Wiltshire Strategic 2018 Base Model

Local Model Validation Report in support of M4 J17 OBC

Wiltshire Council

July 2021

Notice

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This document has 145 pages including the cover.

Document history

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Rev 2.0	Realism Testing Chapter Included	PK	SC	CS	DW	29/03/2019
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Client signoff

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1. Introduction

1.1. Purpose of this report

This Local Model Validation Report (LMVR) (Issue 6.1) documents the development of the Wiltshire Transport Model (WTM) in support of the Outline Business Case (OBC) submission for the M4 J17 Major Road Network (MRN) scheme. This LMVR has been updated following Clarification Questions received from the Department for Transport (DfT) on 14th July 2021.

1.2. Background to development of the Wiltshire Transport Model

In 2017, Atkins produced the A350 Melksham Bypass Strategic Outline Business Case (SOBC) for Wiltshire Council, using the Melksham Transport Model (MTM). This model was cordoned from the A303 Stonehenge Model (which was itself derived from the South West Regional Transport Model (SWRTM, developed by Highways England). Extra refinement within the Melksham urban area was required, based on additional surveys, more detailed network coding and highway demand refinement. Whilst the MTM was sufficiently well calibrated within the Melksham area, outside of this region there was considerable model noise and uncertainty inherited from the SWRTM, which was to be expected as this model scope was defined to cover the strategic road network (SRN). The A350 Melksham Bypass SOBC study recommended that a new base model should be created with appropriate geographical scope, scale and detail.

In 2018, Wiltshire Council commissioned Atkins to scope out the additional traffic data required to enhance the existing A303 Stonehenge model (developed for Highways England) to develop a model which could be used to assess and appraise infrastructure schemes and development planning within the Wiltshire region. Atkins were then commissioned to develop the base model of Wiltshire.

This report outlines the steps taken to develop the Wiltshire 2018 base model, including the data collected, development of the model network and highway matrices and presents the output of the model calibration and validation process. This application of the Wiltshire Transport Model and subsequent issue of the LMVR is in support of the M4 J17 OBC.

1.3. Use of the model

Wiltshire Council is promoting the M4 J17 scheme through the Department for Transport's (DfT) Large Local Majors (LLM) fund. The LLM is funded through the National Roads Fund and is intended to support a small number of exceptionally large local highway authority transport schemes that could not be funded through normal routes and would exceed the upper threshold for Major Road Network (MRN) proposals.

Sub-national Transport Bodies (STB) were tasked with prioritising potential LLM schemes for their area, alongside advice and priorities for the MRN. The Western Gateway STB prioritised the A350 M4 J17 scheme to be promoted through the LLM fund (alongside further A350 schemes promoted through the MRN fund). In June 2019, Wiltshire Council (via the Western Gateway STB) submitted a SOBC to central government (DfT) for the Melksham Bypass scheme. In March 2020, Wiltshire Council was awarded £1.3m funding by the DfT to develop the scheme to the next stage of the business case process – the OBC. Atkins has been commissioned by Wiltshire Council to prepare the OBC, with submission to DfT anticipated in Autumn 2021.

As such, the WTM has been used to provide an evidential basis for informing the M4 J17 OBC. This version of the LMVR (Issue 6.1) documents the development of the WTM in support of the OBC submission, including the provision of localised validation results in section 7.4. The model has been developed in accordance with the current DfT Transport Appraisal Guidance (TAG), which is a general requirement when applying for major scheme business case funding (see Section 2.3.8 for model standards).

1.4. Report structure

This report consists of the following sections:

2. Base model objective, specification and standards
3. Summary of data
4. Highway network development
5. Highway prior trip matrix development and
6. Impact of matrix estimation
7. Model validation results
8. Variable demand
9. Summary

2. Base model objective, specification and standards

2.1. Objective and need for the model

Atkins' objective for the transport model of the Wiltshire and Swindon county regions is to provide a tool which can provide: **clear, transparent & plausible** highway transport forecasts, to inform planning and highway infrastructure decisions in a **fast, flexible** and **visual** way.

To achieve this, the strategy advocated within TAG, is to produce a model which accurately represents observed generalised travel costs (supply) and highway movements (demand). In order to be **proportionate**, it is recommended that the area of focus is within the region which the model sponsor requires analysis of the changes expected to occur.

As recommended in TAG, the model is pivot-point (or incremental) which means that it uses cost changes to estimate the change in the number of trips from a base matrix. The highway traffic forecasts will pivot off the transport model base costs and reference case trip patterns to form an important role in identifying and appraising future schemes and planning decisions in the Wiltshire & Swindon area.

An overview of how this objective was achieved, the limitations of the strategic model (Section 9.2) and the model appropriateness (Section 9.3) are discussed in the report summary.

2.2. Existing traffic models

South West Regional Transport Model (SWRTM, 2015)

The SWRTM was originally developed by Highways England during 2016, with a 2015 base year. The model has good coverage of the strategic network across the South West and includes junction simulation, as well as incorporating a Variable Demand Model (VDM) capability. Traffic forecasts were developed for 2021, 2031 and 2041.

A303 Stonehenge - Amesbury to Berwick Down Model (A303 Stonehenge, 2015)

The A303 Stonehenge model was developed by the Arup Atkins Joint venture (AAJV) on behalf of Highways England for PCF stage 2 of the Amesbury to Berwick Down scheme. The LMVR was issued in April 2017 but used data collected in 2015. The model used the SWRTM as a starting point and enhanced it around the area of the A303 ABD scheme (including Salisbury, Amesbury etc.) The model used locally collected RSI and additional ATC data and provided extra detail in the area equivalent to South/East Wiltshire. The forecast years for the model include 2026 (the expected opening year of the scheme), 2041 & 2051.

Melksham Transport Model (Melksham Model, 2017)

The Melksham Transport Model, developed in 2017 by Atkins, was derived from the A303 Stonehenge Model which was cordoned with Melksham at the centre, and more detail, including zone splitting, network amendments and traffic counts, was added. The base matrix development of this model was recalibrated to NTEM trips ends and observed calibration data around Melksham in 2017.

Swindon Strategic Transport Model (Swindon Urban Model, 2014)

The Swindon strategic transport model was developed by CH2M (Jacobs) with a 2014 Base year. The transport forecast model was developed by Atkins in 2017/2018. This covers the urban area of Swindon and includes forecast years for 2021 and 2036.

2.3. Model description and specification

2.3.1. Overall specification and modelling suite

The Wiltshire 2018 base model uses the A303 Stonehenge / SWRTM as the primary starting point for further enhancement with Melksham and Swindon model detail included.

The highway component of the RTM modelling suite was developed using SATURN software. This highway model interacts with DIADEM which calculates travel demand based on changes in travel costs from the highway model (SATURN). This process iterates between demand calculations and highway assignments until equilibrium is reached with converged results

It is to be assumed that any parameters, processes or techniques used to develop the Wiltshire model suite is consistent with the Highways England RTMs, unless stated in this report.

2.3.2. Software version

The latest version of SATURN v11.4.07H was used for highway assignment.

2.3.3. Base year

The A303 Stonehenge / SWRTM was the starting point for further enhancement. Both model variants were developed using a 2015 prior matrix (derived from mobile phone data) and calibrated/validated with 2015 traffic flow counts and travel times.

Approximately 200 new traffic counts and ANPR surveys within the area of West Wiltshire were undertaken in June 2018 (see Section 3). In consultation and agreement with Highways England, the 2015 data from the wider area and the 2018 data in the localised area are sufficiently close in age to consider this model a 2018 base year without the need to apply growth factors to any of the traffic counts or the prior matrix outside the detailed model area.

2.3.4. Model time periods

The Wiltshire 2018 base model has been developed to represent an average 12-hour weekday in 2018, for the following time periods:

- AM Peak Period average hour (0700-1000)
- Inter peak average hour (1000-1600)
- PM Peak Period average hour (1600-1900)

Throughout this report, any reference to AM, IP or PM (peak) refers to the peak period time slices, unless otherwise stated.

2.3.5. Demand segmentation

The OD trip matrices used for highway modelling are derived from the SWRTM and so comprise the same user classes, based on trip purpose and type of vehicle. Five user classes are modelled:

- Car – business trips
- Car – commuting trips
- Car – other trips
- Light goods vehicles (LGVs)
- Heavy goods vehicles (HGVs)

The demand segmentation structure of the VDM differs from the highway only assignment. This is explained further in Section **Error! Reference source not found.**.

2.3.6. Generalised costs

This allows the model to take account of differences in users' value of time (VoT) and vehicle operating cost (VOC). For example, HGVs have different VOCs in comparison to cars and LGVs. The latter have been split into three trip purposes as the value of time differs between these types, i.e. vehicles on business trips are likely to have a higher value of time than, for example, a vehicle on a journey for leisure purposes.

This is explained further in Section 4.4, with base model generalised costs shown in Table 4-1.

2.3.7. Passenger Car Units

Demand in the SATURN traffic assignment is expressed in term of passenger car units (PCUs). The factors used to convert from vehicles to PCUs are listed in Table 2-1.

Table 2-1 - Passenger Car Unit Factors

Vehicle Type	PCU Factor
Car/LGV commuting	1.00
Car/LGV business	1.00
Car/LGV other	1.00
HGV	2.50

As applied in the SWRTM, the PCU factor for HGVs is a weighted average of the factors given in TAG for Rigid Goods Vehicles and Articulated Goods Vehicles. The weighting was applied using goods vehicle type splits on major roads within the study area from the Department for Transport's Annual Average Daily Flow – Data by Direction Major Roads[1].

2.3.8. Public Transport

As consistent with the RTM on which this model was developed, there is no assigned public transport component. There is an estimated rail demand and associated cost of travel for the demand model.

2.4. Model standards

In general, the Wiltshire model standards are equivalent and consistent with those used for the SWRTM and A303 Stonehenge. The criteria utilised are found in the associated model validation reports. In summary, standard TAG acceptability guidelines have been utilised, with extra near criteria used which is consistent with those for all RTMs.

TAG unit M1.1 – "Principles of modelling and forecasting" states:

> *"It should be emphasised that it may not be necessary to use the most sophisticated or detailed models, nor is it likely to be appropriate to invest the highest proportion of resources to develop the best quality model at the expense of interpreting its outputs carefully and communicating its limitations".*

This report will primarily seek to present the base model outputs, carefully interpret the results and clearly communicate the sufficiency, implications (Section 9.1) and model limitations (Section 9.2).

A summary of the standards employed are discussed below.

2.4.1. Trip matrix validation

The reporting of the trip matrix validation is typically undertaken at a screenline/cordon level. TAG recommends that the differences between modelled flows and observed counts should be less than ±5% for all or nearly all screenlines.

In consistency with the RTMs, screenlines and cordons are considered *near* if the flows are within ±10%. This report will make it clear which screenlines: pass, fail or are near.

Trip matrix validation is presented and discussed in Section 7.1.

2.4.2. Individual link flow calibration

The two measures which are used for the individual link validation are GEH and flow. A link is considered successfully calibrated if one of these measures passes. For a model to be considered as suitably calibrated TAG Unit M3.1 states that 85% of individual links must pass these criteria.

The GEH measure uses the GEH statistic as defined below:

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

Where GEH is the GEH statistic, M is the modelled flow, and C is the observed flow

[1] http://www.dft.gov.uk/traffic-counts/download.php

The flow measure is based on the relative flow difference between modelled flows and observed counts.

TAG Unit M3.1 describes the Link Flow and Turning Movements Validation Criteria and Acceptability Guidelines as shown in Table 2-2.

An additional "near" criteria has been included which assumes that link flow validation is close with marginally relaxed criteria summarised below. This has been used to identify links which are considered good enough and allow focussed calibration on those areas of the model not falling within a pass or near criteria.

Table 2-2 - Link Flow and Turning Movement Validation Criteria and Acceptability Guidelines

Measure	Pass Criteria	Near Criteria
GEH	Less than or equal to 5	Less than or equal to 7
Observed flow less than or equal to 700 veh/h	Flow difference 100 veh/h or less	Flow difference 150 veh/h or less
Observed flow between 700 veh/h and 2,700 veh/h	Flow difference 15% or less	Flow difference 20% or less
Observed flow greater than 2,700 veh/h	Flow difference 400 veh/h or less	Flow difference 500 veh/h or less

Source: TAG Unit M 3.1 Table 2 provides "pass" criteria, "near" criteria is defined by either the RTM or Atkins.

The model link flow validation is presented and discussed in Section 7.2

2.4.3. Journey time validation

For journey time validation, the measure which should be used is the percentage difference between modelled and observed journey times, subject to an absolute maximum difference. TAG Unit M3.1 describes the Journey Time Validation Criterion and Acceptability Guideline as shown in Table 2-3.

Table 2-3 - Journey Time Validation Criterion and Acceptability Guideline

Criterion and Measure	Acceptability Guideline
Modelled times along routes should be within 15% (or 1 minute, if higher)	> 85% of routes

Source: TAG Unit M 3.1 Table 3

All comparisons are to be presented separately for each modelled period. There is no disaggregation presented by vehicle type. The Wiltshire model journey time validation is presented in Section 7.3.

2.4.4. Changes due to matrix estimation

Matrix estimation is a modelling technique that has become a standard feature in many traffic models. The purpose of matrix estimation is to produce a 'most likely' trip matrix that fits with available traffic count data. It is based on the theoretical procedure properly entitled 'Matrix Estimation from Maximum Entropy' and is generally referred to as ME2.

The process uses an iterative procedure to find a set of balancing factors for the origin-destination movements on each link with a traffic count to ensure that the assigned flows match the counts within certain user-defined limits. ME2 can be used to create a new trip matrix from scratch, but the best results are obtained when it is used to update an existing (prior) trip matrix. Within the SATURN suite, this process is run through the SATME2 program.

Traffic count data used for ME2 can be considered part of model calibration, but to properly validate the traffic demand distribution it is recommended that certain screenlines and cordon are not included within ME2. i.e. to allow validation of independent traffic count data.

Successive applications of ME2 should always use the same defined 'prior' trip matrix as an input, to prevent the process magnifying specific matrix changes on successive runs. For each modelled time period, matrix estimation needs to be applied separately for light (cars and LGVs) and heavy vehicles. TAG unit M3.1 suggests a set of benchmark criteria used to review the extent of changes due to matrix estimation relative to the prior matrix. These criteria are outlined in Table 2-4.

Table 2-4 - Matrix Estimation Change Criteria

Measure	TAG Benchmark Criteria	Additional RTM Criteria
Matrix zonal cell values	Slope within 0.98 and 1.02 Intercept near zero R^2 in excess of 0.95	N/A
Matrix zonal trip ends	Slope within 0.99 and 1.01 Intercept near zero R^2 in excess of 0.98	N/A
Trip length distributions	Means within 5% Standard deviations within 5%	N/A
Sector to sector level matrices	Differences within 5%	Trips <100 have been excluded GEH Statistic & proportion of movements which change ±10%

TAG Unit M3.1, with modifications consistent with the RTMs.

The guidance identifies that any exceedances of the criteria above do not mean that the model is unsuitable for the intended uses. The performance of the model should be reviewed against these criteria and exceedances should be examined and assessed for their importance particularly in relation to the area of influence of the scheme to be assessed. For the Wiltshire model, the changes are described in Section 6.3 and detailed in Appendix E.

2.4.5. Assignment convergence criteria

The advice on model convergence is set out in TAG Unit M3.1 (Table 4) and is reproduced below in Table 2-5. The Wiltshire model convergence statistics are presented in Section 7.4.

Table 2-5 - Summary of Convergence Criteria

Convergence Measures	Type	Base Model Acceptable Values
Delta & %GAP	Proximity	Less than 0.1% or at least stable with convergence fully documented and all other criteria met
Percentage of links with flow change (P1) < 1%	Stability	Four consecutive iterations greater than 98%

Source: TAG Unit M 3.1 Table 4

TAG convergence criteria values were adopted, and the results presented separately for each modelled period.

2.4.6. Demand model convergence and realism testing

Realism testing is used to ensure that the model responds to changes in travel costs rationally, behaves realistically and with acceptable elasticities. This involves changing various components of travel costs to check whether the response of the VDM is consistent with general experience. Part of the calibration process involves adjusting the parameters in the VDM model until more acceptable results are obtained from such realism tests. It is recommended that these tests are started with initial logit parameters (i.e. the spread, sensitivity or scaling parameters - lamda and theta) based on median values in TAG Unit M2, Section 5.6.

The primary realism tests require that car fuel cost, car journey time and public transport fare elasticity tests are undertaken.

The elasticities are calculated using model output from different runs using the base year model, from a converged run of the demand/supply loop.

For the Wiltshire model the VDM and realism testing is described and presented in Section 8.

Car Fuel Price Elasticities Targets

The car fuel cost elasticity required is the percentage change in car vehicle-kms with respect to the percentage change in fuel cost. The calculations should be carried out for a 10% or a 20% fuel cost increase. Car fuel elasticities are calculated using a matrix and network based test. The annual average fuel cost elasticity should lie within the **range -0.25 to -0.35** (overall, across all purposes).

TAG, states that target elasticities are considered more plausible if:

- the pattern of annual average elasticities shows values for employers' business trips near to -0.1, for discretionary trips near to -0.4, and for commuting and education somewhere near the average
- the pattern of all-purpose elasticities shows peak period elasticities which are lower than inter-peak elasticities which are lower than off-peak elasticities

Journey Time Elasticity Tests

The car journey time elasticity required is the change in car trips with respect to the change in journey time. I.e. as travel time increases there would be expected to be a resultant reduction in trips. TAG states that

> *"The output elasticities should be checked to ensure that model does not produce very high elasticities (no stronger than -2.0)".*

The approach adopted for testing the journey time elasticity is consistent with the method referenced in the hints and tips section of the DIADEM Manual. This states the following:

DIADEM Manual Method

Elasticities with respect to car travel times are more problematic and require a more approximate approach. The elasticities of vehicle kilometres with respect to fuel costs and journey times are related as follows:

$$E^{time}=E^{fuel} * p^{time} / p^{fuel}$$

where

p^{time} is the cost of travel as a proportion of total generalised cost, and

p^{fuel} is the cost of fuel as a proportion of total generalised cost.

If you know the total vehicle kilometres, K, and the total vehicle hours, T, then you can calculate an average value

$$p^{time} / p^{fuel}= aT / bK$$

where

a is the cost per hour from the generalised cost function and

b is the cost per kilometre.

The elasticity of vehicle kilometres with respect to journey time can then be estimated as:

$$E^{time}=E^{fuel} * aT / bK$$

This formula will be used to demostrate that output elasticites are no stronger than -2.0.

Public Transport Fare Elasticity

The public transport fare elasticity required is the percentage change in public transport trips by all public transport modes with respect to the percentage change in public transport fares. The calculations should be carried out for a 10% or a 20% public transport fare increase, applied to all public transport modes equally. Elasticities of public transport trips with respect to public transport fares have been found to lie typically in the **range –0.2 to -0.9**.

Cost Damping

As per recommended guidance, realism testing is to be conducted initially without cost damping. The algorithm used was fixed step length (0.5).

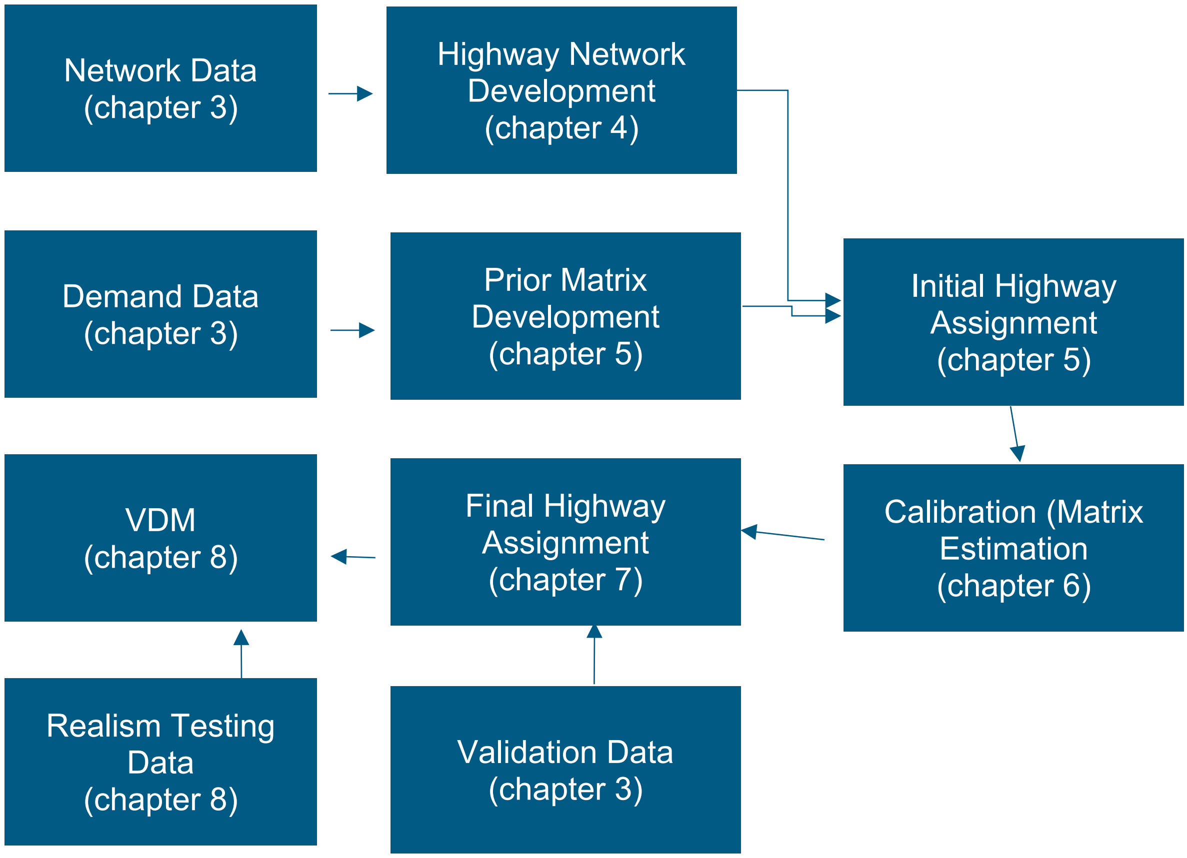
VDM Convergence

It is of crucial importance that the demand model system converges to a satisfactory degree in order to have confidence that the model results are as free from error and noise as possible. In line with guidance, target %GAP values of 0.2% for the sub area and 0.1% for the entire model are used.

2.5. Model Development

A high-level description of the each of the stages of model development and the use of data and process at key stages is shown in Figure 2-1.

Figure 2-1 - Model Development Flowchart



3. Summary of data collection

3.1. Introduction

The Wiltshire 2018 base model was developed using data collected for the development of the following models, (detailed in Section 2.2):

- SWRTM (2015 base)
- A303 Stonehenge Amesbury to Berwick Down (2015 Base)
- Melksham Transport Model (Atkins, 2017 Base)
- Swindon Transport Model (2014 Base)

Additional data was also collected to enhance the base model. One of the conclusions of the Melksham Transport Study (Atkins, 2017) was that there was insufficient transport data in the North West Wiltshire region. The A303 Stonehenge model provided some additional data in the Southern area, but the study recommended a series of volumetric traffic count data and localised distribution data (ANPR surveys) would be required. Subsequently the required traffic count and ANPR site locations were identified, and an independent specialist company was commissioned to undertake the surveys.

This section of the report describes the additional data that was collected to update the A303 Stonehenge (& SWRTM) model. This includes:

- Volumetric traffic count data
- Automatic number plate recognition
- TrafficMasterTM journey time data
- AddressBaseTM plus data

3.2. Volumetric traffic count data

This data was the primary source of traffic flow calibration and validation data, to ensure that traffic demand on each of the major and minor routes across the region was matching observed information.

The locations of the all the new Volumetric Count data (including ATC, TRIS and MCC data) sites are presented in Figure 3-1. There is a total of 738 link counts within the area of detailed modelling (AoDM, discussed in Section 4.1).

Automatic Traffic Counts & variation in traffic data

Automatic traffic counts were undertaken in eight main settlements in the West Wiltshire area by Intelligent Data Company (IDC). The survey data was collected over a three-week period in 15-minute intervals and classified according to the DfT-UK (GB DTp National Core Census) classification scheme.

The 186 ATC counts were undertaken throughout June/July 2018 (outside of school holidays). The data was analysed and averaged into the peak periods identified in Section 2.3.4. The ATC data processed outliers are removed which doesn’t have 95% confidence level. An example of processing sheet is presented in Appendix F.

- General sense-check – any recorded peaks or troughs in the data, inconsistent with the overall trend of the survey site were investigated and removed from the dataset where deemed appropriate;
- Tidality – all flows were plotted within the developed model network by time period and direction to ensure the observed patterns in flow were as expected and consistent for adjacent locations;
- Cross-checking – all link and turning flows were compared against adjacent links and junction turning flow data to ensure flows were consistent in terms of volume by each time period.

Various logic and sense checks were undertaken to ensure consistency between nearby and adjacent sites, and linkages with the ANPR data. The processed data doesn’t show a good quality split between Car/LGV but the totals looked sensible. So it’s logical to use Lights and heavies rather than using Cars, LGV and HGV.

Manual Classified Counts

Direction wise classified link counts were carried out at 11 locations during June 2018 (5th -18th) at 15-minute intervals for 2 weeks.

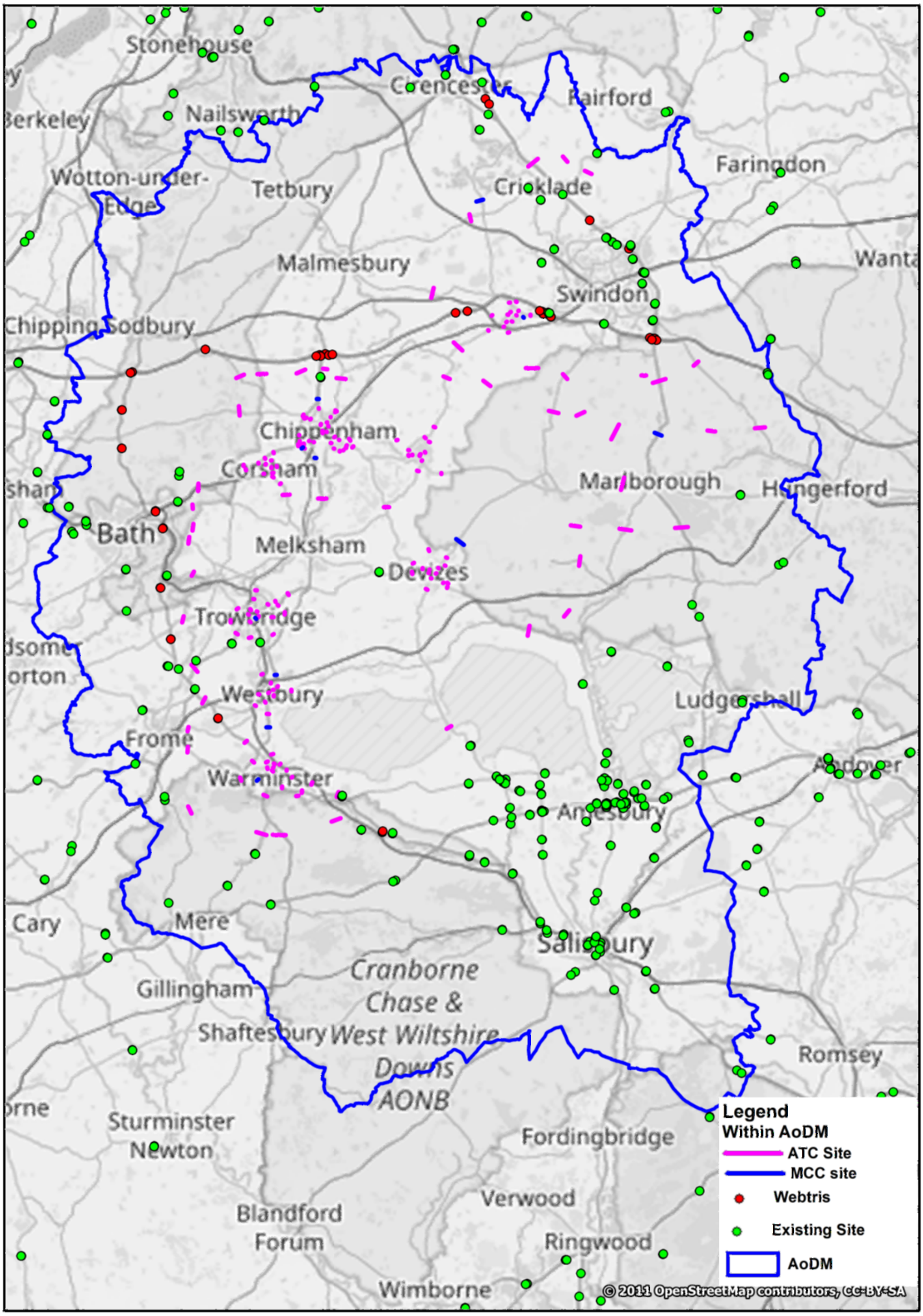
Existing Counts

The data collected was supplemented by data previously collected for the SWRTM, Melksham Transport Model and Swindon transport model. The counts from the A303 Stonehenge / SWRTM were collected or normalised to represent a 2015 Base year. The Swindon traffic counts were collected by Highways England in May 2014.

Webtris

Highways England provides a database of historic traffic count data. Relevant sites, within the AoDM, were included using May 2018 counts. Source: http://webtris.highwaysengland.co.uk/.

Figure 3-1 - Volumetric Traffic Count Data



3.3. Automatic number plate recognition surveys

As well as completing ATC and MCC, IDC also completed ANPR surveys in locations around the West Wiltshire area. Surveys were completed on a Tuesday and Wednesday at the beginning of June 2018 and recorded over a 12-hour time-period in 15-minute intervals. The counts were undertaken to form cordons around the main 9 settlements in the study area, allowing the movement of vehicles through and into each town to be understood. The locations of the all the ANPR sites are presented in Figure 3-2.

Figure 3-2 - ANPR survey Locations

The two days of ANPR data was combined with the ATC data to determine an observed cordon trip matrix for movements through each settlement. The results for each site are found in Appendix B.

This provides observed cordon flows in, out and through each of the main settlements in West Wiltshire; including:

- Chippenham
- Corsham
- Melksham
- Calne
- Devizes
- Trowbridge
- Westbury
- Warminster
- Royal Wotton

This information has been used for development of the prior trip matrix (see Section 5) and for a calibration check on the final model trip distribution. The final model base cordons are found Appendix B.

3.4. Cordon and screenline definition

For the Wiltshire & Swindon Base Model, the data collected was intended to define a range of cordons and screenlines within the Wiltshire region which would capture the highway travel demand for each of the main urban settlements within the region and the main east-west and north-south movements through the area, are presented in Figure 3-3.

Within this area there is limited route choice between or through settlements and summary reporting will focus on these key movements. The observed counts are presented in Table 3-1. The Base model assignment results are shown in Section 7.2 and Table 7-2.

Figure 3-3 - Cordons and Screenline Locations

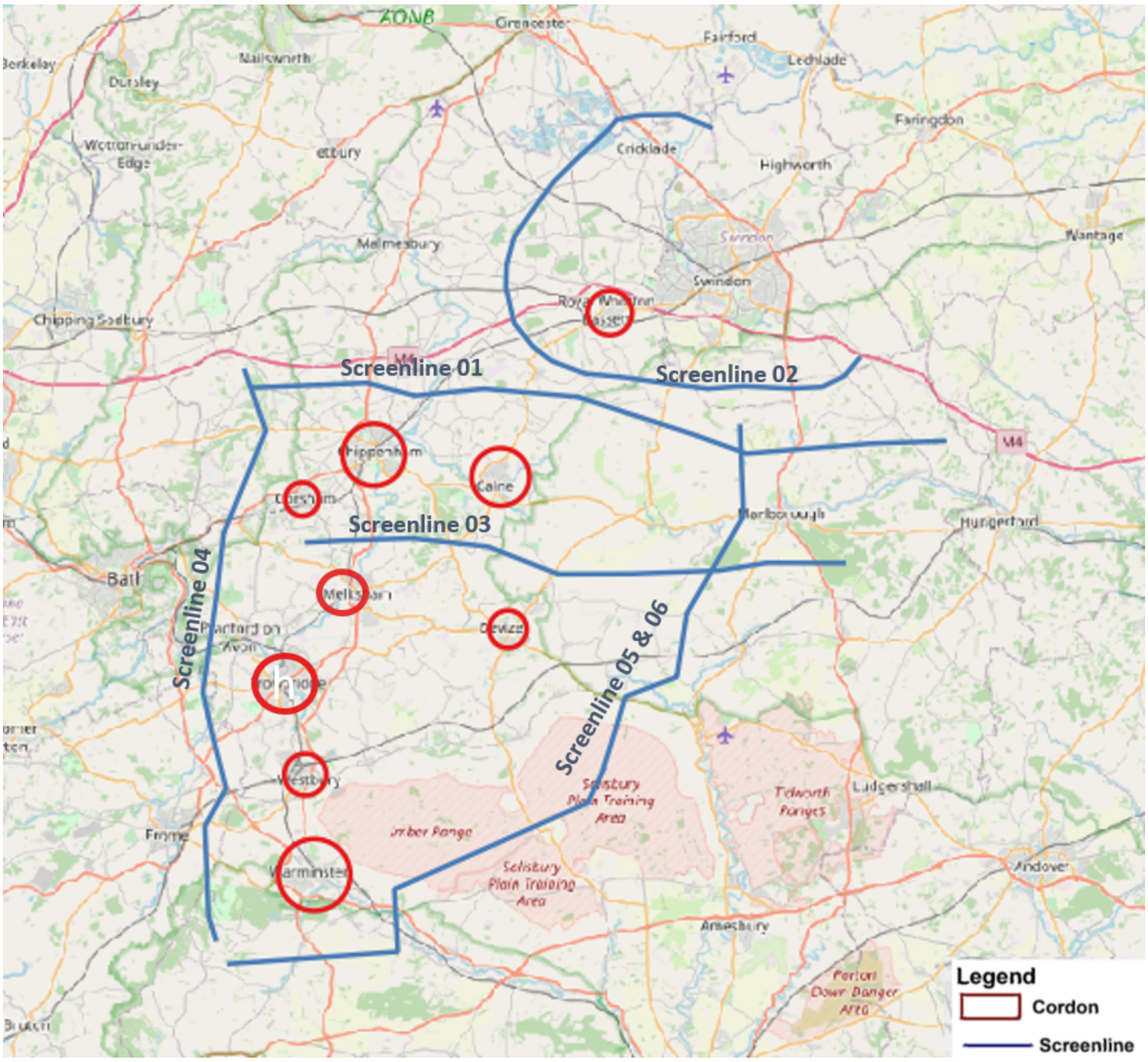


Table 3-1 - Cordon and Screenline Observed Traffic Flow Summary

Cordon / Screenline	Direction	No. links	AM	IP	PM
Calne	Inbound	5	1,564	1,425	2,137
	Outbound	5	2,128	1,376	1,664
Chippenham	Inbound	8	4,787	3,793	4,703
	Outbound	8	4,494	3,789	4,761
Corsham	Inbound	5	1,564	1,299	1,665
	Outbound	5	1,572	1,332	1,677
Devizes	Inbound	5	2,317	2,066	2,535
	Outbound	5	2,366	2,063	2,317
Melksham	Inbound	7	3,896	3,404	4,580
	Outbound	7	4,174	3,322	4,074
Trowbridge	Inbound	7	2,925	2,921	3,820
	Outbound	7	3,292	2,992	3,402
Wootton Bassett	Inbound	6	2,355	2,030	2,926
	Outbound	6	2,667	1,979	2,554
Warminster	Inbound	7	2,936	2,693	3,197
	Outbound	7	3,014	2,667	2,964
Westbury	Inbound	5	1,910	1,793	2,365
	Outbound	5	2,281	1,743	2,061
Screenline 1 North of Chippenham	NB	12	2,230	1,638	2,141
	SB	12	2,130	1,601	2,332
Screenline 2 Swindon	NB	12	2,621	1,863	2,444
	SB	12	2,370	1,829	2,684
Screenline 3 North of Melksham	NB	6	2,728	2,053	2,371
	SB	6	2,358	2,031	2,758
Screenline 4 West of Trowbridge	EB	11	3,958	3,124	4,200
	WB	11	3,985	3,133	3,992
Screenline 5 South of Warminster / East of Devizes	EB	10	2,706	1,794	1,930
	WB	10	1,900	1,886	2,646

All Counts are in Total Vehicles, Peak Period

3.5. TrafficMaster™ journey time data

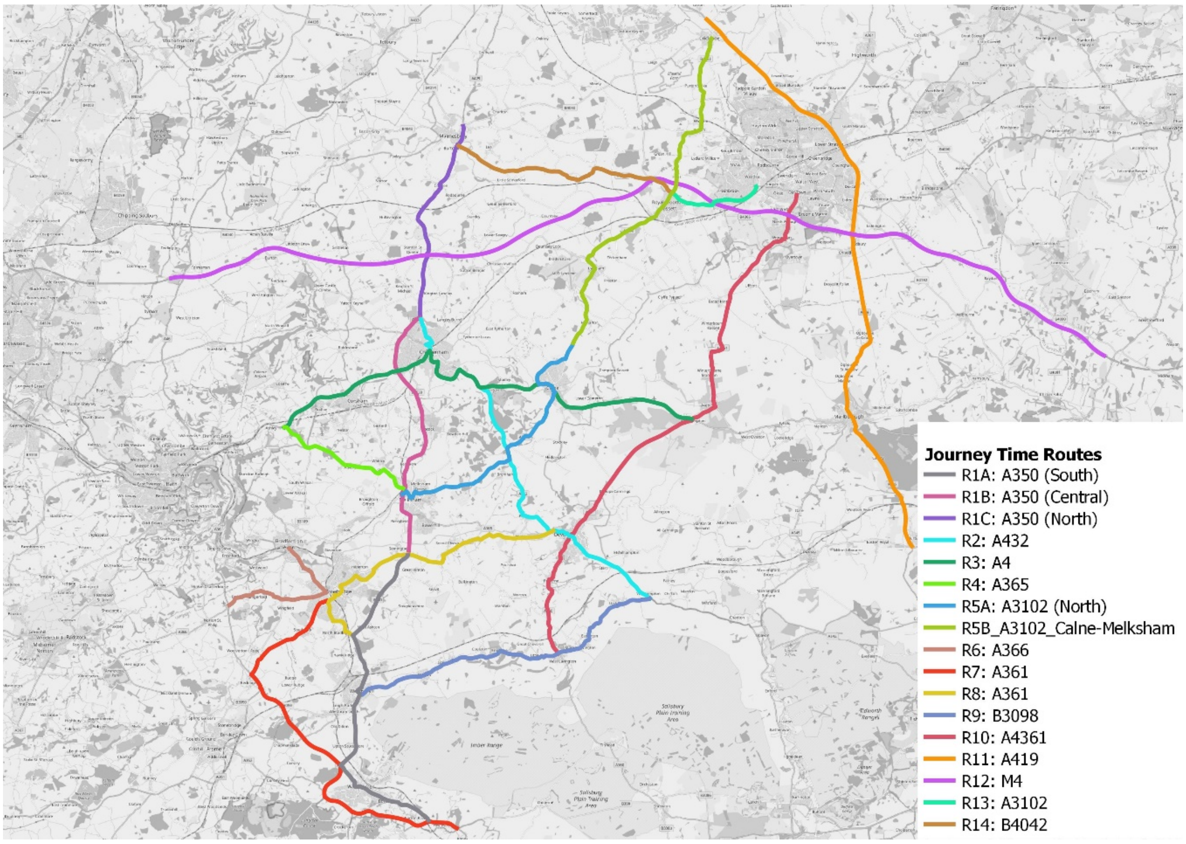
Trafficmaster™ Journey Time data was collected which represents network delay, for each modelled time period in September 2017 for all routes except Route 13 which is from June 2017[2]. Data from 2018 was not available at the time of model development. The routes for which data was collected are shown in Figure 3-4, whilst a description of each is provided in Table 3-2. Time and distance checks were made using online mapping to ensure the data had been processed as accurately as possible. The travel times, by period and trip distances, for each of the routes are shown in Table 3-2.

The calculated journey time data is compared with the popular route planner (Googlemaps). It is found that the observed times are close to travel time of route planner.

The journey time validation of the base model is presented in Section 7.3. Distance-Time graphs for the A350 are found in Appendix F. Any specific plots not provided in this report are available from Atkins upon request.

Journey time routes are longer than TAG recommendations as Wiltshire is predominantly rural, so the county's destinations (i.e. Wiltshire's major towns) are far apart. It was therefore considered to be a proportionate approach. If these routes had been split into sections of 15km there would have been close to 100 routes. The data is available to allow the model to be interrogated at a local level as required.

Figure 3-4 - Journey Time Routes



[2] June 2017 was chosen for Route 13 as there were road works on a major junction during September which were skewing the journey times on this route.

Table 3-2 - Observed Journey Times

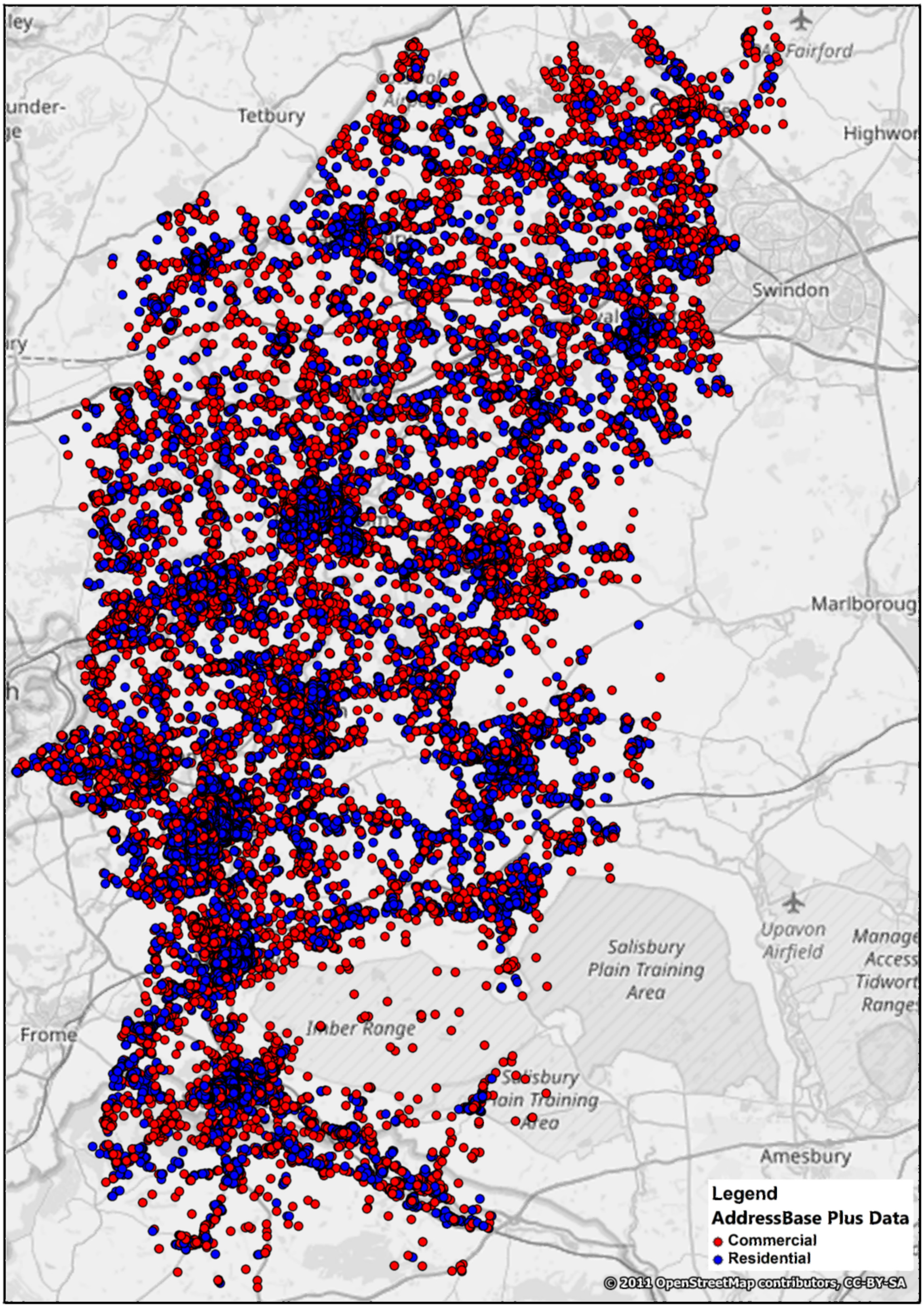
Route No.	Description	Dir	Distance (km)	AM	IP	PM
				(mins)		
1A	Warminster to Melksham (A350)	NB	23	28	29	27
		SB	23	28	28	27
1B	Melksham to Chippenham (A350)	NB	18	21	20	19
		SB	18	21	20	20
1C	Chippenham to Malmesbury (A350)	NB	14	13	13	12
		SB	14	14	13	13
2	Chippenham to Devizes (A432)	NB	28	35	35	35
		SB	28	35	35	33
3	Corsham to Calne (A4)	EB	32	36	36	34
		WB	32	37	37	36
4	A4 to A350 (A365)	EB	10	11	11	10
		WB	10	11	11	11
5A	Cricklade to Calne (A3102)	NB	18	22	22	22
		SB	18	22	22	21
5B	Calne to Melksham (A3102)	NB	26	31	30	28
		SB	26	29	29	28
6	A36 to Bradford-on-Avon via Trowbridge (A366)	EB	11	15	15	15
		WB	11	16	15	15
7	Trowbridge to Warminster (A361 / A36)	NB	28	26	26	25
		SB	28	25	25	25
8	Trowbridge to Devizes (A361)	EB	21	27	26	25
		WB	21	24	25	24
9	Westbury to A432 (B3098)	EB	22	26	26	25
		WB	22	27	26	25
10	Swindon to Devizes (A4361)	NB	38	40	40	38
		SB	38	40	41	40
11	Cricklade to B3098 (A419 / A346)	NB	41	33	34	34
		SB	40	33	32	31
12	J14 to J18 (M4)	EB	66	35	35	34
		WB	66	34	35	34
13	Swindon to Royal Wootton Bassett (A3102)	EB	6	8	7	7
		WB	6	7	7	7
14	Malmesbury to Royal Wootton Bassett (B4042)	EB	15	14	14	14
		WB	15	14	14	13

Data is based on Trafficmaster Journey Time data from September 2017 for all routes except Route 13 (June 2017)
Distances are in km, travel time is in minutes. Distances are rounded to the nearest km and times are rounded to the nearest minute.

3.6. AddressBase™ plus data

AddressBase™ Plus gives up-to-date local authority addresses and OS MasterMap references which differentiates by commercial or residential property types as shown in Figure 3-5. This information was used to assist in zone factoring, splitting and disaggregation in the process of refinement of the initial prior trip matrix (see Section 5.1).

Figure 3-5 - AddressBase Plus Data



4. Highway network development

4.1. Area of detailed modelling

Within the SATURN software suite, highway networks can comprise either a **full simulation** network, in which the operation of individual junctions is fully simulated, or a less detailed **buffer** network, which features link distance and speed information. The strategic road network within the A303 Stonehenge / SWRTM is entirely ‘simulated’. However, to reduce likely wider network convergence issues, model noise and reduce computational power and run times in regions outside the area of interest it was proposed to define an area of detailed modelling (AoDM). Within this region, the network is fully simulated and outside this area, the existing network is buffer.

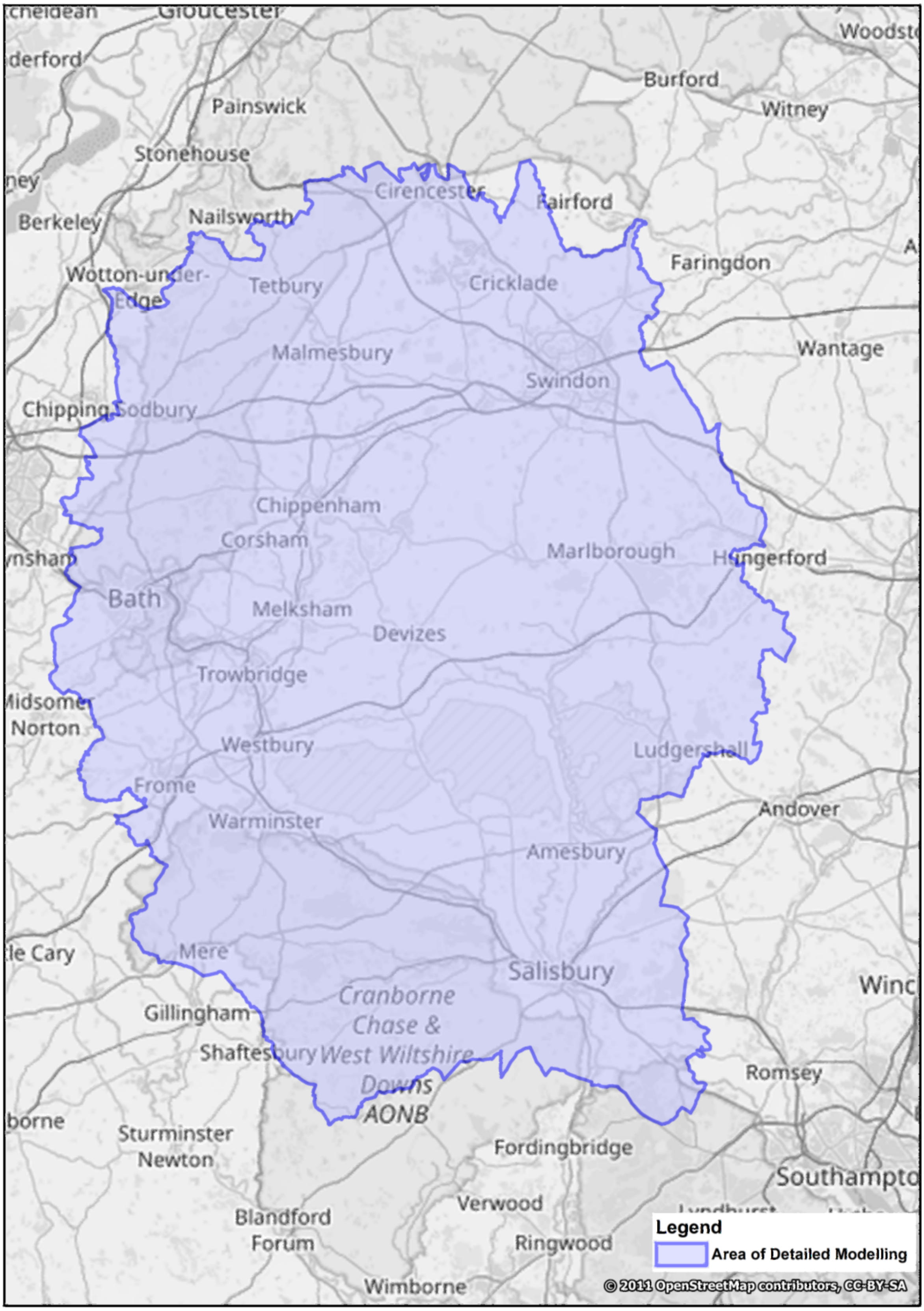
The initially proposed AoDM included only Wiltshire and Swindon, this was discussed with Wiltshire Council and Highways England. It was agreed that the AoDM would be extended to include a wider region which incorporated Bath and parts of South Gloucestershire and the Cotswolds to fully capture the network impacts of changes within Wiltshire.

The agreed AoDM is shown in Figure 4-1. The existing A303 Stonehenge / SWRTM network was converted (using SATBUF feature within SATURN) to buffer outside this area.

Whilst the focus of this report is within the AoDM, the model calibration data and processes (matrix estimation etc.) of the A303 Stonehenge / SWRTM models of the whole SW region has been retained. A summary of the model calibration and validation results is presented in Appendix C. This shows that the wider Wiltshire model retains the same level of calibration as the donor models.

A summary of the differences between the Full Simulation and Buffer variants of the Wiltshire model are presented in Appendix D. This shows that there is little difference between the two models and hence there is limited benefit in fully simulating the model outside the AoDM as this will only increase run times and likelihood of convergence and noise issues and hence reduce opportunities for sensitivity tests and plausible economic analysis within the AoDM.

Figure 4-1 - Area of Detailed Modelling (AoDM)



4.2. Network refinement within the AoDM

Within the AoDM, network additions and refinements were made. These used the RTM coding manual and include all the standard processes and check recommended in section 5.3 of TAG unit 3.1:

- Addition of local and minor roads (see Figure 4-2 for the AoDM, and Figure 4-3 for the scheme vicinity);
- Amendments to speed flow curves to reflect driver behaviour and speeds within towns;
- Extensive refinement of network coding to ensure realistic cost of travel throughout the AoDM. The results of the travel time validation are shown in Section 7.3.
- Distances were updated using GIS tools and checked for reverse link discrepancies and also along journey time routes the model distances are similar to that of the observed distances.
- The staging and timings for signalised junctions were assumed initially through template coding and local knowledge. These signals have been optimized to minimize delay and care is taken to ensure that signals along a journey time have right amount of delay at that junction.
- As part of the network development and calibration, junctions and links were reviewed for their characteristics, including junction saturation flows, link length and speed limits/speed-flow curves.
- The saturation flows used for coding of newly added junctions were taken from the Regional Traffic Model (RTM) network coding manual. The values were chosen based on the characteristics of the junctions and values for key junctions were refined during the calibration process.
- In addition, SFCs were checked throughout the model extension area to check that these were appropriate for the characteristics of the roads.

Figure 4-2 - Network Refinement: AoDM

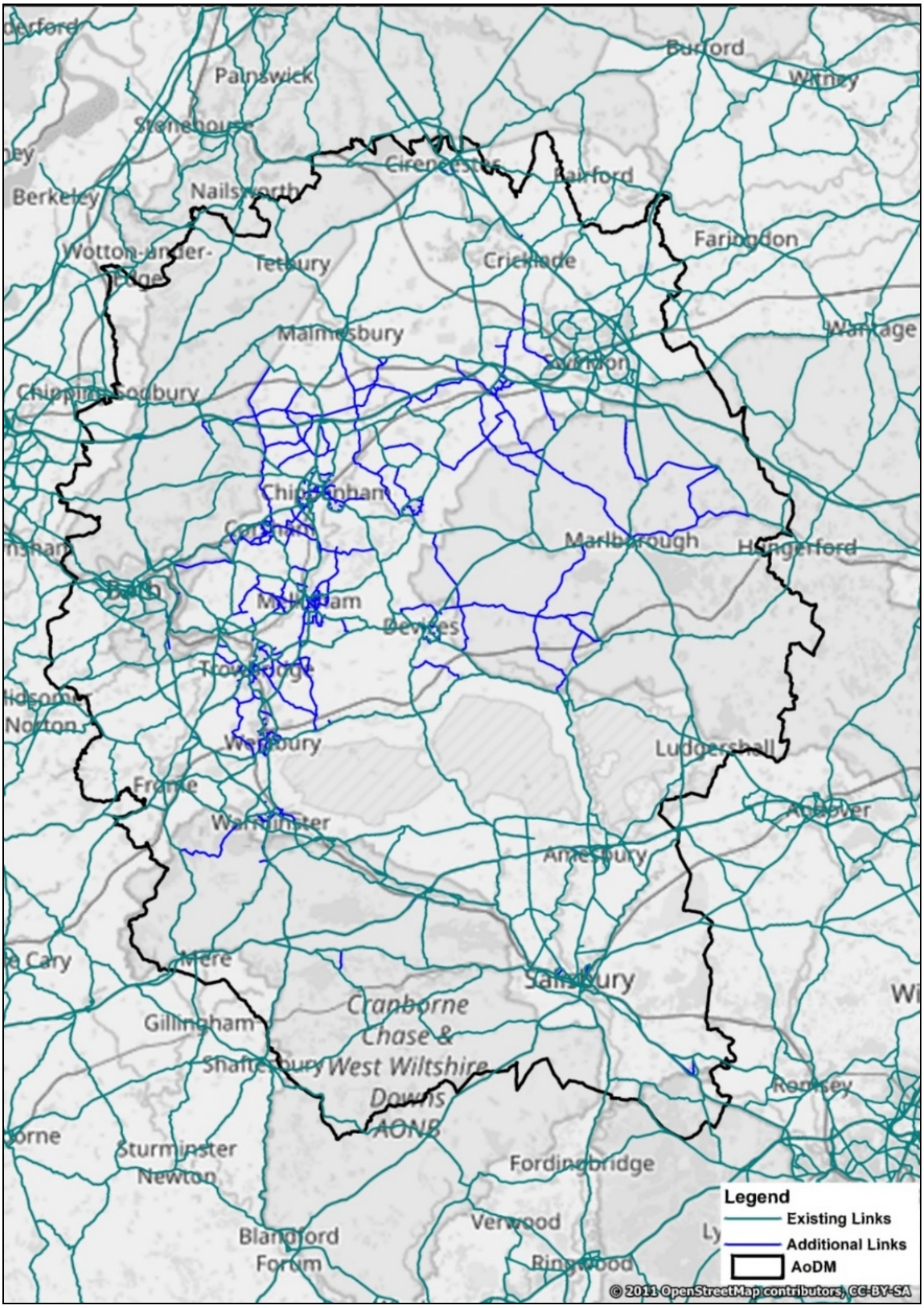
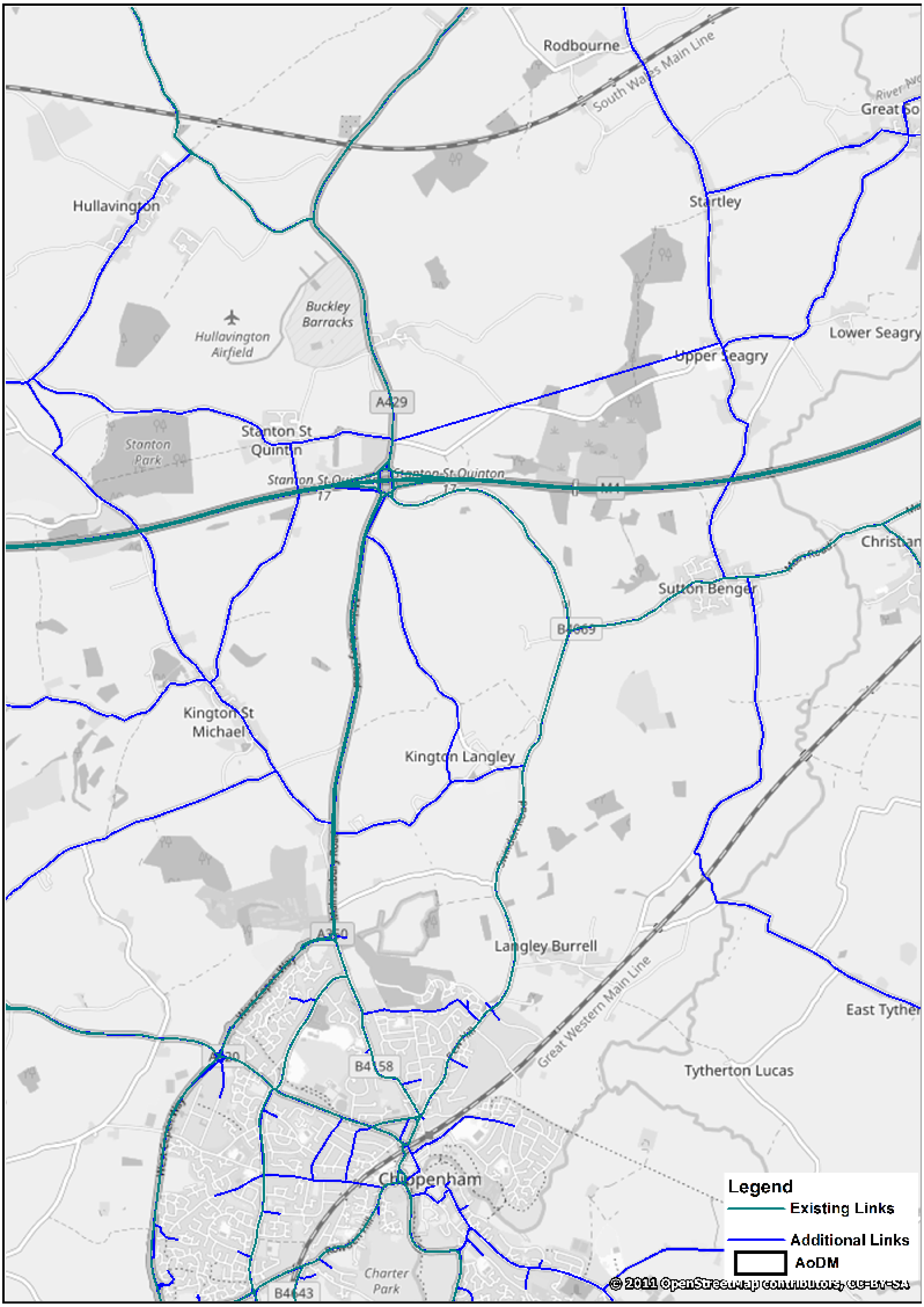


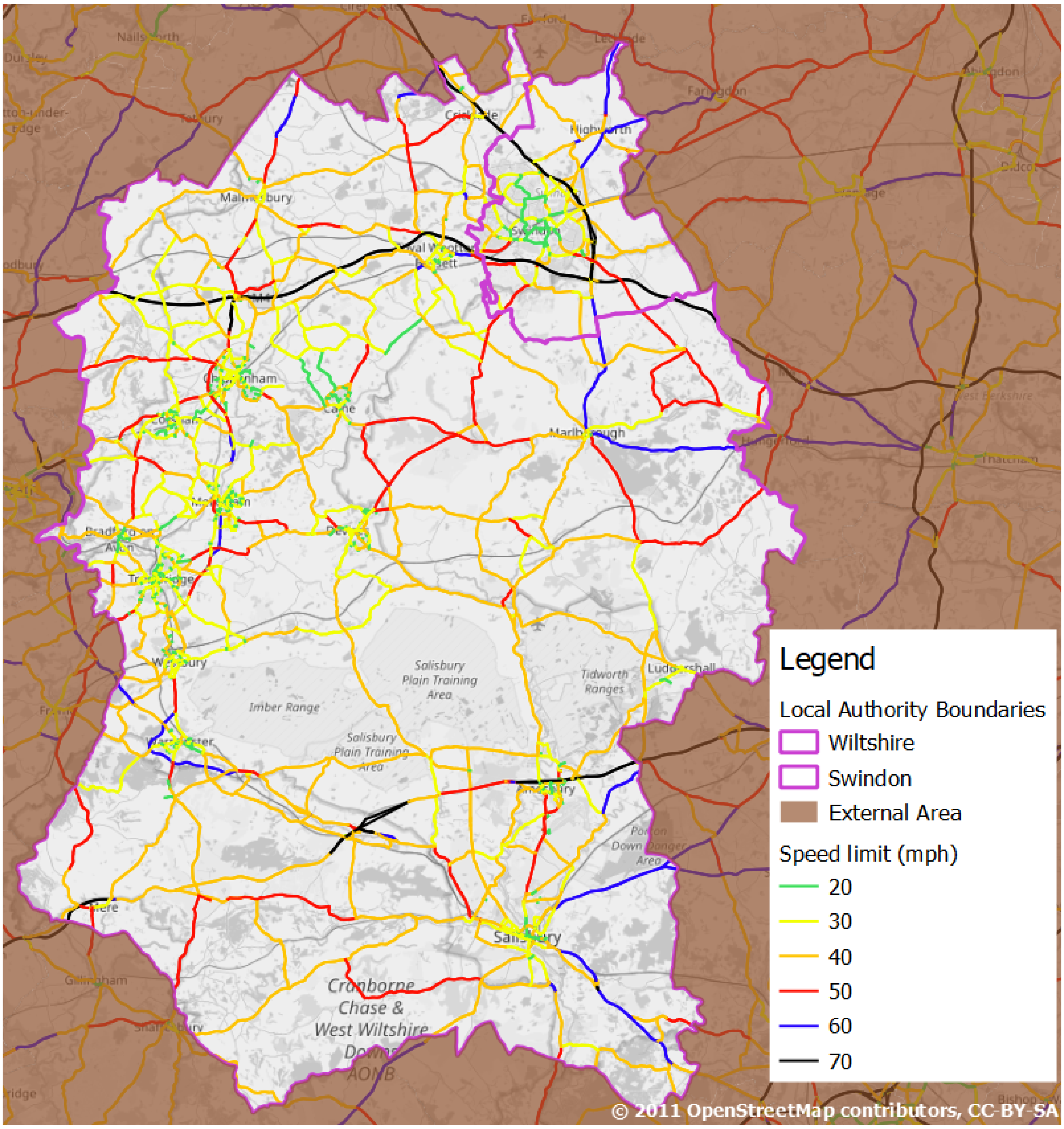
Figure 4-3 - Network Refinement: M4 J17



4.3. Capacity constraints

The cruise speeds used in the models are as shown in Figure 4-4. The speed flow curves (SFC) values are consistent with the SWRTM and A303 Stonehenge models. The network coding standards used are consistent with the RTM coding manual v0.8 Final.

Figure 4-4 - AoDM Network Speeds



4.4. Generalised costs (Value of Time and Vehicle Operating Costs)

The generalised cost of travel is based on a combination of factors that drivers consider when choosing routes, mainly time and distance. Generalised cost parameters are used in a SATURN model to represent drivers' value of time by pence per minute (PPM) and distance by pence per kilometre (PPK).

Values of PPK and PPM can be set universally for the entire model or individually by user class. Where a choice of route exists (as in nearly all cases) these values are used to determine which available route has a lower 'cost' to the driver. Thus, if the PPK value is high, low cost routes will be those which minimise distance; conversely, if the PPM is high then low-cost routes will be those that minimise the travel time.

The TAG databook Tables A1.3.1 and A1.3.2 provide monetary values of time, which can be used to derive values of time in an assignment model in terms of PPM. Similarly, Tables A1.3.10 to A1.3.12 in the databook provide parameters to calculate fuel costs and Table A1.3.15 provides parameters to calculate nonfuel vehicle operating costs. When added together, the fuel and non-fuel elements give the total vehicle operating costs in terms of PPK for different transport users. Unit A1.37 states that, in non-work time, it is assumed that drivers do not perceive non-fuel vehicle operating costs, and so these costs have been omitted from the overall calculation of generalised costs for commuting and other trips. The PPM and PPK parameters then give the overall generalised cost for each of the different user classes, those used for the base model are presented in Table 4-1.

Table 4-1 - Assignment Values of PPM & PPK

UC	Description	PPM (pence per minute)			PPK (pence per kilometre)		
		AM	IP	PM	AM	IP	PM
1	Car (Business)	30.78	31.54	31.22	12.69	12.69	12.69
2	Car (Commute)	20.64	20.98	20.71	6.29	6.29	6.29
3	Car (Other)	14.24	15.17	14.91	6.29	6.29	6.29
4	LGV	22.31	22.31	22.31	13.93	13.93	13.93
5	HGV	44.43	44.43	44.43	40.28	40.28	40.28

TAG Databook v1.14 July 2020

5. Highway prior trip matrix development and assignment

5.1. Prior trip matrix development

5.1.1. A303 Stonehenge / SWRTM Prior Trip Matrices

The prior trip matrices for the SWRTM were primarily informed by mobile phone data (MPD) rather than being developed from more traditional sources. Further details of the SWRTM and A303 Stonehenge prior trip matrix development are found in the associated model validation reports.

The A303/SWRTM are considered a good starting point for a prior matrix as these have been developed by highways England and have undergone a rigorous checking process and are consistent throughout the region and with all the other RTMs.

The Wiltshire prior trip matrix was based on the A303 Stonehenge prior trip matrix (which utilised the Design Fix 2 (DF2) SWRTM prior trip matrix) and zone system which was initially based on MSOAs. This was assumed to provide a reasonable distribution for longer distance trips. The RTM Technical Consistency Group (TCG) advocated using new and alternative data sets to refine and disaggregate the MPD matrices to a spatially proportionate level of disaggregation. The zones within the existing model were refined to provide more detail in key urban areas.

5.1.2. External-External trips

As the prior matrix was created from the A303/SWRTM trip matrices all external-external trips are included within the prior matrices and are representative of the full trip ends within the South west region.

5.1.3. Zone disaggregation

Within the AoDM (see Figure 4-1) a finer zoning system was identified with the intention of representing the loading of trips at a suitable level of detail (see Figure 5-1 for the AoDM, and Figure 5-2 for the scheme vicinity). The zone centroids are assumed to be at the geometric centroids as the refinement is done along the settlements inside AoDM.

This process involved splitting, where required, the A303 Stonehenge / SWRTM zones into the new zone system based on the proportion of houses and employment in each zone and hence the relative proportionate production/attraction. The proportions of housing and employment was determined by the AddressBase™ Plus data described in Section 3.6.

The splitting was done in accordance with the census boundaries OAs, LSOA and MSOA boundaries. Within the OA the zones are further split by the land-use wherever it is required so as to load the traffic as correctly as possible.

The total demand was consistent with the MPD prior trip matrices from the A303 Stonehenge / SWRTM matrices. The total number of zones in the A303 Stonehenge model was increased from 2,033 to 2,250. This includes 23 additional empty zones which are to be used for forecast developments.

Figure 5-1 - Zone Disaggregation: AoDM

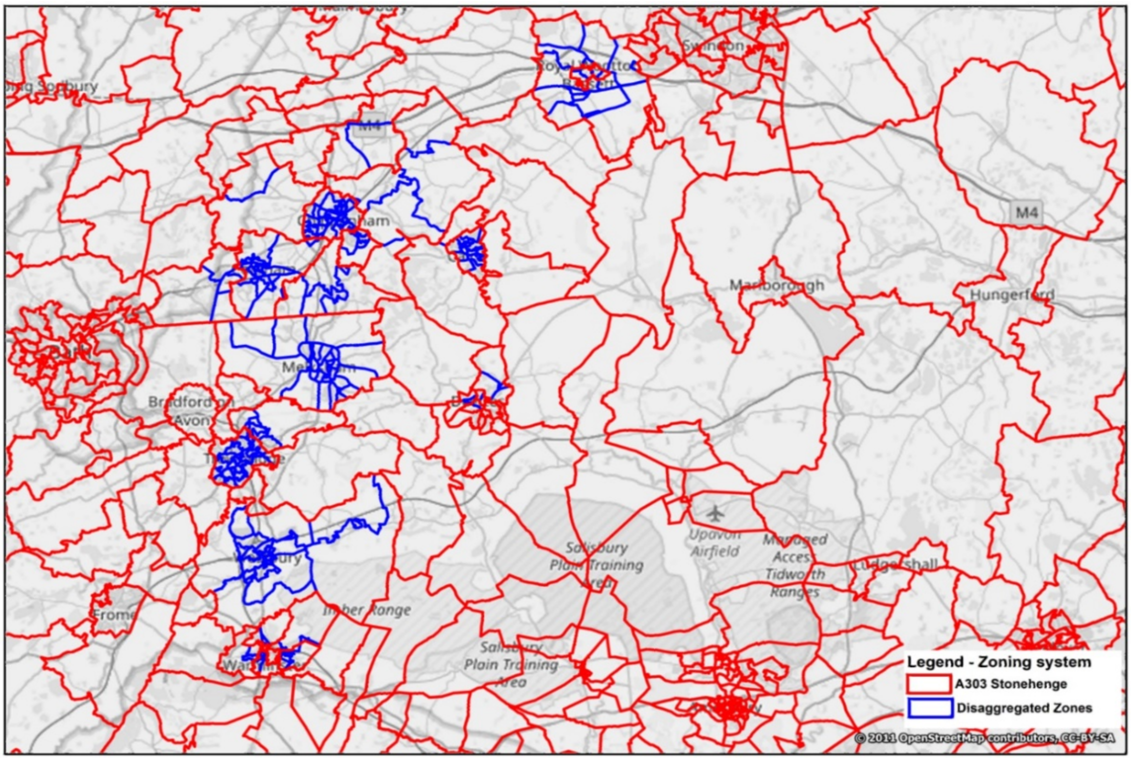
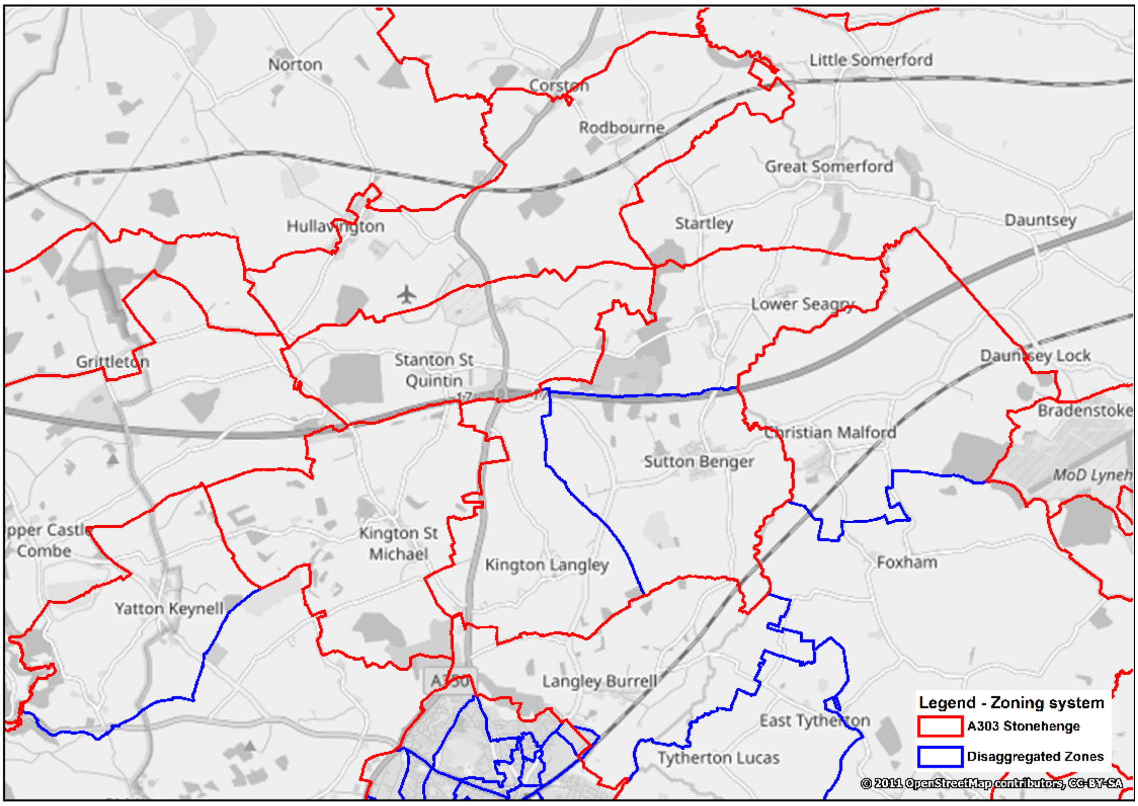


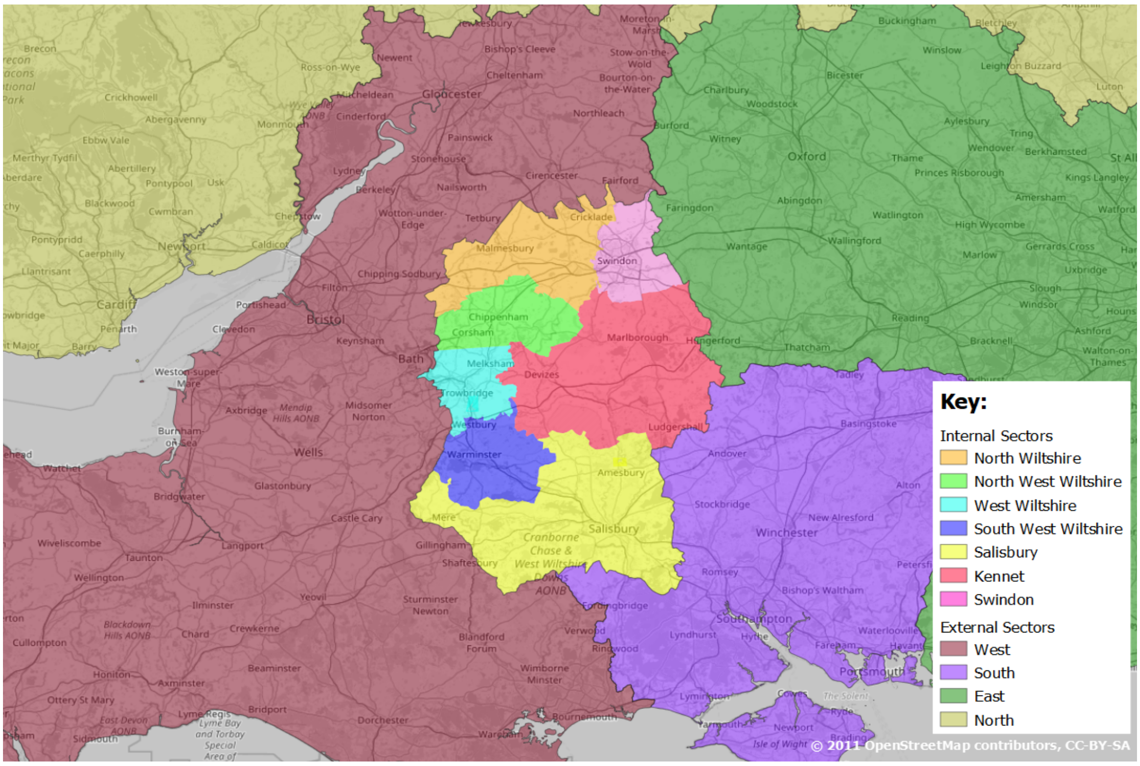
Figure 5-2 - Zone Disagregation: M4 J17



5.2. Sector system

A sector system has been defined to inform model appraisal and matrix development. This is presented in Figure 5-3.

Figure 5-3 - Sector System (11x11)



5.3. ANPR Data

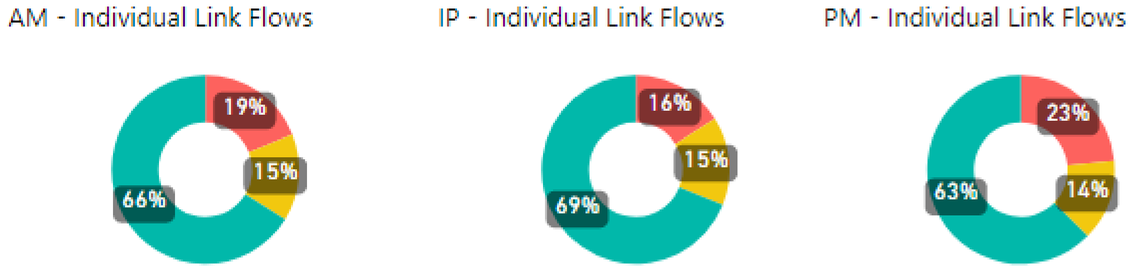
The ANPR data (see section 3.3 and presented in Appendix B) was used to determine the traffic volume of internal-internal, externa-internal, internal-external and external-external trips within each settlement. This was used as an independent check of both the prior and post ME2 trips matrices (see section 6) rather than being used to directly build the matrices.

5.4. Prior trip matrix model assignment output and the need for matrix estimation

A comparison of model output against observed traffic count data, using the prior trip matrices is shown in Figure 5-2. This suggests that whilst the outputs do not meet the expected standards (see "near" criteria in section 2.4.1 and 2.4.2) they are considered a practical standard to assume that the trip patterns and distribution are reasonable. The data is presented for a wide region and full-scale re-modification of the whole mobile phone data was not considered pragmatic.

The prior matrix assignment shows that percentage of links passing is over 60% for all three peaks, which suggests the prior matrix is a reasonable starting position. However, remedial action was deemed necessary to improve correlation with observed data, which is discussed in the following section.

Figure 5-2 – AoDM: Initial Prior Trip Matrices Assignment Pass (Green), Near (Amber) and Fail (Red)



5.4.1. Local Prior Trip matrix comparisons

A localised comparison of the screenlines, near to the scheme, is presented below in Table 5-1. This demonstrates that the prior matrices are considered suitable for assessing the scheme in the local area. However, there are two instances where the prior assignments fail to meet the expected standards (see "near" criteria in section 2.4.1 and 2.4.2) on the local traffic flow screenlines.

- The northbound 'SI1 North of Chippenham' screenline fails to meet the expected standards in the AM peak due to a single count on the A346 at the eastern end of the screenline. Removal of this count on the A346 between Marlborough and Swindon would result in the screenline meeting TAG criteria.
- The northbound 'SI3 North of Melksham' screenline fails to meet the expected standards in the PM peak, but this is only within 0.4% of meeting the "near" criteria.

It is acknowledged that the efficacy of the wider prior matrices is a small risk but are considered acceptable for appraising the scheme as local screenlines are much more reasonable.

Table 5-1 - Prior trip matrix: Local Cordon & Screenline Traffic Flow: Model vs Observed

Cordon/Screenline, Direction			AM			PM		
			Observed	Modelled	Diff (%)	Observed	Modelled	Diff (%)
Cordon	Chippenham	In	4,787	4,613	-3.6%	4,703	4,963	5.5%
		Out	4,494	4,707	4.7%	4,761	4,545	-4.5%
	Melksham	In	3,896	3,672	-5.7%	4,580	4,145	-9.5%
		Out	4,174	4,165	-0.2%	4,074	3,710	-8.9%
Screenline	Sl1 North of Chippenham	NB	2,230	2,544	14.1%	2,141	2,117	-1.1%
		SB	2,130	2,270	6.6%	2,332	2,419	3.7%
	Sl3 North of Melksham	NB	2,728	2,741	0.5%	2,371	2,124	-10.4%
		SB	2,358	2,153	-8.7%	2,758	2,529	-8.3%

All Traffic Flows are in Total Vehicles.

6. Impact of matrix estimation

6.1. Matrix estimation methodology

Assignment of the prior trip matrix (see previous section) showed that this was insufficient to meet TAG flow validation standards, hence use of matrix estimation was required.

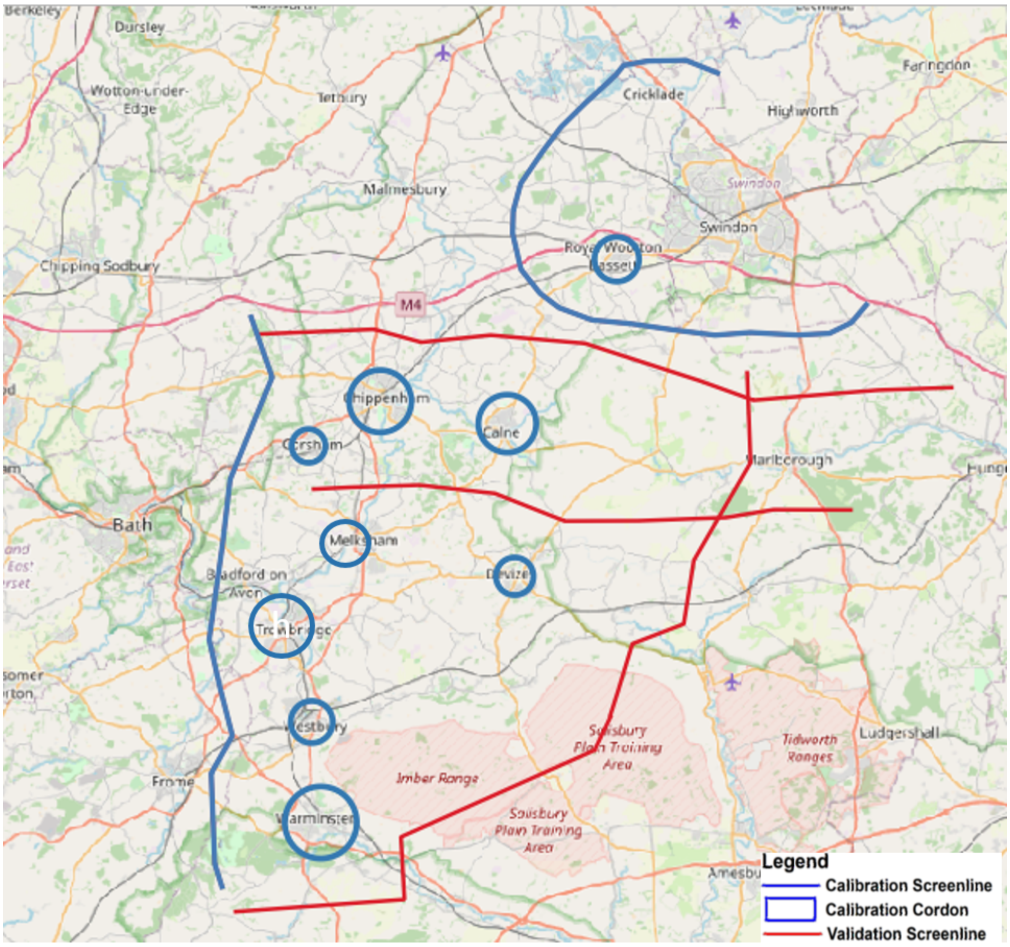
The process of matrix estimation (ME2, described in Section 2.4.4) and the parameters used for this modelling are broadly consistent with the A303 Stonehenge / SWRTM. These are summarised below:

- Lights (Cars/LGVs) and HGVs are treated separately, by constraining them to observed count data. Lights have not been further subdivided, as it is not possible to distinguish between the trip purposes from the existing count data.
- The traffic counts are grouped to form a cordon or screenline in ME process.
- All traffic counts not specifically on a cordon or screenline have been used in this process
- All the calibration screenlines in the wider south west area from the A303 Stonehenge / SWRTM are consistent in this model
- XAMAX defines the maximum balancing factor used to limit excessive changes to the prior matrix. A value of two has been used for the car/LGV and five for HGV estimation. This reflects the relative confidence in the data used to develop the demand for each of these vehicle classes
- A convergence criteria value of 0.001 has been used

6.2. Identification of calibration screenlines

To reduce the impact of ME2, certain traffic counts on selected cordons and screenlines were used for validation, i.e. these counts were not included within ME2. Those selected for calibration in ME2 and kept separate for validation are shown in Figure 6-1 below.

Figure 6-1 - Calibration Screenlines and Cordons



6.3. Monitoring changes due to matrix estimation

This section provides a summary of the changes due to ME2 between the prior trip matrix and the final post ME2 trip demand matrices. The standards used to assess the changes presented are consistent with those required in TAG guidance and described in Section 2.4.4.

In general, the results presented demonstrate that the changes due to ME2 are considered to be within the recommended guidance and the final post-ME matrix are suitable for model validation.

A more detailed output of the all the changes is presented in Appendix E.

6.3.1. Zonal cell values

The demand matrices are compared on a zonal basis to show that the change between the prior trip matrix and post ME2 matrix are within acceptance criteria. This has been done within the AoDM (meaning internal-to-internal, external-to-internal and internal-to-external movements are captured) as well as the full model. The results are presented in Table 6-1.

Across the AoDM, the scale of change induced by ME2 varies by vehicle type. Car and LGV matrices are either within the TAG acceptability limits or very close to achieving the criteria. HGV matrices required a greater level of manipulation to more accurately reflect local movements, as the matrices were derived at a Local Authority District level. In general, it is considered that the changes are within acceptable limits.

For the full model extent, the scale of change induced by ME2 is within TAG criteria across all vehicle types and time periods. ME2 is permitted to manipulate all ij pairs across the matrices, so it is important to consider the impact across the matrices as a whole, rather than solely at the AoDM level.

Table 6-1 - Summary changes in Zonal Cell Values: Post ME2 vs Prior

	TAG Criteria	AODM				Full Model			
		Car	LGV	HGV	All	Car	LGV	HGV	All
AM									
Slope	0.98 to 1.02	0.98	0.99	0.73	0.97	1.00	1.00	1.00	1.00
Intercept	Near zero?	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
R^2	> 0.95	0.97	0.94	0.64	0.97	1.00	1.00	1.00	1.00
IP									
Slope	0.98 to 1.02	0.99	1.01	0.71	0.98	1.00	1.00	1.00	1.00
Intercept	Near zero?	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
R^2	> 0.95	0.97	0.95	0.68	0.97	1.00	1.00	1.00	1.00
PM									
Slope	0.98 to 1.02	0.98	1.00	0.80	0.98	1.00	1.00	1.00	1.00
Intercept	Near zero?	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
R^2	> 0.95	0.97	0.92	0.67	0.97	1.00	1.00	1.00	1.00

6.3.2. Trip ends

This section describes the change for the trip end totals for the AoDM and the full matrix are presented in Table 6-2 and Table 6-3.

Table 6-2 - Summary Changes in Origin Trip Ends: Post ME2 vs Prior

	TAG Criteria	AODM				Full Model			
		Car	LGV	HGV	All	Car	LGV	HGV	All
AM									
Slope	0.99 to 1.01	0.95	0.99	0.59	0.92	1.00	1.00	1.00	1.00
Intercept	Near zero?	0.37	0.26	1.32	0.58	-5.53	-0.39	2.58	-2.87
R^2	> 0.98	0.99	0.96	0.90	0.97	1.00	1.00	1.00	1.00
IP									
Slope	0.99 to 1.01	1.00	1.05	0.42	0.97	1.00	1.00	1.00	1.00
Intercept	Near zero?	0.50	0.26	1.69	0.68	-1.26	0.59	2.58	-0.13
R^2	> 0.98	0.99	0.96	0.74	0.97	1.00	1.00	1.00	1.00
PM									
Slope	0.99 to 1.01	0.99	1.03	0.75	0.98	1.00	1.00	1.00	1.00
Intercept	Near zero?	0.26	0.10	0.70	0.31	-4.73	-0.17	1.30	-2.62
R^2	> 0.98	0.99	0.96	0.94	0.99	1.00	1.00	1.00	1.00

Table 6-3 - Summary Changes in Destination Trip Ends: Post ME2 vs Prior

	TAG Criteria	AODM				Full Model			
		Car	LGV	HGV	All	Car	LGV	HGV	All
AM									
Slope	0.99 to 1.01	0.96	1.00	0.66	0.95	1.00	1.00	1.00	1.00
Intercept	Near zero?	0.16	0.21	1.14	0.36	-5.54	-0.38	2.58	-2.88
R^2	> 0.98	0.99	0.96	0.92	0.98	1.00	1.00	1.00	1.00
IP									
Slope	0.99 to 1.01	1.00	1.06	0.65	0.98	1.00	1.00	1.00	1.00
Intercept	Near zero?	0.54	0.22	1.15	0.59	-1.24	0.60	2.50	-0.13
R^2	> 0.98	0.99	0.97	0.90	0.98	1.00	1.00	1.00	1.00
PM									
Slope	0.99 to 1.01	0.97	1.00	0.75	0.97	1.00	1.00	1.00	1.00
Intercept	Near zero?	0.47	0.19	0.71	0.45	-4.73	-0.18	1.19	-2.62
R^2	> 0.98	0.99	0.95	0.90	0.98	1.00	1.00	1.00	1.00

6.3.3. Trip length distribution

It is important that the ME2 process does not fundamentally alter the trip length distributions (TLD). A high-level comparison of the TLD, by user class, for all movements within the model is presented in Table 6-4. A more detailed comparison is presented in Appendix 0

This shows that there is very little change in the mean trip length of any vehicle type. The biggest change in mean trip length is associated with HGV trips, which show a maximum reduction of 4.3% in the AM peak.

Table 6-4 - Mean Trip Length: Post ME2 vs Prior for whole model

Time Period	Vehicle Type	Prior	Post ME2	% Difference	Standard Deviation
AM	Car	45.7	46.4	1.5%	1.2%
	LGV	54.2	54.8	1.0%	1.2%
	HGV	114.3	109.3	-4.3%	-1.3%
	Total	51.8	52.4	1.1%	0.5%
IP	Car	44.0	44.3	0.7%	1.1%
	LGV	54.8	54.9	0.1%	0.6%
	HGV	114.3	109.9	-3.9%	-0.7%
	Total	52.1	52.2	0.2%	0.4%
PM	Car	44.8	45.6	1.8%	2.1%
	LGV	53.5	54.2	1.2%	1.5%
	HGV	114.4	110.7	-3.2%	-0.6%
	Total	48.8	49.5	1.5%	1.5%

Distances in kilometres, for the whole model.

Light Vehicles are Cars and LGVs.

6.3.4. Sector to sector changes

In considering the differences on a sector to sector level it is important to avoid highlighting large percentage differences which represent only a small number of trips. As such all sector to sector movements with fewer than 100 trips in the prior matrix have been excluded from this analysis. In line with RTMs, the GEH statistic has also been assessed, along with the proportion of movements with less than ±10% change.

Figure 5-3 shows the spatial coverage of the sectors which have been considered in this analysis. The percentage and GEH change in sector-to-sector movements, for each time period, is provided in Appendix E.4. A summary of these changes for all movements within the model is shown in Table 6-5.

Table 6-5 - Sector to Sector Changes: Post ME2 vs Prior

Vehicle Type	Time Period	No. Cells with >100 Trips	% Cells with <5% change	% Cells with <10% change	% Cells with GEH <5 change
Car	AM	81	27%	48%	75%
	IP	73	33%	48%	75%
	PM	81	32%	48%	68%
LGV	AM	40	48%	63%	93%
	IP	36	50%	53%	94%
	PM	34	50%	68%	91%
HGV	AM	29	21%	28%	45%
	IP	28	25%	32%	50%
	PM	24	29%	54%	79%

A cell is defined as a sector to sector movement or sector pair. Note that all analysis has been undertaken on cells with >100 trips in the prior sector matrix.

6.4. Post ME2 sector matrices

It has been demonstrated that the changes resulting from ME2 are acceptable under the standards utilised for the development of the RTMs and those described in Section 2.4.4. The final, post ME2 (sector) matrices, used for model validation are presented in Table 6-6 to Table 6-8. The sector map, defining the regions is shown in Figure 5-3.

Table 6-6 - Sector Matrix: AM Peak Period, Post ME2 (PCU Hourly Trips)

	North Wiltshire	North West Wiltshire	West Wiltshire	South West Wiltshire	Salisbury	Kennet	Swindon	South West	South	East	North	**Total**
North Wiltshire	1,518	661	71	16	13	128	1,877	1,364	68	461	115	**6,292**
North West Wiltshire	645	6,065	903	91	86	452	373	1,475	49	320	123	**10,582**
West Wiltshire	136	1,188	6,448	593	237	384	120	1,943	128	121	66	**11,363**
South West Wiltshire	18	112	814	2,160	457	106	20	595	111	41	19	**4,453**
Salisbury	9	40	109	191	11,029	556	34	885	1,976	179	37	**15,045**
Kennet	151	472	469	132	560	5,092	581	353	668	627	57	**9,160**
Swindon	1,346	248	64	14	32	451	22,601	1,616	132	1,647	334	**28,484**
South West	1,368	1,800	1,564	679	1,610	347	2,035	494,844	5,839	3,873	7,692	**521,651**
South	66	68	86	62	1,775	368	191	3,769	185,745	18,945	1,440	**212,516**
East	323	217	78	37	185	394	1,632	2,972	14,819	1,233,893	29,504	**1,284,053**
North	142	180	135	46	56	55	511	10,011	1,404	36,687	3,270,589	**3,319,817**
Total	**5,721**	**11,051**	**10,742**	**4,022**	**16,039**	**8,333**	**29,975**	**519,827**	**210,938**	**1,296,792**	**3,309,976**	**5,423,416**

Table 6-7 - Sector Matrix: Inter Peak Period, Post ME2 (PCU Hourly Trips)

	North Wiltshire	North West Wiltshire	West Wiltshire	South West Wiltshire	Salisbury	Kennet	Swindon	South West	South	East	North	**Total**
North Wiltshire	1,243	513	93	20	9	117	1,323	943	50	295	137	**4,743**
North West Wiltshire	537	6,006	911	108	49	354	179	1,079	41	166	126	**9,556**
West Wiltshire	87	824	6,698	613	107	350	71	1,444	98	85	104	**10,481**
South West Wiltshire	17	66	666	2,506	194	59	16	548	68	39	35	**4,215**
Salisbury	9	39	110	221	10,150	395	27	972	1,334	166	62	**13,485**
Kennet	118	325	351	90	419	4,774	425	305	345	379	67	**7,598**
Swindon	1,226	190	56	9	16	476	20,362	1,215	88	1,201	364	**25,204**
South West	1,008	1,060	1,291	560	921	267	1,562	426,256	4,373	3,247	7,645	**448,190**
South	62	42	87	70	1,302	413	129	4,121	153,078	10,986	1,405	**171,695**
East	279	202	93	40	201	407	1,362	3,796	11,961	1,063,071	26,545	**1,107,957**
North	128	124	142	40	41	72	329	7,101	1,267	24,750	3,060,920	**3,094,912**
Total	**4,713**	**9,392**	**10,498**	**4,278**	**13,407**	**7,684**	**25,786**	**447,780**	**172,703**	**1,104,385**	**3,097,410**	**4,898,036**

Table 6-8 - Sector Matrix: PM Peak Period, Post ME2 (PCU Hourly Trips)

	North Wiltshire	North West Wiltshire	West Wiltshire	South West Wiltshire	Salisbury	Kennet	Swindon	South West	South	East	North	**Total**
North Wiltshire	1,415	680	126	14	7	166	1,613	1,345	35	327	171	**5,899**
North West Wiltshire	652	6,228	1,295	96	33	438	257	1,510	43	187	165	**10,903**
West Wiltshire	83	1,020	7,170	815	118	501	104	1,517	79	82	59	**11,548**
South West Wiltshire	15	77	720	2,605	203	99	22	674	54	30	19	**4,518**
Salisbury	17	60	172	393	11,826	523	44	1,468	1,800	163	57	**16,523**
Kennet	192	411	454	169	575	5,071	652	361	340	402	68	**8,696**
Swindon	1,890	377	109	12	24	809	25,984	1,797	132	1,546	462	**33,142**
South West	1,258	1,647	2,045	712	1,007	405	1,875	511,424	4,735	3,177	9,904	**538,190**
South	67	57	109	90	1,962	689	193	5,764	185,547	14,891	1,098	**210,466**
East	449	256	119	41	206	635	1,866	4,019	17,473	1,361,124	33,546	**1,419,734**
North	96	107	134	20	36	77	276	7,427	1,356	28,399	3,781,337	**3,819,264**
Total	**6,136**	**10,920**	**12,453**	**4,968**	**15,997**	**9,413**	**32,885**	**537,306**	**211,594**	**1,410,327**	**3,826,885**	**6,078,884**

7. Model validation results

7.1. Overview

In TAG Unit M3.1 **calibration** is defined as adjustments to the model intended to reduce the differences between the modelled and observed data. **Validation** is the process of demonstrating the quality of the model by comparing the model output with observed data, which should be independent of data used for model development.

This chapter outlines the outcomes from validation of traffic flows, journey times within the AoDM and the model stability. The aim is to demonstrate that the model adheres to the standards presented in Section 2.3.8. All assignment results presented use the post ME2 highway traffic demand matrices discussed in Section 6.

7.2. Traffic flow and routeing calibration and validation

The overall results of the screenline and cordon traffic flows and the individual link flow calibration and validation for total vehicles and light vehicles are shown in Table 7-1 and Table 7-2 respectively. The total flows (model vs observed) for each screenline and cordon are shown in Table 7-3 (note that the observed data is presented in Table 3-1). This information shows a very high level of model validation. It is to be noted that screenlines and cordons that are at near or fail are with low observed flow. The individual counts forming screenline and cordon are within the criteria.

A full set of data, for each of the 748 count sites within the AoDM is available from Atkins upon request. The wider level of validation within the South West region (outside the AoDM) is presented in Appendix C.

Table 7-1 - Traffic Flow Calibration & Validation Summary Post ME2, Total Vehicles

Measure	Cal or Val	No. Sites	Pass	Near	Fail
AM Peak Period					
Screenlines (Two Directions)	Calibration	22	91%	9%	0%
	Validation	6	50%	50%	0%
	Total	28	82%	18%	0%
Link flows	Calibration	569	89%	6%	5%
	Validation	181	78%	8%	14%
	Total	750	86%	7%	7%
IP					
Screenlines (Two Directions)	Calibration	22	95%	5%	0%
	Validation	6	83%	17%	0%
	Total	28	93%	7%	0%
Link flows	Calibration	569	93%	5%	3%
	Validation	177	81%	8%	11%
	Total	746	90%	6%	4%
PM Peak Period					
Screenlines (Two Directions)	Calibration	22	95%	5%	0%
	Validation	6	83%	17%	0%
	Total	28	93%	7%	0%
Link flows	Calibration	569	88%	7%	5%
	Validation	181	75%	9%	16%
	Total	750	85%	7%	8%

Table 7-2 - Traffic Flow Calibration & Validation Summary Post ME2, Cars and LGVs

Measure	Cal or Val	No. Sites	Pass	Near	Fail
AM Peak Period					
Screenlines (Two Directions)	Calibration	22	86%	14%	0%
	Validation	6	50%	50%	0%
	Total	28	79%	21%	0%
Link flows	Calibration	569	89%	6%	5%
	Validation	181	78%	8%	14%
	Total	750	87%	6%	7%
IP					
Screenlines (Two Directions)	Calibration	22	86%	14%	0%
	Validation	6	96%	4%	0%
	Total	28	86%	14%	0%
Link flows	Calibration	569	94%	4%	2%
	Validation	177	82%	7%	11%
	Total	746	91%	5%	4%
PM Peak Period					
Screenlines (Two Directions)	Calibration	22	95%	5%	0%
	Validation	6	83%	17%	0%
	Total	28	93%	7%	0%
Link flows	Calibration	569	88%	7%	5%
	Validation	181	74%	9%	17%
	Total	750	84%	8%	8%

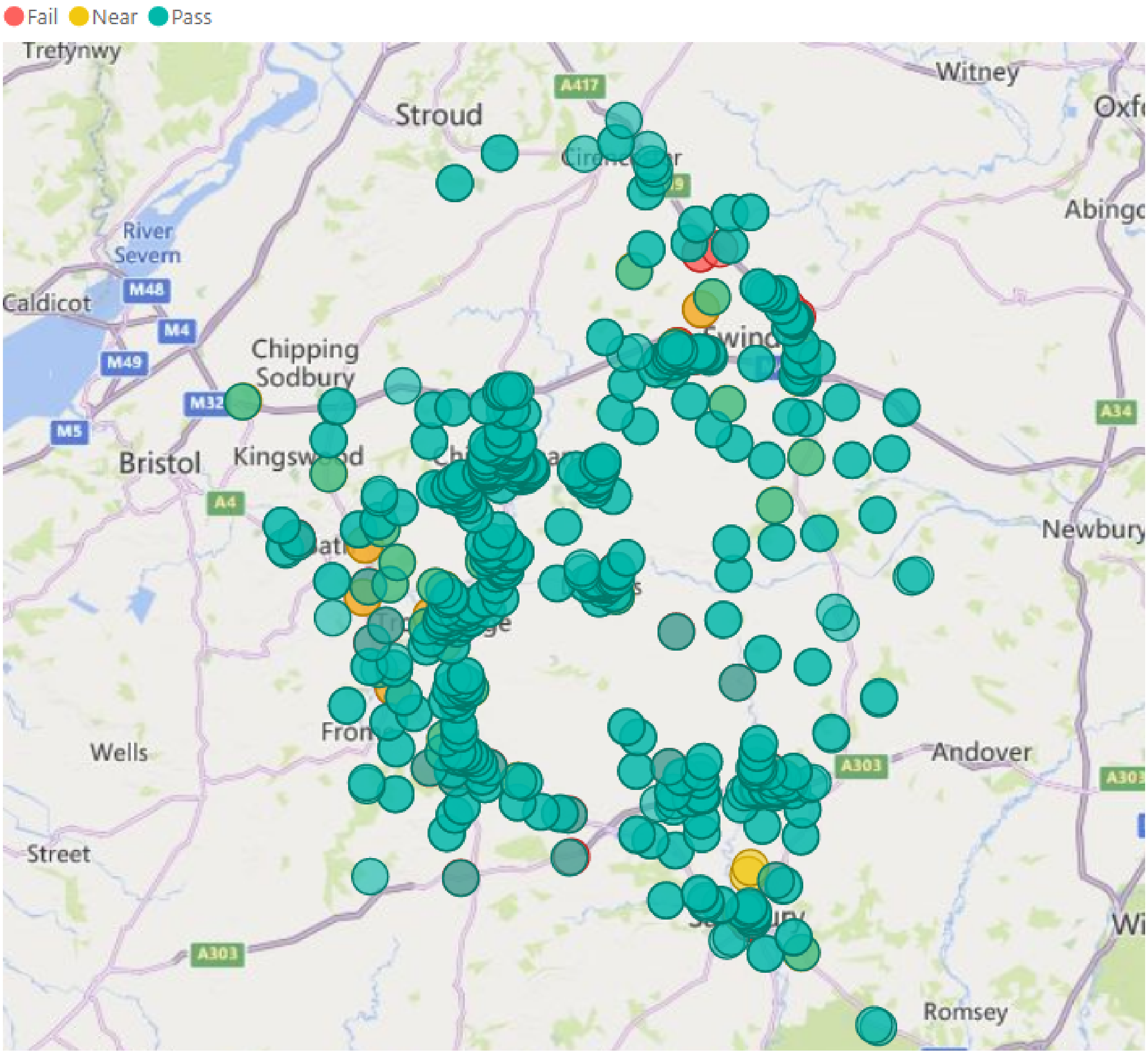
Table 7-3 - Cordon & Screenline Traffic Flow: Model vs Observed

Cordon/Screenline, Direction and Calibration/Validation				AM Peak Period			Inter Peak Peak			PM Peak Period		
				Observed	Modelled	Difference (%)	Observed	Modelled	Difference (%)	Observed	Modelled	Difference (%)
Cordon	Calne	In	C	1564	1567	0.2%	1425	1425	0.0%	2137	2163	1.2%
		Out	C	2128	2133	0.2%	1376	1384	0.6%	1664	1705	2.5%
	Chippenham	In	C	4787	4902	2.4%	3793	3847	1.4%	4703	4694	-0.2%
		Out	C	4494	4609	2.6%	3789	3940	4.0%	4761	4752	-0.2%
	Corsham	In	C	1564	1572	0.5%	1299	1293	-0.5%	1665	1662	-0.2%
		Out	C	1572	1595	1.5%	1332	1332	0.0%	1677	1667	-0.6%
	Devizes	In	C	2317	2336	0.8%	2066	2081	0.7%	2535	2535	0.0%
		Out	C	2366	2412	1.9%	2063	2069	0.3%	2317	2290	-1.2%
	Melksham	In	C	3896	4034	3.5%	3404	3516	3.3%	4580	4804	4.9%
		Out	C	4174	4360	4.5%	3322	3489	5.0%	4074	4254	4.4%
	Trowbridge	In	C	2925	2867	-2.0%	2921	2881	-1.4%	3820	3771	-1.3%
		Out	C	3292	3157	-4.1%	2992	3006	0.5%	3402	3405	0.1%
	Warminster	In	C	2936	2916	-0.7%	2693	2762	2.6%	3197	3315	3.7%
		Out	C	3014	3069	1.8%	2667	2666	0.0%	2964	2940	-0.8%
	Westbury	In	C	1910	1893	-0.9%	1793	1773	-1.1%	2365	2340	-1.1%
		Out	C	2281	2254	-1.2%	1743	1723	-1.1%	2061	2038	-1.1%
	RWB	In	C	2355	2284	-3.0%	2030	1993	-1.8%	2926	2842	-2.9%
		Out	C	2667	2583	-3.1%	1979	1953	-1.3%	2554	2502	-2.0%
Screenline	Sl1 North of Chippenham	NB	V	2230	2101	-5.8%	1638	1684	2.8%	2141	2221	3.7%
		SB	V	2130	2009	**-5.7%**	1601	1622	1.3%	2332	2391	2.5%
	Sl2 Swindon	In	C	2621	2400	-8.4%	1863	1817	-2.5%	2444	2631	7.7%
		Out	C	2370	2187	-7.7%	1829	1689	-7.7%	2684	2667	-0.6%
	Sl3 North of Melksham	NB	V	2728	2693	-1.3%	2053	2033	-1.0%	2371	2372	0.0%
		SB	V	2358	2148	-8.9%	2031	2022	-0.4%	2758	2730	-1.0%
	Sl4 West of Trowbridge	EB	C	3958	3831	-3.2%	3124	3051	-2.3%	4200	4125	-1.8%
		WB	C	3985	3827	-4.0%	3133	3116	-0.5%	3992	3911	-2.0%
	Sl5 South of Warminster & Sl6 East of Devizes	EB	V	2706	2790	3.1%	1794	1916	6.8%	1930	1870	-3.1%
		WB	V	1900	1932	1.7%	1886	1839	-2.5%	2646	2473	-6.5%

Observed data is presented in Table 3-1. All Traffic Flows are in Total Vehicles. C = Calibration, V = Validation

Figure 7-1 shows the locations of all calibration and validation count sites in the AoDM. Using plots like this it was possible to ensure that areas of key interest (such as Chippenham) obtained a high level of calibration/validation so that future models would not encounter significant issues.

Figure 7-1 - Post ME2 Trip Matrix Link calibration/validation sites, for all vehicles in the AM



7.3. Journey time validation

The purpose of journey time validation is to show that the model is correctly replicating journey times, or entire route costs on key routes through the AoDM. The model standards utilised are shown in Section 2.4.3. The 14 routes (28 two-way) identified are presented in Figure 3-4. A summary of the total modelled journey time is shown in Table 7-4. This shows that all routes are within the model standards and the route costs within the AoDM are assumed to be an accurate reflection of delays within the network. Distance-Time graphs for the A350 are presented in Appendix F. All other graphs are available from Atkins on request.

Table 7-4 - Journey Time Validation Summary (mins)

No.	Route	Dir	AM Peak Period			Inter Peak Peak			PM Peak Period		
			Observed	Modelled	% Difference	Observed	Modelled	% Difference	Observed	Modelled	% Difference
1A	Warminster to Melksham (A350	NB	28	27	5.3%	29	27	9.2%	27	27	0.7%
		SB	28	28	1.4%	28	28	1.1%	27	28	4.5%
1B	Melksham to Chippenham (A350)	NB	21	21	2.0%	20	20	2.0%	19	21	6.2%
		SB	21	21	0.9%	20	20	0.0%	20	21	4.0%
1C	Chippenham to Malmesbury (A350)	NB	13	14	7.7%	13	13	6.4%	12	14	11.6%
		SB	14	14	2.2%	13	13	3.1%	13	14	10.2%
2	Chippenham to Devizes (A432)	NB	35	36	1.4%	35	34	4.8%	38	40	6.4%
		SB	35	34	3.2%	35	33	6.5%	40	41	2.8%
3	Corsham to Calne (A4)	EB	36	38	5.8%	36	37	3.4%	34	31	8.6%
		WB	37	38	1.9%	37	36	2.4%	31	30	1.0%
4	A4 to A350 (A365)	EB	11	10	6.5%	11	10	7.4%	34	37	8.3%
		WB	11	11	2.7%	11	10	6.4%	34	37	9.7%
5A	Cricklade to Calne (A3102)	NB	22	21	4.5%	22	21	5.9%	7	7	9.2%
		SB	22	21	0.9%	22	21	2.8%	7	8	8.7%
5B	Calne to Melksham (A3102)	NB	31	30	3.9%	30	28	5.0%	14	15	5.1%
		SB	29	29	2.4%	29	28	4.1%	13	14	7.5%
6	A36 to Bradford-on-Avon via Trowbridge	EB	15	13	14.1%	15	13	12.2%	35	35	0.9%
		WB	16	14	9.7%	15	14	6.1%	33	34	2.1%
7	Trowbridge to Warminster (A361)	NB	26	25	2.3%	26	25	2.0%	34	38	12.0%
		SB	25	26	1.2%	25	25	1.2%	36	37	4.8%
8	Trowbridge to Devizes (A361)	EB	27	25	6.4%	26	25	3.1%	10	10	0.0%
		WB	24	24	0.4%	25	24	1.6%	11	10	2.8%
9	Westbury to A432 (B3098)	EB	26	26	1.1%	26	25	1.6%	22	21	1.9%
		WB	27	26	2.6%	26	26	0.4%	21	22	3.8%
10	Swindon to Devizes (A4361)	NB	40	40	1.5%	40	39	2.0%	28	29	2.1%
		SB	40	39	3.3%	41	39	5.6%	28	30	6.1%
11	Cricklade to B3098 (A419 / A346)	NB	33	30	8.8%	34	30	12.1%	15	13	10.9%
		SB	33	29	10.7%	32	29	9.2%	15	14	7.2%
12	J14 to J18 (M4)	EB	35	38	7.7%	35	36	5.2%	25	26	3.7%
		WB	34	36	5.6%	35	37	5.2%	25	25	0.0%
13	Swindon to RWB (A3102)	EB	8	7	6.4%	7	7	1.5%	25	26	2.0%
		WB	7	8	10.3%	7	7	9.0%	24	25	3.3%
14	Malmesbury to RWB (B4042)	EB	14	14	3.6%	14	14	2.9%	25	26	3.2%
		WB	14	15	5.7%	14	14	1.4%	25	26	5.6%

Journey Time route plots are shown in Figure 3-4. All route times are in minutes

7.4. Local calibration/validation in M4 J17

This section summarises localised calibration and validation statistics specific to M4 J17. Flow and journey time calibration and validation results have been provided for all modelled time periods.

7.4.1. Flow calibration / validation

A localised comparison of the screenlines, near to the scheme, is presented below in Table 7-5. This shows a good level of correlation between modelled and observed data on the local highway network, demonstrating that the base assignments are considered suitable for assessing the M4 J17 scheme.

Table 7-5 - Cordon & Screenline Traffic Flow: Model vs Observed

Cordon/Screenline, Direction and Calibration/Validation			AM Peak Period			Inter Peak Peak			PM Peak Period		
			Observed	Modelled	Difference (%)	Observed	Modelled	Difference (%)	Observed	Modelled	Difference (%)
Cordon	Chippenham	In	4787	4902	2.4%	3793	3847	1.4%	4703	4694	-0.2%
		Out	4494	4609	2.6%	3789	3940	4.0%	4761	4752	-0.2%
	Melksham	In	3896	4034	3.5%	3404	3516	3.3%	4580	4804	4.9%
		Out	4174	4360	4.5%	3322	3489	5.0%	4074	4254	4.4%
Screenline	Sl1 North of Chippenham	NB	2230	2101	-5.8%	1638	1684	2.8%	2141	2221	3.7%
		SB	2130	2009	-5.7%	1601	1622	1.3%	2332	2391	2.5%
	Sl3 North of Melksham	NB	2728	2693	-1.3%	2053	2033	-1.0%	2371	2372	0.0%
		SB	2358	2148	-8.9%	2031	2022	-0.4%	2758	2730	-1.0%

All Traffic Flows are in Total Vehicles.

Table 7-6 shows how observed counts in and around M4 J17 correlate with modelled data, whilst Figure 7-2 provides a geographical reference. This shows that there is very good correlation between modelled and observed data within proximity of the proposed M4 J17 scheme.

Figure 7-2 - Individual Link Count Location

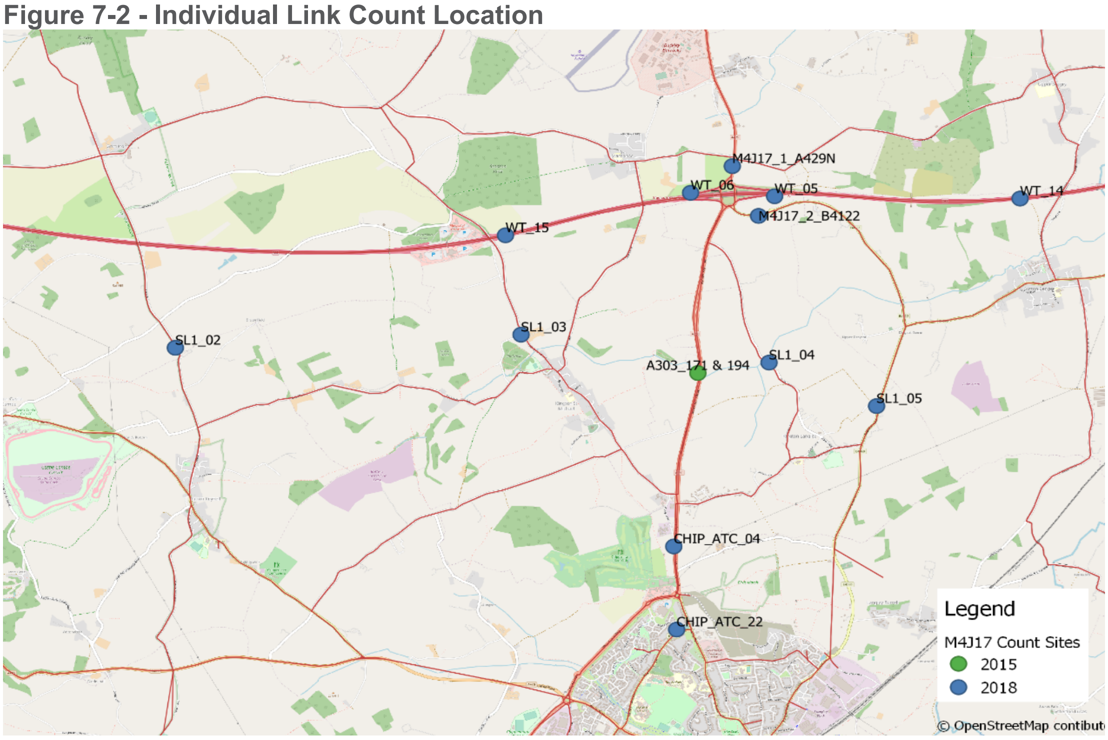


Table 7-6 - TAG compliance – individual link counts

SiteID	Site Description	Dir	Cali/ Vali	AM					IP					PM				
				Obs.	Mod.	Diff	GEH	TAG?	Obs	Mod	Diff	GEH	TAG?	Obs	Mod	Diff	GEH	TAG?
A303_171	M4 J17 South (A350)	SB	C	1127	1129	2	0.1	Pass	893	921	28	0.9	Pass	1367	1346	21	0.6	Pass
A303_194	M4 J17 South (A350)	NB	C	1322	1296	26	0.7	Pass	926	925	1	0	Pass	1146	1120	26	0.8	Pass
CHIP_ATC_04	Chippenham North (A350)	NB	C	1478	1498	20	0.5	Pass	1100	1109	9	0.3	Pass	1340	1346	6	0.2	Pass
CHIP_ATC_04	Chippenham North (A350)	SB	C	1355	1296	59	1.6	Pass	1083	1061	22	0.7	Pass	1555	1491	64	1.6	Pass
CHIP_ATC_22	Hardenhuish Lane (B4158)	EB	C	332	316	16	0.9	Pass	219	204	15	1	Pass	278	200	78	5	Pass
CHIP_ATC_22	Hardenhuish Lane (B4158)	WB	C	305	297	8	0.5	Pass	224	223	1	0.1	Pass	391	387	4	0.2	Pass
SL1_01	B4039 (Castle Combe)	NB	V	113	102	11	1.1	Pass	102	112	10	1	Pass	163	140	23	1.9	Pass
SL1_01	B4039 (Castle Combe)	SB	V	155	192	37	2.8	Pass	99	91	8	0.8	Pass	142	117	25	2.2	Pass
SL1_02	The Street (Yatton Keynell)	NB	V	79	18	61	8.8	Pass	56	13	43	7.3	Pass	83	15	68	9.7	Pass
SL1_02	The Street (Yatton Keynell)	SB	V	85	14	71	10.1	Pass	56	12	44	7.5	Pass	74	22	52	7.5	Pass
SL1_03	Honey Knob Hill (Kington Saint Michael)	NB	V	33	29	4	0.7	Pass	21	27	6	1.2	Pass	24	37	13	2.4	Pass
SL1_03		SB	V	28	40	12	2.1	Pass	23	24	1	0.2	Pass	34	27	7	1.3	Pass
SL1_04	Day's Lane (nr. A350)	NB	V	2	0	2	2	Pass	2	0	2	2	Pass	2	0	2	2	Pass
SL1_04	Day's Lane (nr. A350)	SB	V	2	33	31	7.4	Pass	4	21	17	4.8	Pass	5	30	25	6	Pass
SL1_05	B4069 Swindon Road	NB	V	307	272	35	2.1	Pass	237	277	40	2.5	Pass	341	352	11	0.6	Pass
SL1_05	B4069 Swindon Road	SB	V	374	381	7	0.4	Pass	237	233	4	0.3	Pass	282	218	64	4	Pass
WT_05	M4/3526M	EB	C	800	764	36	1.3	Pass	462	438	24	1.1	Pass	607	574	33	1.4	Pass
WT_05	M4/3526J	WB	C	586	568	18	0.7	Pass	459	446	13	0.6	Pass	748	717	31	1.1	Pass
WT_06	M4/3533L	EB	C	710	718	8	0.3	Pass	445	453	8	0.4	Pass	712	658	54	2.1	Pass
WT_06	M4/3535K	WB	C	737	700	37	1.4	Pass	492	454	38	1.7	Pass	676	652	24	0.9	Pass
WT_14	M4/3522B	EB	C	3394	3291	103	1.8	Pass	2763	2669	94	1.8	Pass	2897	2899	2	0	Pass
WT_14	M4/3521A	WB	C	2499	2433	66	1.3	Pass	2764	2756	8	0.2	Pass	3557	3388	169	2.9	Pass
WT_15	M4/3536A	EB	C	3243	3245	2	0	Pass	2689	2684	5	0.1	Pass	2950	2983	33	0.6	Pass
WT_15	M4/3537B	WB	C	2469	2565	96	1.9	Pass	2637	2763	126	2.4	Pass	3283	3323	40	0.7	Pass

SiteID	Site Description	Dir	Cali/ Vali	AM					IP					PM				
				Obs.	Mod.	Diff	GEH	TAG?	Obs	Mod	Diff	GEH	TAG?	Obs	Mod	Diff	GEH	TAG?
M4J17_1	A429_N	NB	V	943	873	70	2.3	Pass	-	-	-	-	-	772	728	44	1.6	Pass
M4J17_1	A429_N	SB	V	718	820	102	3.7	Pass	-	-	-	-	-	832	831	1	0	Pass
M4J17_2	B4122	EB	V	522	220	302	15.7	Fail	-	-	-	-	-	580	155	425	22.2	Fail
M4J17_2	B4122	WB	V	362	125	237	15.2	Fail	-	-	-	-	-	289	152	87	6.2	Pass

7.4.2. Journey time validation

As previously shown in Table 7-4, all journey time routes meet TAG criteria across all modelled time periods. This section provides further details of the A350 journey time route between Malmesbury and Chippenham (Figure 7-3).

Figure 7-4 to Figure 7-7 compare modelled journey times against observed data on the A350 in the morning and evening peaks. Equivalent journey time profiles for the IP are provided in Appendix G. These profiles show that the model journey times correlate well with observed data across the entirety of the A350 route, in both directions and all time periods.

Figure 7-3 - A350 (1C) timing point locations

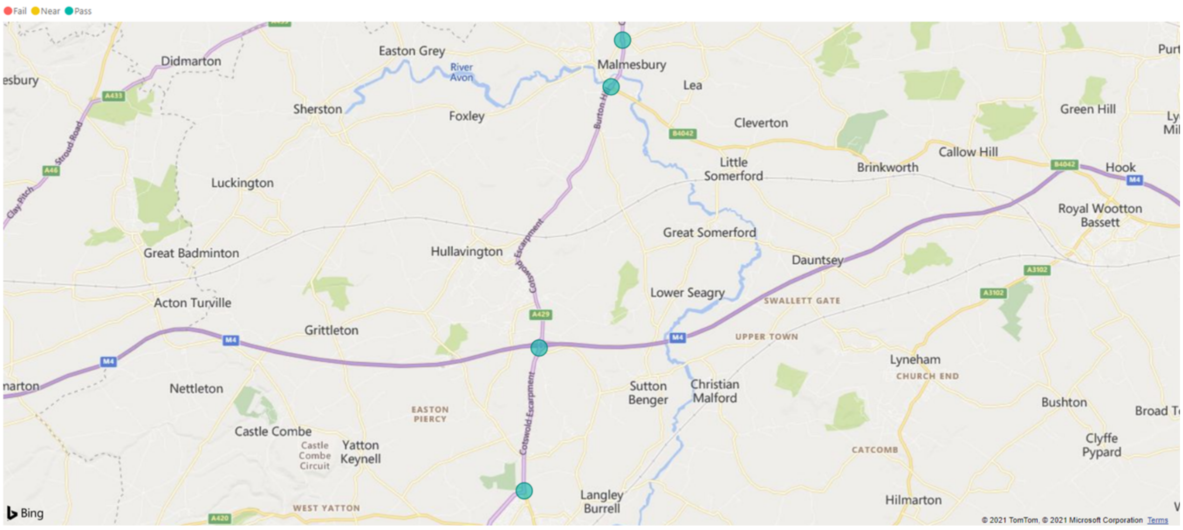


Figure 7-4 - Route 1C A350: AM Northbound

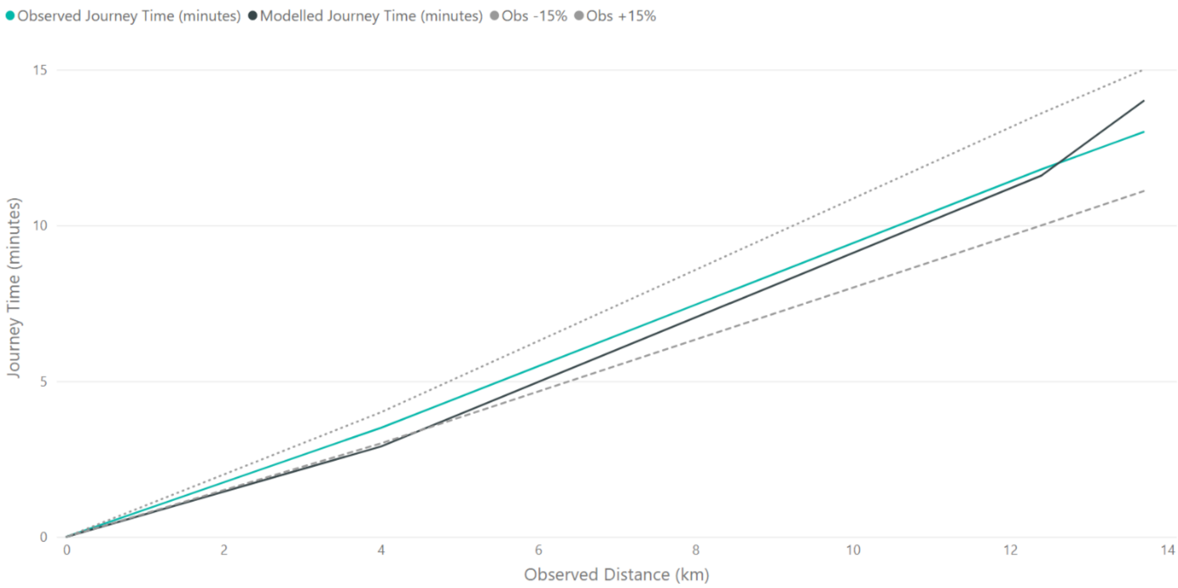


Figure 7-5 - Route 1C A350: AM Southbound

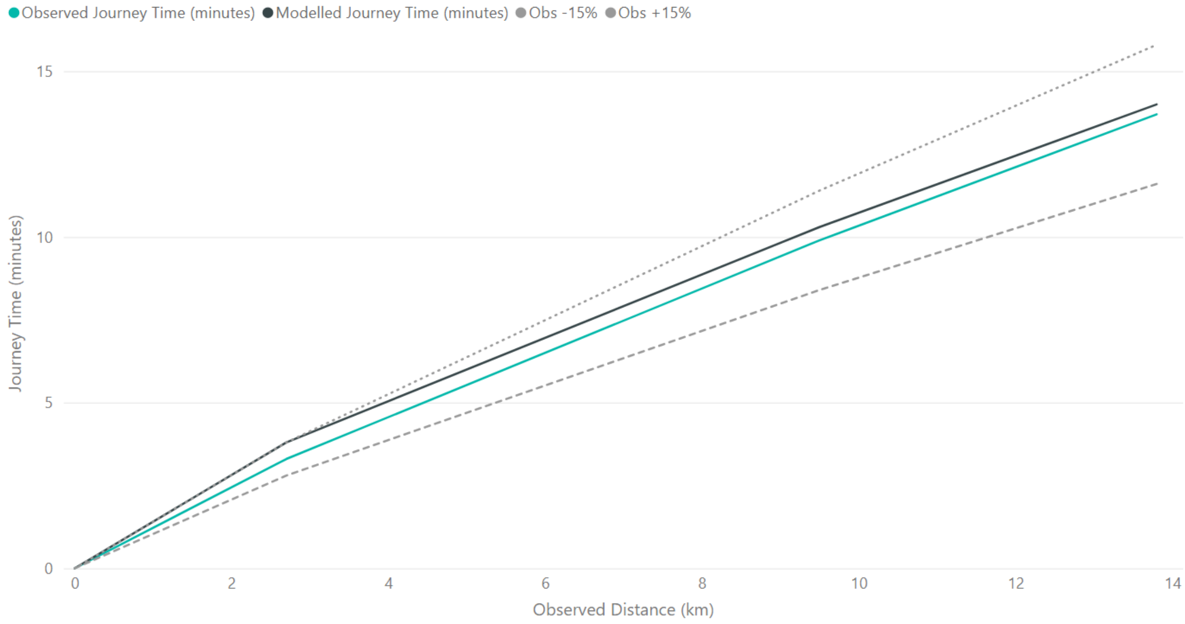


Figure 7-6 - Route 1C A350: PM Northbound

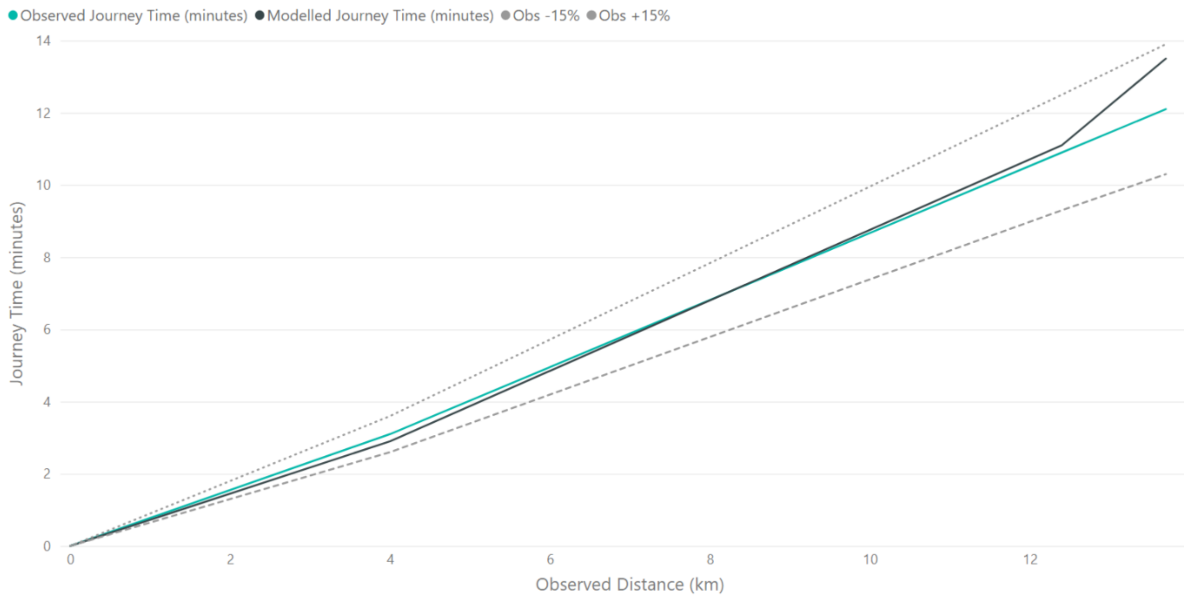
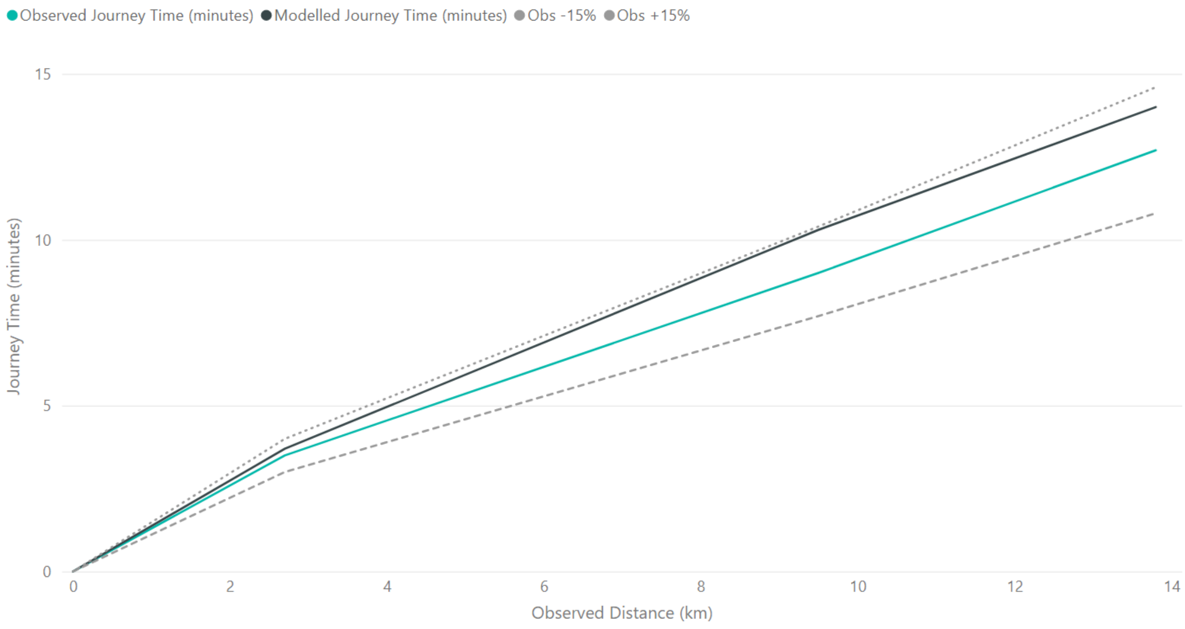


Figure 7-7 - Route 1C A350: PM Southbound



7.5. Route Choice Validation

The validity of route choice has also been checked in the model by examining modelled routes between selected origins and destinations. The movements considered, in both directions and at each time period, were between:

- Chippenham and Swindon;
- Amesbury and Chippenham;
- Bath and Chippenham
- Devizes and Chippenham;
- Swindon and Warminster;

Model diagrams with journey planners (Google maps) for these routes are displayed in 9.3.3.Appendix H. Routes were examined for User Class 1 (Car – Business)

Overall, the routes taken in the model and the journey planners (Google Map routes by time period) match for the above routes. It is considered that confidence can be had in the ability of the West Wiltshire Model to replicate the route choices of drivers in the model study area.

7.6. Assignment convergence stability

The level of stability and convergence achieved, as required within the model standards (see Section 2.4.5) are presented in Table 7-7. The results indicate that the model achieves a good level of convergence that complies with recommended criteria.

Table 7-7 - Assignment Convergence Statistics

AM Peak			Inter Peak			PM Peak		
Loop	% Flows	%GAP	Loop	% Flows	%GAP	Loop	% Flows	%GAP
12	98.6	0.0035	11	98.3	0.0045	11	98.2	0.0058
13	98.9	0.0044	12	98.9	0.0027	12	98.5	0.0032
14	99.2	0.0031	13	98.9	0.0022	13	98.5	0.0029
15	99.5	0.0018	14	99.2	0.0015	14	99.0	0.0022

8. Variable demand modelling

8.1. Overview of VDM

To support funding of a major infrastructure scheme from the DfT (defined as in excess of £5 million capital costs) which requires a full business case, it is a TAG (Unit M2) requirement to develop a Variable Demand Model (VDM)

Any change to (forecast) transport conditions will, in principle, cause a change in demand. The purpose of variable demand modelling is to predict and quantify these changes. Therefore, a road traffic forecast would be expected to include estimated changes in reference case **demand** (i.e. demographic change in travel demand prior to changes in costs) and any changes to the highway network **supply** which may alter the capacity and affect journey times and costs. This can lead to car tip redistribution, trip generation, modal switch and changes in macro time period choice which need to be calculated outside the highway assignment (SATURN) model.

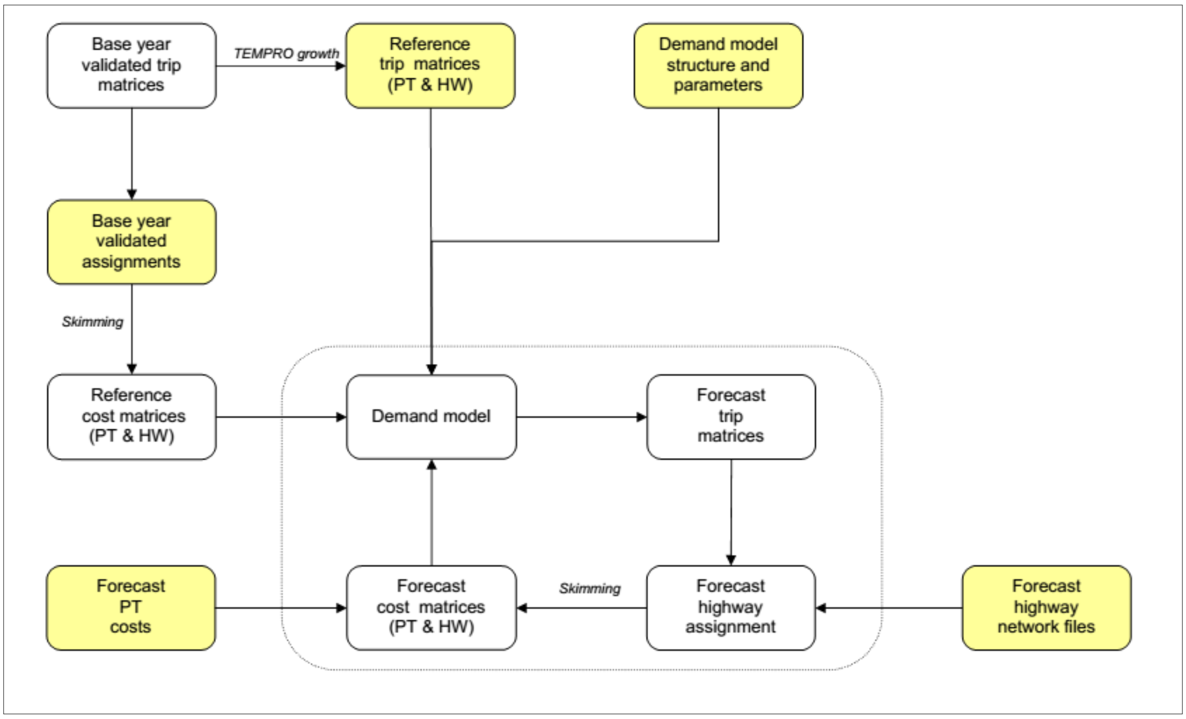
The VDM structure (24-hour incremental PA VDM, with macro time period, public transport and trip redistribution choice) and main parameters and inputs of the Wiltshire VDM are essentially consistent with the A303 Stonehenge and SWRTM VDM see associated reports for details. Any changes to the VDM are detailed later but a short summary of the main features is described below.

The output from the VDM runs are used to calculate incremental changes between the base year and the forecast year, which are then applied to the validated base year 'assignment' matrices. This approach is shown in Figure 8-1. The methodology is consistent with Appendix B of TAG Unit M2.

Incremental models rely more on observed origin-destination data, and less on the mathematical specification of the model than absolute models. Consequently, the DfT has a long-established preference for the use of incremental rather than absolute demand models, as outlined in TAG Unit M2. Therefore, an incremental VDM Model has been applied which updates the validated base year trip matrices and costs for forecast year scenarios.

The VDM modelling process uses trip demand matrices in production/attraction (PA) format, rather than origin-destination (OD) format for home-based trips as required in the traffic assignments. This is to retain the linkage between outbound and return trips. This approach allows the model to consider both legs of a home-based journey when modelling a change in travel pattern as a result of the VDM responses, which ensures the consistency of the change between the outbound and return journeys.

Figure 8-1 - Application of Incremental VDM (pivoting off the base demand)



The application of VDM requires that a supply model represents the whole route costs as well as wide area reassignments, both of which are provided by the highway base model. The model suite includes a VDM utilising DIADEM (Dynamic integrated Assignment and Demand Model, v6.3.3) which enables a link between the Highway Assignment Model (SATURN) and the VDM. DIADEM also provides a means of achieving convergence between demand and supply models.

The **mode choice** between car and public transport (in this case only rail) is considered in the DIADEM model through modelling the Car Available (CA) portion of public transport demand. The impact on Non-Car Available (non-CA) demand would be through indirect mechanisms such as crowding on public transport services or changes in highway delay. Changes in the demand patterns of non-CA trips would not result in changes to highway demand. Therefore, these would not directly affect the design or assessment of the various highway scheme the region. Consequently, the non-CA trips are not modelled in SWRTM. Data on rail services including routes, frequencies and fare information were taken from skims derived from the public transport component of the SWRTM.

The VDM models use a hierarchical logit formulation, in which the choice between travel alternatives (mode choice, macro time period choice and destination choice) depends upon an exponential function of the generalised cost or disutility. The appropriate hierarchy or sequence of choice mechanisms must be determined by the relative sensitivities (the lambdas of a logit model) of the choices to the generalised costs or dis-utilities of travel.

The demand segmentation, matrix type and choice response mechanisms and structure are shown in Table 8-1.

Table 8-1 - Demand Model Responses in DIADEM

Demand Segment	Tour and purpose	Main Mode Choice	Macro Time Period Choice	Trip Distribution Constraint
1. HBW	Incremental PA	Car / Rail	24 Hr	Doubly
2. HBEB				Singly
3. HBO				
4. NHBEB	Incremental OD		Fixed - Peak Period only	
5. NHBO				
6. Fixed W	Ports / Airports / Other	Fixed		-
7. Fixed EB				-
8. Fixed O				-
9. LGV	-			-
10. HGV	-			-

HB = Home Based, NHB = Non-Home Based; W = Work (Commute), EB = Employers Business, O = Other, LGV = Light Goods Vehicle, HGV = Heavy Goods Vehicle; PA = Production/Attraction, OD = Origin/Destination

24 hour car and rail PA demand is derived from SWRTM matrices which were developed using MPD and other sources, Active and sub-mode choice (i.e. walk, cycle, bus, light rail, P&R) is not included, hence trip frequency is not included.

Peak spreading / micro time period choice, whilst considered 2nd only to route choice in the model hierarchy is not included as the current implementation of HADES in DIADEM is only available in an absolute demand model.

8.2. Realism testing

Realism testing is used to ensure that the model responds to changes in travel costs rationally, behaves realistically and with acceptable elasticities. This involves changing various components of travel costs to check whether the response of the VDM is consistent with general experience. Part of the calibration process involves adjusting the parameters in the VDM model until more acceptable results are obtained from such realism tests.

This section summarises the realism tests for car fuel cost elasticity, car journey time elasticity and Public Transport (PT) fare elasticity, as specified in TAG unit M2.1. It should be noted that, in accordance with TAG advice, output elasticities are based on trips within the internal simulated area.

The VDM realism tests have produced elasticities which are broadly in-line with general expectations and experience. Therefore, the VDM model is considered suitable for preparing forecasts to use in the appraisal of schemes.

8.2.1. Cost damping

There is strong empirical evidence that the sensitivity of demand responses to changes in generalised cost reduces with increasing trip length. DfT research has demonstrated that for all trip purposes there is a relationship between travel distance and the value of travel time savings. The evidence indicates that travellers' sensitivity to cost declines more rapidly with distance than their sensitivity to time. The mechanism within the transport model by which this is achieved is referred to as 'cost damping' and would generally be expected to be incorporated into VDM. As consistent with the A303 Stonehenge/SWRTM, a distance-based deterrence function was used.

8.2.2. Car fuel cost output elasticities

Car fuel elasticities are calculated using a matrix-based approach (note that network-based outputs are similar). The calculations are carried out for a 10% fuel cost increase. The model standards utilised are presented in section 2.4.6. These tests started with the logit parameters (i.e. the spread, sensitivity or scaling parameters - lamda and theta) which were based on median values in TAG Unit M2, section 5.6 and without cost damping.

The results of the realism testing are presented in Table 8-2. This shows the tests and changes required to ensure some plausible elasticities.

The A303 Stonehenge model (which was consistent with SWRTM) car fuel elasticity was 0.37. It is stated in the A303 Stonehenge LMVR that this was deemed acceptable for the SWRTM model by the Highways England Technical Consistency Group. No further calibration of the A303 Stonehenge VDM model was therefore considered necessary to alter this value.

For the Wiltshire model, calibration of the VDM was undertaken to improve upon the realistic demand response of the model.

The initial (1st) Wiltshire realism test showed an increased model sensitivity (-0.73). This was due to the absence of cost damping, which was included with the A303 Stonehenge model.

The 2nd realism test introduces cost damping consistent with A303 Stonehenge model (i.e. K = 30, α = 0.5 for each purpose). This resulted in an overall elasticity value which was less sensitive than the A303 Stonehenge model (-0.3). The change is predicted to be due to the different Transport Analysis Guidance (TAG) databook values used and the refinements within the Wiltshire region.

The final test, with parameter values utilised presented in the table, shows that the level of output elasticity is within the recommended values within TAG.

Table 8-2 - Realism Tests: Logit Parameters, cost damping and car fuel cost output elasticities

No.	Test	Logit Parameters	Cost Damping	EB	Work	Other	Total
-	A303 Stonehenge	λ, θ Median	K=30, α=0.5	-0.21	-0.19	-0.54	-0.37
Final	Wiltshire Model	λ, θ Median	EB-K=20, α = 0.5 W-K =1, α =0.5 O-K= 30, α =0.5	-0.16	-0.25	-0.43	-0.32
1	M4 J17 OBC	λ, θ Median	EB-K=20, α = 0.5 W-K =1, α =0.5 O-K= 30, α =0.5	-0.19	-0.29	-0.46	-0.36
2		λ, θ Max	EB-K=20, α = 0.5 W-K =1, α =0.5 O-K= 30, α =0.5	-0.25	-0.45	-0.75	-0.56
3 (Final)		λ, θ Minimum	EB-K=20, α = 0.5 W-K =1, α =0.5 O-K= 30, α =0.5	-0.13	-0.25	-0.40	-0.30

The A303 Stonehenge model used TAG databook July 2016 v1.6 values, The Wiltshire model utilised May 2018 v1.10; The M4 J17 model used July 2020 TAG databook.

All Elasticities are presented for a 24 Hour Total, based on Distance Matrix skims (Note that elasticities calculated using network statistics show similar results but with marginally reduced sensitivity);

Median Parameter values for λ, θ are derived from TAG Unit M2;

K = Av dist (km) is derived from the validated base model

Table 8-3 - Realism Tests: Car fuel cost output elasticities by time period

Time Period	EB	Work	Other	Total
AM	-0.12	-0.22	-0.40	-0.27
IP	-0.13	-0.30	-0.41	-0.35
PM	-0.10	-0.25	-0.36	-0.28
OP	-0.27	-0.32	-0.47	-0.41
24-hour	-0.13	-0.25	-0.40	-0.30

8.2.3. Car journey time elasticities

Car journey time elasticities were derived from the car fuel cost elasticities, as specified in 2.4.6. Table 8-4 presents car journey time elasticity values calculated for each car purpose by time period. As specified in TAG unit M2.1, car journey time elasticity values are shown to be no stronger than -2.0.

Table 8-4 - Realism Tests: car journey time output elasticities by time period

Time Period	EB	Work	Other
AM	-0.23	-0.66	-0.89
IP	-0.24	-0.84	-0.85
PM	-0.20	-0.73	-0.76
OP	-0.49	-0.86	-0.93
24-hour	-0.14	-0.26	-0.41

8.2.4. PT fare elasticities

As recommended in TAG unit M2.1, PT fare elasticity values have been calculated by implementing a 10% fare increase. The updated PT cost files were input in to the Wiltshire Transport Model base year VDM.

PT fare elasticities are expected to lie in the range of -0.2 to -0.9 at a total trip level (all purpose). Table 8-5 shows that the elasticity value for all purpose trips achieves the TAG criteria (-0.39). The values provided for all other purposes (business, commuting and other) are also shown fall within the TAG criteria.

Table 8-5 - Realism Tests: 24-hour PT fare elasticity by purpose

Purpose	Elasticity
Business	-0.23
Commuting	-0.26
Others	-0.63
All Purpose	-0.39

8.2.5. VDM convergence

It important that the VDM converges to a satisfactory degree in order to have confidence that the model results are as free from error and noise as possible. In line with TAG guidance, target %GAP values of 0.1% for the full model area and 0.2% for the subset area have been achieved (Table 8-6).

Table 8-6 - Convergence Statistics for Realism Test

No	Final Loop	% GAP Full Model Area	%GAP Subset Area
1	6	0.07	0.20
2	7	0.06	0.17
3	6	0.06	0.11

9. Summary

9.1. Overview

The cordon/screenline, link flow and journey time comparisons reported (Section 7), the VDM set-up and realism testing (Section 8) and the consistency of the model to retain the validation across the wider region (see Appendix C) demonstrate that the development work carried out for the Wiltshire 2018 base model has significantly improved the existing model within the AoDM (see Section 4.1) without compromising the wider integrity of the validated A303 Stonehenge / SWRTM models.

The results demonstrate that the traffic model has achieved the objectives discussed in Section 2.1 and is suitable, within the requirements of TAG, to be used to support the strategic appraisal of an infrastructure project or planning decision which is required to understand the impact on local roads or the SRN within Wiltshire and the AoDM.

The model is considered a suitable basis for generating highway traffic forecasts, consistent with DfT guidance and hence strategic assessment of highway mitigation measures and land developments.

9.2. Limitations of the model

This section describes the known model limitations. The recommended appropriate usage, in response to these limitations, is described in the next section.

9.2.1. Intervention limitations

The model has been developed to assess strategic highway schemes. it has not been specifically developed to analyse and assess the following types of transport schemes and improvements:

- Pedestrian/Cycle Improvements e.g. localised carriage widening, minor improvements to traffic signal operation, standalone pedestrian crossing, cycle improvements etc.
- Certain types of infrastructure schemes e.g. linked or vehicle actuated (MOVA) traffic signal improvements, shared space or other more complex infrastructure
- Public Transport (PT) schemes e.g. Bus, Rail, LRT or metrobus schemes
    - As the model is consistent with the RTM it doesn’t include a full PT assignment element, it does include an estimation of rail demand, but this is not a fully responsive element within the modelling set.
- Parking schemes e.g. changes to parking strategy or Park & Ride sites

In light of these limitations, Atkins recommend the following appropriate usage guidance.

9.3. Appropriate usage

It is recommended that the model could be used to assess schemes or developments of an “appropriate” scale or type. This “appropriateness” is difficult to quantify precisely, and it is expected that any scheme or development should be assessed based on a **proportionate** approach and the limitations of this (and any alternate) model need to be clearly communicated, through collaboration and discussion with decision makers or stakeholders. It is recommended that any decision maker, or user, seek Atkins’ advice on how to effectively utilise the Wiltshire strategic model. The following considerations are recommended to assist in the decision-making process.

9.3.1. Geographic area

The model has been developed to strategically assess the highway impact across the AoDM.

For a scheme or development assessment within the Swindon urban area, Atkins recommend usage of the Swindon model to understand the impact within this region. For a scheme or development which lies outside of the Wiltshire boundary, Atkins recommend engagement with Highways England or the appropriate Highway Authority to determine the most appropriate model or assessment tool depending on the nature and location of the assessment.

For schemes within the Wiltshire Authority boundary the Wiltshire strategic model is considered the most appropriate initial tool, unless a more detailed model is already available.

For testing of junctions which are expected to be have an impact within Wiltshire only, the peak hour model is most appropriate. For wider impact assessment and schemes which require economic or environmental appraisal the peak period model is assumed to be the default version to utilise.

9.3.2. Scheme type

For a highway scheme of appropriate scale and type, the Wiltshire model is considered suitable for initial assessment. If the intervention to be assessed is of a type which the model has known limitations (such as: Pedestrian/Cycle Improvements, PT & Parking schemes) Atkins are able to provide advice on how to estimate/quantify the likely modal shift from vehicle trips or trip redistribution as a result of these types of intervention and calculate possible highway benefit and operational impact using the Wiltshire strategic model.

9.3.3. Donor model

The Wiltshire model is able to provide a strategic forecast and assessment of a highway intervention. For an analysis and assessment of local impacts, Atkins recommend that the strategic model act as a donor for a localised application. This may include developing, using the strategic model as an input (one, or more of) the following:

- A highway cordon of the SATURN model
- Use of bespoke local junction software e.g. LINSIG, ARCADY
- Development of a micro-simulation model (Paramics, VISSIM)

Depending on the purpose, nature and scale of the scheme or development to be assessed, Atkins advise that the strategic model is used in conjunction with local cordoned refinements or other software applications in order to meet the objectives of the assessment. It would be necessary to define an appropriate area of influence (which the strategic model could provide) with potential for localised recalibration and possible adjustments to reflect peak hour demand.

Appendices

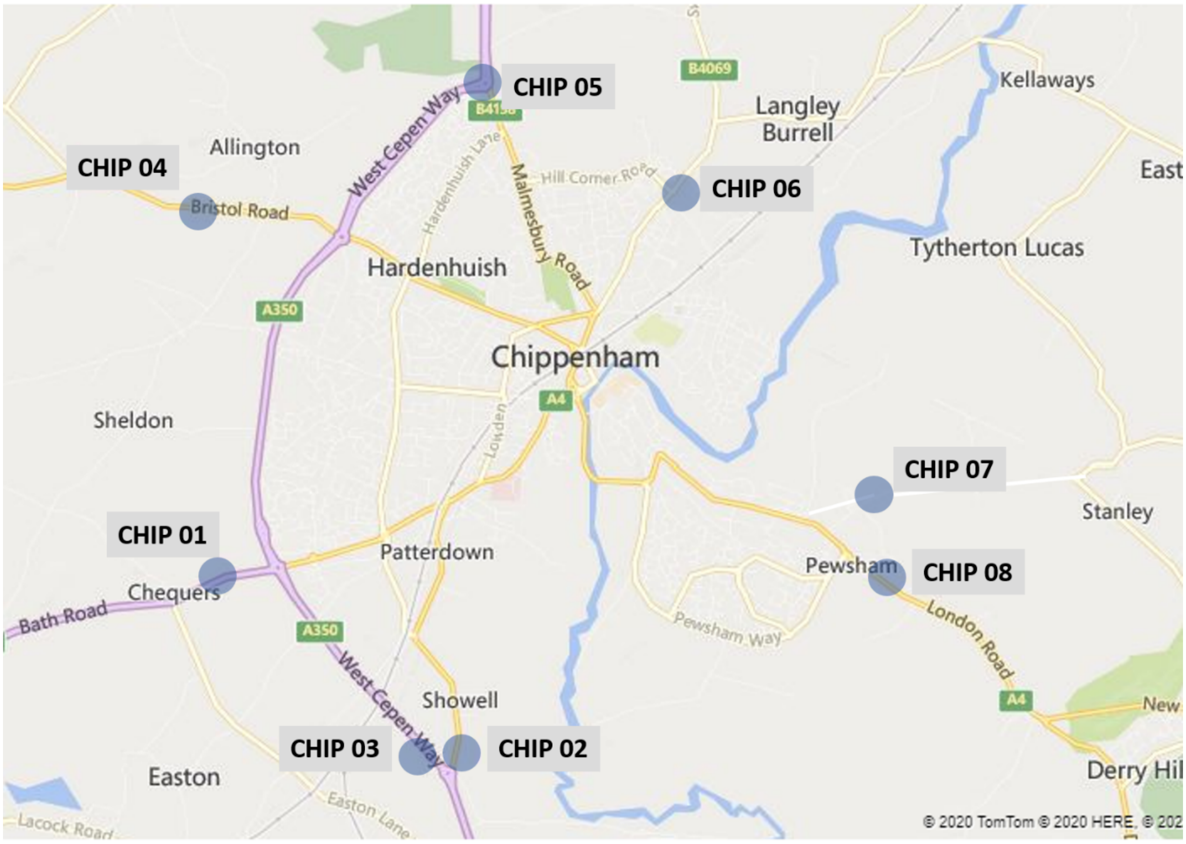
Appendix A. Abbreviations

AADT	Annual Average Daily Traffic	NTS	National Travel Survey
AAWT	Annual Average Weekday Traffic	OD	Origin-Destination
AM	Morning peak period	OGV1	Goods Vehicle – 2 or 3 axle rigid
ANPR	Automatic Number Plate Recognition	OGV2	Goods Vehicle – 4 axle rigid or 3+ axle articulated
AoDM	Area of Detailed Modelling	ONS	Office for National Statistics
ARN	Affected Road Network	OP	Off-peak period
ASR	Appraisal Specification Report	PA	Production-Attraction
ATC	Automatic Traffic Count	PCF	Project Control Framework
COBA	Cost Benefit Appraisal (software)	PCU	Passenger Car Unit
DF2	Design Fix 2 (Version No. of the Base SWRTM)	PM	Evening peak period
DfT	Department for Transport	PPK	Pence per kilometre
DM	Do Minimum	PPM	Pence per minute
DMRB	Design Manual for Roads and Bridges	RIS	Road Investment Strategy
DS	Do Something	RoF	Region of Focus (of the model)
EB	Eastbound	RSI	Roadside Interview
EB	Employer's Business	RTM	Regional Traffic Model
FMA	Fully Modelled Area	SB	Southbound
GEH	Statistic used to assess the quality of model validation	S2	Single two-lane carriageway
HBEB	Home Based Employer's Business	SATURN	Simulation and Assignment of Traffic to Urban Road Networks
HBO	Home Based Other	SOBC	Strategic Outline Business Case
HBW	Home Based Work	SRN	Strategic Road Network
HGV	Heavy Goods Vehicle	SWRTM	South West Regional Traffic Model
HOV	High Occupancy Vehicle	TAG	Traffic Appraisal Guidance
IAN	Interim Advice Note	TAME	Traffic Appraisal, Modelling and Economics
IP	Inter-peak period	TCG	Technical Consistency Group
Kph	kilometres per hour	TDCR	Traffic Data Collection Report
LGV	Light Goods Vehicle	TEMPro	Trip End Model Presentation Program
LMVR	Local Model Validation Report	TIS	Trip Information System
LSOA	Lower Layer Super Output Area	TRL	Transport Research Laboratory
MCC	Manual Classified Count	VDM	Variable Demand Model
MCTC	Manual Classified Turning Count	VOC	Vehicle Operating Cost
ME	Matrix Estimation	VoT	Value of Time
ME2	Matrix Estimation from Maximum Entropy	vph	Vehicles per hour
MPD	Mobile Phone Data	WB	Westbound
MSOA	Middle Layer Super Output Area	WebTAG	Web-based Transport Appraisal Guidance
MVR	Model Validation Report	WebTRIS	Highways England Traffic Information System
NB	Northbound		
NHBEB	Non-Home Based Employer's Business		
NHBO	Non-Home Based Other		
NTEM	National Trip End Model		

Appendix B. ANPR & ATC data cordons

The sections B.1 to B.9 are the analysis of the ANPR surveys conducted and Section B10 shows the period wise validation

B.1. Chippenham



Chippenham – ANPR Cordon

AM Peak	Bath Rd West	B4528 South	A350 South	Bristol Rd West	A350 North	B4069 NE	East	London Rd East	Chippenham	ATC
Bath Rd West	22	4	14	12	207	5	3	39	365	670
B4528 South	6	16	2	5	14	15	4	11	317	390
A350 South	11	1	3	34	282	1	0	1	181	513
Bristol Rd West	9	6	27	27	79	5	2	46	321	522
A350 North	151	29	213	82	52	6	1	95	728	1356
B4069 NE	9	26	1	9	7	26	1	17	234	330
East	7	4	0	2	1	1	20	25	49	109
London Rd East	50	13	2	43	94	13	28	70	463	774
Chippenham	363	277	85	300	742	212	79	470		2528
ATC	627	376	347	513	1478	284	137	773	2658	7193
Inter Peak	Bath Rd West	B4528 South	A350 South	Bristol Rd West	A350 North	B4069 NE	East	London Rd East	Chippenham	ATC
Bath Rd West	37	7	12	15	121	4	1	36	343	575
B4528 South	6	17	2	4	10	12	1	13	247	312
A350 South	18	2	9	32	215	2	0	2	118	399
Bristol Rd West	10	5	30	36	89	6	1	32	277	487
A350 North	120	20	201	65	58	5	1	75	538	1085
B4069 NE	7	11	1	4	5	18	1	13	166	225
East	4	1	0	2	2	1	10	12	42	75
London Rd East	38	11	4	40	76	8	11	44	381	613
Chippenham	328	248	134	276	522	165	36	387		2096
ATC	569	322	394	473	1100	222	63	613	2112	5867
PM Peak	Bath Rd West	B4528 South	A350 South	Bristol Rd West	A350 North	B4069 NE	East	London Rd East	Chippenham	ATC
Bath Rd West	44	3	15	6	191	8	4	43	394	706
B4528 South	6	14	2	4	13	17	2	12	305	375
A350 South	16	1	5	30	220	0	0	1	109	382
Bristol Rd West	7	6	25	23	75	6	4	48	325	520
A350 North	180	46	247	89	59	10	2	87	835	1556
B4069 NE	7	15	1	3	4	22	1	11	193	257
East	5	0	0	2	1	0	7	16	61	91
London Rd East	45	9	1	49	80	10	16	46	539	795
Chippenham	428	334	174	315	696	234	41	531		2754
ATC	738	428	470	520	1340	307	78	795	2761	7437

B.2. Corsham

Corsham - ANPR Cordon

AM Peak	A4 Bath Rd (West)	B3109 Bradford Rd	A4 Bath Rd (East)	Lacock Rd	B3353 Silver St	Corsham	ATC
A4 Bath Rd (West)	10	8	164	12	4	136	334
B3109 Bradford Rd	4	5	100	5	2	86	202
A4 Bath Rd (East)	130	112	27	10	12	394	686
Lacock Rd	12	7	4	5	4	68	99
B3353 Silver St	9	4	14	4	22	226	280
Corsham	169	73	376	90	168		877
ATC	334	210	685	127	212	910	2478
Inter Peak	A4 Bath Rd (West)	B3109 Bradford Rd	A4 Bath Rd (East)	Lacock Rd	B3353 Silver St	Corsham	ATC
A4 Bath Rd (West)	8	3	134	9	6	122	282
B3109 Bradford Rd	4	7	84	4	2	76	178
A4 Bath Rd (East)	106	99	17	8	15	352	596
Lacock Rd	8	5	2	2	2	54	73
B3353 Silver St	7	3	9	2	16	164	200
Corsham	143	70	365	58	167		803
ATC	276	187	611	83	208	767	2132
PM Peak	A4 Bath Rd (West)	B3109 Bradford Rd	A4 Bath Rd (East)	Lacock Rd	B3353 Silver St	Corsham	ATC
A4 Bath Rd (West)	10	11	172	22	7	164	385
B3109 Bradford Rd	4	6	99	7	5	83	203
A4 Bath Rd (East)	157	134	27	4	18	439	778
Lacock Rd	15	6	2	5	5	78	111
B3353 Silver St	5	4	11	3	23	178	224
Corsham	156	74	378	94	207		909
ATC	347	235	689	134	265	941	2611

B.3. Melksham


ANPR Site 08
Lyneham
NETTLETON GREEN
EASTON PIERCY
Marshfield
Biddestone
Chippenham
Colerne
Corsham
Calne
ANPR Site 01
WASHWELL
ANPR Site 02
Monkton Farleigh
ANPR Site 03
Melksham
ANPR Site 07
ANPR Site 04
Devizes
Coate
ANPR Site 06
Poulshot
ANPR Site 05
Potterne
NEW TOWN
Trowbridge
Wedhampton
NORTHBROOK
Hawkeridge
ANPR Site 09
SHAWFORD
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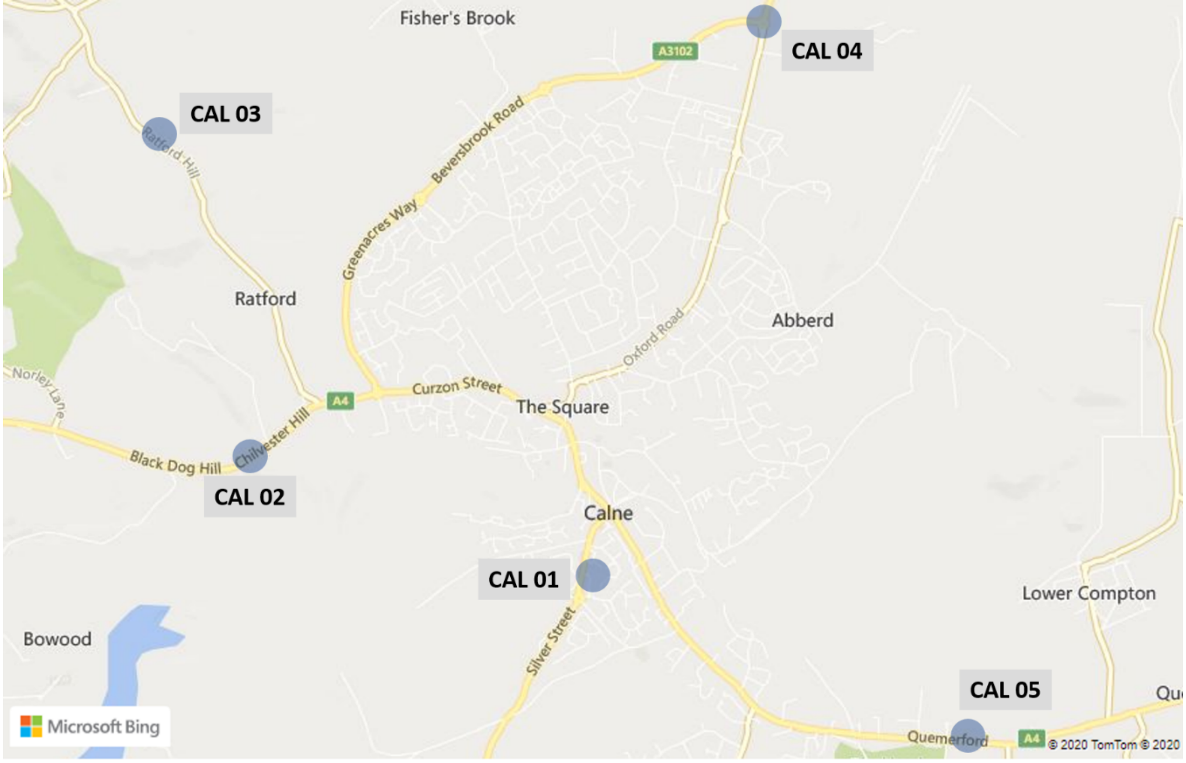
Melksham - ANPR Cordon (2017)

AM Peak	MELK 01	MELK 02	MELK 03	MELK 04	MELK 05	MELK 06	MELK 07	Inbound	ATC
MELK 01	6	4	2	17	19	54	42	655	800
MELK 02	3	18	12	68	10	17	18	311	458
MELK 03	1	11	14	3	12	41	26	212	322
MELK 04	6	77	5	12	2	3	30	234	369
MELK 05	14	38	42	4	3	7	3	506	616
MELK 06	14	24	43	5	4	18	3	551	662
MELK 07	15	12	22	22	1	1	8	156	236
Outbound	538	352	239	218	429	411	152		2338
Tot	597	535	379	350	481	552	283	2625	5802
ATC	671	543	335	595	626	592	253		
IP	MELK 01	MELK 02	MELK 03	MELK 04	MELK 05	MELK 06	MELK 07	Inbound	Tot Counts
MELK 01	5	5	4	12	19	23	14	458	539
MELK 02	6	23	9	46	16	18	12	283	413
MELK 03	2	11	12	3	19	27	17	171	260
MELK 04	11	48	5	13	2	5	19	205	308
MELK 05	11	12	13	2	5	6	2	369	420
MELK 06	21	15	26	4	5	15	2	365	453
MELK 07	16	14	11	16	3	4	10	151	224
Outbound	447	258	154	178	364	357	136		1893
Tot	519	386	234	273	432	455	212	2000	4510
ATC	641	425	276	482	525	454	219		
PM Peak	MELK 01	MELK 02	MELK 03	MELK 04	MELK 05	MELK 06	MELK 07	Inbound	Tot Counts
MELK 01	6	2	5	21	27	27	20	525	633
MELK 02	6	23	14	73	30	25	15	384	570
MELK 03	2	10	20	8	46	51	30	299	466
MELK 04	17	64	6	11	2	7	30	292	429
MELK 05	12	13	15	1	7	4	2	495	550
MELK 06	41	19	46	3	8	21	2	484	624
MELK 07	27	13	26	21	1	1	8	174	270
Outbound	666	303	230	191	510	571	188		2659
Tot	777	448	362	328	631	707	295	2652	6201

B.4. Calne


Fisher's Brook
CAL 04
A3102
CAL 03
Ratford Hill
Beversbrook Road
Greenacres Way
Ratford
Abberd
Oxford Road
Norley Lane
Curzon Street
A4
The Square
Chilvester Hill
Black Dog Hill
CAL 02
Calne
CAL 01
Lower Compton
Silver Street
Bowood
CAL 05
Quemerford
Microsoft Bing
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Calne - ANPR Cordon

AM Peak	A3102 Silver St	A4 Black Dog Hill	Turf Horse Ln	A3102 Oxford Rd	A4 Quemerford	Calne	ATC
A3102 Silver St	13	8	1	36	65	140	263
A4 Black Dog Hill	7	29	5	103	108	335	587
Turf Horse Ln	2	3	3	0	8	24	40
A3102 Oxford Rd	31	78	2	25	16	204	354
A4 Quemerford	33	83	9	18	22	162	327
Calne	180	549	34	308	365		1436
ATC	266	750	53	490	583	865	3007
Inter Peak	A3102 Silver St	A4 Black Dog Hill	Turf Horse Ln	A3102 Oxford Rd	A4 Quemerford	Calne	ATC
A3102 Silver St	10	9	1	21	38	115	194
A4 Black Dog Hill	8	33	4	58	80	319	502
Turf Horse Ln	1	4	1	1	6	22	35
A3102 Oxford Rd	31	65	1	25	18	184	322
A4 Quemerford	37	91	8	16	18	217	387
Calne	105	298	16	163	194		776
ATC	192	499	31	285	353	858	2218
PM Peak	A3102 Silver St	A4 Black Dog Hill	Turf Horse Ln	A3102 Oxford Rd	A4 Quemerford	Calne	ATC
A3102 Silver St	6	5	2	28	39	187	268
A4 Black Dog Hill	6	26	5	79	81	493	689
Turf Horse Ln	2	5	3	1	10	39	60
A3102 Oxford Rd	43	118	0	37	15	366	579
A4 Quemerford	71	118	7	13	16	351	577
Calne	137	388	24	203	191		943
ATC	265	661	41	362	352	1435	3116

B.5. Devizes

DEV 01
DEV 02
DEV 03
DEV 04
DEV 05
Northfields
Devizes
Little Coate
Nursteed
Hartmoor
Green Lane Hospital
Monument Hill
London Road
Dunkirk Hill
Bath Road
Caen Hill
Nursteed Road
Brickley Lane
Windsor Drive
Pans Lane
Wick Lane
Potterne Road
Monument Hill
A342
A361
A360
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Devizes - ANPR Cordon

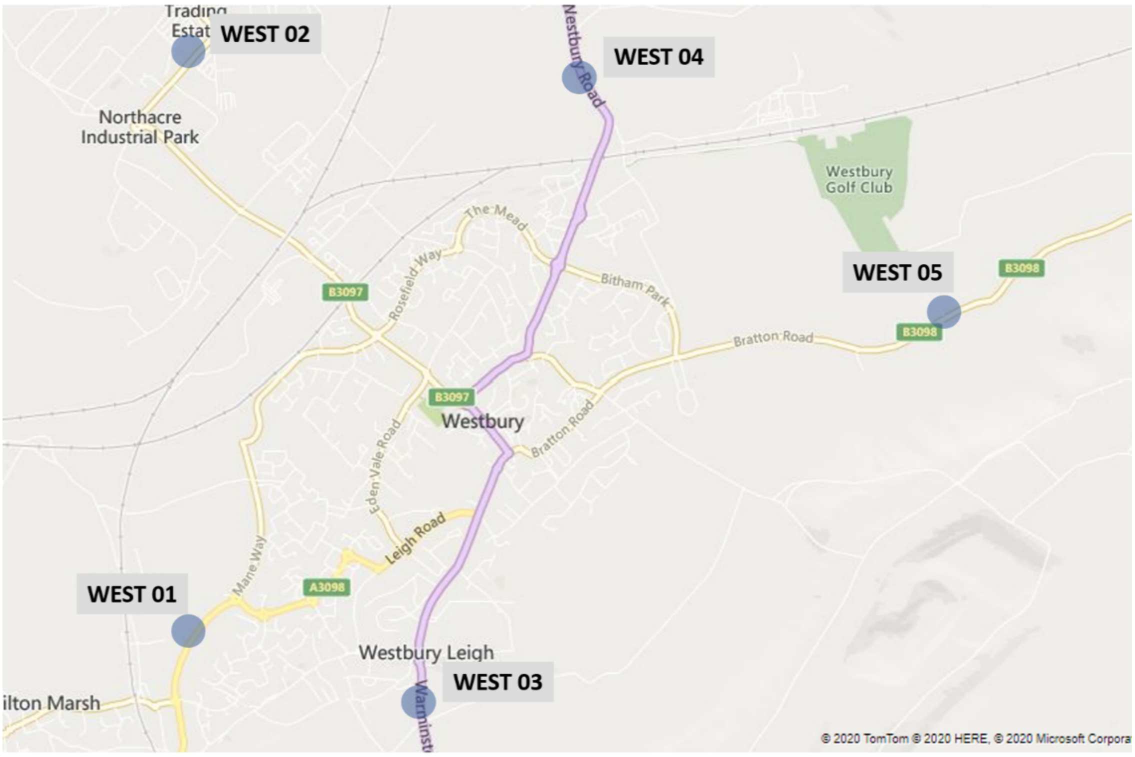
AM Peak	A361 London Rd	A432 Nursteed Rd	A360 Potterne Rd	A361 Bath Rd	A432 Dunkirk Hill	Devizes	ATC
A361 London Rd	58	80	85	120	27	391	761
A432 Nursteed Rd	88	15	6	52	30	155	347
A360 Potterne Rd	123	10	19	21	29	239	441
A361 Bath Rd	157	57	12	17	4	291	539
A432 Dunkirk Hill	24	37	19	5	7	173	265
Devizes	542	186	151	245	146		1271
ATC	993	385	292	460	244	1249	3623
Inter Peak	A361 London Rd	A432 Nursteed Rd	A360 Potterne Rd	A361 Bath Rd	A432 Dunkirk Hill	Devizes	ATC
A361 London Rd	69	68	78	124	28	453	820
A432 Nursteed Rd	68	12	9	43	28	147	308
A360 Potterne Rd	77	7	20	19	21	170	313
A361 Bath Rd	110	40	15	23	8	247	444
A432 Dunkirk Hill	25	21	20	7	12	137	221
Devizes	426	134	166	256	146		1128
ATC	775	283	308	472	243	1153	3234
PM Peak	A361 London Rd	A432 Nursteed Rd	A360 Potterne Rd	A361 Bath Rd	A432 Dunkirk Hill	Devizes	ATC
A361 London Rd	44	72	120	155	24	591	1006
A432 Nursteed Rd	81	11	13	66	49	209	430
A360 Potterne Rd	85	6	19	16	24	194	344
A361 Bath Rd	109	46	20	20	6	303	505
A432 Dunkirk Hill	19	28	27	5	10	169	260
Devizes	380	153	206	321	173		1233
ATC	719	316	405	584	286	1467	3777

B.6. Trowbridge

Trowbridge - ANPR Cordon

AM Peak	A366 Wingfield Rd	A363 Cockhill	A361 Frome Rd	B3106 Hammond Way	A361 nr Semington	A363 Bradley Rd	West Ashton Rd	Trowbridge	ATC
A366 Wingfield Rd	9	8	4	4	22	10	2	191	250
A363 Cockhill	5	16	7	3	16	92	4	210	352
A361 Frome Rd	5	14	32	9	16	14	2	297	390
B3106 Hammond Way	5	6	10	19	15	18	23	273	369
A361 nr Semington	22	15	13	18	26	9	5	495	603
A363 Bradley Rd	8	72	15	8	7	36	3	432	579
West Ashton Rd	6	10	5	42	9	12	25	291	399
Trowbridge	232	275	317	360	550	554	262		2549
ATC	290	416	402	463	661	745	326	2188	5491
Inter Peak	A366 Wingfield Rd	A363 Cockhill	A361 Frome Rd	B3106 Hammond Way	A361 nr Semington	A363 Bradley Rd	West Ashton Rd	Trowbridge	ATC
A366 Wingfield Rd	10	6	4	3	16	11	1	151	202
A363 Cockhill	5	25	9	6	15	61	3	232	357
A361 Frome Rd	4	9	29	7	14	20	1	253	337
B3106 Hammond Way	4	5	6	28	11	14	39	266	373
A361 nr Semington	14	14	12	13	30	11	13	416	523
A363 Bradley Rd	12	63	16	10	8	47	3	620	780
West Ashton Rd	3	3	3	27	8	10	46	254	353
Trowbridge	144	238	249	257	392	764	221		2264
ATC	195	364	328	352	494	938	327	2192	5190
PM Peak	A366 Wingfield Rd	A363 Cockhill	A361 Frome Rd	B3106 Hammond Way	A361 nr Semington	A363 Bradley Rd	West Ashton Rd	Trowbridge	ATC
A366 Wingfield Rd	7	5	6	5	23	12	8	272	339
A363 Cockhill	4	19	12	4	13	76	8	281	418
A361 Frome Rd	2	9	26	10	20	22	4	338	430
B3106 Hammond Way	4	4	10	18	14	19	46	404	518
A361 nr Semington	23	17	15	15	25	13	10	666	784
A363 Bradley Rd	9	91	17	16	11	52	7	710	914
West Ashton Rd	2	6	4	31	7	8	35	390	484
Trowbridge	178	255	329	283	492	712	313		2563
ATC	231	405	420	381	607	914	431	3061	6450

B.7. Westbury


WEST 01
WEST 02
WEST 03
WEST 04
WEST 05
Northacre Industrial Park
Westbury
Westbury Leigh
Westbury Golf Club
Bratton Road
Bitham Park
The Mead
Rosefield Way
Eden Vale Road
Leigh Road
Mane Way
B3097
B3098
A3098
Westbury Road
ilton Marsh
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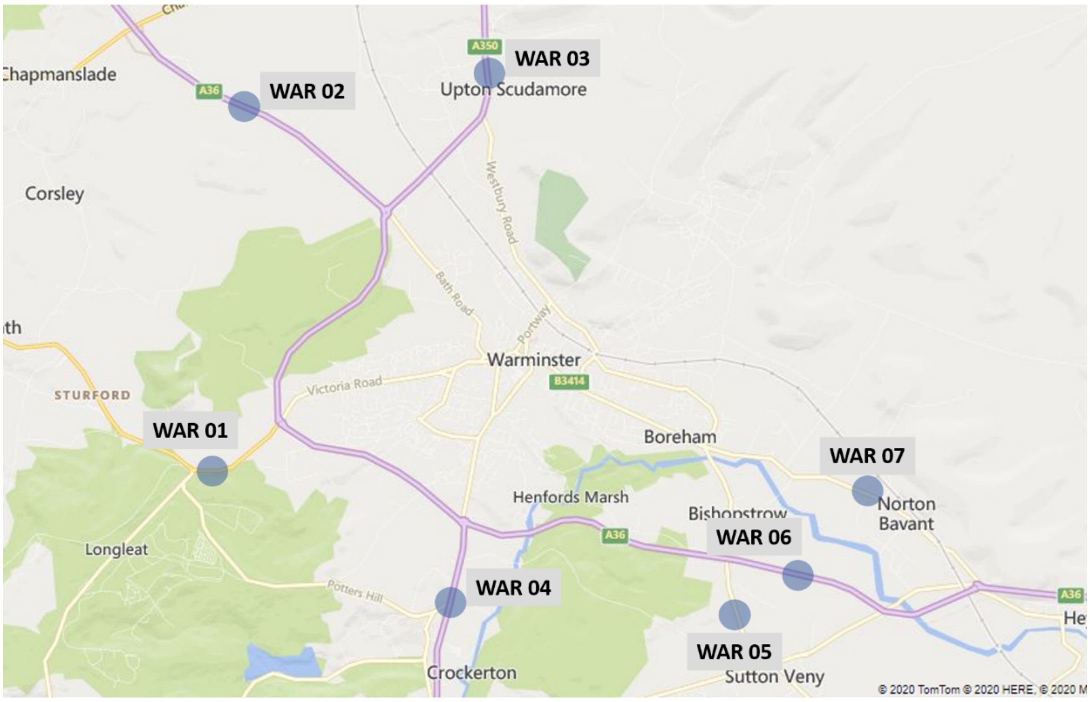
Westbury - ANPR Cordon

AM Peak	A3098 Mane Way	The Ham	A350 Warminster Rd	A350 Trowbridge Rd	B3098 Bratton Rd	Westbury	ATC
A3098 Mane Way	28	42	18	18	31	219	356
The Ham	22	13	44	2	2	134	217
A350 Warminster Rd	11	61	22	214	63	264	635
A350 Trowbridge Rd	14	2	296	18	12	178	520
B3098 Bratton Rd	26	3	56	9	10	83	187
Westbury	253	231	387	248	117		1237
ATC	354	352	824	509	236	877	3152
Inter Peak	A3098 Mane Way	The Ham	A350 Warminster Rd	A350 Trowbridge Rd	B3098 Bratton Rd	Westbury	ATC
A3098 Mane Way	30	31	10	21	13	162	267
The Ham	28	19	36	4	1	144	232
A350 Warminster Rd	12	47	21	257	24	280	641
A350 Trowbridge Rd	14	4	231	26	10	218	504
B3098 Bratton Rd	21	2	40	13	5	73	156
Westbury	163	103	251	185	101		804
ATC	269	207	590	505	155	876	2602
PM Peak	A3098 Mane Way	The Ham	A350 Warminster Rd	A350 Trowbridge Rd	B3098 Bratton Rd	Westbury	ATC
A3098 Mane Way	53	30	10	19	19	249	379
The Ham	56	27	69	5	3	234	394
A350 Warminster Rd	20	66	19	297	52	326	779
A350 Trowbridge Rd	28	4	248	22	15	284	602
B3098 Bratton Rd	37	4	54	12	9	112	228
Westbury	208	112	265	147	124		856
ATC	400	243	665	502	222	1205	3238

B.8. Warminster



Warminster - ANPR Cordon

AM Peak	A362 nr Longleat	A36 NW Warminster	A350 N Warminster	A350 S Warminster	Bishops WAR Rd	A36 SE Warminster	B3414 Boreham Rd	Warminster	ATC
A362 nr Longleat Forest	12	16	27	40	1	189	3	138	426
A36 NW Warminster	31	16	17	91		183	9	202	550
A350 N Warminster	76	35	52	129	10	76	47	408	833
A350 S Warminster	40	128	101	9	0	14	2	135	430
BishopsWAR Rd	2	5	11	1	7	0	2	62	90
A36 SE Warminster	87	163	57	13	0	2	1	61	384
B3414 Boreham Rd	2	4	19	1	3	0	10	150	189
Warminster	195	248	356	167	53	149	147		1316
ATC	444	616	639	451	77	614	221	1157	4219
Inter Peak	**A362 nr Longleat**	**A36 NW Warminster**	**A350 N Warminster**	**A350 S Warminster**	**Bishops WAR Rd**	**A36 SE Warminster**	**B3414 Boreham Rd**	**Warminster**	**ATC**
A362 nr Longleat Forest	14	24	49	44	1	121	3	176	432
A36 NW Warminster	32	14	22	133	5	154	9	186	555
A350 N Warminster	45	20	40	111	7	50	26	313	611
A350 S Warminster	52	112	113	13	2	12	2	175	482
BishopsWAR Rd	1	3	8	1	6	0	2	52	74
A36 SE Warminster	135	166	59	18	0	4	2	78	462
B3414 Boreham Rd	2	6	25	2	3	1	10	119	167
Warminster	156	159	324	181	51	88	120		1079
ATC	437	504	641	504	75	429	174	1099	3863
PM Peak	**A362 nr Longleat Forest**	**A36 NW Warminster**	**A350 N Warminster**	**A350 S Warminster**	**Bishops WAR Rd**	**A36 SE Warminster**	**B3414 Boreham Rd**	**Warminster**	**ATC**
A362 nr Longleat Forest	11	35	74	55	2	118	3	216	514
A36 NW Warminster	17	12	26	147	5	164	11	274	654
A350 N Warminster	33	20	35	118	8	52	22	406	694
A350 S Warminster	46	100	125	14	1	10	3	175	476
BishopsWAR Rd	1	3	7	0	7	0	2	55	76
A36 SE Warminster	185	193	78	18	0	2	1	139	615
B3414 Boreham Rd	2	7	42	1	2	0	9	172	235
Warminster	161	201	387	169	63	68	150		1199
ATC	456	571	773	522	90	414	201	1436	4463

B.9. Royal Wotton Bassett

RWB - ANPR Cordon

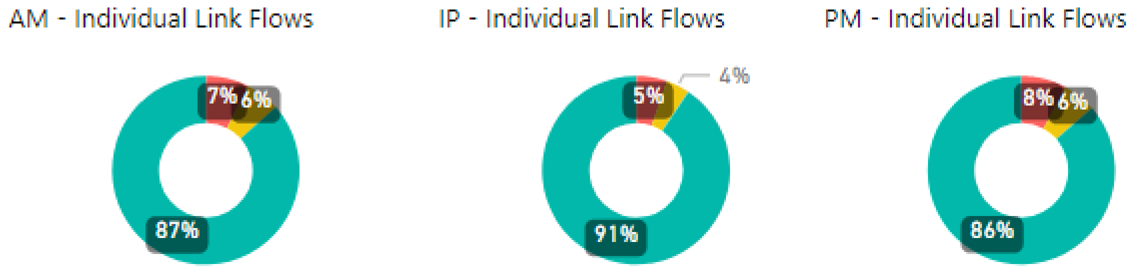
AM Peak	A3102 Hunts Mill Rd	Whitehill Lane	B4042 Malmesbury Rd	B4042 N of Wotton Bassett	A3102 Swindon Rd	Marlborough Rd	Wotton Bassett	ATC
A3102 Hunts Mill Rd	14	4	41	80	198	10	119	465
Whitehill Lane	2	4	1	1	4	8	21	42
B4042 Malmesbury Rd	27	0	15	63	219	30	126	481
B4042 N of Wotton Bassett	85	0	51	39	68	32	195	471
A3102 Swindon Rd	127	9	174	34	34	26	323	727
Marlborugh Rd	9	4	20	16	52	14	79	193
Wotton Bassett	132	25	137	186	569	114	0	1162
ATC	395	46	440	419	1144	234	863	3541
Inter Peak	A3102 Hunts Mill Rd	Whitehill Lane	B4042 Malmesbury Rd	B4042 N of Wotton Bassett	A3102 Swindon Rd	Marlborugh Rd	Wotton Bassett	ATC
A3102 Hunts Mill Rd	14	3	25	47	145	8	115	357
Whitehill Lane	3	4	1	1	7	2	16	34
B4042 Malmesbury Rd	26	1	14	32	149	16	107	346
B4042 N of Wotton Bassett	43	1	29	27	51	17	143	312
A3102 Swindon Rd	142	6	159	48	55	39	377	826
Marlborugh Rd	9	2	14	18	32	10	70	157
Wotton Bassett	105	16	94	140	350	69	0	773
ATC	342	34	337	313	788	162	829	2805
PM Peak	A3102 Hunts Mill Rd	Whitehill Lane	B4042 Malmesbury Rd	B4042 N of Wotton Bassett	A3102 Swindon Rd	Marlborugh Rd	Wotton Bassett	ATC
A3102 Hunts Mill Rd	12	1	25	77	145	7	149	416
Whitehill Lane	1	4	1	2	11	6	23	49
B4042 Malmesbury Rd	62	6	18	50	184	24	183	527
B4042 N of Wotton Bassett	92	1	55	27	45	15	229	463
A3102 Swindon Rd	224	4	260	77	47	52	622	1285
Marlborugh Rd	10	6	24	19	27	11	104	201
Wotton Bassett	142	20	115	206	384	69	0	936
ATC	543	42	498	458	843	183	1311	3878

Appendix C. Summary Checks in the South West Region

C.1. Individual link flow validation for all sites in south west

Note that there are a total of 1833 traffic count sites included within the SW region (including the AoDM). The link flow validation achieves a very good proportion and demonstrates that the wider model has retained the integrity of the A303 Stonehenge / SWRTM models.

Figure C-1 - Individual Link Flow Validation, South West



C.2. Screenline flow checks outside the AoDM

The table below shows the output of eight screenlines from the wider region, outside the AoDM. This shows the observed, A303 Stonehenge model and Wiltshire model across all time periods. A description of the screenlines is found in the associated model validation reports.

It shows that there is no notable variation between the A303 Stonehenge and Wiltshire modelled flows.

Table C-1 - Screenline Comparison Outside AoDM, Total Vehicle flows

Screenline	Dir	AM				IP				PM			
		Obs	Wiltshire Model Flows	A303 Model Flows	% Diff	Obs	Wiltshire Model Flows	A303 Model Flows	% Diff	Obs	Wiltshire Model Flows	A303 Model Flows	% Diff
Athelney to Newbury	NB	5341	5,498	5367	2.9%	4737	4,892	4740	3.3%	5863	6,047	5827	3.1%
	SB	5742	6,289	5728	9.5%	4478	4,811	4483	7.4%	5644	5,838	5680	3.4%
Boscastle to West Looe	EB	2035	1,961	2044	-3.6%	2262	2,212	2270	-2.2%	2195	2,171	2204	-1.1%
	WB	2080	2,048	2088	-1.5%	2149	2,116	2159	-1.5%	2266	2,224	2271	-1.9%
Holsworthy to Exmoor	NB	1064	1,030	1116	-3.1%	984	970	1000	-1.4%	1196	1,102	1281	-7.9%
	SB	1141	1,187	1150	4.1%	1049	1,037	1069	-1.2%	1060	983	1179	-7.3%
Midlands – South West	NB	11511	11,318	11583	-1.7%	11353	10,926	11459	-3.8%	14109	13,808	14115	-2.1%
	SB	13233	13,209	13324	-0.2%	10713	10,336	10840	-3.5%	12644	12,480	12910	-1.3%
Nether Stowey to Lyme Regis	EB	5520	5,410	5522	-2.0%	5689	5,631	5675	-1.0%	6210	6,199	6201	-0.2%
	WB	5980	5,966	5900	-0.2%	5260	5,265	5222	0.1%	5970	5,982	5967	0.2%
New Forest	NB	5414	4,801	4987	-11.3%	4087	3,902	4082	-4.5%	4757	4,378	4731	-8.0%
	SB	4914	4,430	4097	-9.8%	4105	3,989	4105	-2.8%	5747	5,657	5756	-1.6%
Penzance	EB	1224	1,243	1224	1.6%	1384	1,406	1384	1.6%	1345	1,373	1348	2.1%
	WB	1252	1,265	1251	1.1%	1370	1,391	1370	1.6%	1447	1,476	1451	2.0%
South East Boundary	EB	15777	15,911	15631	0.9%	11303	11,420	11373	1.0%	12351	12,384	12303	0.3%
	WB	11390	11,749	11509	3.2%	11710	12,225	11817	4.4%	16125	16,399	16068	1.7%

Appendix D. Full Simulation vs Buffer Output Summary

Prior to model development, a test was done using the disaggregated Stonehenge A303 prior matrix model and an early version of the refined network to understand the relative impact of fully simulating the model vs converting the model to buffer outside of the AoDM. This was primarily undertaken to reduce model run time and improve model convergence.

A cordon of the model was considered, but a decision was made to include the full network extents to ensure that long distance trips, through the AoDM, would be retained.

Below is a comparison output from each model variant. This demonstrates that there is relatively minimal change in the global statistics but that the model run time and convergence levels suggest that for sensitivity testing and forecasting that the simulation-buffer model is the recommended model to use for future iterations.

Table D-1 - AM Buffer vs Full Simulation, Model Development, Summary Stats

Statistics	AoDM Simulation & Outside Buffer	Full Simulation
Run Times (mins)	6	23
Total Assigned Trips (pcus)	1,816,107	1,816,107
Link Cruise Time (pcu-hrs)	1,343,927	1,350,002
Transient Queued Time (pcu-hrs)	18,977	22,450
Overcapacity Queued Time (pcu-hrs)	14,998	17,020
Total Travel Time (pcu-hrs)	1,377,902	1,389,472
Travel Distance (pcu-kms)	95,748,240	95,836,336
Average Journey Speed (kph)	69.5	69
Convergence	11	23
%GAP	0.003	0.011
%flows	99.3	98

Note this information is not the validated model, shows an early test version

Table D-2 - IP Buffer vs Full Simulation, Model Development, Summary Stats

Statistics	AoDM Simulation & Outside AoDM Buffer	Full Simulation
Run Times (mins)	5	11
Total Assigned Trips (pcus)	1,390,915	1,390,916
Link Cruise Time (pcu-hrs)	992,343	962,163
Transient Queued Time (pcu-hrs)	8,649	13,469
Overcapacity Queued Time (pcu-hrs)	1,744	3,027
Total Travel Time (pcu-hrs)	1,002,736	978,659
Travel Distance (pcu-kms)	72,938,656	72,972,640
Average Journey Speed (kph)	72.7	74.6
Convergence	11	16
%GAP	0	0.004
%flows	99.1	98.5

Table D-3 - PM Buffer vs Full Simulation, Model Development, Summary Stats

Statistics	AoDM Simulation & Outside AoDM Buffer	Full Simulation
Run Times (mins)	6	20
Total Assigned Trips (pcus)	1,855,971	1,855,971
Link Cruise Time (pcu-hrs)	1,271,859	1,289,368
Transient Queued Time (pcu-hrs)	18,821	22,965
Overcapacity Queued Time (pcu-hrs)	17,439	20,151
Total Travel Time (pcu-hrs)	1,308,119	1,332,483
Travel Distance (pcu-kms)	92,261,992	92,404,184
Average Journey Speed (kph)	70.5	69.3
Convergence	11	22
%GAP	0.002	0.008
%flows	99	98.3

Appendix E. Changes due to ME2

E.1. Post ME2 vs Prior: Zonal Trip Ends

Figure E-1 - AM Origin Trip Ends – Car

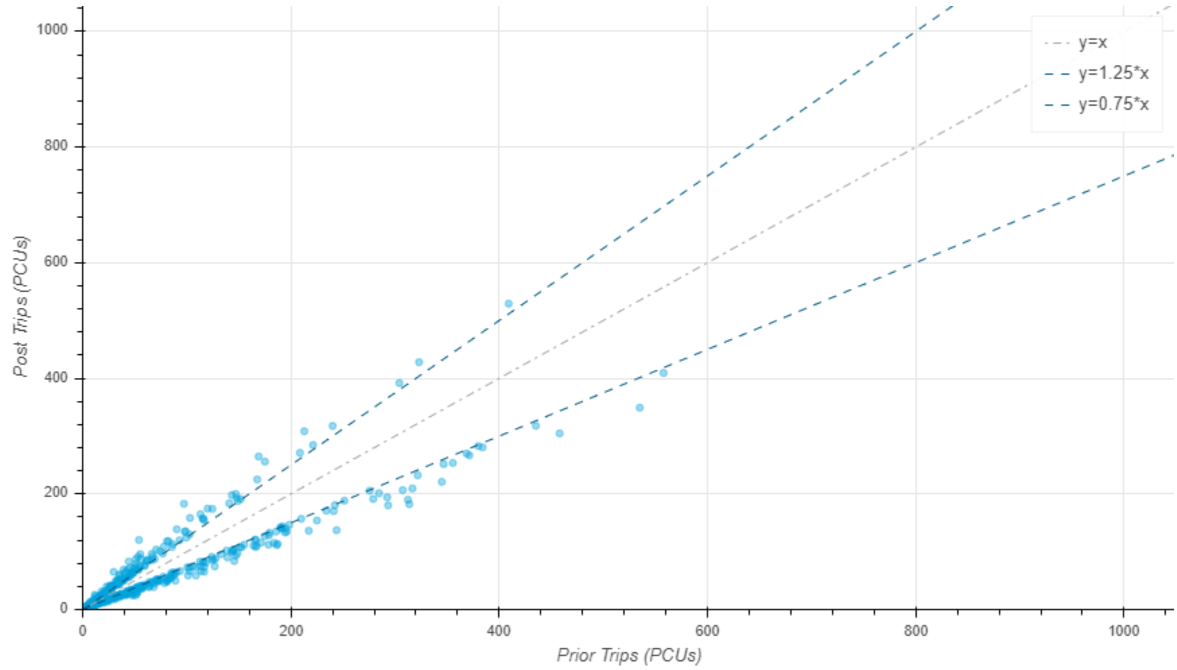


Figure E-2 - AM Destination Trip Ends – Car

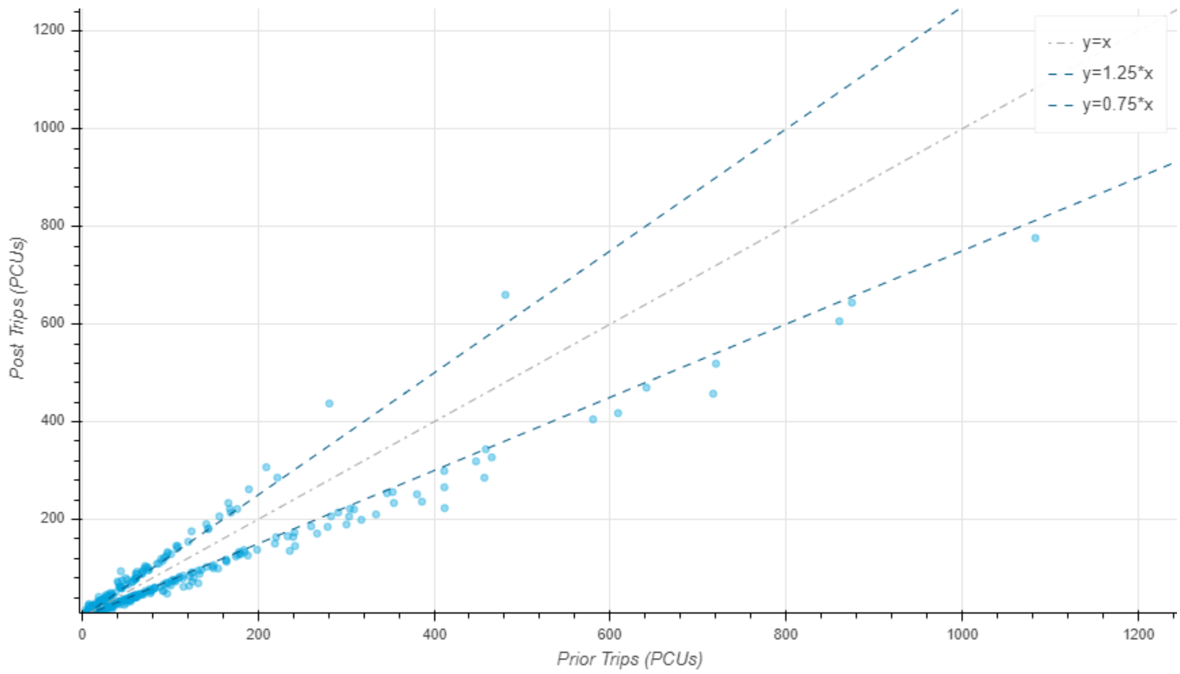


Figure E-3 - IP Origin Trip Ends – Car

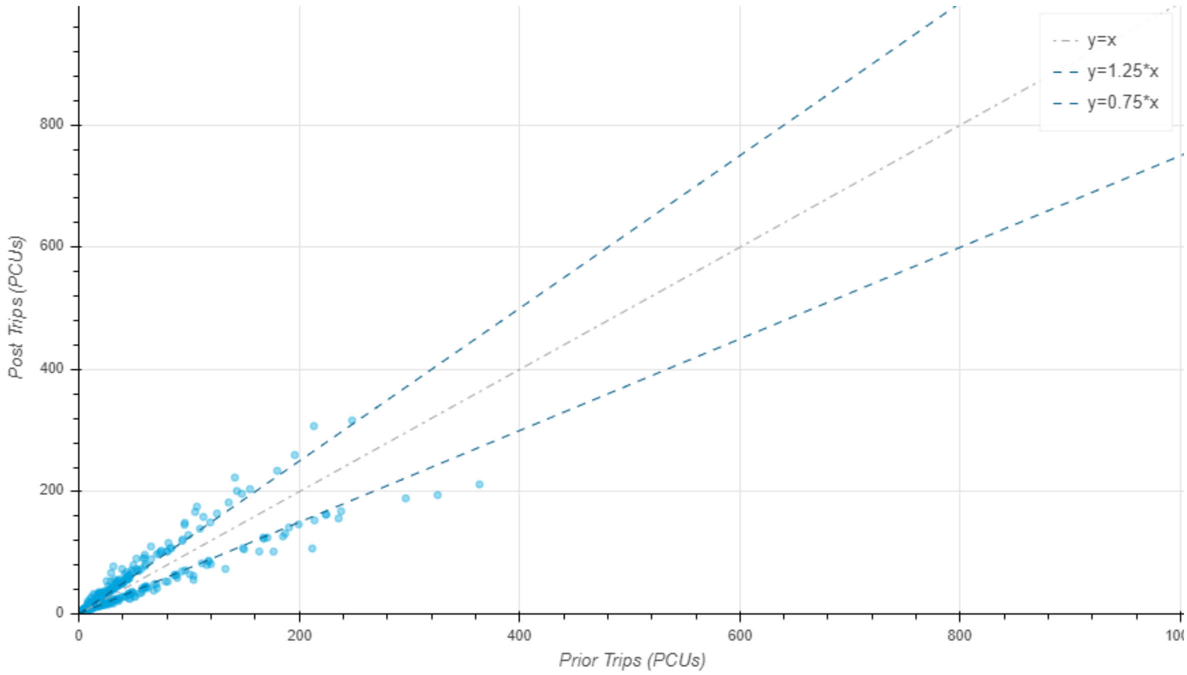


Figure E-4 - IP Destination Trip Ends – Car

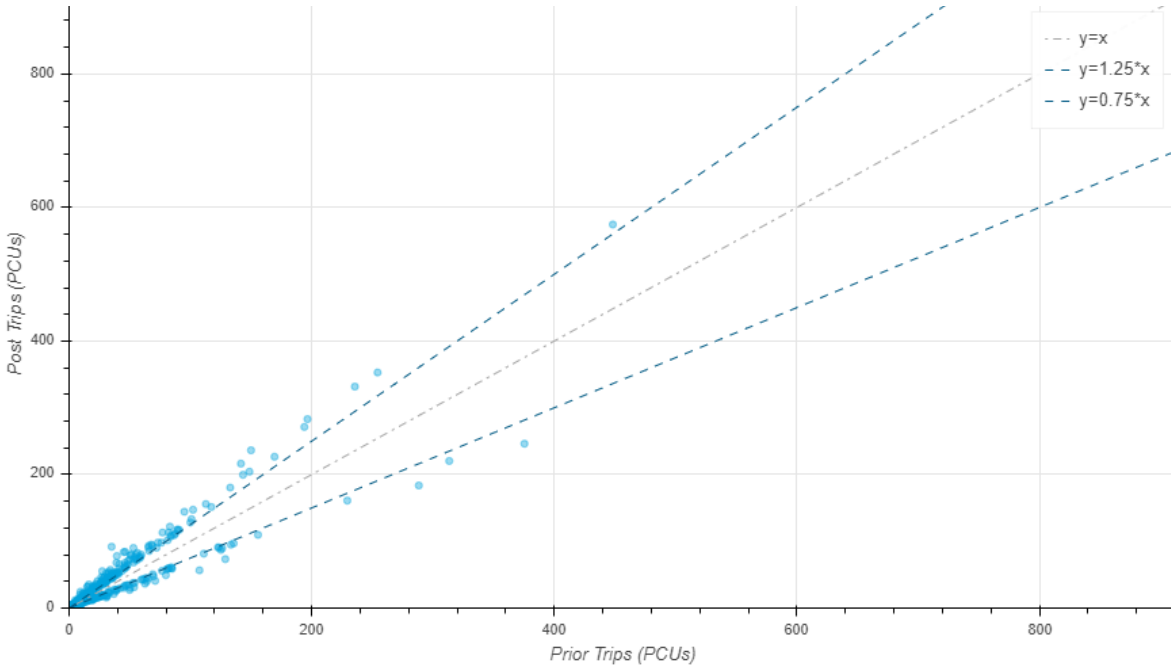


Figure E-5 - PM Origin Trip Ends – Car

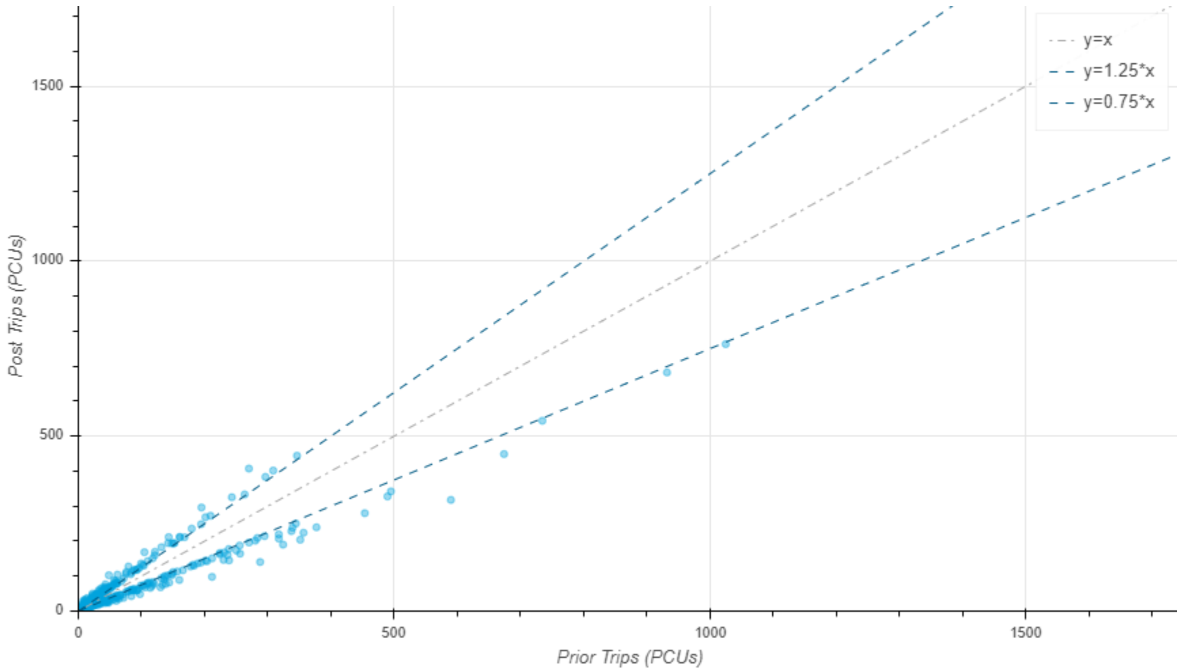
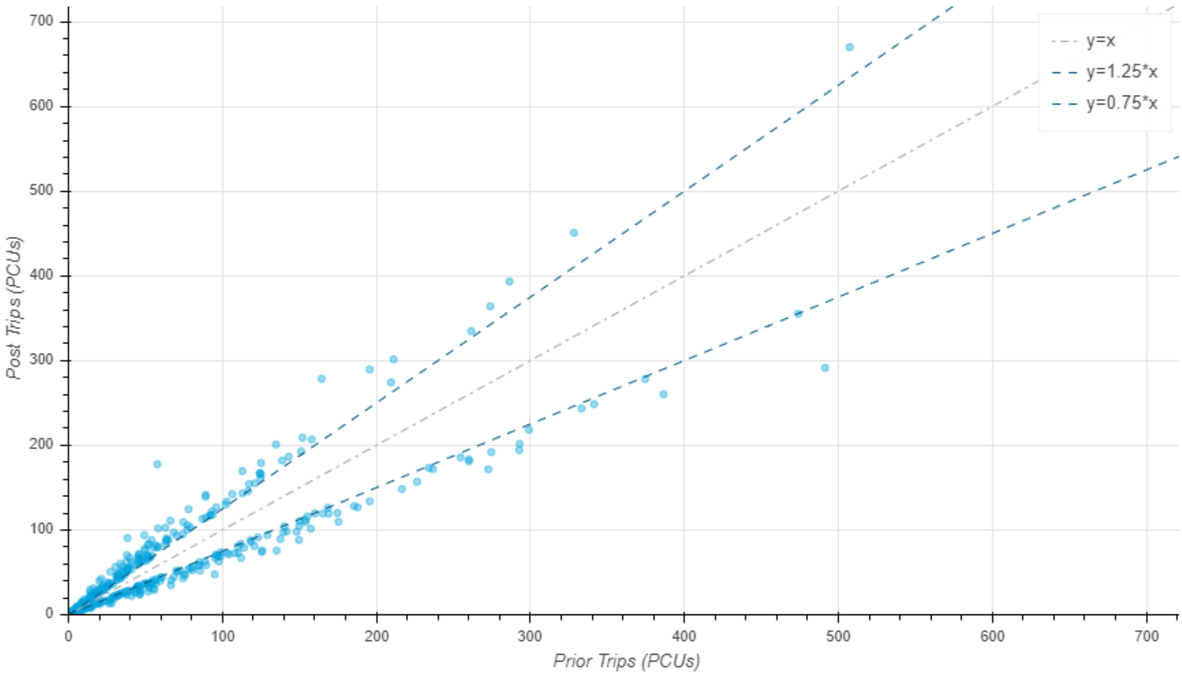


Figure E-6 - PM Destination Trip Ends – Car



E.2. Post ME2 vs Prior: Zonal Cell Values

Figure E-7 - AM cell by cell All Vehicles

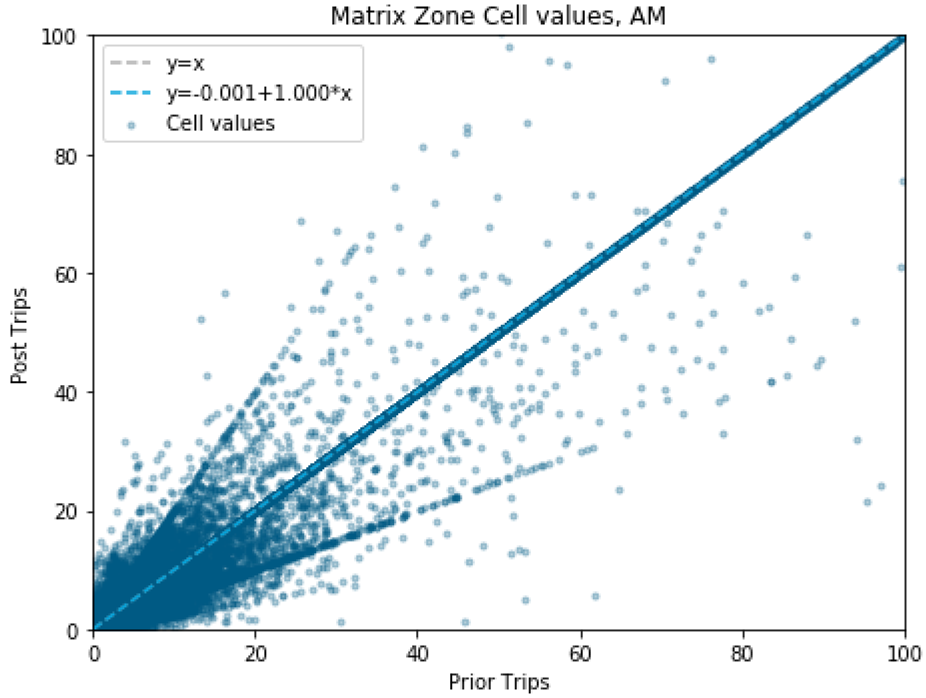


Figure E-8 - IP cell by cell All Vehicles

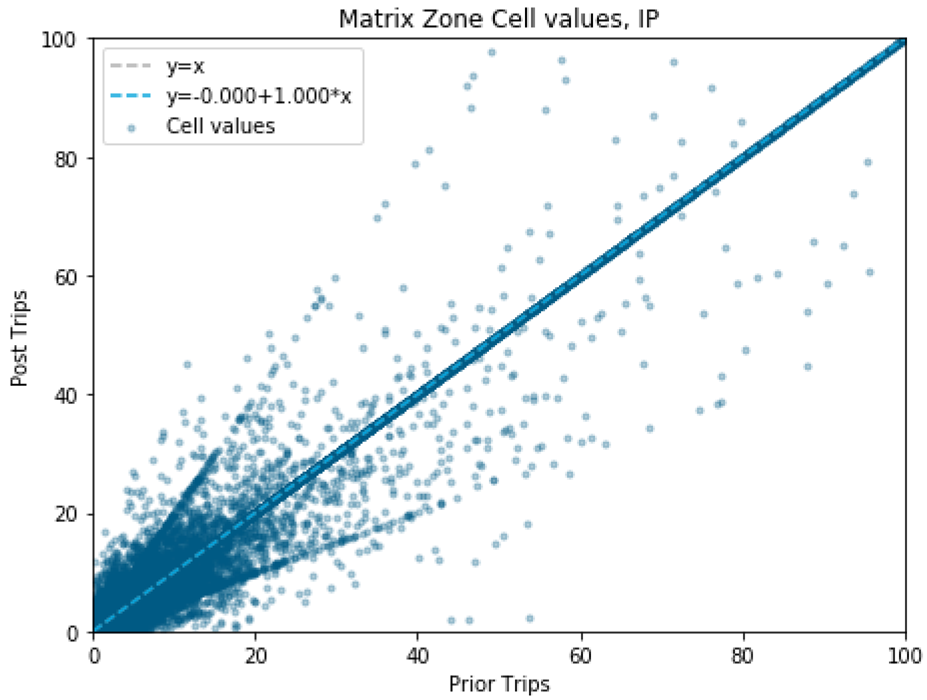
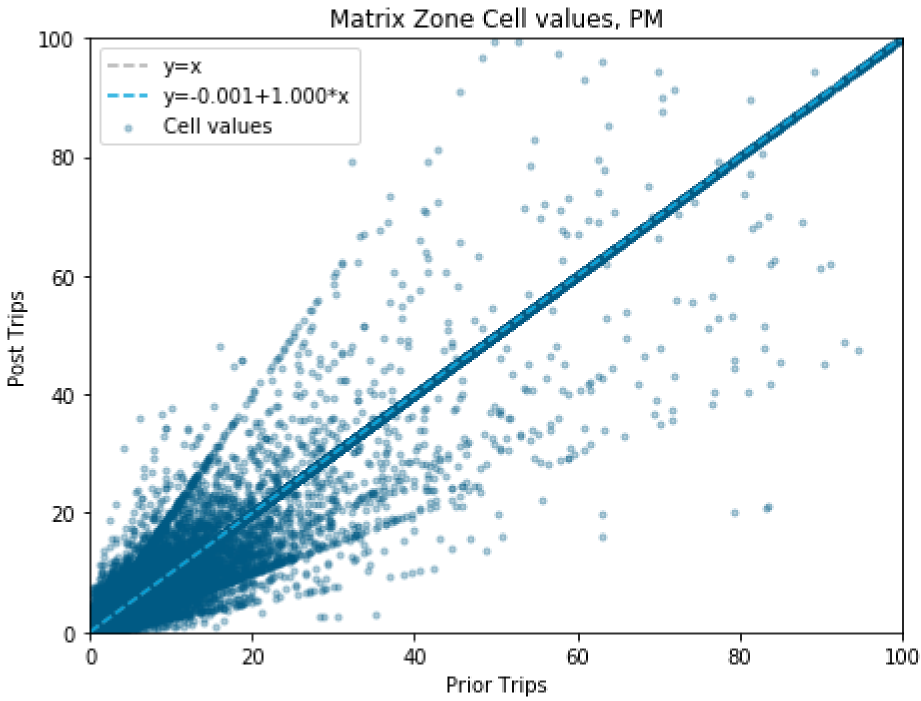


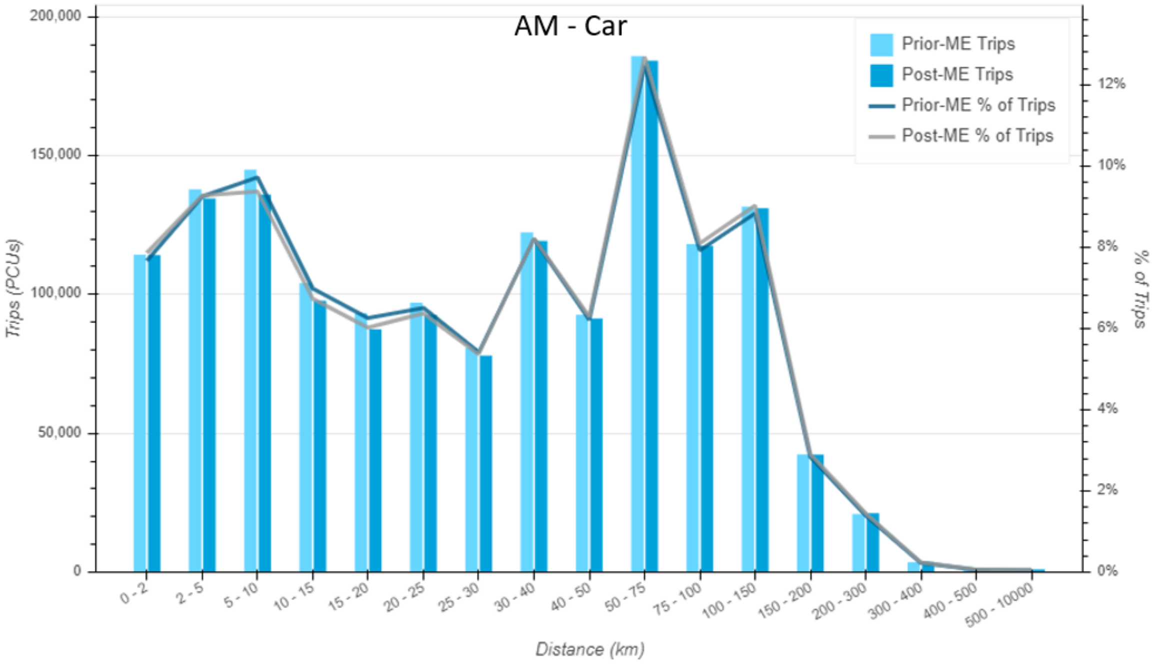
Figure E-9 - PM cell by cell All Vehicles

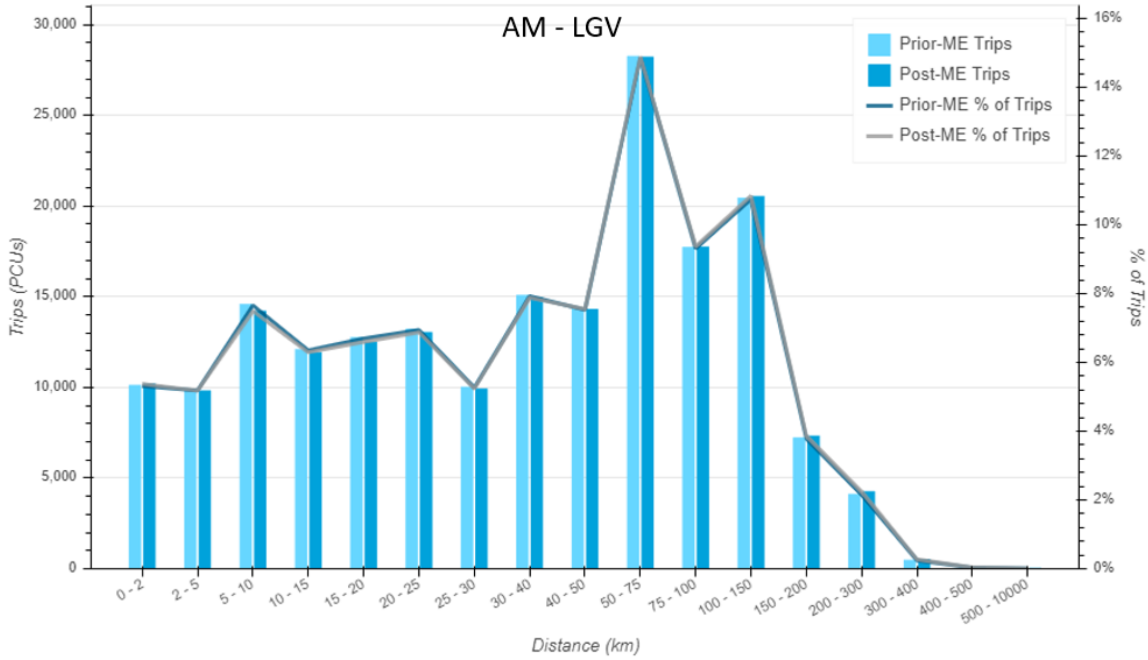


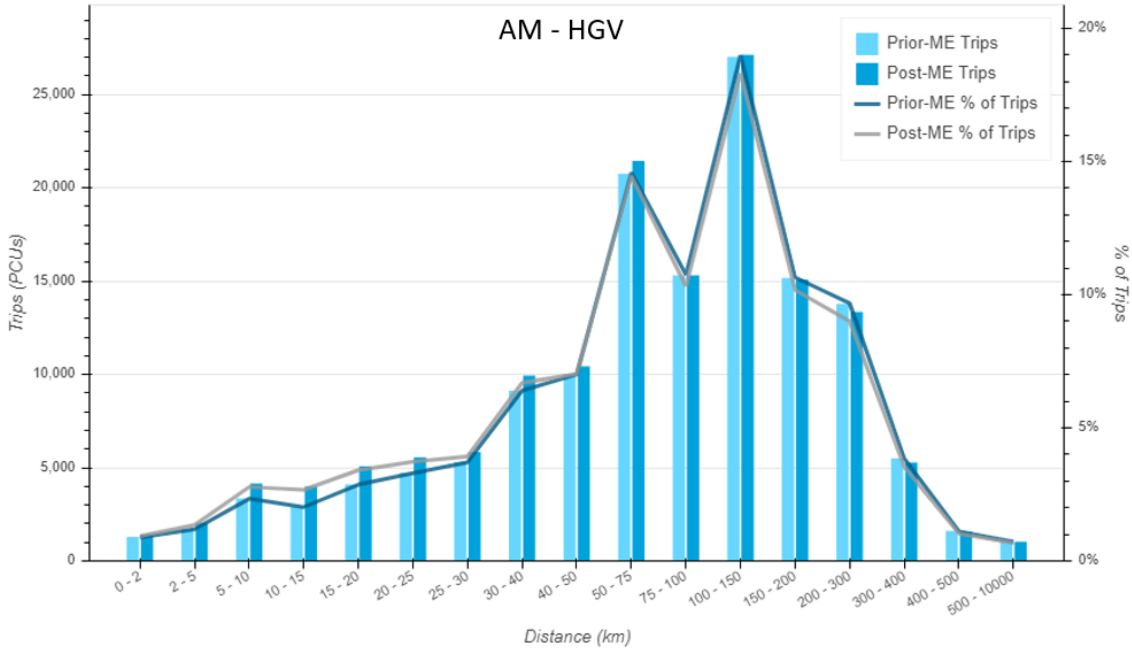
E.3. Post ME2 vs Prior: Trip Length Distributions

All Trip Length Distribution plots are shown for the whole model.

Figure E-10 - Trip Length Distribution AM






AM - HGV
Prior-ME Trips
Post-ME Trips
Prior-ME % of Trips
Post-ME % of Trips
Trips (PCUs)
% of Trips
Distance (km)
0 - 2
2 - 5
5 - 10
10 - 15
15 - 20
20 - 25
25 - 30
30 - 40
40 - 50
50 - 75
75 - 100
100 - 150
150 - 200
200 - 300
300 - 400
400 - 500
500 - 10000

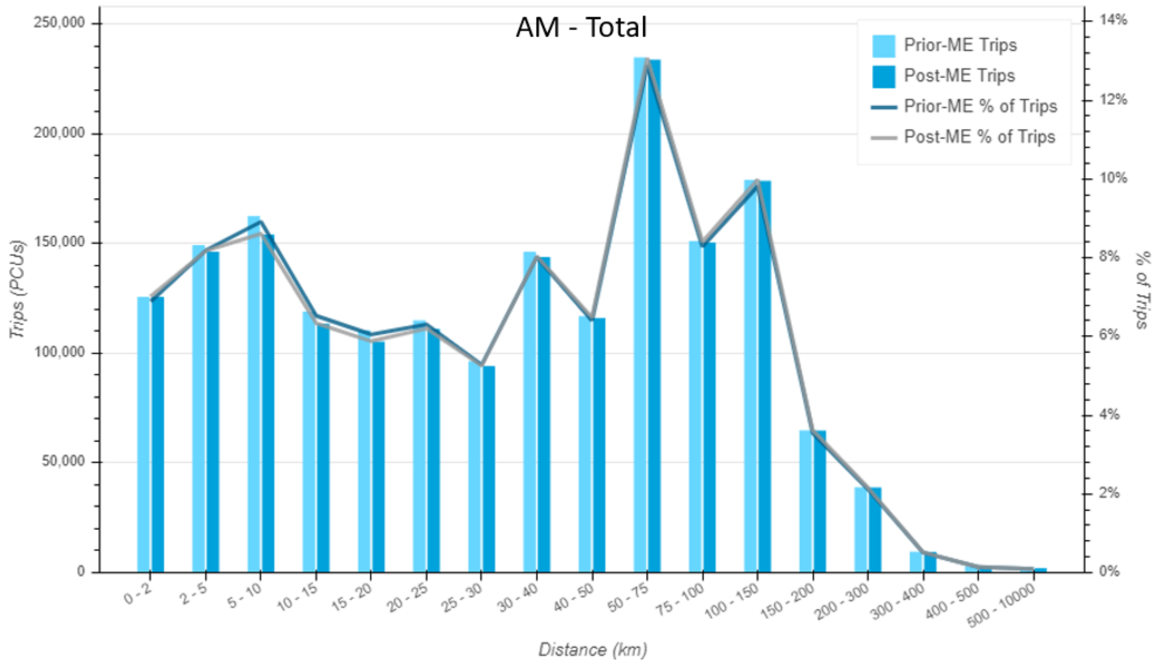
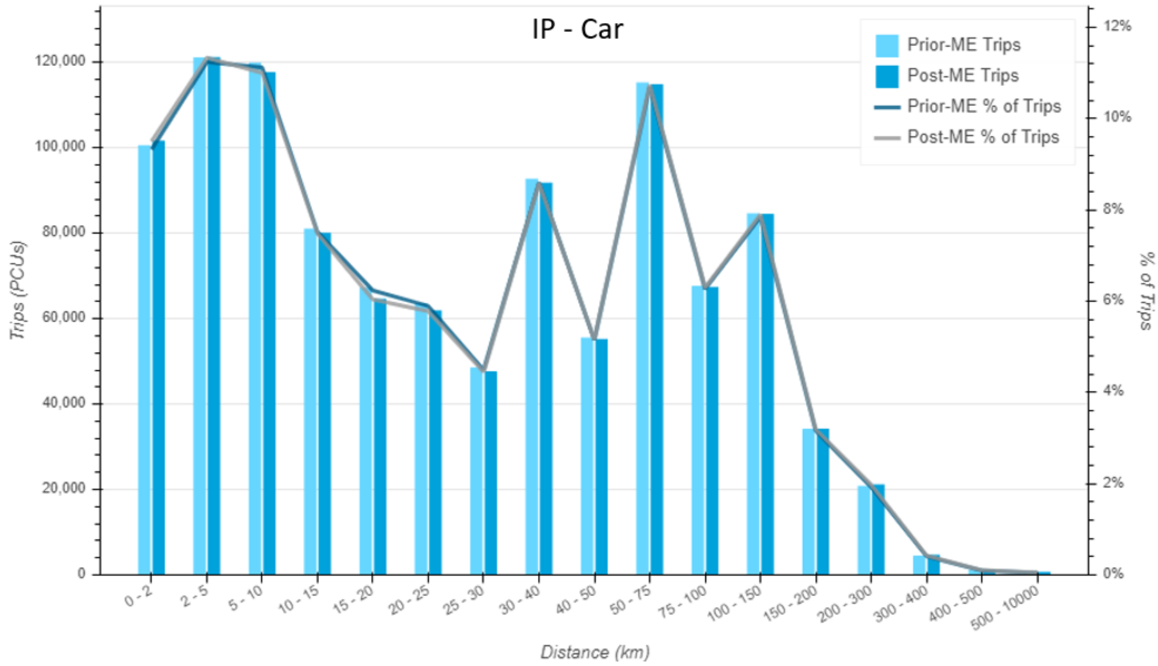
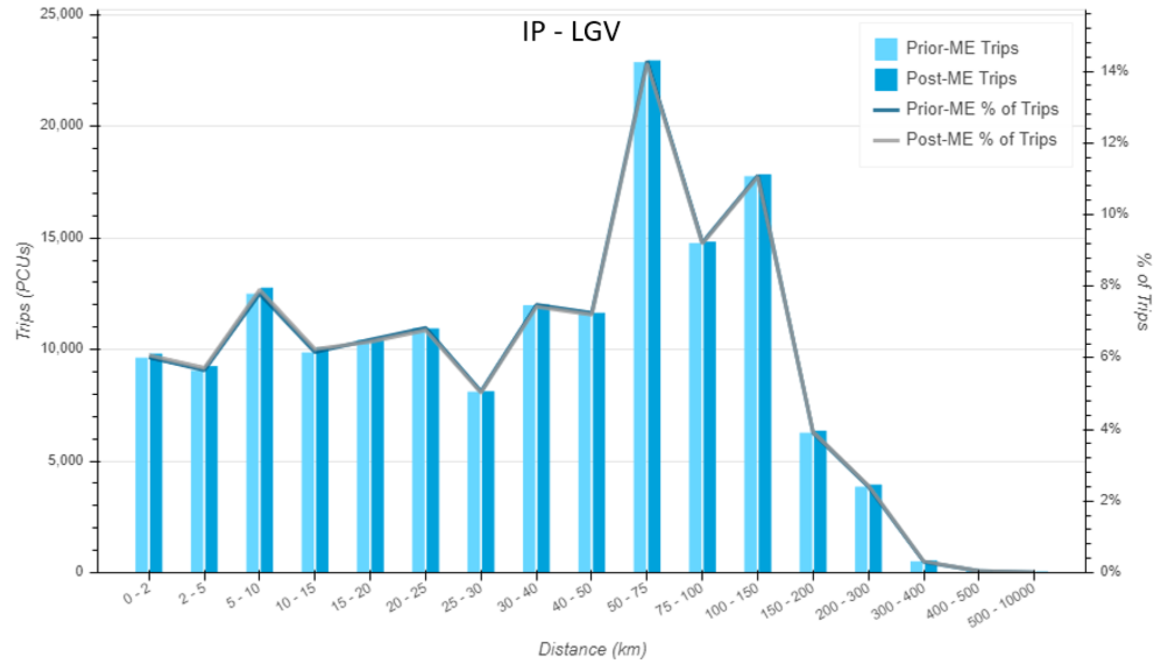
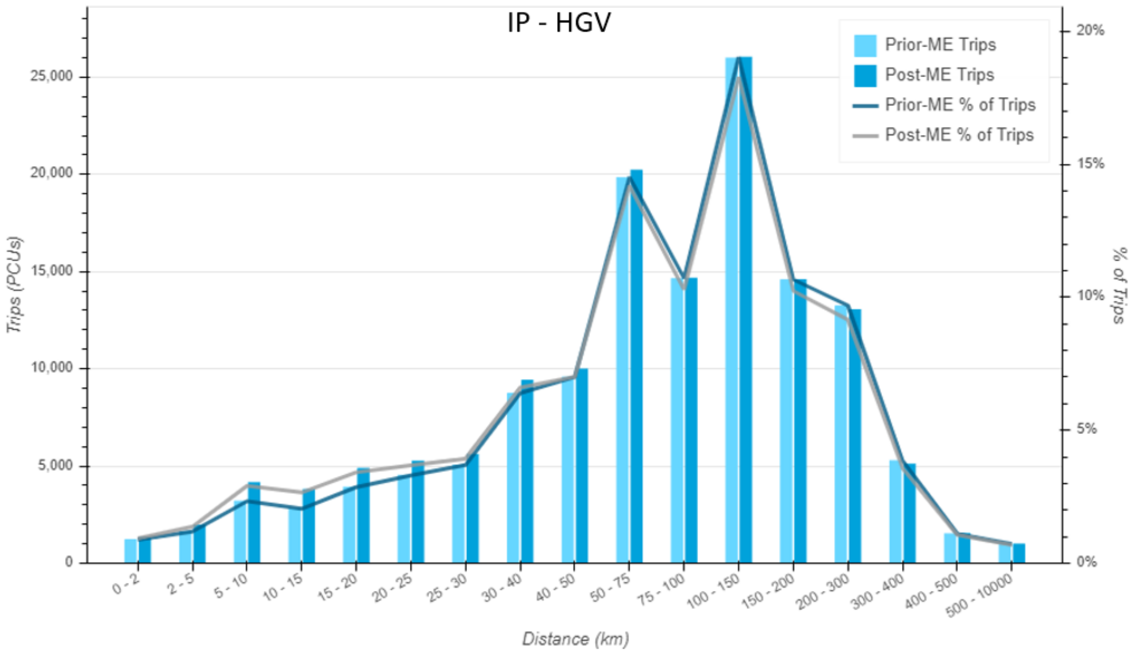

AM - Total
Prior-ME Trips
Post-ME Trips
Prior-ME % of Trips
Post-ME % of Trips
Trips (PCUs)
% of Trips
Distance (km)
0 - 2
2 - 5
5 - 10
10 - 15
15 - 20
20 - 25
25 - 30
30 - 40
40 - 50
50 - 75
75 - 100
100 - 150
150 - 200
200 - 300
300 - 400
400 - 500
500 - 10000

Figure E-11 - Trip Length Distribution IP






IP - HGV
Prior-ME Trips
Post-ME Trips
Prior-ME % of Trips
Post-ME % of Trips
Trips (PCUs)
% of Trips
Distance (km)
0 - 2
2 - 5
5 - 10
10 - 15
15 - 20
20 - 25
25 - 30
30 - 40
40 - 50
50 - 75
75 - 100
100 - 150
150 - 200
200 - 300
300 - 400
400 - 500
500 - 10000

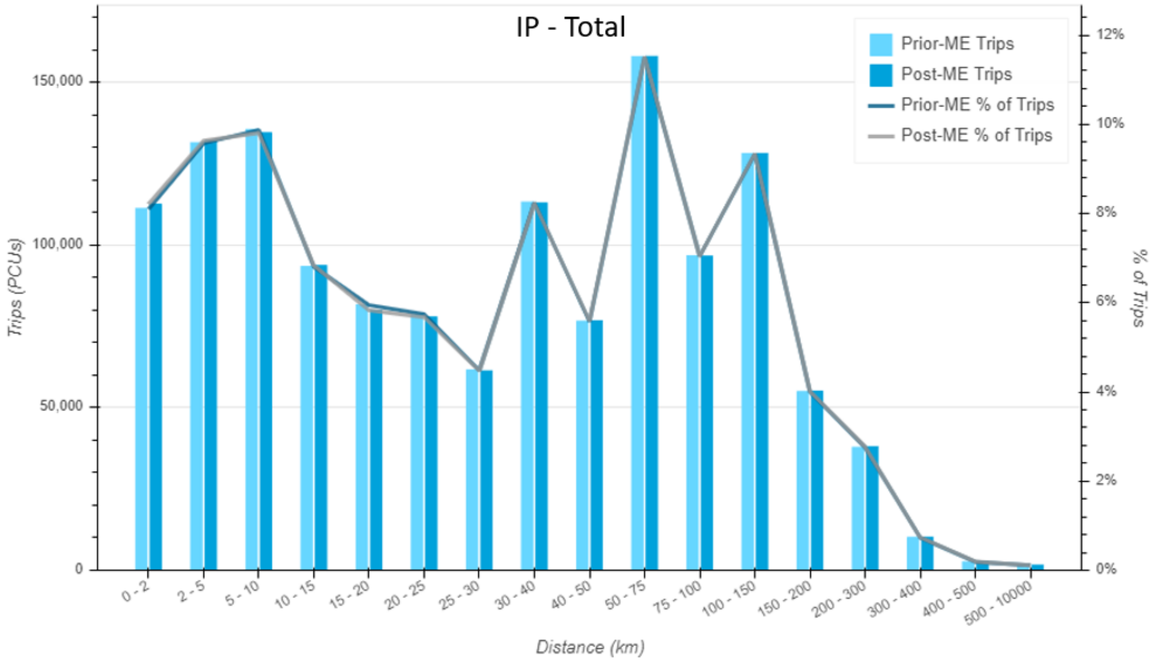
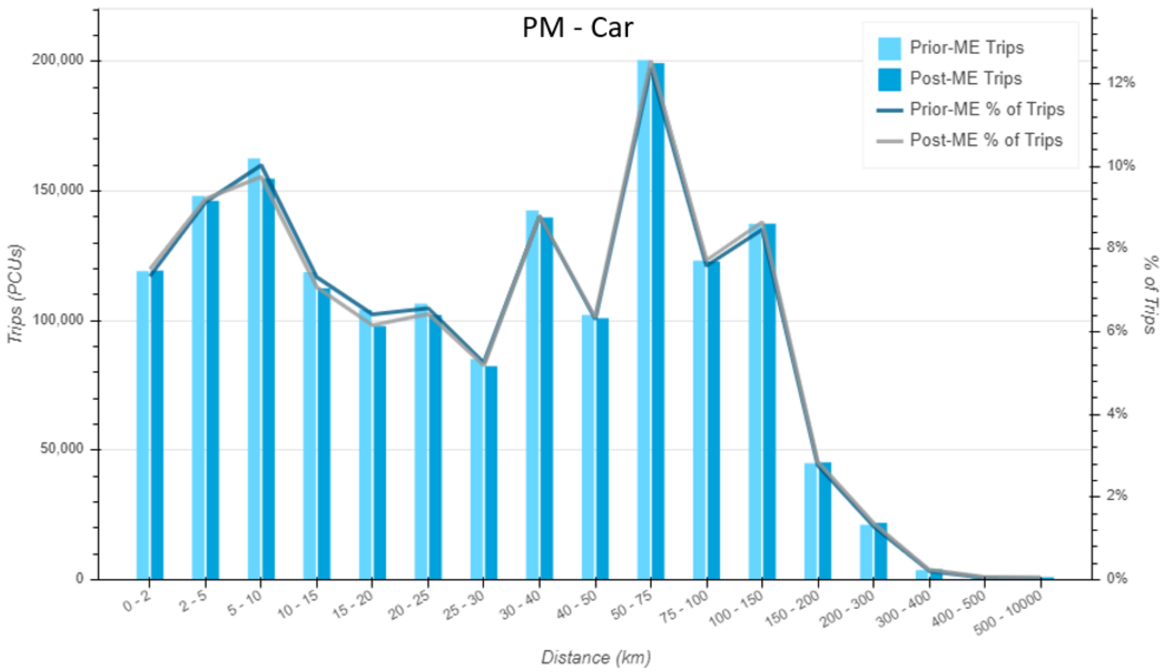
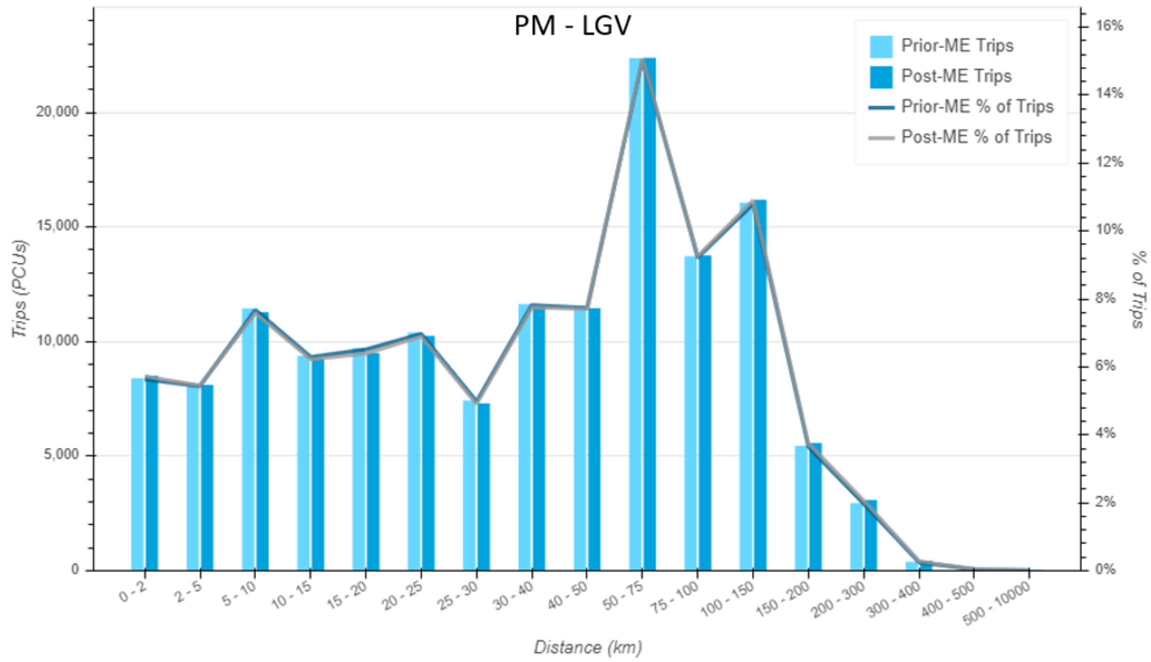
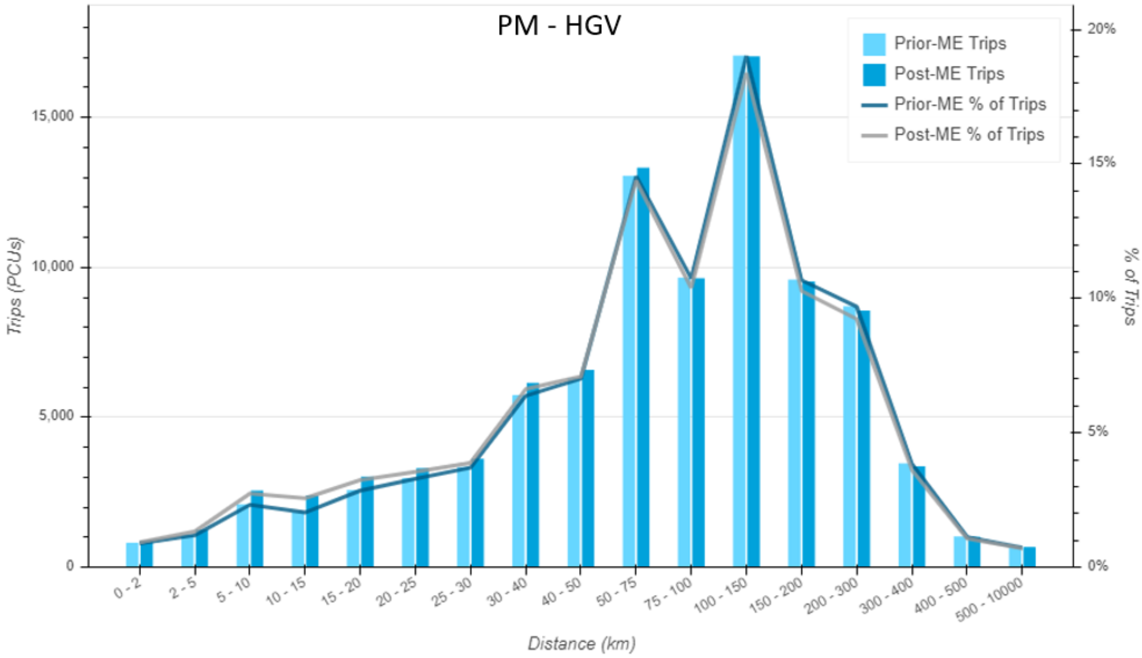
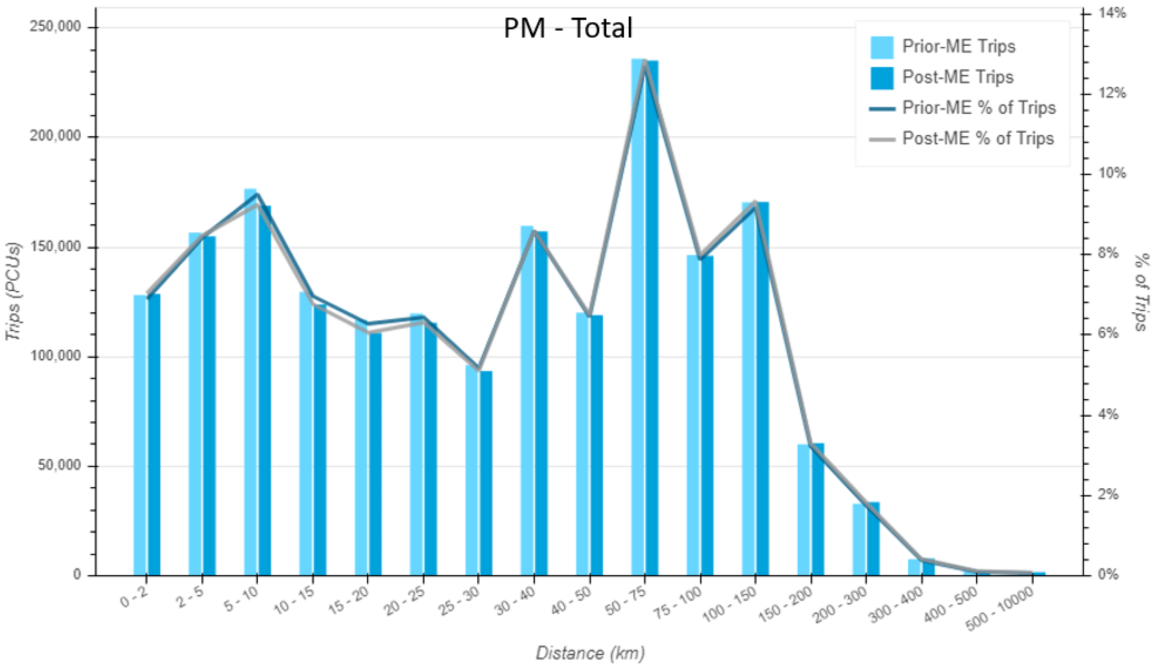

IP - Total
Prior-ME Trips
Post-ME Trips
Prior-ME % of Trips
Post-ME % of Trips
Trips (PCUs)
% of Trips
Distance (km)
0 - 2
2 - 5
5 - 10
10 - 15
15 - 20
20 - 25
25 - 30
30 - 40
40 - 50
50 - 75
75 - 100
100 - 150
150 - 200
200 - 300
300 - 400
400 - 500
500 - 10000

Figure E-12 - Trip Length Distribution PM






PM - HGV
Prior-ME Trips
Post-ME Trips
Prior-ME % of Trips
Post-ME % of Trips
Trips (PCUs)
% of Trips
0
5,000
10,000
15,000
0%
5%
10%
15%
20%
0 - 2
2 - 5
5 - 10
10 - 15
15 - 20
20 - 25
25 - 30
30 - 40
40 - 50
50 - 75
75 - 100
100 - 150
150 - 200
200 - 300
300 - 400
400 - 500
500 - 10000
Distance (km)


PM - Total
Prior-ME Trips
Post-ME Trips
Prior-ME % of Trips
Post-ME % of Trips
Trips (PCUs)
% of Trips
0
50,000
100,000
150,000
200,000
250,000
0%
2%
4%
6%
8%
10%
12%
14%
0 - 2
2 - 5
5 - 10
10 - 15
15 - 20
20 - 25
25 - 30
30 - 40
40 - 50
50 - 75
75 - 100
100 - 150
150 - 200
200 - 300
300 - 400
400 - 500
500 - 10000
Distance (km)

E.4. Post ME2 vs Prior: Sector to Sector Changes

Figure E-13 - AM Sector to Sector % Change

Green	Pass: Absolute % difference between 0% - 5%
Amber	Near: Absolute % difference between 5% - 10%
Red	Fail: Absolute % difference > 10%
Blank (-)	Prior trips < 100.

	North Wiltshire	North West Wiltshire	West Wiltshire	South West Wiltshire	Salisbury	Kennet	Swindon	South West	South	East	North	Total
North Wiltshire	3%	18%	-	-	-	11%	-7%	11%	-	51%	-	**6%**
North West Wiltshire	-11%	4%	28%	-	-	4%	-36%	-21%	-	4%	3%	**-2%**
West Wiltshire	6%	21%	11%	65%	68%	33%	-4%	-14%	22%	-7%	-	**9%**
South West Wiltshire	-	-17%	12%	50%	53%	-1%	-	-19%	-	-	-	**22%**
Salisbury	-	-	-	17%	1%	26%	-	-3%	4%	-23%	-	**2%**
Kennet	15%	9%	19%	-	-4%	-2%	-17%	-14%	-14%	-30%	-	**-5%**
Swindon	-10%	-30%	-	-	-	-32%	-2%	-22%	-22%	-20%	-22%	**-7%**
South West	-12%	-2%	4%	43%	3%	3%	-12%	-2%	5%	1%	-6%	**-2%**
South	-	-	-	-	3%	-16%	-20%	11%	-9%	-3%	17%	**-8%**
East	38%	6%	-	-	-12%	-18%	-12%	0%	-3%	0%	-1%	**0%**
North	-4%	2%	-	-	-	-	-23%	-9%	18%	-1%	0%	**0%**
Total	**-4%**	**4%**	**12%**	**48%**	**3%**	**-2%**	**-5%**	**-2%**	**-8%**	**0%**	**0%**	**-1%**

Figure E-14 - AM Sector to Sector GEH Change

Green	Pass: GEH between 0 - 5
Amber	Near: GEH between 5 - 7
Red	Fail: GEH > 7
Blank (-)	Prior trips < 100.

	North Wiltshire	North West Wiltshire	West Wiltshire	South West Wiltshire	Salisbury	Kennet	Swindon	South West	South	East	North	Total
North Wiltshire	1	4	-	-	-	1	3	4	-	8	-	**4**
North West Wiltshire	3	3	7	-	-	1	10	10	-	1	0	**2**
West Wiltshire	1	6	8	11	7	5	0	7	2	1	-	**9**
South West Wiltshire	-	2	3	17	8	0	-	5	-	-	-	**13**
Salisbury	-	-	-	2	1	5	-	1	2	4	-	**2**
Kennet	2	2	4	-	1	1	5	3	4	10	-	**5**
Swindon	4	6	-	-	-	9	3	11	3	10	5	**12**
South West	5	1	1	8	1	1	6	16	4	1	5	**16**
South	-	-	-	-	1	3	3	6	39	5	6	**37**
East	5	1	-	-	2	4	5	0	4	2	1	**3**
North	0	0	-	-	-	-	6	9	6	1	0	**1**
Total	**3**	**4**	**11**	**22**	**3**	**2**	**9**	**18**	**37**	**4**	**0**	**15**

Figure E-15 - IP Sector to Sector % Change

Green	Pass: Absolute % difference between 0% - 5%
Amber	Near: Absolute % difference between 5% - 10%
Red	Fail: Absolute % difference > 10%
Blank (-)	Prior trips < 100.

	North Wiltshire	North West Wiltshire	West Wiltshire	South West Wiltshire	Salisbury	Kennet	Swindon	South West	South	East	North	Total
North Wiltshire	5%	16%	-	-	-	-	-2%	9%	-	59%	12%	**9%**
North West Wiltshire	23%	14%	51%	-	-	23%	-32%	6%	-	0%	0%	**15%**
West Wiltshire	-	59%	33%	39%	-	47%	-	11%	-	-	-	**32%**
South West Wiltshire	-	-	53%	55%	33%	-	-	14%	-	-	-	**45%**
Salisbury	-	-	-	26%	6%	2%	-	0%	13%	-22%	-	**5%**
Kennet	-	15%	42%	-	20%	5%	-21%	21%	-19%	-22%	-	**4%**
Swindon	-4%	-27%	-	-	-	-10%	-2%	-16%	-17%	0%	-21%	**-4%**
South West	12%	-18%	-9%	20%	6%	4%	16%	0%	16%	3%	-2%	**0%**
South	-	-	-	-	10%	-9%	-9%	5%	-6%	-3%	15%	**-5%**
East	33%	-6%	-10%	-	-8%	-24%	-5%	12%	-4%	0%	0%	**0%**
North	27%	9%	-	-	-	-	-28%	-7%	3%	0%	0%	**0%**
Total	**10%**	**10%**	**28%**	**44%**	**7%**	**3%**	**-2%**	**0%**	**-5%**	**0%**	**0%**	**0%**

Figure E-16 - IP Sector to Sector GEH Change

Green	Pass: GEH between 0 - 5
Amber	Near: GEH between 5 - 7
Red	Fail: GEH > 7
Blank (-)	Prior trips < 100.

	North Wiltshire	North West Wiltshire	West Wiltshire	South West Wiltshire	Salisbury	Kennet	Swindon	South West	South	East	North	Total
North Wiltshire	2	3	-	-	-	-	1	2	-	7	1	**6**
North West Wiltshire	5	10	11	-	-	4	6	2	-	0	0	**13**
West Wiltshire	-	12	22	7	-	7	-	4	-	-	-	**27**
South West Wiltshire	-	-	10	20	4	-	-	3	-	-	-	**22**
Salisbury	-	-	-	3	5	0	-	0	4	3	-	**6**
Kennet	-	2	6	-	4	4	5	3	4	5	-	**3**
Swindon	2	5	-	-	-	2	3	6	2	0	5	**6**
South West	4	7	4	4	2	1	6	1	10	2	2	**2**
South	-	-	-	-	4	2	1	3	23	3	5	**21**
East	4	1	1	-	1	6	2	7	4	1	0	**1**
North	3	1	-	-	-	-	6	6	1	0	0	**0**
Total	**6**	**9**	**24**	**22**	**7**	**3**	**4**	**2**	**21**	**1**	**0**	**1**

Figure E-17 - PM Sector to Sector % Change

Green	Pass: Absolute % difference between 0% - 5%
Amber	Near: Absolute % difference between 5% - 10%
Red	Fail: Absolute % difference > 10%
Blank (-)	Prior trips < 100.

	North Wiltshire	North West Wiltshire	West Wiltshire	South West Wiltshire	Salisbury	Kennet	Swindon	South West	South	East	North	Total
North Wiltshire	4%	-1%	10%	-	-	48%	-3%	0%	-	65%	33%	**4%**
North West Wiltshire	16%	4%	34%	-19%	-	2%	-29%	4%	-	15%	16%	**6%**
West Wiltshire	-	35%	19%	9%	-	40%	-	-6%	-	-	-	**17%**
South West Wiltshire	-	-	71%	63%	30%	-	-	43%	-	-	-	**56%**
Salisbury	-	-	54%	48%	0%	-16%	-	-1%	2%	-19%	-	**0%**
Kennet	59%	-5%	50%	52%	5%	-1%	-5%	20%	-28%	-18%	-	**1%**
Swindon	-7%	-26%	-3%	-	-	3%	-1%	-1%	-9%	-6%	15%	**-2%**
South West	1%	-32%	-15%	0%	6%	-3%	3%	-2%	25%	8%	-4%	**-2%**
South	-	-	-	-	2%	-14%	-1%	-12%	-9%	-3%	27%	**-8%**
East	30%	-15%	-8%	-	-17%	-30%	-18%	13%	-7%	0%	0%	**0%**
North	-	-13%	-	-	-	-	-29%	-7%	26%	0%	0%	**0%**
Total	**4%**	**-4%**	**16%**	**33%**	**1%**	**-3%**	**-3%**	**-2%**	**-8%**	**0%**	**0%**	**-1%**

Figure E-18 - PM Sector to Sector GEH Change

Green	Pass: GEH between 0 - 5
Amber	Near: GEH between 5 - 7
Red	Fail: GEH > 7
Blank (-)	Prior trips < 100.

	North Wiltshire	North West Wiltshire	West Wiltshire	South West Wiltshire	Salisbury	Kennet	Swindon	South West	South	East	North	Total
North Wiltshire	1	0	1	-	-	5	1	0	-	8	3	**3**
North West Wiltshire	4	3	10	2	-	0	6	1	-	2	2	**6**
West Wiltshire	-	9	14	2	-	7	-	2	-	-	-	**16**
South West Wiltshire	-	-	12	22	3	-	-	9	-	-	-	**27**
Salisbury	-	-	5	7	0	4	-	0	1	3	-	**0**
Kennet	6	1	8	5	1	1	1	3	7	4	-	**1**
Swindon	3	6	0	-	-	1	2	1	1	2	3	**4**
South West	0	17	8	0	2	1	1	15	15	4	4	**15**
South	-	-	-	-	1	4	0	10	41	4	7	**41**
East	5	3	1	-	3	10	9	7	10	2	0	**3**
North	-	2	-	-	-	-	6	6	8	0	0	**0**
Total	**3**	**5**	**16**	**19**	**1**	**3**	**6**	**15**	**39**	**2**	**0**	**12**

Appendix F. Data Processing Example

F.1. Step 1 Data Collection

Client:	ATKINS									
Project Number:	ID03962									
Junction Number:	Site Chip-06									
Flow from:	Pheonix Close (W)		**to:**	Blackcross (E)						
Date	Monday	28/05/2018								
Time	Total	Cycle	Motor Cycle	Car	LGV	2 Axled Rigid	3 Axled Rigid	4 Axled Rigid	3 Axled Artic	4 Axled Artic
00:00	*	*	*	*	*	*	*	*	*	*
00:15	*	*	*	*	*	*	*	*	*	*
00:30	*	*	*	*	*	*	*	*	*	*
00:45	*	*	*	*	*	*	*	*	*	*
01:00	*	*	*	*	*	*	*	*	*	*
01:15	*	*	*	*	*	*	*	*	*	*
01:30	*	*	*	*	*	*	*	*	*	*
01:45	*	*	*	*	*	*	*	*	*	*
02:00	*	*	*	*	*	*	*	*	*	*
02:15	*	*	*	*	*	*	*	*	*	*
02:30	*	*	*	*	*	*	*	*	*	*
02:45	*	*	*	*	*	*	*	*	*	*
03:00	*	*	*	*	*	*	*	*	*	*
03:15	*	*	*	*	*	*	*	*	*	*
03:30	*	*	*	*	*	*	*	*	*	*

The raw data collected by Intelligent data collection.

F.2. Processing

Site ID	Date	Day	AM - (07:00-10:00)				IP - (10:00 - 16:00)				PM - (16:00-19:00)				
			CAR	LGV	HGV	Total	CAR	LGV	HGV	Total	CAR	LGV	HGV	Total	
Chip-06	28/05/2018	Monday													remove
	29/05/2018	Tuesday													remove
	30/05/2018	Wednesday													remove
	31/05/2018	Thursday					5	13	1	18	129	210	7	347	remove
	01/06/2018	Friday	87	86	8	181	96	184	16	296	116	235	9	360	remove
	02/06/2018	Saturday	44	71	5	120	109	194	8	311	89	167	8	264	
	03/06/2018	Sunday	32	67	1	100	91	185	6	283	71	138	4	213	
	04/06/2018	Monday	109	154	16	279	90	173	19	282	147	274	7	428	yes
	05/06/2018	Tuesday	145	102	7	254	101	151	12	264	162	249	11	422	remove
	06/06/2018	Wednesday	138	112	12	263	96	182	19	296	156	258	13	427	yes
	07/06/2018	Thursday	147	146	11	304	98	169	16	283	163	259	14	436	remove
	08/06/2018	Friday	137	107	11	255	109	178	15	302	153	255	10	418	yes
	09/06/2018	Saturday	47	80	6	134	108	200	10	317	82	190	7	279	
	10/06/2018	Sunday	29	73	2	105	93	192	5	290	77	157	4	238	
	11/06/2018	Monday	108	153	17	278	95	162	18	275	148	255	15	418	yes
	12/06/2018	Tuesday	130	150	10	290	107	163	18	288	161	260	11	432	remove
	13/06/2018	Wednesday	117	147	12	277	97	178	17	292	144	267	11	422	yes
	14/06/2018	Thursday	132	138	11	281	97	172	15	284	162	273	13	448	yes
	15/06/2018	Friday	115	146	18	279	111	187	18	316	148	246	13	406	remove
	16/06/2018	Saturday	43	79	6	128	118	193	5	316	88	199	6	293	
	17/06/2018	Sunday	35	69	2	106	110	188	5	303	73	137	3	213	
	18/06/2018	Monday	110	145	15	270	95	174	18	287	138	241	14	394	yes
	19/06/2018	Tuesday	107	157	17	281	88	174	19	281	146	228	14	388	yes
	20/06/2018	Wednesday	116	153	16	284	95	172	20	287	150	246	8	404	yes
	21/06/2018	Thursday	109	123	8	240	90	173	22	285	146	240	11	397	remove
	22/06/2018	Friday	122	145	18	285	98	183	17	299	134	232	15	380	remove
	23/06/2018	Saturday	61	91	9	161	110	195	10	315	79	152	7	239	
	24/06/2018	Sunday	40	100	4	144	91	186	5	282	68	137	6	210	
	25/06/2018	Monday	92	150	16	258	89	170	18	278	133	239	12	384	remove
	26/06/2018	Tuesday	100	153	18	271	91	167	20	278	145	252	14	412	yes
	27/06/2018	Wednesday	99	152	16	267	90	157	15	262	145	241	13	399	yes
	28/06/2018	Thursday	88	165	19	271	92	169	20	281	164	241	13	417	yes
	29/06/2018	Friday	134	97	15	247	105	186	17	308	127	249	14	389	yes
	30/06/2018	Saturday	9	19	2	30									
	01/07/2018	Sunday													

Data is then extracted from the raw data sheets broken down by vehicle, day and time period.

F.3. Removing Outliers

	Before removing outliers											
	AM – (07:00-10:00)				IP – (10:00 – 16:00)				PM – (16:00-19:00)			
	CAR	LGV	HGV	Total	CAR	LGV	HGV	Total	CAR	LGV	HGV	Total
5 day average	15	14	1	31	27	19	1	47	48	31	1	80
Standard devia	3	2	1	4	4	3	0	7	4	3	0	6
confidence lev	1	1	0	2	2	1	0	3	2	2	0	3
Lower limit	14	13	1	29	25	18	1	44	46	30	1	77
Upper limit	17	15	1	32	29	21	1	50	50	33	1	83

An average weekday flow is calculated as well as a standard deviation over all weekday data. The confidence level is then calculated utilising the standard deviation and all weekday data. The lower and upper limits are calculated by respectively subtracting and adding the confidence level to the average weekday flow.

F.4. Final Flows

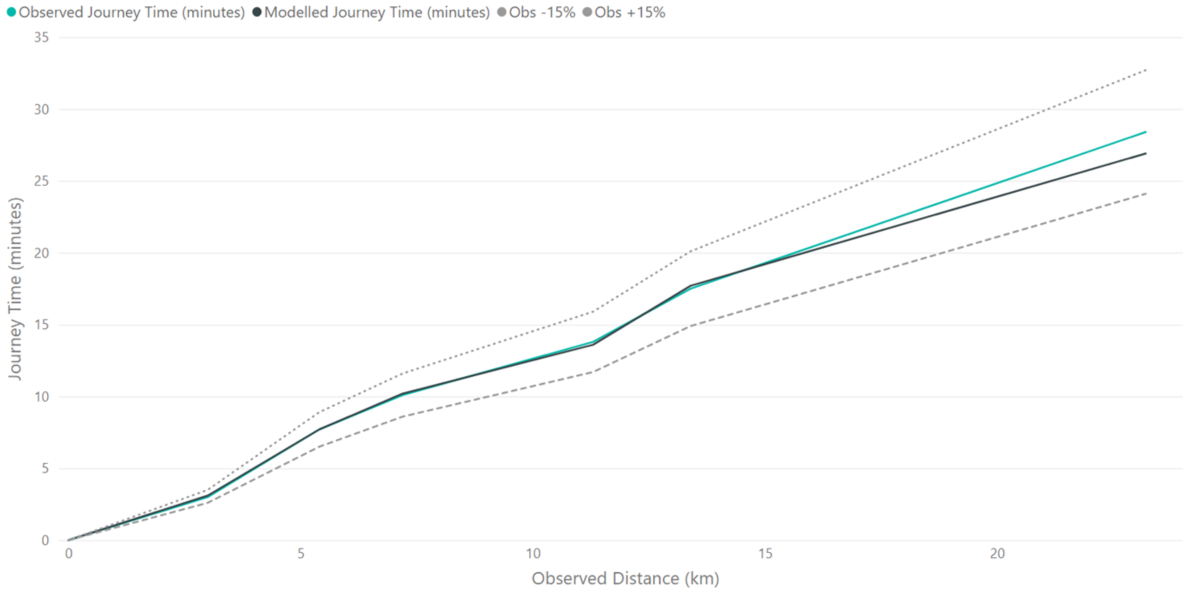
	Before removing outliers											
	AM – (07:00-10:00)				IP – (10:00 – 16:00)				PM – (16:00-19:00)			
	CAR	LGV	HGV	Total	CAR	LGV	HGV	Total	CAR	LGV	HGV	Total
5 day average	15	14	1	31	27	19	1	47	48	31	1	80
Standard devia	3	2	1	4	4	3	0	7	4	3	0	6
confidence lev	1	1	0	2	2	1	0	3	2	2	0	3
Lower limit	14	13	1	29	25	18	1	44	46	30	1	77
Upper limit	17	15	1	32	29	21	1	50	50	33	1	83

	After removing outliers											
	AM – (07:00-10:00)				IP – (10:00 – 16:00)				PM – (16:00-19:00)			
	CAR	LGV	HGV	Total	CAR	LGV	HGV	Total	CAR	LGV	HGV	Total
5 day average	16	14	1	31	27	19	1	48	47	32	1	80

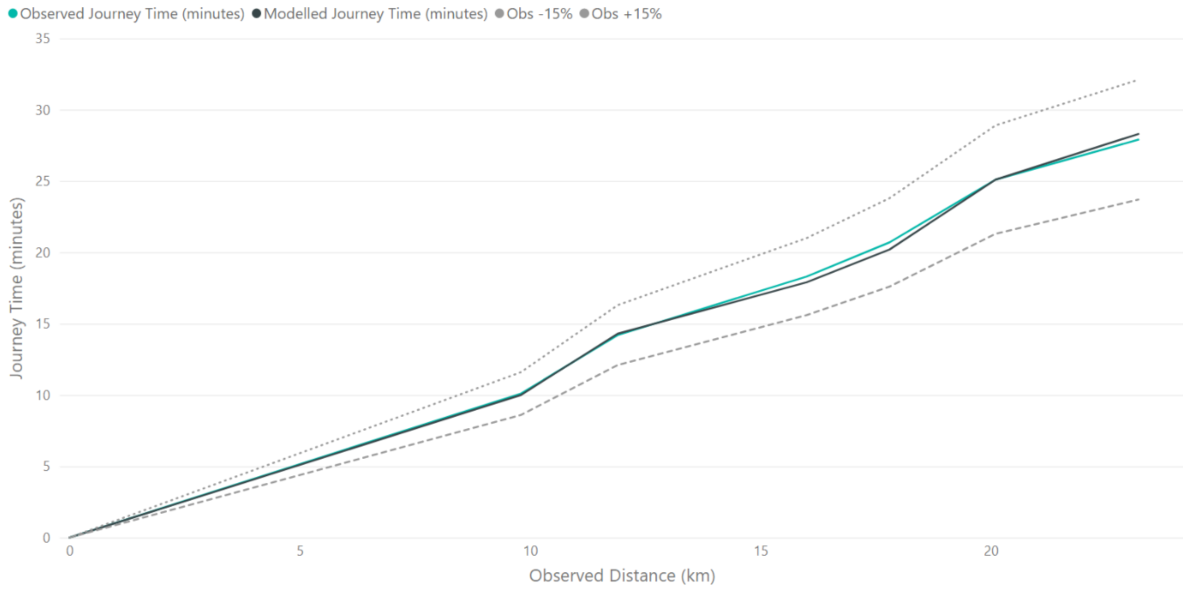
For any given weekday and time period, if the total flow (Car, LGV and HGV combined) lies within the total lower and upper limit, then for that day and time period the distinct Car, LGV and HGV flows are incorporated into the weekday average. Once the weekday averages by time period have been calculated for the given count site, the model is validated and calibrated against these calculated flows.

Appendix G. Distance-Time Validation

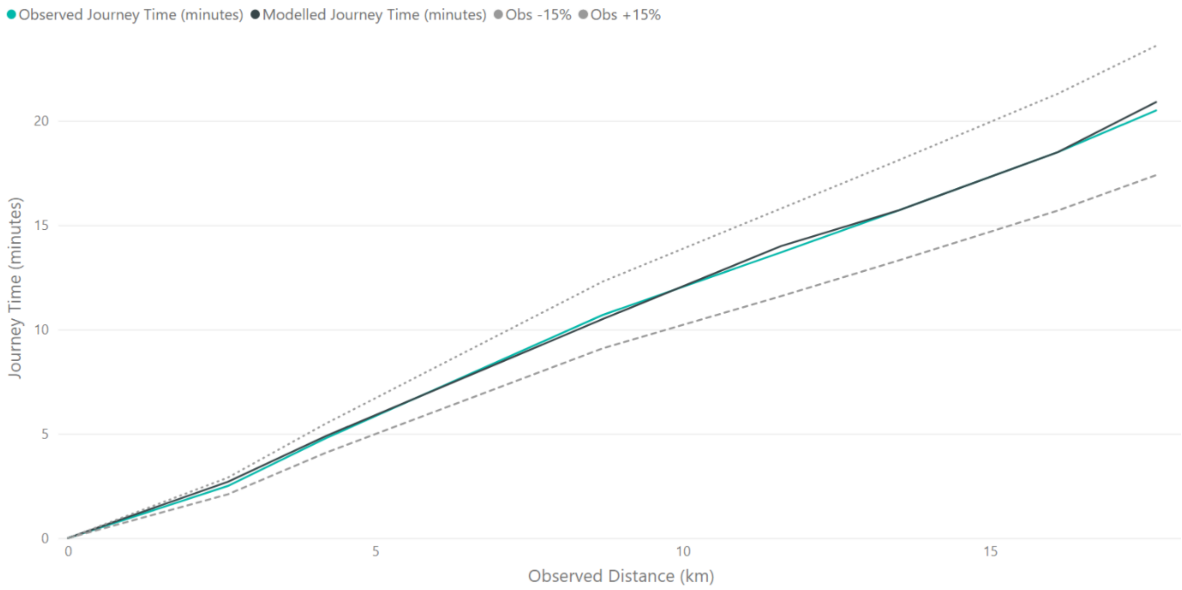
G.1. Route 1A: A350 Northbound AM Peak



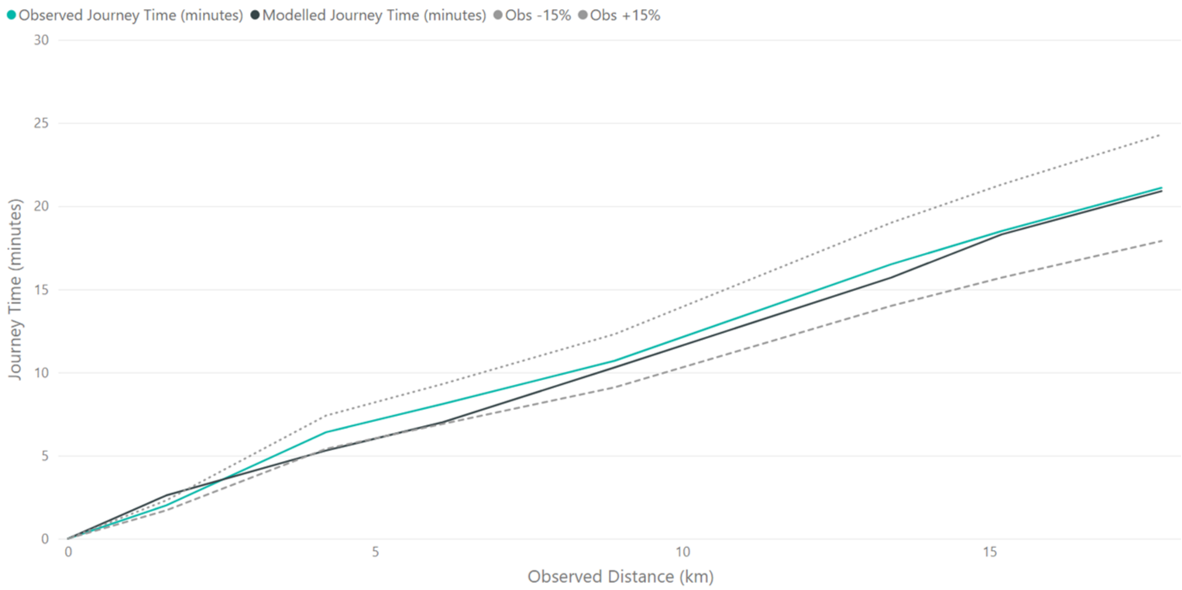
G.2. Route 1A: A350 Southbound AM Peak



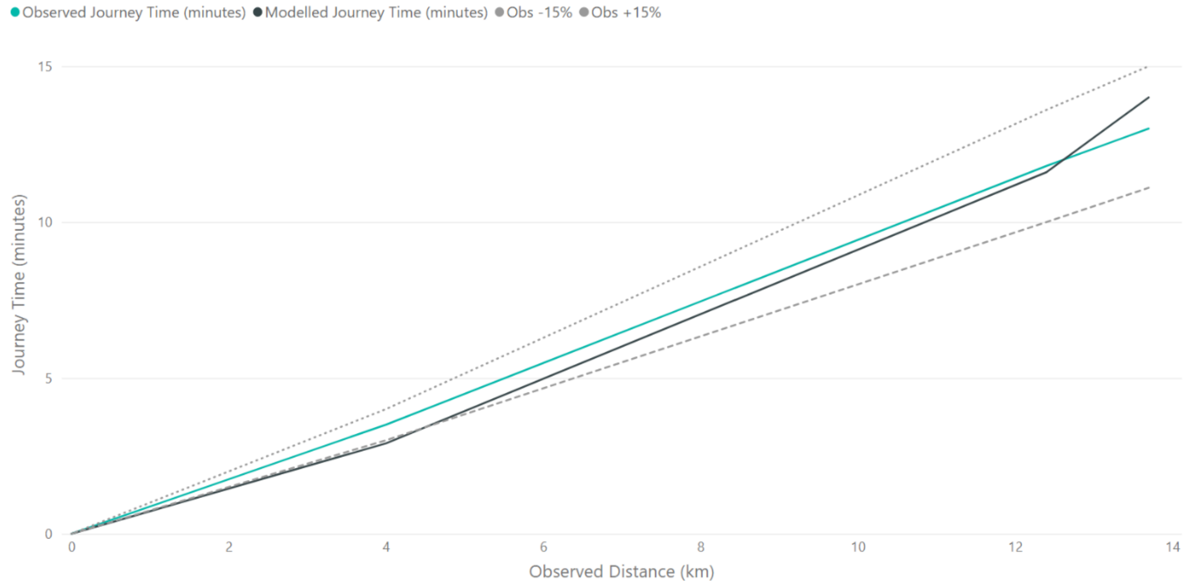
G.3. Route 1B: A350 Northbound AM



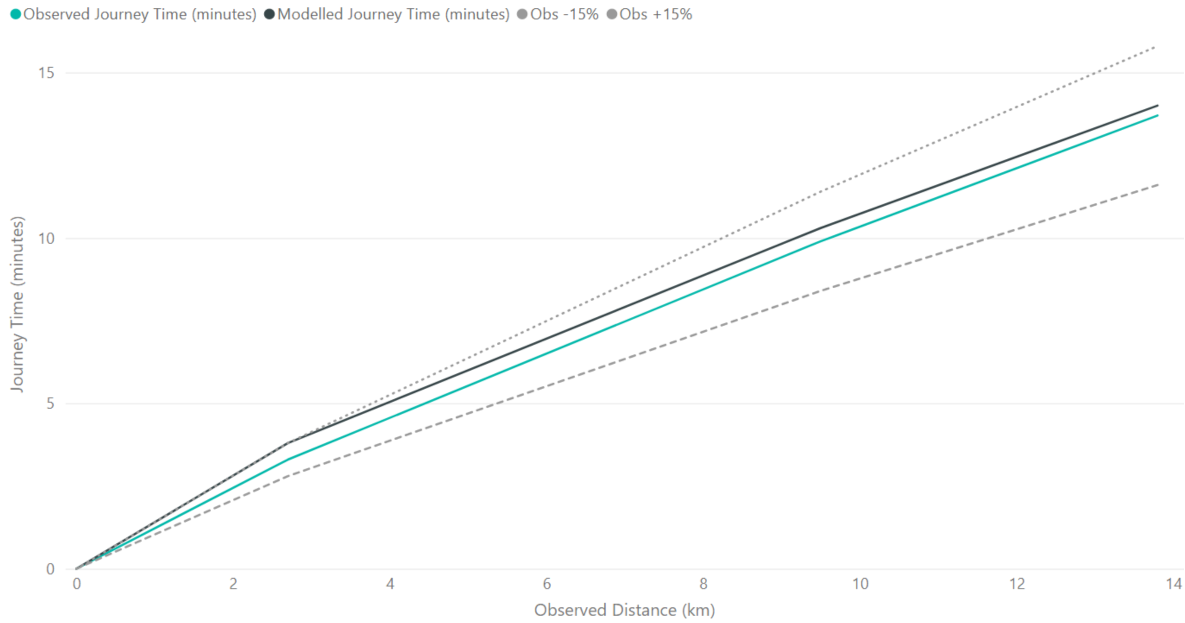
G.4. Route 1B: A350 Southbound AM



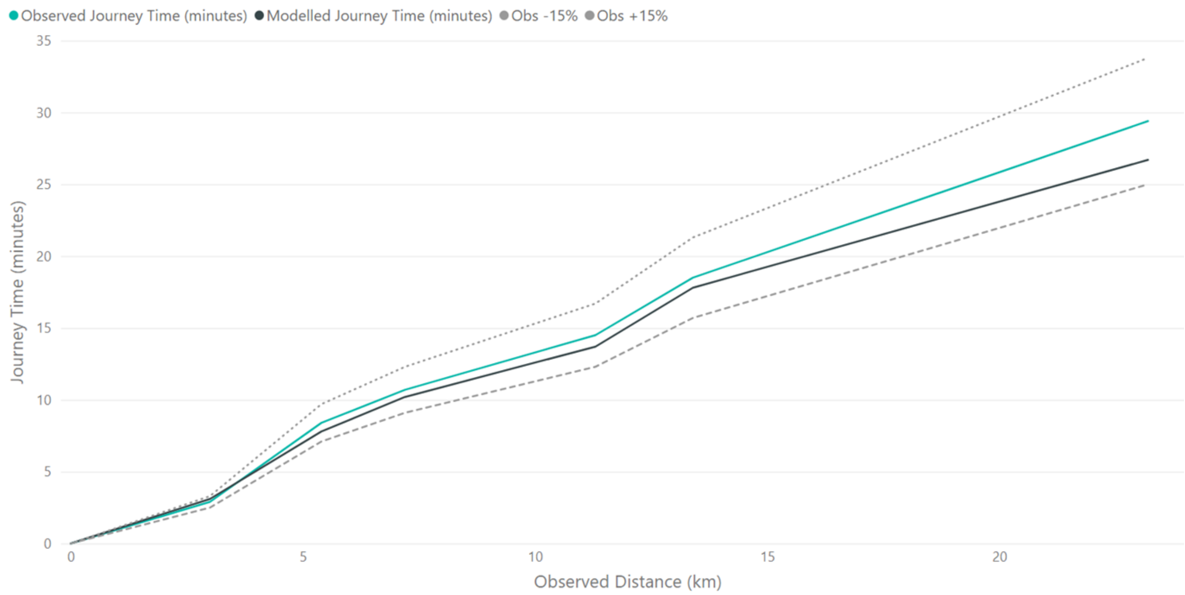
G.5. Route 1C: A350 Northbound AM



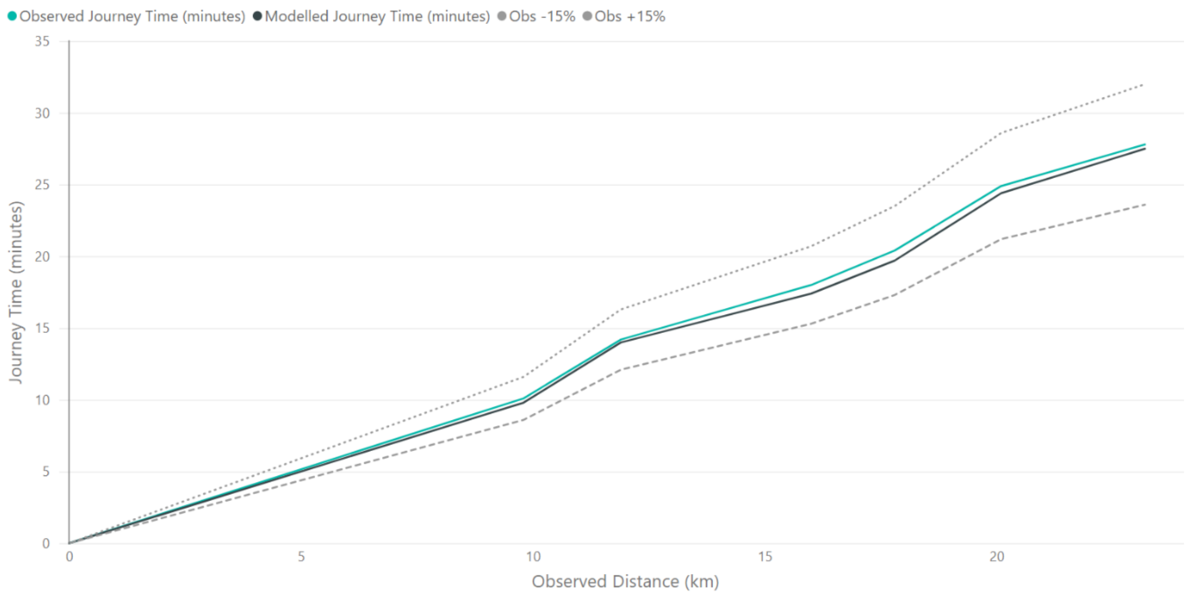
G.6. Route 1C: A350 Southbound AM



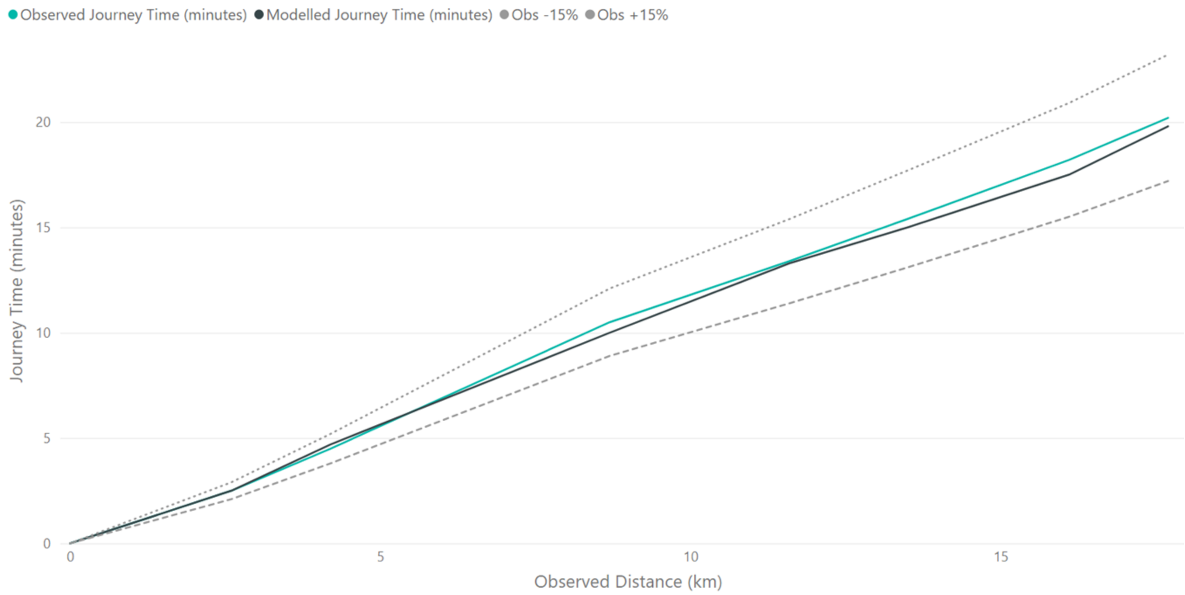
G.7. Route 1A: A350 Northbound Inter Peak



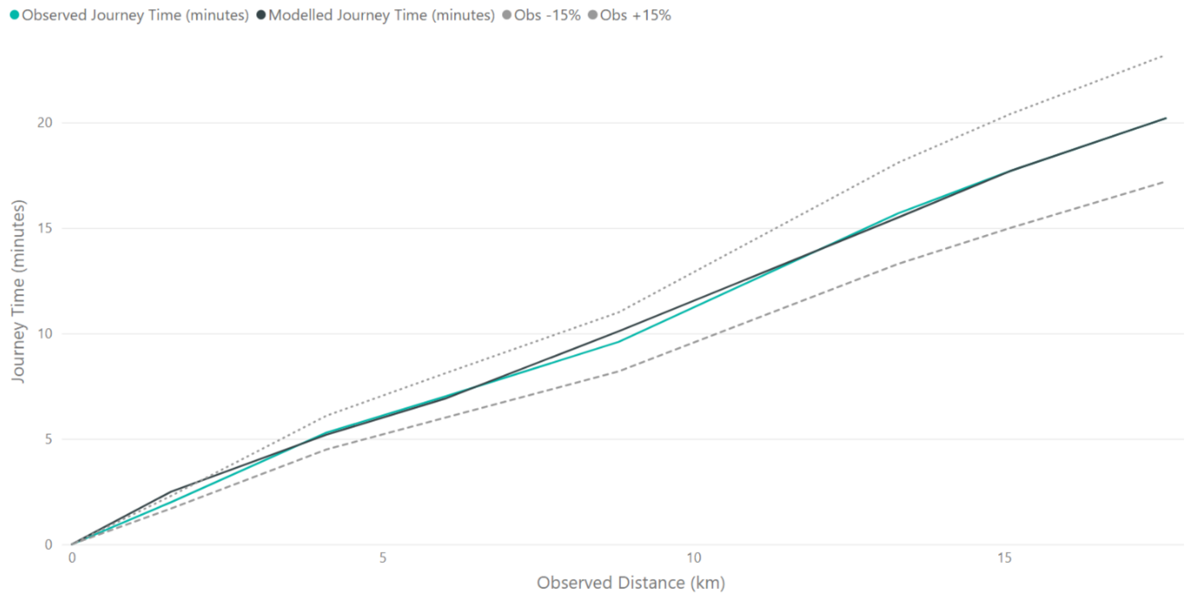
G.8. Route 1A: A350 Southbound Inter Peak



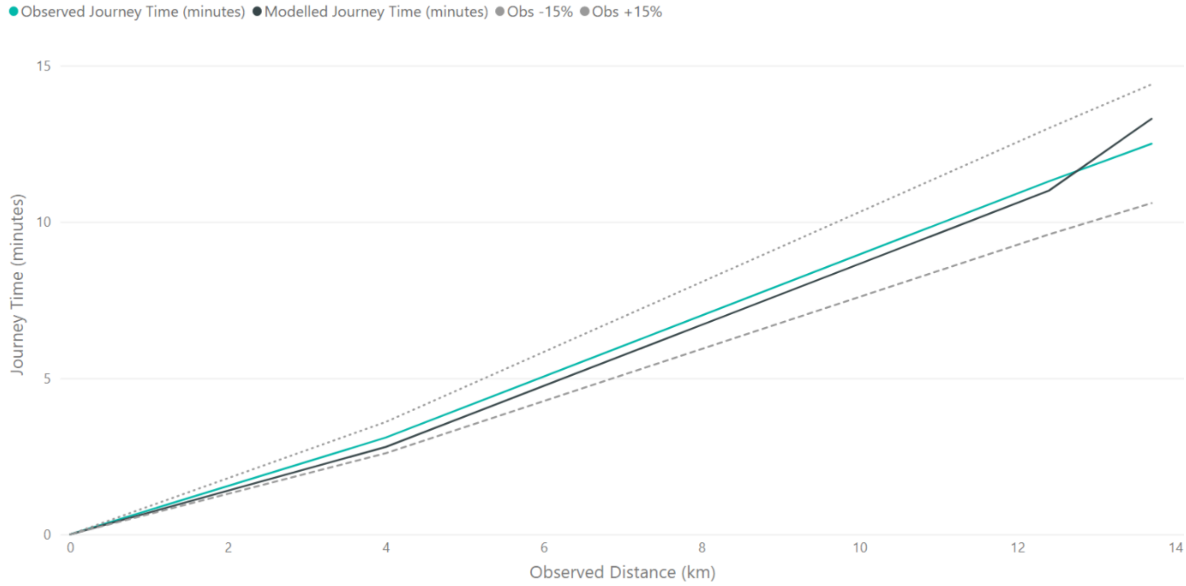
G.9. Route 1B: A350 Northbound Inter Peak



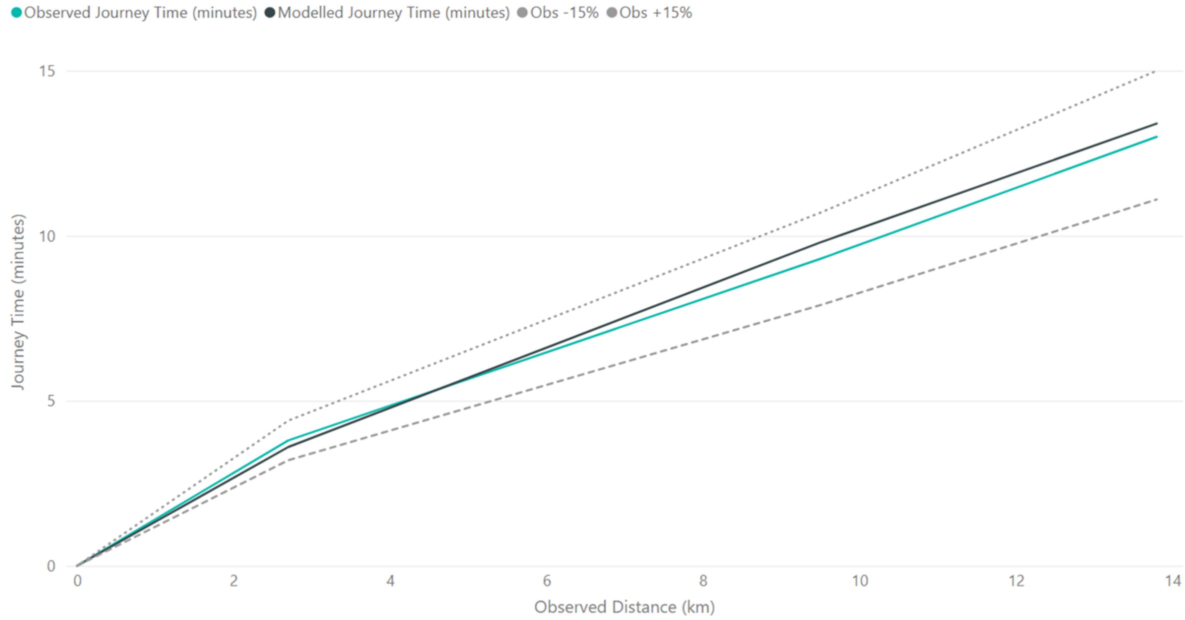
G.10. Route 1B: A350 Southbound Inter Peak



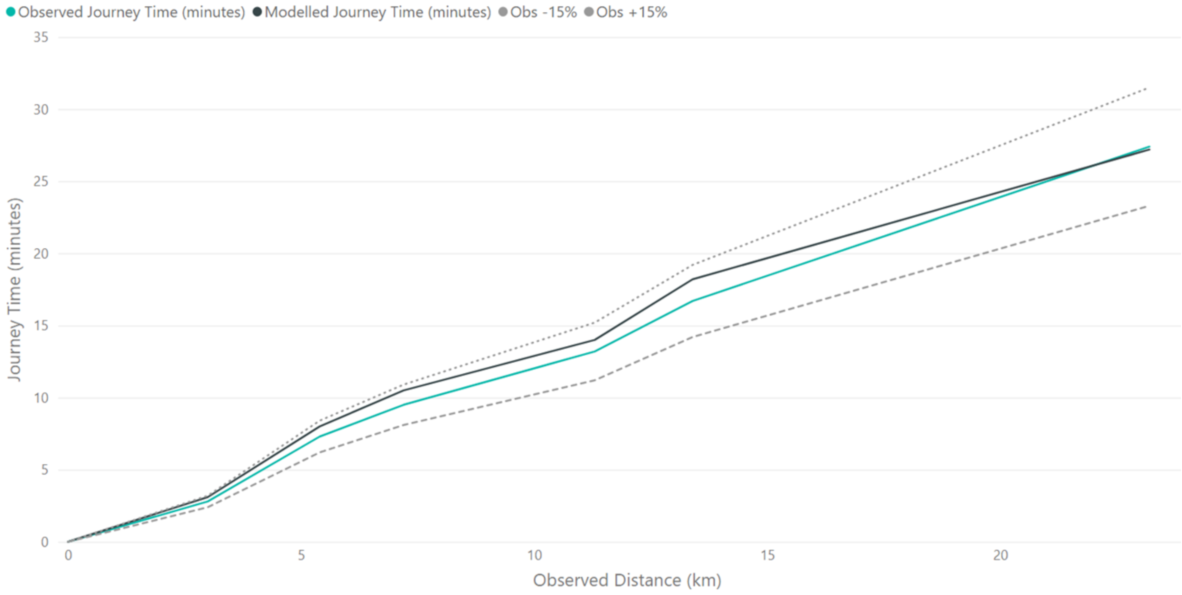
G.11. Route 1C: A350 Northbound Inter Peak



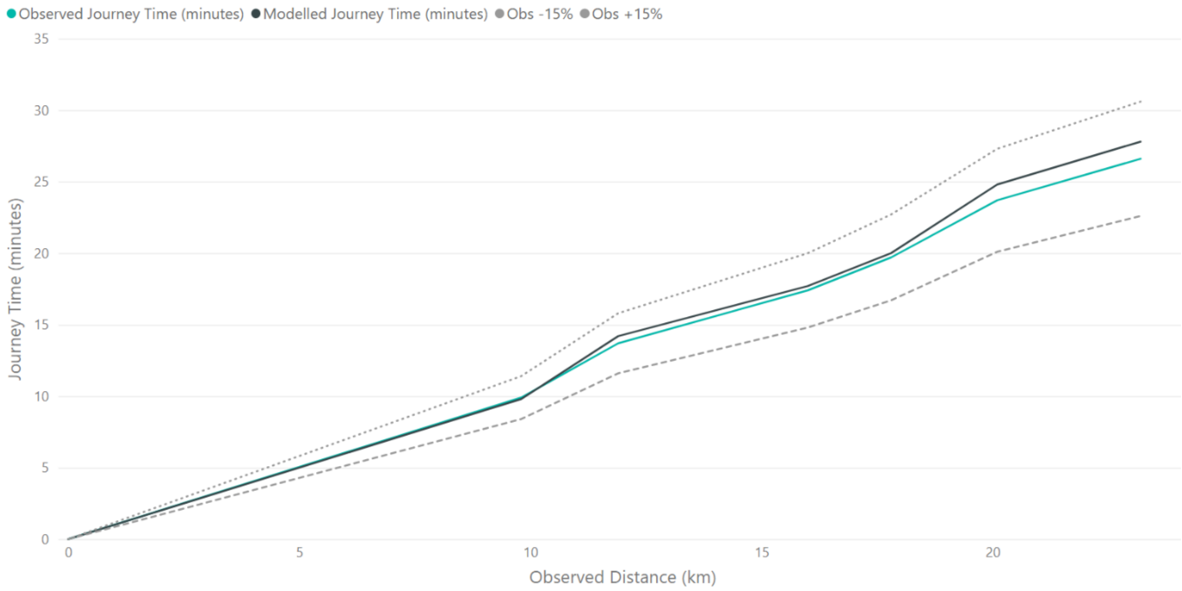
G.12. Route 1C: A350 Southbound Inter Peak



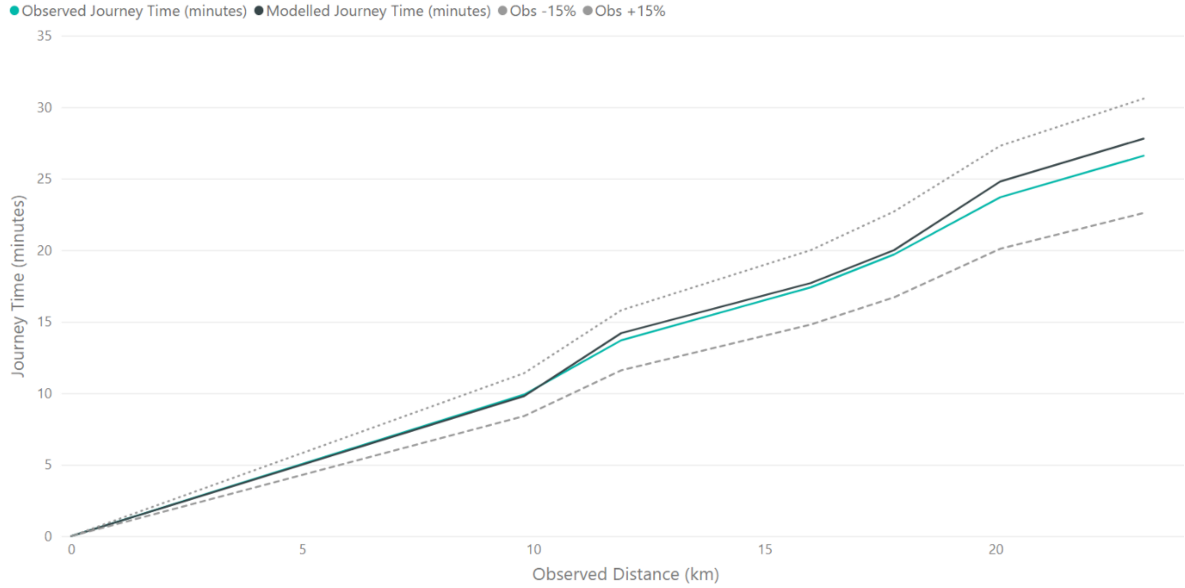
G.13. Route 1A: A350 Northbound PM Peak



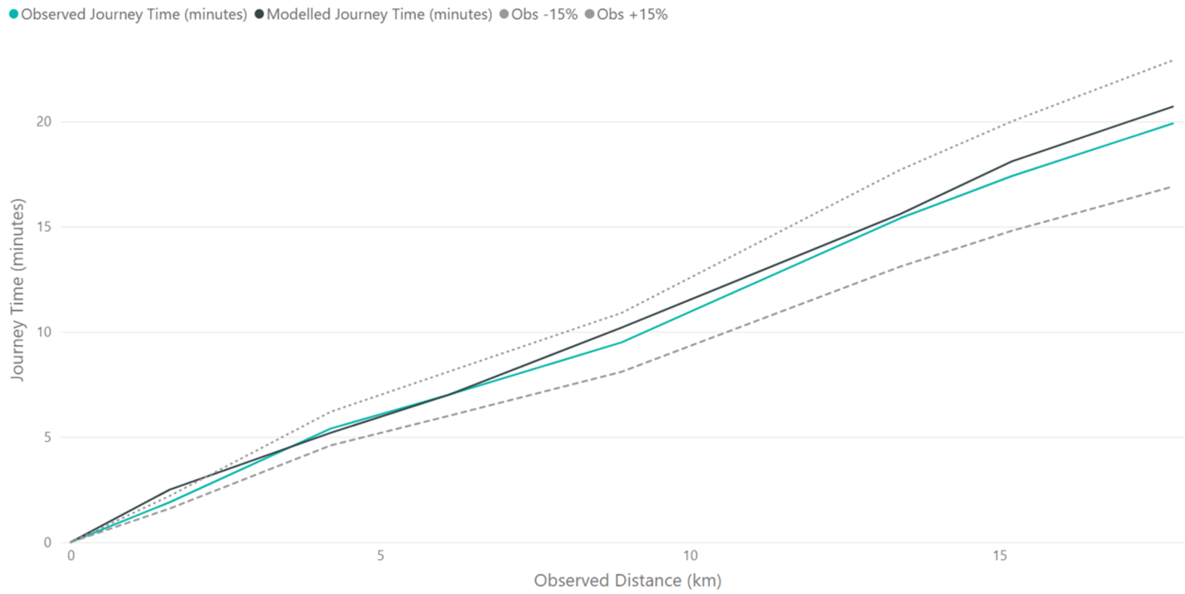
G.14. Route 1A: A350 Southbound PM Peak



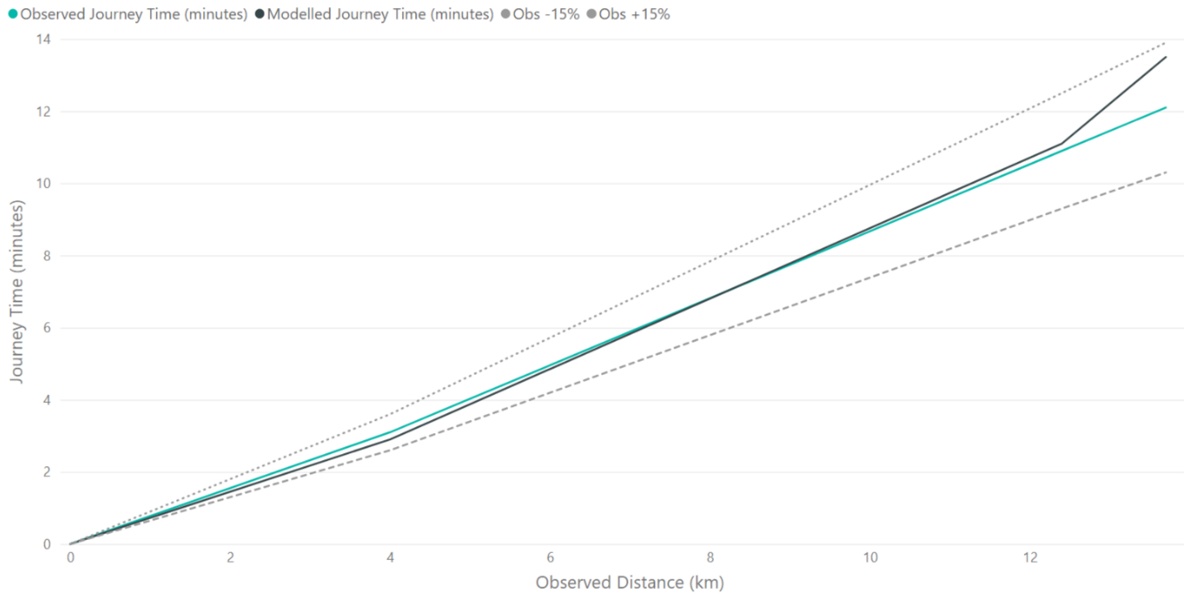
G.15. Route 1B: A350 Northbound PM



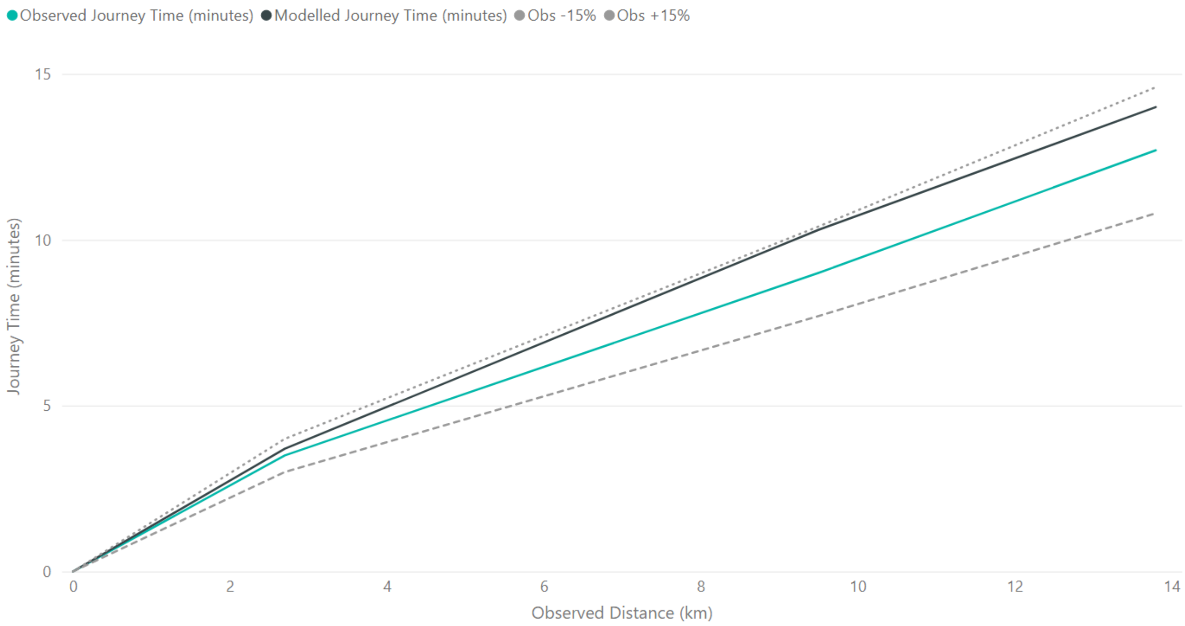
G.16. Route 1B: A350 Southbound PM



G.17. Route 1C: A350 Northbound PM



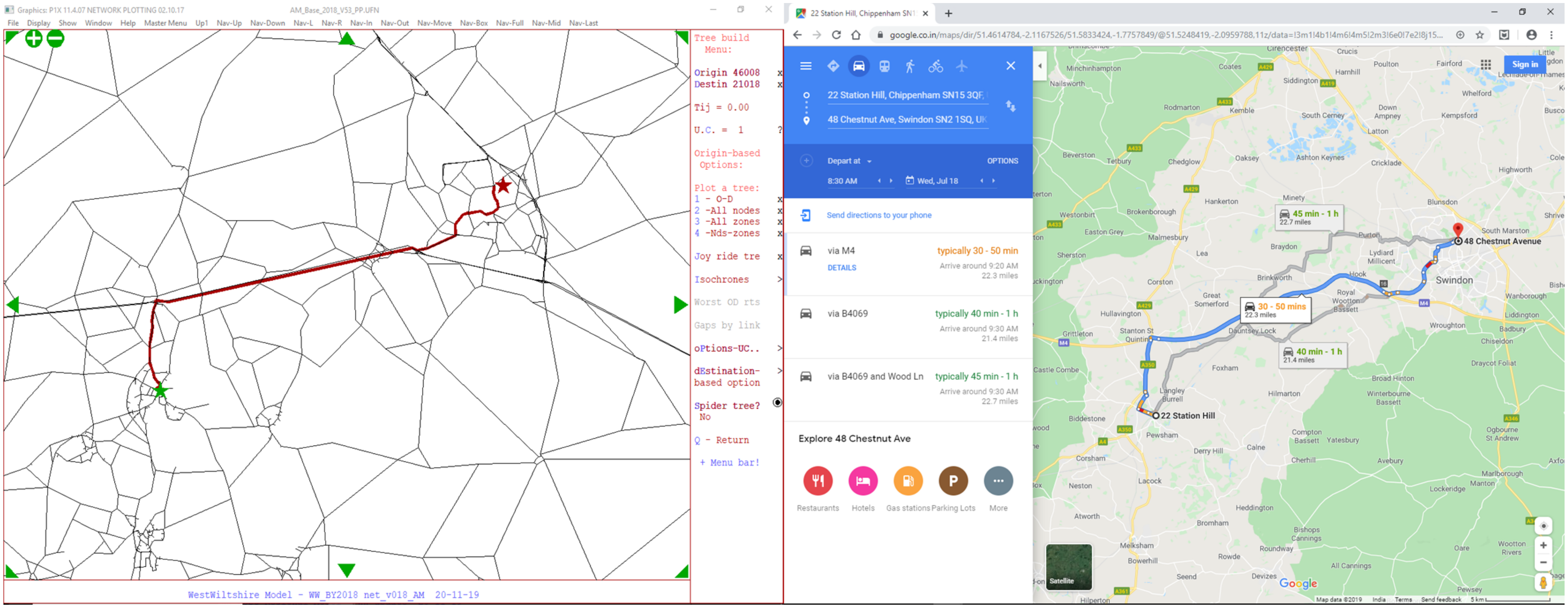
G.18. Route 1C: A350 Southbound PM



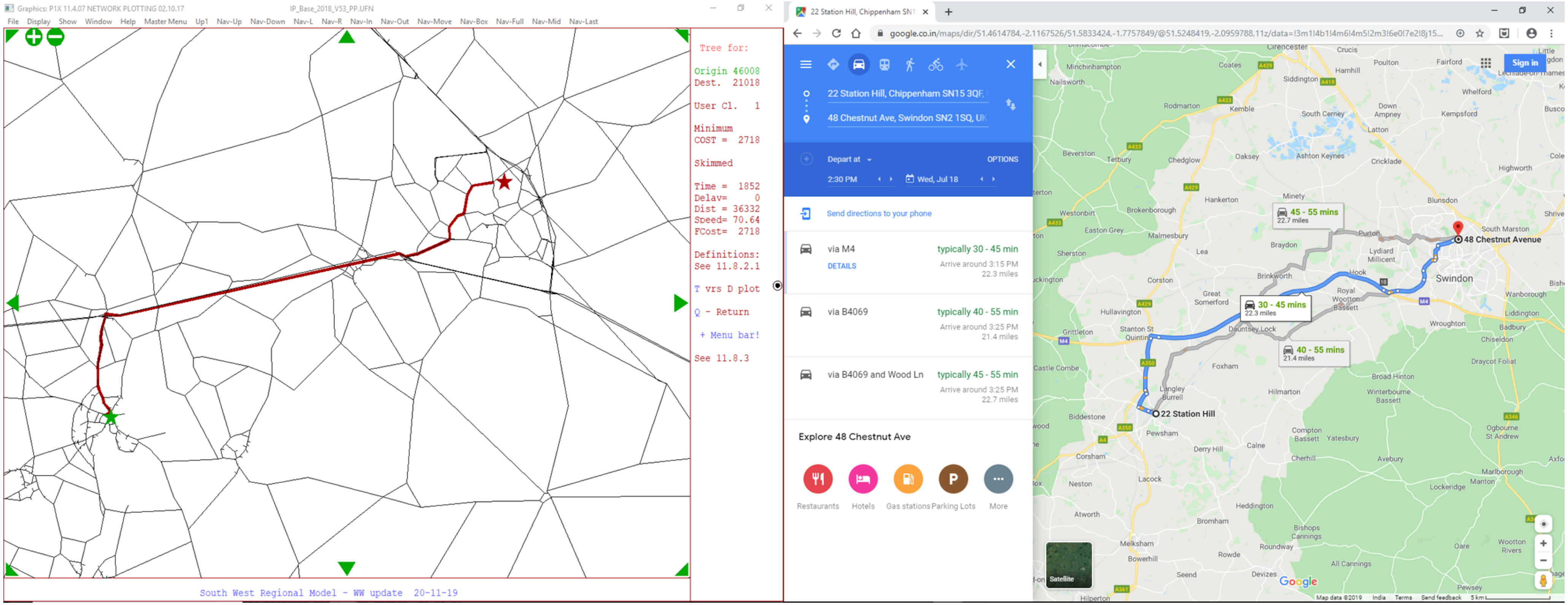
Appendix H. Route Choice validation

H.1. Chippenham to Swindon

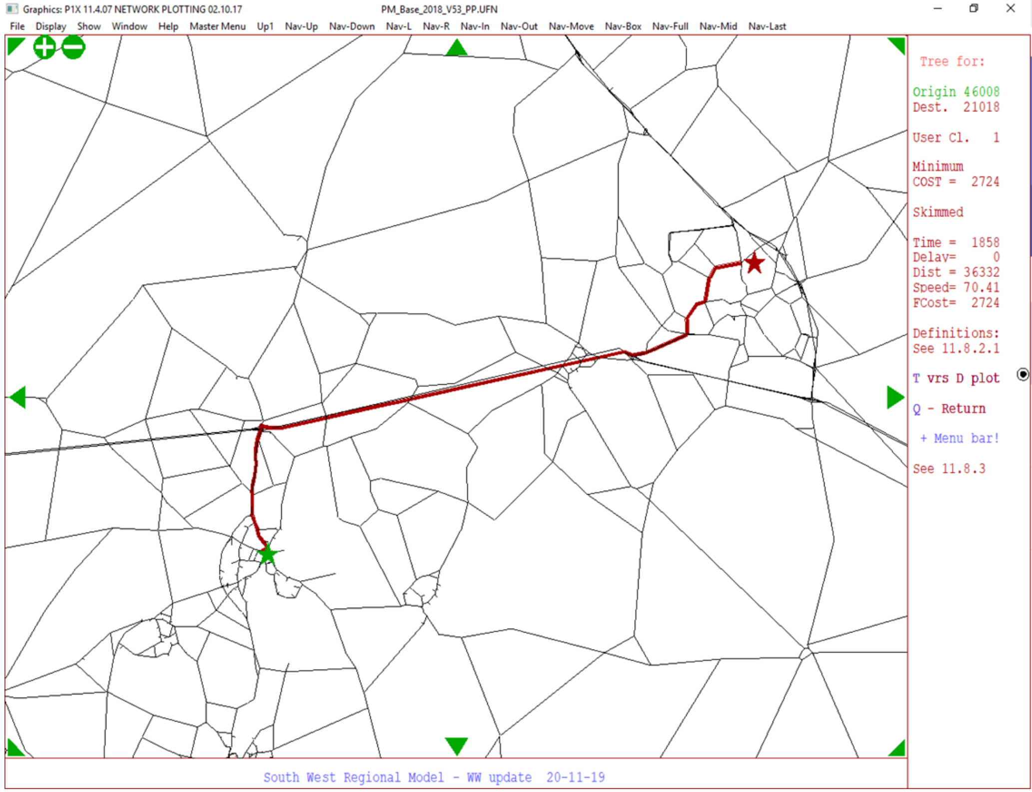
H.1.1. AM

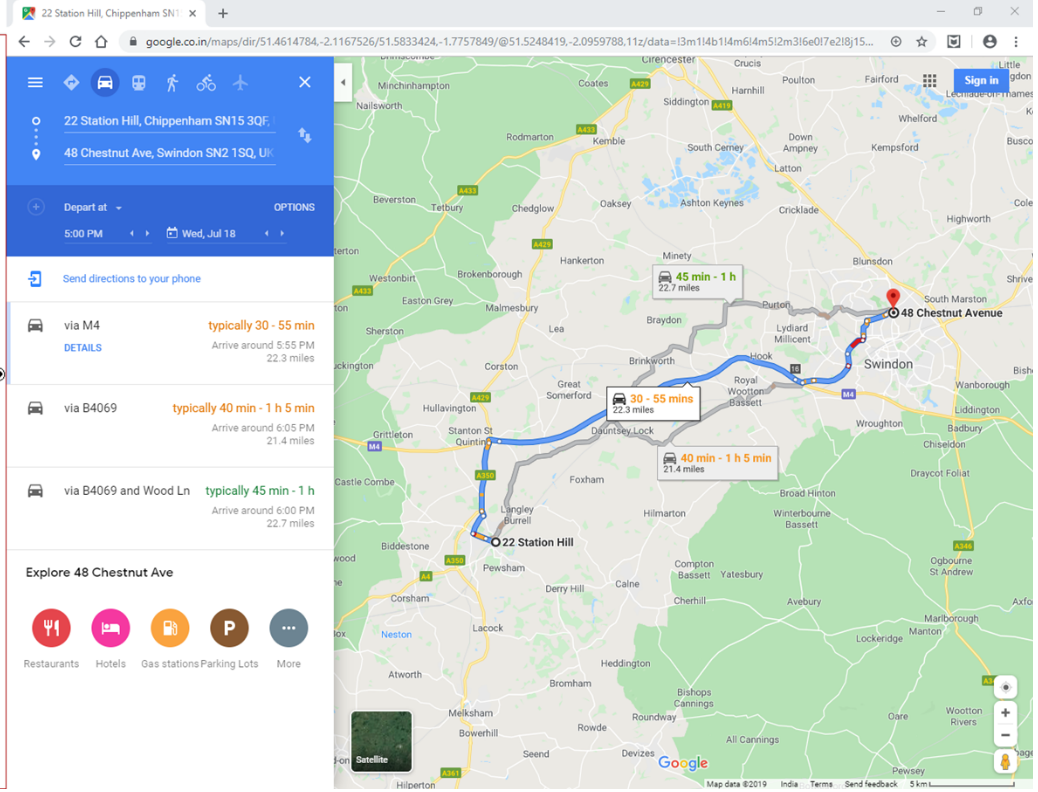


H.1.2. IP


Tree for:
Origin 46008
Dest. 21018
User Cl. 1
Minimum
COST = 2718
Skimmed
Time = 1852
Delay= 0
Dist = 36332
Speed= 70.64
FCost= 2718
Definitions:
See 11.8.2.1
T vrs D plot
Q - Return
+ Menu bar!
See 11.8.3
South West Regional Model - WW update 20-11-19
22 Station Hill, Chippenham SN15 3QF,
48 Chestnut Ave, Swindon SN2 1SQ, UK
Depart at
OPTIONS
2:30 PM
Wed, Jul 18
Send directions to your phone
via M4
DETAILS
typically 30 - 45 min
Arrive around 3:15 PM
22.3 miles
via B4069
typically 40 - 55 min
Arrive around 3:25 PM
21.4 miles
via B4069 and Wood Ln
typically 45 - 55 min
Arrive around 3:25 PM
22.7 miles
Explore 48 Chestnut Ave
Restaurants
Hotels
Gas stations
Parking Lots
More
45 - 55 mins
22.7 miles
30 - 45 mins
22.3 miles
40 - 55 mins
21.4 miles
48 Chestnut Avenue
22 Station Hill
Swindon
Satellite

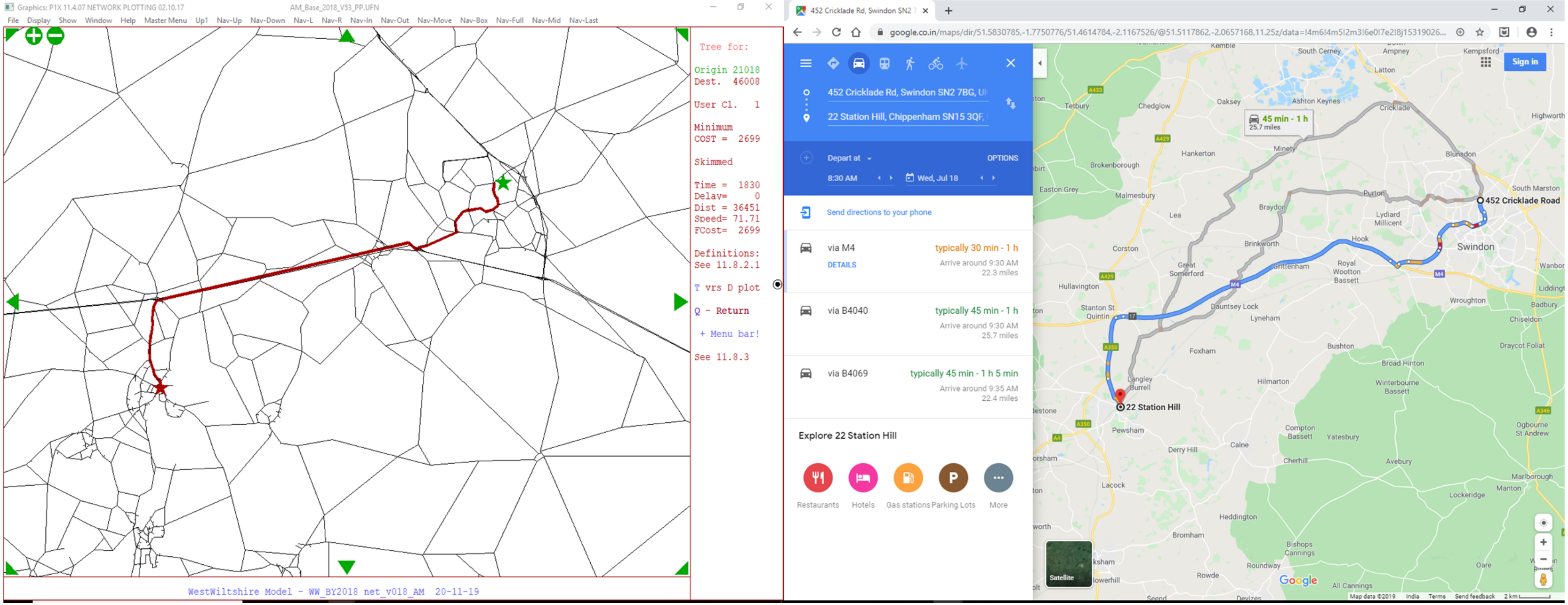
H.1.3. PM


Graphics: P1X 11.4.07 NETWORK PLOTTING 02.10.17
PM_Base_2018_V53_PP.UFN
File Display Show Window Help Master Menu Up1 Nav-Up Nav-Down Nav-L Nav-R Nav-In Nav-Out Nav-Move Nav-Box Nav-Full Nav-Mid Nav-Last
Tree for:
Origin 46008
Dest. 21018
User Cl. 1
Minimum
COST = 2724
Skimmed
Time = 1858
Delay= 0
Dist = 36332
Speed= 70.41
FCost= 2724
Definitions:
See 11.8.2.1
T vrs D plot
Q - Return
+ Menu bar!
See 11.8.3
South West Regional Model - WW update 20-11-19

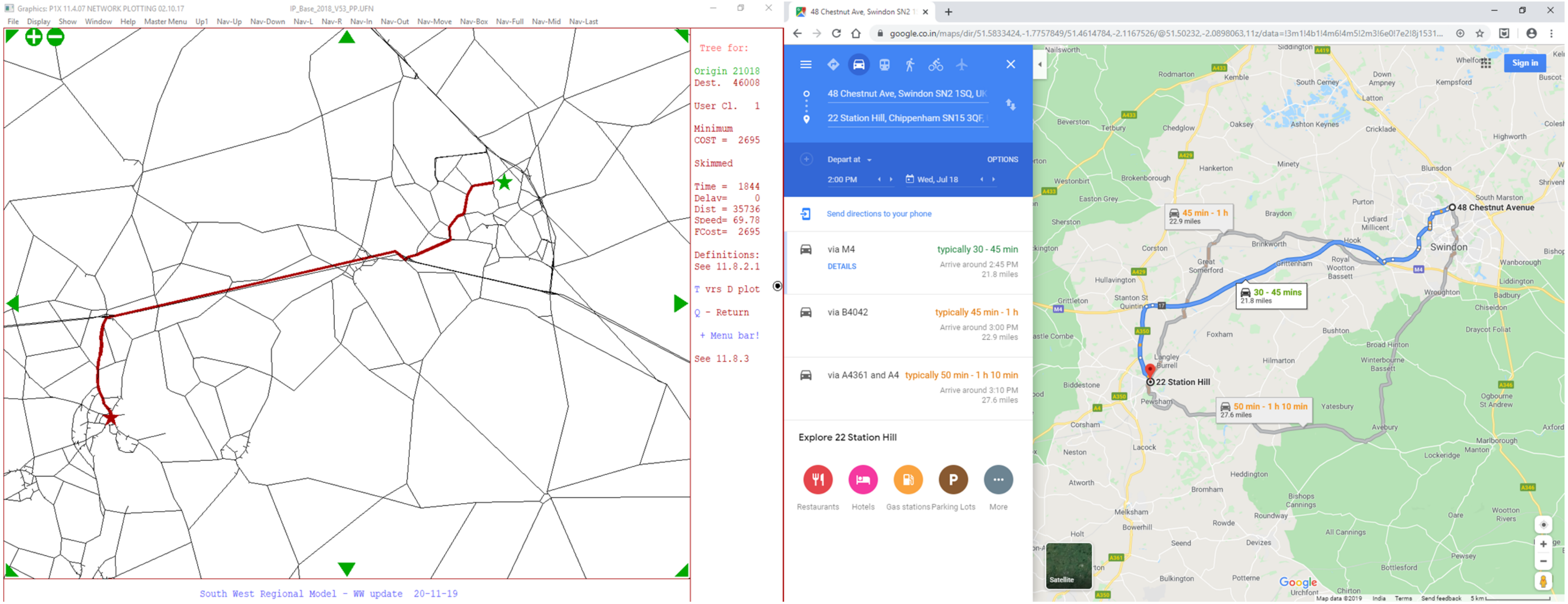

22 Station Hill, Chippenham SN15 3QF
48 Chestnut Ave, Swindon SN2 1SQ, UK
Depart at
OPTIONS
5:00 PM
Wed, Jul 18
Send directions to your phone
via M4
typically 30 - 55 min
DETAILS
Arrive around 5:55 PM
22.3 miles
via B4069
typically 40 min - 1 h 5 min
Arrive around 6:05 PM
21.4 miles
via B4069 and Wood Ln
typically 45 min - 1 h
Arrive around 6:00 PM
22.7 miles
Explore 48 Chestnut Ave
Restaurants
Hotels
Gas stations
Parking Lots
More
45 min - 1 h
22.7 miles
30 - 55 mins
22.3 miles
40 min - 1 h 5 min
21.4 miles
48 Chestnut Avenue
22 Station Hill
Swindon
Satellite
Google

H.2. Swindon to Chippenham

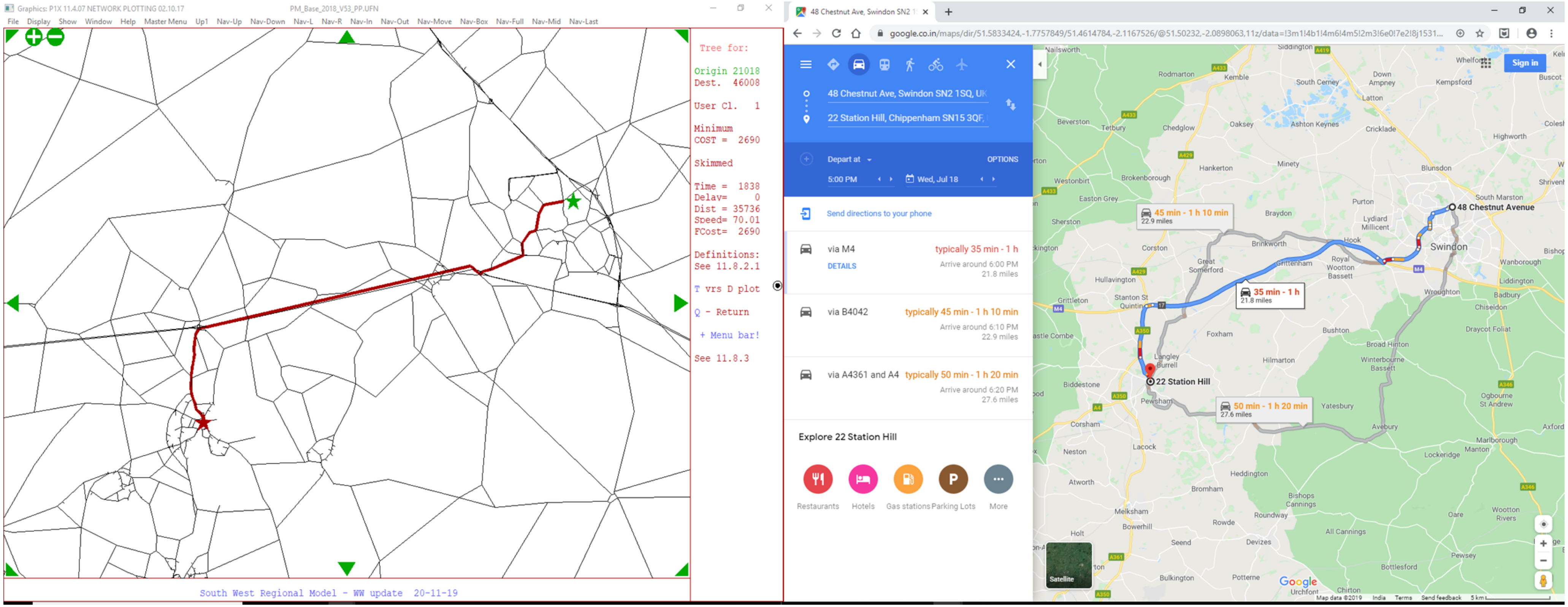
H.2.1. AM



H.2.2. IP

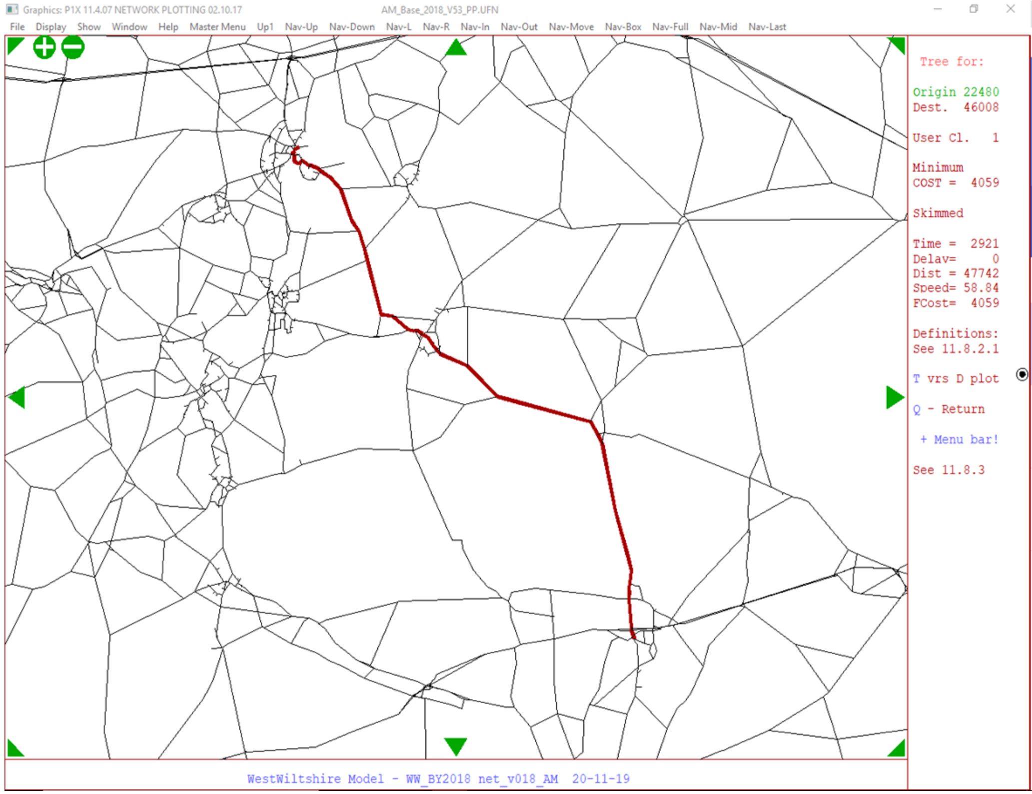

Tree for:
Origin 21018
Dest. 46008
User Cl. 1
Minimum
COST = 2695
Skimmed
Time = 1844
Delav= 0
Dist = 35736
Speed= 69.78
FCost= 2695
Definitions:
See 11.8.2.1
T vrs D plot
Q - Return
+ Menu bar!
See 11.8.3
South West Regional Model - WW update 20-11-19
48 Chestnut Ave, Swindon SN2 1SQ, UK
22 Station Hill, Chippenham SN15 3QF,
Depart at
OPTIONS
2:00 PM
Wed, Jul 18
Send directions to your phone
via M4
DETAILS
typically 30 - 45 min
Arrive around 2:45 PM
21.8 miles
via B4042
typically 45 min - 1 h
Arrive around 3:00 PM
22.9 miles
via A4361 and A4
typically 50 min - 1 h 10 min
Arrive around 3:10 PM
27.6 miles
Explore 22 Station Hill
Restaurants
Hotels
Gas stations
Parking Lots
More
48 Chestnut Avenue
22 Station Hill
Swindon
Sign in

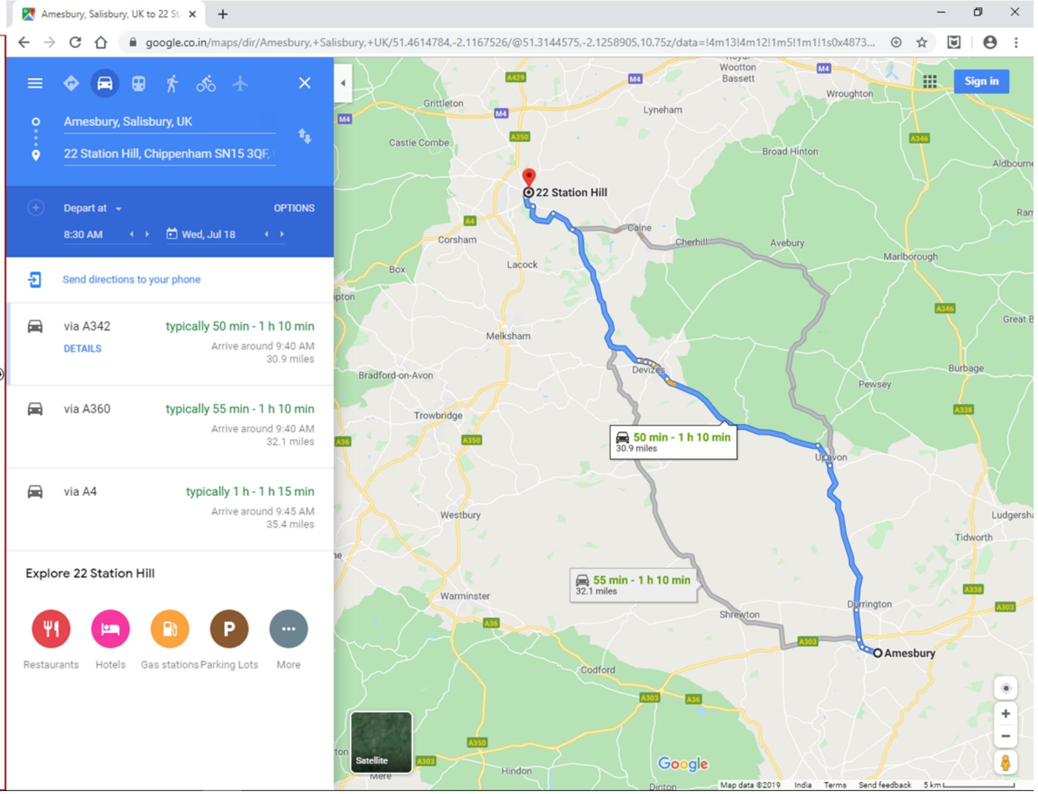
H.2.3. PM


Tree for:
Origin 21018
Dest. 46008
User Cl. 1
Minimum COST = 2690
Skimmed
Time = 1838
Delay= 0
Dist = 35736
Speed= 70.01
FCost= 2690
Definitions:
See 11.8.2.1
T vrs D plot
Q - Return
+ Menu bar!
See 11.8.3
South West Regional Model - WW update 20-11-19
48 Chestnut Ave, Swindon SN2 1SQ, UK
22 Station Hill, Chippenham SN15 3QF
Depart at
5:00 PM
Wed, Jul 18
OPTIONS
Send directions to your phone
via M4
typically 35 min - 1 h
Arrive around 6:00 PM
21.8 miles
DETAILS
via B4042
typically 45 min - 1 h 10 min
Arrive around 6:10 PM
22.9 miles
via A4361 and A4
typically 50 min - 1 h 20 min
Arrive around 6:20 PM
27.6 miles
Explore 22 Station Hill
Restaurants
Hotels
Gas stations
Parking Lots
More
48 Chestnut Avenue
22 Station Hill
Swindon
35 min - 1 h
45 min - 1 h 10 min
50 min - 1 h 20 min

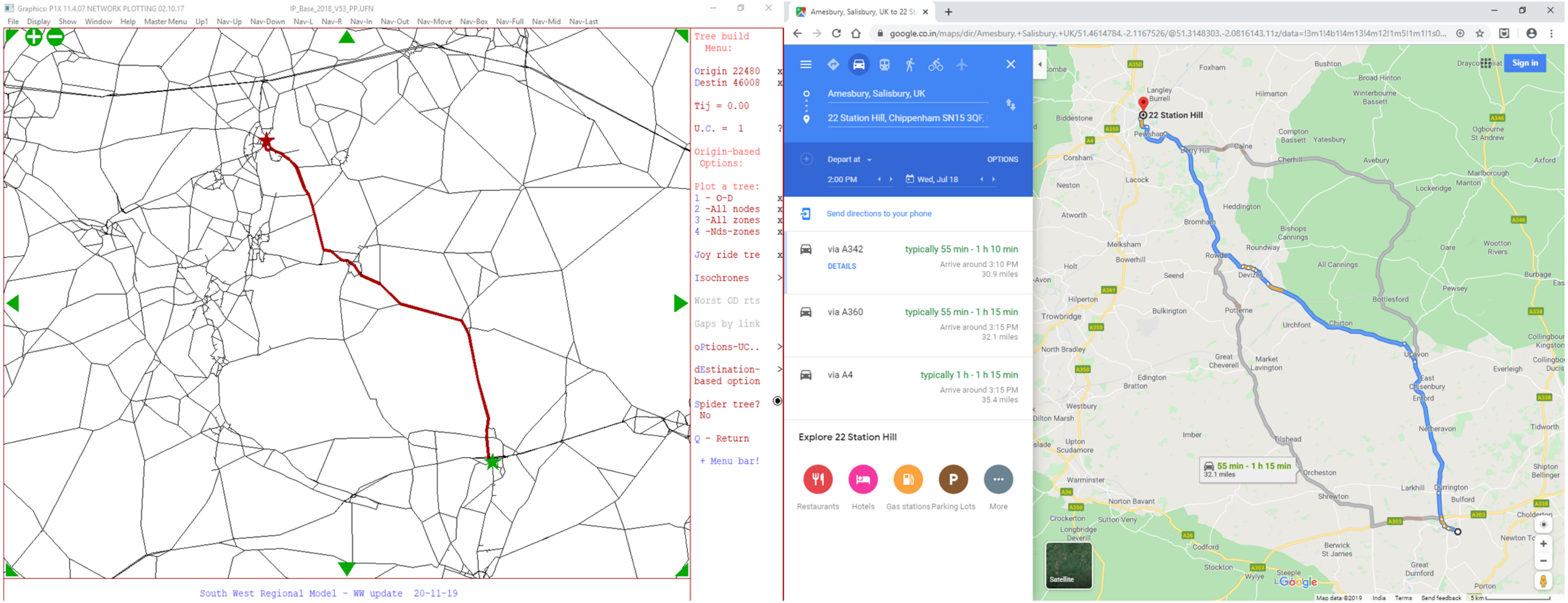
H.3. Amesbury to Chippenham

H.3.1. AM

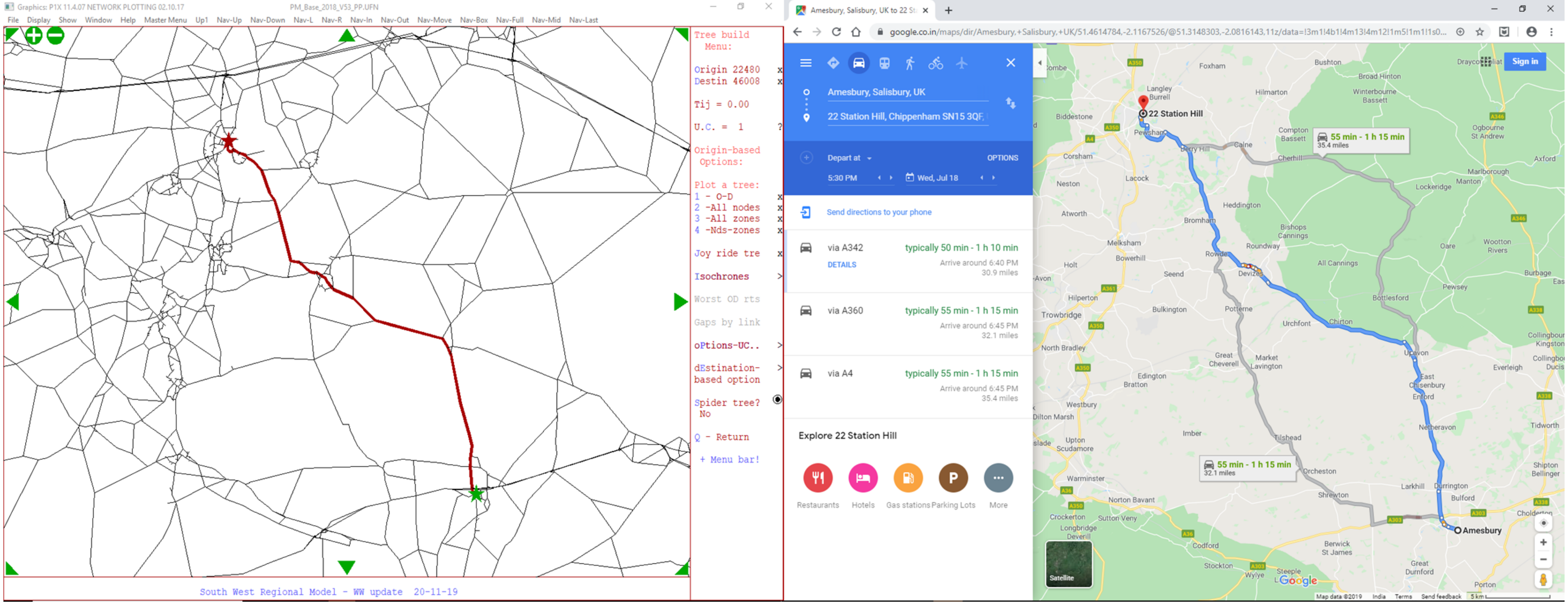




H.3.2. IP

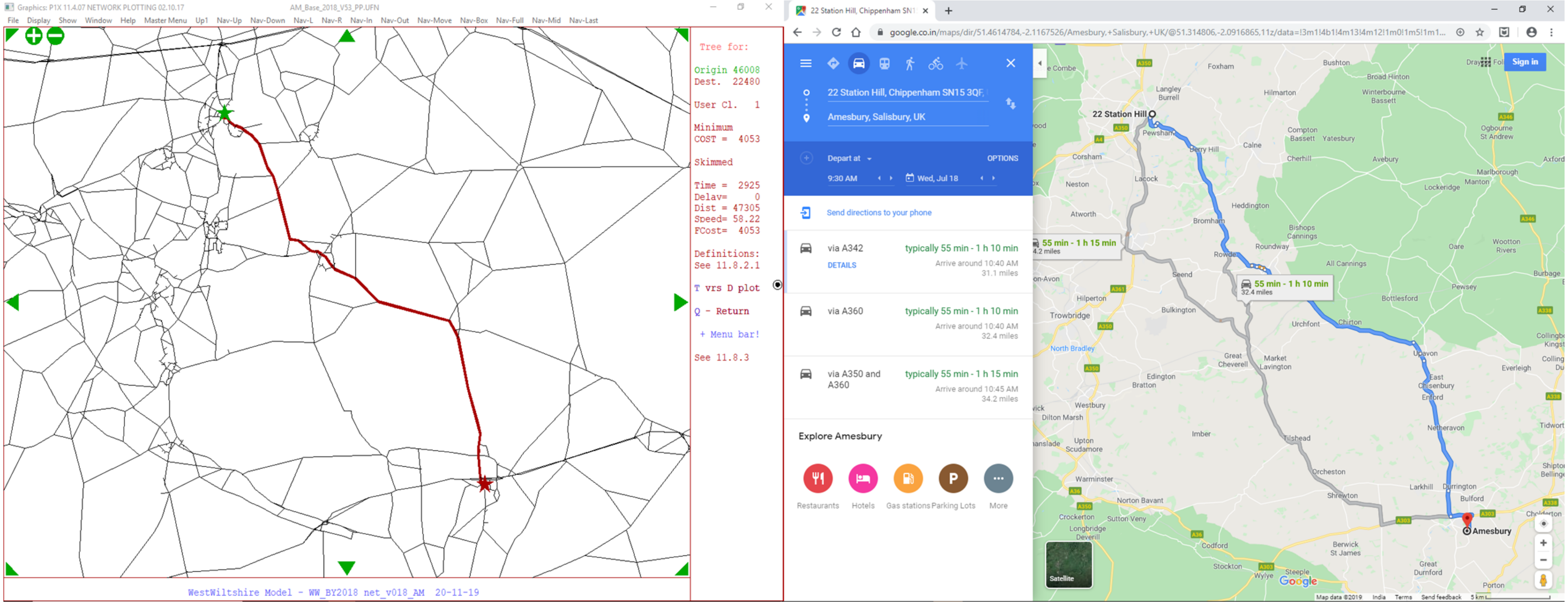

Tree build Menu:
Origin 22480
Destin 46008
Tij = 0.00
U.C. = 1
Origin-based Options:
Plot a tree:
1 - O-D
2 -All nodes
3 -All zones
4 -Nds-zones
Joy ride tre
Isochrones
Worst OD rts
Gaps by link
oPtions-UC..
dEstination-based option
Spider tree? No
Q - Return
+ Menu bar!
South West Regional Model - WW update 20-11-19
Amesbury, Salisbury, UK
22 Station Hill, Chippenham SN15 3QF,
Depart at
OPTIONS
2:00 PM
Wed, Jul 18
Send directions to your phone
via A342
typically 55 min - 1 h 10 min
Arrive around 3:10 PM
30.9 miles
DETAILS
via A360
typically 55 min - 1 h 15 min
Arrive around 3:15 PM
32.1 miles
via A4
typically 1 h - 1 h 15 min
Arrive around 3:15 PM
35.4 miles
Explore 22 Station Hill
Restaurants
Hotels
Gas stations
Parking Lots
More
22 Station Hill
55 min - 1 h 15 min
32.1 miles

H.3.3. PM

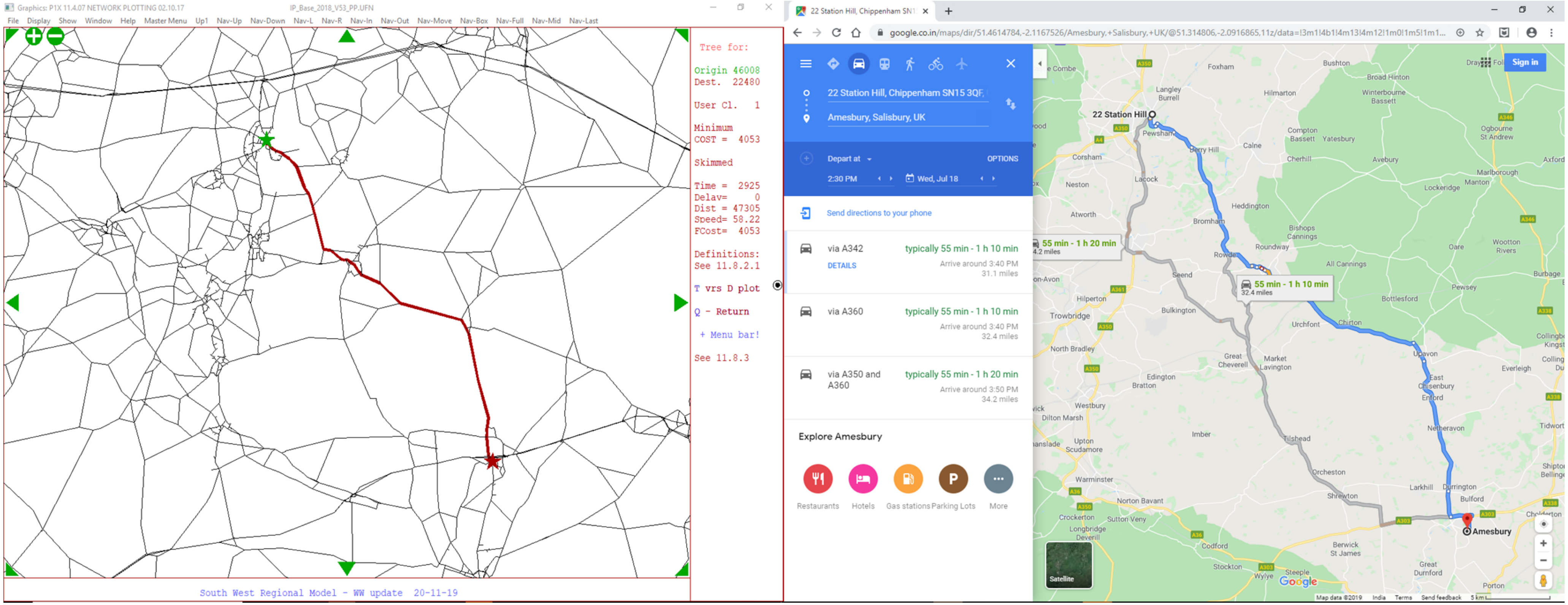

Graphics: P1X 11.4.07 NETWORK PLOTTING 02.10.17
PM_Base_2018_V53_PP.UFN
File Display Show Window Help Master Menu Up1 Nav-Up Nav-Down Nav-L Nav-R Nav-In Nav-Out Nav-Move Nav-Box Nav-Full Nav-Mid Nav-Last
Tree build Menu:
Origin 22480
Destin 46008
Tij = 0.00
U.C. = 1
Origin-based Options:
Plot a tree:
1 - O-D
2 -All nodes
3 -All zones
4 -Nds-zones
Joy ride tre
Isochrones
Worst OD rts
Gaps by link
oPtions-UC..
dEstination-based option
Spider tree? No
Q - Return
+ Menu bar!
South West Regional Model - WW update 20-11-19
Amesbury, Salisbury, UK
22 Station Hill, Chippenham SN15 3QF
Depart at
OPTIONS
5:30 PM
Wed, Jul 18
Send directions to your phone
via A342
DETAILS
typically 50 min - 1 h 10 min
Arrive around 6:40 PM
30.9 miles
via A360
typically 55 min - 1 h 15 min
Arrive around 6:45 PM
32.1 miles
via A4
typically 55 min - 1 h 15 min
Arrive around 6:45 PM
35.4 miles
Explore 22 Station Hill
Restaurants
Hotels
Gas stations
Parking Lots
More
22 Station Hill
55 min - 1 h 15 min
35.4 miles
55 min - 1 h 15 min
32.1 miles
Amesbury
Sign in
Satellite

H.4. Chippenham to Amesbury

H.4.1. AM

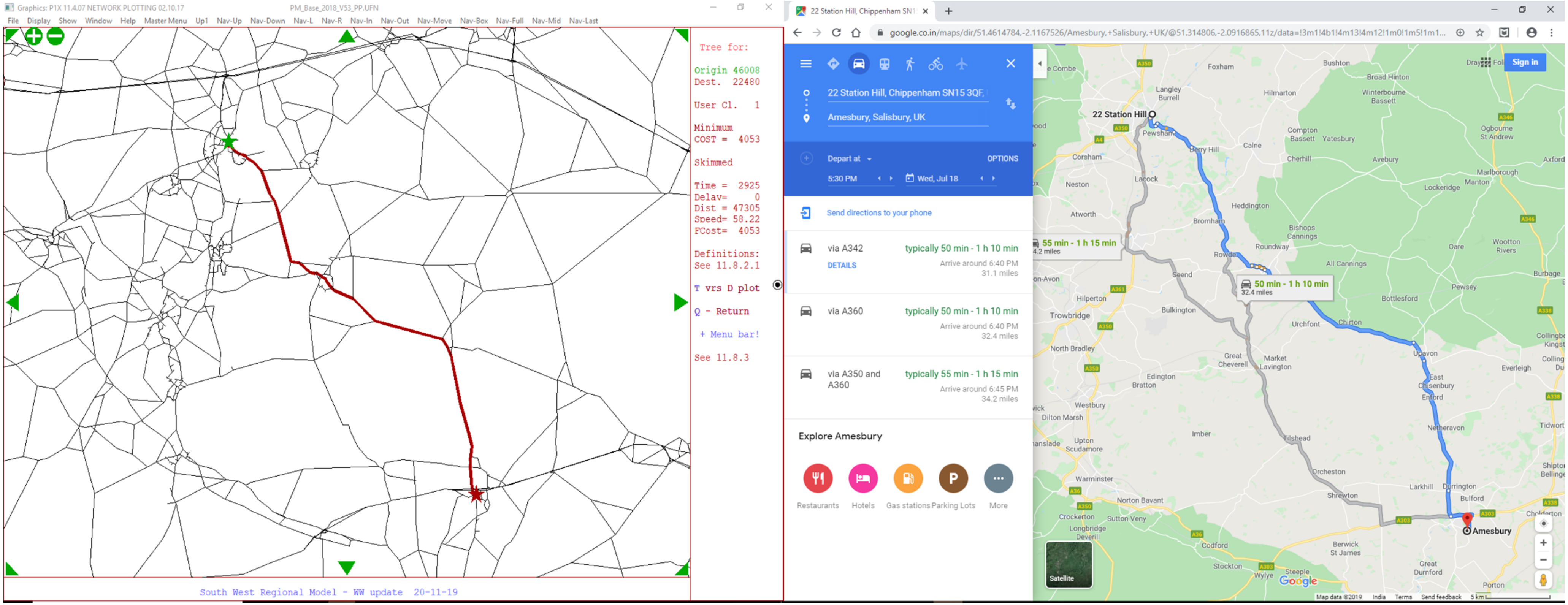


H.4.2. IP



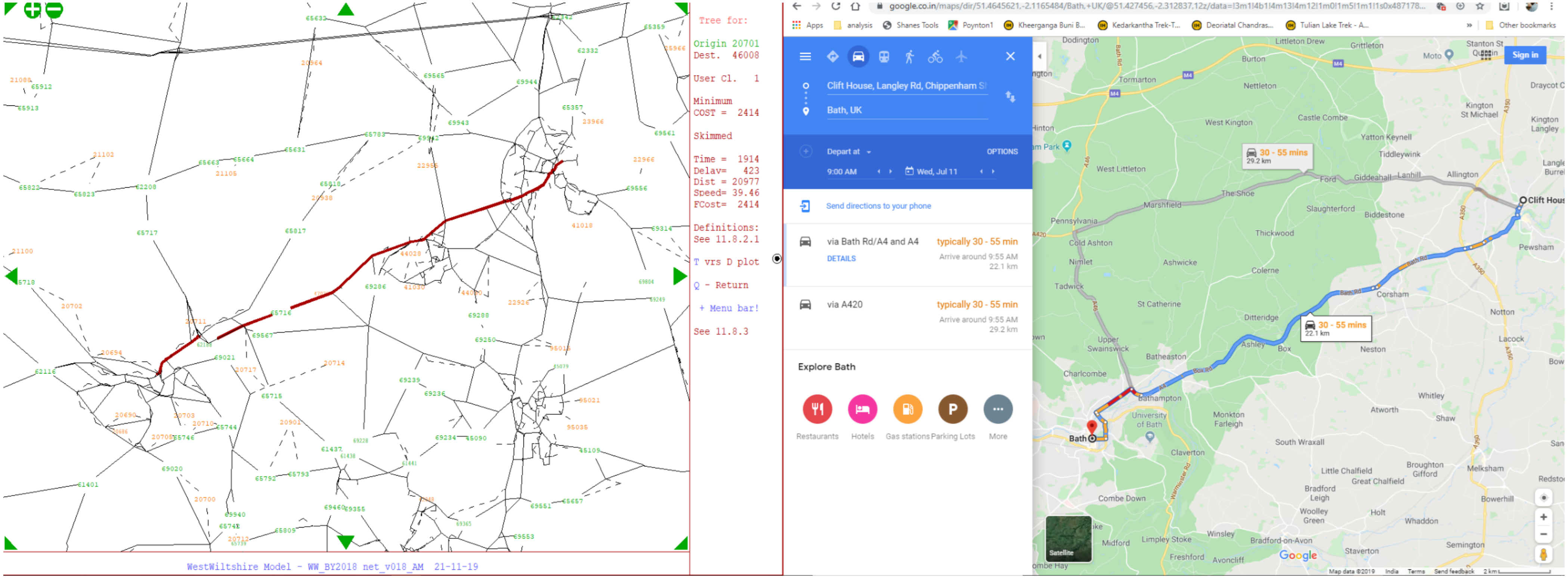
Tree for:
Origin 46008
Dest. 22480
User Cl. 1
Minimum
COST = 4053
Skimmed
Time = 2925
Delay= 0
Dist = 47305
Speed= 58.22
FCost= 4053
Definitions:
See 11.8.2.1
T vrs D plot
Q - Return
+ Menu bar!
See 11.8.3
South West Regional Model - WW update 20-11-19
22 Station Hill, Chippenham SN15 3QF,
Amesbury, Salisbury, UK
Depart at
OPTIONS
2:30 PM
Wed, Jul 18
Send directions to your phone
via A342
DETAILS
typically 55 min - 1 h 10 min
Arrive around 3:40 PM
31.1 miles
via A360
typically 55 min - 1 h 10 min
Arrive around 3:40 PM
32.4 miles
via A350 and A360
typically 55 min - 1 h 20 min
Arrive around 3:50 PM
34.2 miles
Explore Amesbury
Restaurants
Hotels
Gas stations
Parking Lots
More
22 Station Hill
Amesbury
55 min - 1 h 20 min
55 min - 1 h 10 min
32.4 miles

H.4.3. PM

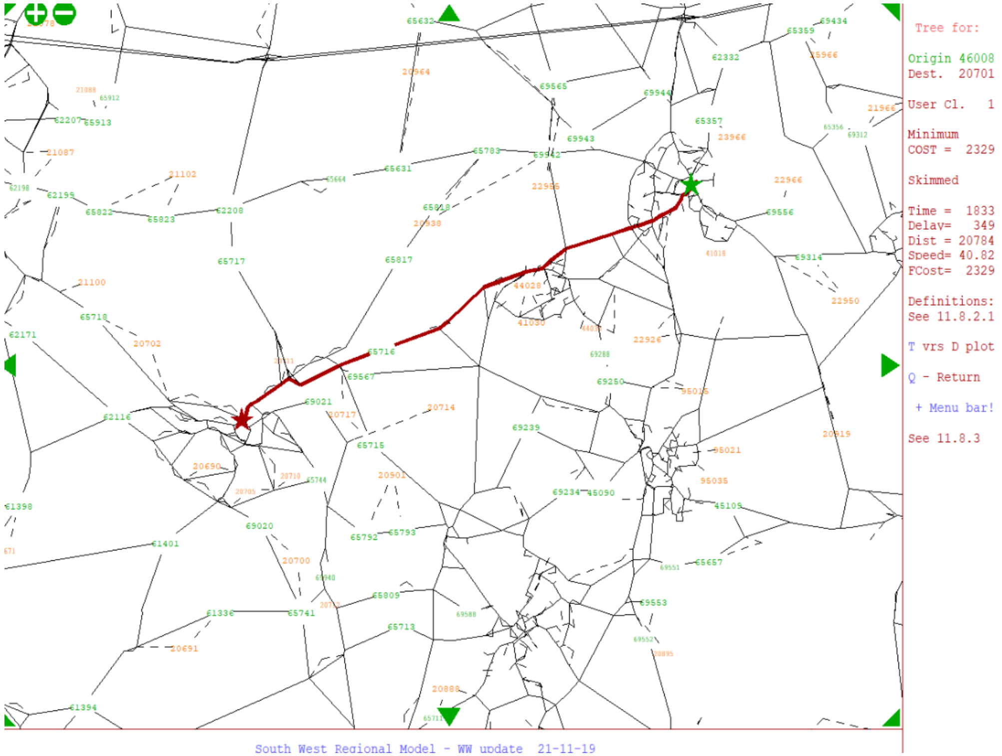

Graphics: P1X 11.4.07 NETWORK PLOTTING 02.10.17
PM_Base_2018_V53_PP.UFN
File Display Show Window Help Master Menu Up1 Nav-Up Nav-Down Nav-L Nav-R Nav-In Nav-Out Nav-Move Nav-Box Nav-Full Nav-Mid Nav-Last
Tree for:
Origin 46008
Dest. 22480
User Cl. 1
Minimum
COST = 4053
Skimmed
Time = 2925
Delay= 0
Dist = 47305
Speed= 58.22
FCost= 4053
Definitions:
See 11.8.2.1
T vrs D plot
Q - Return
+ Menu bar!
See 11.8.3
South West Regional Model - WW update 20-11-19
22 Station Hill, Chippenham SN15 3QF,
Amesbury, Salisbury, UK
Depart at
OPTIONS
5:30 PM
Wed, Jul 18
Send directions to your phone
via A342
DETAILS
typically 50 min - 1 h 10 min
Arrive around 6:40 PM
31.1 miles
via A360
typically 50 min - 1 h 10 min
Arrive around 6:40 PM
32.4 miles
via A350 and A360
typically 55 min - 1 h 15 min
Arrive around 6:45 PM
34.2 miles
Explore Amesbury
Restaurants
Hotels
Gas stations
Parking Lots
More
22 Station Hill
55 min - 1 h 15 min
50 min - 1 h 10 min
32.4 miles
Amesbury
Sign in
Satellite
Google

H.5. Chippenham to Bath

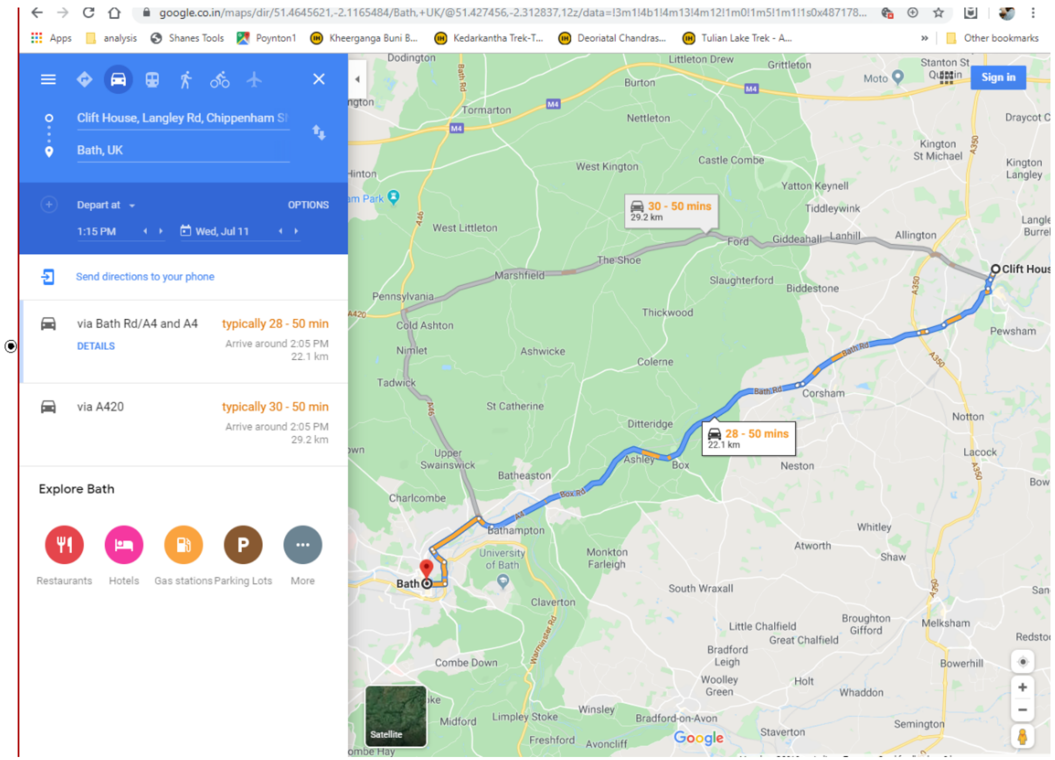
H.5.1. AM



H.5.2. IP

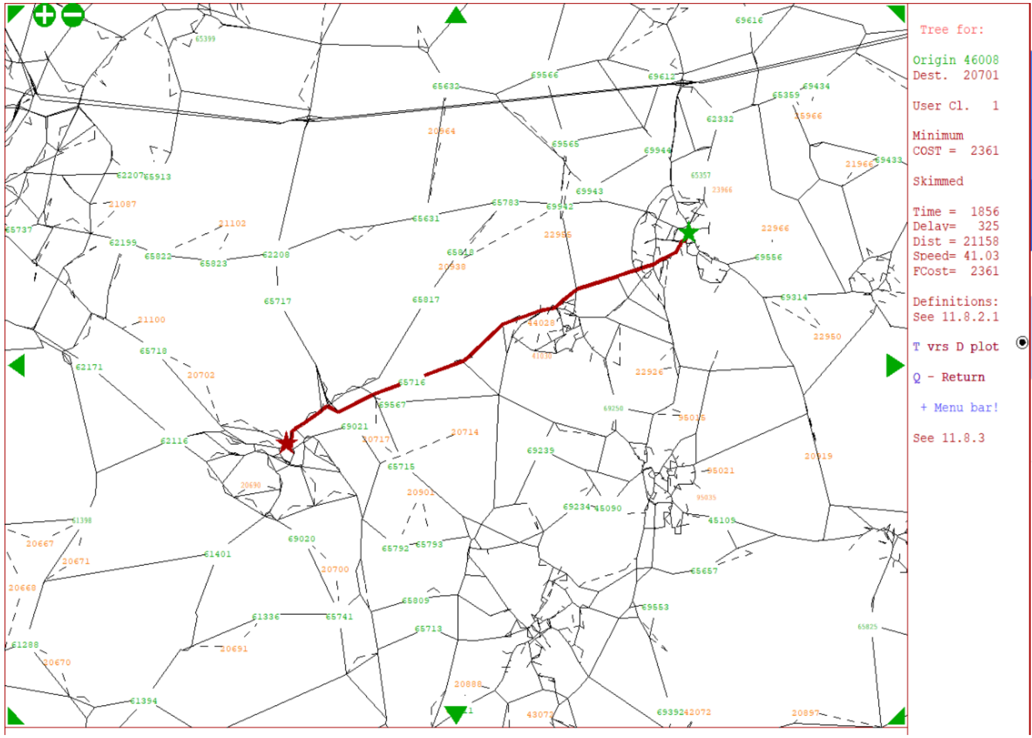


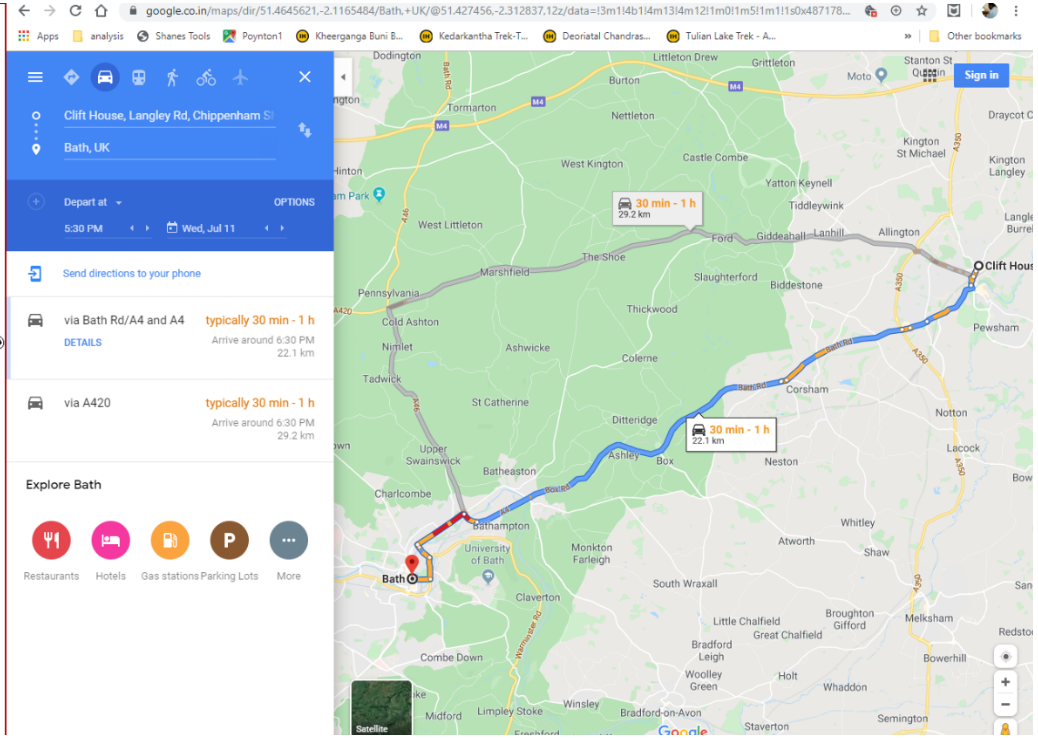
Tree for:
Origin 46008
Dest. 20701
User Cl. 1
Minimum
COST = 2329
Skimmed
Time = 1833
Delay= 349
Dist = 20784
Speed= 40.82
FCost= 2329
Definitions:
See 11.8.2.1
T vrs D plot
Q - Return
+ Menu bar!
See 11.8.3
South West Regional Model - WW update 21-11-19



Clift House, Langley Rd, Chippenham
Bath, UK
Depart at
OPTIONS
1:15 PM
Wed, Jul 11
Send directions to your phone
via Bath Rd/A4 and A4
typically 28 - 50 min
DETAILS
Arrive around 2:05 PM
22.1 km
via A420
typically 30 - 50 min
Arrive around 2:05 PM
29.2 km
Explore Bath
Restaurants
Hotels
Gas stations
Parking Lots
More
30 - 50 mins
29.2 km
28 - 50 mins
22.1 km
Clift Hous
Bath
Corsham
Box
Bathampton
Satellite
Google

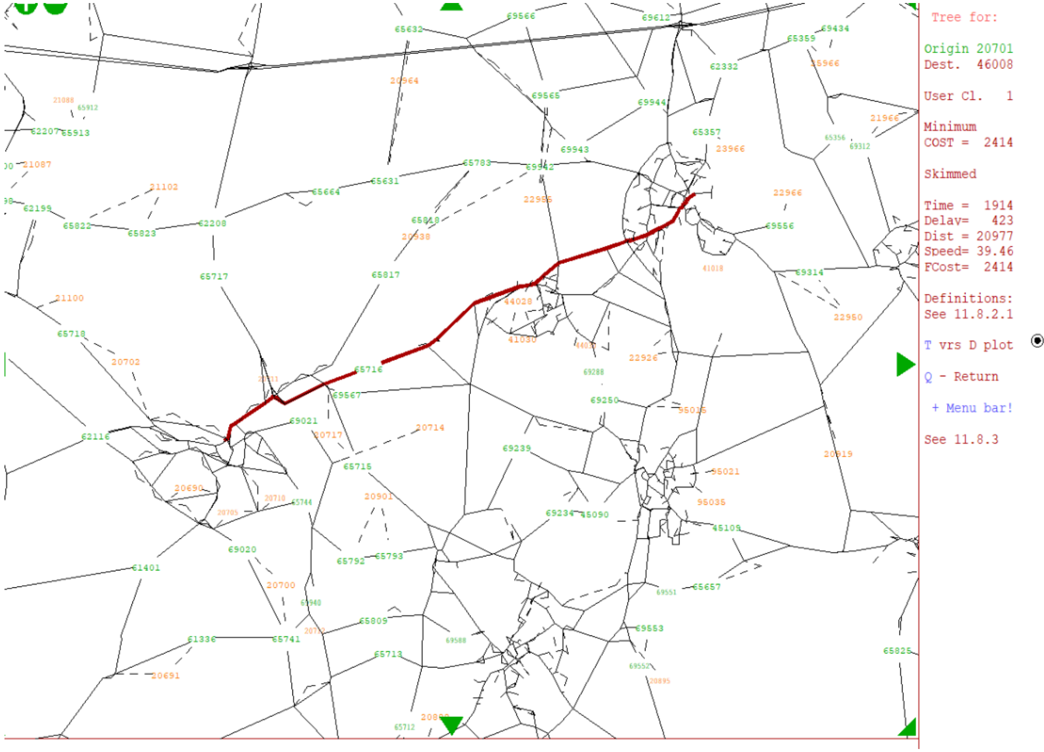
H.5.3. PM

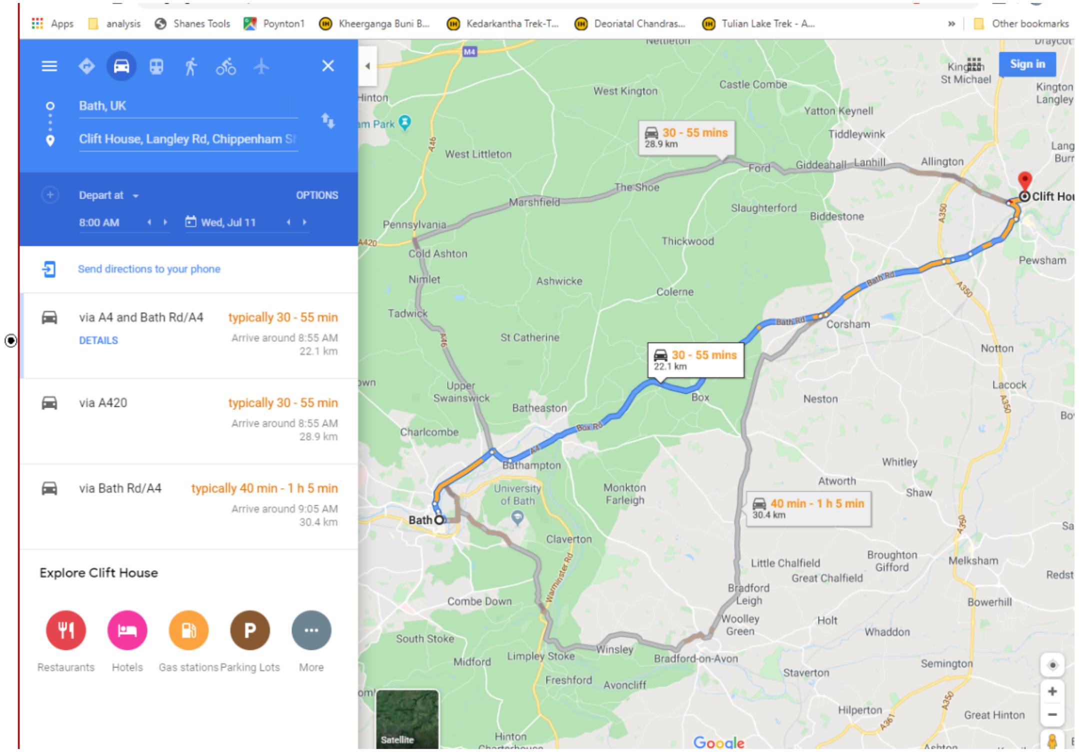

Tree for:
Origin 46008
Dest. 20701
User Cl. 1
Minimum
COST = 2361
Skimmed
Time = 1856
Delay= 325
Dist = 21158
Speed= 41.03
FCost= 2361
Definitions:
See 11.8.2.1
T vrs D plot
Q - Return
+ Menu bar!
See 11.8.3


Clift House, Langley Rd, Chippenham
Bath, UK
Depart at
OPTIONS
5:30 PM
Wed, Jul 11
Send directions to your phone
via Bath Rd/A4 and A4
typically 30 min - 1 h
DETAILS
Arrive around 6:30 PM
22.1 km
via A420
typically 30 min - 1 h
Arrive around 6:30 PM
29.2 km
Explore Bath
Restaurants
Hotels
Gas stations
Parking Lots
More

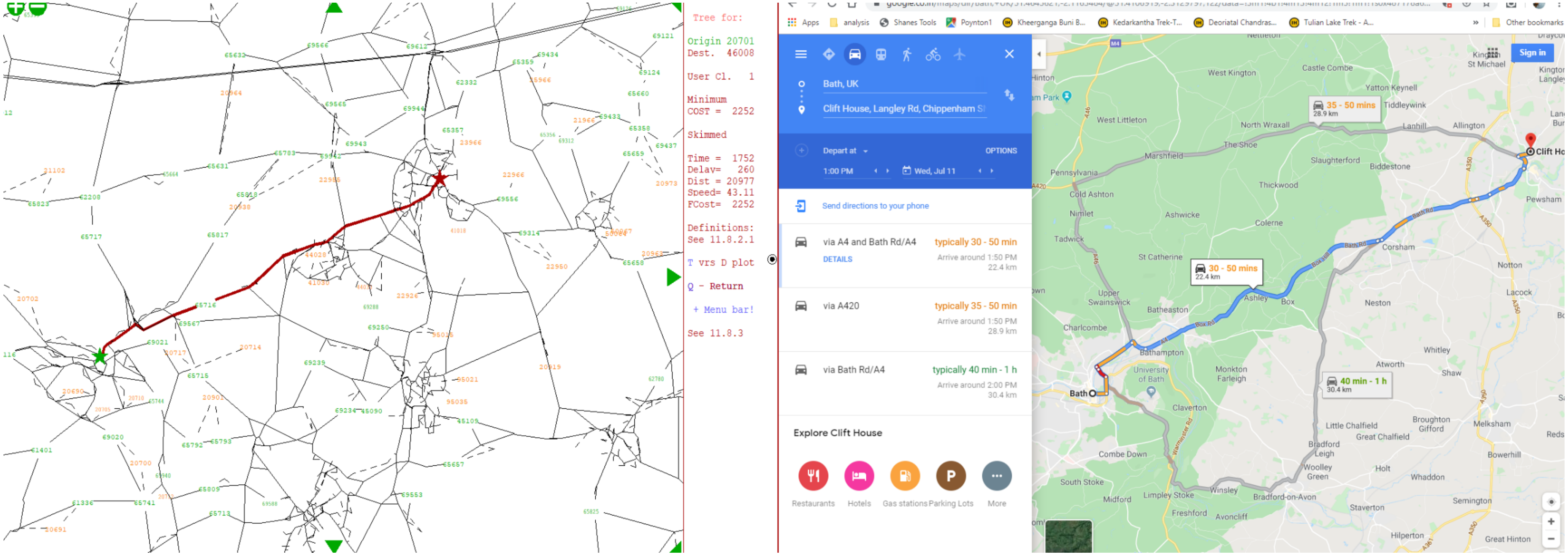
H.6. Bath to Chippenham

H.6.1. AM

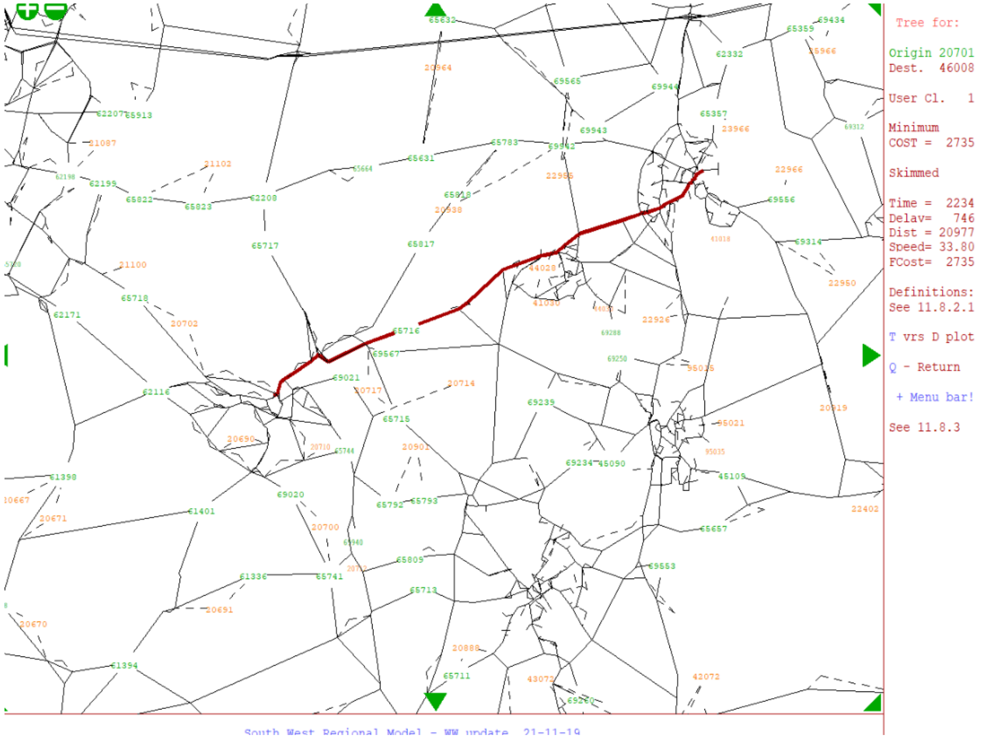


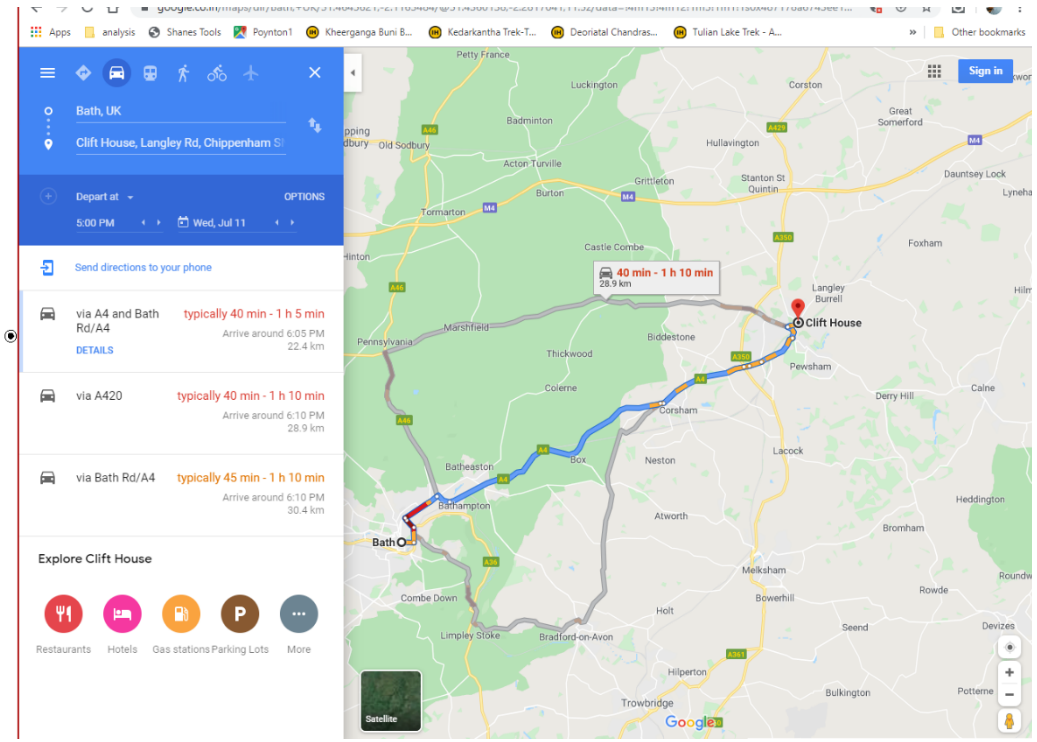


H.6.2. IP


Tree for:
Origin 20701
Dest. 46008
User Cl. 1
Minimum
COST = 2252
Skimmed
Time = 1752
Delay= 260
Dist = 20977
Speed= 43.11
FCost= 2252
Definitions:
See 11.8.2.1
T vrs D plot
Q - Return
+ Menu bar!
See 11.8.3
Bath, UK
Clift House, Langley Rd, Chippenham
Depart at
OPTIONS
1:00 PM
Wed, Jul 11
Send directions to your phone
via A4 and Bath Rd/A4
DETAILS
typically 30 - 50 min
Arrive around 1:50 PM
22.4 km
via A420
typically 35 - 50 min
Arrive around 1:50 PM
28.9 km
via Bath Rd/A4
typically 40 min - 1 h
Arrive around 2:00 PM
30.4 km
Explore Clift House
Restaurants
Hotels
Gas stations
Parking Lots
More
30 - 50 mins
22.4 km
35 - 50 mins
28.9 km
40 min - 1 h
30.4 km
Sign in

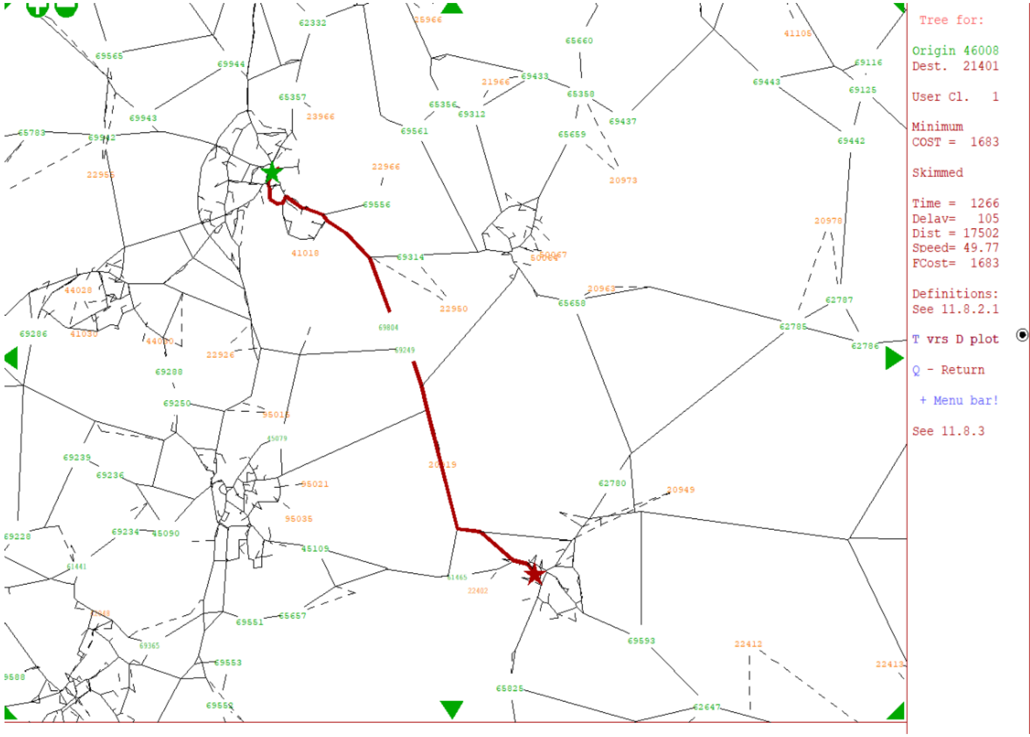
H.6.3. PM

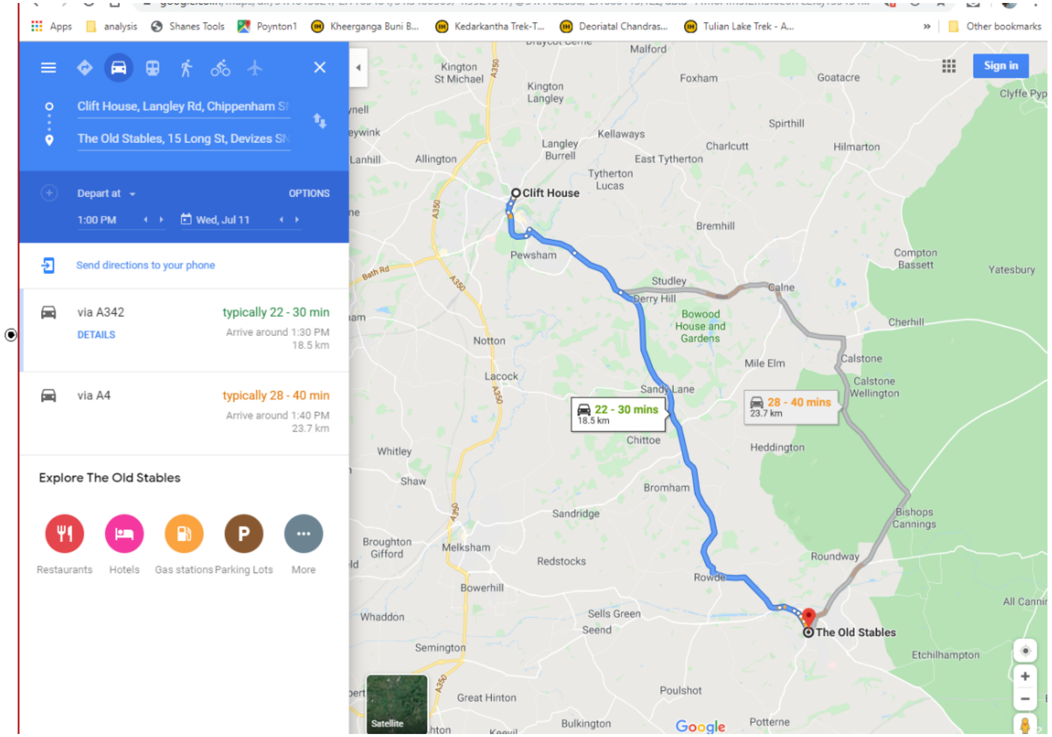

Tree for:
Origin 20701
Dest. 46008
User Cl. 1
Minimum
COST = 2735
Skimmed
Time = 2234
Delav= 746
Dist = 20977
Speed= 33.80
FCost= 2735
Definitions:
See 11.8.2.1
T vrs D plot
Q - Return
+ Menu bar!
See 11.8.3
South West Regional Model - WM update 21-11-19


Bath, UK
Clift House, Langley Rd, Chippenham
Depart at
OPTIONS
5:00 PM
Wed, Jul 11
Send directions to your phone
via A4 and Bath Rd/A4
typically 40 min - 1 h 5 min
Arrive around 6:05 PM
22.4 km
DETAILS
via A420
typically 40 min - 1 h 10 min
Arrive around 6:10 PM
28.9 km
via Bath Rd/A4
typically 45 min - 1 h 10 min
Arrive around 6:10 PM
30.4 km
Explore Clift House
Restaurants
Hotels
Gas stations
Parking Lots
More
40 min - 1 h 10 min
28.9 km
Clift House
Bath
Sign in
Satellite

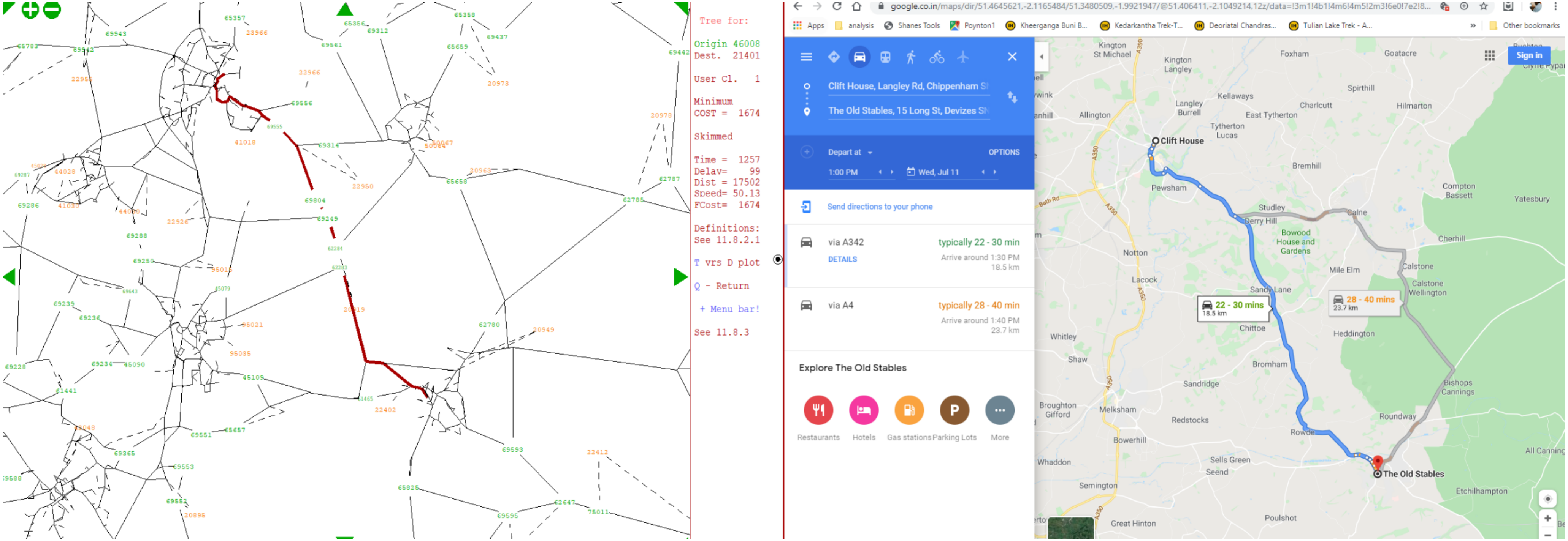
H.7. Chippenham to devizes

H.7.1. AM



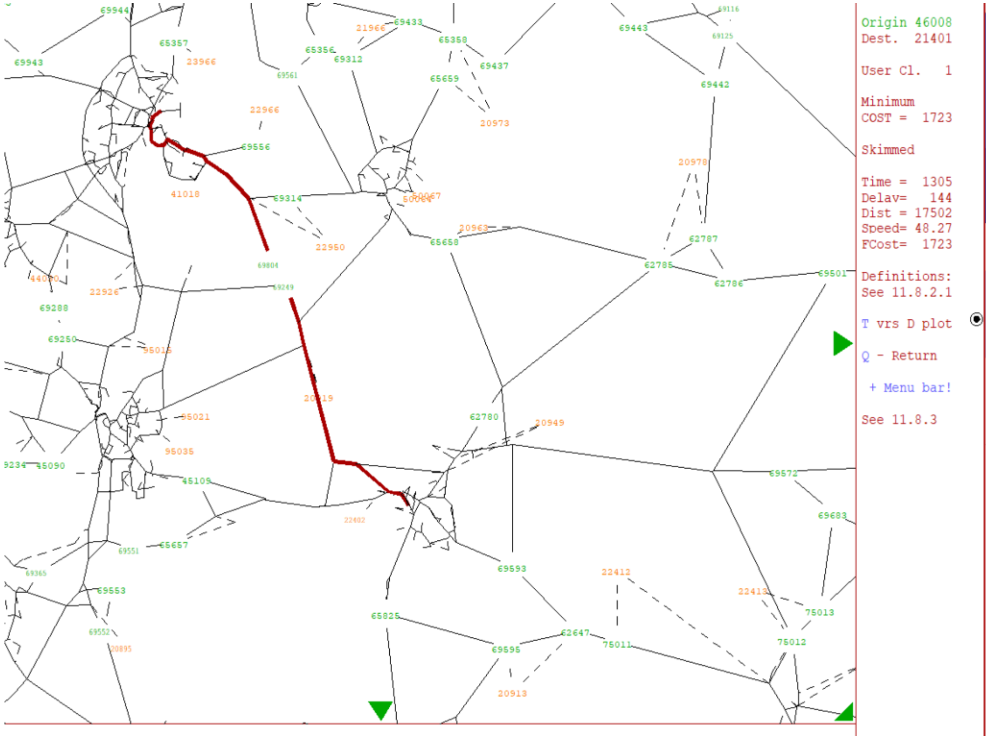


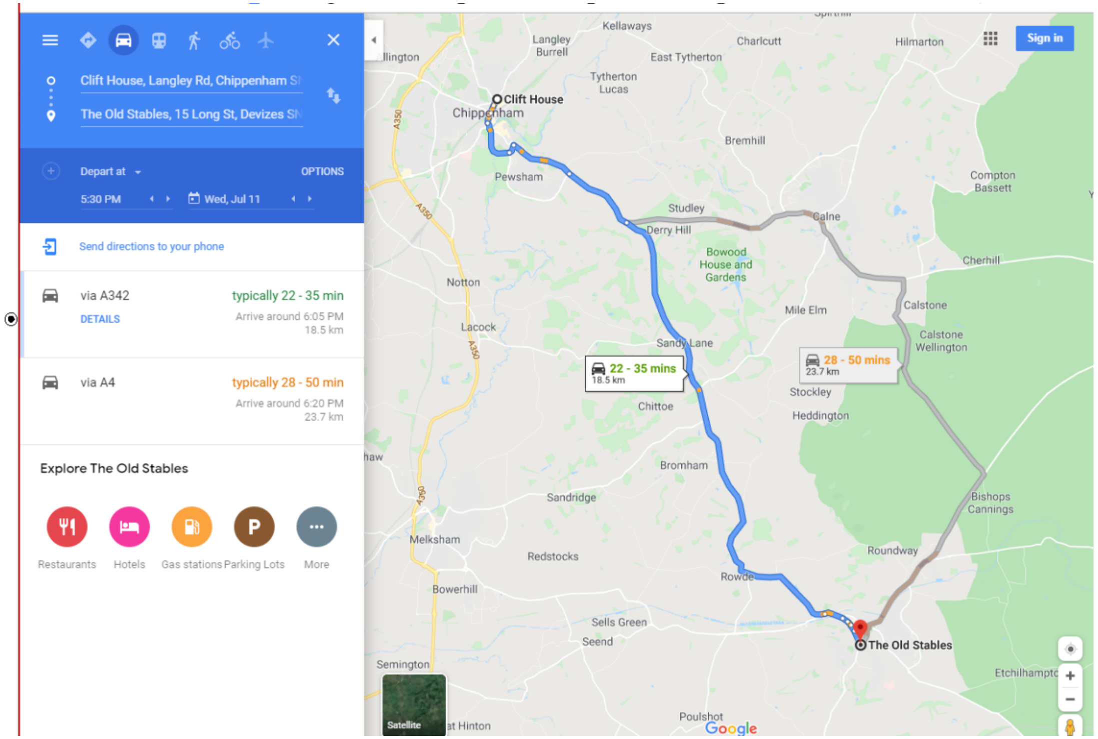
H.7.2. IP



Tree for:
Origin 46008
Dest. 21401
User Cl. 1
Minimum
COST = 1674
Skimmed
Time = 1257
Delav= 99
Dist = 17502
Speed= 50.13
FCost= 1674
Definitions:
See 11.8.2.1
T vrs D plot
Q - Return
+ Menu bar!
See 11.8.3
Clift House, Langley Rd, Chippenham SN
The Old Stables, 15 Long St, Devizes SN
Depart at
OPTIONS
1:00 PM
Wed, Jul 11
Send directions to your phone
via A342
DETAILS
typically 22 - 30 min
Arrive around 1:30 PM
18.5 km
via A4
typically 28 - 40 min
Arrive around 1:40 PM
23.7 km
Explore The Old Stables
Restaurants
Hotels
Gas stations
Parking Lots
More
Clift House
The Old Stables
22 - 30 mins
18.5 km
28 - 40 mins
23.7 km

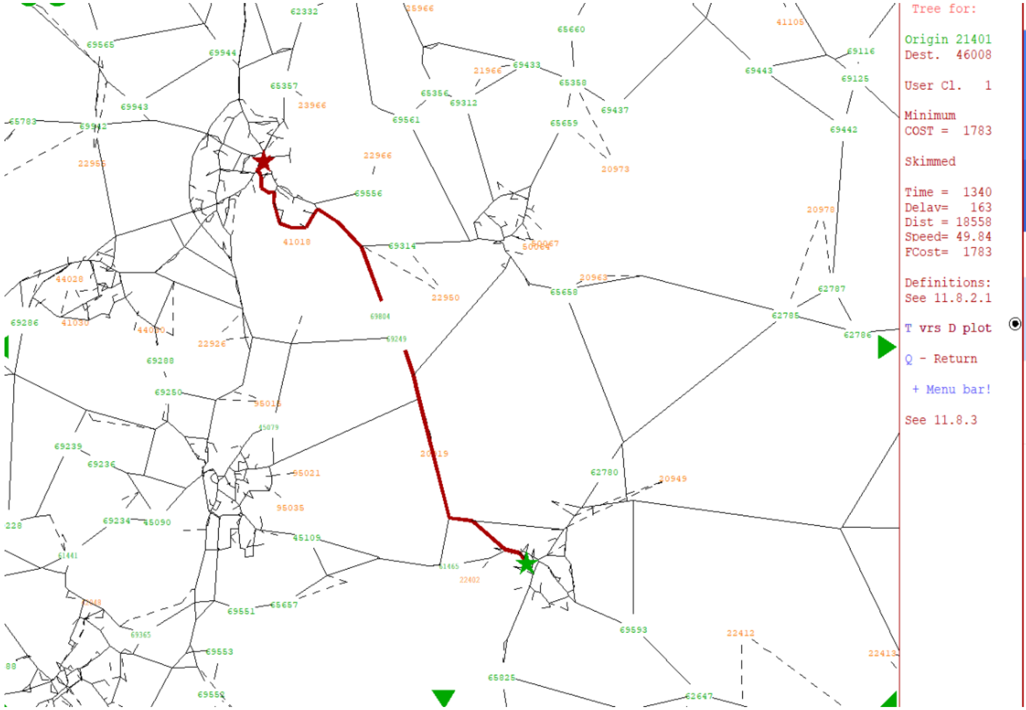
H.7.3. PM

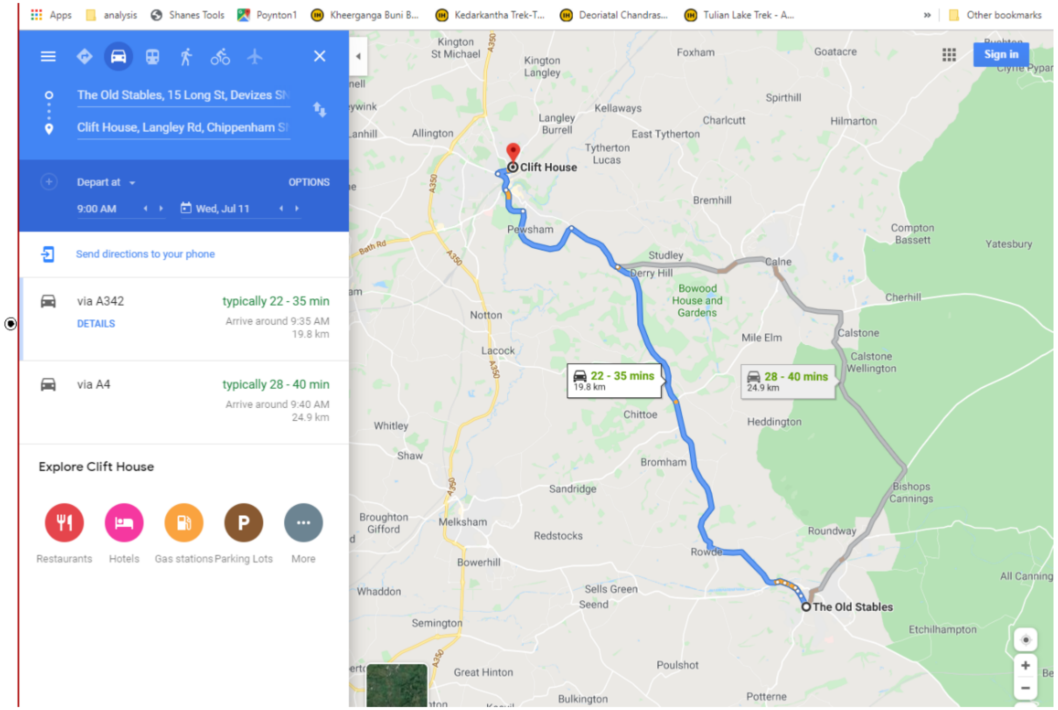

Origin 46008
Dest. 21401
User Cl. 1
Minimum
COST = 1723
Skimmed
Time = 1305
Delav= 144
Dist = 17502
Speed= 48.27
FCost= 1723
Definitions:
See 11.8.2.1
T vrs D plot
Q - Return
+ Menu bar!
See 11.8.3


Clift House, Langley Rd, Chippenham S
The Old Stables, 15 Long St, Devizes S
Depart at
OPTIONS
5:30 PM
Wed, Jul 11
Send directions to your phone
via A342
typically 22 - 35 min
Arrive around 6:05 PM
18.5 km
DETAILS
via A4
typically 28 - 50 min
Arrive around 6:20 PM
23.7 km
Explore The Old Stables
Restaurants
Hotels
Gas stations
Parking Lots
More
Clift House
The Old Stables
22 - 35 mins
28 - 50 mins
Sign in

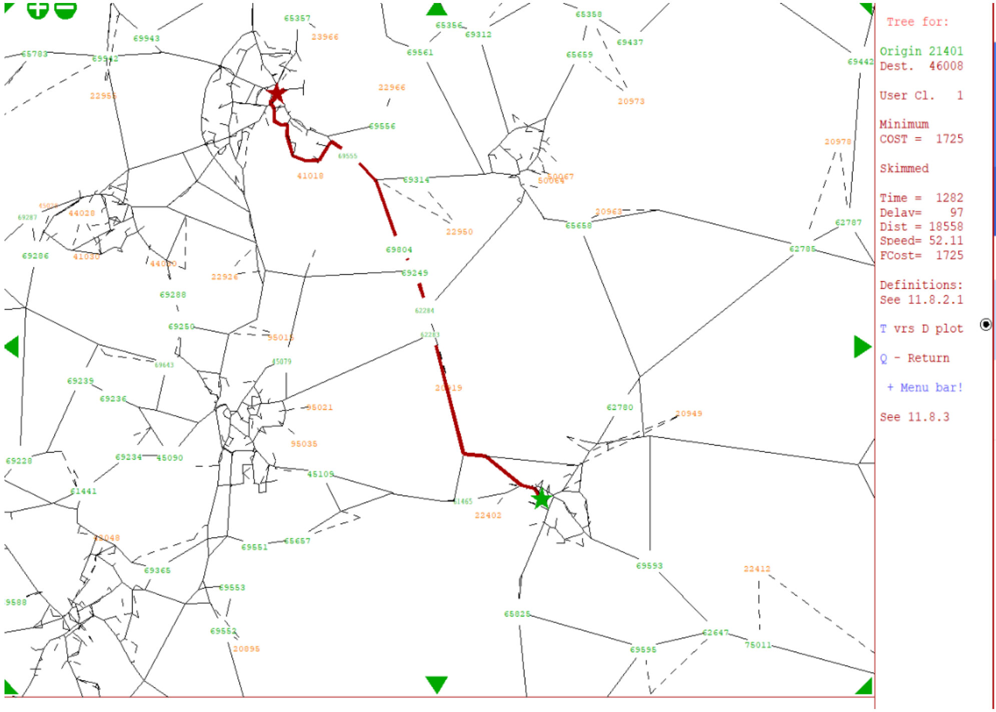
H.8. Devizes to Chippenham

H.8.1. AM

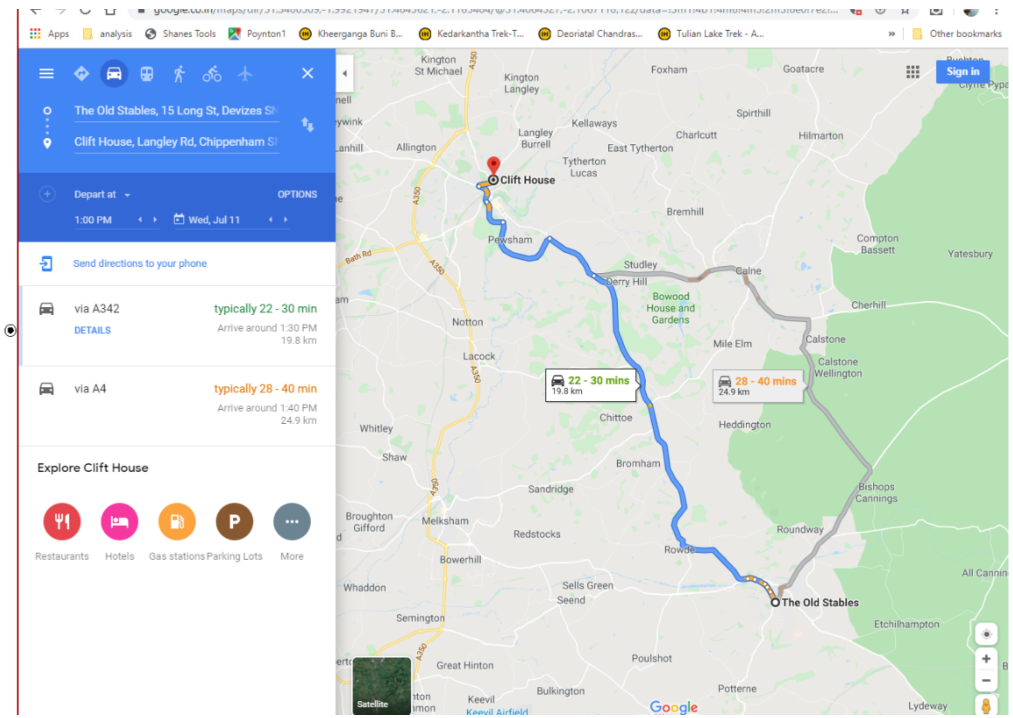




H.8.2. IP

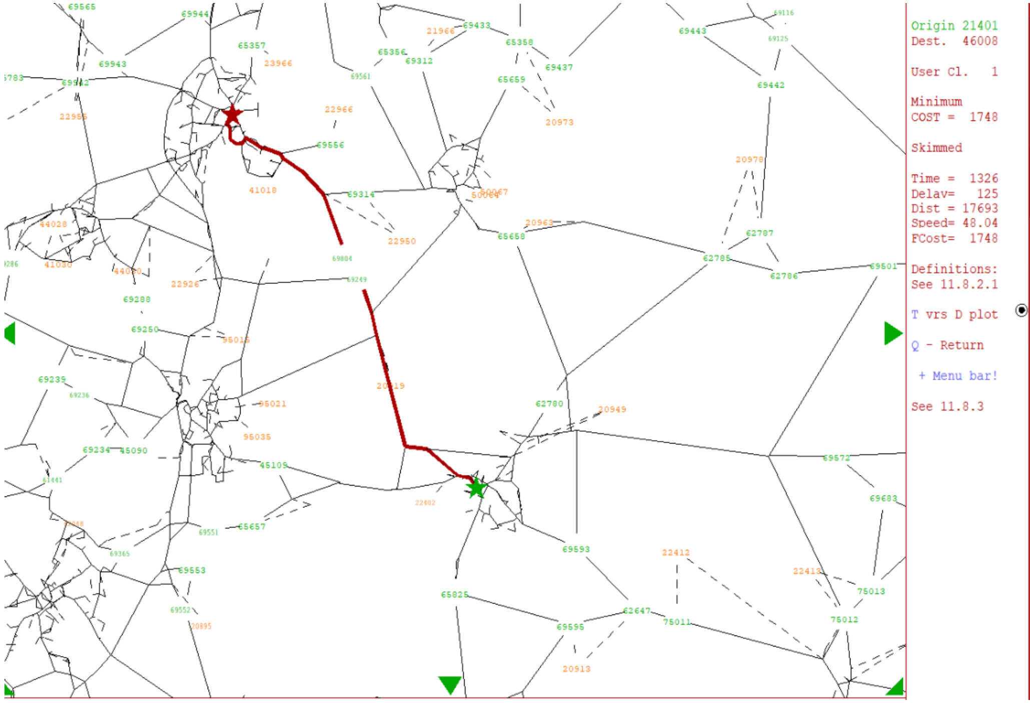


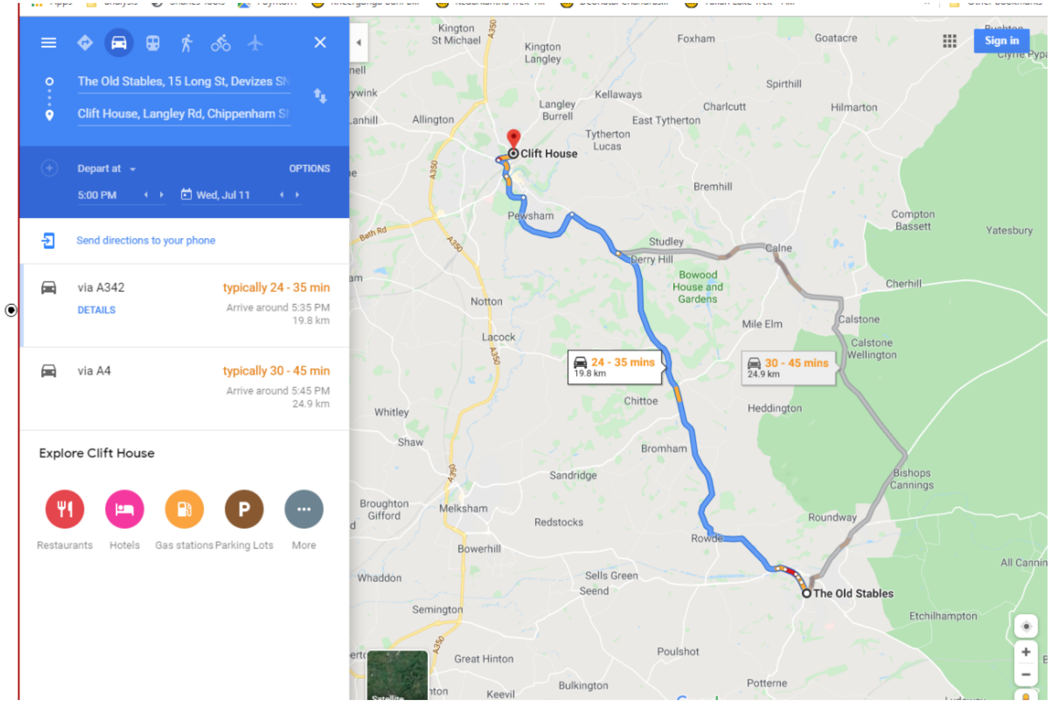
Tree for:
Origin 21401
Dest. 46008
User Cl. 1
Minimum
COST = 1725
Skimmed
Time = 1282
Delay= 97
Dist = 18558
Speed= 52.11
FCost= 1725
Definitions:
See 11.8.2.1
T vrs D plot
Q - Return
+ Menu bar!
See 11.8.3



The Old Stables, 15 Long St, Devizes
Clift House, Langley Rd, Chippenham
Depart at
OPTIONS
1:00 PM
Wed, Jul 11
Send directions to your phone
via A342
DETAILS
typically 22 - 30 min
Arrive around 1:30 PM
19.8 km
via A4
typically 28 - 40 min
Arrive around 1:40 PM
24.9 km
Explore Clift House
Restaurants
Hotels
Gas stations
Parking Lots
More
Clift House
The Old Stables
22 - 30 mins
19.8 km
28 - 40 mins
24.9 km

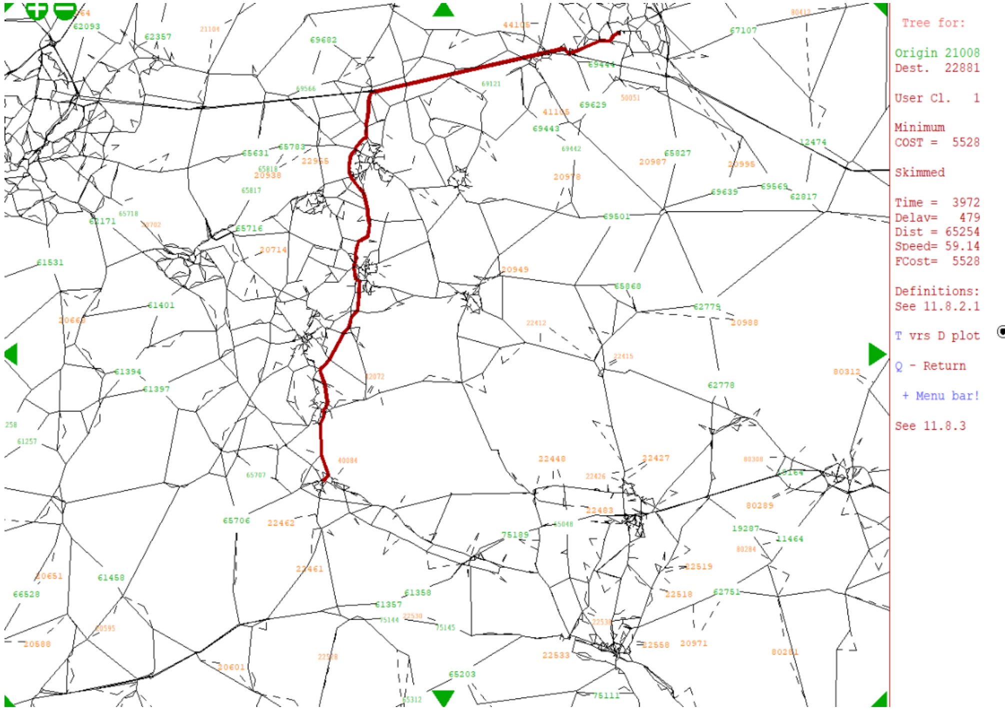
H.8.3. PM

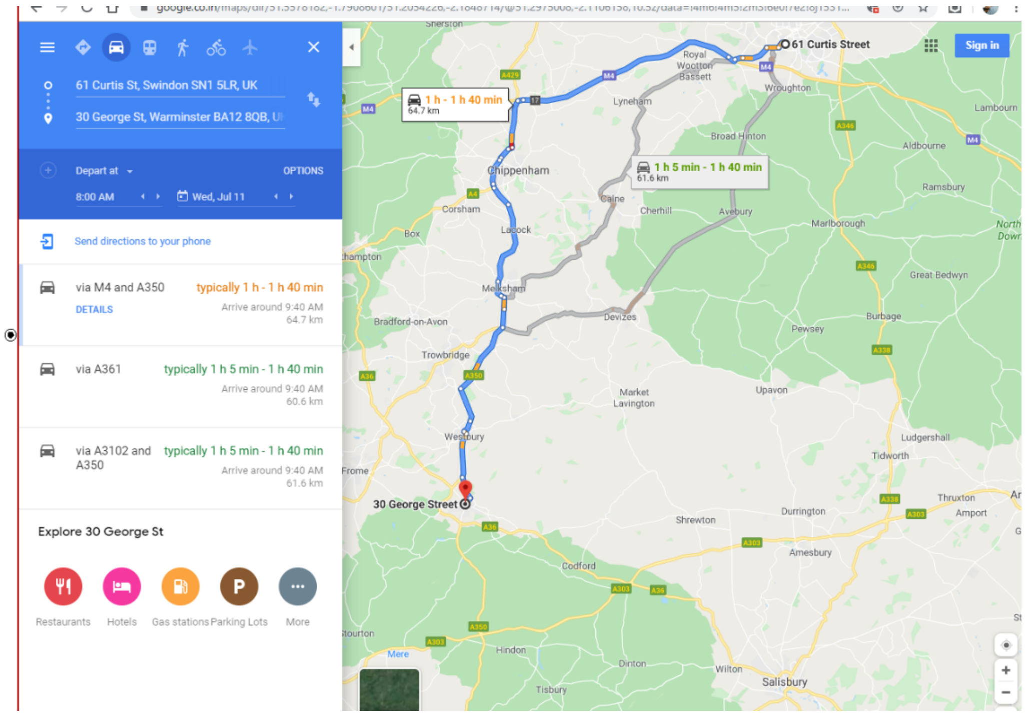

Origin 21401
Dest. 46008
User Cl. 1
Minimum
COST = 1748
Skimmed
Time = 1326
Delav= 125
Dist = 17693
Speed= 48.04
FCost= 1748
Definitions:
See 11.8.2.1
T vrs D plot
Q - Return
+ Menu bar!
See 11.8.3


The Old Stables, 15 Long St, Devizes
Clift House, Langley Rd, Chippenham
Depart at
OPTIONS
5:00 PM
Wed, Jul 11
Send directions to your phone
via A342
typically 24 - 35 min
DETAILS
Arrive around 5:35 PM
19.8 km
via A4
typically 30 - 45 min
Arrive around 5:45 PM
24.9 km
Explore Clift House
Restaurants
Hotels
Gas stations
Parking Lots
More
Sign in
Clift House
The Old Stables
24 - 35 mins
19.8 km
30 - 45 mins
24.9 km

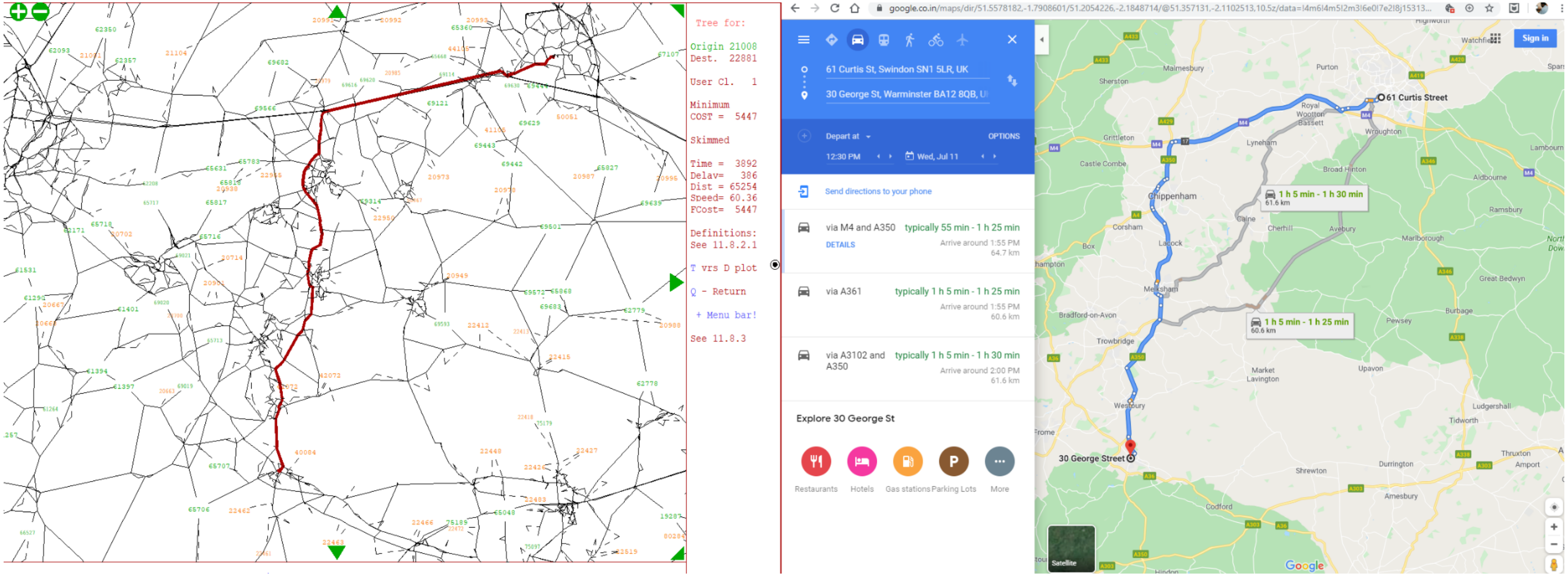
H.9. Swindon to Warminster

H.9.1. AM

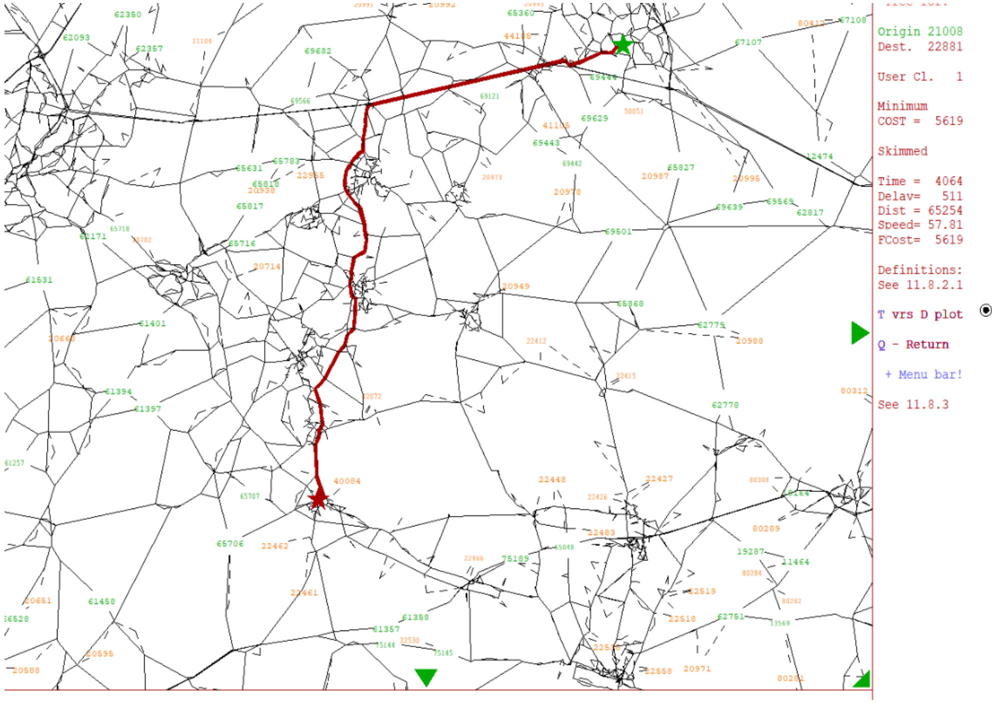


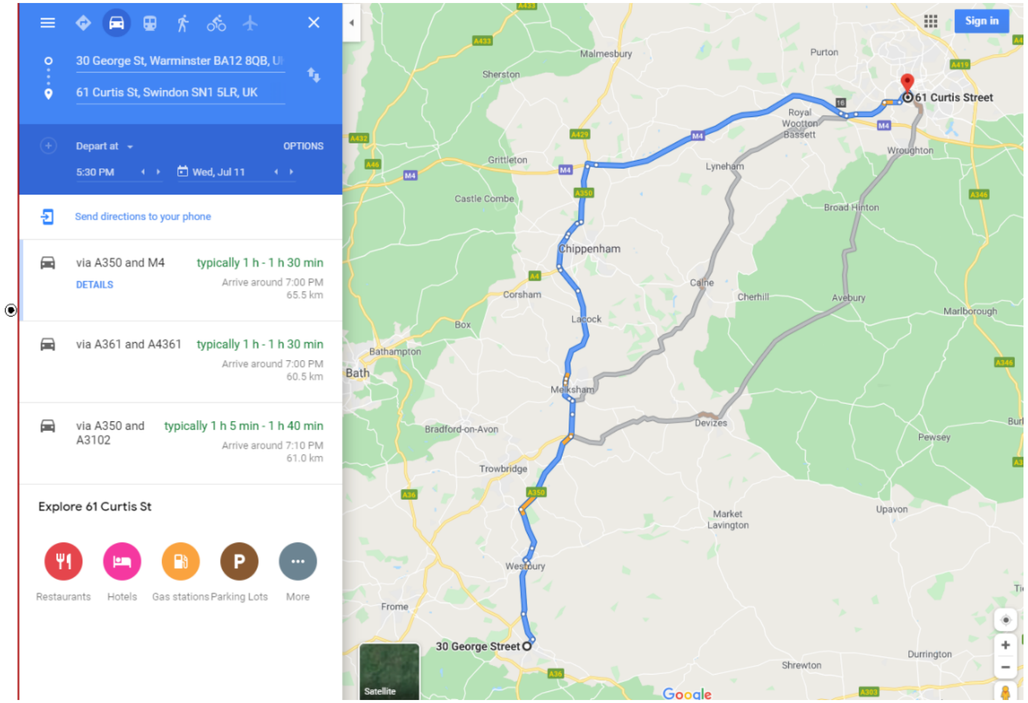


H.9.2. IP


Tree for:
Origin 21008
Dest. 22881
User Cl. 1
Minimum
COST = 5447
Skimmed
Time = 3892
Delav= 386
Dist = 65254
Speed= 60.36
FCost= 5447
Definitions:
See 11.8.2.1
T vrs D plot
Q - Return
+ Menu bar!
See 11.8.3
61 Curtis St, Swindon SN1 5LR, UK
30 George St, Warminster BA12 8QB, UK
Depart at
OPTIONS
12:30 PM
Wed, Jul 11
Send directions to your phone
via M4 and A350
typically 55 min - 1 h 25 min
DETAILS
Arrive around 1:55 PM
64.7 km
via A361
typically 1 h 5 min - 1 h 25 min
Arrive around 1:55 PM
60.6 km
via A3102 and A350
typically 1 h 5 min - 1 h 30 min
Arrive around 2:00 PM
61.6 km
Explore 30 George St
Restaurants
Hotels
Gas stations
Parking Lots
More
61 Curtis Street
30 George Street
1 h 5 min - 1 h 30 min
61.6 km
1 h 5 min - 1 h 25 min
60.6 km
Chippenham
Sign in
Satellite
Google

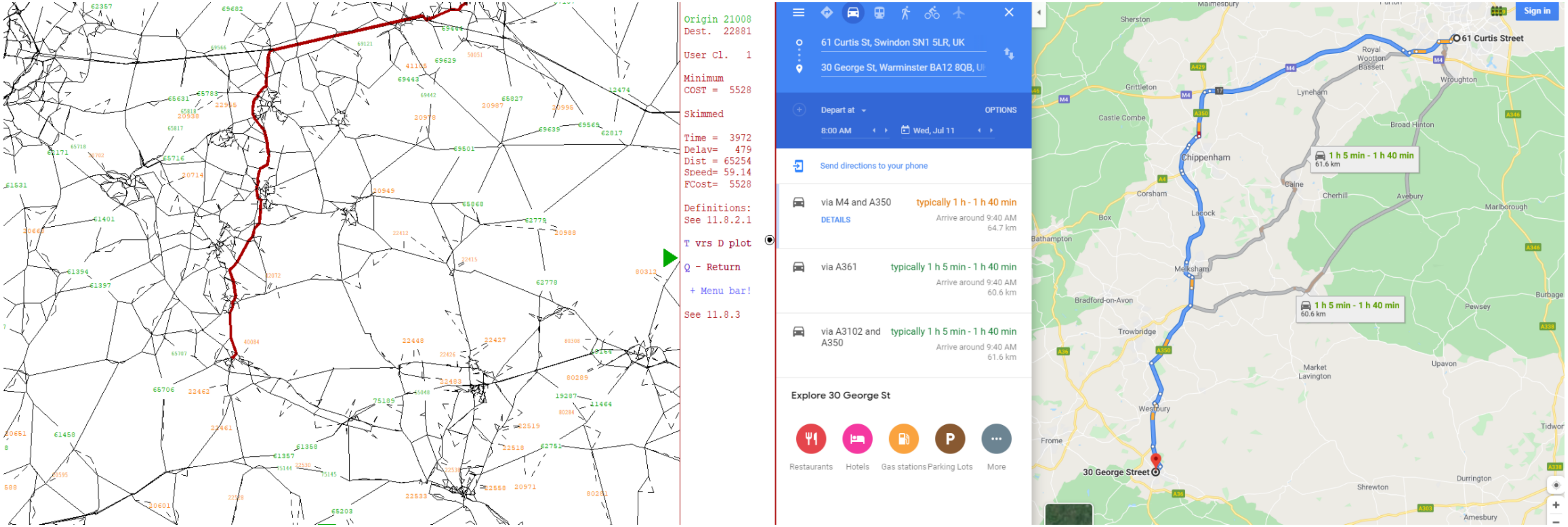
H.9.3. PM


Origin 21008
Dest. 22881
User Cl. 1
Minimum
COST = 5619
Skimmed
Time = 4064
Delav= 511
Dist = 65254
Speed= 57.81
FCost= 5619
Definitions:
See 11.8.2.1
T vrs D plot
Q - Return
+ Menu bar!
See 11.8.3

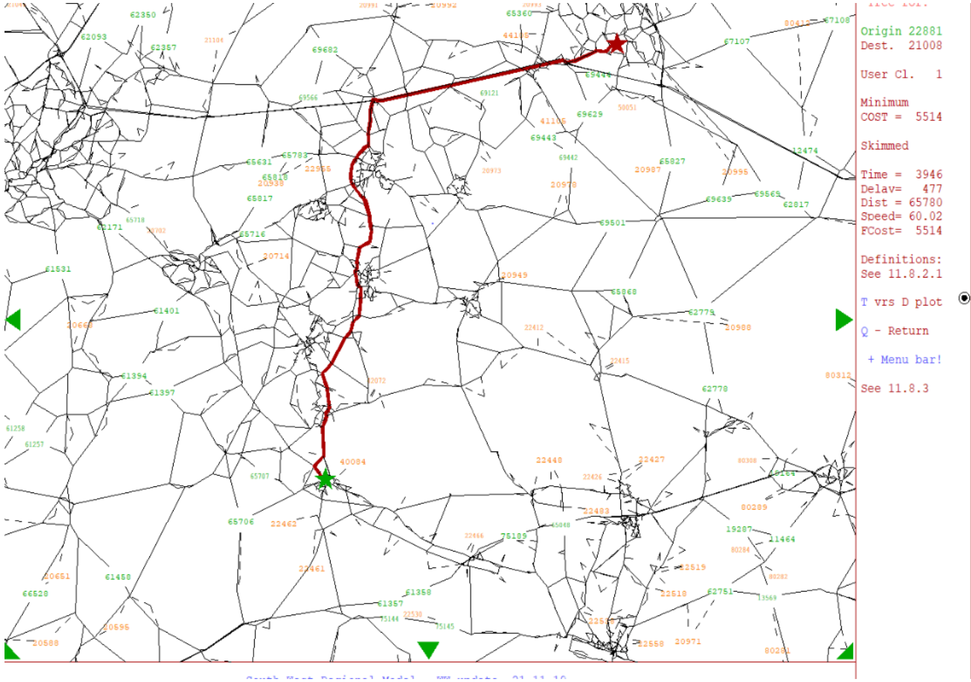

30 George St, Warminster BA12 8QB, U
61 Curtis St, Swindon SN1 5LR, UK
Depart at
OPTIONS
5:30 PM
Wed, Jul 11
Send directions to your phone
via A350 and M4
typically 1 h - 1 h 30 min
DETAILS
Arrive around 7:00 PM
65.5 km
via A361 and A4361
typically 1 h - 1 h 30 min
Arrive around 7:00 PM
60.5 km
via A350 and A3102
typically 1 h 5 min - 1 h 40 min
Arrive around 7:10 PM
61.0 km
Explore 61 Curtis St
Restaurants
Hotels
Gas stations
Parking Lots
More
Sign in
61 Curtis Street
30 George Street
Malmesbury
Sherston
Purton
Royal Wootton Bassett
Wroughton
Grittleton
Lyneham
Castle Combe
Broad Hinton
Chippenham
Calne
Cherhill
Avebury
Marlborough
Corsham
Lacock
Box
Bathampton
Bath
Melksham
Devizes
Bradford-on-Avon
Pewsey
Trowbridge
Market Lavington
Upavon
Westbury
Frome
Shrewton
Durrington
Satellite
Google

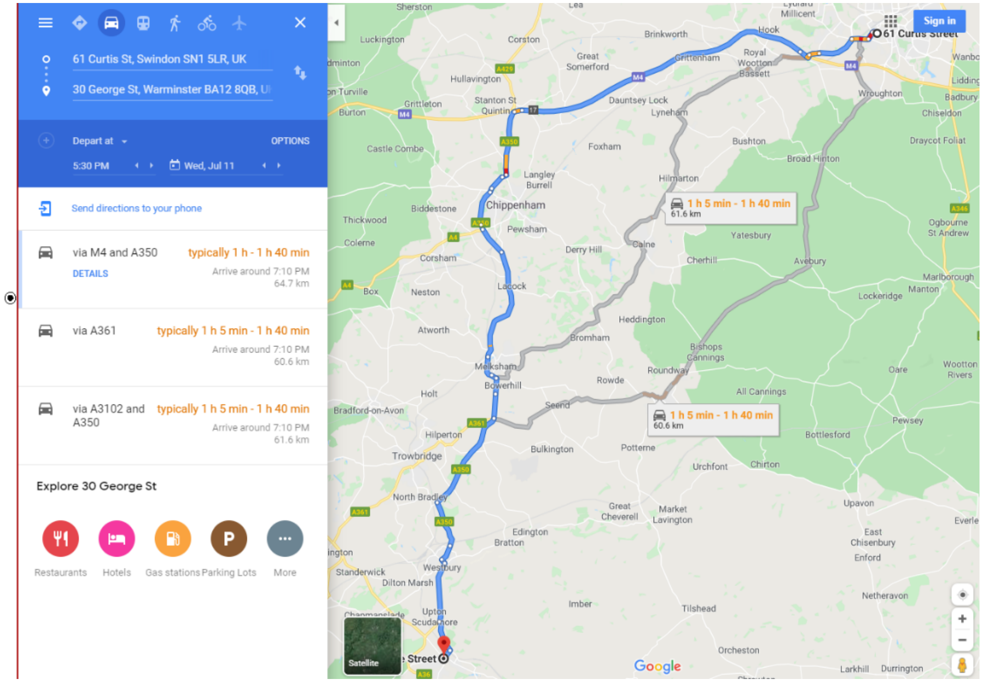
H.10. Warminster to Swindon

H.10.1. AM

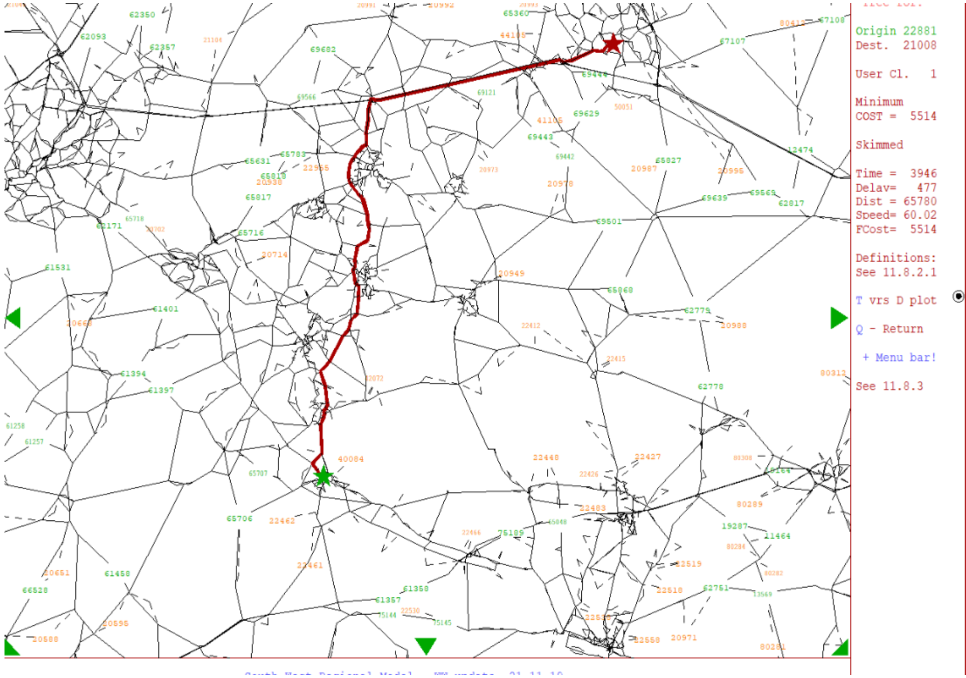


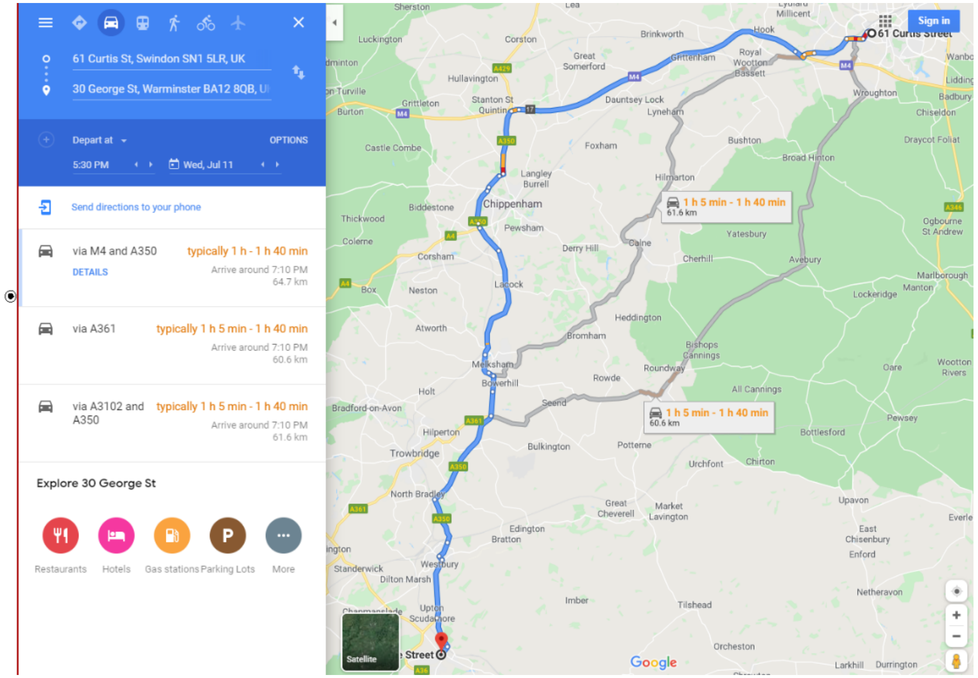
H.10.2. IP


Origin 22881
Dest. 21008
User Cl. 1
Minimum
COST = 5514
Skimmed
Time = 3946
Delay= 477
Dist = 65780
Speed= 60.02
FCost= 5514
Definitions:
See 11.8.2.1
T vrs D plot
Q - Return
+ Menu bar!
See 11.8.3


61 Curtis St, Swindon SN1 5LR, UK
30 George St, Warminster BA12 8QB, U
Depart at
OPTIONS
5:30 PM
Wed, Jul 11
Send directions to your phone
via M4 and A350
typically 1 h - 1 h 40 min
DETAILS
Arrive around 7:10 PM
64.7 km
via A361
typically 1 h 5 min - 1 h 40 min
Arrive around 7:10 PM
60.6 km
via A3102 and A350
typically 1 h 5 min - 1 h 40 min
Arrive around 7:10 PM
61.6 km
Explore 30 George St
Restaurants
Hotels
Gas stations
Parking Lots
More
Sign in
61 Curtis Street
1 h 5 min - 1 h 40 min
61.6 km
1 h 5 min - 1 h 40 min
60.6 km
Chippenham
Trowbridge
Westbury
Google

H.10.3. PM


Origin 22881
Dest. 21008
User Cl. 1
Minimum
COST = 5514
Skimmed
Time = 3946
Delay= 477
Dist = 65780
Speed= 60.02
FCost= 5514
Definitions:
See 11.8.2.1
T vrs D plot
Q - Return
+ Menu bar!
See 11.8.3


61 Curtis St, Swindon SN1 5LR, UK
30 George St, Warminster BA12 8QB, U
Depart at
OPTIONS
5:30 PM
Wed, Jul 11
Send directions to your phone
via M4 and A350
typically 1 h - 1 h 40 min
DETAILS
Arrive around 7:10 PM
64.7 km
via A361
typically 1 h 5 min - 1 h 40 min
Arrive around 7:10 PM
60.6 km
via A3102 and A350
typically 1 h 5 min - 1 h 40 min
Arrive around 7:10 PM
61.6 km
Explore 30 George St
Restaurants
Hotels
Gas stations
Parking Lots
More
Sign in
1 h 5 min - 1 h 40 min
61.6 km
1 h 5 min - 1 h 40 min
60.6 km
Satellite
Google

Pete Knightbridge
Atkins Limited
The Hub
500 Park Avenue
Aztec West
Bristol
BS32 4RZ

Tel: +44 (0)1454 662000
Fax: +44 (0)1454 663333