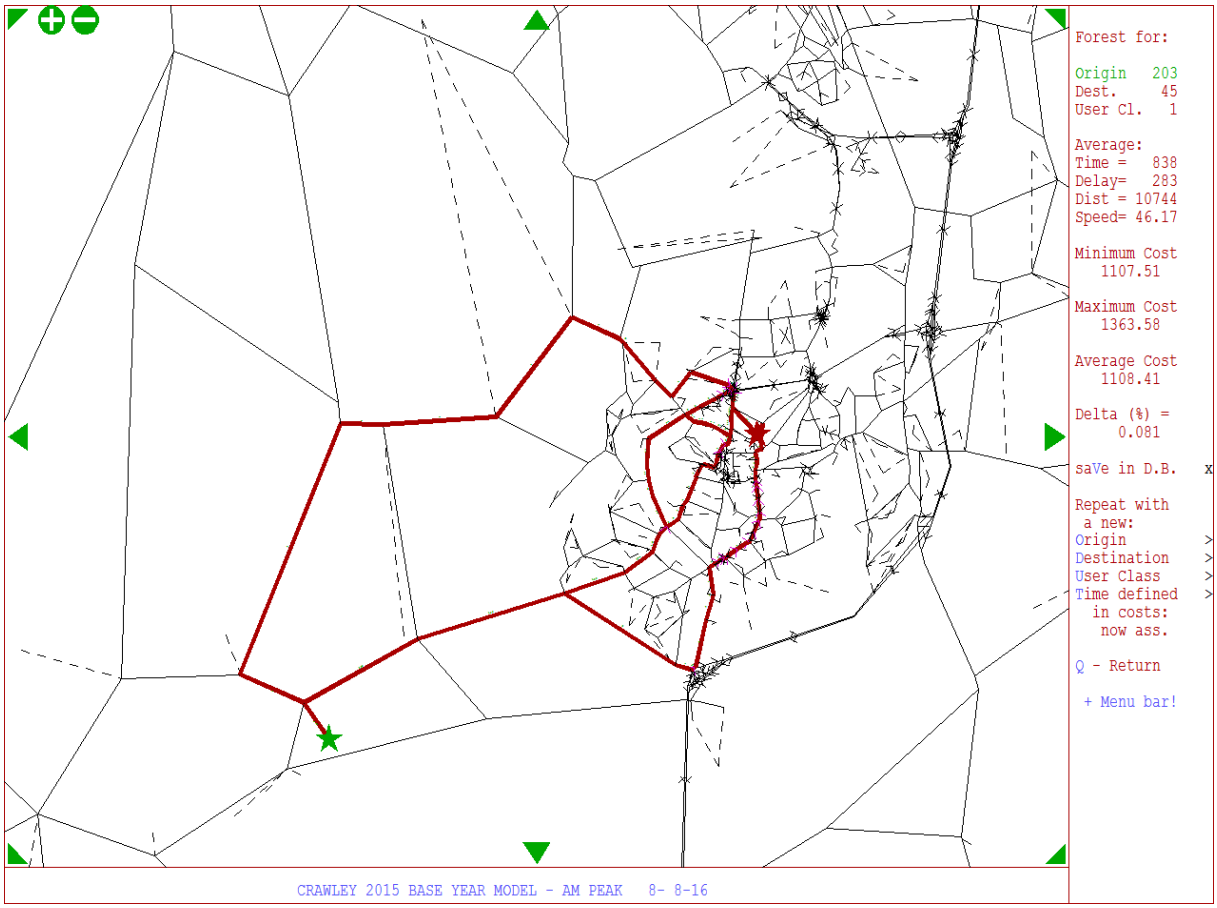
Route 4 – Zone 201 (A235) to Zone 115 (Manor Royal) – Northbound



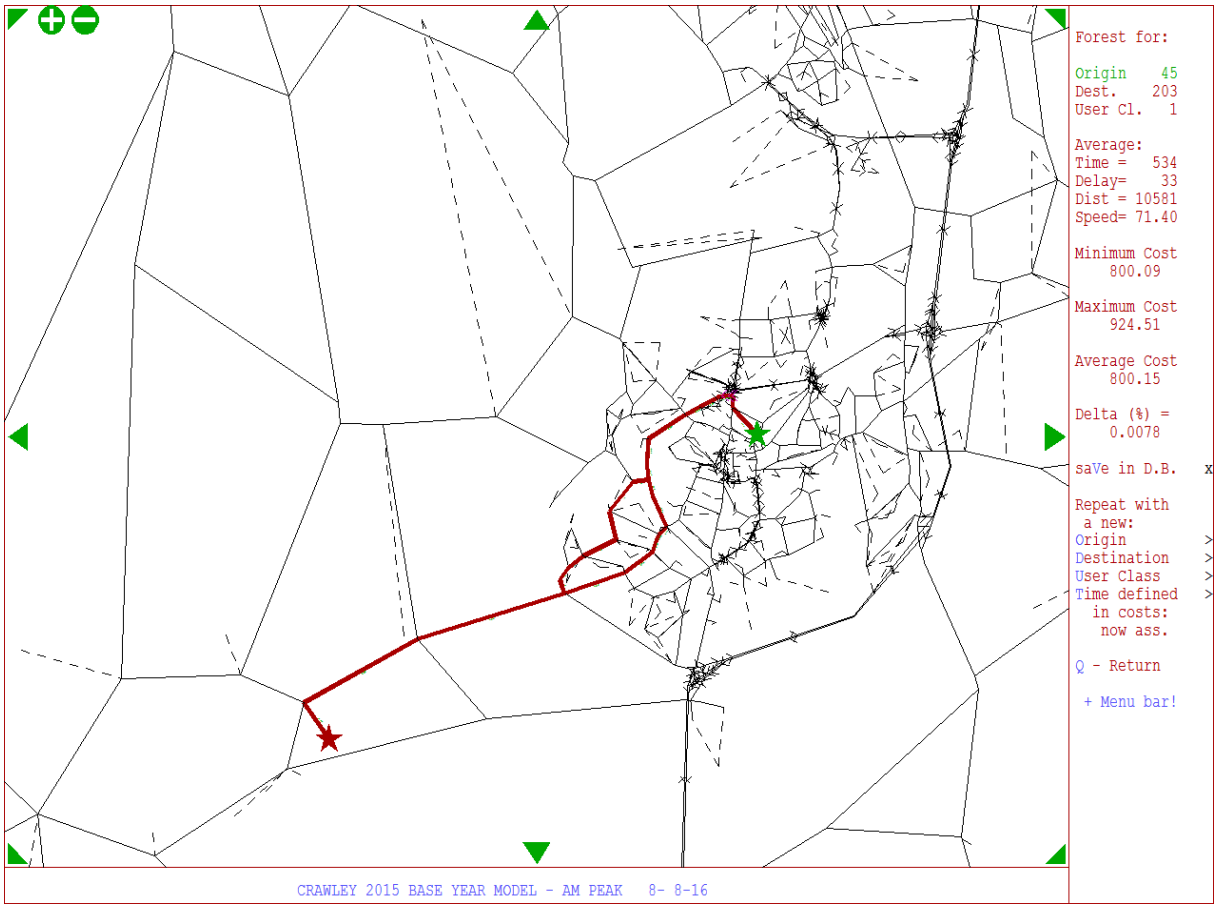
Route 4 – Zone 115 (Manor Royal) to Zone 201 (A235) – Southbound



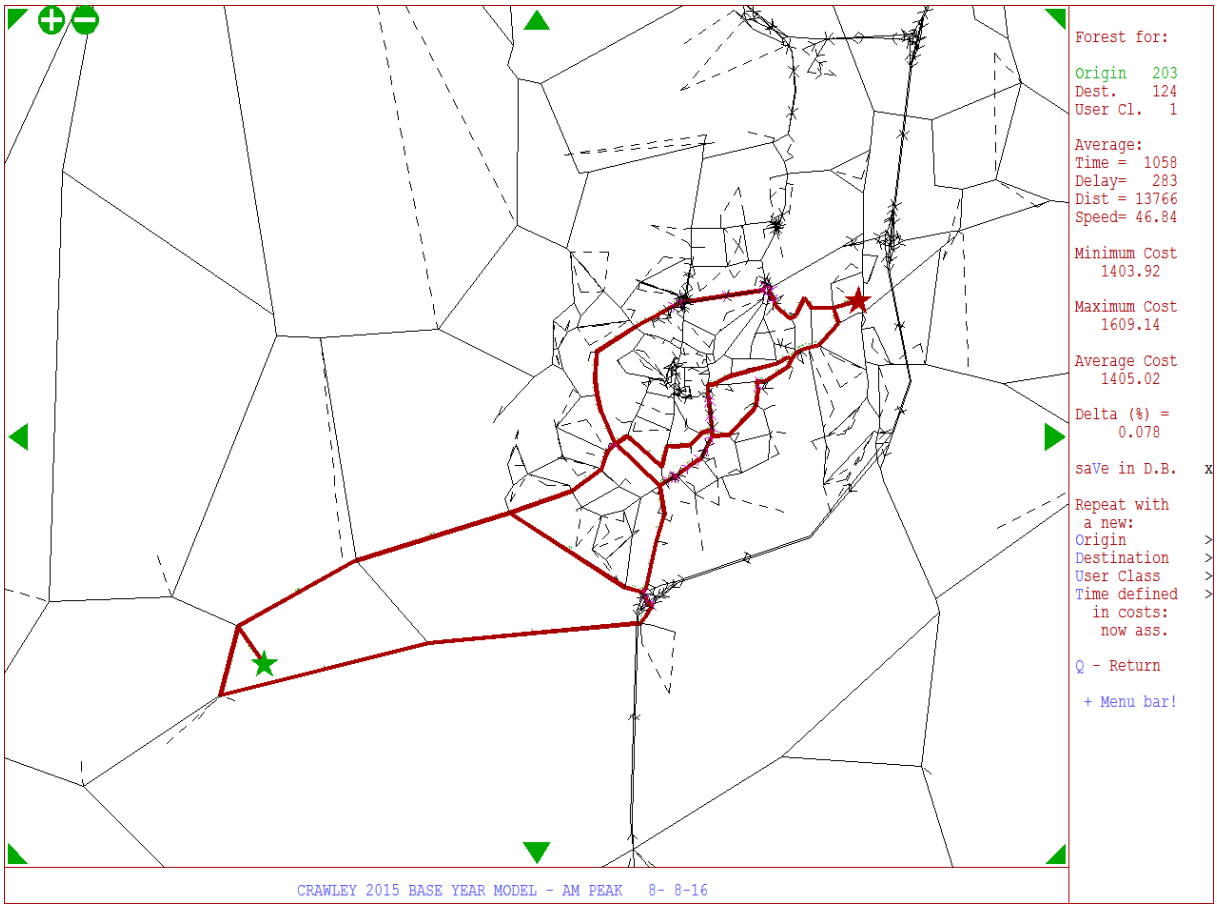
Route 5 – Zone 203 (Horsham) to Zone 45 (TC) – Eastbound



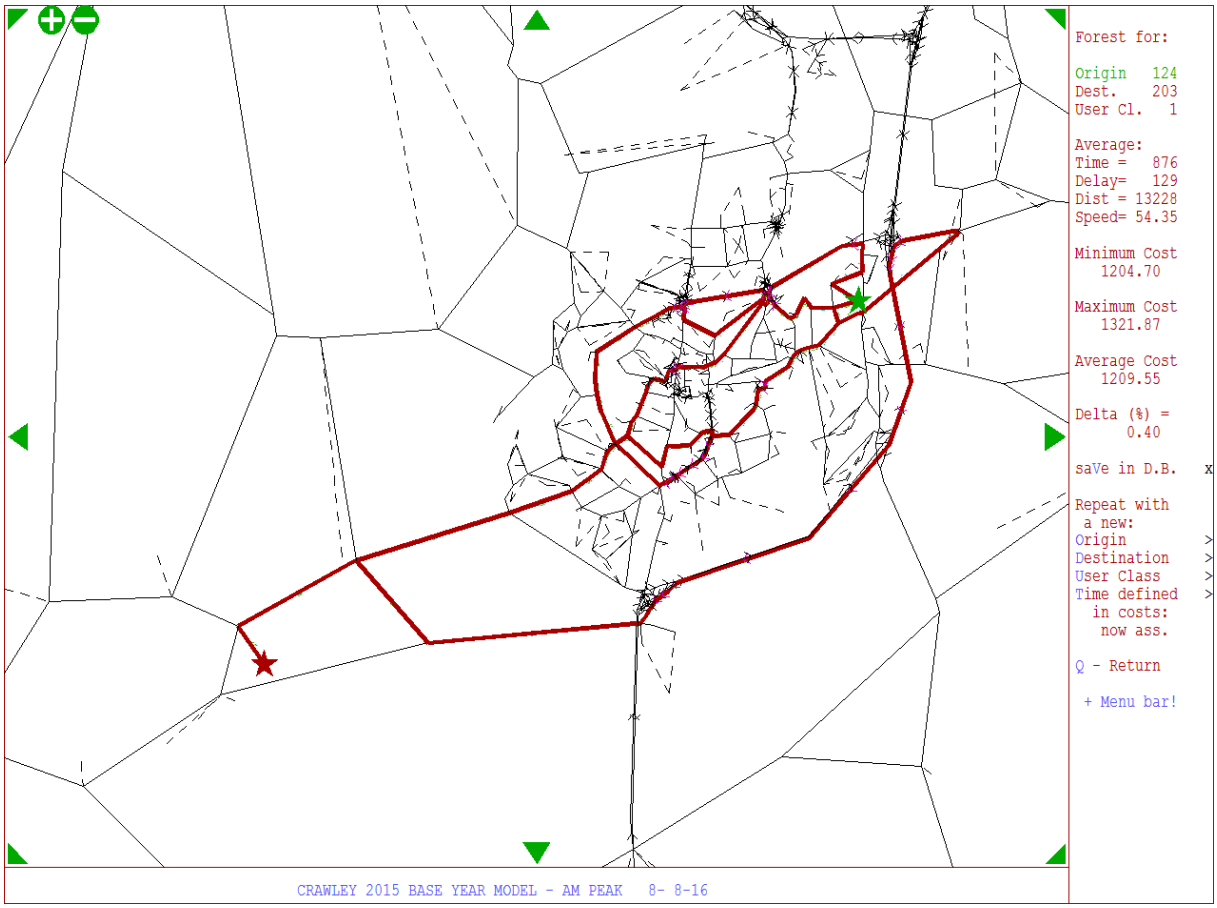
Route 5 – Zone 45 (TC) to Zone 203 (Horsham) – Westbound



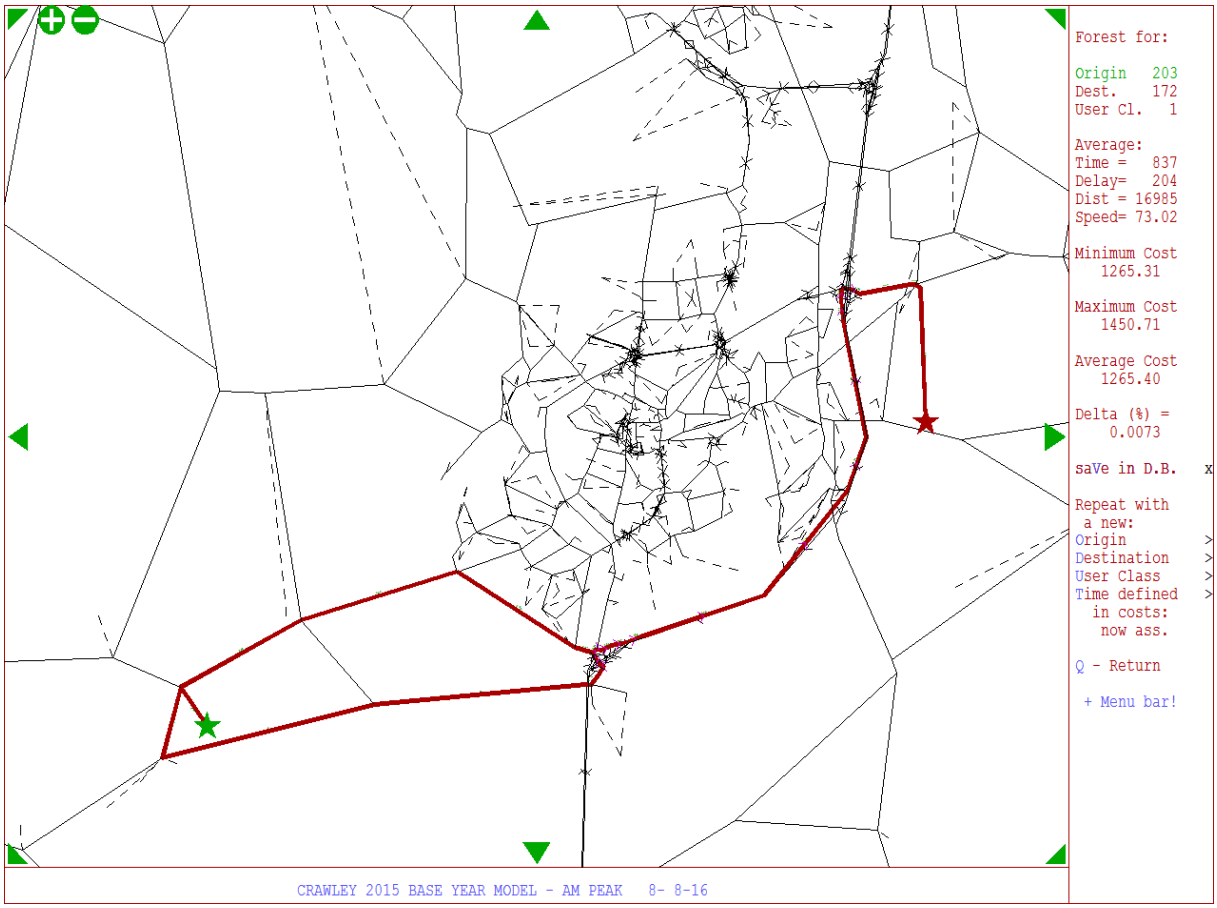
Route 6 – Zone 203 (Horsham) to Zone 124 (Heathfield within M23) – Eastbound



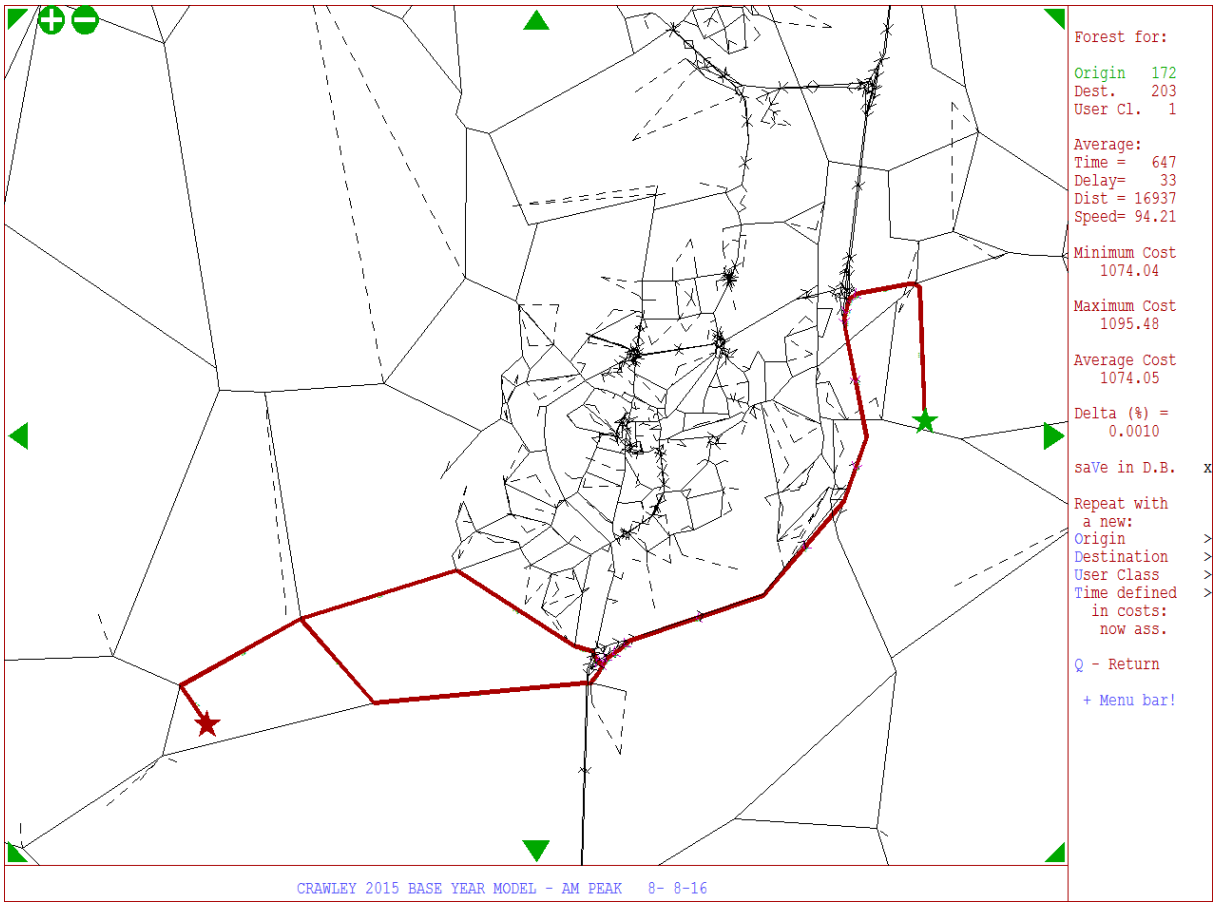
Route 6 – Zone 124 (Heathfield within M23) to Zone 203 (Horsham) – Westbound



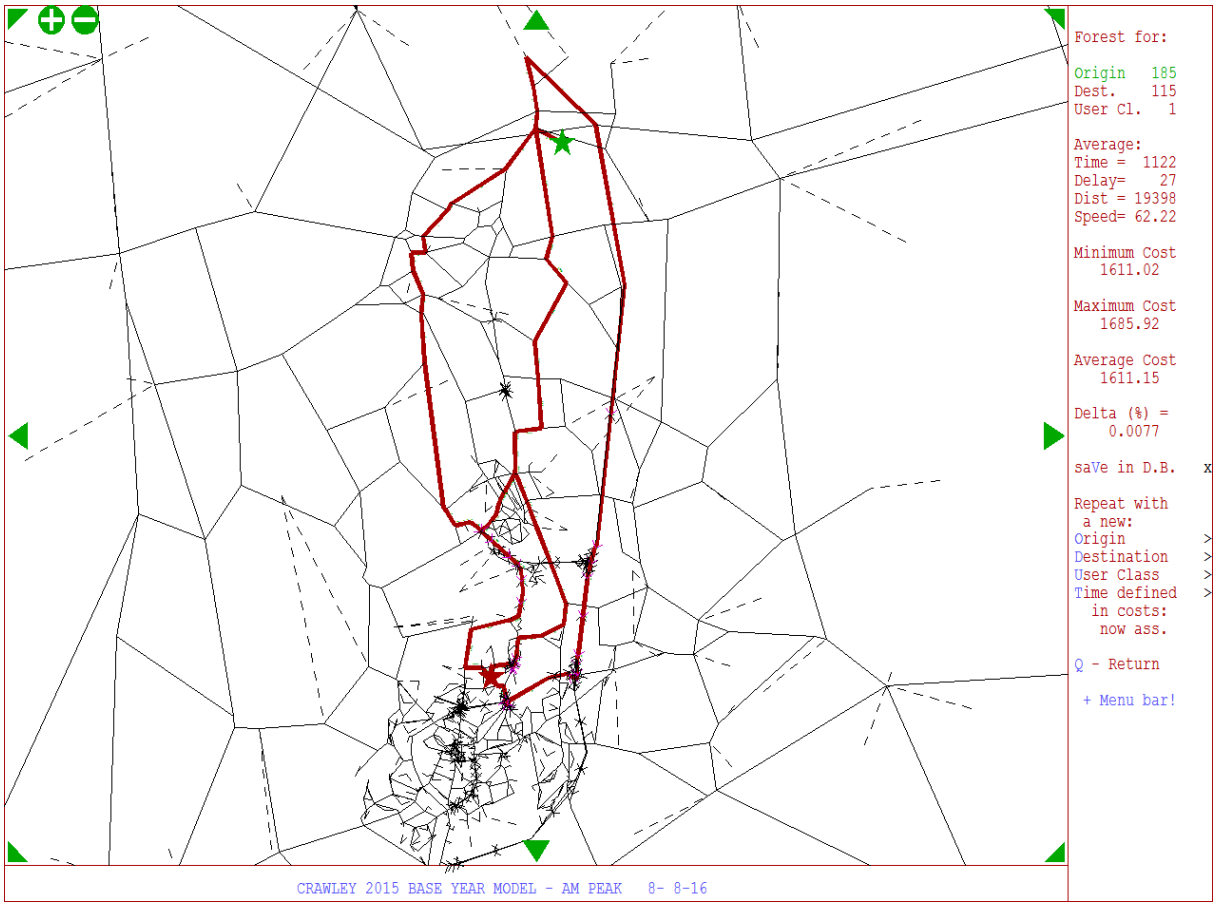
Route 7 – Zone 203 (Horsham) to Zone 172 () – Eastbound



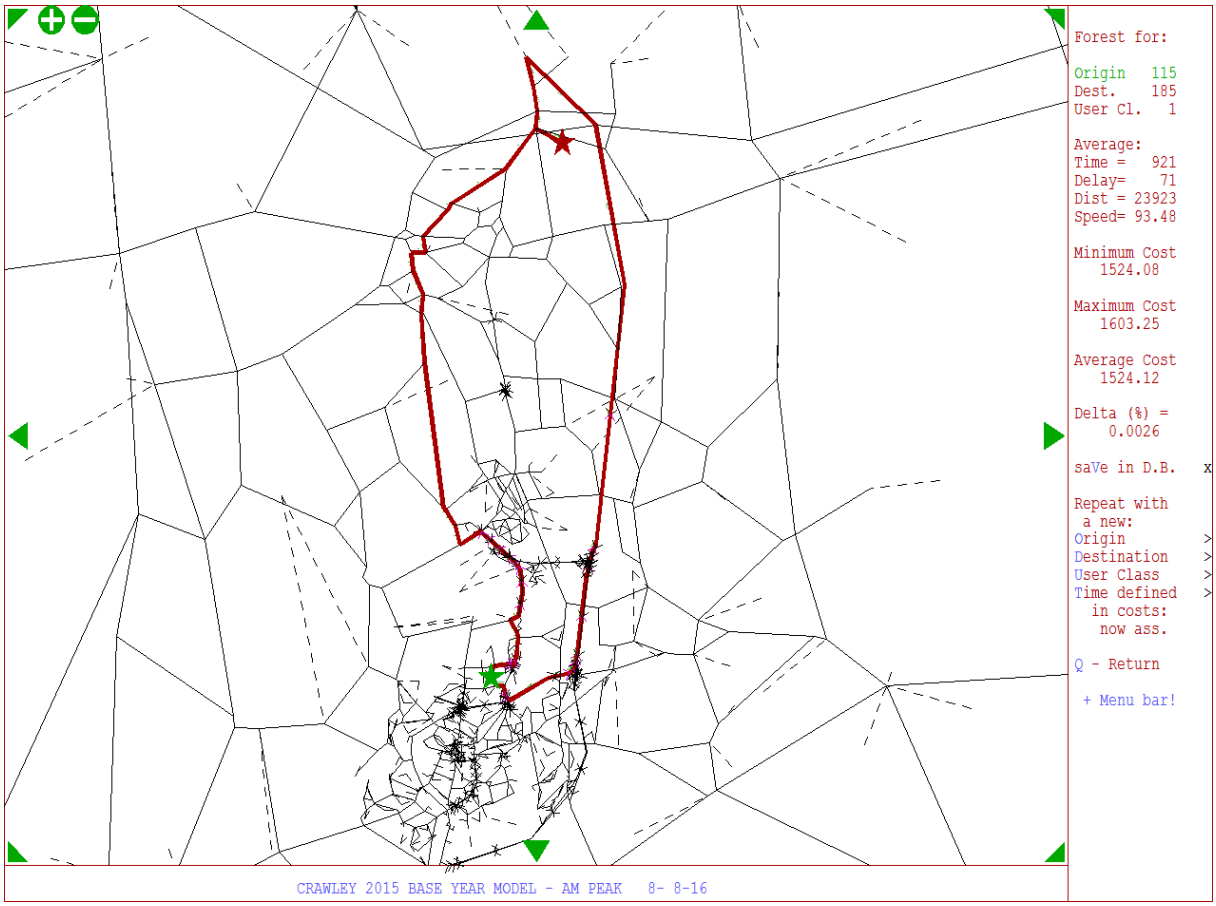
Route 7 – Zone 172 () to Zone 203 (Horsham) – Westbound



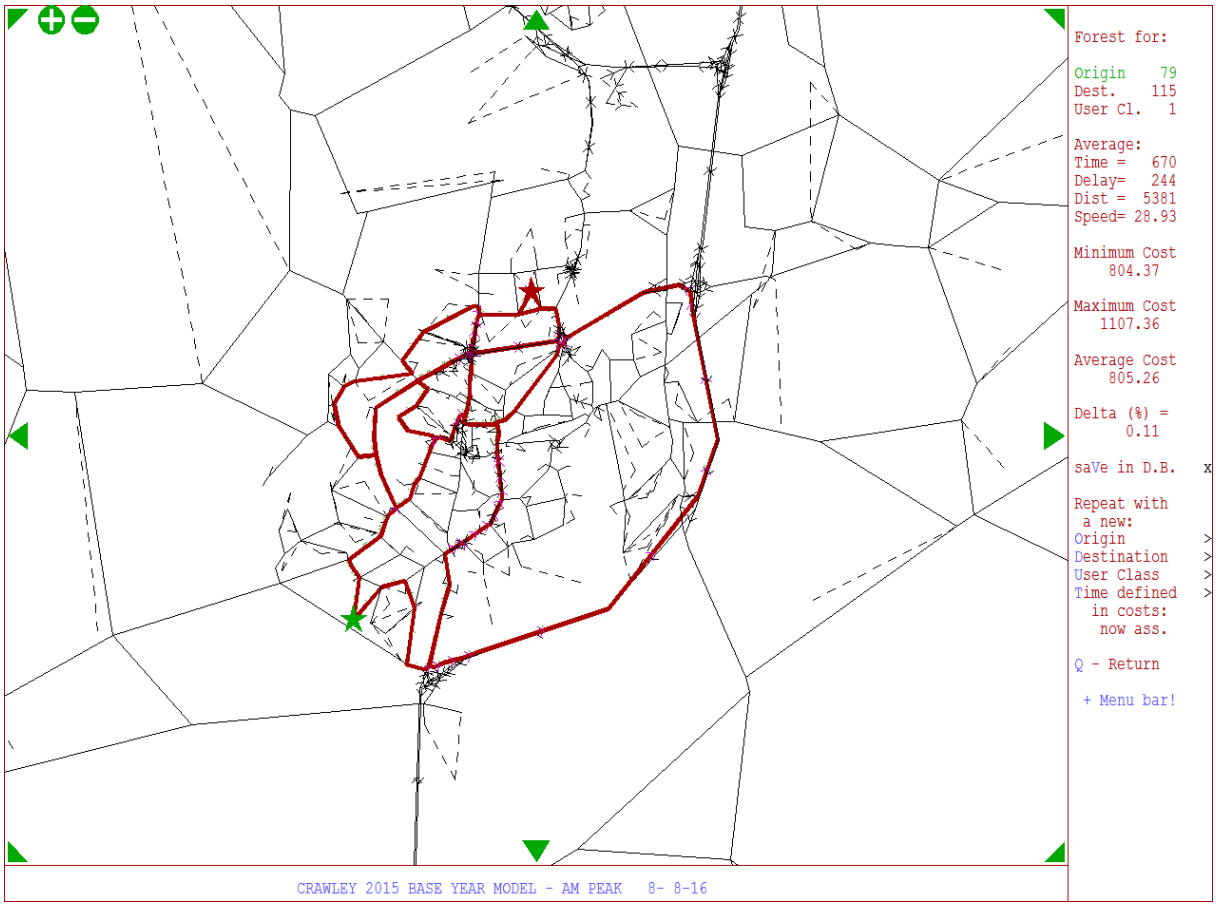
Route 8 – Zone 185 (M25N) to Zone 115 (Manor Royal) – Southbound



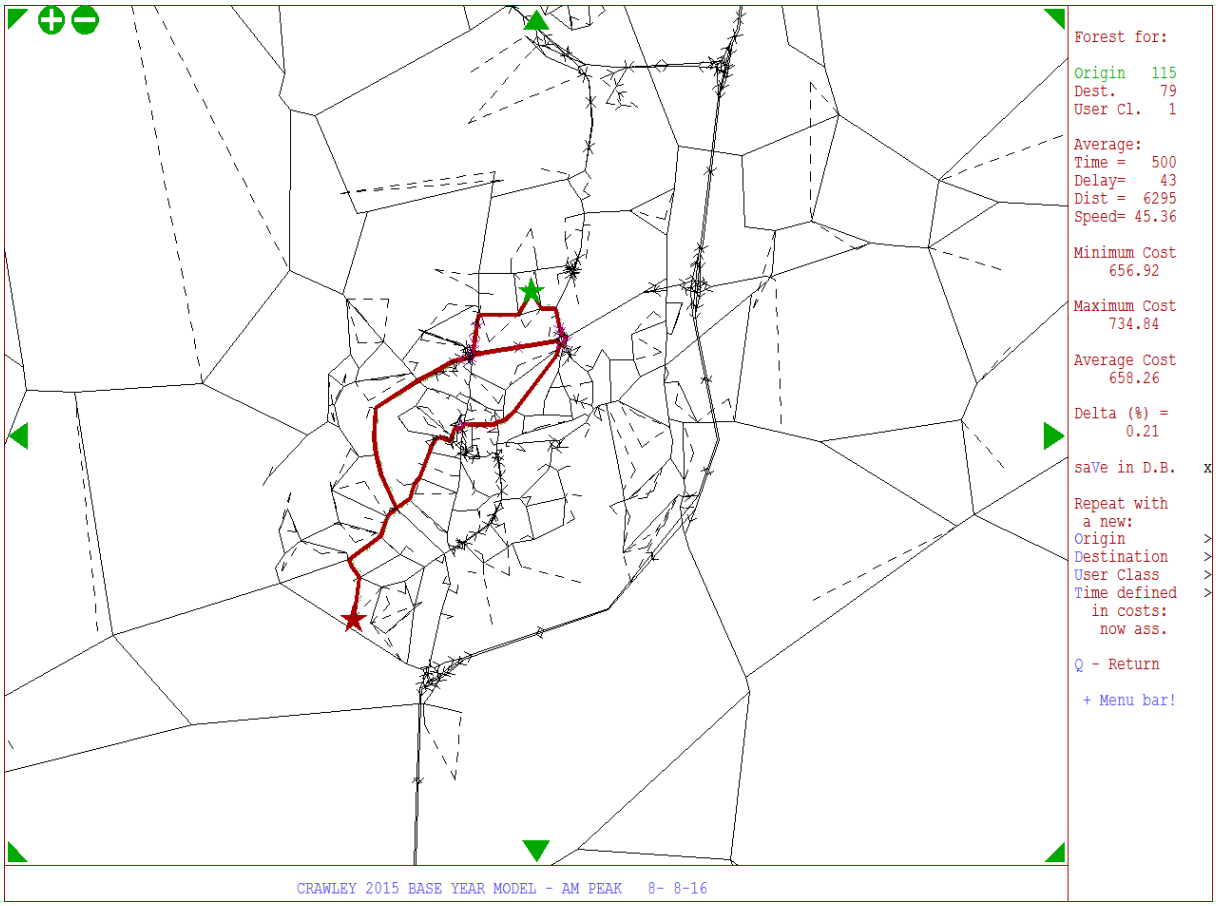
Route 8 – Zone 115 (Manor Royal) to Zone 185 (M25N) – Northbound



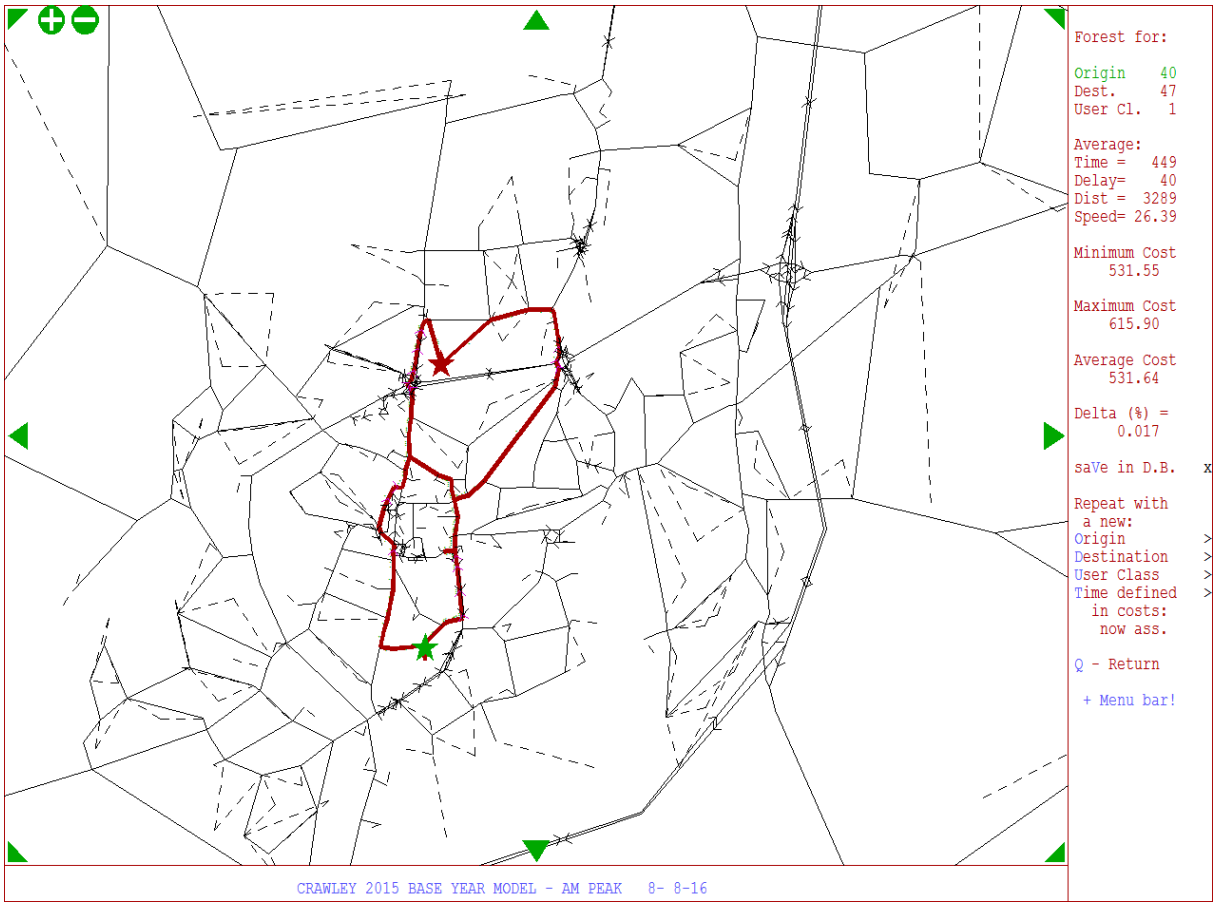
Route 9 – Zone 79 (Broadfield) to Zone 115 (Manor Royal) – Northbound



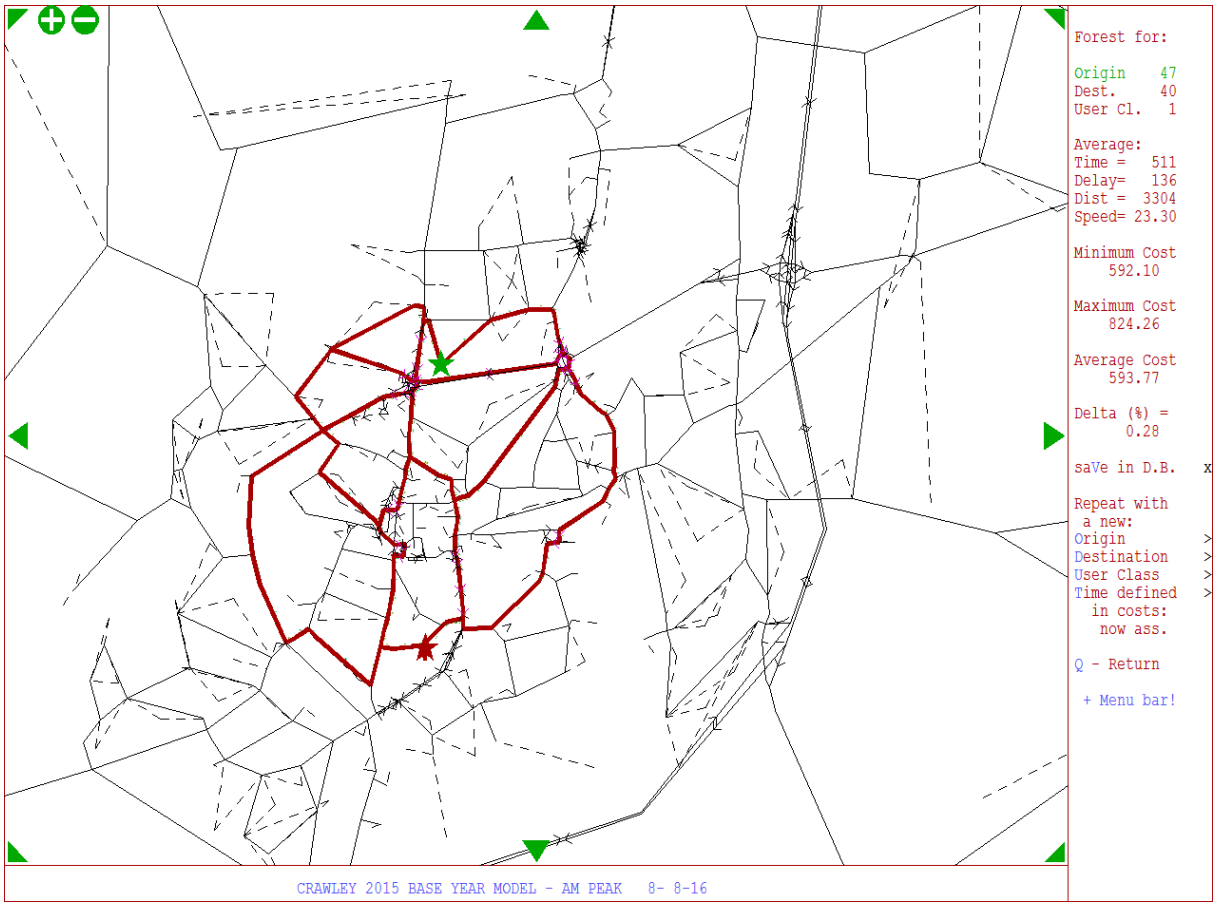
Route 9 – Zone 115 (Manor Royal) to Zone 79 (Broadfield) – Southbound



Route 10 – Zone 40 (TC/Crawley South) to Zone 47 (Manor Royal) – Northbound



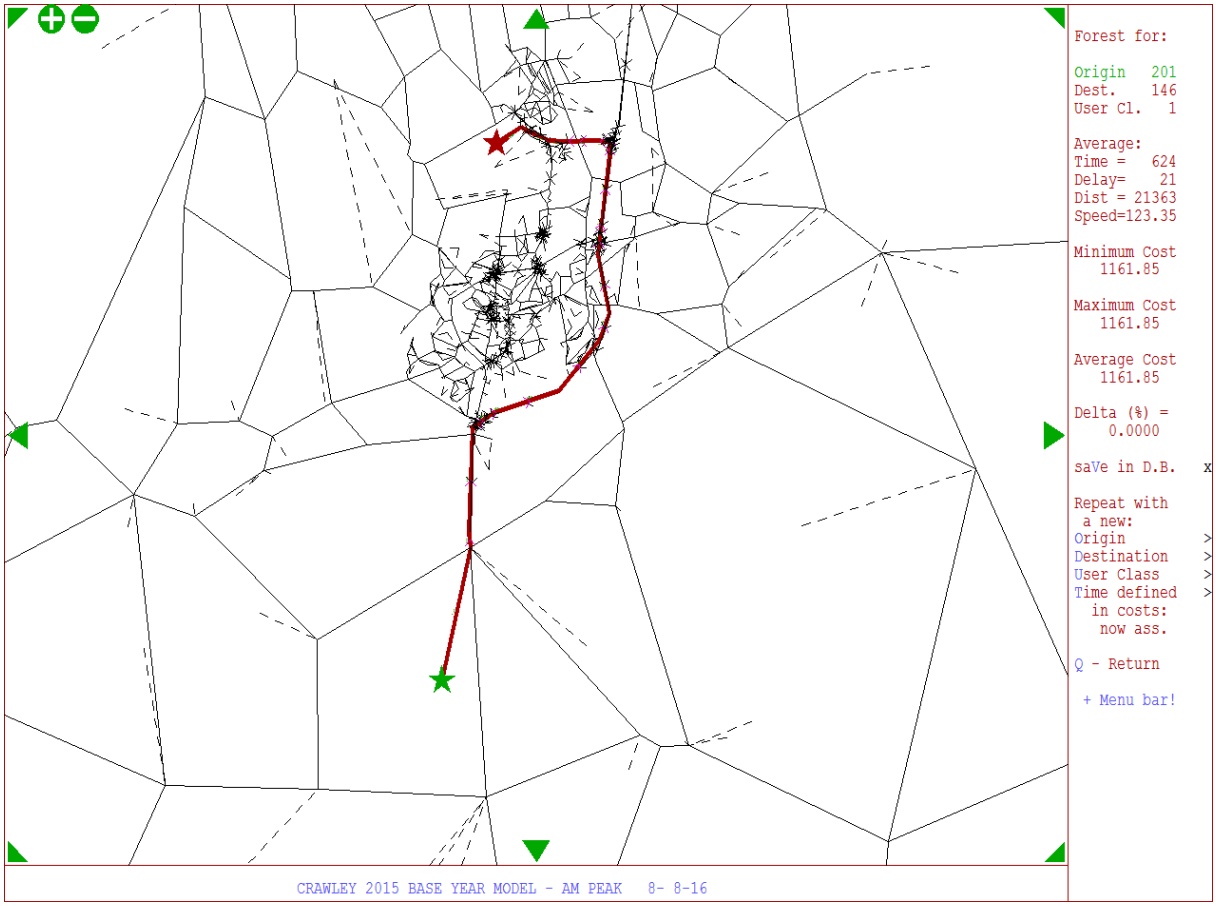
Route 10 – Zone 47 (Manor Royal) to Zone 40 (TC/Crawley South) – Southbound



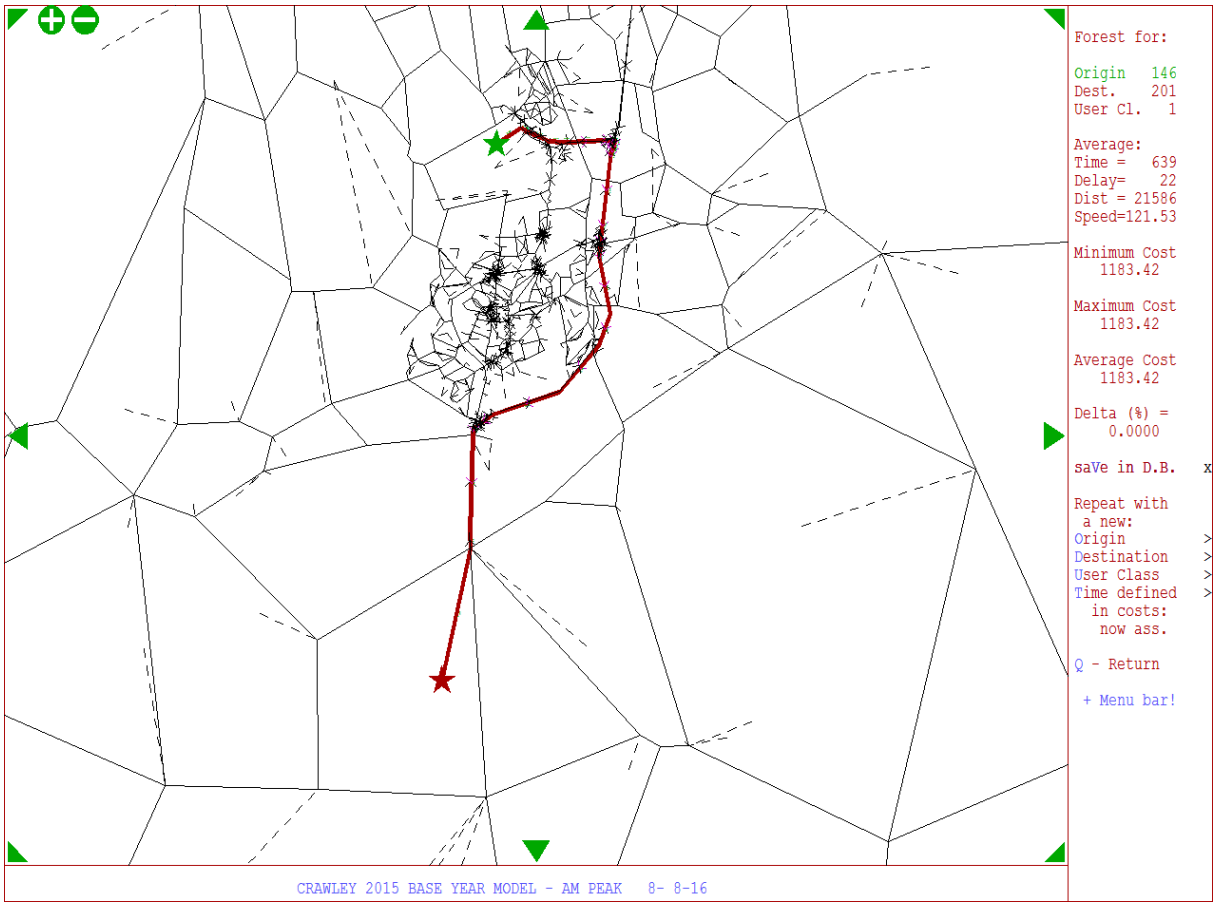
Appendix B Inter Peak Route Checks

Job Name:	Crawley Transport Model
Job No:	35981
Note No:	N002
Date:	8 August 2016
Prepared By:	Carlos Ferrando
Subject:	**IP Routes**

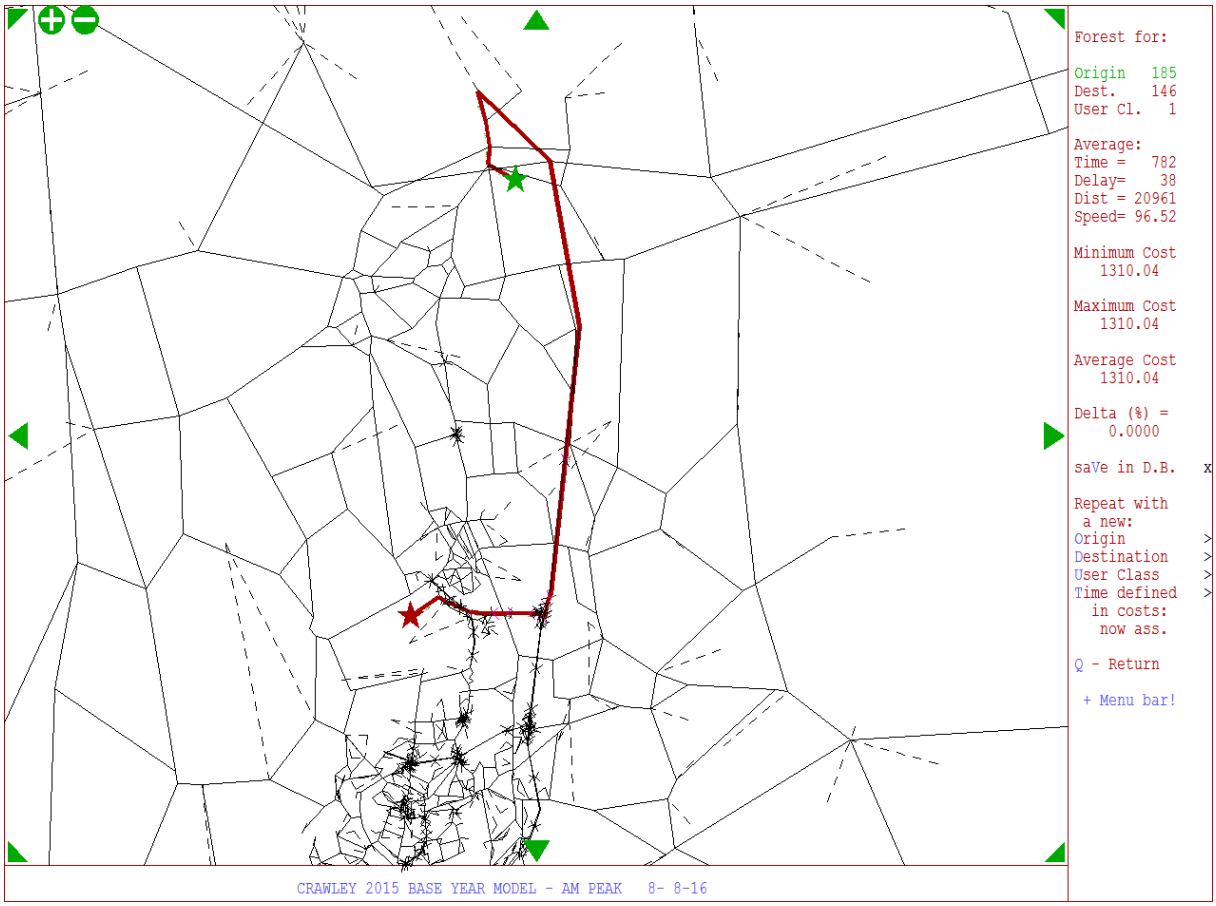
Route 1 – Zone 201 (A23) to Zone 146 (Gatwick Airport) – Northbound



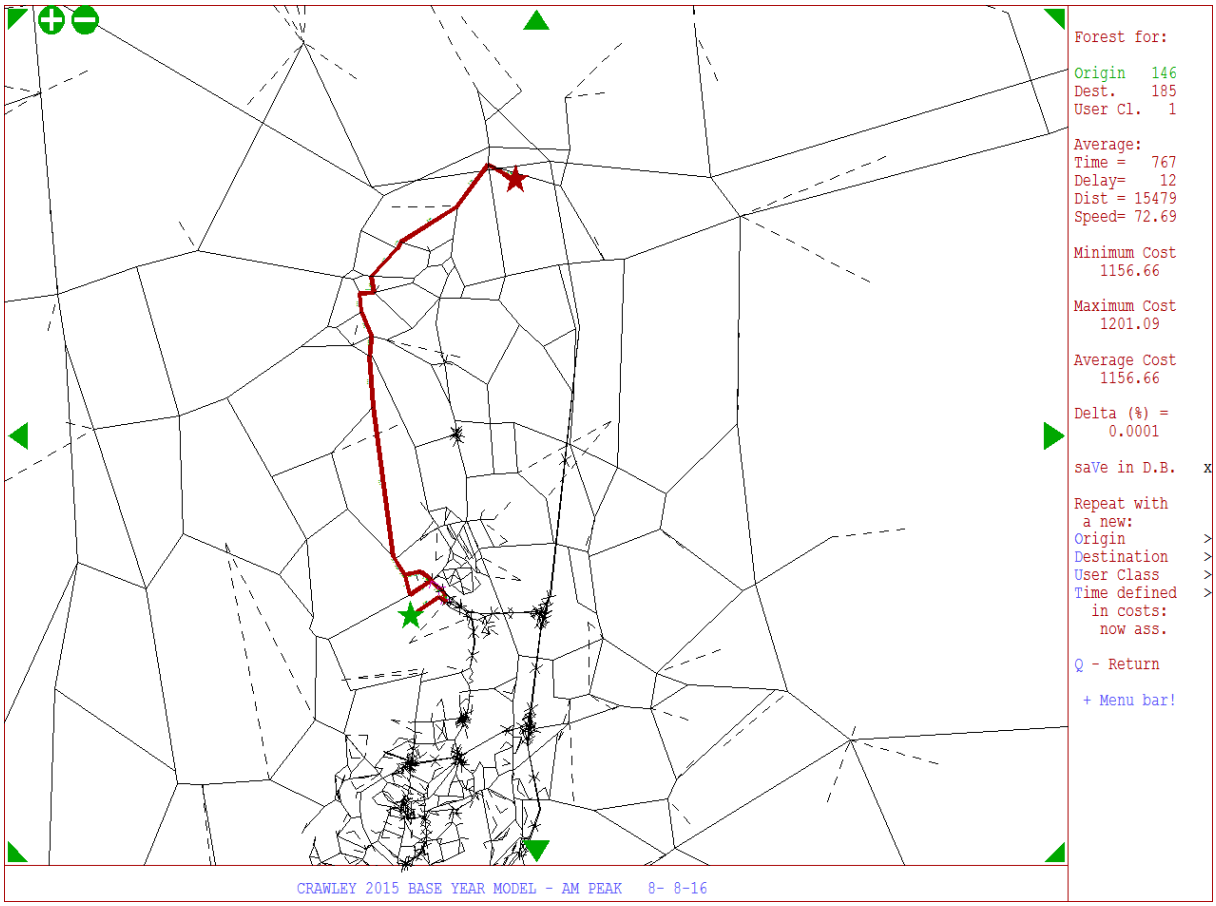
Route 1 – Zone 146 (Gatwick Airport) to Zone 201 (A23) - Southbound



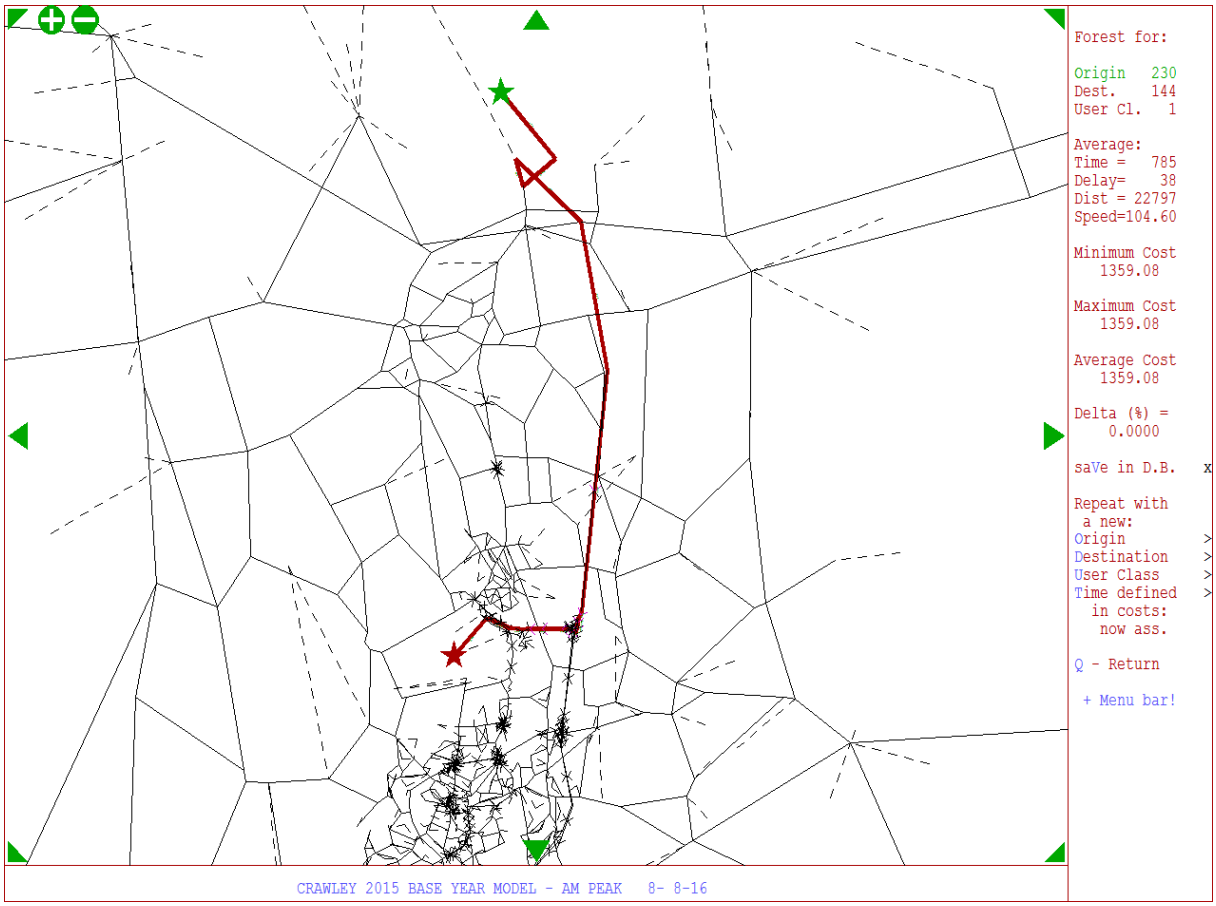
Route 2 – Zone 185 (M25N) to Zone 146 (Gatwick Airport) – Southbound



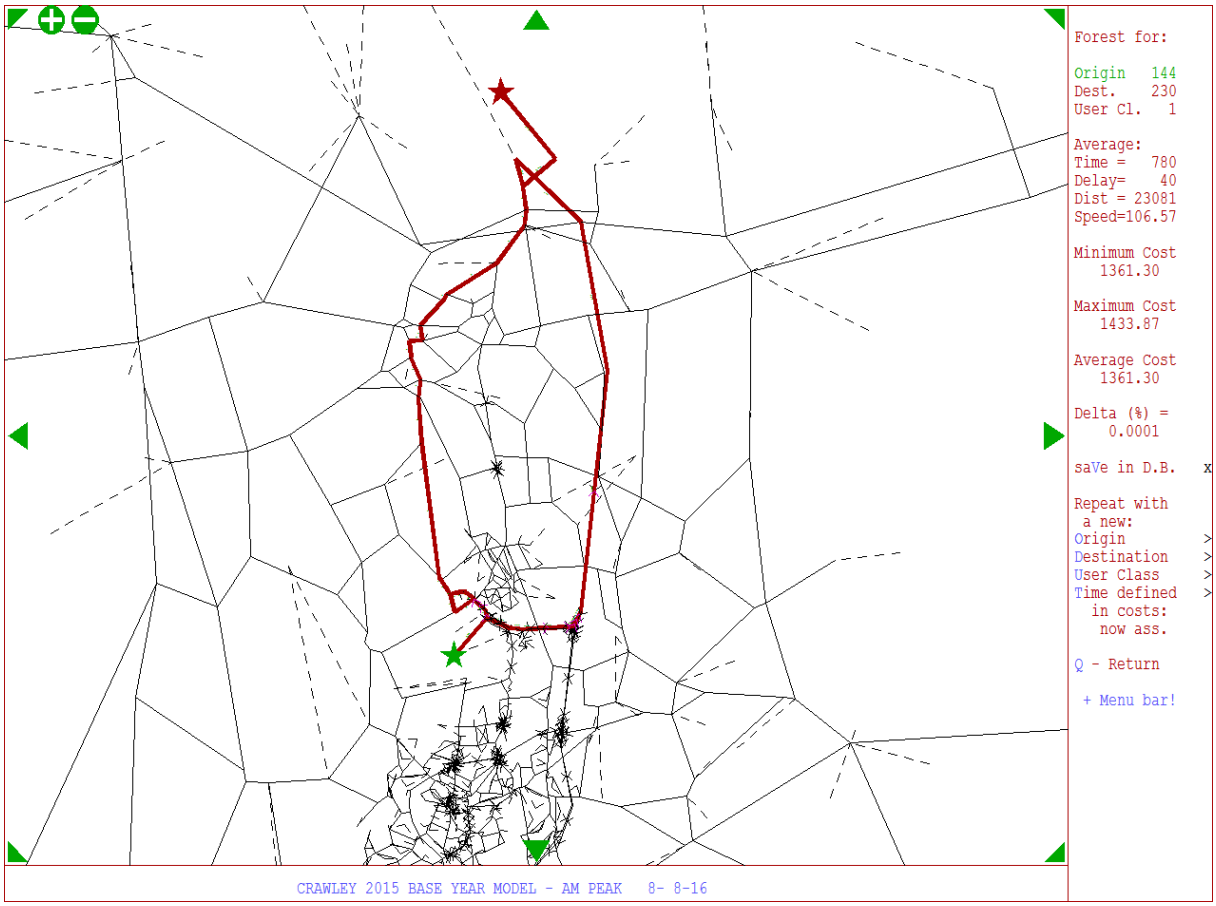
Route 2 – Zone 146 (Gatwick Airport) to Zone 185 (M25N) - Northbound



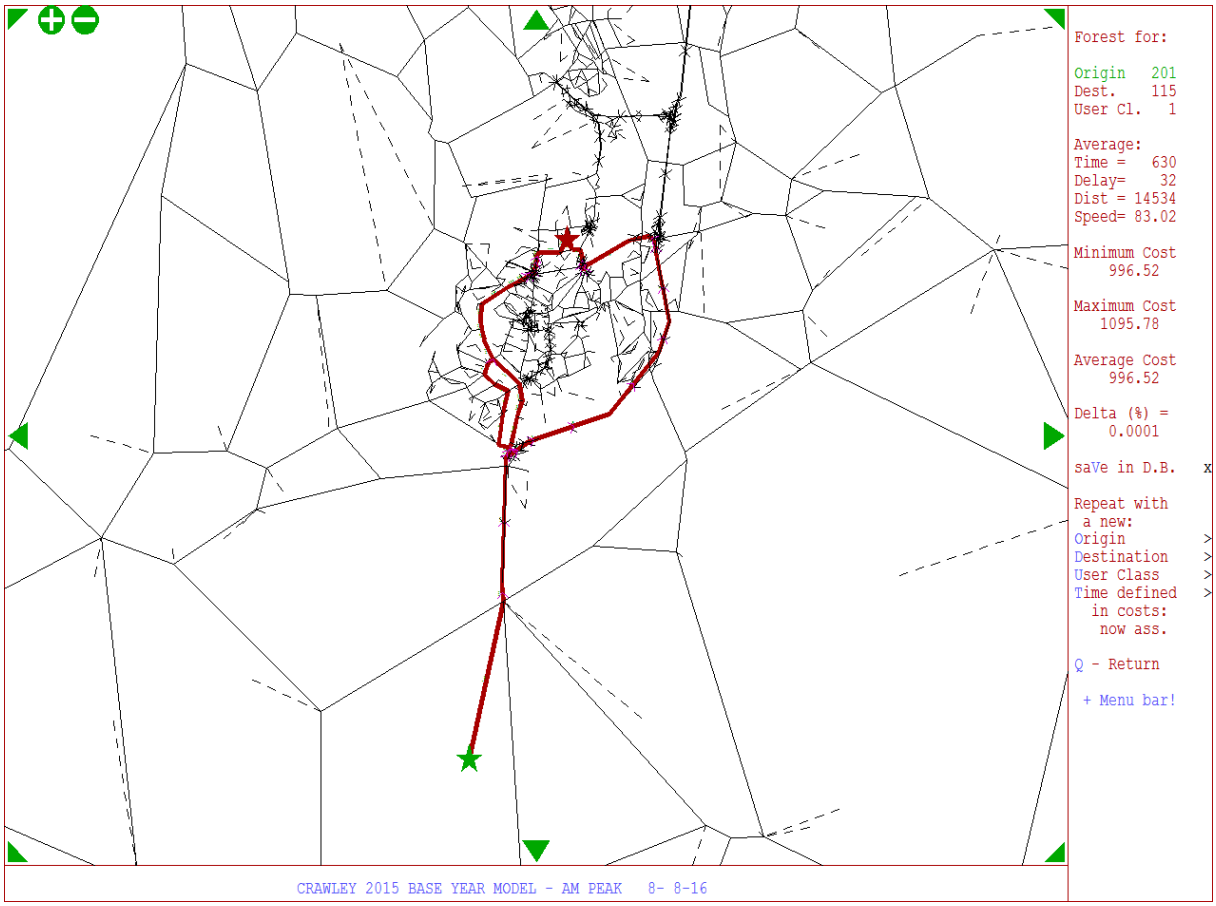
Route 3 – Zone 230 (M25N) to Zone 144 (Gatwick Airport) - Southbound



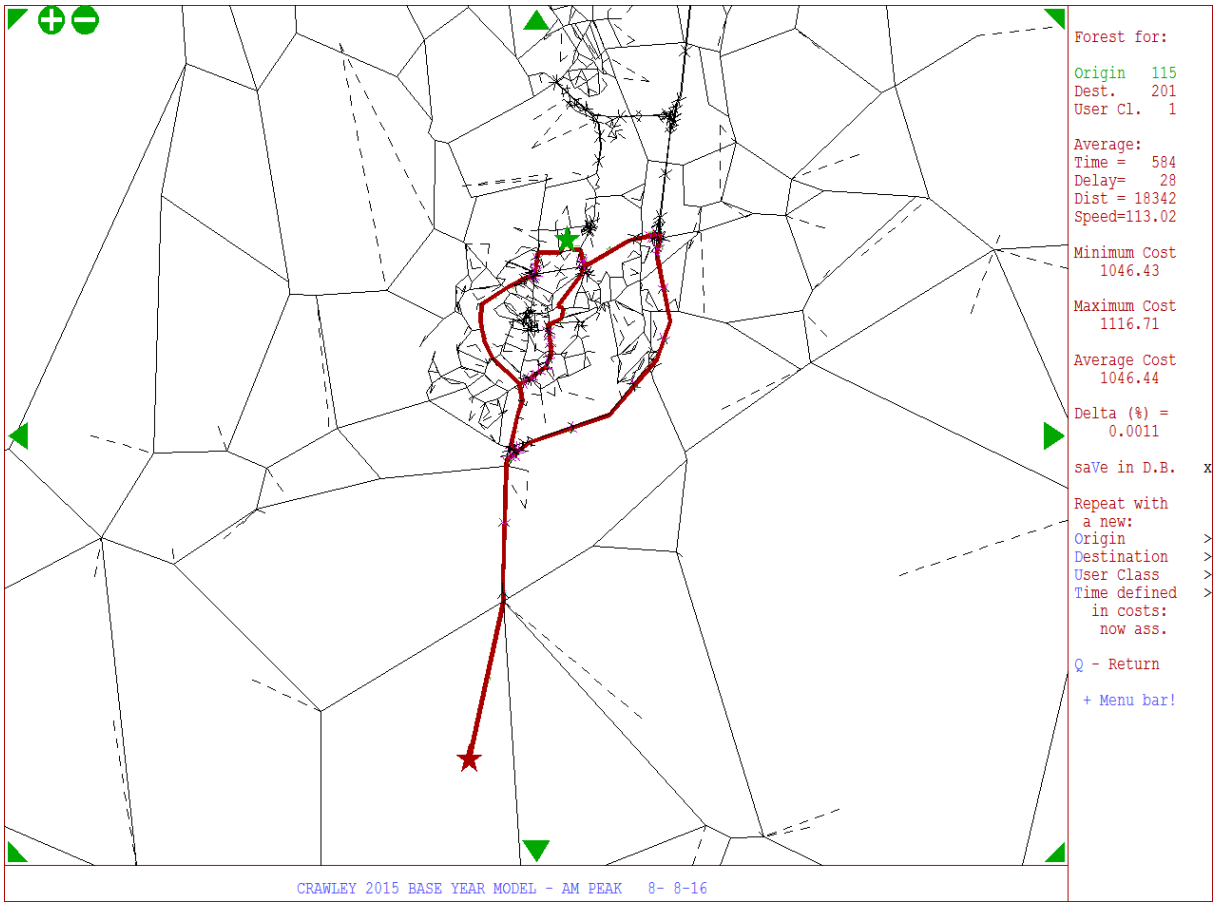
Route 3 – Zone 144 (Gatwick Airport) to Zone 230 (MN25N) – Northbound



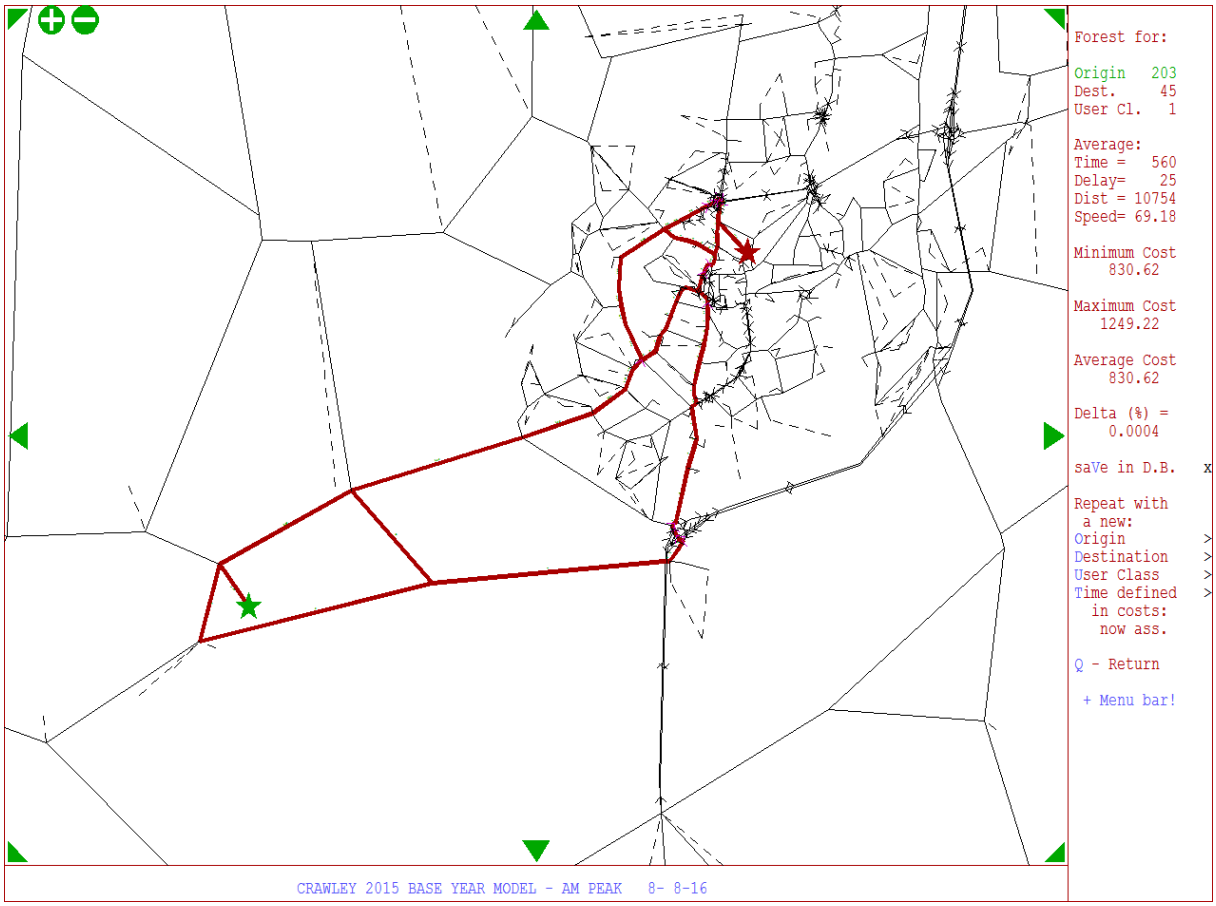
Route 4 – Zone 201 (A235) to Zone 115 (Manor Royal) – Northbound



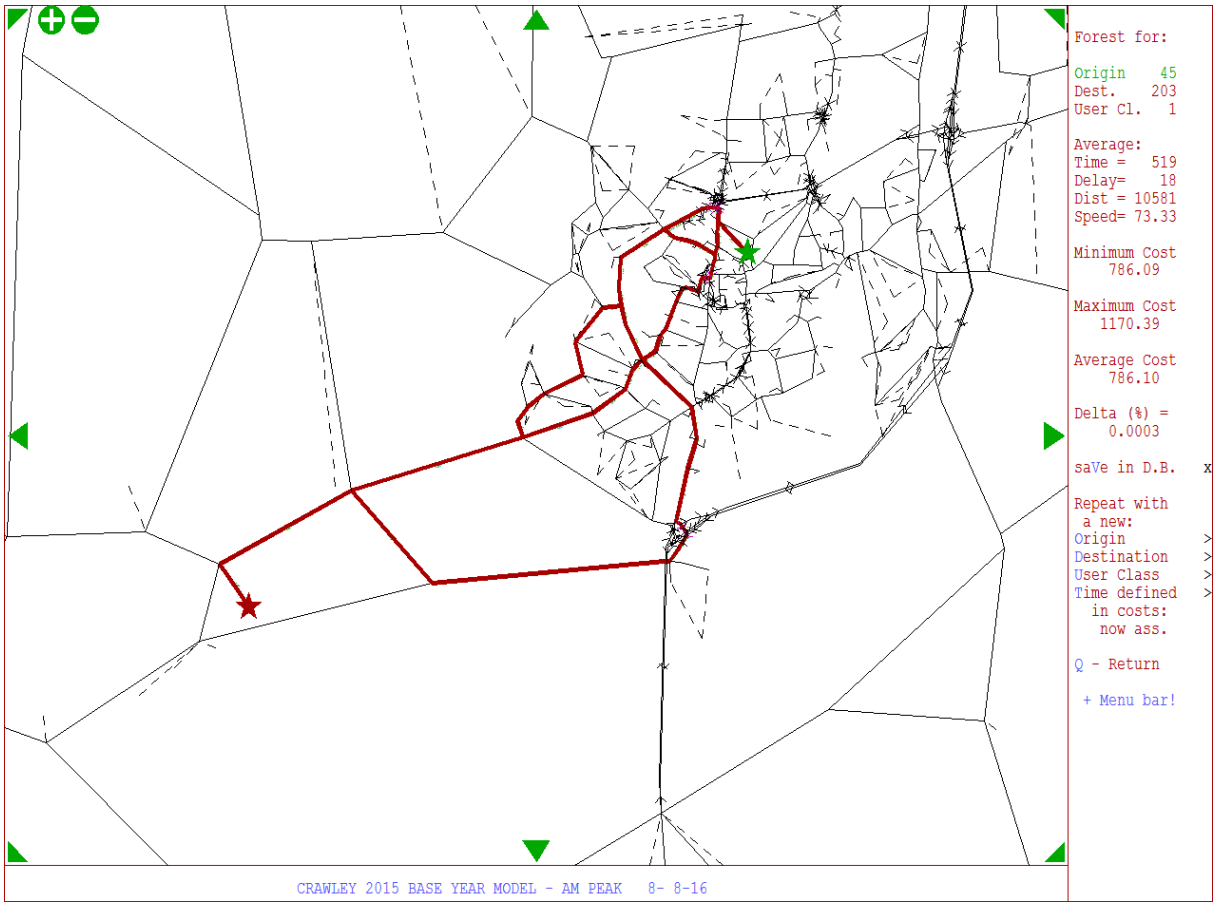
Route 4 – Zone 115 (Manor Royal) to Zone 201 (A235) – Southbound



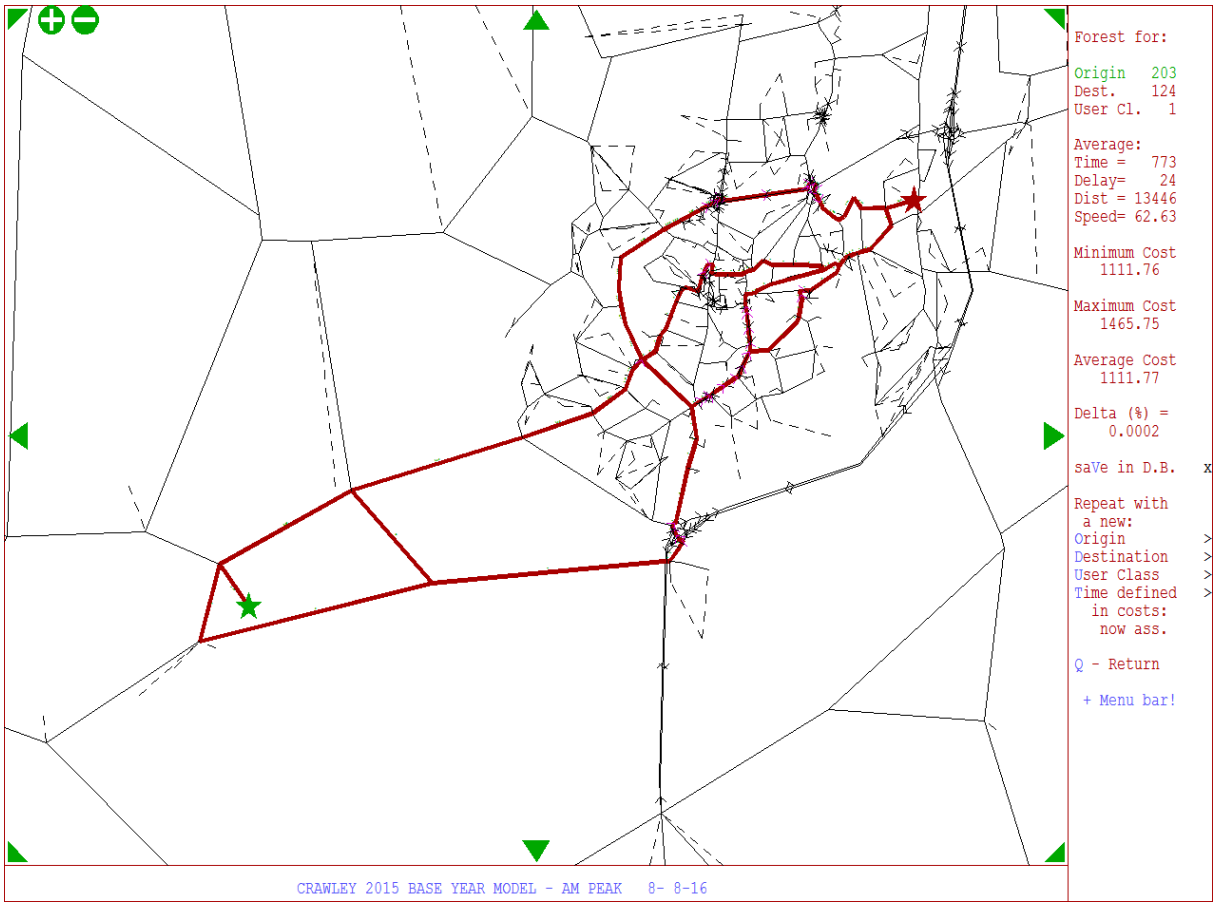
Route 5 – Zone 203 (Horsham) to Zone 45 (TC) – Eastbound



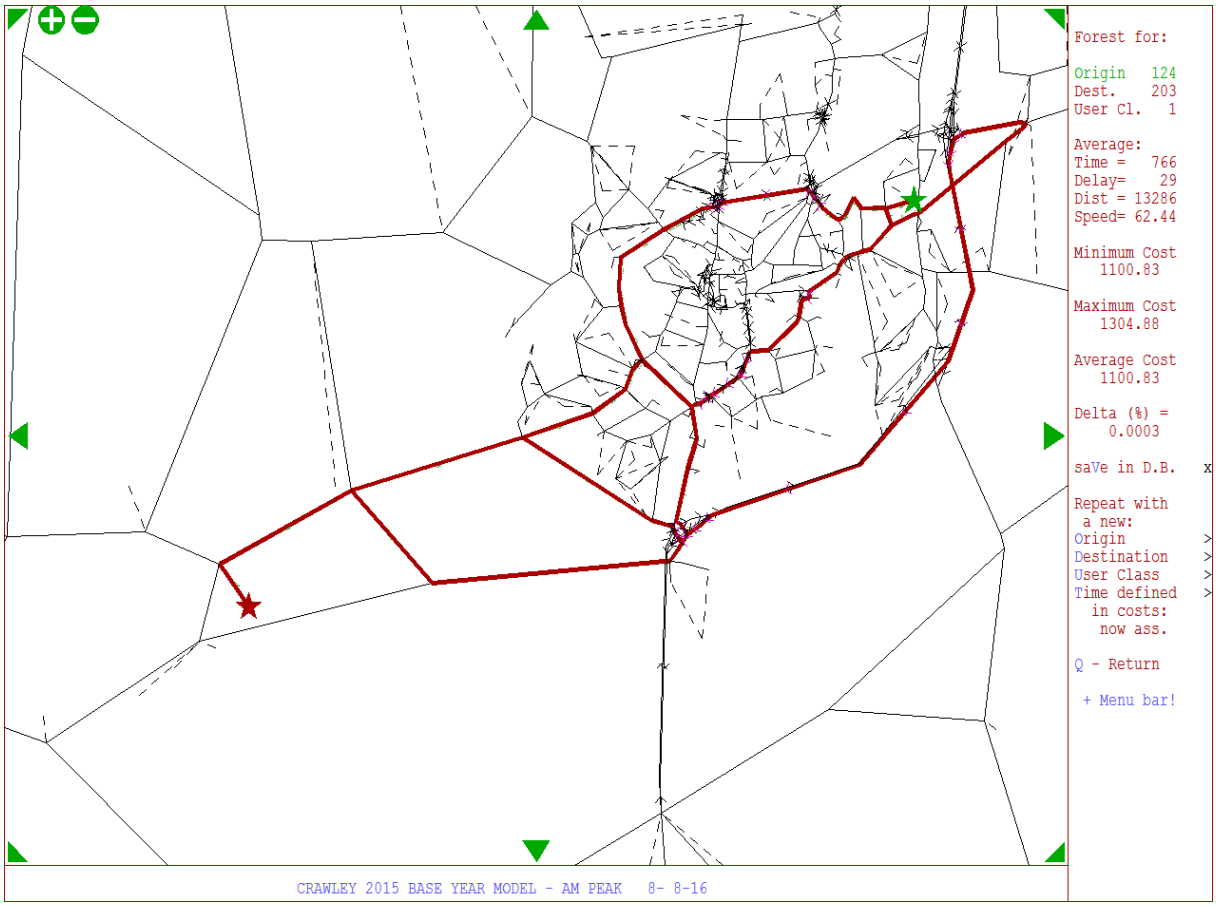
Route 5 – Zone 45 (TC) to Zone 203 (Horsham) – Westbound



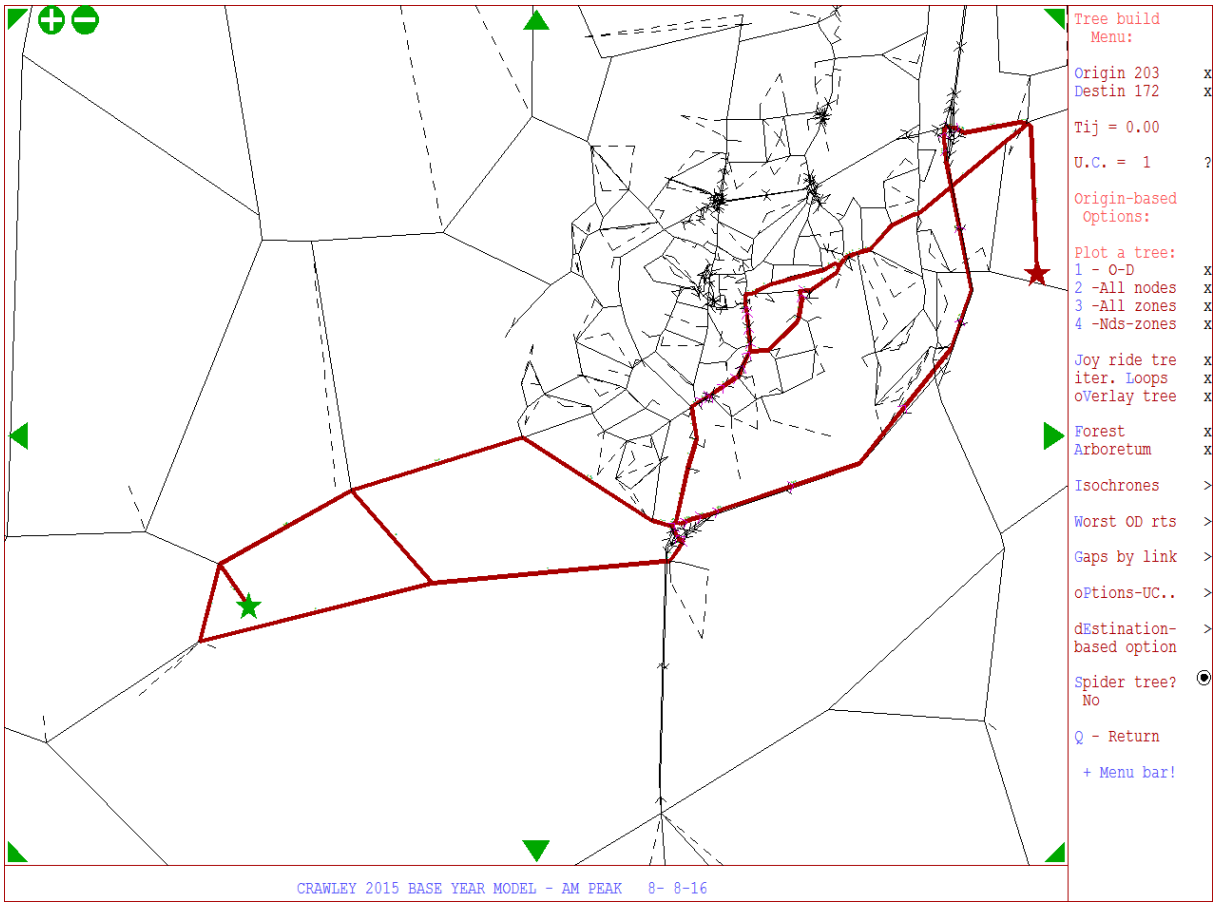
Route 6 – Zone 203 (Horsham) to Zone 124 (Heathfield within M23) – Eastbound



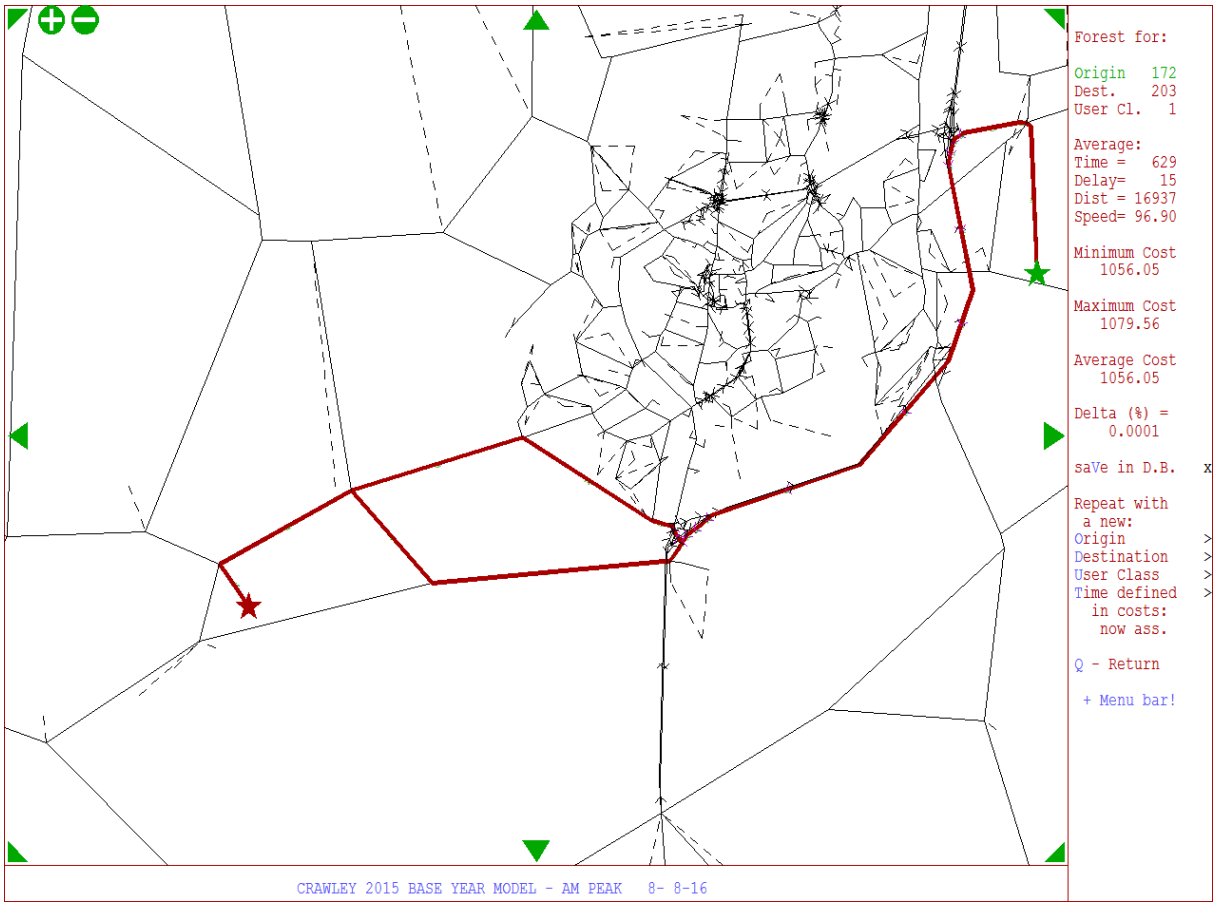
Route 6 – Zone 124 (Heathfield within M23) to Zone 203 (Horsham) – Westbound



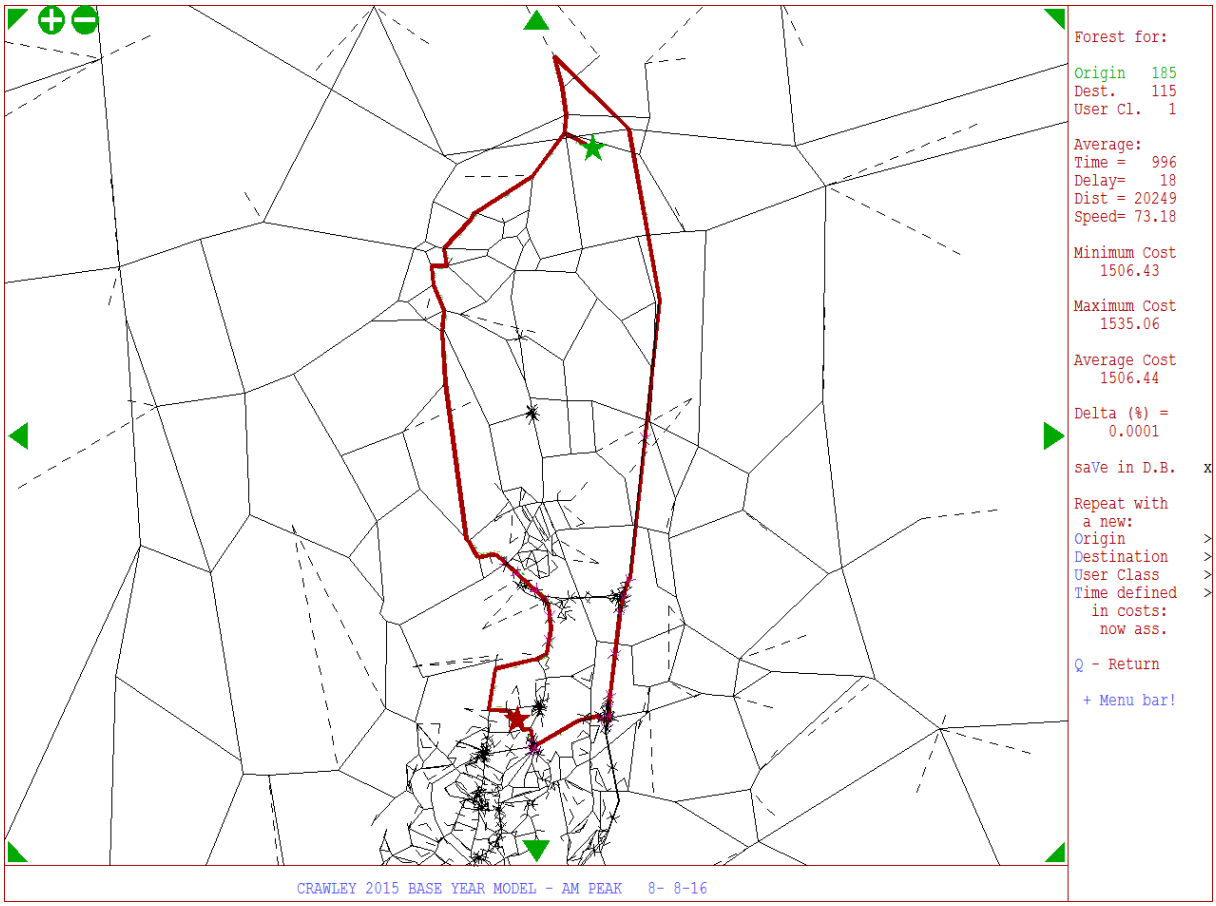
Route 7 – Zone 203 (Horsham) to Zone 172 () – Eastbound



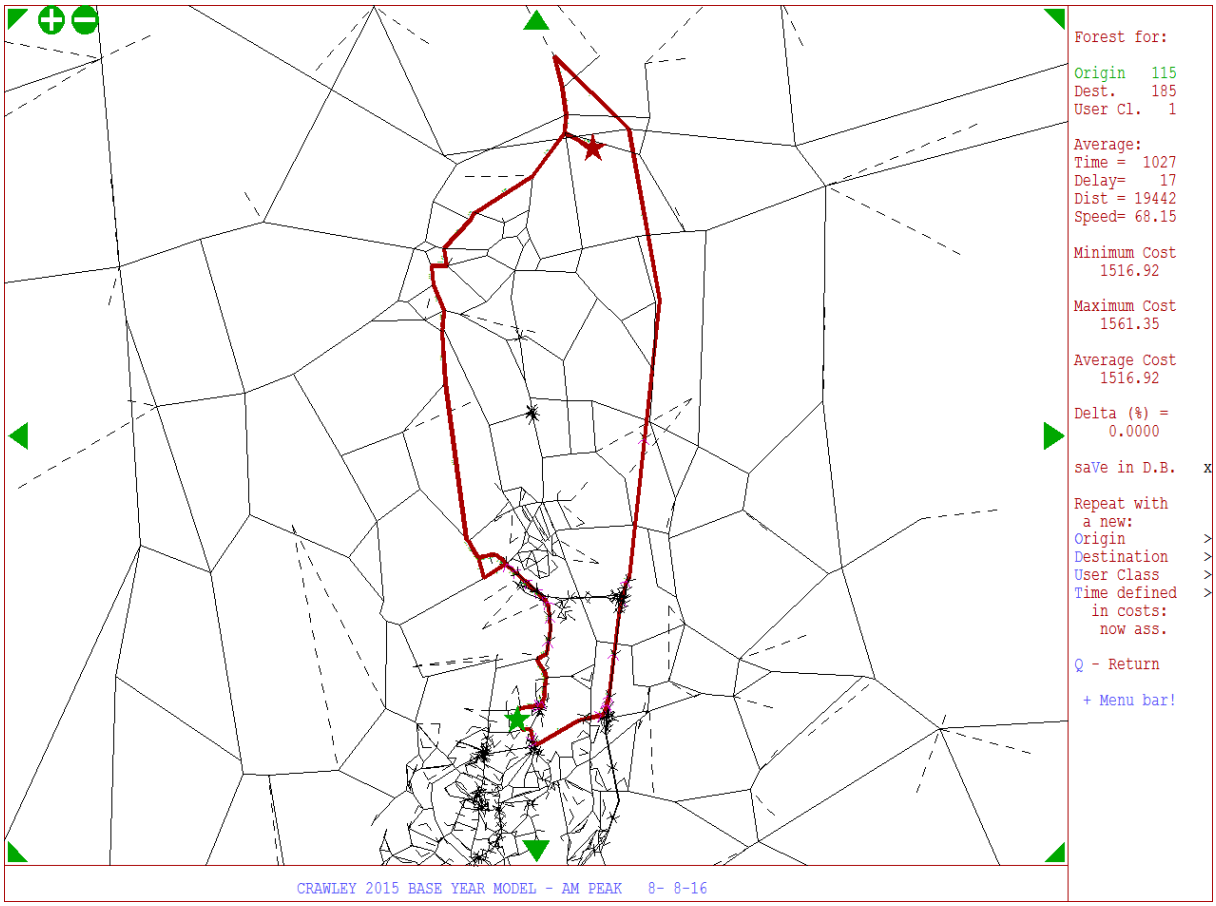
Route 7 – Zone 172 () to Zone 203 (Horsham) – Westbound



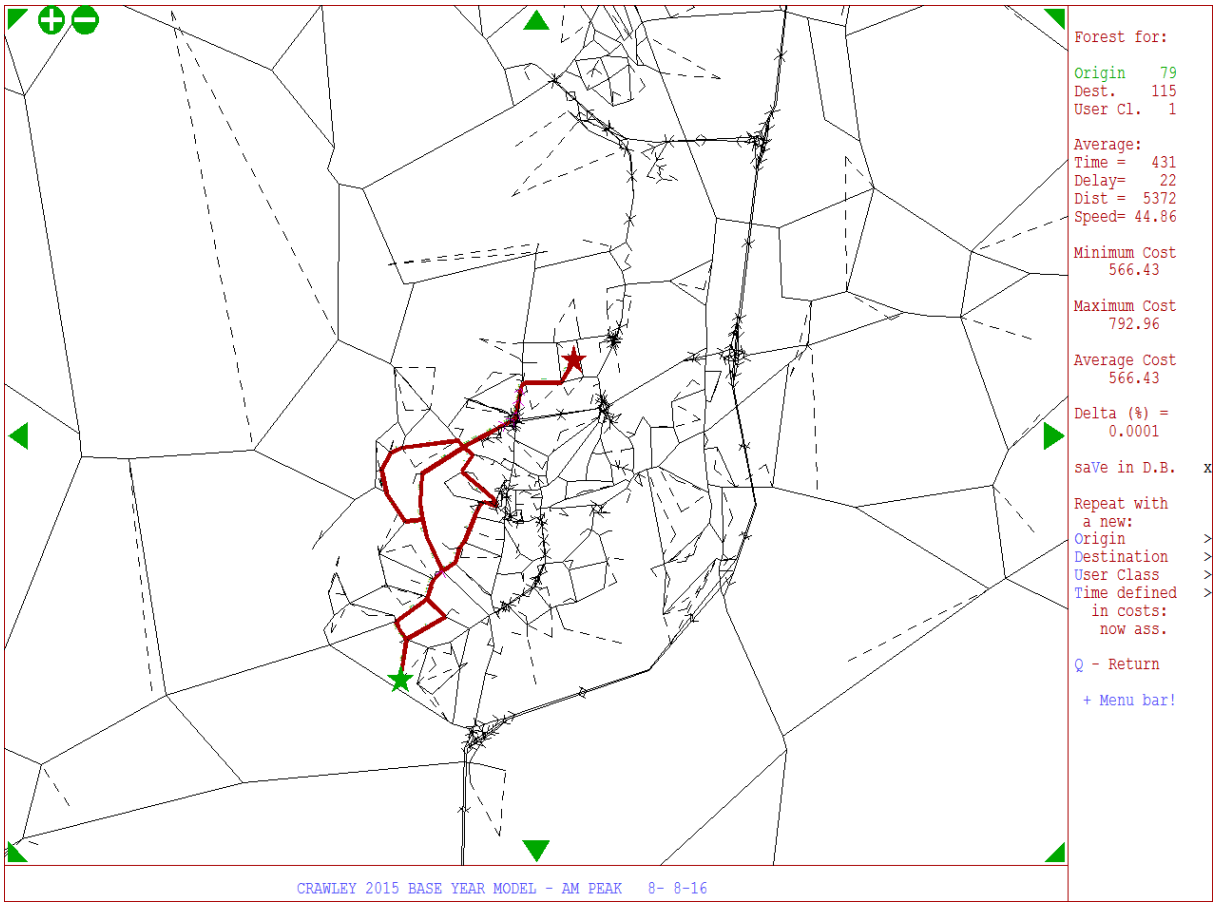
Route 8 – Zone 185 (M25N) to Zone 115 (Manor Royal) – Southbound



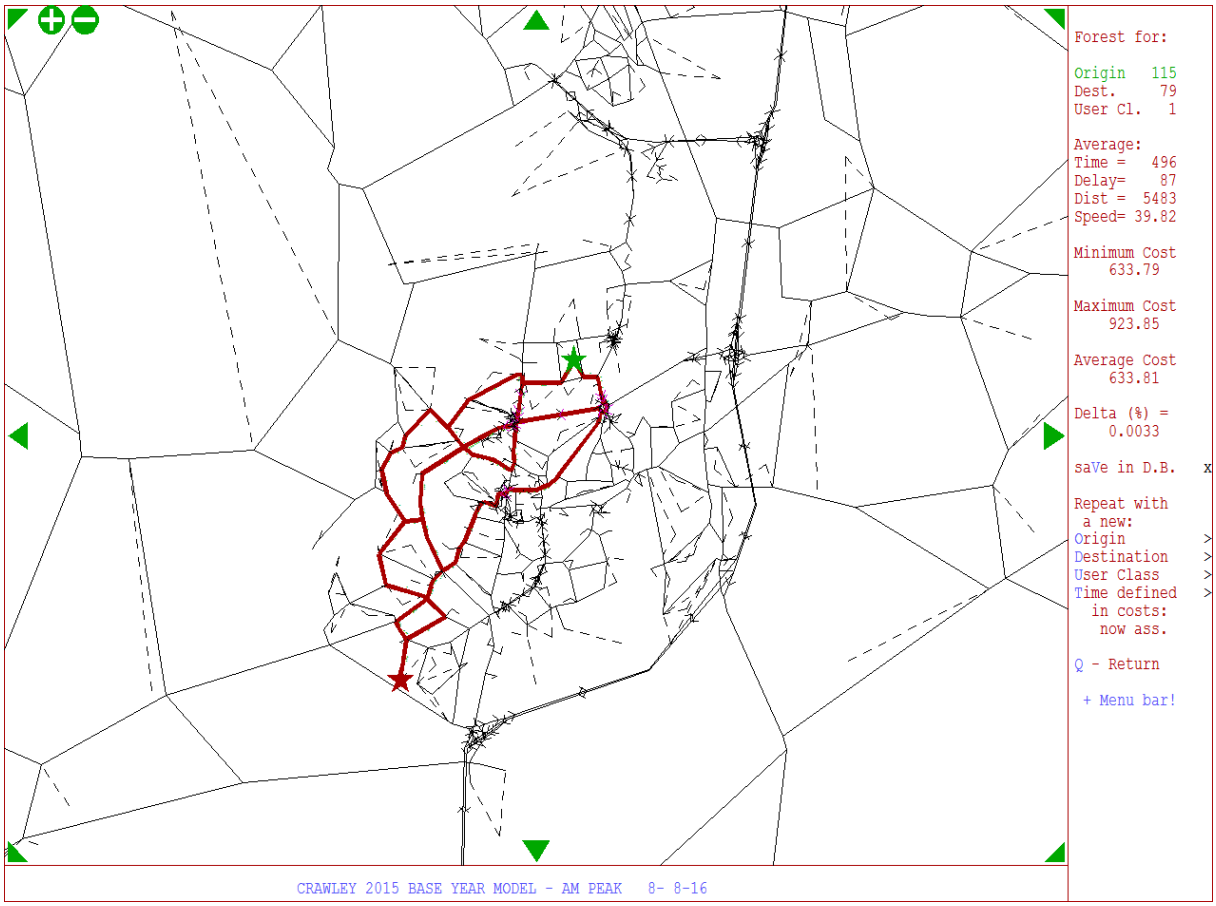
Route 8 – Zone 115 (Manor Royal) to Zone 185 (M25N) – Northbound



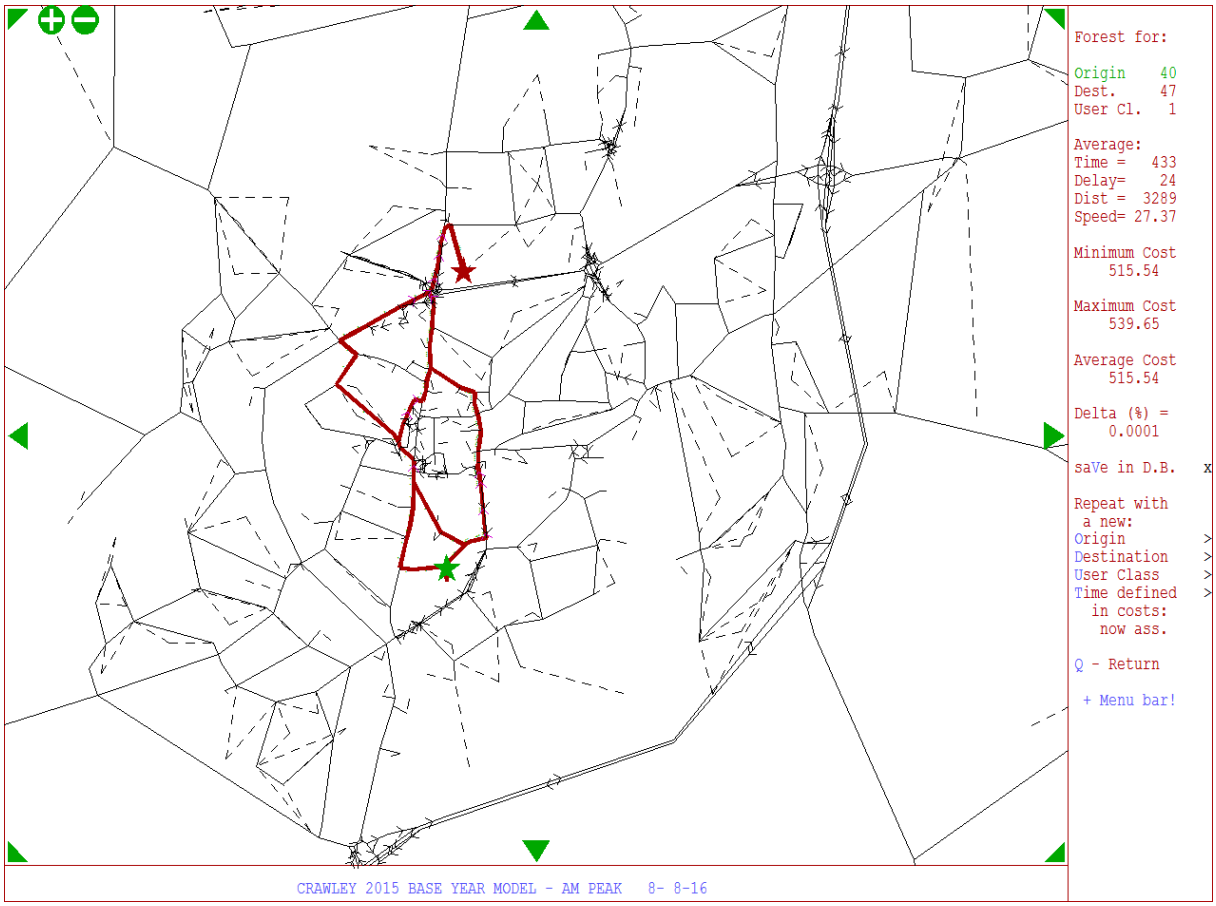
Route 9 – Zone 79 (Broadfield) to Zone 115 (Manor Royal) – Northbound



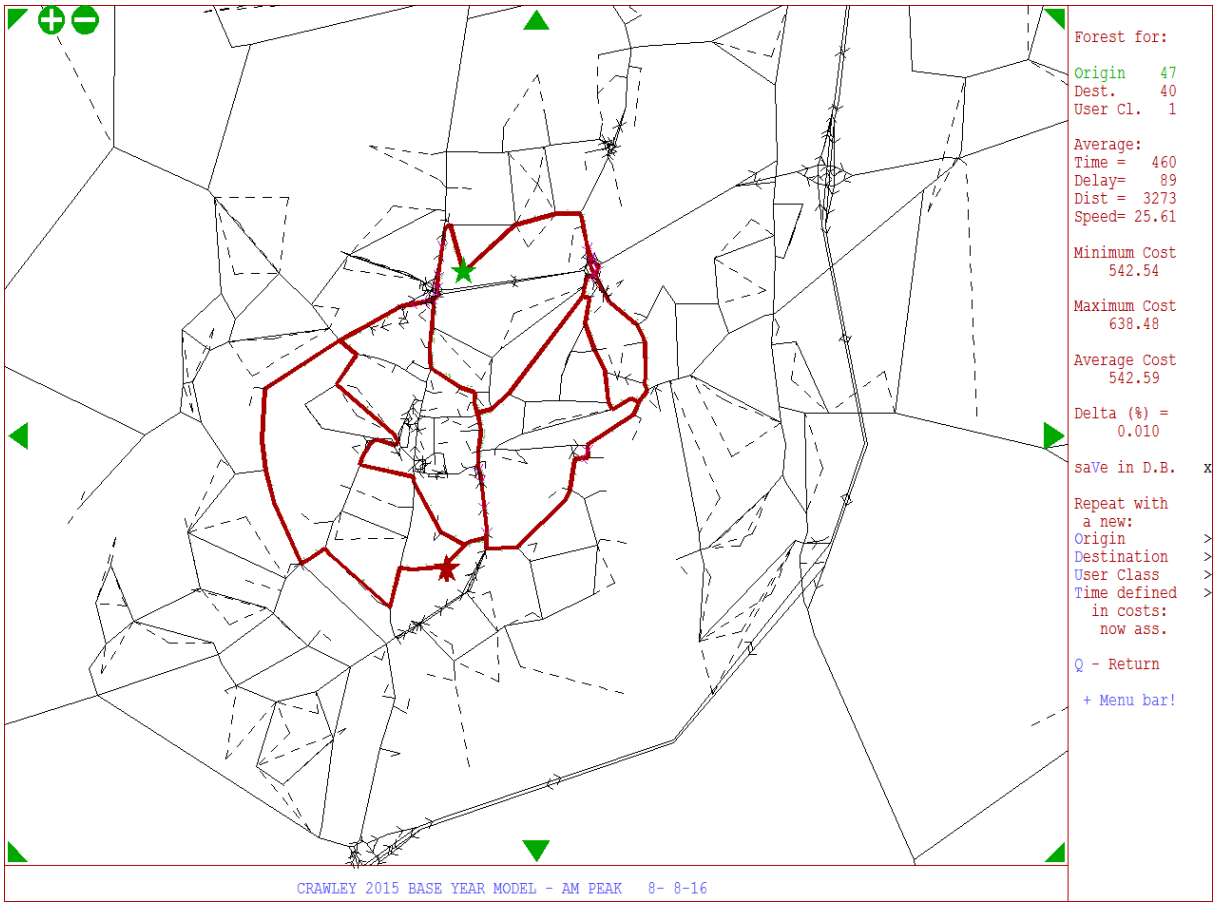
Route 9 – Zone 115 (Manor Royal) to Zone 79 (Broadfield) – Southbound



Route 10 – Zone 40 (TC/Crawley South) to Zone 47 (Manor Royal) – Northbound



Route 10 – Zone 47 (Manor Royal) to Zone 40 (TC/Crawley South) – Southbound



Appendix C PM Peak Route Checks

Job Name: Crawley Transport Model

Job No: 35981

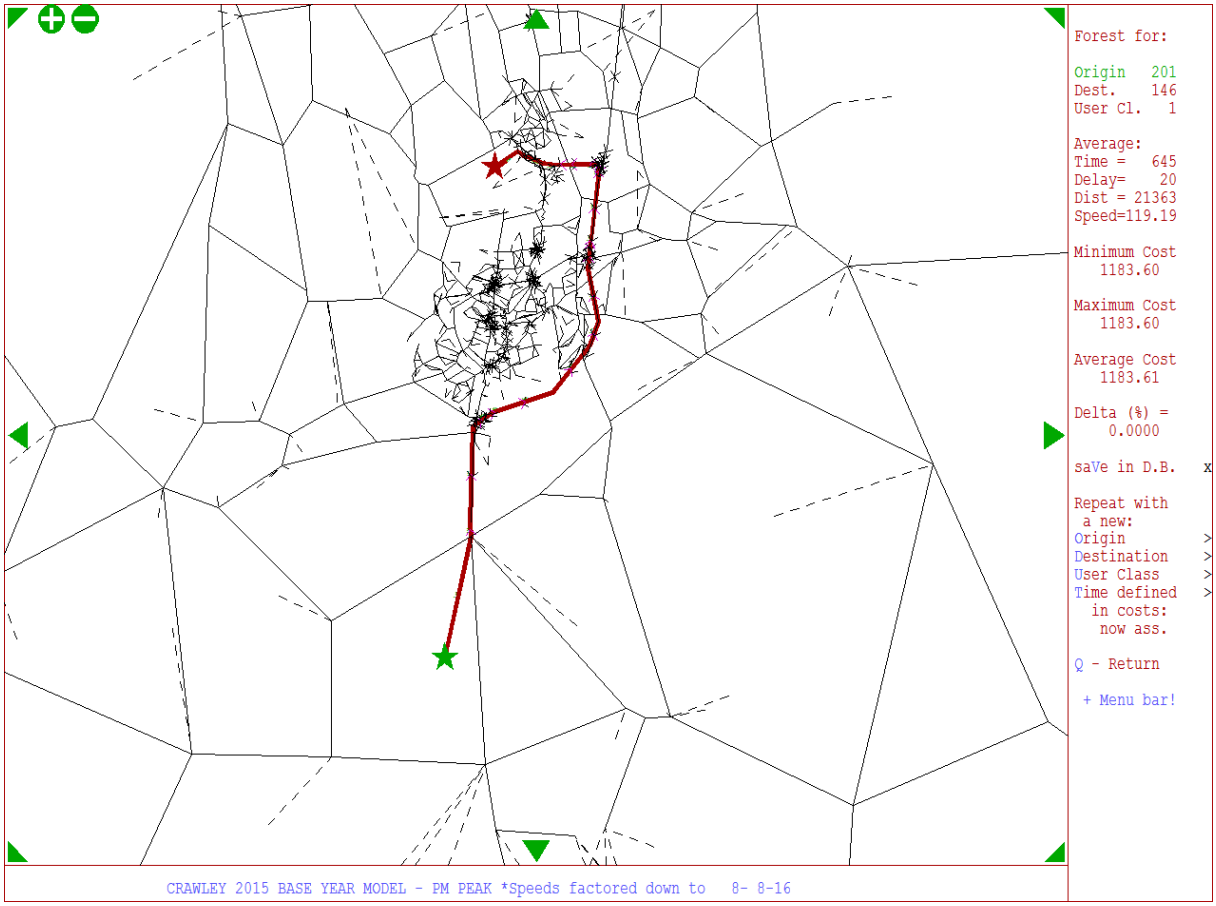
Note No: N003

Date: 8 August 2016

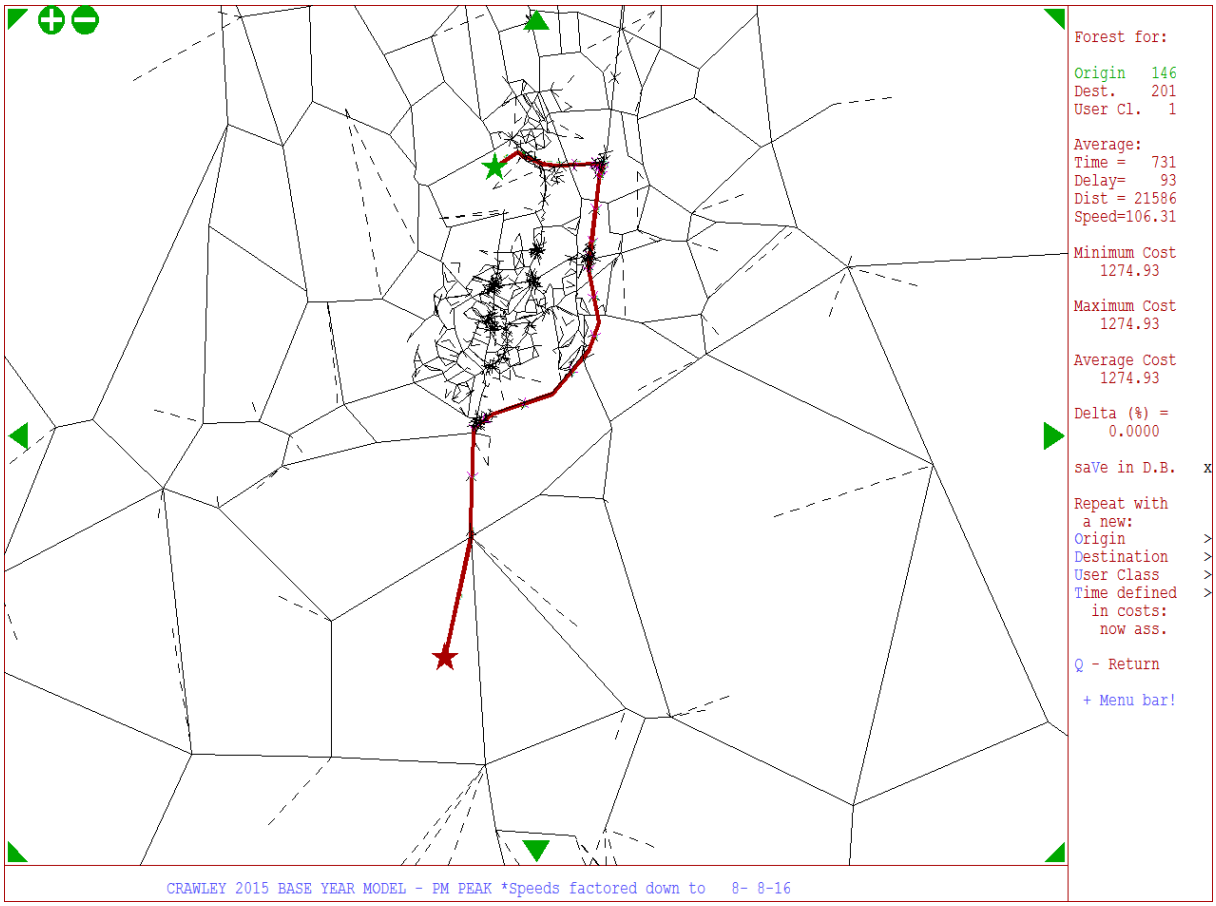
Prepared By: Carlos Ferrando

Subject: **PM Routes**

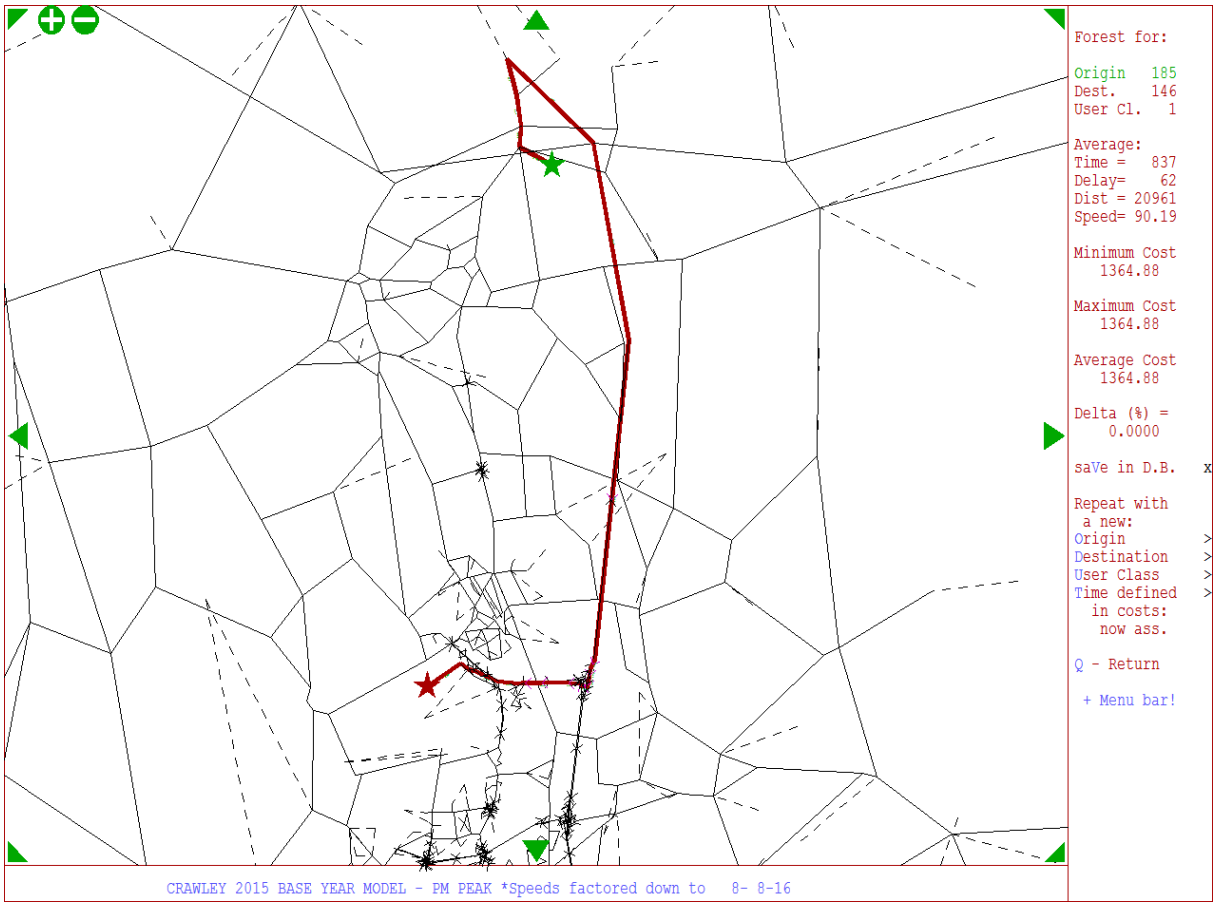
Route 1 – Zone 201 (A23) to Zone 146 (Gatwick Airport) – Northbound



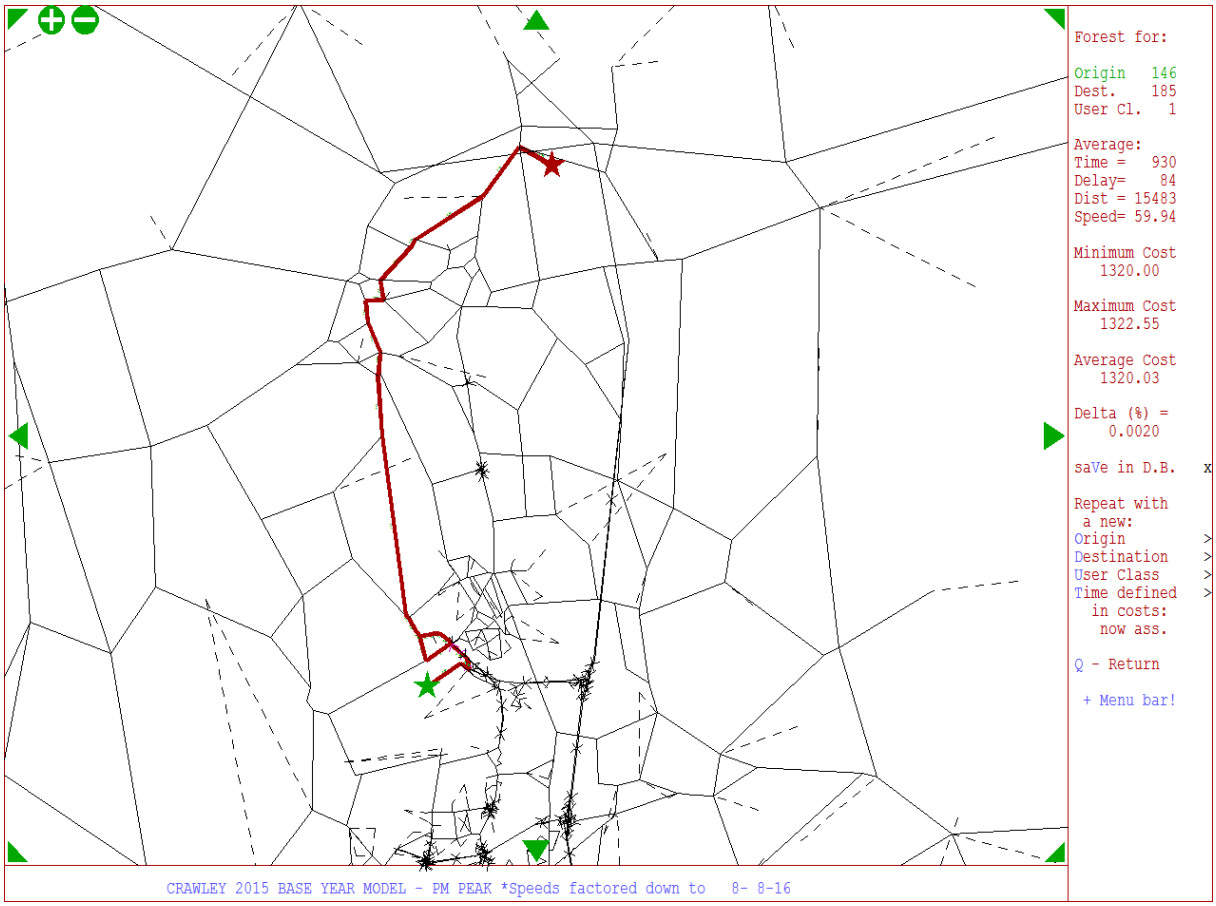
Route 1 – Zone 146 (Gatwick Airport) to Zone 201 (A23) – Southbound



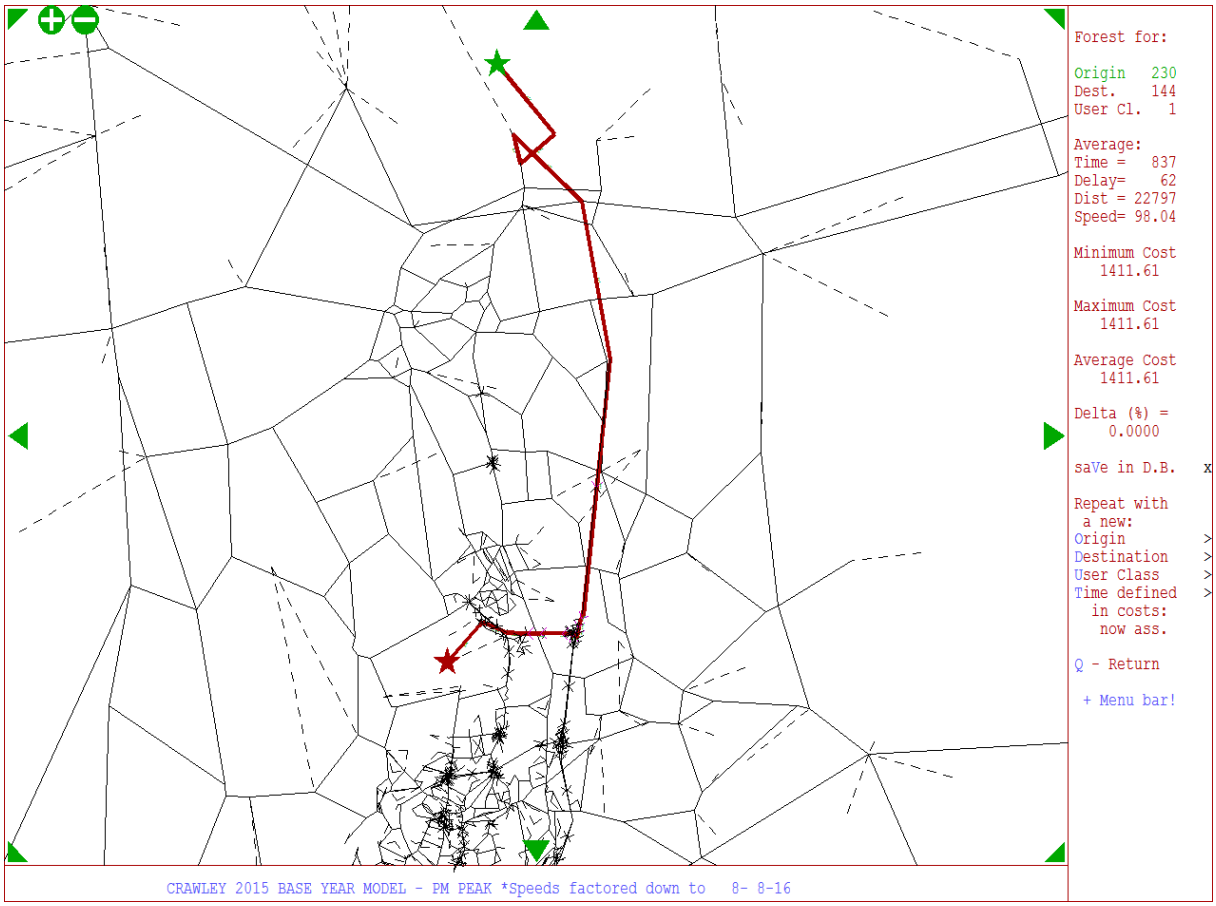
Route 2 – Zone 185 (M25N) to Zone 146 (Gatwick Airport) – Southbound



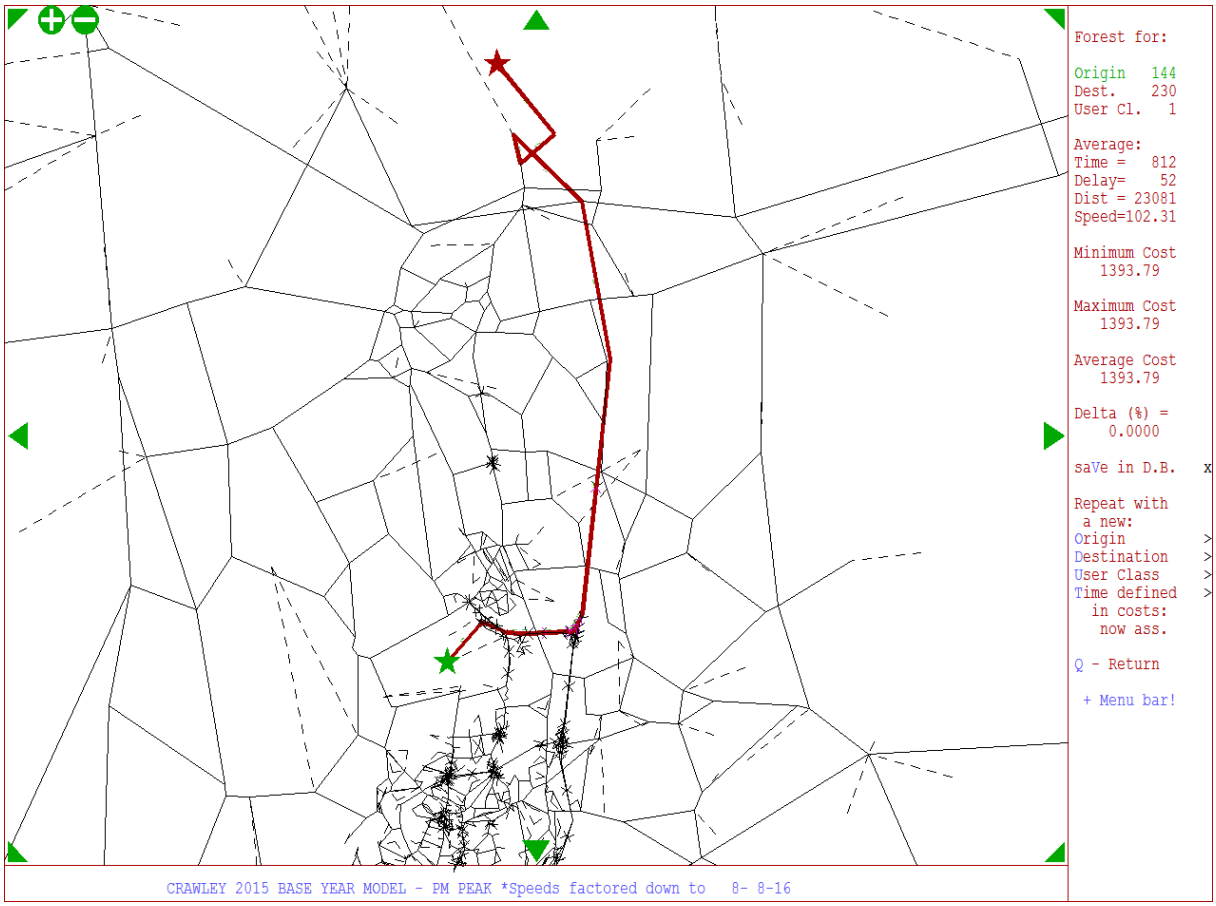
Route 2 – Zone 146 (Gatwick Airport) to Zone 185 (M25N) – Northbound



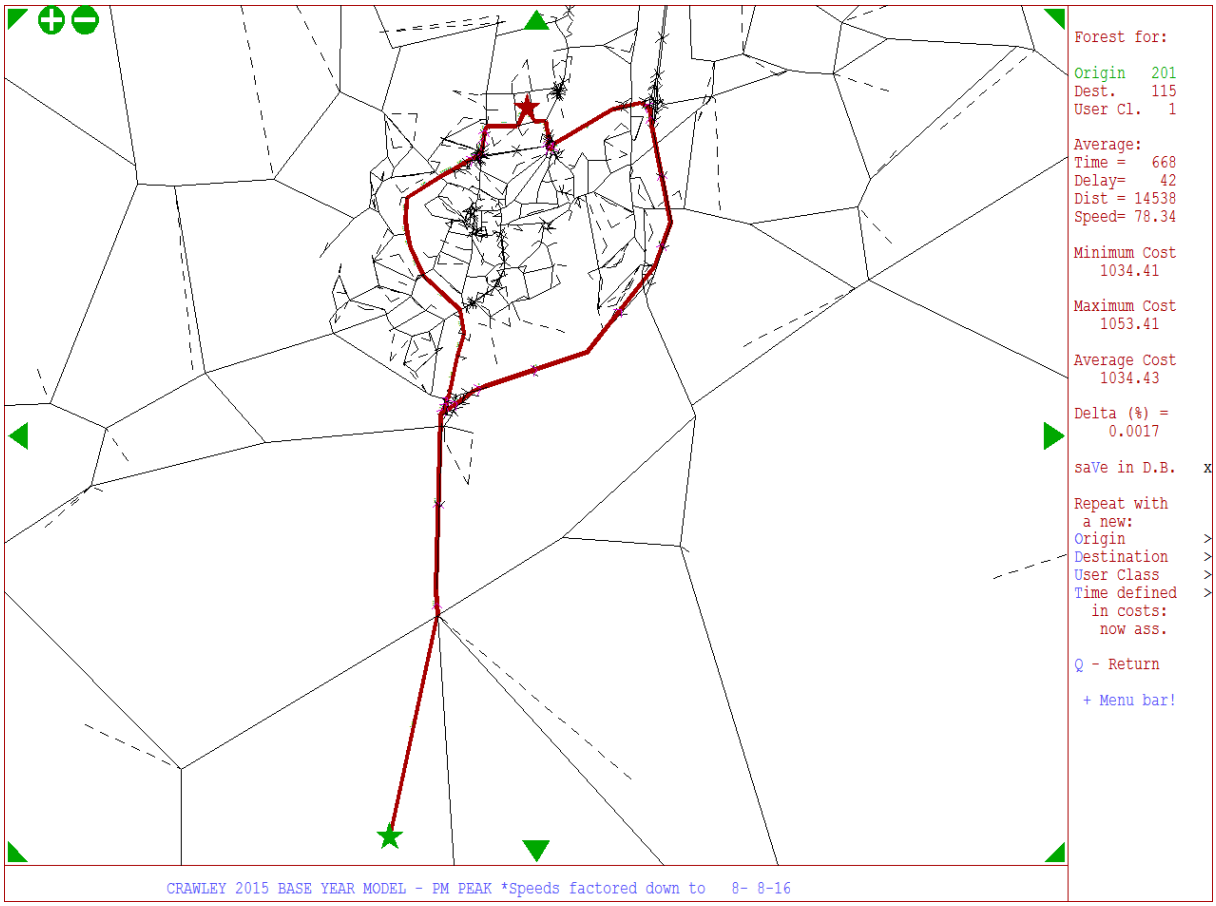
Route 3 – Zone 230 (M25N) to Zone 144 (Gatwick Airport) – Southbound



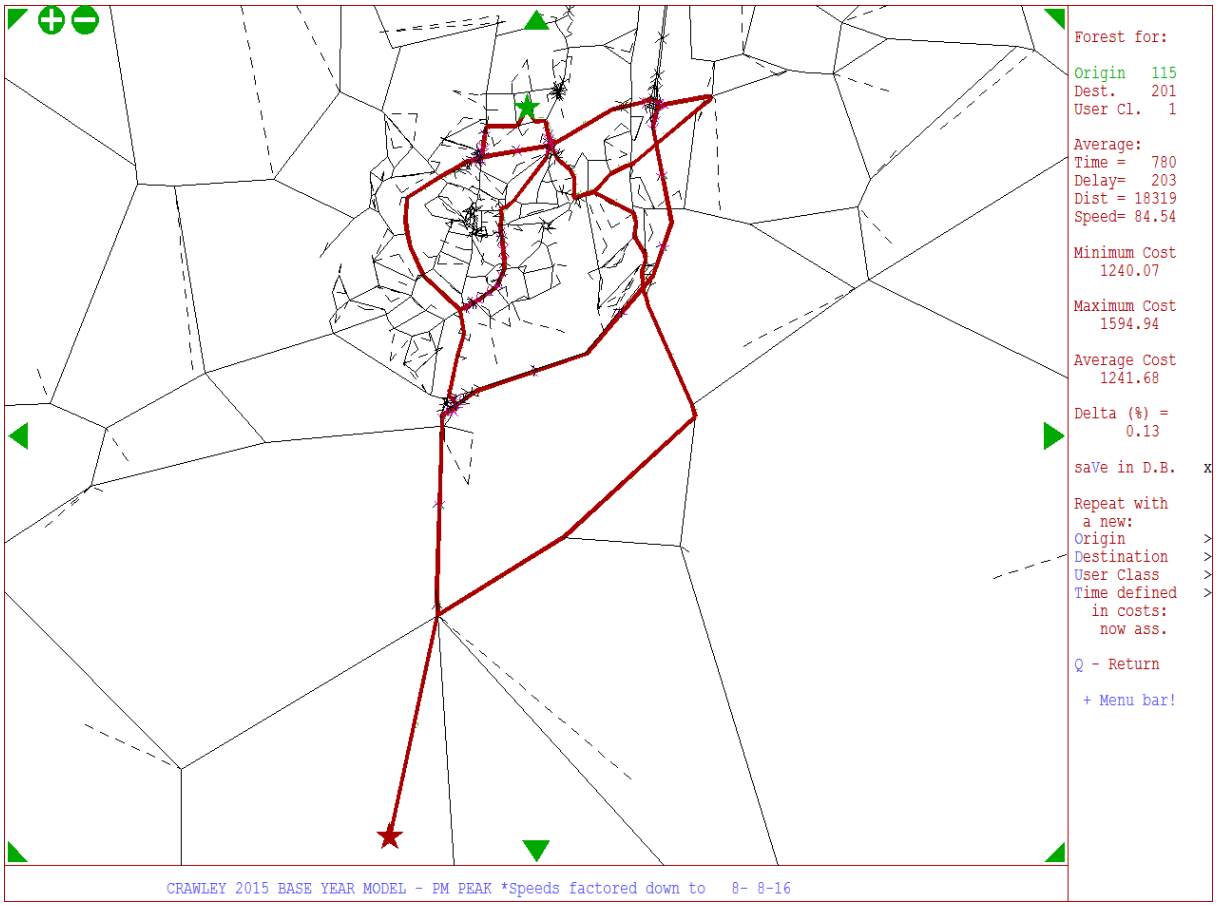
Route 3 – Zone 144 (Gatwick Airport) to Zone 230 (MN25N) – Northbound



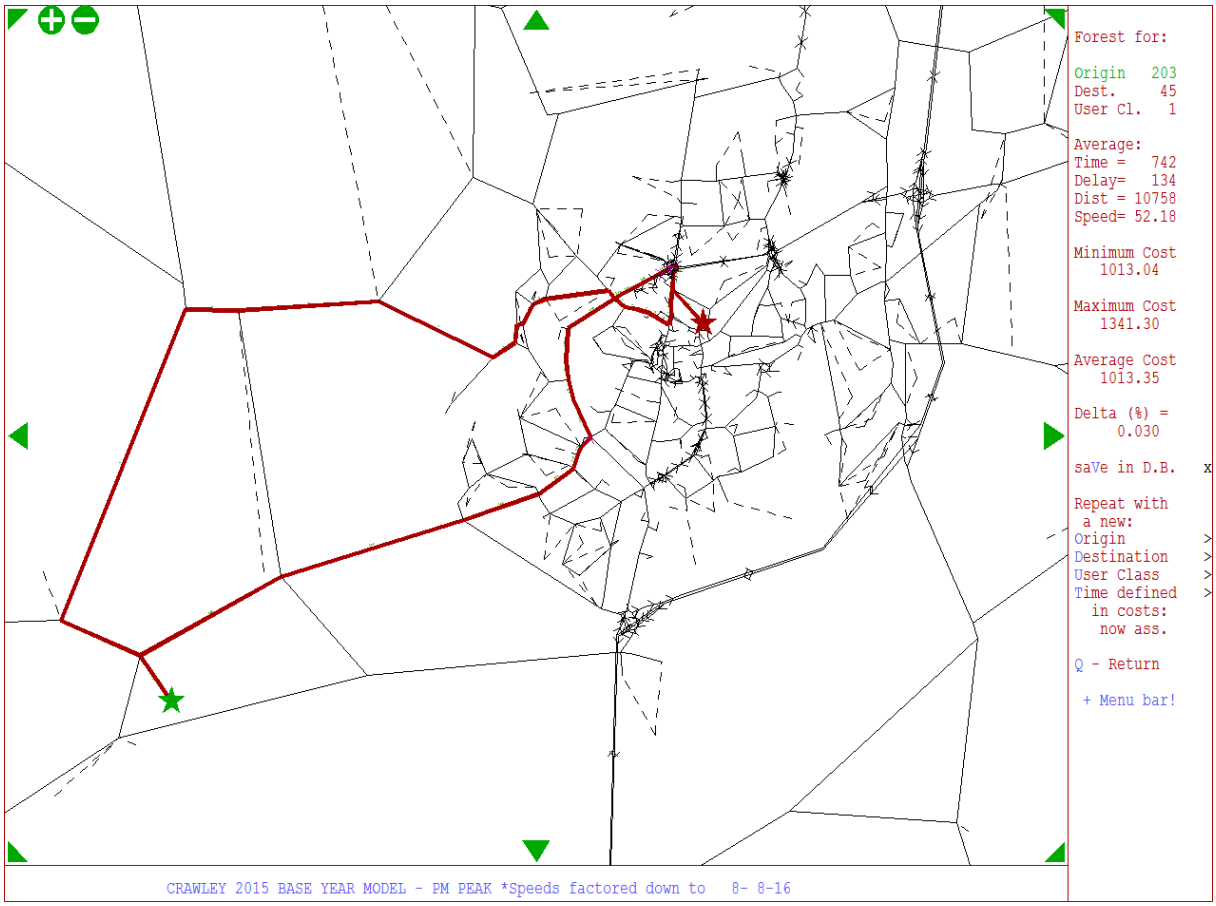
Route 4 – Zone 201 (A235) to Zone 115 (Manor Royal) – Northbound



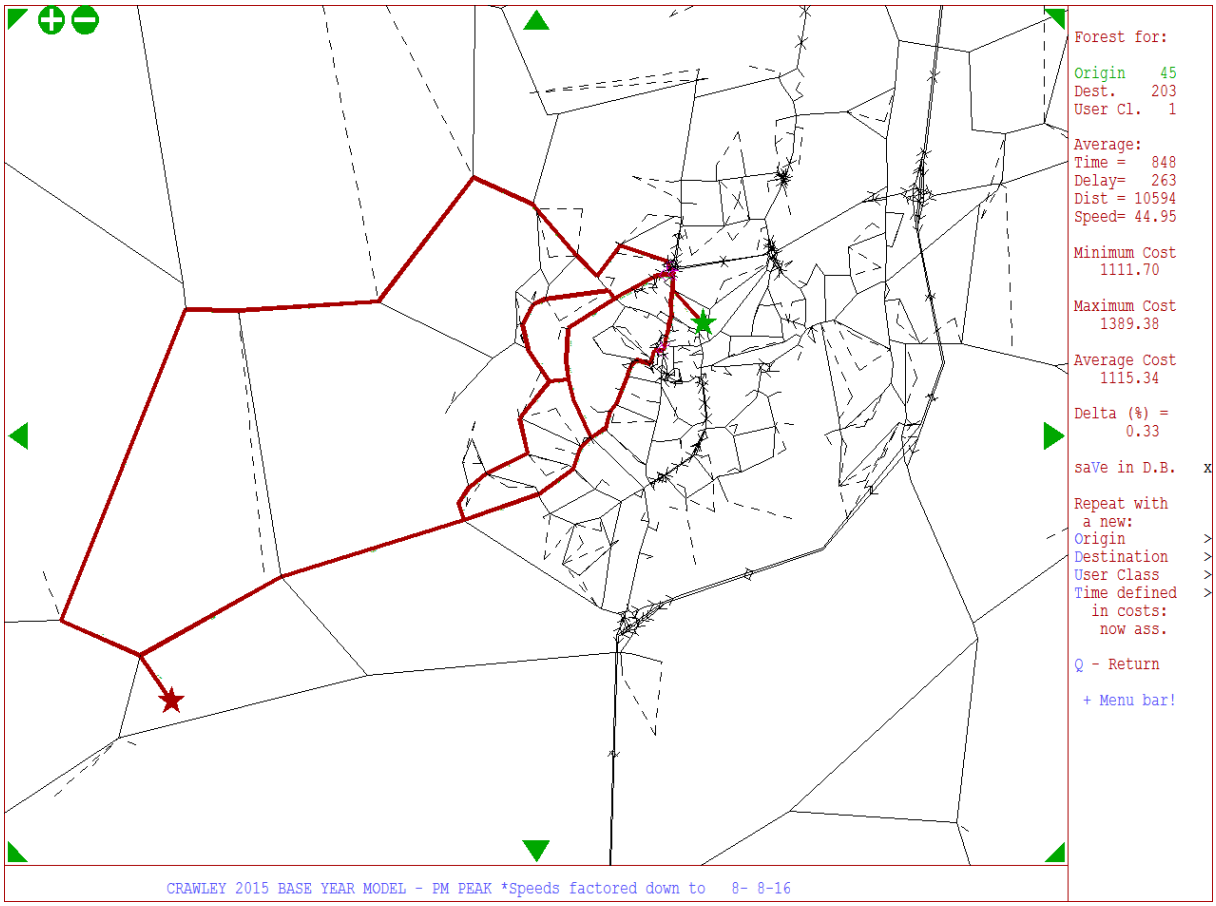
Route 4 – Zone 115 (Manor Royal) to Zone 201 (A235) – Southbound



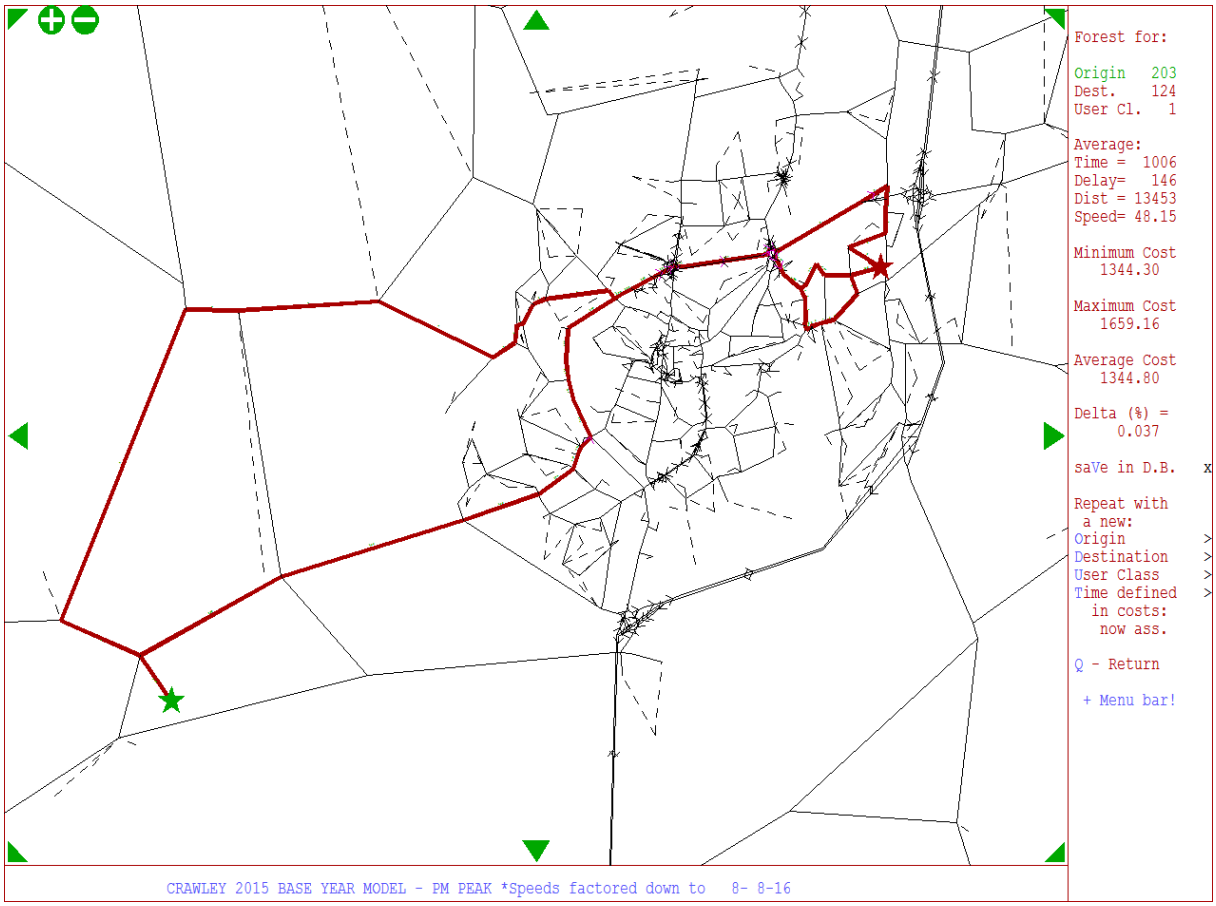
Route 5 – Zone 203 (Horsham) to Zone 45 (TC) – Eastbound



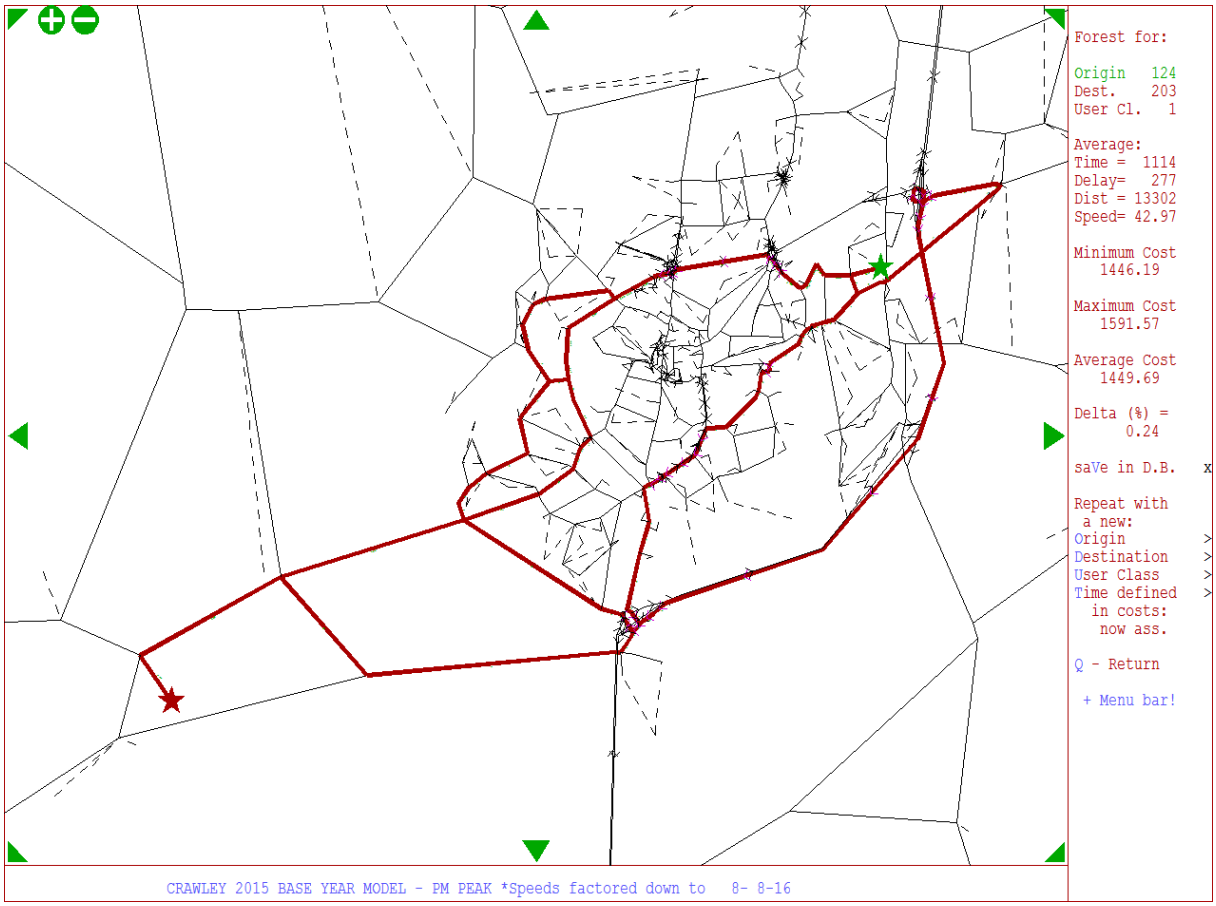
Route 5 – Zone 45 (TC) to Zone 203 (Horsham) – Westbound



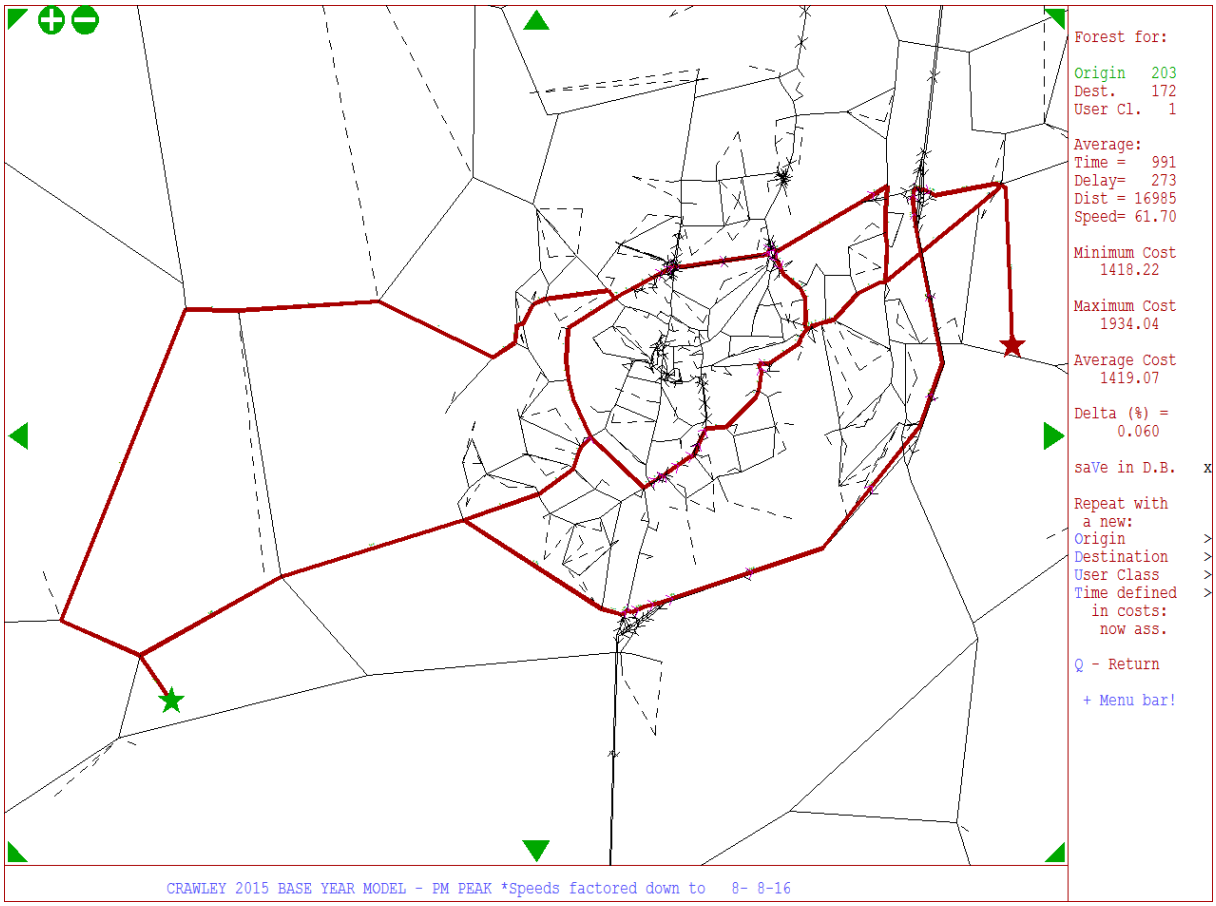
Route 6 – Zone 203 (Horsham) to Zone 124 (Heathfield within M23) – Eastbound



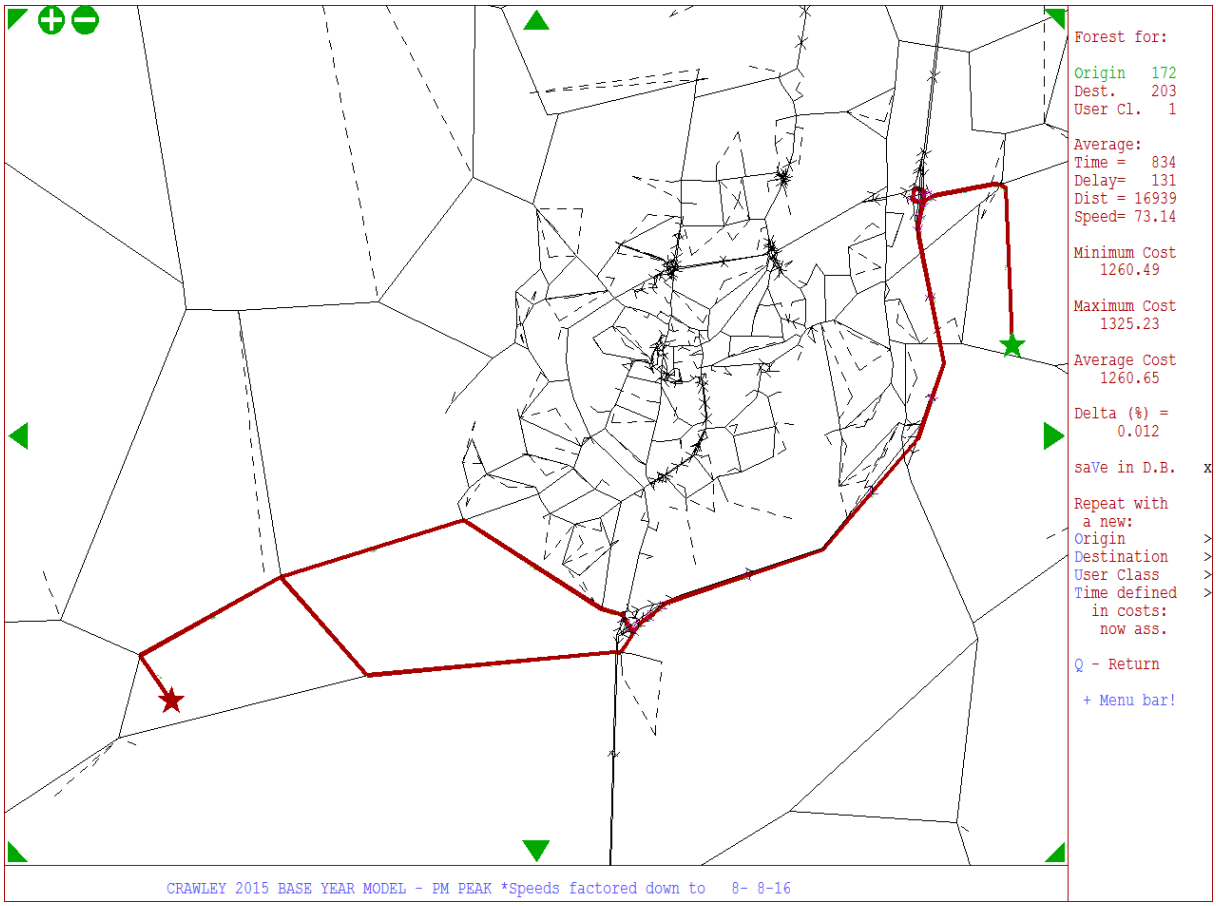
Route 6 – Zone 124 (Heathfield within M23) to Zone 203 (Horsham) – Westbound



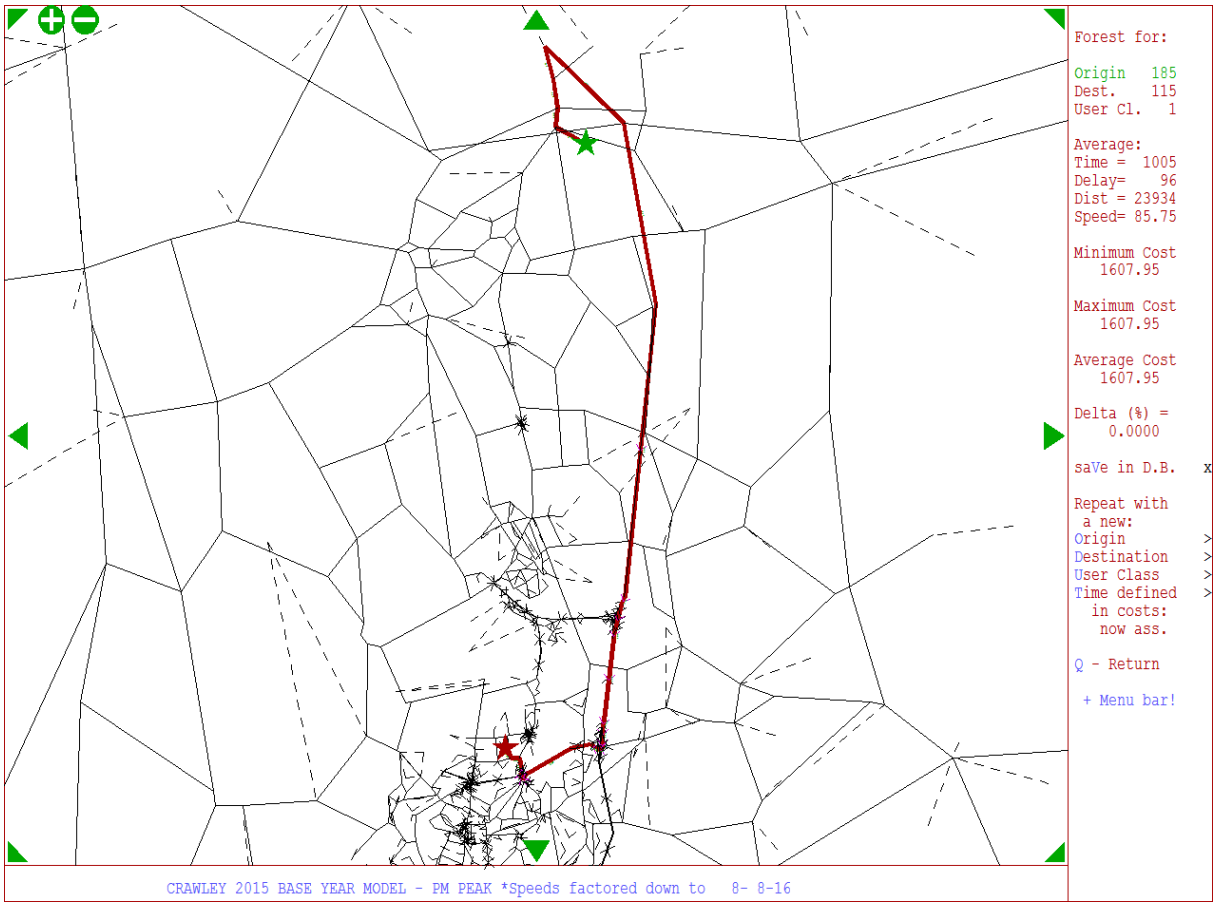
Route 7 – Zone 203 (Horsham) to Zone 172 () – Eastbound



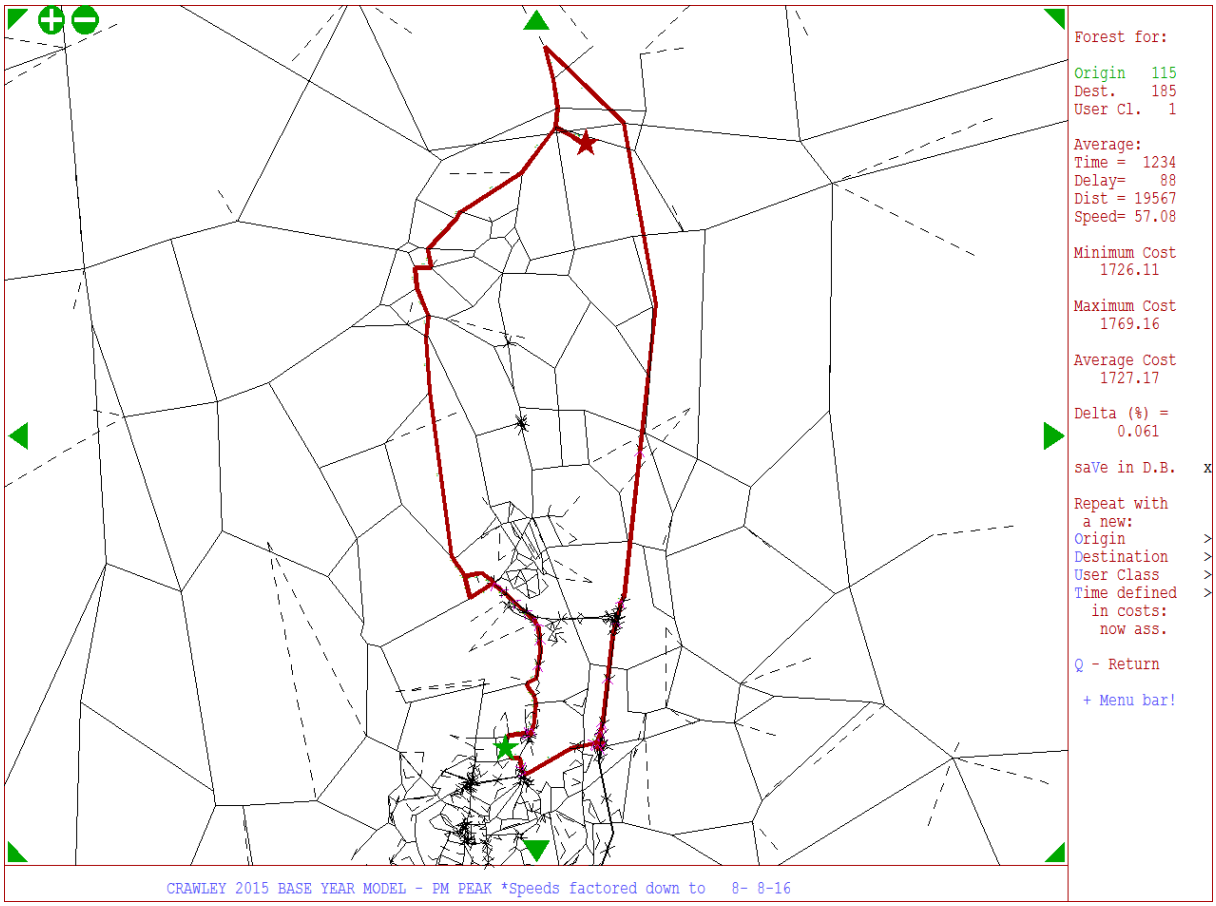
Route 7 – Zone 172 () to Zone 203 (Horsham) – Westbound



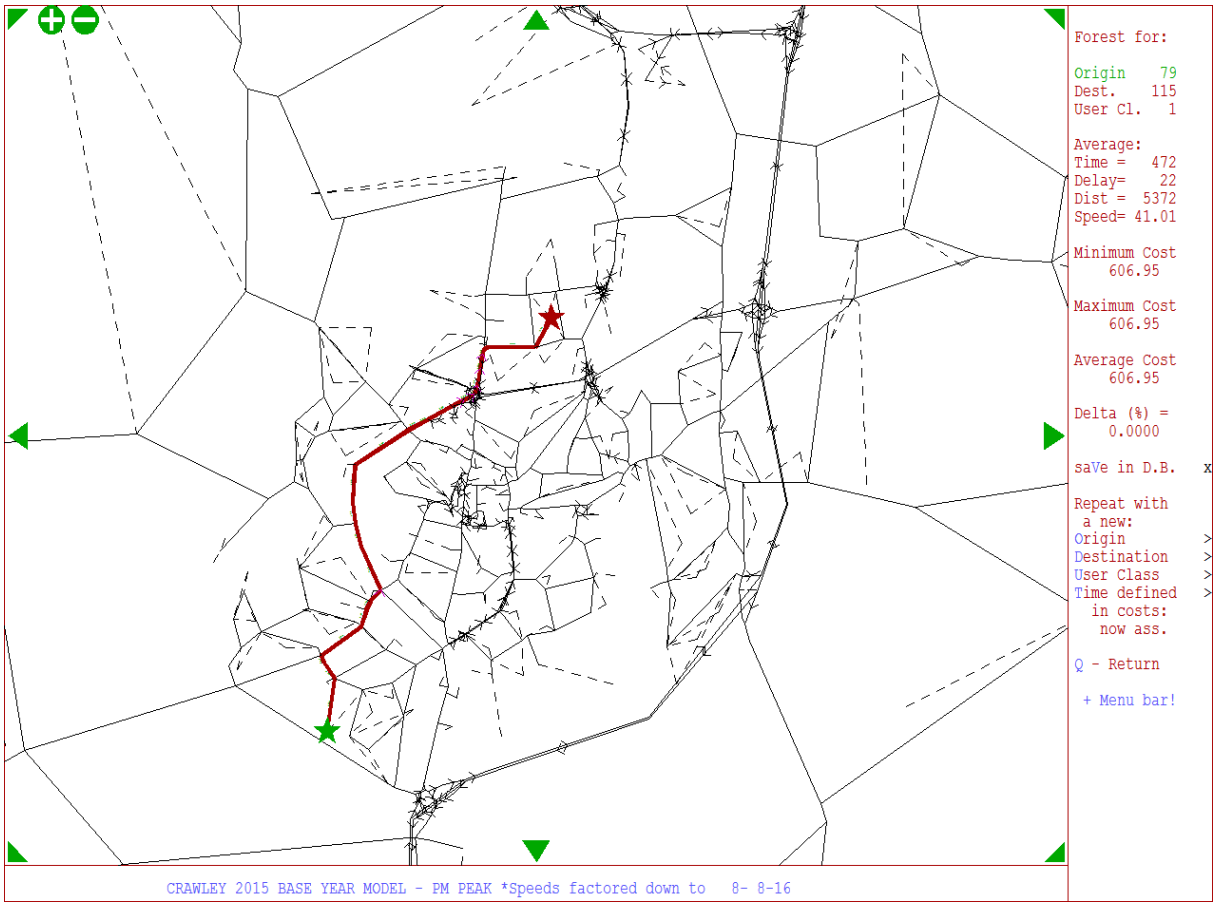
Route 8 – Zone 185 (M25N) to Zone 115 (Manor Royal) – Southbound



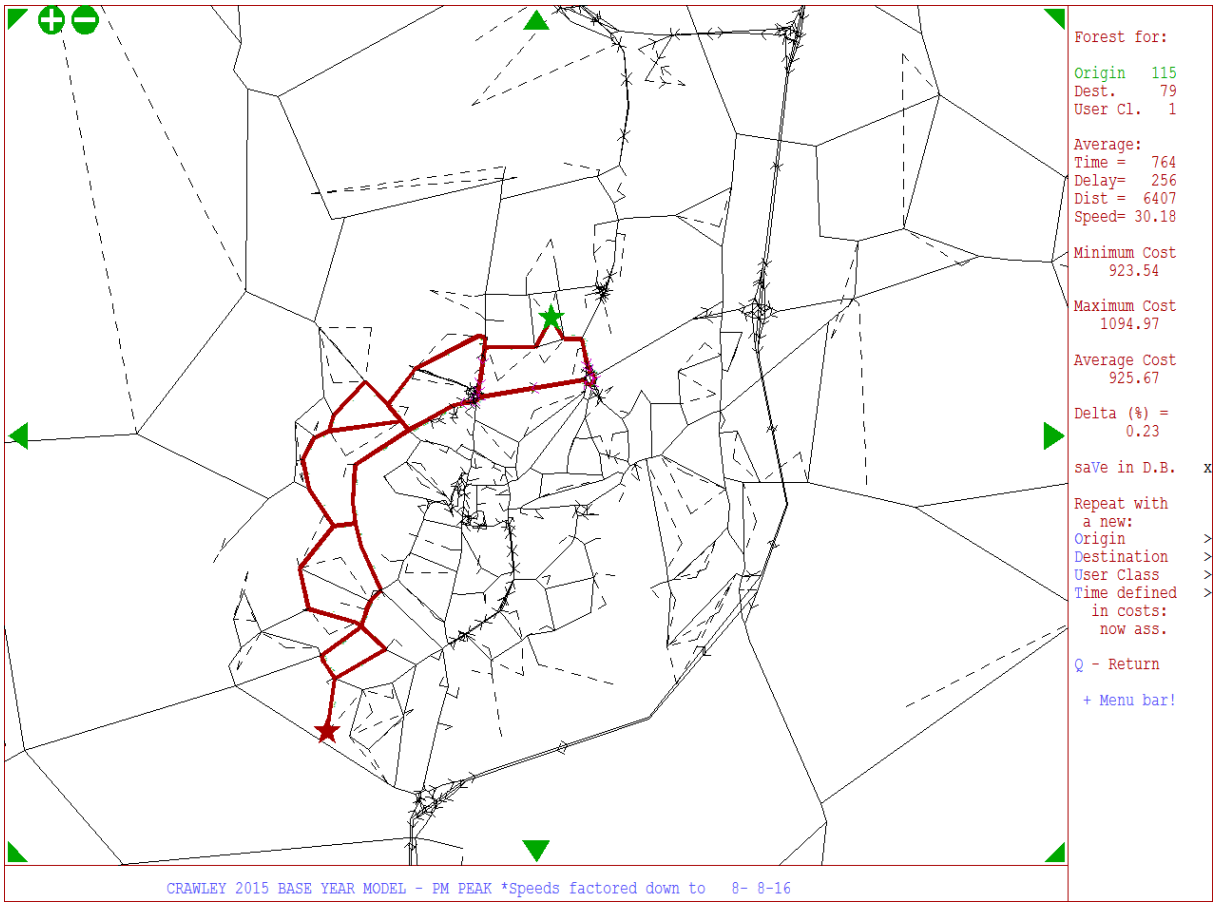
Route 8 – Zone 115 (Manor Royal) to Zone 185 (M25N) – Northbound



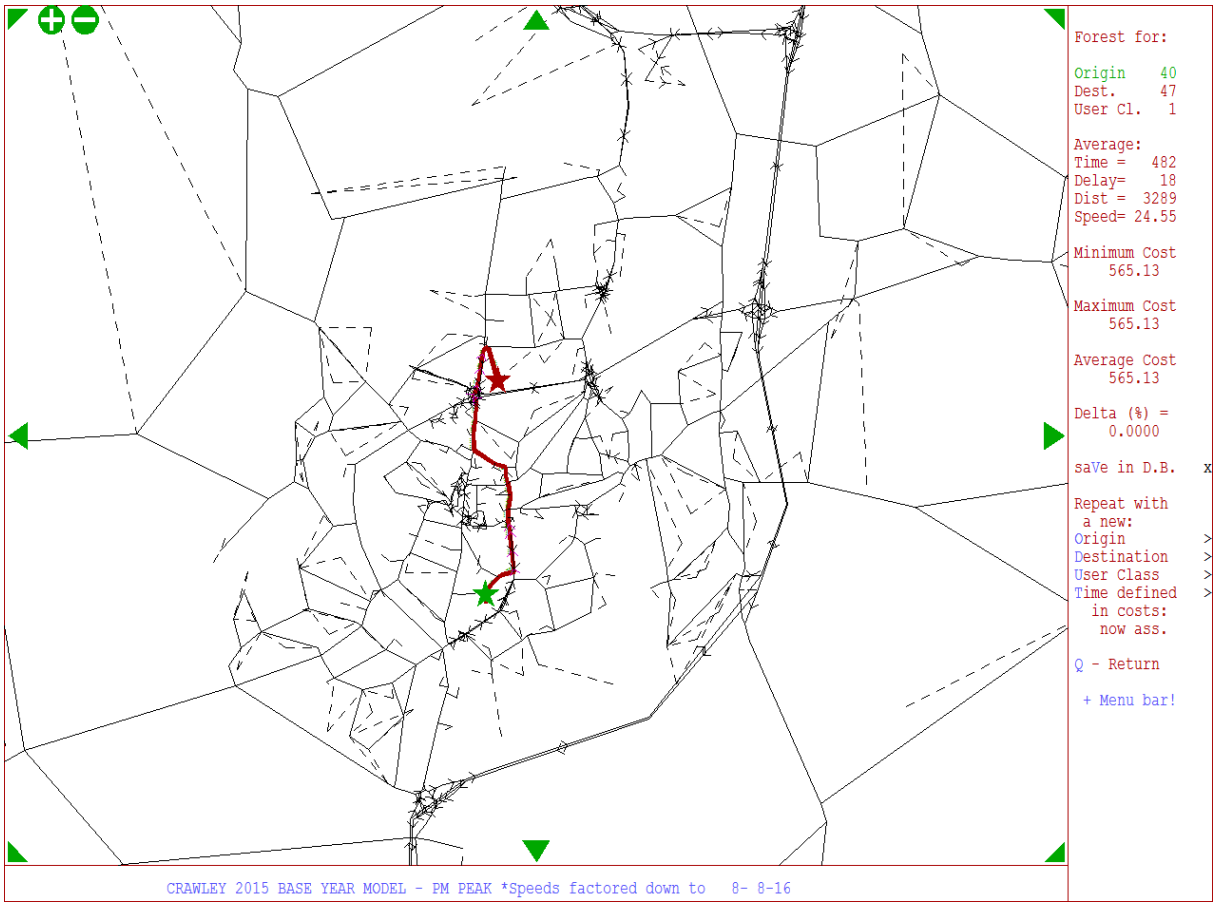
Route 9 – Zone 79 (Broadfield) to Zone 115 (Manor Royal) – Northbound



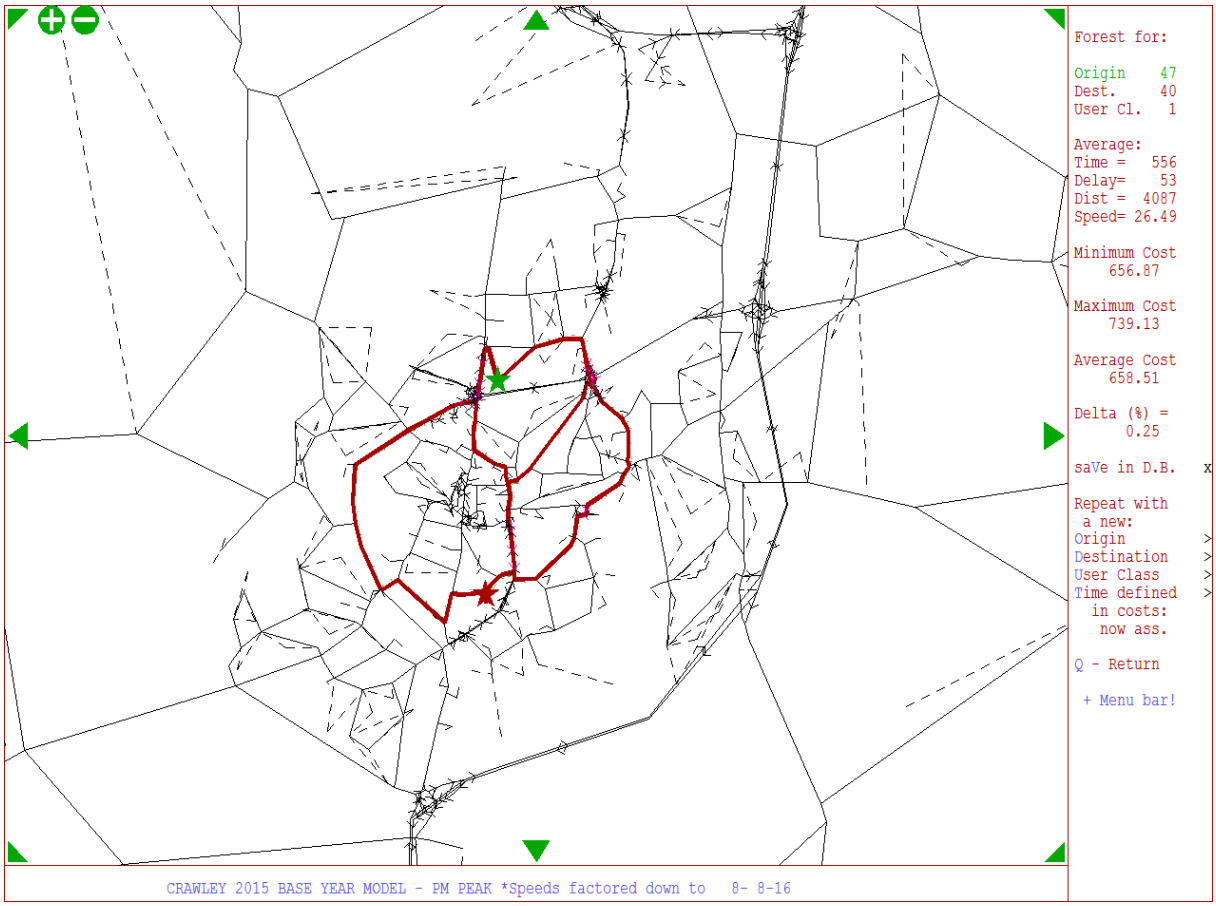
Route 9 – Zone 115 (Manor Royal) to Zone 79 (Broadfield) – Southbound



Route 10 – Zone 40 (TC/Crawley South) to Zone 47 (Manor Royal) – Northbound



Route 10 – Zone 47 (Manor Royal) to Zone 40 (TC/Crawley South) - Southbound



Appendix D Crawley Calibration Counts

AM PEAK - CRAWLEY CALIBRATION

Junction/Count	All (PCU) Observed	Modelled	GEH	DMRB
A264 Copthorne Way/A220 Copthorne Road	311	286	1.48	✓
A264 Copthorne Way/A220 Copthorne Road	211	219	0.52	✓
A264 Copthorne Way/A220 Copthorne Road	9	10	0.25	✓
A264 Copthorne Way/A220 Copthorne Road	56	57	0.16	✓
A264 Copthorne Way/A220 Copthorne Road	922	955	1.09	✓
A264 Copthorne Way/A220 Copthorne Road	283	267	0.97	✓
A264 Copthorne Way/A220 Copthorne Road	21	19	0.52	✓
A264 Copthorne Way/A220 Copthorne Road	9	10	0.35	✓
A264 Copthorne Way/A220 Copthorne Road	34	39	0.77	✓
A264 Copthorne Way/A220 Copthorne Road	5	12	2.51	✓
A264 Copthorne Way/A220 Copthorne Road	314	269	2.66	✓
A264 Copthorne Way/A220 Copthorne Road	231	124	8.02	×
A264 Copthorne Way/A220 Copthorne Road	177	84	8.16	✓
A264 Copthorne Way/A220 Copthorne Road	87	110	2.37	✓
A264 Copthorne Way/A220 Copthorne Road	700	647	2.03	✓
A264 Copthorne Way/A220 Copthorne Road	165	262	6.65	✓
A220 Copthorne Road/B2036 Balcombe Road	191	71	10.51	×
A220 Copthorne Road/B2036 Balcombe Road	201	231	2.08	✓
A220 Copthorne Road/B2036 Balcombe Road	57	45	1.66	✓
A220 Copthorne Road/B2036 Balcombe Road	80	64	1.79	✓
A220 Copthorne Road/B2036 Balcombe Road	443	355	4.38	✓
A220 Copthorne Road/B2036 Balcombe Road	129	174	3.70	✓
A220 Copthorne Road/B2036 Balcombe Road	94	64	3.28	✓
A220 Copthorne Road/B2036 Balcombe Road	346	653	13.72	×
A220 Copthorne Road/B2036 Balcombe Road	222	237	1.02	✓
A220 Copthorne Road/B2036 Balcombe Road	141	118	1.99	✓
A220 Copthorne Road/B2036 Balcombe Road	357	302	3.08	✓
A220 Copthorne Road/B2036 Balcombe Road	214	244	1.99	✓
B2036 Balcombe Road/Lucerne Drive	30	43	2.18	✓
B2036 Balcombe Road/Lucerne Drive	335	358	1.22	✓
B2036 Balcombe Road/Lucerne Drive	199	128	5.51	✓
B2036 Balcombe Road/Lucerne Drive	40	36	0.65	✓
B2036 Balcombe Road/Lucerne Drive	9	5	1.45	✓
B2036 Balcombe Road/Lucerne Drive	11	5	1.91	✓
B2036 Balcombe Road/Lucerne Drive	354	323	1.66	✓
B2036 Balcombe Road/Lucerne Drive	34	32	0.26	✓
B2036 Balcombe Road/Lucerne Drive	405	536	6.05	×
B2036 Balcombe Road/Lucerne Drive	54	54	0.05	✓
B2036 Balcombe Road/Lucerne Drive	14	0	5.29	✓
B2036 Balcombe Road/Lucerne Drive	68	69	0.08	✓
B2036 Balcombe Road/Lucerne Drive	152	92	5.38	✓
B2036 Balcombe Road/Lucerne Drive	236	318	4.94	✓
A2004 Southgate Avenue/Crawley Avenue	368	345	1.20	✓
A2004 Southgate Avenue/Crawley Avenue	307	306	0.03	✓
A2004 Southgate Avenue/Crawley Avenue	446	391	2.69	✓
A2004 Southgate Avenue/Crawley Avenue	9	8	0.32	✓
A2004 Southgate Avenue/Crawley Avenue	463	445	0.84	✓
A2004 Southgate Avenue/Crawley Avenue	1040	1071	0.95	✓
A2004 Southgate Avenue/Crawley Avenue	587	481	4.56	×
A2004 Southgate Avenue/Crawley Avenue	2	9	2.91	✓
A2004 Southgate Avenue/Crawley Avenue	2	5	1.42	✓
A2004 Southgate Avenue/Crawley Avenue	11	12	0.20	✓
A2004 Southgate Avenue/Crawley Avenue	3	3	0.09	✓

Junction/Count	All (PCU) Observed	Modelled	GEH	DMRB
A220 Horsham Road/Breezehurst Drive	42	7	6.99	✓
A220 Horsham Road/Breezehurst Drive	40	54	2.01	✓
A220 Horsham Road/Breezehurst Drive	748	726	0.83	✓
A220 Horsham Road/Breezehurst Drive	102	100	0.26	✓
A220 Horsham Road/Breezehurst Drive	120	226	8.05	×
A220 Horsham Road/Breezehurst Drive	113	115	0.20	✓
A220 Horsham Road/Breezehurst Drive	55	66	1.43	✓
A220 Horsham Road/Breezehurst Drive	610	709	3.86	✓
A220 Horsham Road/Breezehurst Drive	31	27	0.72	✓
A220 Horsham Road/Crawley Avenue	520	504	0.69	✓
A220 Horsham Road/Crawley Avenue	397	394	0.14	✓
A220 Horsham Road/Crawley Avenue	275	246	1.77	✓
A220 Horsham Road/Crawley Avenue	86	72	1.50	✓
A220 Horsham Road/Crawley Avenue	405	358	2.41	✓
A220 Horsham Road/Crawley Avenue	99	76	2.48	✓
A220 Horsham Road/Crawley Avenue	128	143	1.28	✓
A220 Horsham Road/Crawley Avenue	467	373	4.57	✓
A220 Horsham Road/Crawley Avenue	422	360	3.17	✓
A220 Horsham Road/Crawley Avenue	188	190	0.09	✓
A220 Horsham Road/Crawley Avenue	561	537	1.02	✓
A220 Horsham Road/Crawley Avenue	808	1038	7.56	×
Crawley Avenue/Gossops Drive	362	305	3.12	✓
Crawley Avenue/Gossops Drive	474	206	14.57	×
Crawley Avenue/Gossops Drive	214	217	0.22	✓
Crawley Avenue/Gossops Drive	815	841	0.92	✓
Crawley Avenue/Gossops Drive	1218	1226	0.25	✓
Crawley Avenue/Gossops Drive	179	257	5.28	✓
Crawley Avenue/Ifield Avenue	275	257	1.10	✓
Crawley Avenue/Ifield Avenue	411	450	1.86	✓
Crawley Avenue/Ifield Avenue	188	134	4.25	✓
Crawley Avenue/Ifield Avenue	151	176	1.96	✓
Crawley Avenue/Ifield Avenue	562	620	2.38	✓
Crawley Avenue/Ifield Avenue	129	193	5.11	✓
Crawley Avenue/Ifield Avenue	50	9	7.54	✓
Crawley Avenue/Ifield Avenue	159	0	17.79	×
Crawley Avenue/Ifield Avenue	595	545	2.09	✓
Crawley Avenue/Ifield Avenue	191	179	0.89	✓
Crawley Avenue/Ifield Avenue	246	409	8.97	×
Crawley Avenue/Ifield Avenue	1117	828	9.26	×
Crawley Avenue/Ifield Avenue	250	232	1.16	✓
Crawley Avenue/London Road	106	102	0.39	✓
Crawley Avenue/London Road	117	651	27.27	×
Crawley Avenue/London Road	638	485	6.45	×
Crawley Avenue/London Road	784	889	3.63	✓
Crawley Avenue/London Road	232	294	3.81	✓
Crawley Avenue/London Road	28	7	4.81	✓
Crawley Avenue/London Road	1431	965	13.48	×
Crawley Avenue/London Road	137	146	0.79	✓
Crawley Avenue/London Road	587	799	8.07	×
Crawley Avenue/London Road	50	36	2.05	✓
Crawley Avenue/London Road	290	294	0.25	✓
Crawley Avenue/London Road	1693	1336	9.16	×
Crawley Avenue/London Road	325	408	4.34	✓

Junction/Count	All (PCU) Observed	Modelled	GEH	DMRB
Crawley Avenue/London Road	98	137	3.59	✓
Crawley Avenue/London Road	746	737	0.30	✓
Crawley Avenue/London Road	427	532	4.76	×
Crawley Avenue/London Road	187	170	1.27	✓
Crawley Avenue/London Road	721	760	1.44	✓
Crawley Avenue/London Road	933	908	0.83	✓
Crawley Avenue/London Road	413	375	1.91	✓
Crawley Avenue/London Road	2281	2693	8.26	×
Crawley Avenue/London Road	447	668	9.35	×
Crawley Avenue/London Road	546	786	9.30	×
Crawley Avenue/London Road	2148	2282	2.84	✓
Crawley Avenue/London Road	443	669	9.56	×
Crawley Avenue/London Road	686	760	2.75	✓
Crawley Avenue/London Road	1922	2191	5.92	✓
Crawley Avenue/London Road	1587	1951	8.64	×
Crawley Avenue/London Road	778	909	4.50	×
Crawley Avenue/London Road	494	343	7.41	×
Crawley Avenue/London Road	262	283	1.23	✓
Crawley Avenue/London Road	778	909	4.50	×
Crawley Avenue/London Road	2272	2680	8.20	×
Crawley Avenue/London Road	377	455	3.82	✓
Crawley Avenue/London Road	356	441	4.30	✓
Crawley Avenue/London Road	2293	2693	8.01	×
Northgate Avenue/College road/Exchange Road	30	34	0.66	✓
Northgate Avenue/College road/Exchange Road	294	221	4.54	✓
Northgate Avenue/College road/Exchange Road	95	38	7.01	✓
Northgate Avenue/College road/Exchange Road	110	2	14.48	×
Northgate Avenue/College road/Exchange Road	224	241	1.13	✓
Northgate Avenue/College road/Exchange Road	263	328	3.75	✓
Northgate Avenue/College road/Exchange Road	250	273	1.39	✓
Northgate Avenue/College road/Exchange Road	473	480	0.32	✓
Northgate Avenue/College road/Exchange Road	115	81	3.47	✓
Northgate Avenue/College road/Exchange Road	38	31	1.25	✓
Northgate Avenue/College road/Exchange Road	120	98	2.17	✓
Northgate Avenue/College road/Exchange Road	127	130	0.27	✓
Northgate Avenue/College road/Exchange Road	38	35	0.40	✓
Ifield Road/Pegler Way	58	51	0.98	✓
Ifield Road/Pegler Way	147	144	0.20	✓
Ifield Road/Pegler Way	133	140	0.63	✓
Ifield Road/Pegler Way	244	287	2.64	✓
Ifield Road/Pegler Way	141	130	0.96	✓
Ifield Road/Pegler Way	63	58	0.63	✓
Ifield Road/Pegler Way	44	46	0.32	✓
Ifield Road/Pegler Way	90	92	0.17	✓
Ifield Road/Pegler Way	249	277	1.68	✓
Ifield Road/Pegler Way	16	16	0.01	✓
Ifield Road/Pegler Way	16	0	5.66	✓
Ifield Road/Pegler Way	53	63	1.38	✓
Ifield Road/Pegler Way	115	101	1.30	✓
field Road/Pegler Way	73	74	0.17	✓
Total	56216	58622	10.04	×
Percentage			77%	82%

INTER PEAK - CRAWLEY CALIBRATION

Description	All (pcus)			
	Observed	Modelled	GEH	DMRB
A264 Copthorne Way/A220 Copthorne Road	169	171	0.15	✓
A264 Copthorne Way/A220 Copthorne Road	102	107	0.49	✓
A264 Copthorne Way/A220 Copthorne Road	4	4	0.04	✓
A264 Copthorne Way/A220 Copthorne Road	28	26	0.42	✓
A264 Copthorne Way/A220 Copthorne Road	696	703	0.24	✓
A264 Copthorne Way/A220 Copthorne Road	176	175	0.04	✓
A264 Copthorne Way/A220 Copthorne Road	10	10	0.00	✓
A264 Copthorne Way/A220 Copthorne Road	11	12	0.28	✓
A264 Copthorne Way/A220 Copthorne Road	17	18	0.12	✓
A264 Copthorne Way/A220 Copthorne Road	13	17	0.92	✓
A264 Copthorne Way/A220 Copthorne Road	201	209	0.55	✓
A264 Copthorne Way/A220 Copthorne Road	101	104	0.35	✓
A264 Copthorne Way/A220 Copthorne Road	84	65	2.17	✓
A264 Copthorne Way/A220 Copthorne Road	82	82	0.03	✓
A264 Copthorne Way/A220 Copthorne Road	695	686	0.33	✓
A264 Copthorne Way/A220 Copthorne Road	148	171	1.84	✓
A220 Copthorne Road/B2036 Balcombe Road	110	79	3.18	✓
A220 Copthorne Road/B2036 Balcombe Road	220	226	0.43	✓
A220 Copthorne Road/B2036 Balcombe Road	52	47	0.73	✓
A220 Copthorne Road/B2036 Balcombe Road	43	44	0.10	✓
A220 Copthorne Road/B2036 Balcombe Road	211	210	0.06	✓
A220 Copthorne Road/B2036 Balcombe Road	97	90	0.73	✓
A220 Copthorne Road/B2036 Balcombe Road	69	68	0.02	✓
A220 Copthorne Road/B2036 Balcombe Road	260	273	0.83	✓
A220 Copthorne Road/B2036 Balcombe Road	134	131	0.23	✓
A220 Copthorne Road/B2036 Balcombe Road	154	148	0.55	✓
A220 Copthorne Road/B2036 Balcombe Road	225	233	0.53	✓
A220 Copthorne Road/B2036 Balcombe Road	133	135	0.14	✓
B2036 Balcombe Road/Lucerne Drive	79	79	0.01	✓
B2036 Balcombe Road/Lucerne Drive	170	171	0.06	✓
B2036 Balcombe Road/Lucerne Drive	44	42	0.30	✓
B2036 Balcombe Road/Lucerne Drive	33	28	0.86	✓
B2036 Balcombe Road/Lucerne Drive	11	11	0.09	✓
B2036 Balcombe Road/Lucerne Drive	18	21	0.76	✓
B2036 Balcombe Road/Lucerne Drive	143	155	0.98	✓
B2036 Balcombe Road/Lucerne Drive	12	12	0.15	✓
B2036 Balcombe Road/Lucerne Drive	221	224	0.21	✓
B2036 Balcombe Road/Lucerne Drive	47	47	0.10	✓
B2036 Balcombe Road/Lucerne Drive	2	0	2.00	✓
B2036 Balcombe Road/Lucerne Drive	19	19	0.05	✓
B2036 Balcombe Road/Lucerne Drive	37	62	3.50	✓
B2036 Balcombe Road/Lucerne Drive	90	92	0.17	✓
A2004 Southgate Avenue/Crawley Avenue	291	286	0.33	✓
A2004 Southgate Avenue/Crawley Avenue	361	332	1.54	✓
A2004 Southgate Avenue/Crawley Avenue	2	0	1.81	✓
A2004 Southgate Avenue/Crawley Avenue	9	10	0.41	✓
A2004 Southgate Avenue/Crawley Avenue	388	386	0.13	✓
A2004 Southgate Avenue/Crawley Avenue	492	485	0.33	✓
A2004 Southgate Avenue/Crawley Avenue	258	277	1.21	✓
A2004 Southgate Avenue/Crawley Avenue	7	9	0.58	✓
A2004 Southgate Avenue/Crawley Avenue	4	5	0.30	✓
A2004 Southgate Avenue/Crawley Avenue	12	12	0.05	✓
A2004 Southgate Avenue/Crawley Avenue	10	13	0.96	✓

Description	All (pcus)			
	Observed	Modelled	GEH	DMRB
A220 Horsham Road/Breezehurst Drive	15	14	0.37	✓
A220 Horsham Road/Breezehurst Drive	57	82	2.95	✓
A220 Horsham Road/Breezehurst Drive	654	663	0.36	✓
A220 Horsham Road/Breezehurst Drive	142	142	0.02	✓
A220 Horsham Road/Breezehurst Drive	128	131	0.29	✓
A220 Horsham Road/Breezehurst Drive	48	49	0.12	✓
A220 Horsham Road/Breezehurst Drive	38	39	0.22	✓
A220 Horsham Road/Breezehurst Drive	664	694	1.17	✓
A220 Horsham Road/Breezehurst Drive	15	13	0.49	✓
A220 Horsham Road/Crawley Avenue	550	569	0.79	✓
A220 Horsham Road/Crawley Avenue	402	385	0.83	✓
A220 Horsham Road/Crawley Avenue	156	154	0.10	✓
A220 Horsham Road/Crawley Avenue	111	126	1.38	✓
A220 Horsham Road/Crawley Avenue	320	376	3.00	✓
A220 Horsham Road/Crawley Avenue	56	56	0.04	✓
A220 Horsham Road/Crawley Avenue	34	32	0.34	✓
A220 Horsham Road/Crawley Avenue	282	323	2.36	✓
A220 Horsham Road/Crawley Avenue	325	286	2.24	✓
A220 Horsham Road/Crawley Avenue	207	190	1.16	✓
A220 Horsham Road/Crawley Avenue	446	461	0.71	✓
A220 Horsham Road/Crawley Avenue	638	682	1.72	✓
Crawley Avenue/Gossops Drive	192	190	0.14	✓
Crawley Avenue/Gossops Drive	213	216	0.22	✓
Crawley Avenue/Gossops Drive	277	217	3.79	✓
Crawley Avenue/Gossops Drive	937	919	0.62	✓
Crawley Avenue/Gossops Drive	825	918	3.17	✓
Crawley Avenue/Gossops Drive	211	214	0.21	✓
Crawley Avenue/Ifield Avenue	164	245	5.70	✓
Crawley Avenue/Ifield Avenue	331	433	5.23	×
Crawley Avenue/Ifield Avenue	174	172	0.17	✓
Crawley Avenue/Ifield Avenue	302	276	1.50	✓
Crawley Avenue/Ifield Avenue	781	644	5.14	×
Crawley Avenue/Ifield Avenue	255	155	7.00	×
Crawley Avenue/Ifield Avenue	78	79	0.10	✓
Crawley Avenue/Ifield Avenue	97	93	0.45	✓
Crawley Avenue/Ifield Avenue	401	397	0.21	✓
Crawley Avenue/Ifield Avenue	249	251	0.09	✓
Crawley Avenue/Ifield Avenue	222	240	1.21	✓
Crawley Avenue/Ifield Avenue	662	727	2.44	✓
Crawley Avenue/Ifield Avenue	153	172	1.49	✓
Crawley Avenue/London Road	275	270	0.28	✓
Crawley Avenue/London Road	279	413	7.20	×
Crawley Avenue/London Road	612	470	6.10	×
Crawley Avenue/London Road	1095	836	8.34	×
Crawley Avenue/London Road	152	131	1.69	✓
Crawley Avenue/London Road	19	20	0.02	✓
Crawley Avenue/London Road	998	1051	1.66	✓
Crawley Avenue/London Road	153	63	8.60	✓
Crawley Avenue/London Road	512	481	1.39	✓
Crawley Avenue/London Road	31	33	0.20	✓
Crawley Avenue/London Road	151	153	0.14	✓
Crawley Avenue/London Road	968	992	0.79	✓
Crawley Avenue/London Road	544	540	0.20	✓

Description	All (pcus)			
	Observed	Modelled	GEH	DMRB
Crawley Avenue/London Road	127	90	3.59	✓
Crawley Avenue/London Road	1018	577	15.60	×
Crawley Avenue/London Road	542	545	0.15	✓
Crawley Avenue/London Road	154	147	0.53	✓
Crawley Avenue/London Road	686	714	1.04	✓
Crawley Avenue/London Road	1172	723	14.57	×
Crawley Avenue/London Road	502	484	0.78	✓
Crawley Avenue/London Road	1581	1788	5.03	✓
Crawley Avenue/London Road	585	632	1.88	✓
Crawley Avenue/London Road	630	797	6.25	×
Crawley Avenue/London Road	1446	1475	0.77	✓
Crawley Avenue/London Road	656	635	0.84	✓
Crawley Avenue/London Road	676	714	1.45	✓
Crawley Avenue/London Road	1406	1393	0.34	✓
Crawley Avenue/London Road	858	862	0.13	✓
Crawley Avenue/London Road	1204	1166	1.10	✓
Crawley Avenue/London Road	553	518	1.52	✓
Crawley Avenue/London Road	352	524	8.20	×
Crawley Avenue/London Road	1204	1166	1.10	✓
Crawley Avenue/London Road	1497	1528	0.78	✓
Crawley Avenue/London Road	552	702	5.96	×
Crawley Avenue/London Road	425	442	0.77	✓
Crawley Avenue/London Road	1624	1788	3.96	✓
Northgate Avenue/College road/Exchange Road	35	36	0.21	✓
Northgate Avenue/College road/Exchange Road	260	237	1.44	✓
Northgate Avenue/College road/Exchange Road	76	49	3.44	✓
Northgate Avenue/College road/Exchange Road	39	2	8.17	✓
Northgate Avenue/College road/Exchange Road	216	271	3.54	✓
Northgate Avenue/College road/Exchange Road	258	271	0.76	✓
Northgate Avenue/College road/Exchange Road	284	283	0.02	✓
Northgate Avenue/College road/Exchange Road	364	344	1.08	✓
Northgate Avenue/College road/Exchange Road	160	130	2.53	✓
Northgate Avenue/College road/Exchange Road	97	56	4.65	✓
Northgate Avenue/College road/Exchange Road	190	126	5.12	✓
Northgate Avenue/College road/Exchange Road	187	179	0.58	✓
Northgate Avenue/College road/Exchange Road	67	66	0.05	✓
Ifield Road/Pegler Way	35	34	0.14	✓
Ifield Road/Pegler Way	215	234	1.27	✓
Ifield Road/Pegler Way	173	178	0.35	✓
Ifield Road/Pegler Way	240	226	0.93	✓
Ifield Road/Pegler Way	132	134	0.11	✓
Ifield Road/Pegler Way	118	111	0.63	✓
Ifield Road/Pegler Way	65	66	0.14	✓
Ifield Road/Pegler Way	79	83	0.45	✓
Ifield Road/Pegler Way	133	116	1.58	✓
Ifield Road/Pegler Way	15	14	0.05	✓
Ifield Road/Pegler Way	35	0	8.32	✓
Ifield Road/Pegler Way	73	71	0.32	✓
Ifield Road/Pegler Way	115	111	0.38	✓
field Road/Pegler Way	87	87	0.04	✓
Total	47803	47428	1.72	✓
Percentage			89%	93%

PM PEAK - CRAWLEY CALIBRATION

Junction/Count	All (PCU) Observed	Modelled	GEH	DMRB
A264 Copthorne Way/A220 Copthorne Road	307	284	1.33	✓
A264 Copthorne Way/A220 Copthorne Road	260	247	0.80	✓
A264 Copthorne Way/A220 Copthorne Road	5	6	0.49	✓
A264 Copthorne Way/A220 Copthorne Road	44	44	0.01	✓
A264 Copthorne Way/A220 Copthorne Road	685	707	0.83	✓
A264 Copthorne Way/A220 Copthorne Road	258	239	1.20	✓
A264 Copthorne Way/A220 Copthorne Road	14	14	0.00	✓
A264 Copthorne Way/A220 Copthorne Road	18	18	0.06	✓
A264 Copthorne Way/A220 Copthorne Road	15	16	0.22	✓
A264 Copthorne Way/A220 Copthorne Road	12	12	0.05	✓
A264 Copthorne Way/A220 Copthorne Road	362	333	1.57	✓
A264 Copthorne Way/A220 Copthorne Road	184	169	1.14	✓
A264 Copthorne Way/A220 Copthorne Road	101	75	2.75	✓
A264 Copthorne Way/A220 Copthorne Road	112	87	2.46	✓
A264 Copthorne Way/A220 Copthorne Road	791	684	3.95	✓
A264 Copthorne Way/A220 Copthorne Road	187	151	2.77	✓
A220 Copthorne Road/B2036 Balcombe Road	143	142	0.09	✓
A220 Copthorne Road/B2036 Balcombe Road	439	546	4.83	×
A220 Copthorne Road/B2036 Balcombe Road	67	55	1.51	✓
A220 Copthorne Road/B2036 Balcombe Road	65	58	0.81	✓
A220 Copthorne Road/B2036 Balcombe Road	332	304	1.57	✓
A220 Copthorne Road/B2036 Balcombe Road	211	200	0.71	✓
A220 Copthorne Road/B2036 Balcombe Road	112	105	0.63	✓
A220 Copthorne Road/B2036 Balcombe Road	304	281	1.34	✓
A220 Copthorne Road/B2036 Balcombe Road	126	126	0.01	✓
A220 Copthorne Road/B2036 Balcombe Road	286	505	11.02	×
A220 Copthorne Road/B2036 Balcombe Road	404	393	0.54	✓
A220 Copthorne Road/B2036 Balcombe Road	163	112	4.31	✓
B2036 Balcombe Road/Lucerne Drive	128	127	0.04	✓
B2036 Balcombe Road/Lucerne Drive	526	528	0.06	✓
B2036 Balcombe Road/Lucerne Drive	39	46	1.07	✓
B2036 Balcombe Road/Lucerne Drive	34	34	0.08	✓
B2036 Balcombe Road/Lucerne Drive	13	13	0.01	✓
B2036 Balcombe Road/Lucerne Drive	17	16	0.22	✓
B2036 Balcombe Road/Lucerne Drive	124	142	1.59	✓
B2036 Balcombe Road/Lucerne Drive	16	16	0.11	✓
B2036 Balcombe Road/Lucerne Drive	517	549	1.37	✓
B2036 Balcombe Road/Lucerne Drive	161	164	0.22	✓
B2036 Balcombe Road/Lucerne Drive	10	0	4.47	✓
B2036 Balcombe Road/Lucerne Drive	40	40	0.00	✓
B2036 Balcombe Road/Lucerne Drive	41	84	5.45	✓
B2036 Balcombe Road/Lucerne Drive	117	117	0.04	✓
A2004 Southgate Avenue/Crawley Avenue	477	527	2.24	✓
A2004 Southgate Avenue/Crawley Avenue	362	287	4.17	✓
A2004 Southgate Avenue/Crawley Avenue	510	429	3.75	✓
A2004 Southgate Avenue/Crawley Avenue	20	17	0.67	✓
A2004 Southgate Avenue/Crawley Avenue	645	657	0.50	✓
A2004 Southgate Avenue/Crawley Avenue	810	765	1.58	✓
A2004 Southgate Avenue/Crawley Avenue	367	385	0.94	✓
A2004 Southgate Avenue/Crawley Avenue	6	9	1.05	✓
A2004 Southgate Avenue/Crawley Avenue	10	10	0.15	✓
A2004 Southgate Avenue/Crawley Avenue	43	43	0.13	✓
A2004 Southgate Avenue/Crawley Avenue	21	22	0.27	✓

Junction/Count	All (PCU) Observed	Modelled	GEH	DMRB
A220 Horsham Road/Breezehurst Drive	16	4	3.78	✓
A220 Horsham Road/Breezehurst Drive	90	72	1.96	✓
A220 Horsham Road/Breezehurst Drive	1071	975	2.98	✓
A220 Horsham Road/Breezehurst Drive	227	200	1.84	✓
A220 Horsham Road/Breezehurst Drive	165	170	0.37	✓
A220 Horsham Road/Breezehurst Drive	51	50	0.07	✓
A220 Horsham Road/Breezehurst Drive	94	104	0.98	✓
A220 Horsham Road/Breezehurst Drive	862	876	0.46	✓
A220 Horsham Road/Breezehurst Drive	29	34	0.87	✓
A220 Horsham Road/Crawley Avenue	584	483	4.41	×
A220 Horsham Road/Crawley Avenue	480	526	2.04	✓
A220 Horsham Road/Crawley Avenue	146	166	1.58	✓
A220 Horsham Road/Crawley Avenue	106	152	4.07	✓
A220 Horsham Road/Crawley Avenue	678	691	0.52	✓
A220 Horsham Road/Crawley Avenue	91	98	0.80	✓
A220 Horsham Road/Crawley Avenue	45	46	0.09	✓
A220 Horsham Road/Crawley Avenue	374	397	1.18	✓
A220 Horsham Road/Crawley Avenue	496	393	4.89	×
A220 Horsham Road/Crawley Avenue	295	220	4.67	✓
A220 Horsham Road/Crawley Avenue	519	492	1.19	✓
A220 Horsham Road/Crawley Avenue	735	809	2.66	✓
Crawley Avenue/Gossops Drive	152	150	0.15	✓
Crawley Avenue/Gossops Drive	183	190	0.47	✓
Crawley Avenue/Gossops Drive	501	210	15.45	×
Crawley Avenue/Gossops Drive	1060	1038	0.67	✓
Crawley Avenue/Gossops Drive	886	1013	4.10	✓
Crawley Avenue/Gossops Drive	294	359	3.59	✓
Crawley Avenue/Ifield Avenue	252	269	1.06	✓
Crawley Avenue/Ifield Avenue	418	414	0.18	✓
Crawley Avenue/Ifield Avenue	152	172	1.61	✓
Crawley Avenue/Ifield Avenue	243	422	9.82	×
Crawley Avenue/Ifield Avenue	923	732	6.67	×
Crawley Avenue/Ifield Avenue	269	201	4.41	✓
Crawley Avenue/Ifield Avenue	69	18	7.77	✓
Crawley Avenue/Ifield Avenue	70	73	0.35	✓
Crawley Avenue/Ifield Avenue	505	572	2.88	✓
Crawley Avenue/Ifield Avenue	392	272	6.59	×
Crawley Avenue/Ifield Avenue	235	295	3.64	✓
Crawley Avenue/Ifield Avenue	591	716	4.88	×
Crawley Avenue/Ifield Avenue	209	159	3.75	✓
Crawley Avenue/London Road	169	183	1.03	✓
Crawley Avenue/London Road	170	403	13.75	×
Crawley Avenue/London Road	924	744	6.24	×
Crawley Avenue/London Road	1024	1078	1.66	✓
Crawley Avenue/London Road	115	112	0.23	✓
Crawley Avenue/London Road	24	73	7.08	✓
Crawley Avenue/London Road	718	905	6.56	×
Crawley Avenue/London Road	237	121	8.68	×
Crawley Avenue/London Road	431	394	1.80	✓
Crawley Avenue/London Road	26	26	0.01	✓
Crawley Avenue/London Road	133	158	2.11	✓
Crawley Avenue/London Road	613	703	3.50	✓
Crawley Avenue/London Road	537	597	2.55	✓

Junction/Count	All (PCU) Observed	Modelled	GEH	DMRB
Crawley Avenue/London Road	292	193	6.39	✓
Crawley Avenue/London Road	1381	1161	6.17	×
Crawley Avenue/London Road	547	612	2.72	✓
Crawley Avenue/London Road	123	143	1.78	✓
Crawley Avenue/London Road	560	631	2.92	✓
Crawley Avenue/London Road	1504	1305	5.31	✓
Crawley Avenue/London Road	516	525	0.41	✓
Crawley Avenue/London Road	1395	1613	5.64	×
Crawley Avenue/London Road	686	762	2.81	✓
Crawley Avenue/London Road	616	722	4.08	×
Crawley Avenue/London Road	1290	1417	3.43	✓
Crawley Avenue/London Road	859	805	1.89	✓
Crawley Avenue/London Road	539	631	3.81	✓
Crawley Avenue/London Road	1455	1548	2.40	✓
Crawley Avenue/London Road	655	703	1.83	✓
Crawley Avenue/London Road	1659	1649	0.23	✓
Crawley Avenue/London Road	1024	982	1.32	✓
Crawley Avenue/London Road	308	391	4.47	✓
Crawley Avenue/London Road	1659	1649	0.23	✓
Crawley Avenue/London Road	1443	1583	3.60	✓
Crawley Avenue/London Road	559	648	3.64	✓
Crawley Avenue/London Road	594	618	0.97	✓
Crawley Avenue/London Road	1408	1613	5.29	✓
Northgate Avenue/College road/Exchange Road	52	45	1.07	✓
Northgate Avenue/College road/Exchange Road	336	267	3.96	✓
Northgate Avenue/College road/Exchange Road	160	88	6.54	✓
Northgate Avenue/College road/Exchange Road	42	9	6.58	✓
Northgate Avenue/College road/Exchange Road	228	250	1.42	✓
Northgate Avenue/College road/Exchange Road	229	274	2.85	✓
Northgate Avenue/College road/Exchange Road	371	378	0.35	✓
Northgate Avenue/College road/Exchange Road	354	381	1.42	✓
Northgate Avenue/College road/Exchange Road	159	160	0.06	✓
Northgate Avenue/College road/Exchange Road	80	79	0.16	✓
Northgate Avenue/College road/Exchange Road	150	149	0.09	✓
Northgate Avenue/College road/Exchange Road	268	248	1.26	✓
Northgate Avenue/College road/Exchange Road	62	57	0.65	✓
Ifield Road/Pegler Way	45	40	0.79	✓
Ifield Road/Pegler Way	387	379	0.42	✓
Ifield Road/Pegler Way	222	170	3.71	✓
Ifield Road/Pegler Way	272	234	2.36	✓
Ifield Road/Pegler Way	162	147	1.24	✓
Ifield Road/Pegler Way	141	141	0.02	✓
Ifield Road/Pegler Way	76	75	0.16	✓
Ifield Road/Pegler Way	71	79	0.97	✓
Ifield Road/Pegler Way	133	113	1.82	✓
Ifield Road/Pegler Way	19	16	0.76	✓
Ifield Road/Pegler Way	26	0	7.21	✓
Ifield Road/Pegler Way	98	106	0.83	✓
Ifield Road/Pegler Way	172	208	2.65	✓
field Road/Pegler Way	100	98	0.24	✓
Total	56221	56765	2.29	×
Percentage			87%	90%

Appendix E HE Calibration Counts

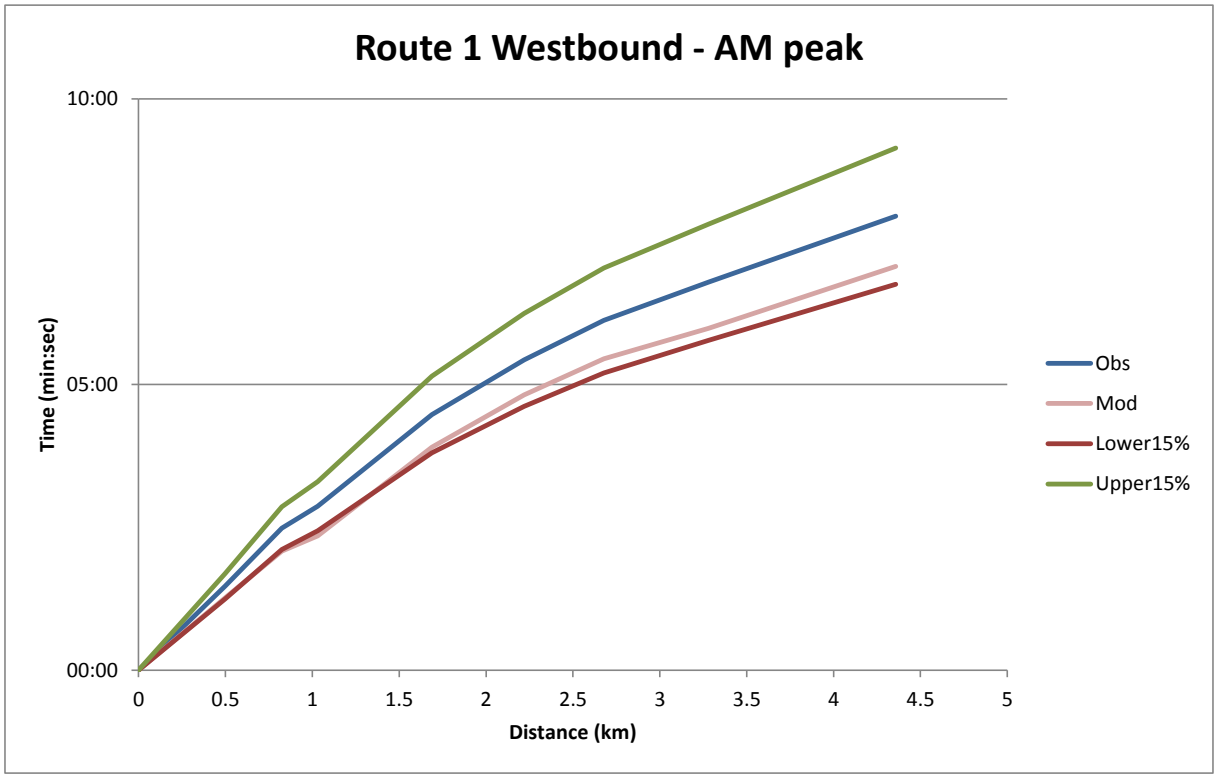
AM PEAK - HE CALIBRATION				
	Total PCU's			
Location	Observed	Modelled	GEH	DMRB
M23 soutbound between J8 and J9	4921	5143	3.12	✓
M23 J9 Southbound Off-Slip	1615	1571	1.12	✓
M23 J9 Southbound Within Junction	3474	3572	1.64	✓
M23 J9 Southbound on slip	517	532	0.65	✓
M23 Southbound between j9 and J10	4041	4104	0.99	✓
M23 J10 Southbound Off-Slip	1459	1497	0.97	✓
M23 J10 Southbound Within Junction	2484	2607	2.44	✓
M23 J10A Southbound Off-Slip	365	384	0.96	✓
M23 Southbound within J11	1924	1924	0.01	✓
A23 Northbound towards J11	4326	4482	2.35	✓
M23 Northbound within J11	2572	2749	3.43	✓
M23 J11 Northbound On-Slip	1118	1211	2.74	✓
M23 J10A Northbound On-Slip	673	549	5.00	×
M23 Northbound between J10A and J10	4497	4510	0.19	✓
M23 Junction 10 northbound off slip	1319	1243	2.12	✓
M23 Junction 10 Northbound within Junction	3373	3267	1.84	✓
M23 J10 Northbound On-Slip	1021	967	1.71	✓
M23 Northbound between J10 and J9	4394	4234	2.43	✓
M23 J9 Northbound Off-Slip	1324	1162	4.61	✓
M23 J9 Northbound within junction	3074	3072	0.02	✓
M23 J9 Northbound on-slip	1050	1049	0.03	✓
M23 Gatwick Spur Westbound towards Gatwick Airport	2833	2728	1.99	✓
Airport Way Westbound	2475	2343	2.69	✓
Airport Way Eastbound	774	764	0.34	✓
London Road to Airport Way slip Road	851	852	0.02	✓
M23 Gatwick Spur Eastbound (Airport Way to J9)	1524	1577	1.36	✓
	52376	52557		✓
			96%	96%

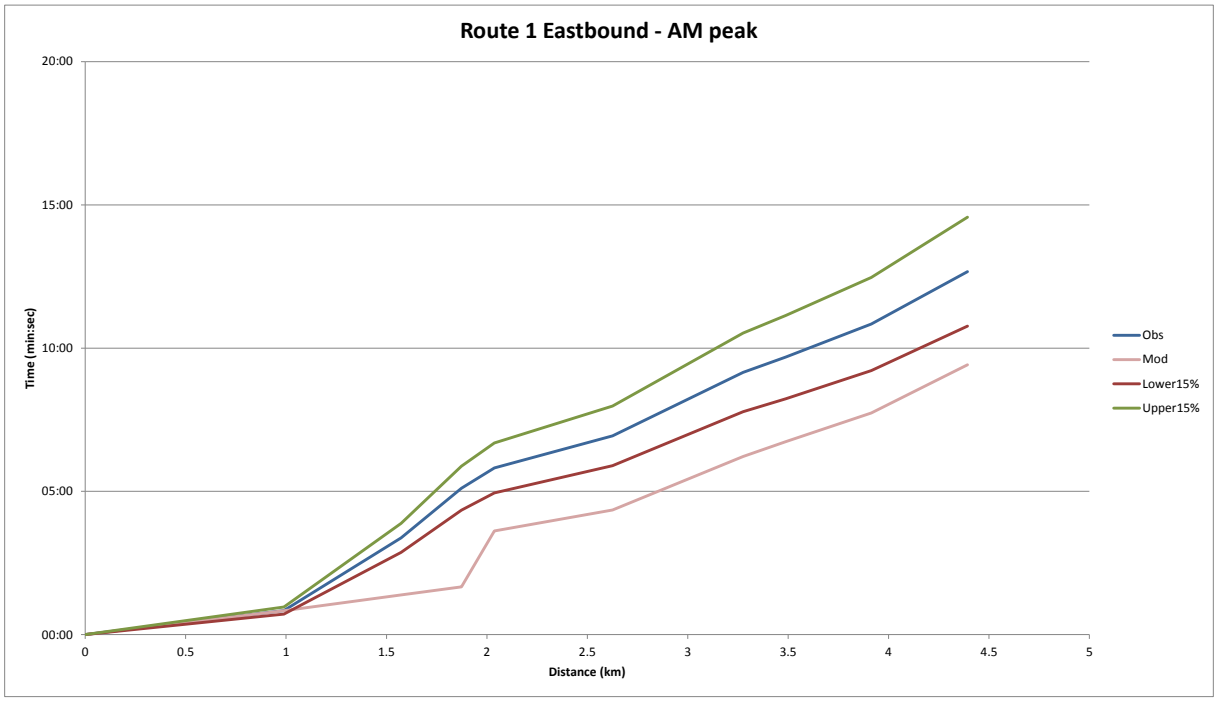
INTER PEAK HE CALIBRATION				
	All (PCU)			
Location	Observed	Modelled	GEH	DMRB
M23 soutbound between J8 and J9	3568	3649	1.36	✓
M23 J9 Southbound Off-Slip	938	963	0.80	✓
M23 J9 Southbound Within Junction	2697	2686	0.21	✓
M23 J9 Southbound on slip	520	528	0.33	✓
M23 Southbound between j9 and J10	3239	3214	0.44	✓
M23 J10 Southbound Off-Slip	931	1027	3.05	✓
M23 J10 Southbound Within Junction	2180	2188	0.16	✓
M23 J10A Southbound Off-Slip	279	303	1.41	✓
M23 Southbound within J11	1664	1670	0.14	✓
A23 Northbound towards J11	2305	2907	11.80	×
M23 Northbound within J11	1763	1743	0.48	✓
M23 J11 Northbound On-Slip	785	793	0.28	✓
M23 J10A Northbound On-Slip	259	280	1.28	✓
M23 Northbound between J10A and J10	2881	2815	1.23	✓
M23 Junction 10 northbound off slip	545	487	2.53	✓
M23 Junction 10 Northbound within Junctio	2348	2328	0.41	✓
M23 J10 Northbound On-Slip	952	903	1.62	✓
M23 Northbound between J10 and J9	2622	3231	11.25	×
M23 J9 Northbound Off-Slip	475	478	0.14	✓
M23 J9 Northbound within junction	2754	2753	0.02	✓
M23 J9 Northbound on-slip	1037	1049	0.37	✓
M23 Gatwick Spur Westbound towards Gat	1352	1441	2.37	✓
Airport Way Westbound	1261	1279	0.51	✓
Airport Way Eastbound	805	824	0.67	✓
London Road to Airport Way slip Road	596	600	0.17	✓
M23 Gatwick Spur Eastbound (Airport Way	1519	1577	1.47	✓
	36096	37437	6.99	×
			92%	92%

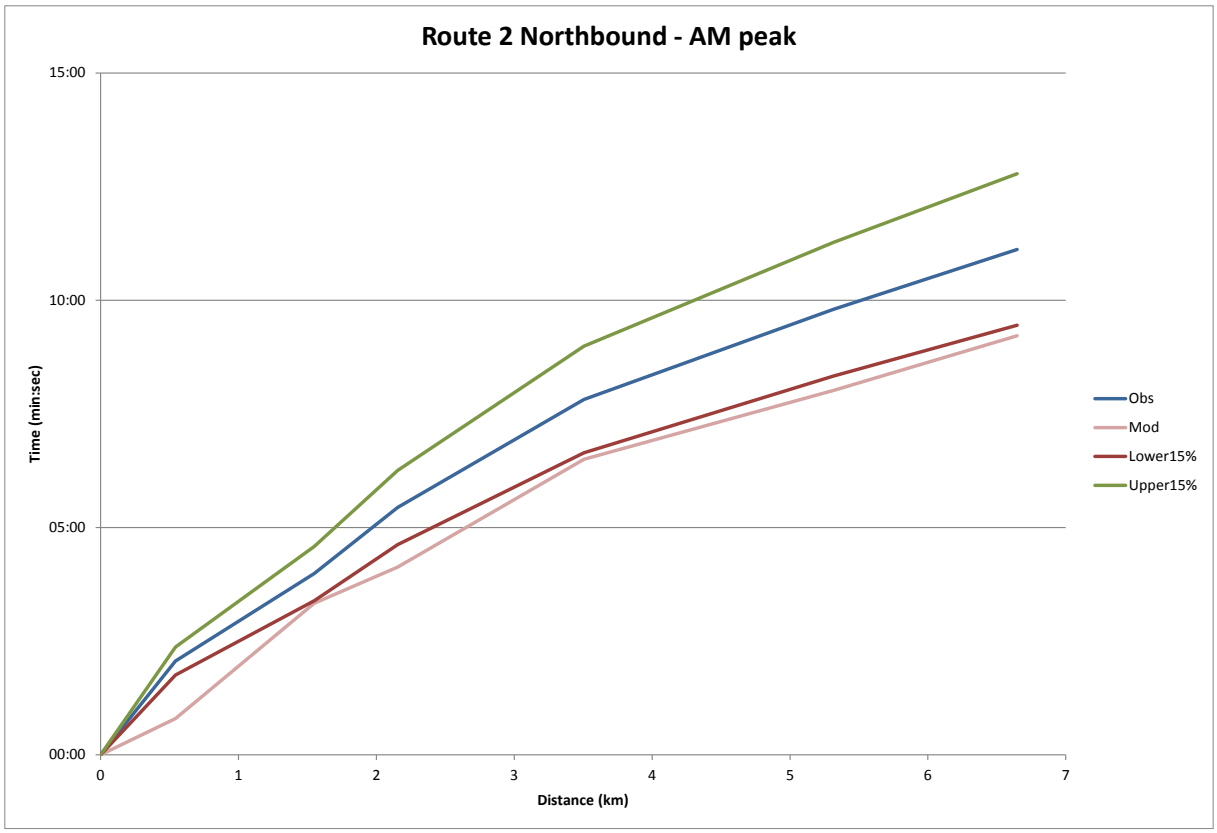
PM PEAK - HE CALIBRATION				
	Total PCU's			
Location	Observed	Modelled	GEH	DMRB
M23 soutbound between J8 and J9	4527	4371	2.34	✓
M23 J9 Southbound Off-Slip	976	897	2.59	✓
M23 J9 Southbound Within Junction	3638	3474	2.74	✓
M23 J9 Southbound on slip	1226	1342	3.24	✓
M23 Southbound between j9 and J10	4898	4816	1.18	✓
M23 J10 Southbound Off-Slip	1173	1201	0.83	✓
M23 J10 Southbound Within Junction	3612	3615	0.05	✓
M23 J10A Southbound Off-Slip	701	713	0.45	✓
M23 Southbound within J11	2904	2887	0.31	✓
A23 Northbound towards J11	2570	2560	0.19	✓
M23 Northbound within J11	1701	1546	3.86	✓
M23 J11 Northbound On-Slip	876	871	0.19	✓
M23 J10A Northbound On-Slip	290	288	0.09	✓
M23 Northbound between J10A and J10	2980	2704	5.19	✓
M23 Junction 10 northbound off slip	754	558	7.66	×
M23 Junction 10 Northbound within Junction	2246	2146	2.13	✓
M23 J10 Northbound On-Slip	1218	1172	1.34	✓
M23 Northbound between J10 and J9	3464	3317	2.52	✓
M23 J9 Northbound Off-Slip	629	662	1.27	✓
M23 J9 Northbound within junction	2815	2656	3.04	✓
M23 J9 Northbound on-slip	1297	1280	0.47	✓
M23 Gatwick Spur Westbound towards Gatwick Airport	1539	1537	0.05	✓
Airport Way Westbound	1537	1540	0.06	✓
Airport Way Eastbound	1235	1357	3.39	✓
London Road to Airport Way slip Road	971	996	0.80	✓
M23 Gatwick Spur Eastbound (Airport Way to J9)	2465	2601	2.71	✓
	46033	44613		×
			92%	96%

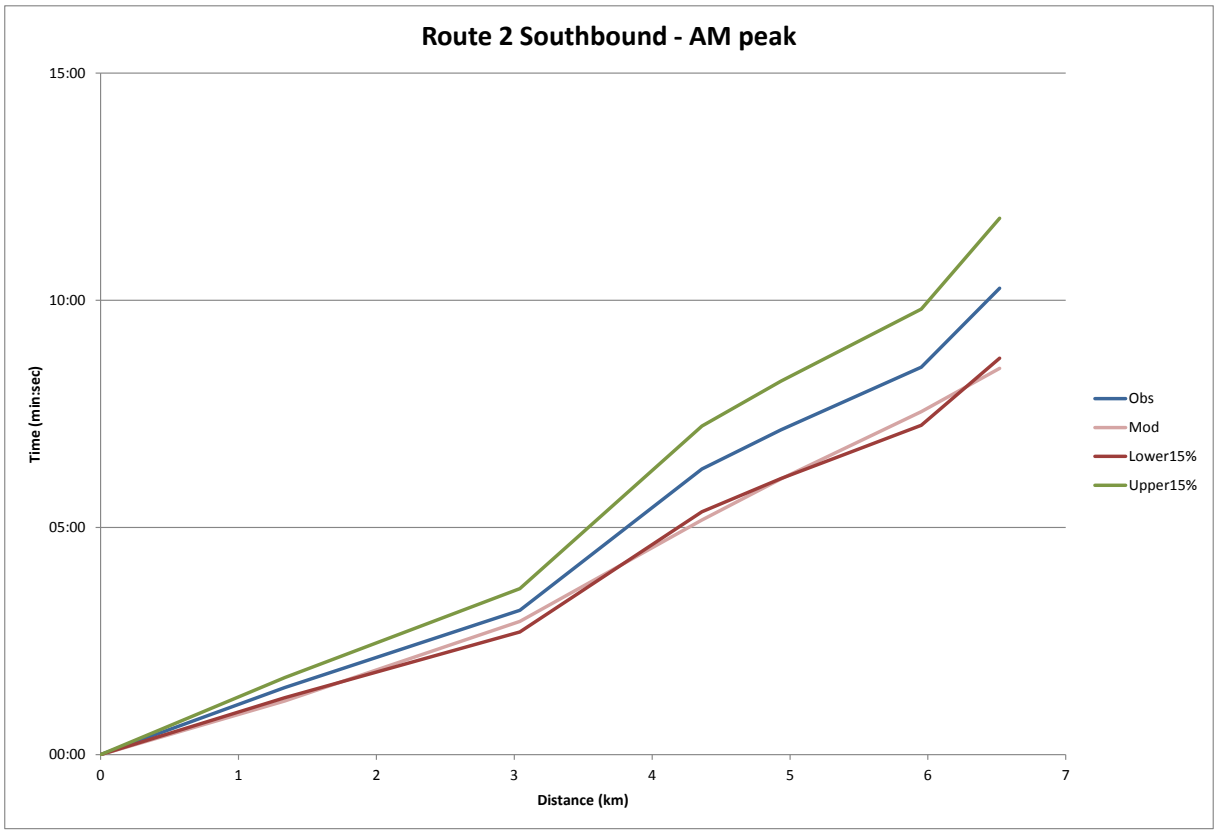
Appendix F Journey Time Validation

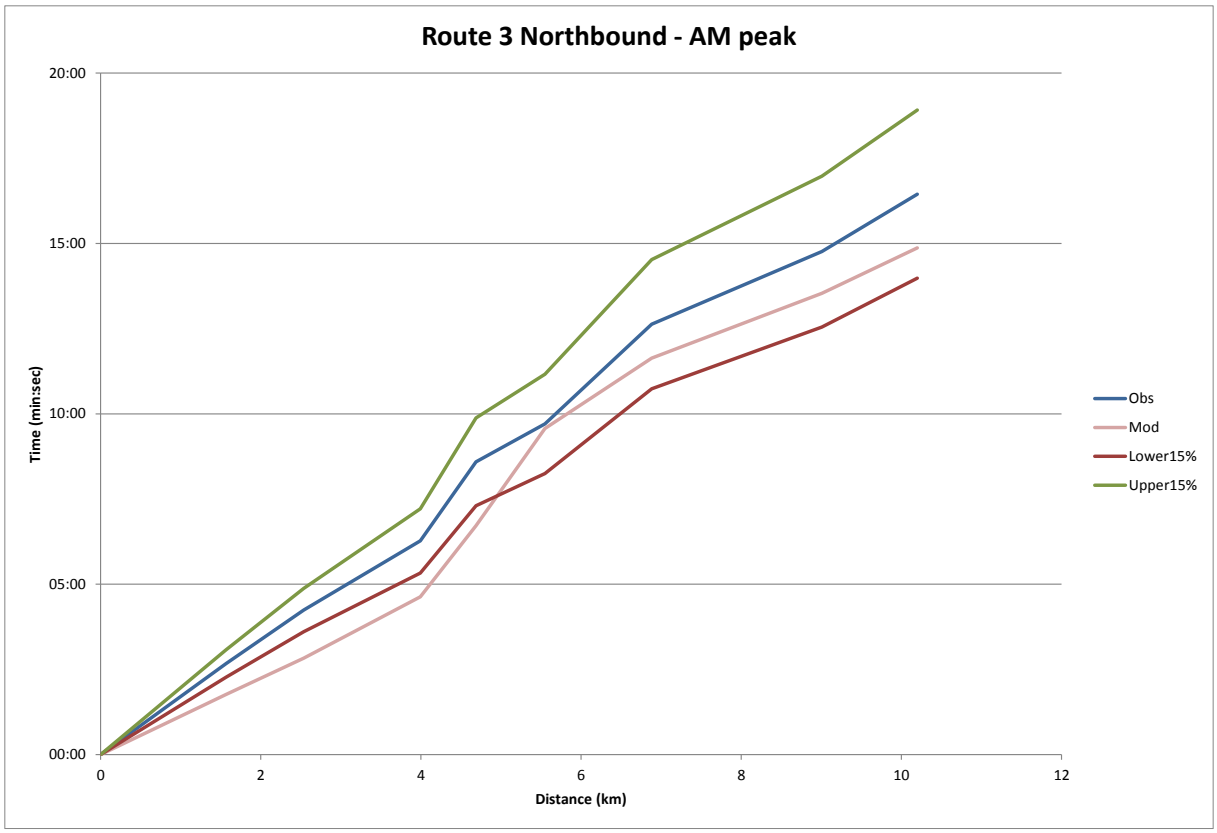
AM PEAK

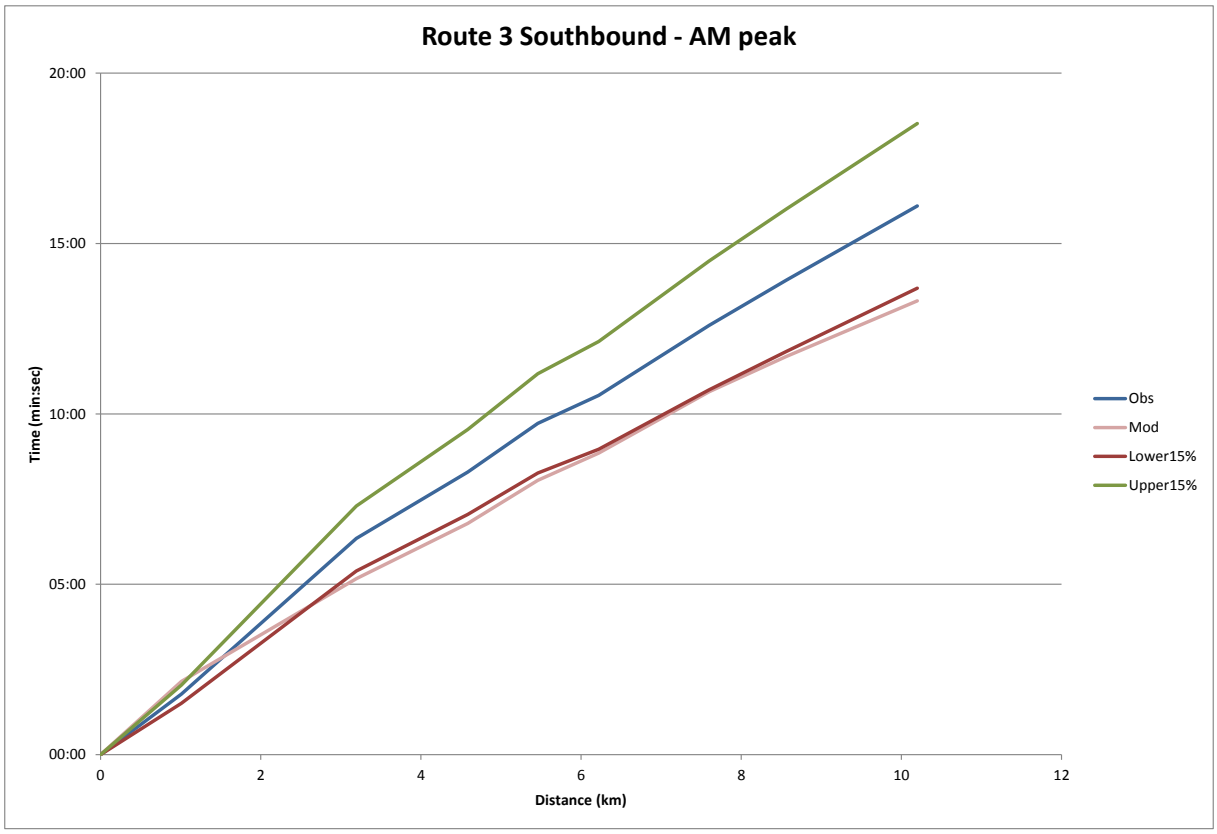

Route 1 Westbound - AM peak
10:00
05:00
00:00
Time (min:sec)
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
Distance (km)
Obs
Mod
Lower15%
Upper15%

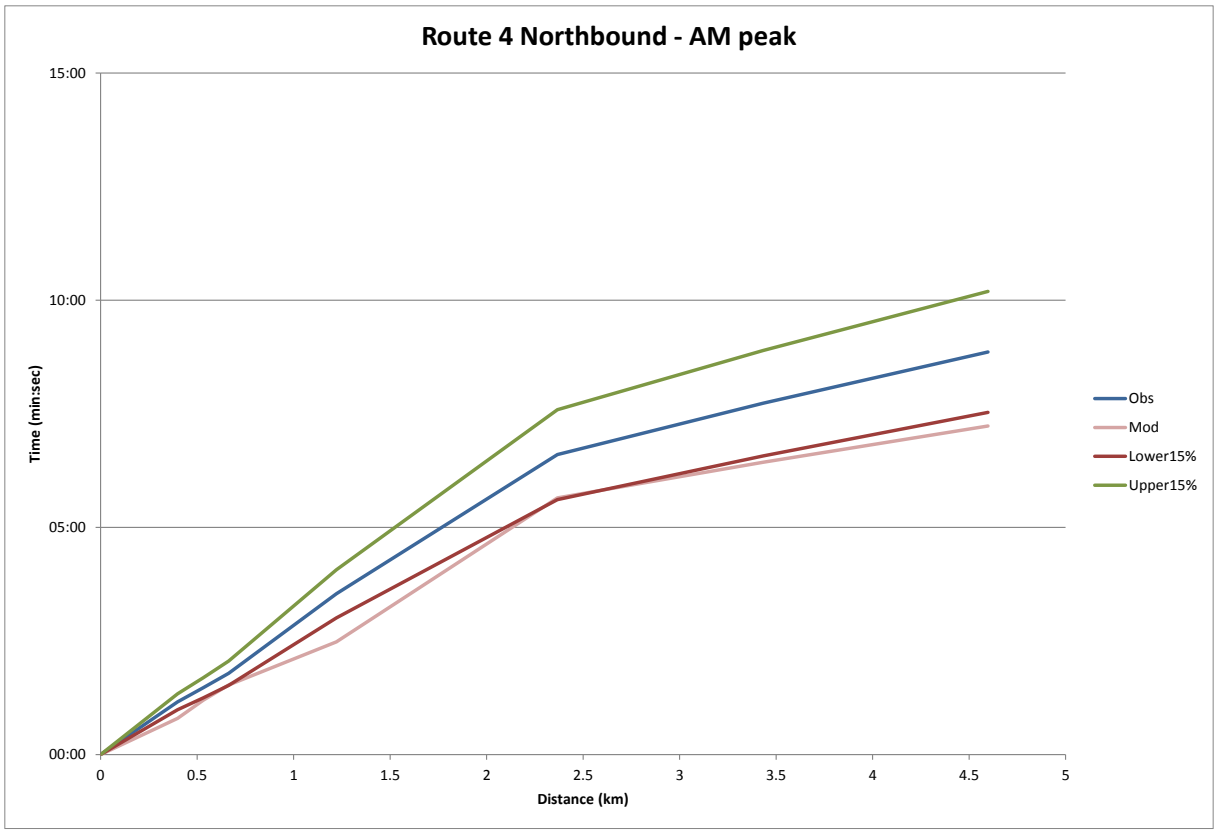

Route 1 Eastbound - AM peak
20:00
15:00
10:00
05:00
00:00
Time (min:sec)
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
Distance (km)
Obs
Mod
Lower15%
Upper15%

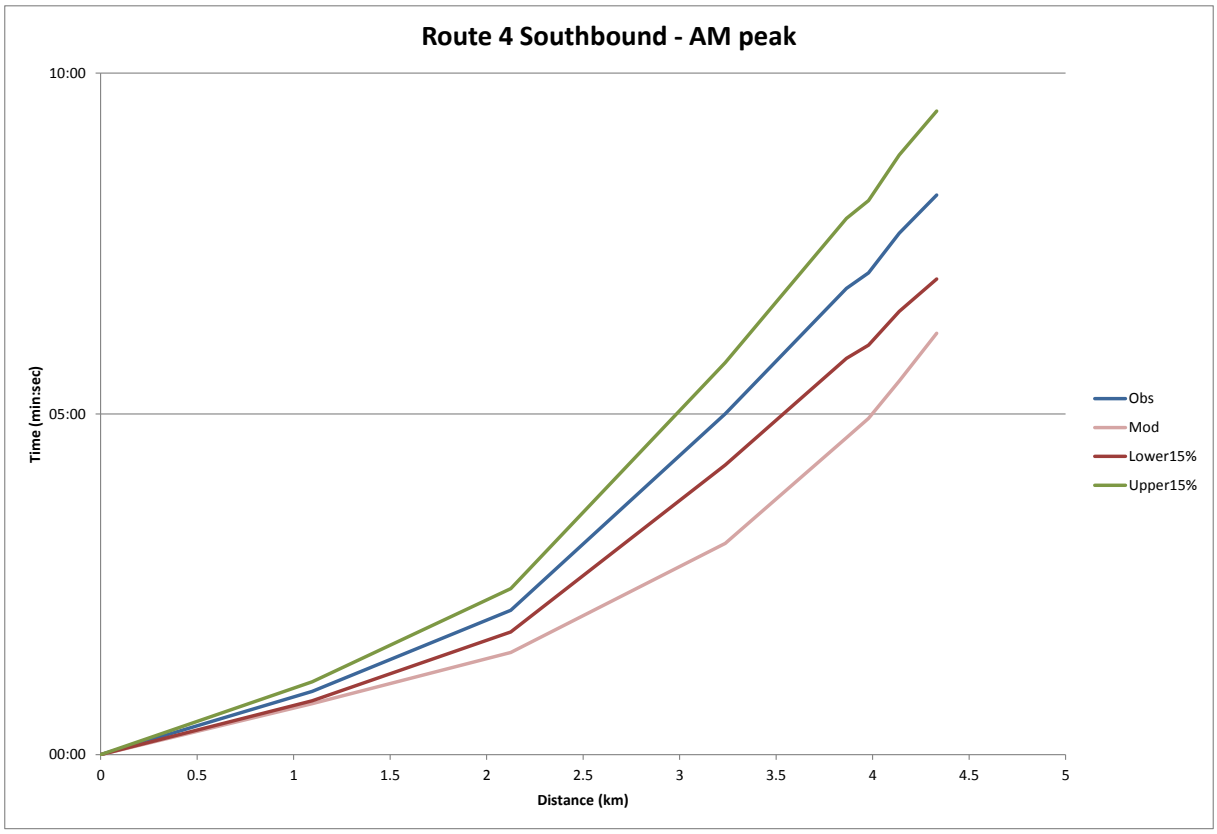

Route 2 Northbound - AM peak
15:00
10:00
05:00
00:00
Time (min:sec)
0
1
2
3
4
5
6
7
Distance (km)
Obs
Mod
Lower15%
Upper15%

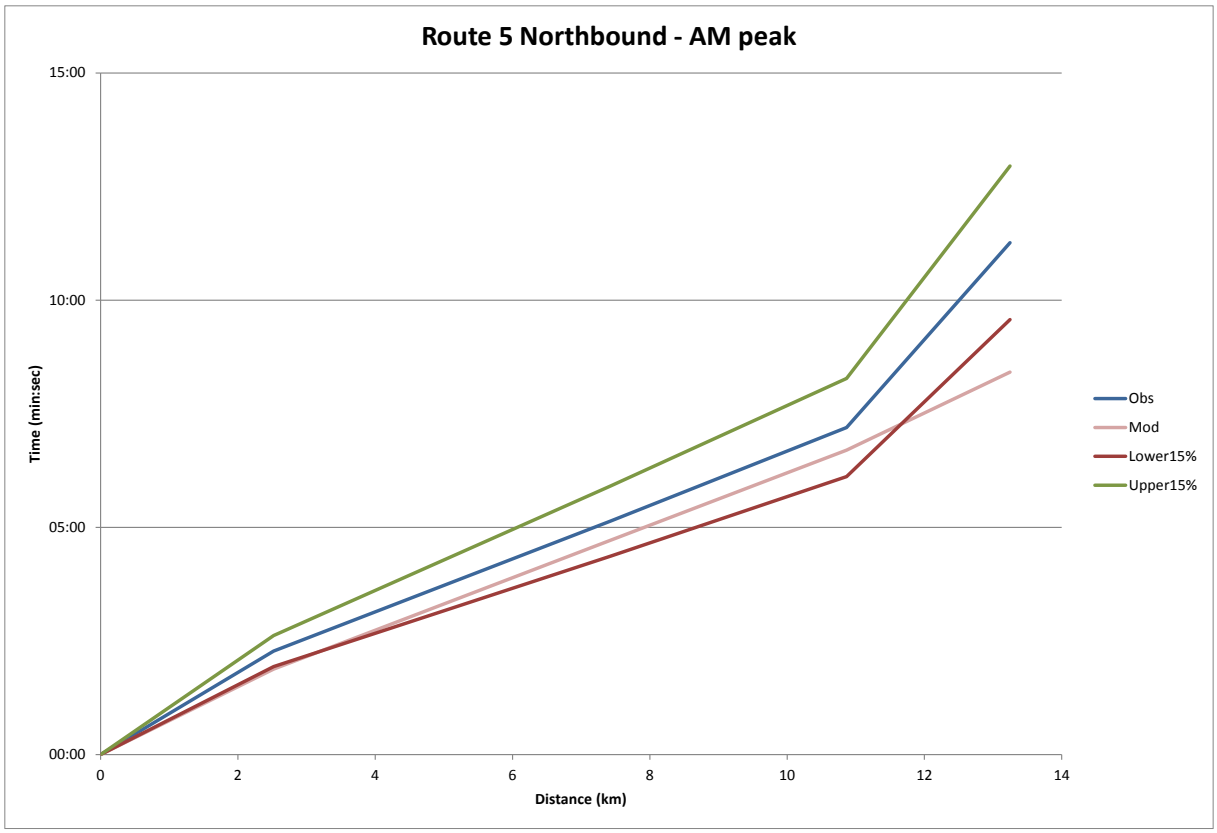

Route 2 Southbound - AM peak
15:00
10:00
05:00
00:00
Time (min:sec)
0
1
2
3
4
5
6
7
Distance (km)
Obs
Mod
Lower15%
Upper15%

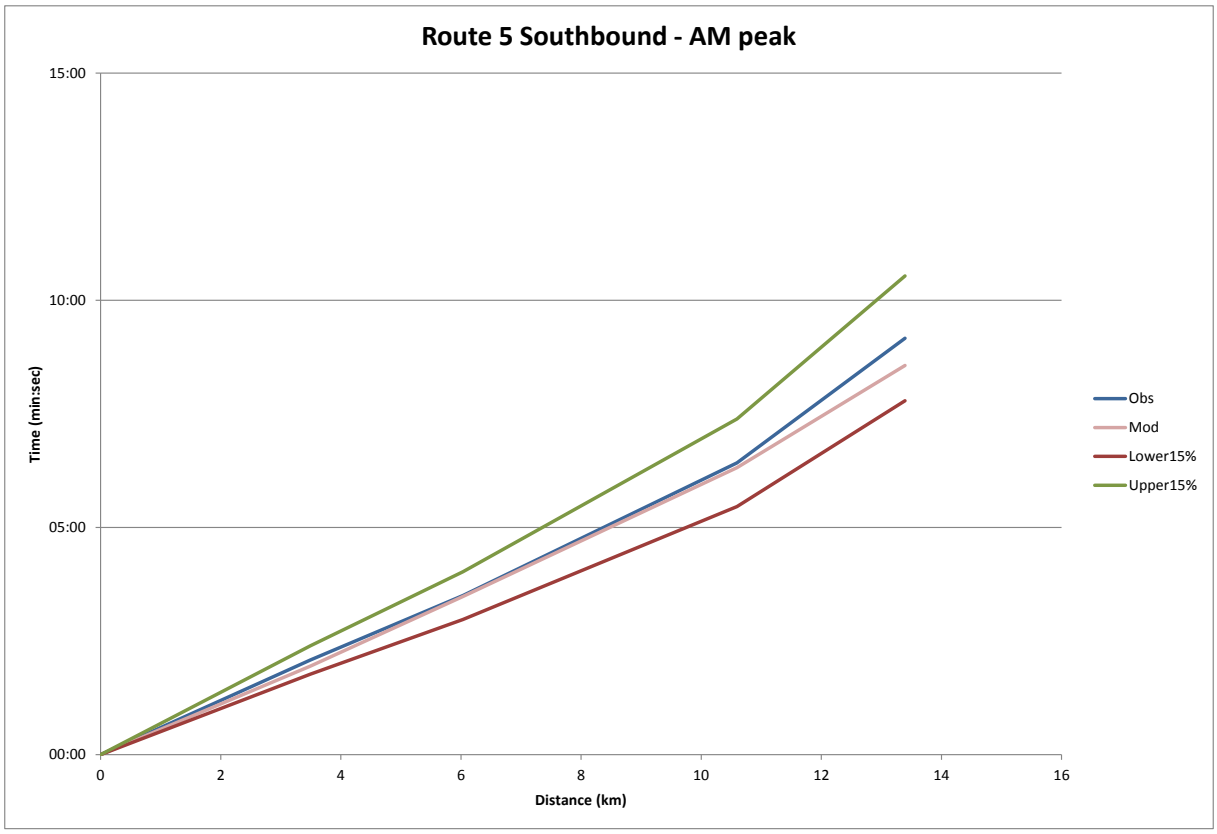

Route 3 Northbound - AM peak
20:00
15:00
10:00
05:00
00:00
Time (min:sec)
0
2
4
6
8
10
12
Distance (km)
Obs
Mod
Lower15%
Upper15%

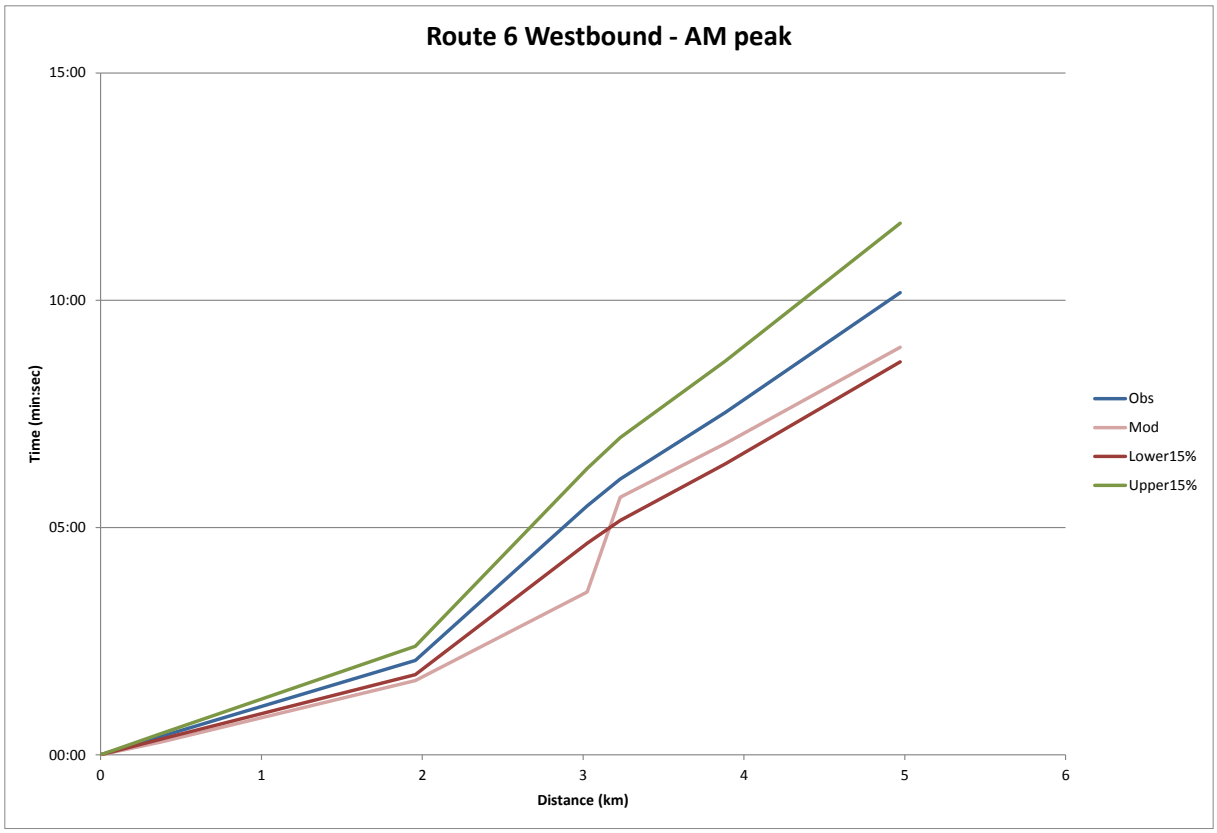

Route 3 Southbound - AM peak
20:00
15:00
10:00
05:00
00:00
Time (min:sec)
0
2
4
6
8
10
12
Distance (km)
Obs
Mod
Lower15%
Upper15%

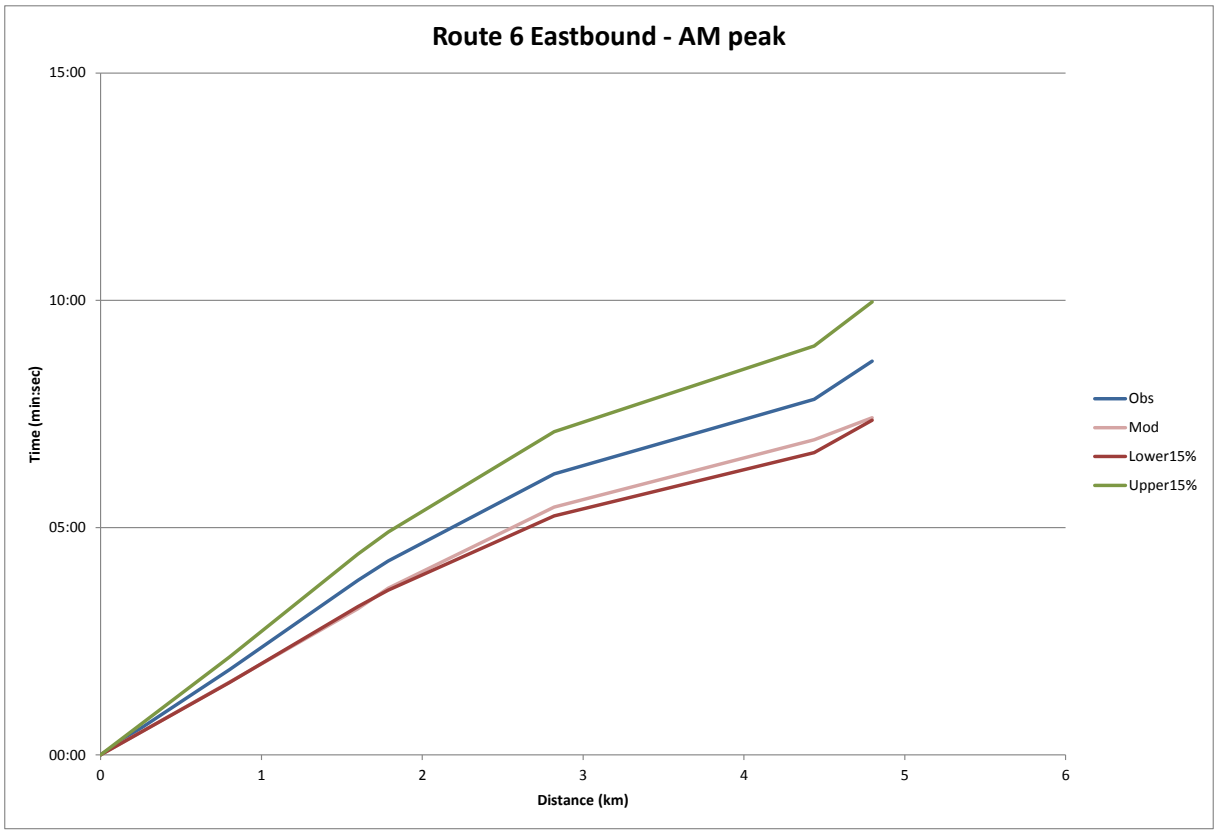

Route 4 Northbound - AM peak
15:00
10:00
05:00
00:00
Time (min:sec)
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
Distance (km)
Obs
Mod
Lower15%
Upper15%

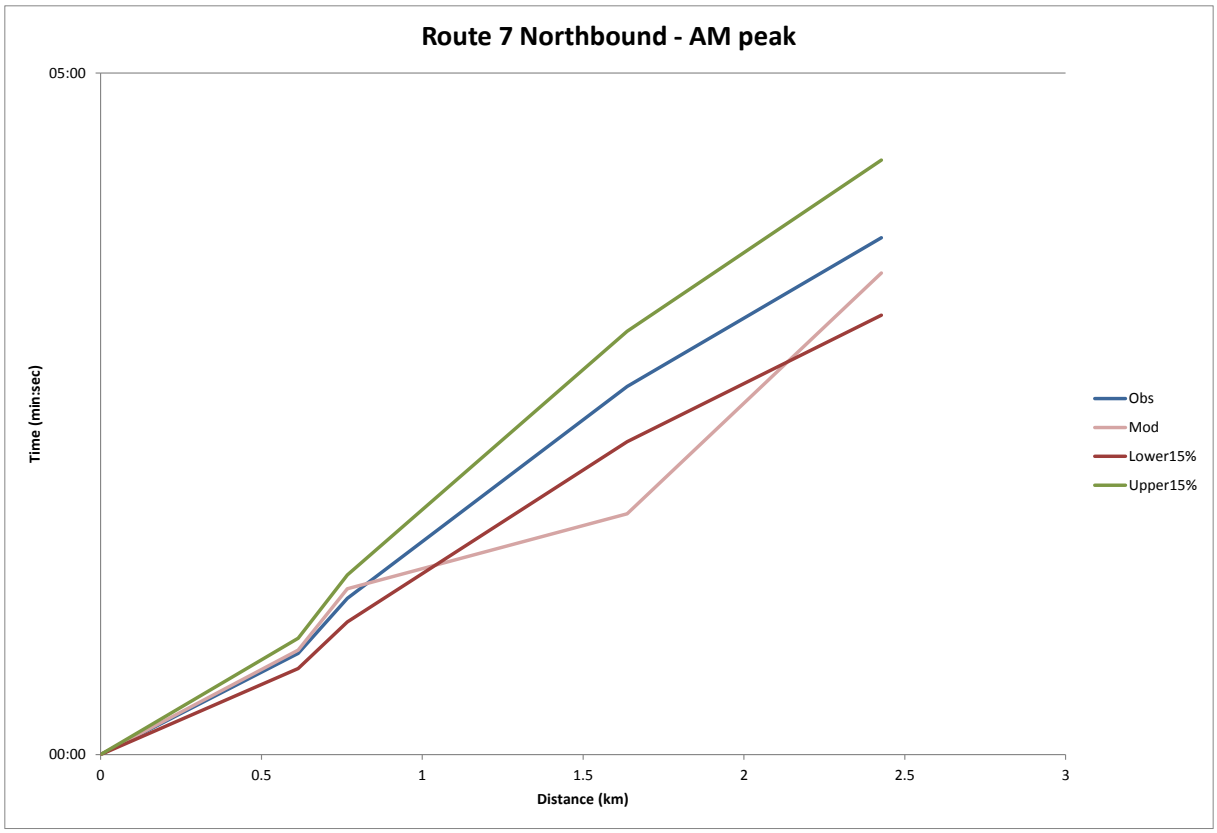

Route 4 Southbound - AM peak
10:00
05:00
00:00
Time (min:sec)
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
Distance (km)
Obs
Mod
Lower15%
Upper15%

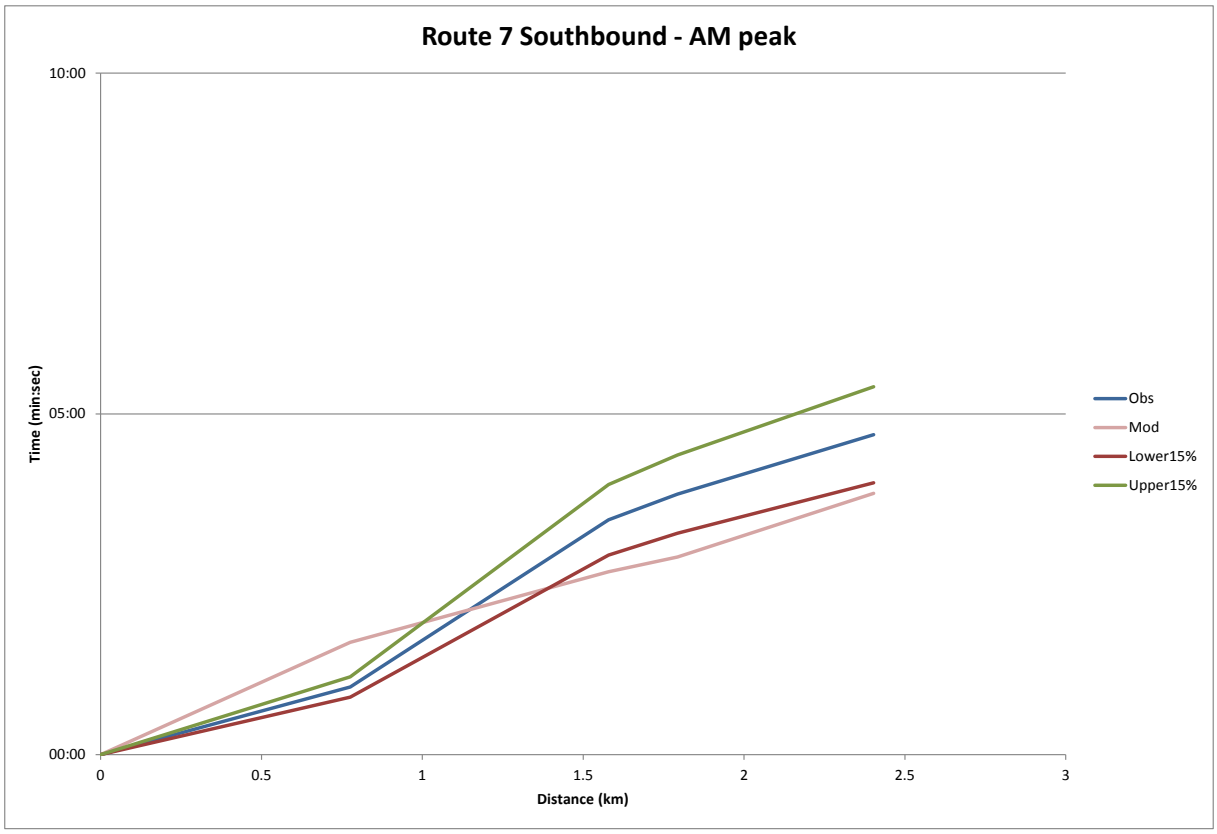

Route 5 Northbound - AM peak
15:00
10:00
05:00
00:00
Time (min:sec)
0
2
4
6
8
10
12
14
Distance (km)
Obs
Mod
Lower15%
Upper15%

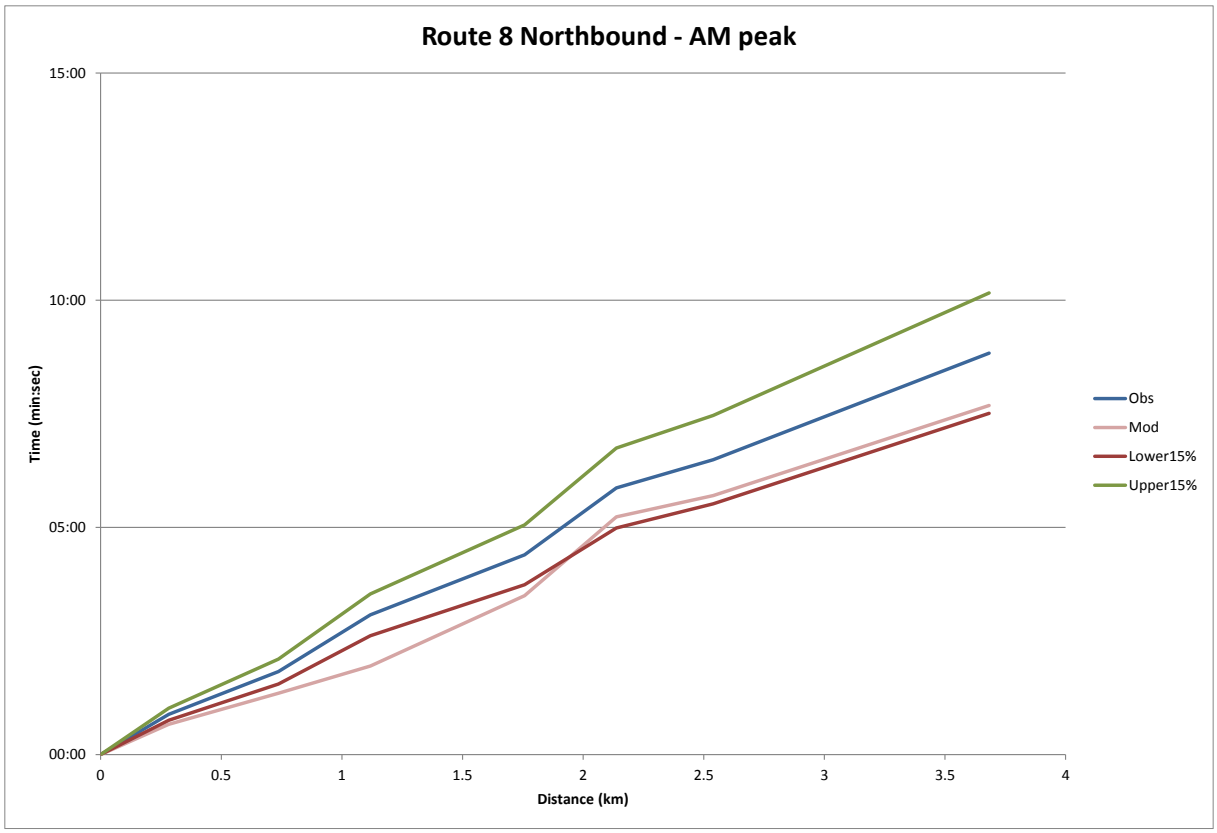

Route 5 Southbound - AM peak
15:00
10:00
05:00
00:00
Time (min:sec)
0
2
4
6
8
10
12
14
16
Distance (km)
Obs
Mod
Lower15%
Upper15%

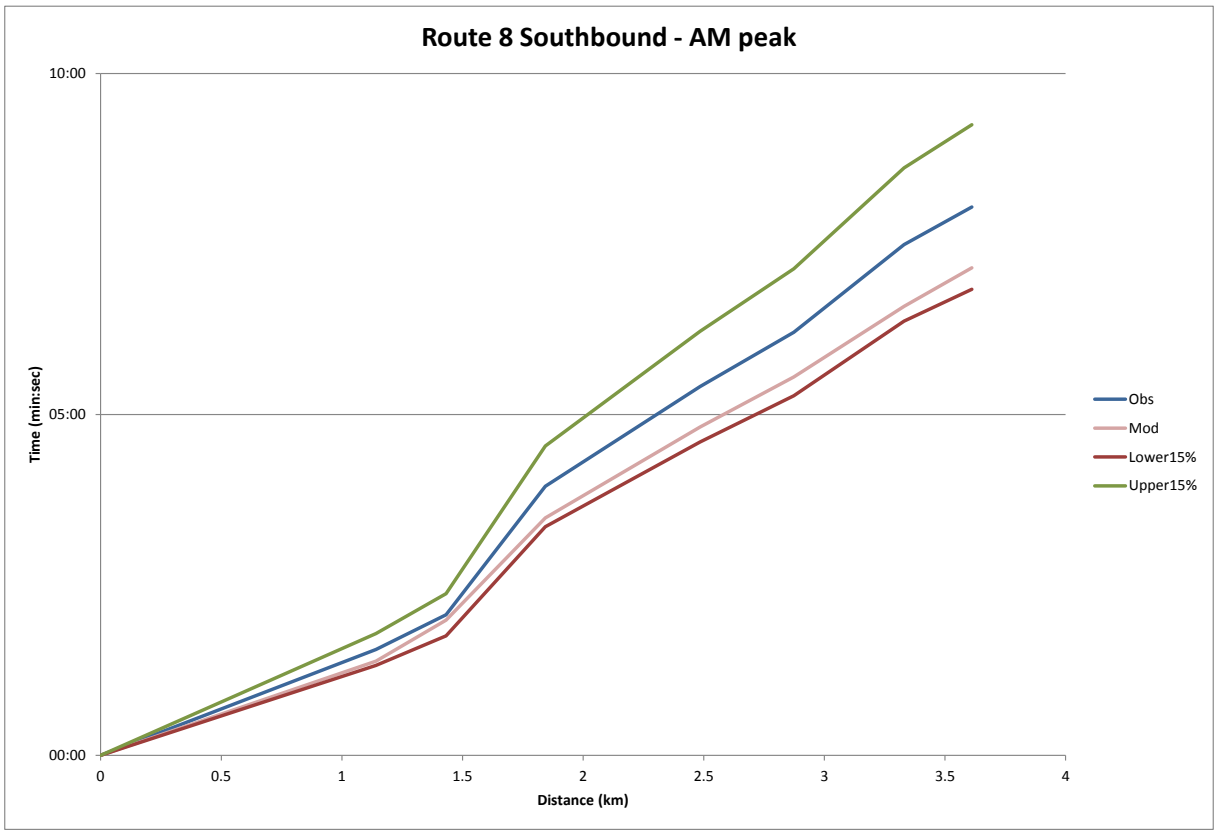

Route 6 Westbound - AM peak
15:00
10:00
05:00
00:00
Time (min:sec)
0
1
2
3
4
5
6
Distance (km)
Obs
Mod
Lower15%
Upper15%


Route 6 Eastbound - AM peak
15:00
10:00
05:00
00:00
Time (min:sec)
0
1
2
3
4
5
6
Distance (km)
Obs
Mod
Lower15%
Upper15%

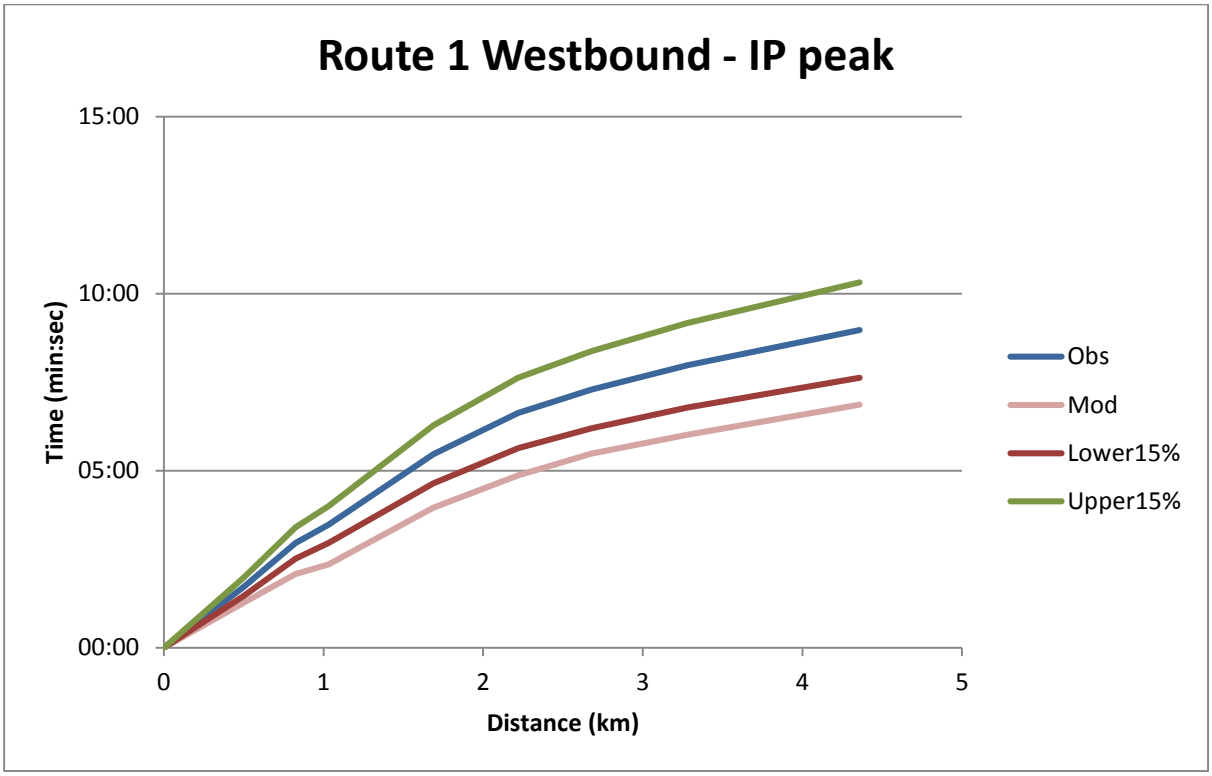

Route 7 Northbound - AM peak
05:00
00:00
Time (min:sec)
0
0.5
1
1.5
2
2.5
3
Distance (km)
Obs
Mod
Lower15%
Upper15%

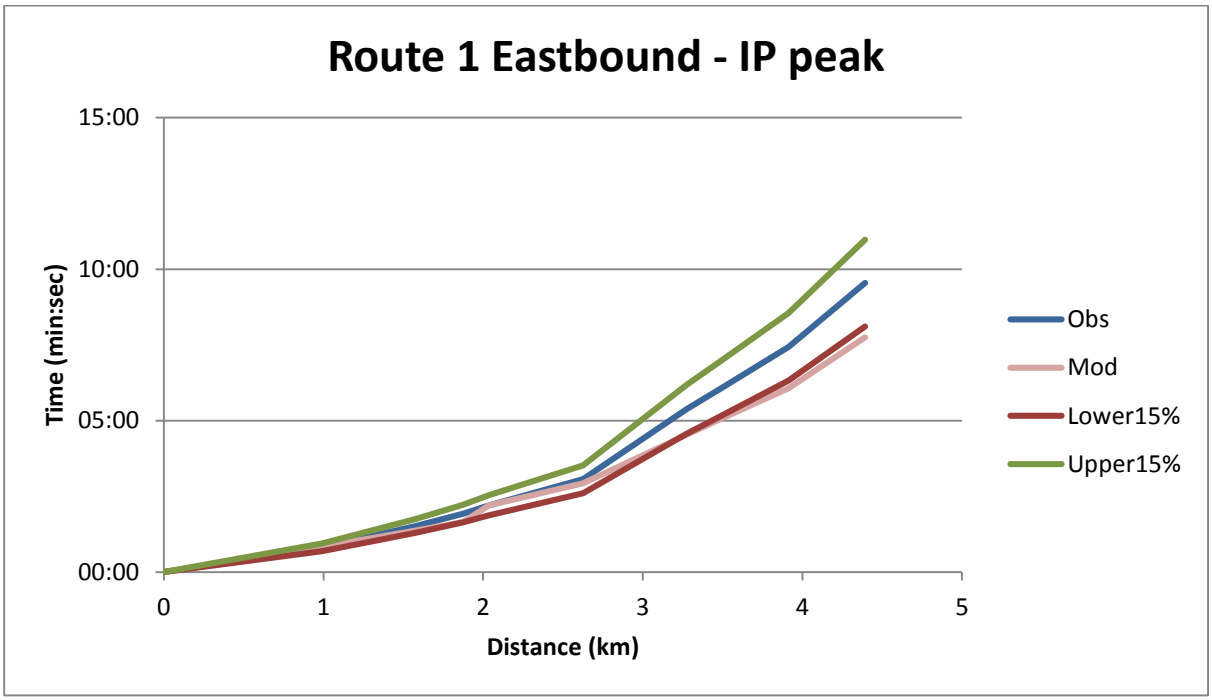

Route 7 Southbound - AM peak
10:00
05:00
00:00
Time (min:sec)
0
0.5
1
1.5
2
2.5
3
Distance (km)
Obs
Mod
Lower15%
Upper15%

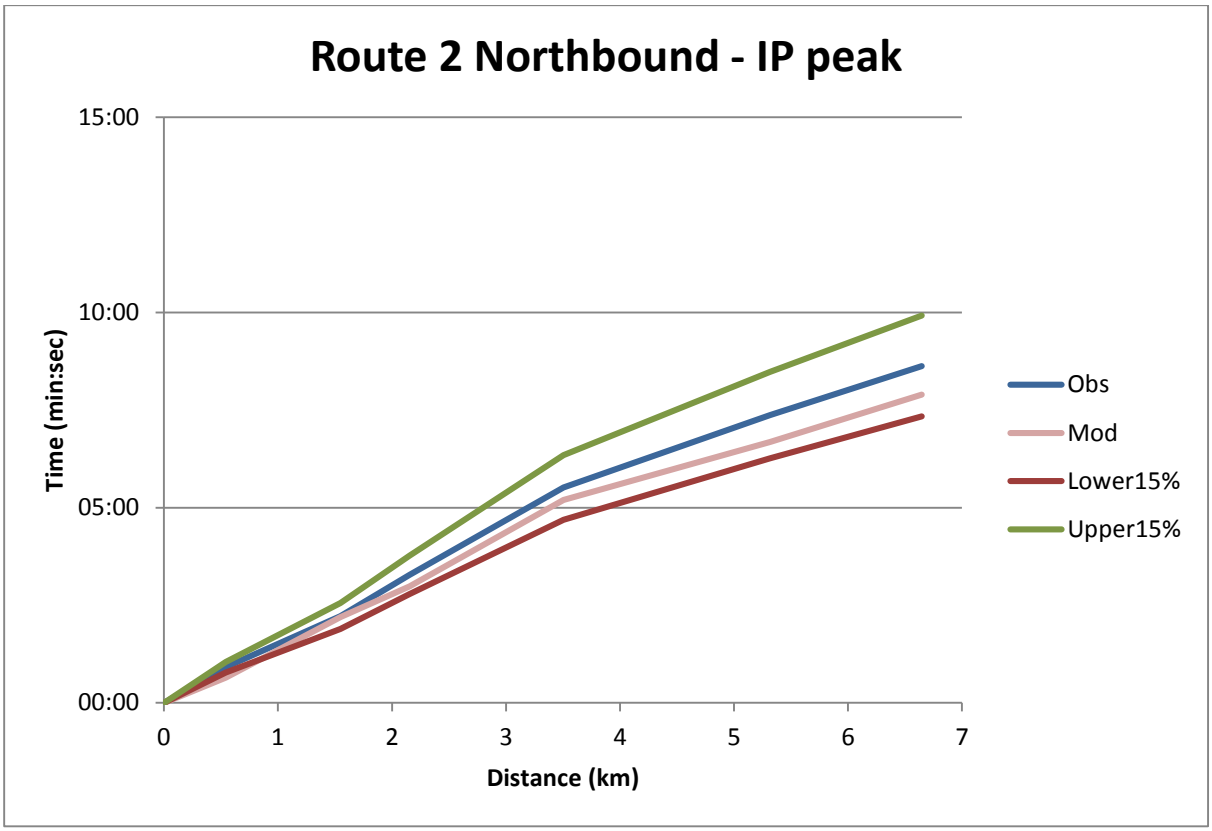

Route 8 Northbound - AM peak
15:00
10:00
05:00
00:00
Time (min:sec)
0
0.5
1
1.5
2
2.5
3
3.5
4
Distance (km)
Obs
Mod
Lower15%
Upper15%

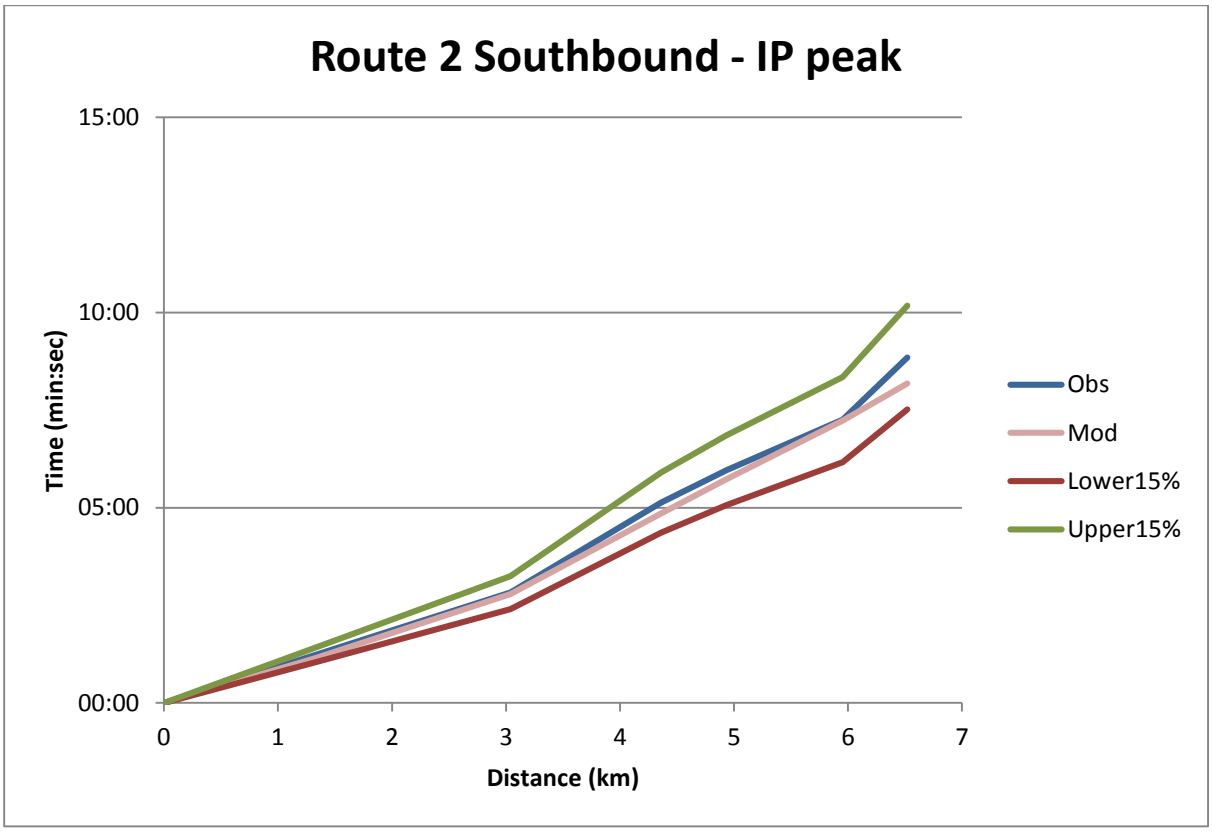

Route 8 Southbound - AM peak
10:00
05:00
00:00
Time (min:sec)
0
0.5
1
1.5
2
2.5
3
3.5
4
Distance (km)
Obs
Mod
Lower15%
Upper15%

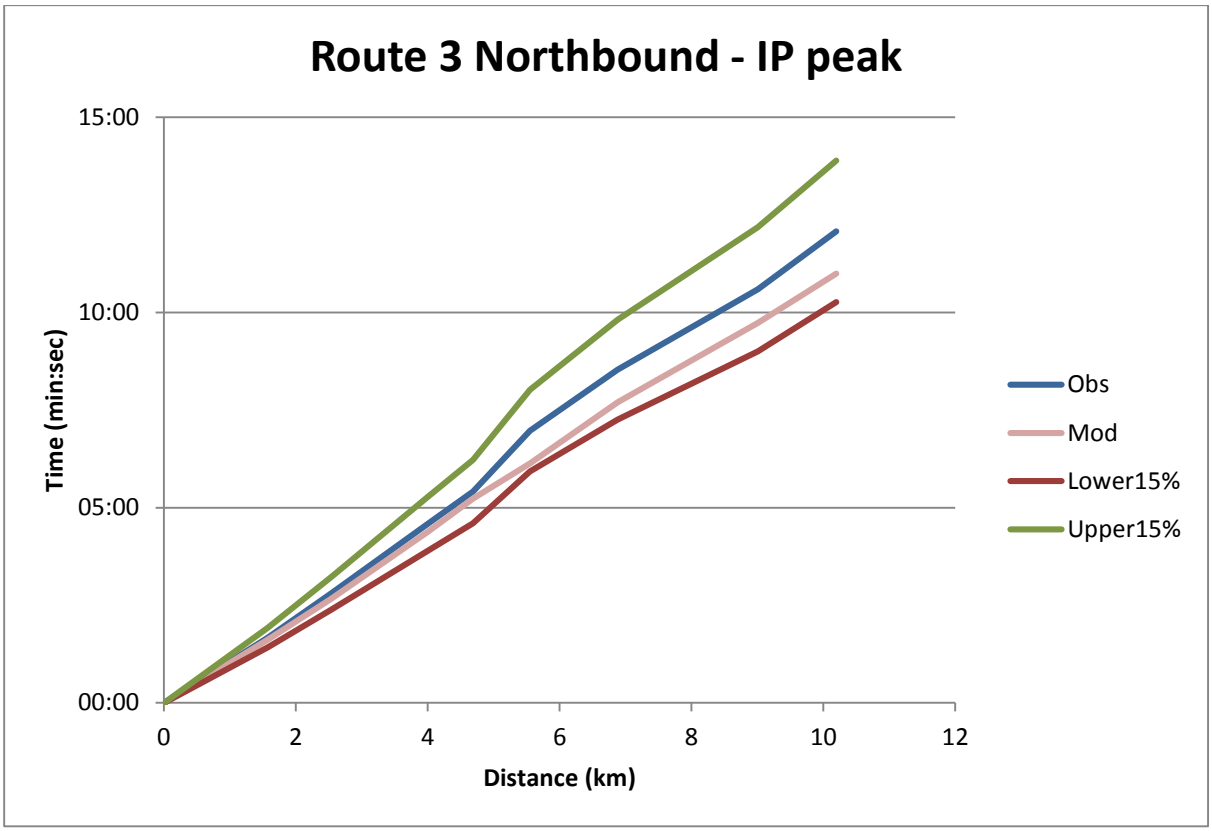
INTER PEAK

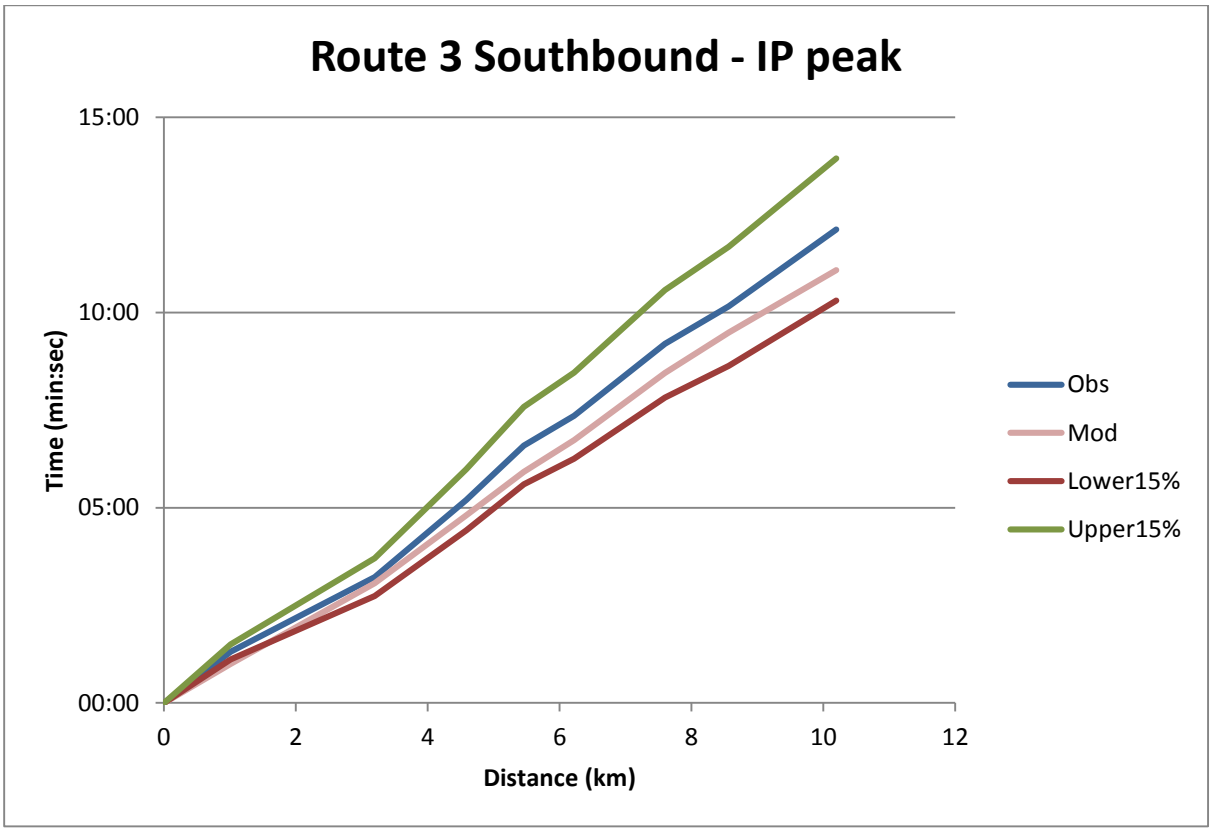

Route 1 Westbound - IP peak
15:00
10:00
05:00
00:00
Time (min:sec)
0
1
2
3
4
5
Distance (km)
Obs
Mod
Lower15%
Upper15%

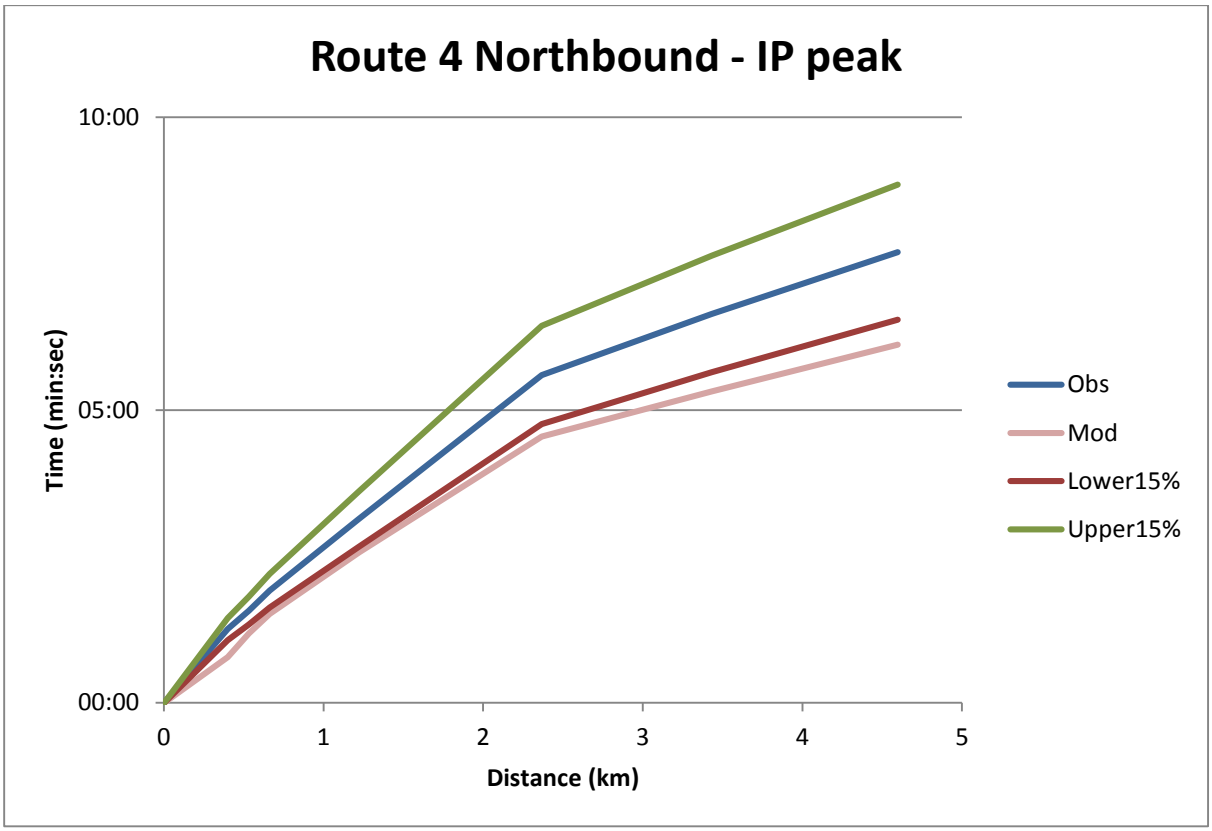

Route 1 Eastbound - IP peak
15:00
10:00
05:00
00:00
Time (min:sec)
0
1
2
3
4
5
Distance (km)
Obs
Mod
Lower15%
Upper15%

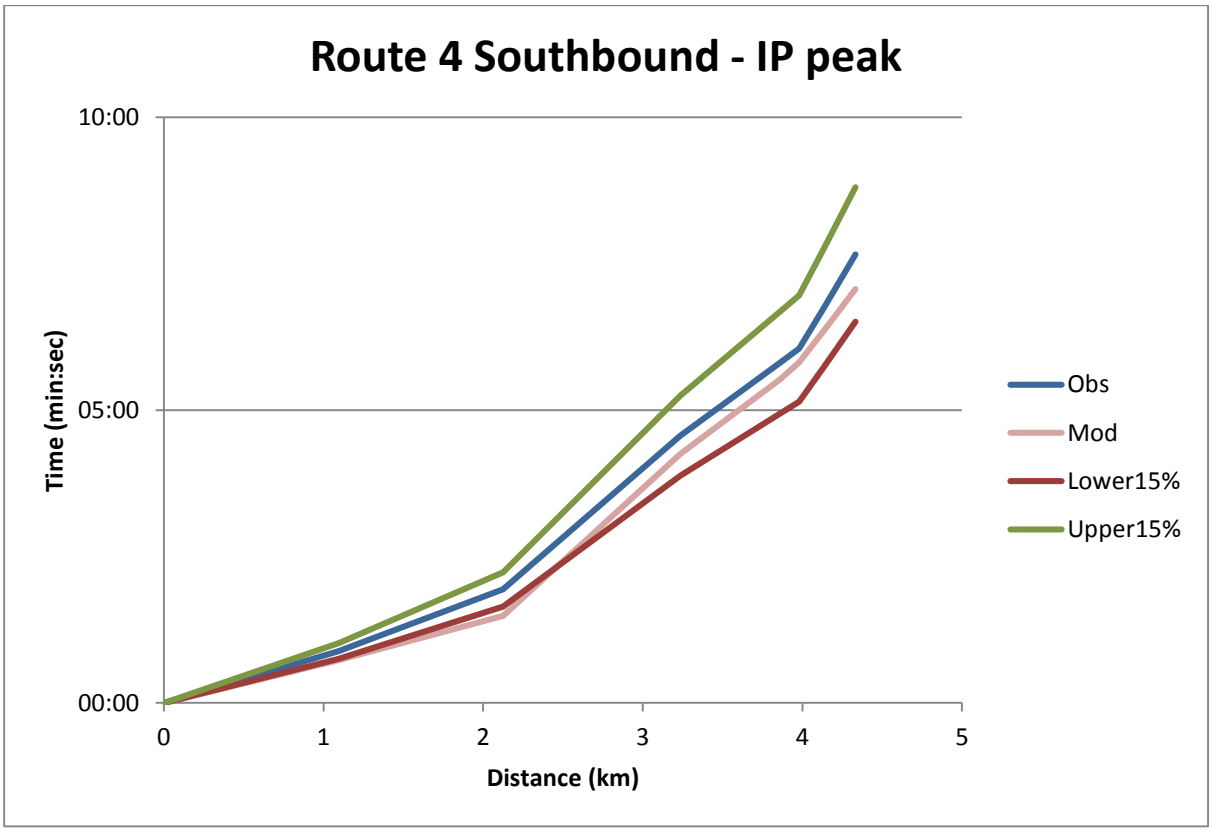

Route 2 Northbound - IP peak
15:00
10:00
05:00
00:00
Time (min:sec)
0
1
2
3
4
5
6
7
Distance (km)
Obs
Mod
Lower15%
Upper15%

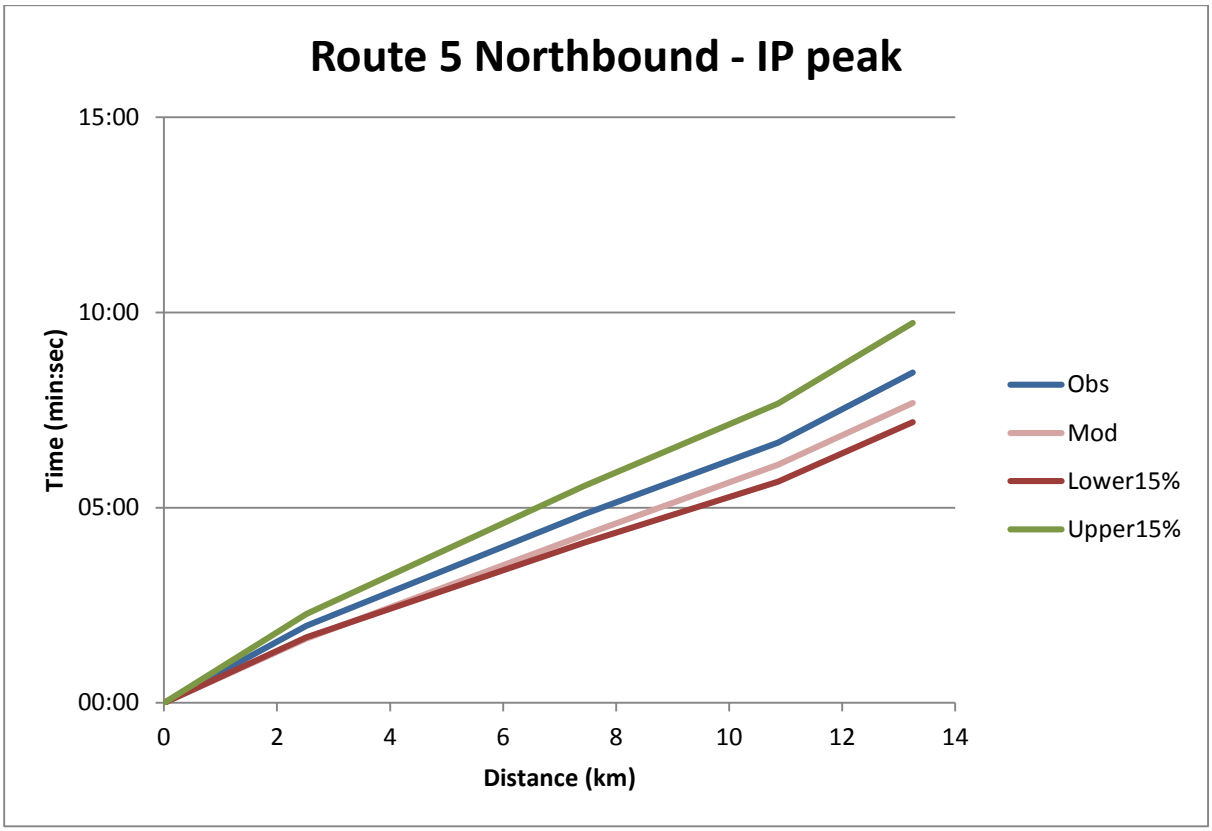

Route 2 Southbound - IP peak
15:00
10:00
05:00
00:00
Time (min:sec)
0
1
2
3
4
5
6
7
Distance (km)
Obs
Mod
Lower15%
Upper15%

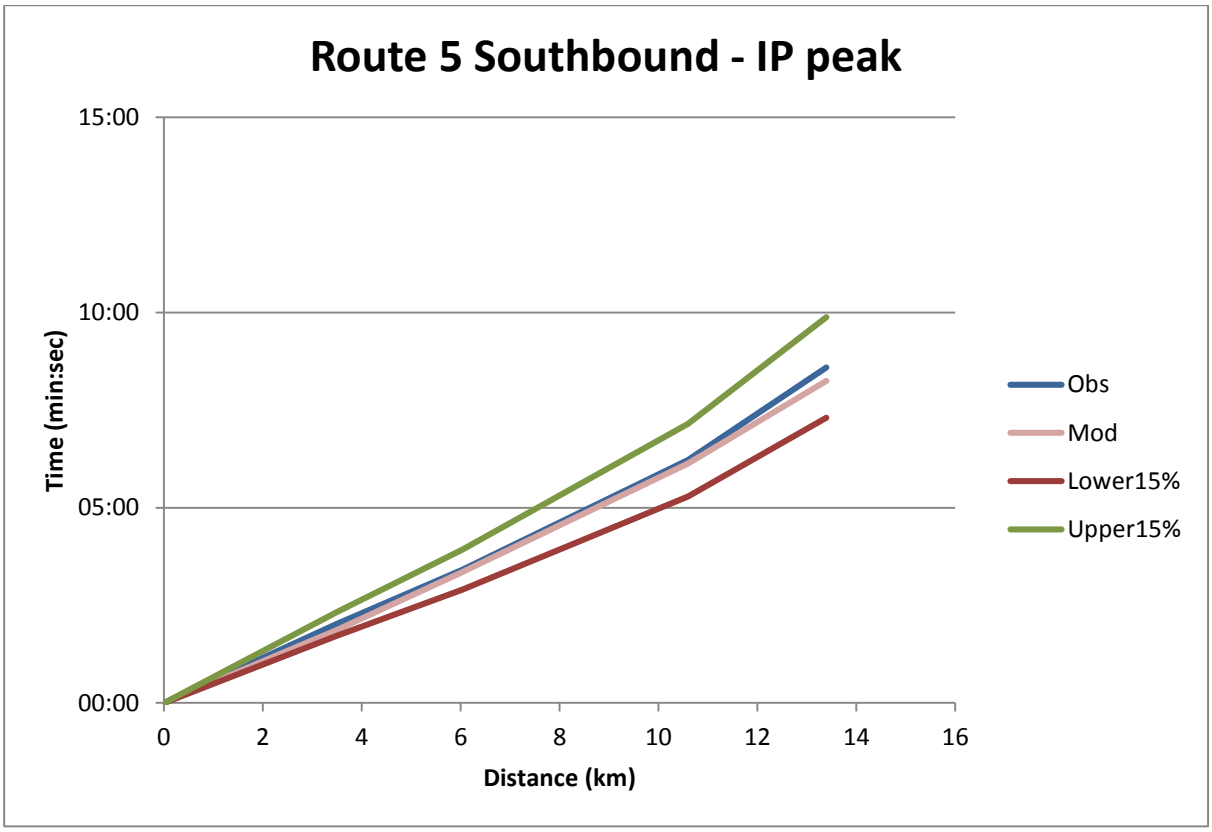

Route 3 Northbound - IP peak
15:00
10:00
05:00
00:00
Time (min:sec)
0
2
4
6
8
10
12
Distance (km)
Obs
Mod
Lower15%
Upper15%

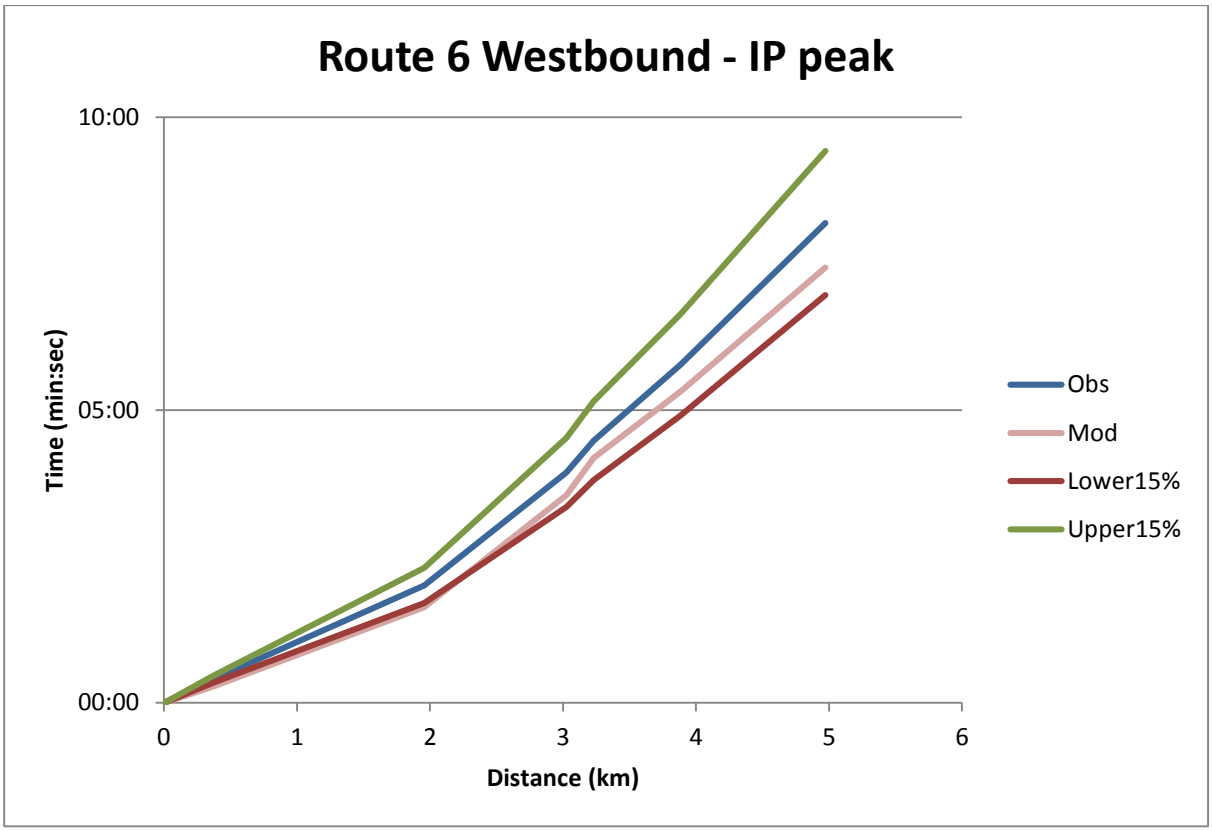

Route 3 Southbound - IP peak
15:00
10:00
05:00
00:00
Time (min:sec)
0
2
4
6
8
10
12
Distance (km)
Obs
Mod
Lower15%
Upper15%

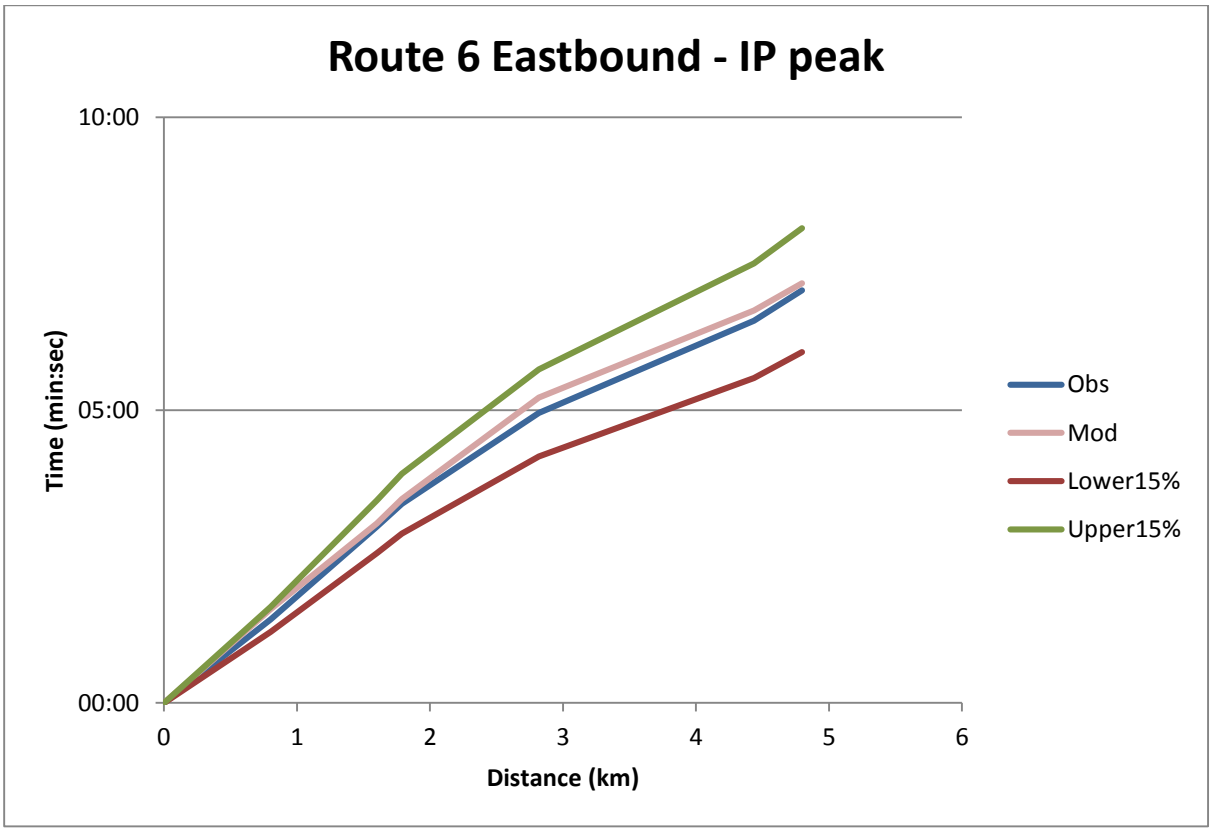

Route 4 Northbound - IP peak
10:00
05:00
00:00
Time (min:sec)
0
1
2
3
4
5
Distance (km)
Obs
Mod
Lower15%
Upper15%

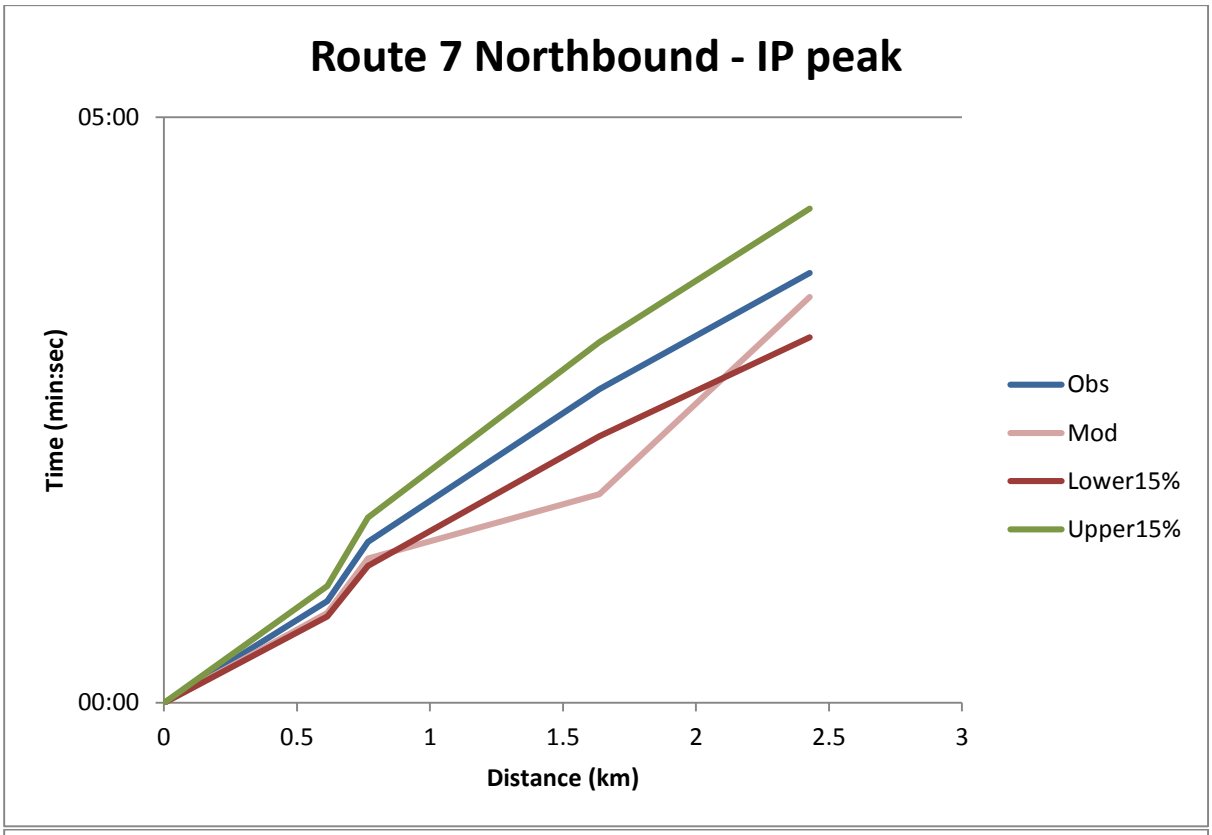

Route 4 Southbound - IP peak
10:00
05:00
00:00
Time (min:sec)
0
1
2
3
4
5
Distance (km)
Obs
Mod
Lower15%
Upper15%

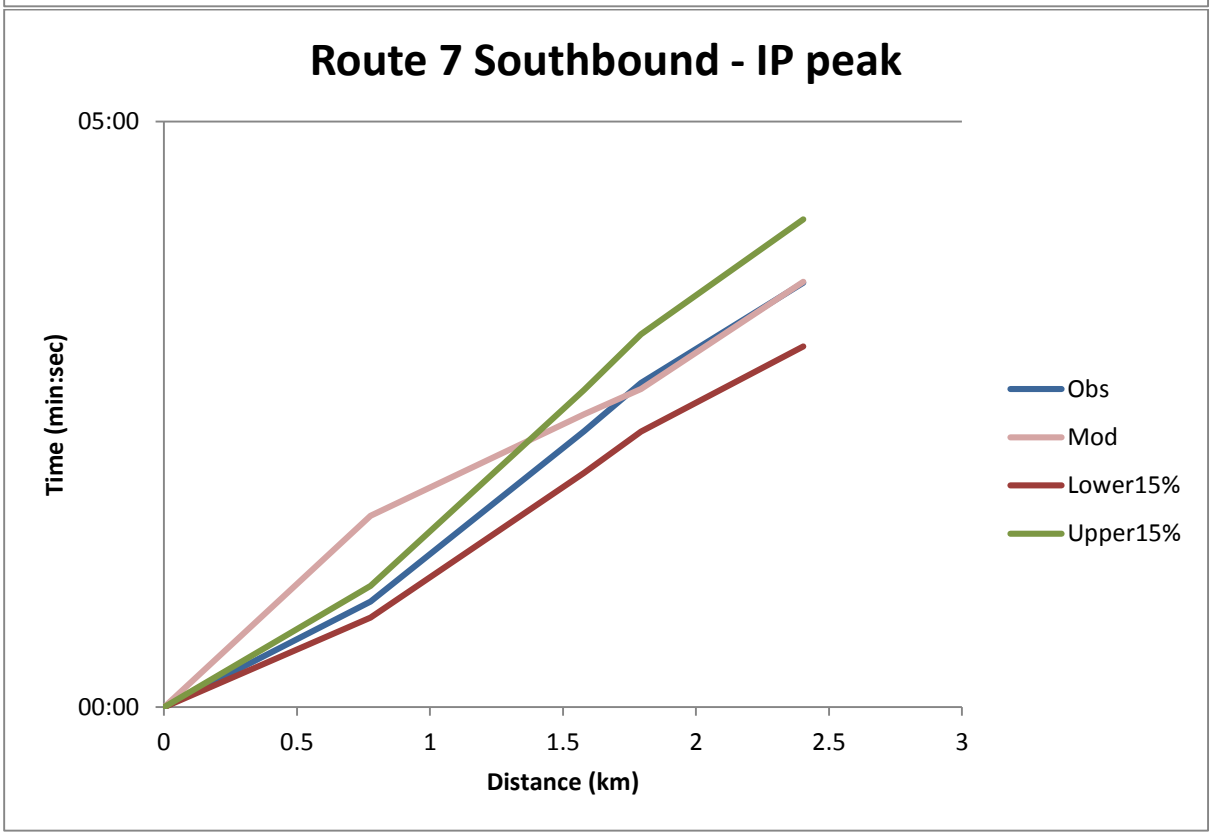

Route 5 Northbound - IP peak
15:00
10:00
05:00
00:00
Time (min:sec)
0
2
4
6
8
10
12
14
Distance (km)
Obs
Mod
Lower15%
Upper15%

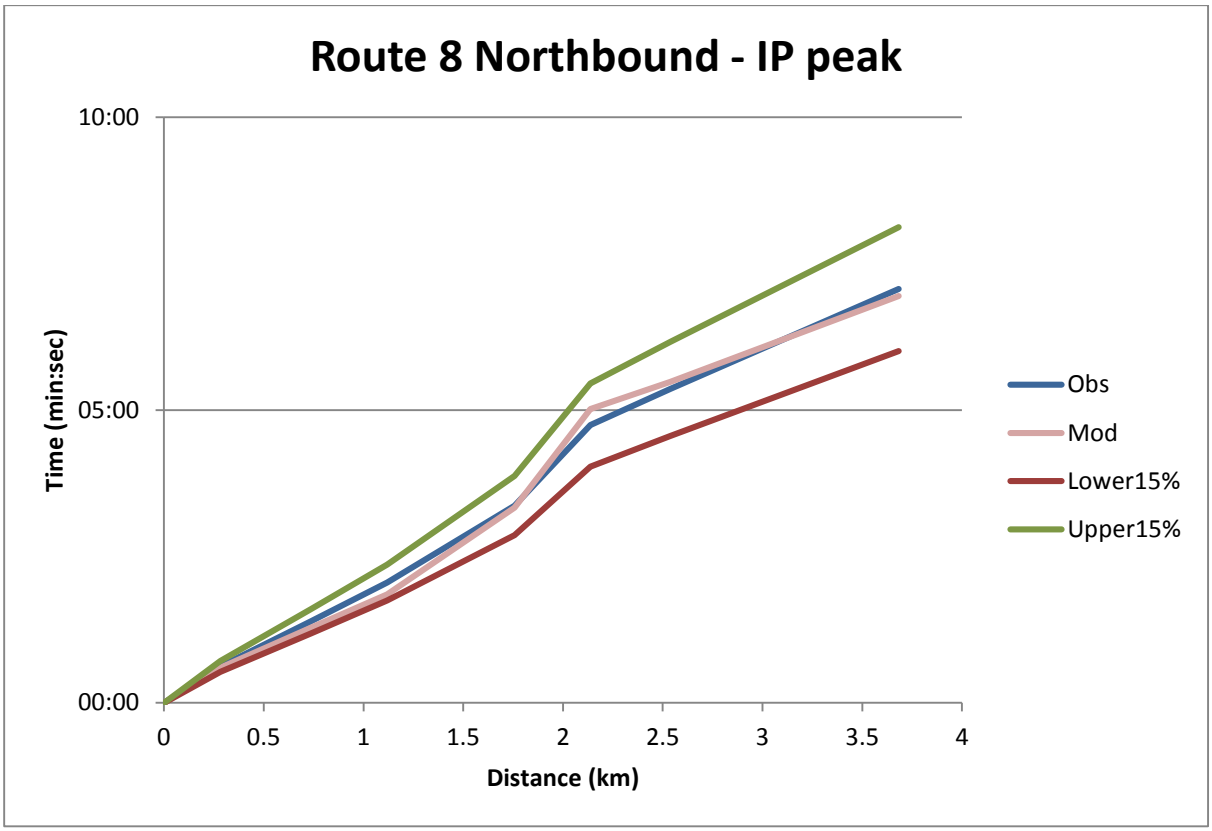

Route 5 Southbound - IP peak
15:00
10:00
05:00
00:00
Time (min:sec)
0
2
4
6
8
10
12
14
16
Distance (km)
Obs
Mod
Lower15%
Upper15%

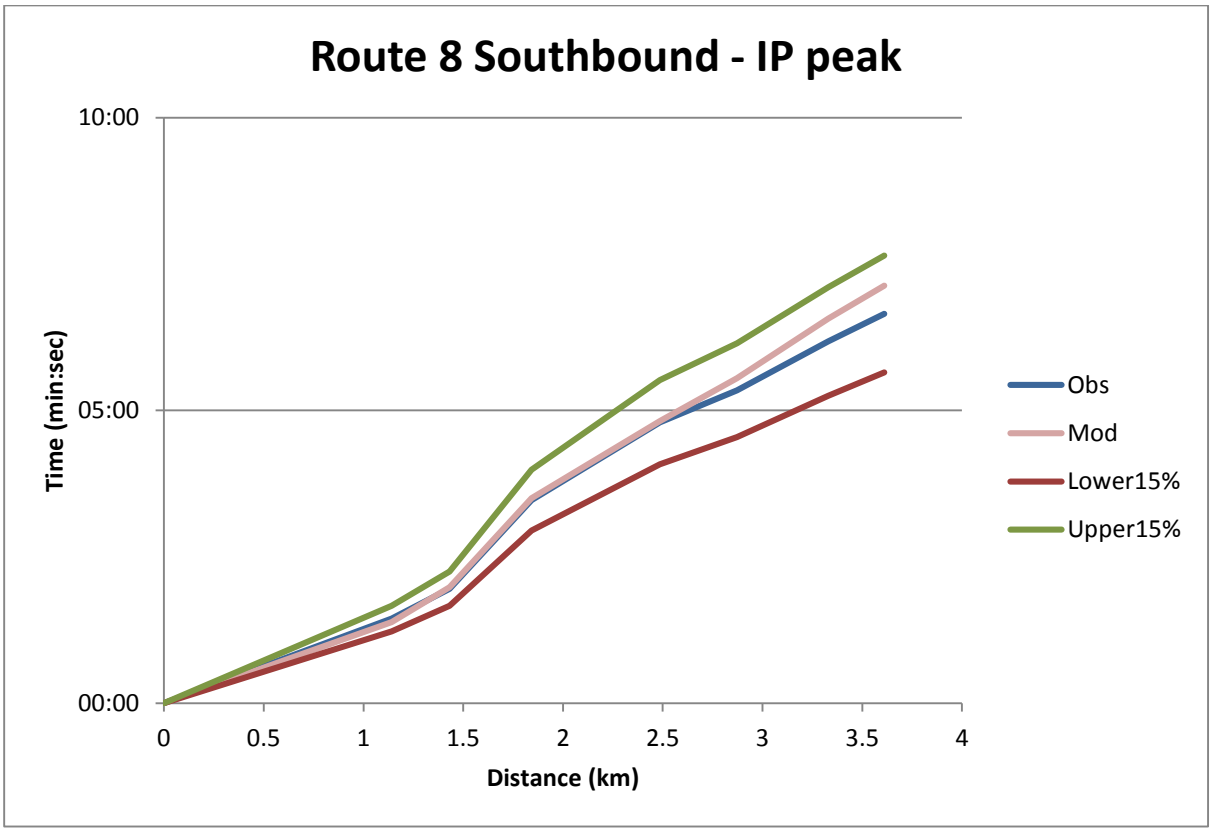

Route 6 Westbound - IP peak
10:00
05:00
00:00
Time (min:sec)
0
1
2
3
4
5
6
Distance (km)
Obs
Mod
Lower15%
Upper15%


Route 6 Eastbound - IP peak
10:00
05:00
00:00
Time (min:sec)
0
1
2
3
4
5
6
Distance (km)
Obs
Mod
Lower15%
Upper15%

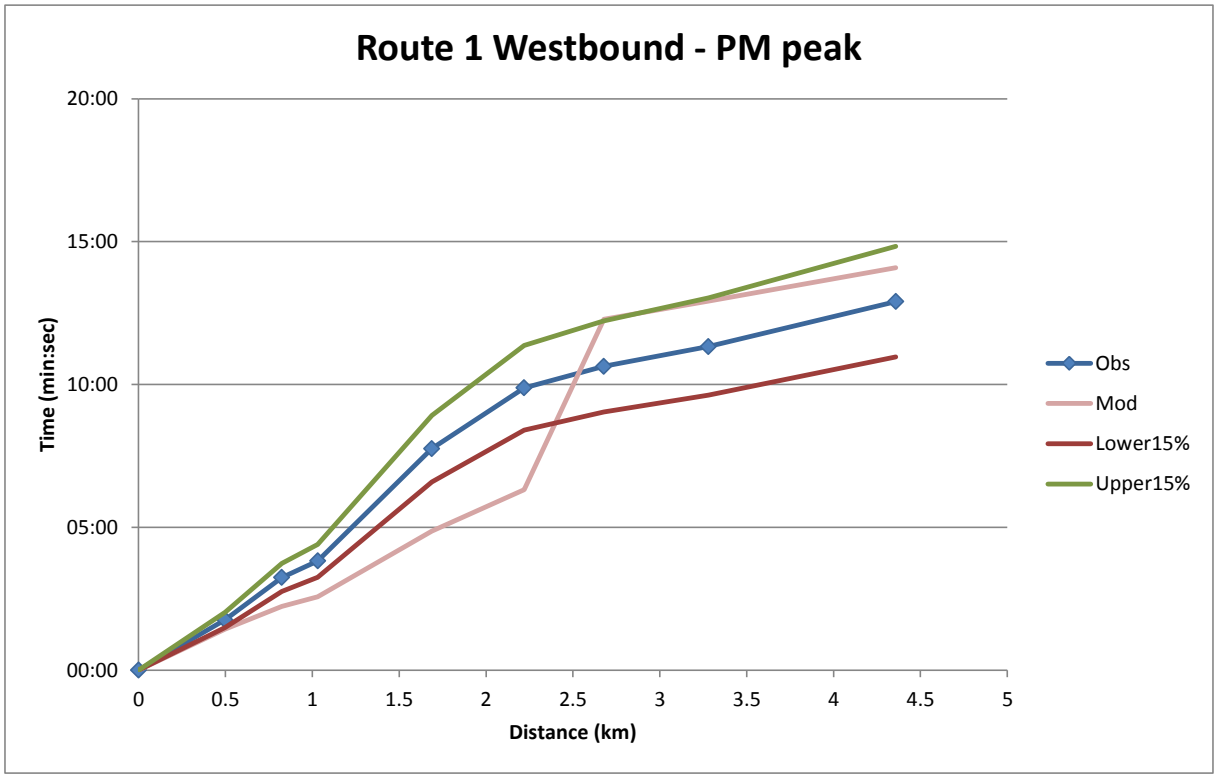

Route 7 Northbound - IP peak
05:00
00:00
Time (min:sec)
0
0.5
1
1.5
2
2.5
3
Distance (km)
Obs
Mod
Lower15%
Upper15%

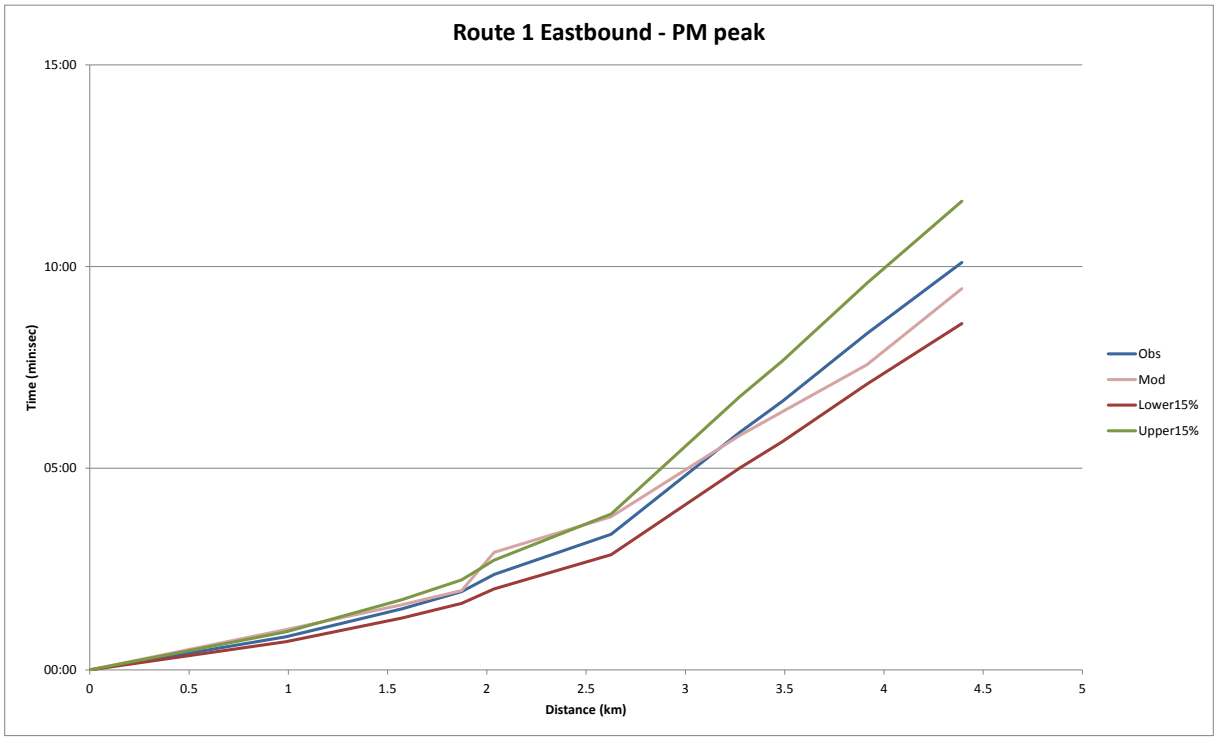

Route 7 Southbound - IP peak
05:00
00:00
Time (min:sec)
0
0.5
1
1.5
2
2.5
3
Distance (km)
Obs
Mod
Lower15%
Upper15%

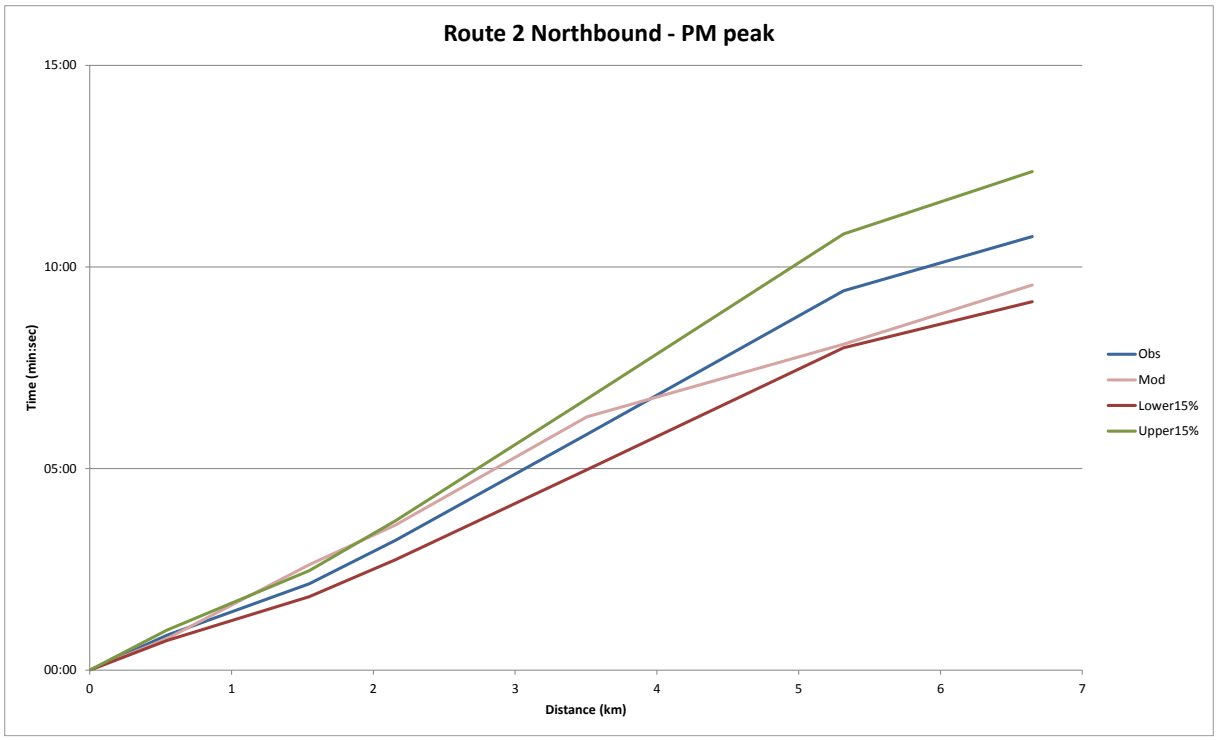

Route 8 Northbound - IP peak
10:00
05:00
00:00
Time (min:sec)
0
0.5
1
1.5
2
2.5
3
3.5
4
Distance (km)
Obs
Mod
Lower15%
Upper15%

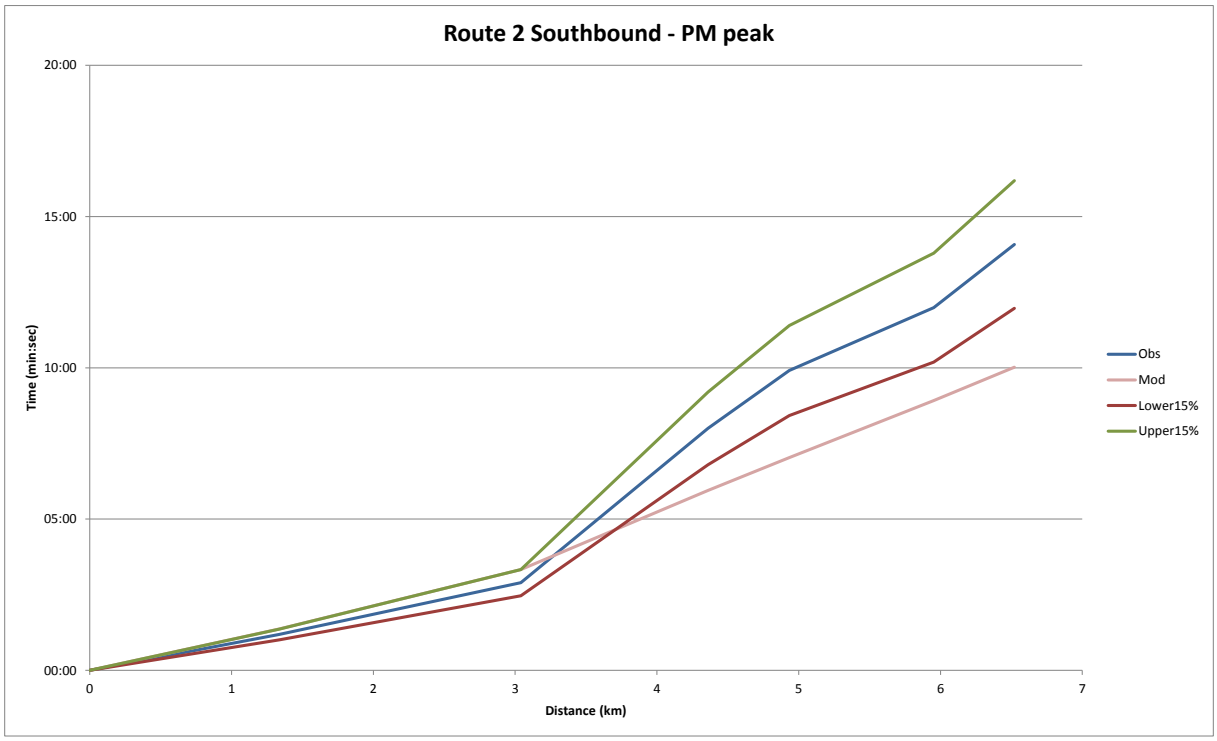

Route 8 Southbound - IP peak
10:00
05:00
00:00
Time (min:sec)
0
0.5
1
1.5
2
2.5
3
3.5
4
Distance (km)
Obs
Mod
Lower15%
Upper15%

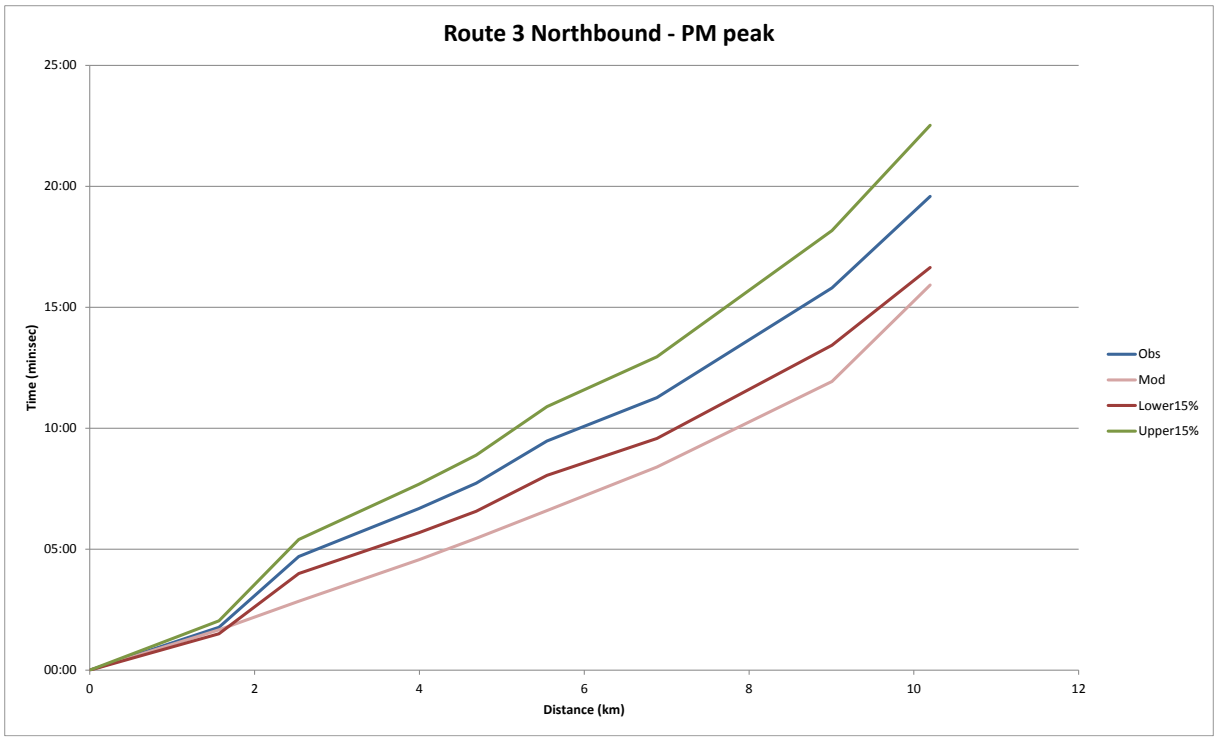
PM PEAK

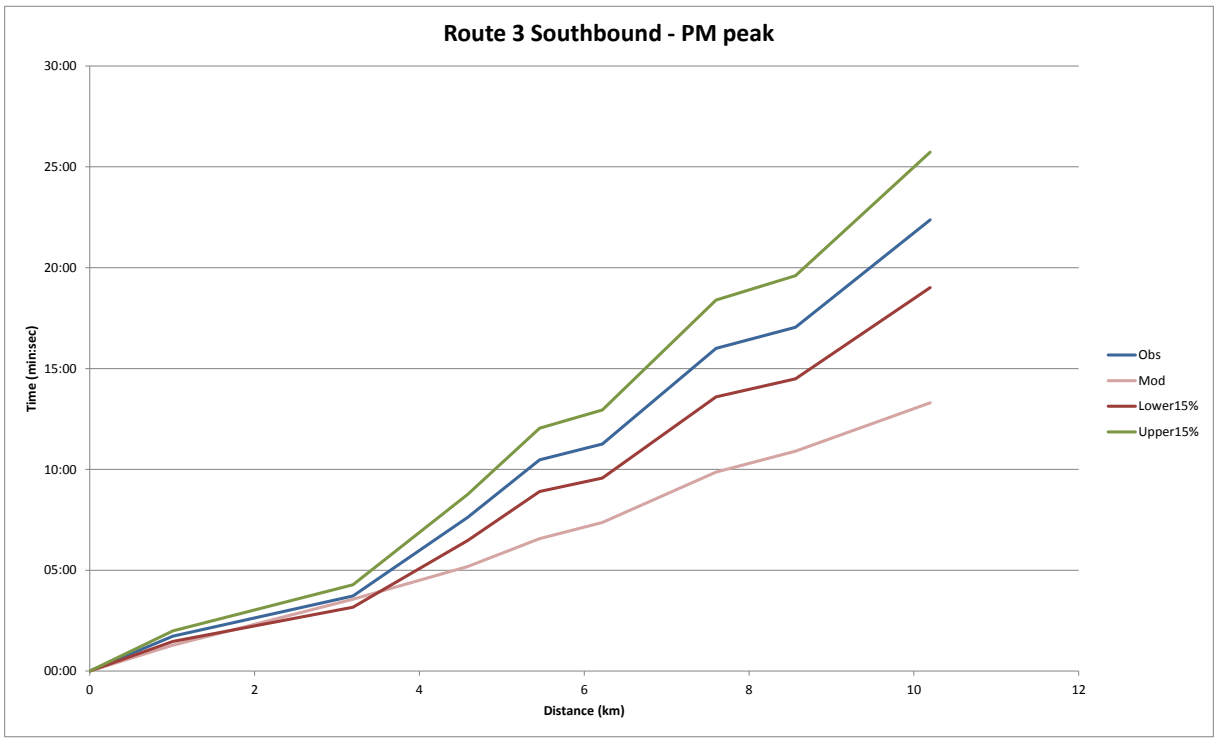

Route 1 Westbound - PM peak
20:00
15:00
10:00
05:00
00:00
Time (min:sec)
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
Distance (km)
Obs
Mod
Lower15%
Upper15%

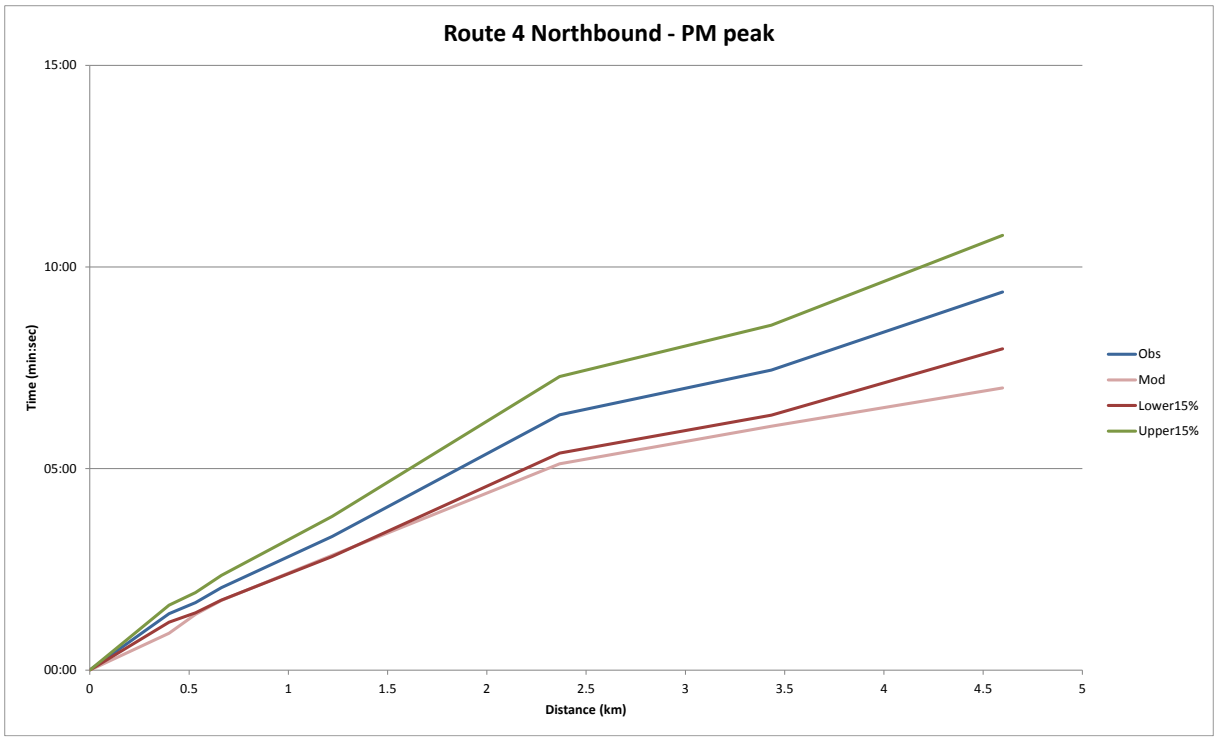

Route 1 Eastbound - PM peak
15:00
10:00
05:00
00:00
Time (min:sec)
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
Distance (km)
Obs
Mod
Lower15%
Upper15%

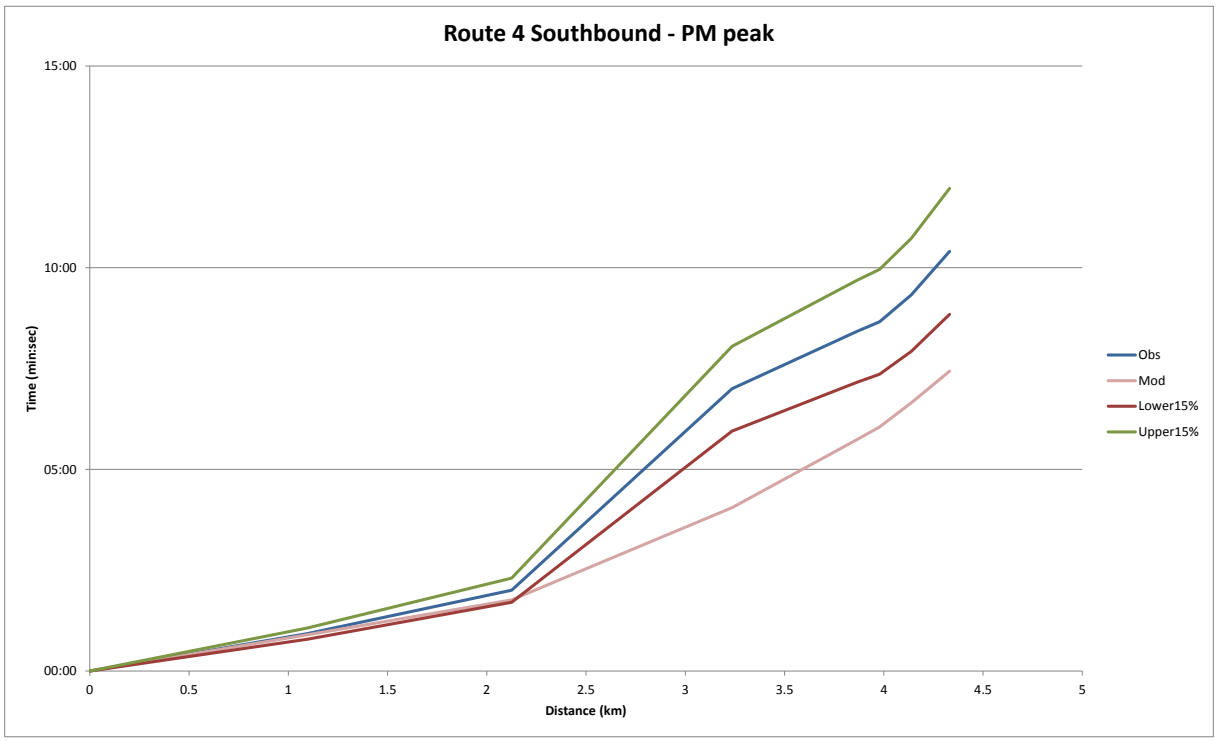

Route 2 Northbound - PM peak
15:00
10:00
05:00
00:00
Time (min:sec)
0
1
2
3
4
5
6
7
Distance (km)
Obs
Mod
Lower15%
Upper15%

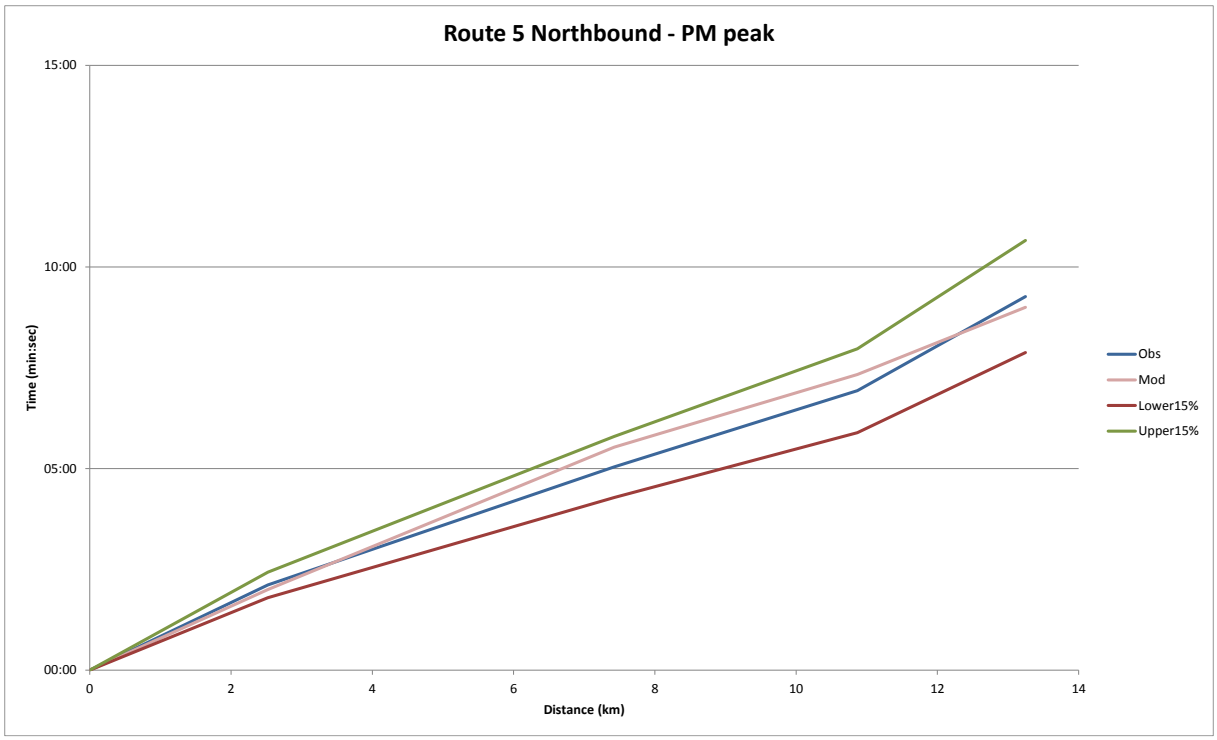

Route 2 Southbound - PM peak
20:00
15:00
10:00
05:00
00:00
Time (min:sec)
0
1
2
3
4
5
6
7
Distance (km)
Obs
Mod
Lower15%
Upper15%

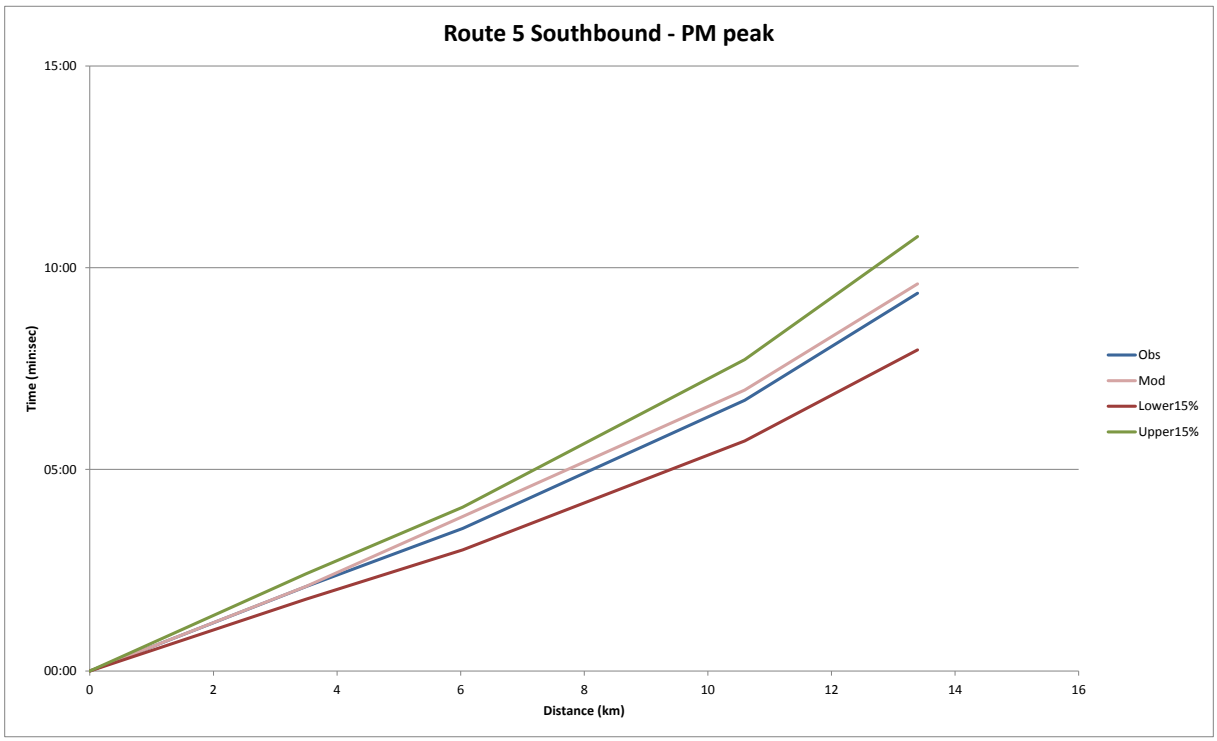

Route 3 Northbound - PM peak
25:00
20:00
15:00
10:00
05:00
00:00
Time (min:sec)
0
2
4
6
8
10
12
Distance (km)
Obs
Mod
Lower15%
Upper15%

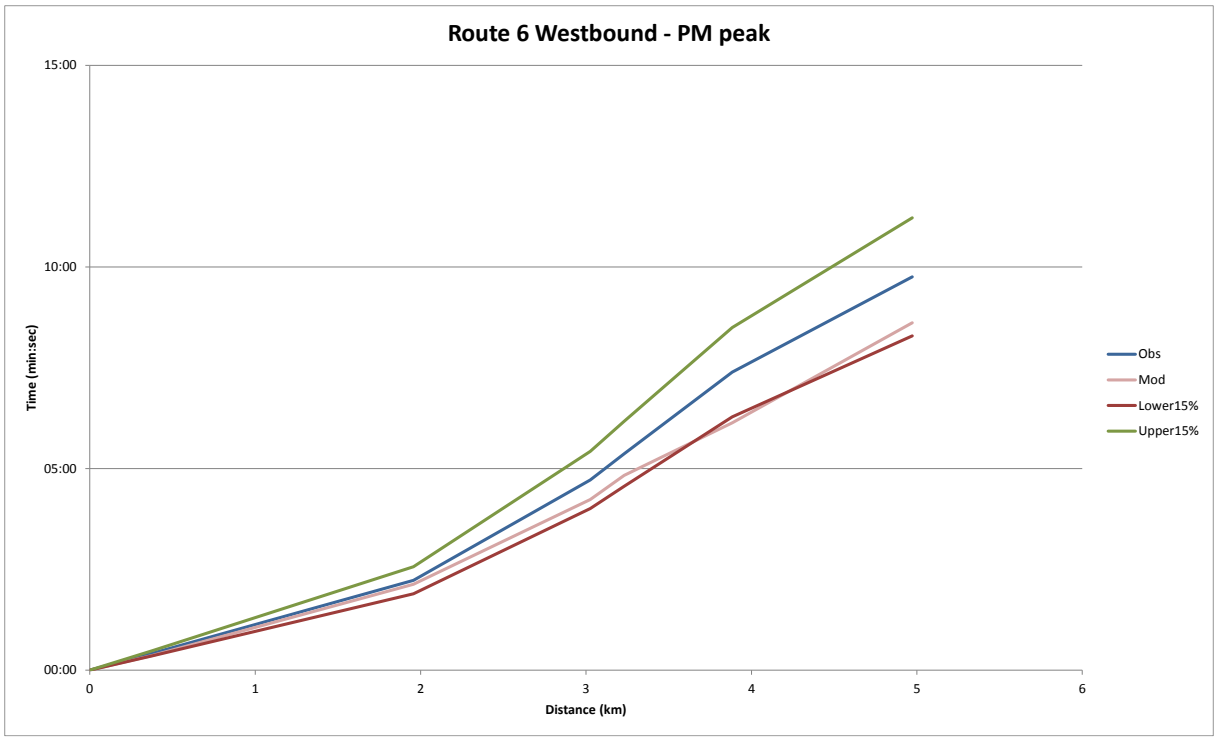

Route 3 Southbound - PM peak
30:00
25:00
20:00
15:00
10:00
05:00
00:00
Time (min:sec)
0
2
4
6
8
10
12
Distance (km)
Obs
Mod
Lower15%
Upper15%

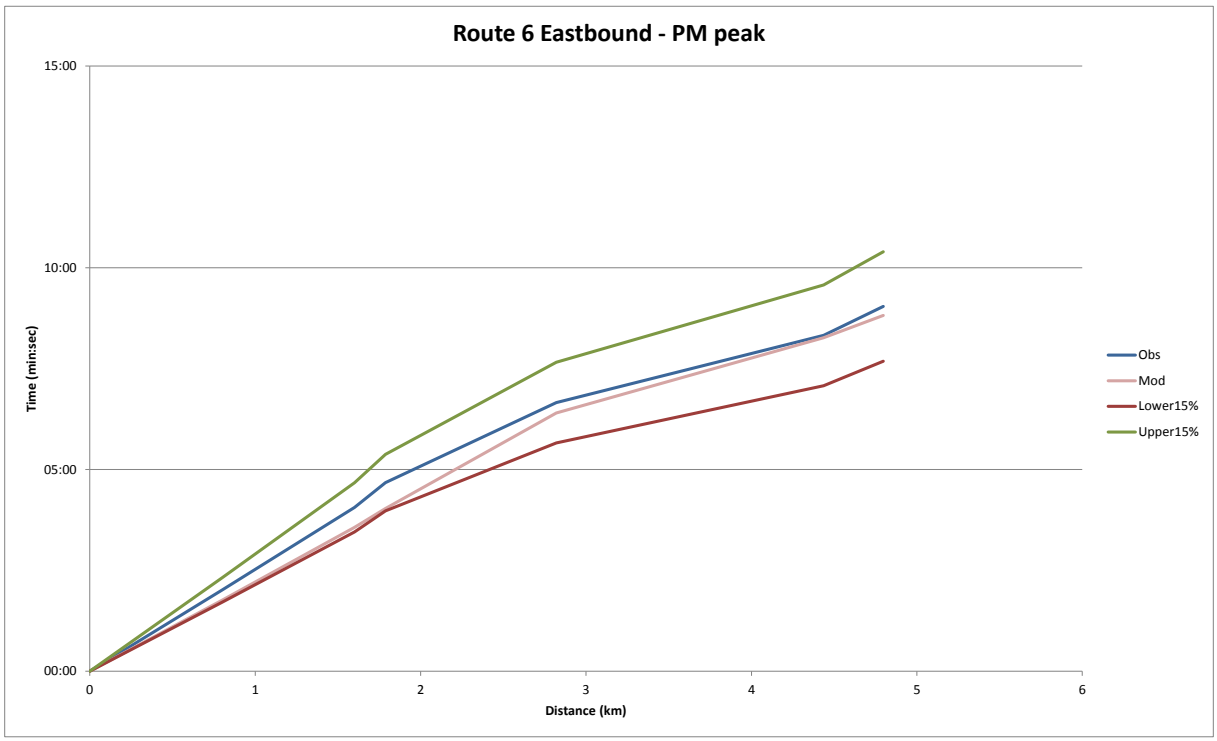

Route 4 Northbound - PM peak
15:00
10:00
05:00
00:00
Time (min:sec)
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
Distance (km)
Obs
Mod
Lower15%
Upper15%

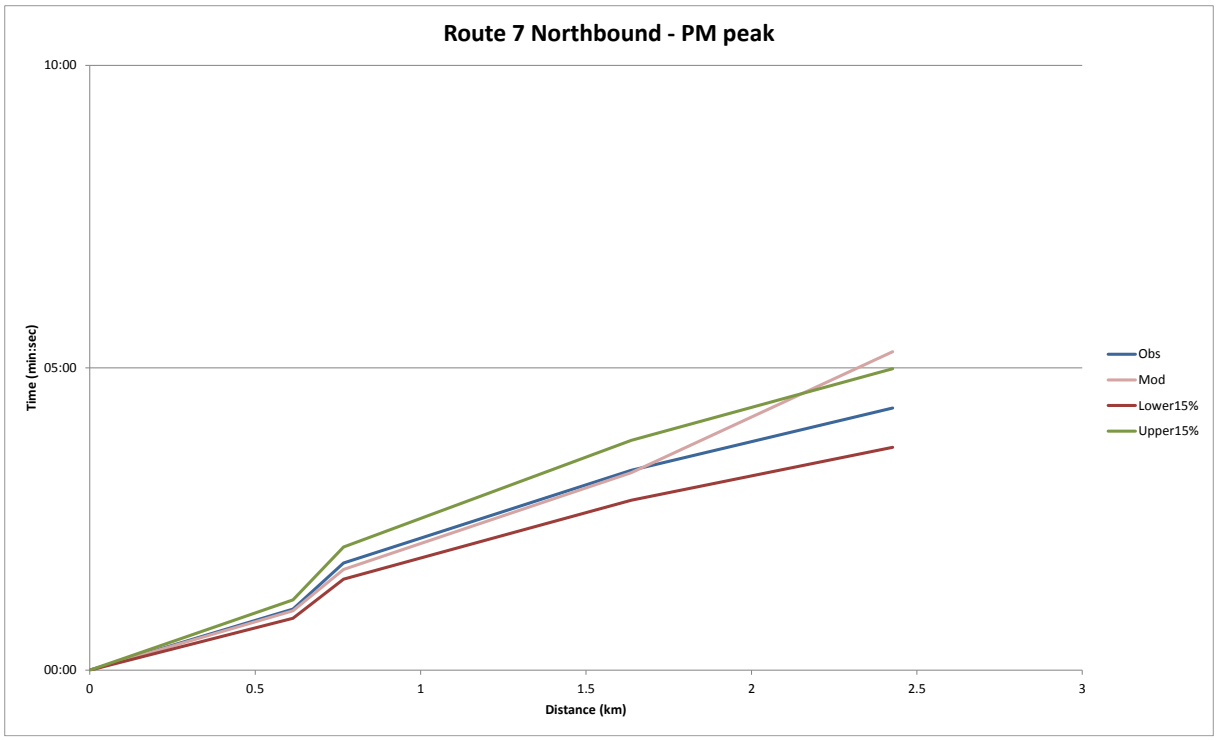

Route 4 Southbound - PM peak
15:00
10:00
05:00
00:00
Time (min:sec)
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
Distance (km)
Obs
Mod
Lower15%
Upper15%

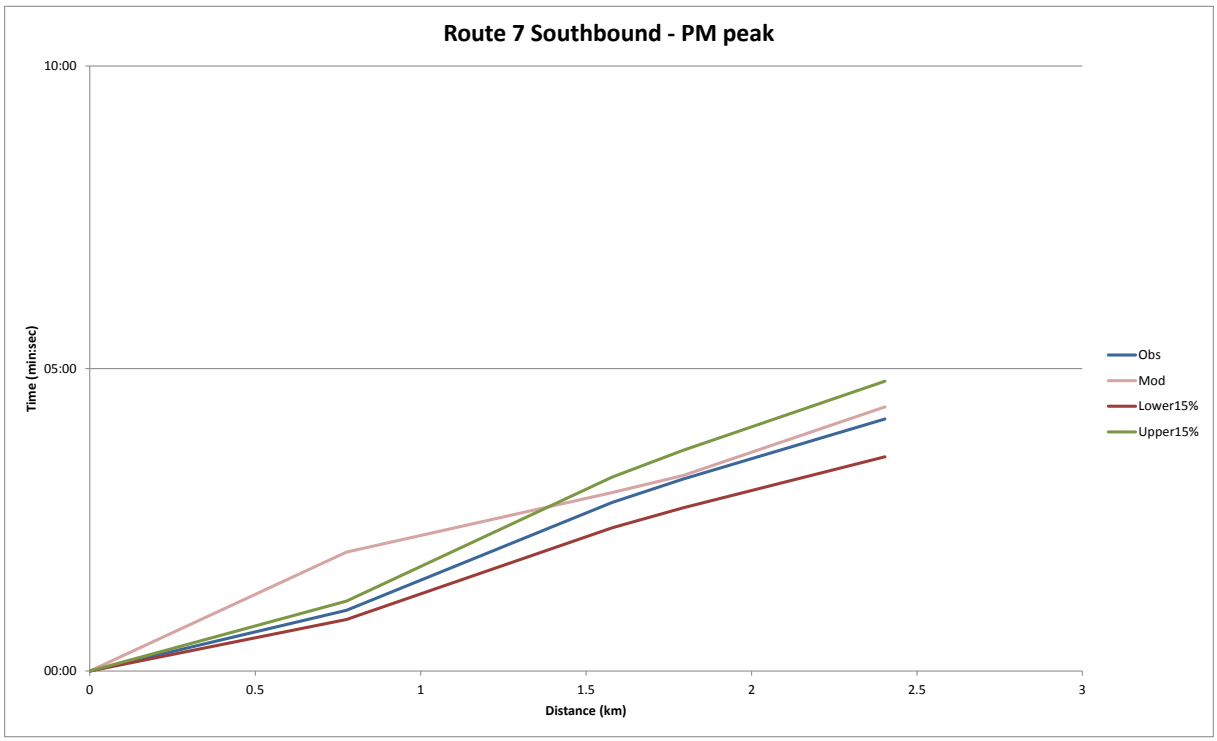

Route 5 Northbound - PM peak
15:00
10:00
05:00
00:00
Time (min:sec)
0
2
4
6
8
10
12
14
Distance (km)
Obs
Mod
Lower15%
Upper15%

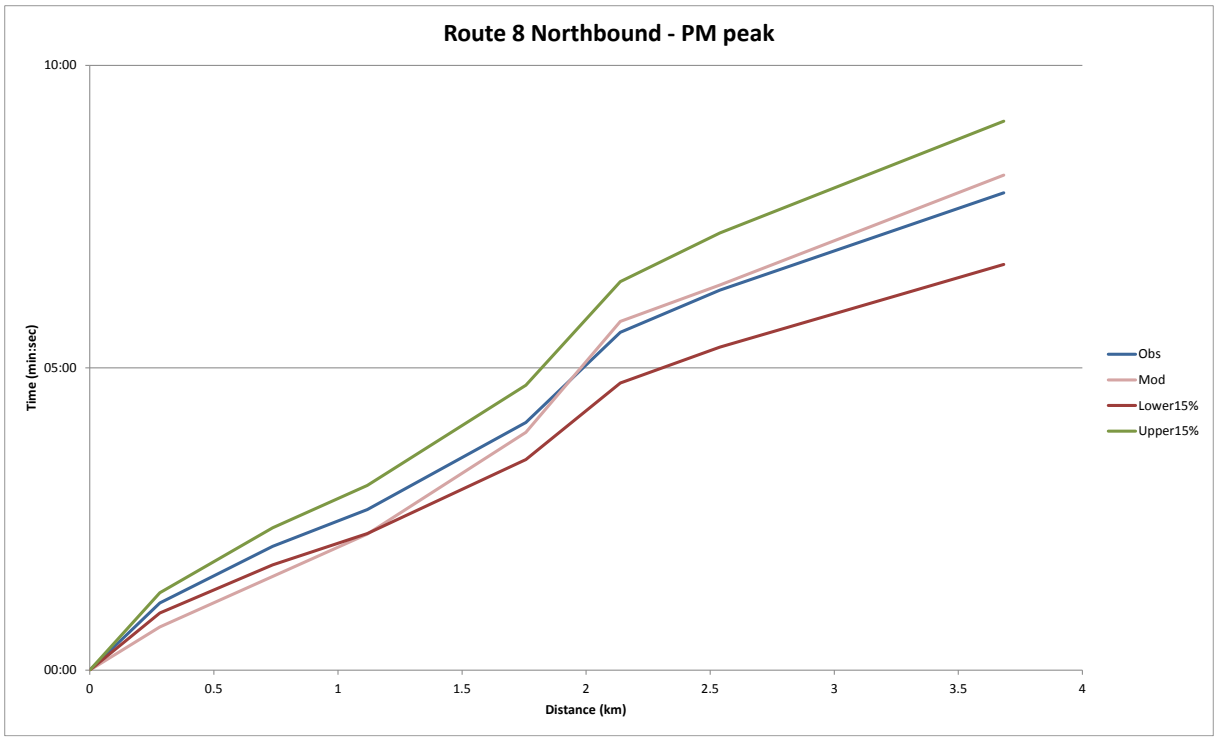

Route 5 Southbound - PM peak
15:00
10:00
05:00
00:00
Time (min:sec)
0
2
4
6
8
10
12
14
16
Distance (km)
Obs
Mod
Lower15%
Upper15%

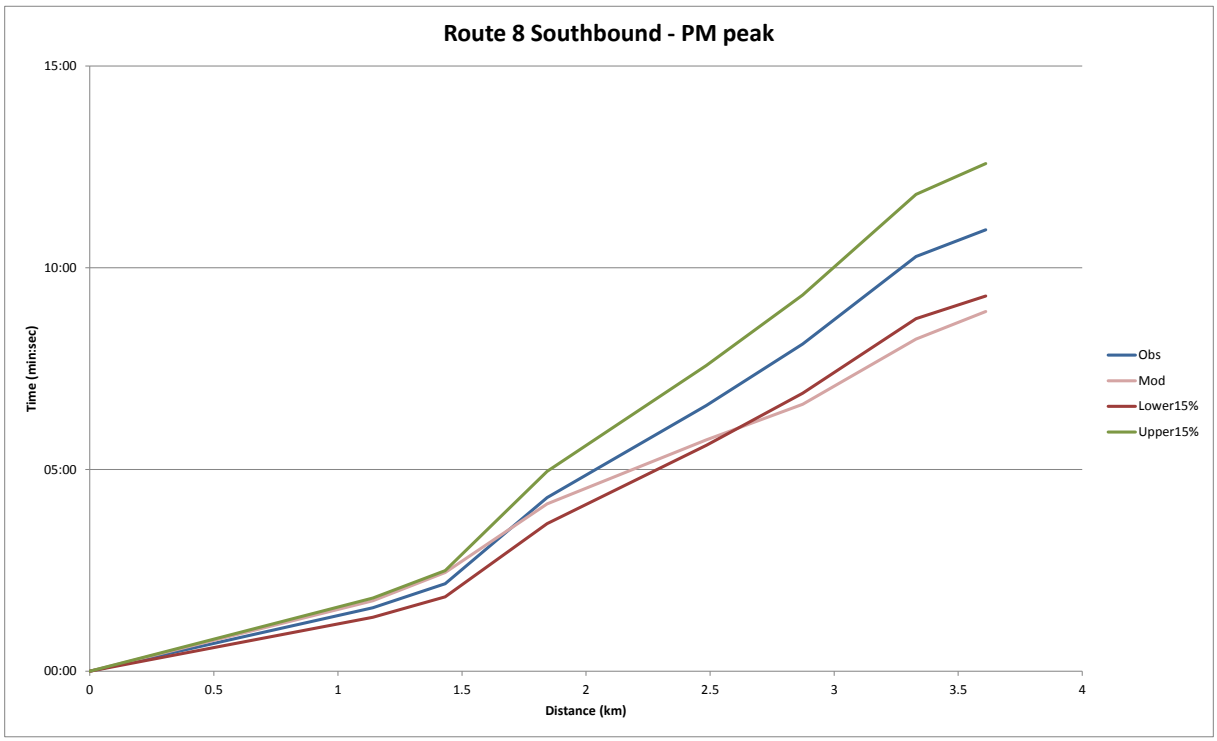

Route 6 Westbound - PM peak
15:00
10:00
05:00
00:00
Time (min:sec)
0
1
2
3
4
5
6
Distance (km)
Obs
Mod
Lower15%
Upper15%


Route 6 Eastbound - PM peak
15:00
10:00
05:00
00:00
Time (min:sec)
0
1
2
3
4
5
6
Distance (km)
Obs
Mod
Lower15%
Upper15%


Route 7 Northbound - PM peak
10:00
05:00
00:00
Time (min:sec)
0
0.5
1
1.5
2
2.5
3
Distance (km)
Obs
Mod
Lower15%
Upper15%


Route 7 Southbound - PM peak
10:00
05:00
00:00
Time (min:sec)
0
0.5
1
1.5
2
2.5
3
Distance (km)
Obs
Mod
Lower15%
Upper15%


Route 8 Northbound - PM peak
10:00
05:00
00:00
Time (min:sec)
0
0.5
1
1.5
2
2.5
3
3.5
4
Distance (km)
Obs
Mod
Lower15%
Upper15%


Route 8 Southbound - PM peak
15:00
10:00
05:00
00:00
Time (min:sec)
0
0.5
1
1.5
2
2.5
3
3.5
4
Distance (km)
Obs
Mod
Lower15%
Upper15%