Lower Thames Crossing

9.15 Localised Traffic Modelling Appendix I – ASDA Roundabout VISSIM Local Model Validation Report

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Lower Thames Crossing

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1 Introduction

1.1 Purpose of document

1.1.1 This document presents the local VISSIM model validation report for the A1089 Asda roundabout and A126 Dock Road.

1.2 Modelling software

1.2.1 Road traffic micro-simulation models represent individual vehicles travelling within the road network, providing realistic driver behaviour such as lane changing and overtaking. The micro-simulation software selected for the Lower Thames Crossing is VISSIM. The model has been developed in VISSIM version 2020 (SP14).

1.3 The Project

1.3.1 The A122 Lower Thames Crossing (the Project) would provide a connection between the A2 and M2 in Kent, south-east of Gravesend, crossing under the River Thames through a tunnel, before joining the M25 south of junction 29. The Project route is presented in Plate 1.1.

1.3.2 The A122 would be approximately 23km long, 4.25km of which would be in tunnel. On the south side of the River Thames, the Project route would link the tunnel to the A2 and M2. On the north side, it would link to the A13, M25 junction 29 and the M25 south of junction 29. The tunnel entrances would be located to the east of the village of Chalk on the south of the River Thames and to the west of East Tilbury on the north side.

1.3.3 Junctions are proposed at the following locations:

a. New junction with the A2 to the south-east of Gravesend

b. Modified junction with the A13/A1089 in Thurrock

c. New junction with the M25 between junctions 29 and 30

1.3.4 To align with National Policy Statement for National Networks (Department for Transport, 2014) policy and to help the Project meet the Scheme Objectives, it is proposed that road user charges would be levied in line with the Dartford Crossing. Vehicles would be charged for using the new tunnel.

1.3.5 The Project route would be three lanes in both directions, except for:

a. link roads

b. stretches of the carriageway through junctions

c. the southbound carriageway from the M25 to the junction with the A13/A1089, which would be two lanes

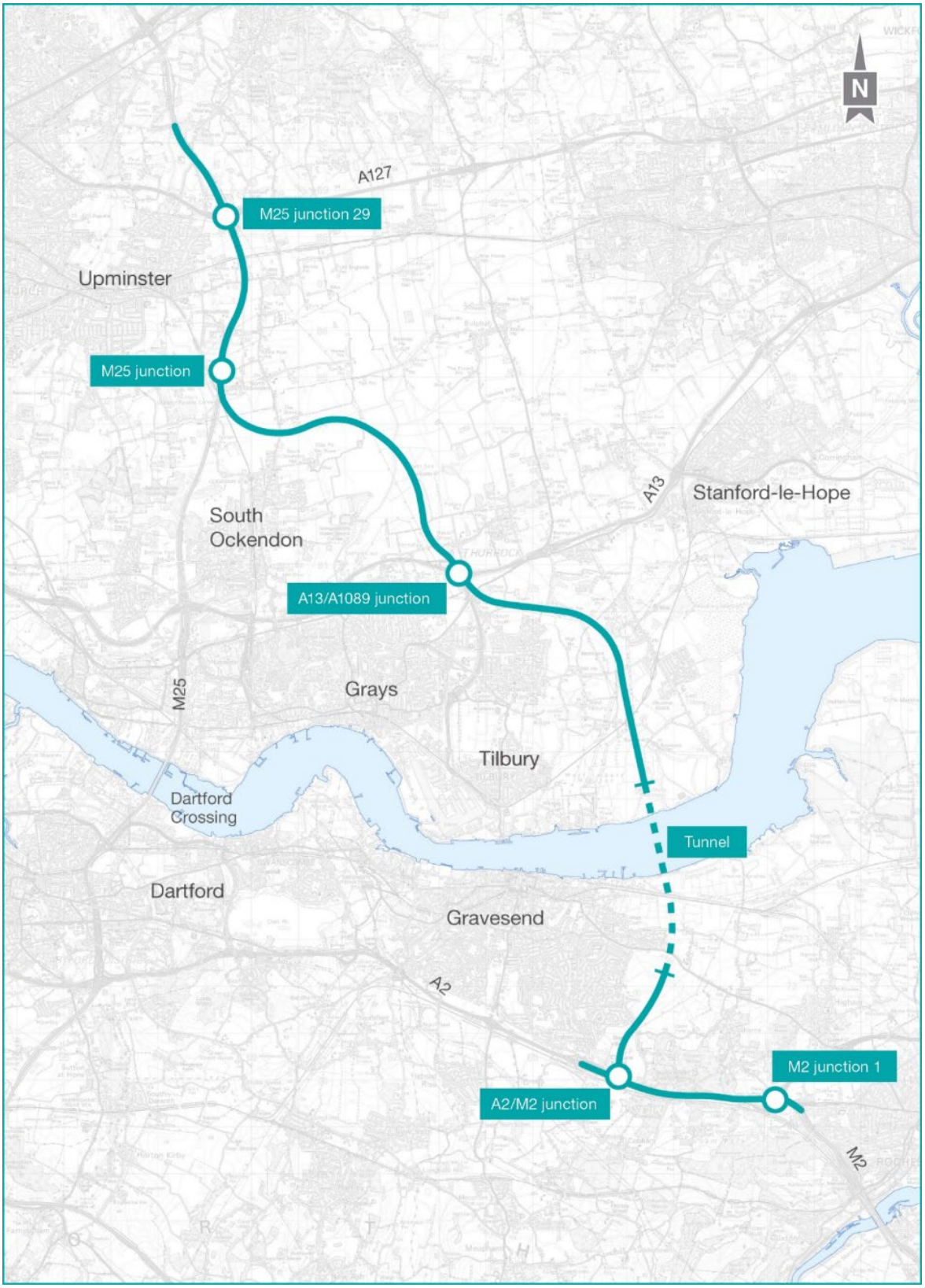
1.3.6 In common with most A-roads, the A122 would operate with no hard shoulder but would feature a 1m hard strip on either side of the carriageway. It would also feature technology including stopped vehicle and incident detection, lane control, variable speed limits and electronic signage and signalling. The A122 design outside of the tunnel would include emergency areas. The tunnel would include a range of enhanced systems and response measures instead of emergency areas.

1.3.7 The A122 would be classified as an ‘all-purpose trunk road’ with green signs. For safety reasons, walkers, cyclists, horse riders and slow-moving vehicles would be prohibited from using it.

1.3.8 The Project would include adjustment to a number of local roads. There would also be changes to a number of Public Rights of Way used by walkers, cyclists and horse riders. Construction of the Project would also require the installation and diversion of a number of utilities including gas mains, overhead electricity powerlines and underground electricity cables, as well as water supplies and telecommunications assets and associated infrastructure.

1.3.9 The Project has been developed to avoid or minimise significant effects on the environment. The measures adopted include landscaping, noise mitigation, green bridges, floodplain compensation, new areas of ecological habitat and two new parks.

Plate 1.1 Project route



1.4 Structure of this report

1.4.1 The report summarises the methodology of the modelling process including:

a. Chapter 2: Modelling scope

b. Chapter 3: Traffic data analysis

c. Chapter 4: Technical guidelines

d. Chapter 5: Model development

e. Chapter 7: Model calibration and validation results

f. Chapter 8: Conclusion.

2 Modelling scope

2.1 Study area

2.1.1 The study area as shown in Plate 2.1 is located on the A1089 next to Asda and Amazon in Tilbury. It includes the Asda roundabout and extends to the Tilbury Port access and Amazon southern access on A126 Dock Road in the south.

Plate 2.1 Traffic operations study area

2.1.2 The Asda roundabout is the first at grade junction on the A1089 when travelling from the A13 to the Port of Tilbury / Tilbury2. It is an entrance to an area predominantly made up of industrial activities, transport facilities, wholesale and trade retail warehouses as well as the Tilbury residential area. As a result, the proportion of all vehicles that are Heavy Goods Vehicles (HGV) at the junction is very high, typically 25% to 29% of total traffic in the AM peak and 9% to 17% in the PM peak.

2.1.3 The key characteristics of the junction are:

a. To the north, the A1089 is an all-purpose dual carriageway with a speed limit of 70mph.

b. To the south, four corridors act as road collectors. Clockwise from the east:

   i. A 30mph unnamed street providing access to the London Distribution Park (which includes Amazon)

   ii. A126 Dock Road, a 30mph corridor leading to a roundabout providing access to Tilbury and a southern access to the London Distribution Park (including Amazon, which is used as their staff access)

   iii. A1089 south, a 40mph dual carriageway corridor giving direct access to the Port of Tilbury/Tilbury2

   iv. Thurrock Park Way, a 30mph road giving access to Asda and the industrial and commercial estate to the west.

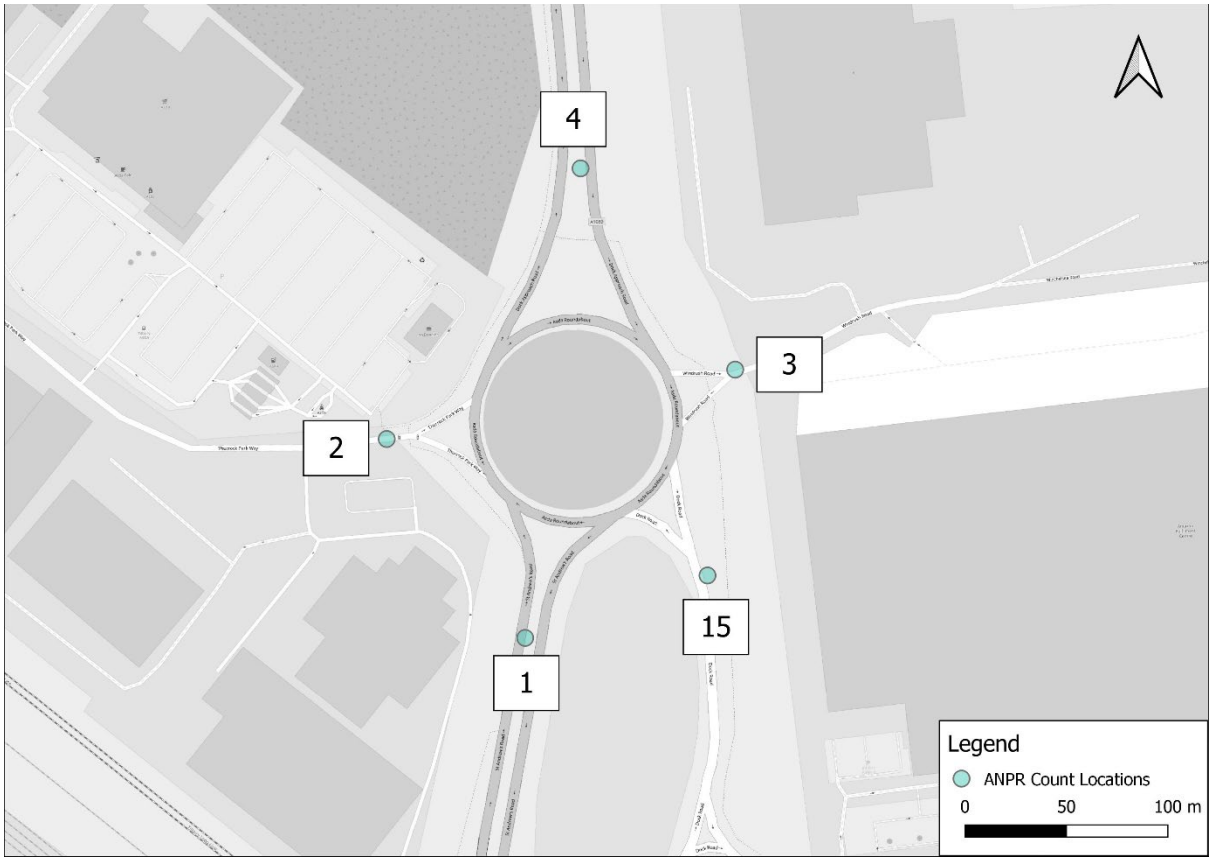
3 Traffic data analysis

3.1 Traffic data collection

3.1.1 The traffic demand for the Asda roundabout model is based on Manual Classified Counts (MCC) and Automatic Number Plate Recognition (ANPR) data from an origin-destination traffic survey held on 17 May 2018 (Thursday). The data is split by vehicle type: car, Light Goods Vehicle (LGV) and Heavy Goods Vehicle (HGV).

3.1.2 Plate 3.1 shows the location of the cameras used to collect the MCC and ANPR traffic data. The cameras were used to count the total amount of traffic using each entrance and exit of the roundabout. The ANPR data provided data on the entry and exit arm used by each vehicle recorded at the roundabout.

Plate 3.1 ANPR Camera Locations



3.1.3 The junction at the access to the Port of Tilbury and the roundabout on A126 Dock Road at the southern access to Amazon were also included in the model due to their proximity to the Asda roundabout. There were no traffic counts available for these junctions. The proportions of flow travelling to/ from these two accesses were derived using data from the Transport Assessment for Tilbury2 (Ref: PH/GM/PR/RH/ITL11323-005B R) and London Distribution Park, Tilbury (Ref: PH/RH/PR/ITB10336-003B R).

3.1.4 The Traffic Flow Diagrams for the AM and PM peak hours are shown in Appendix A.

3.2 Journey time data

3.2.1 The journey time data used for the model validation was extracted from Trafficmaster data for May 2018 supplied by DfT for all neutral weekdays (Tuesday, Wednesday and Thursday) excluding bank holidays. For the link south of the southern access roundabout to the London Distribution Park on Dock Road, another neutral month – October 2018 – has been used due to discrepancies within the May 2018 Trafficmaster data for that particular link

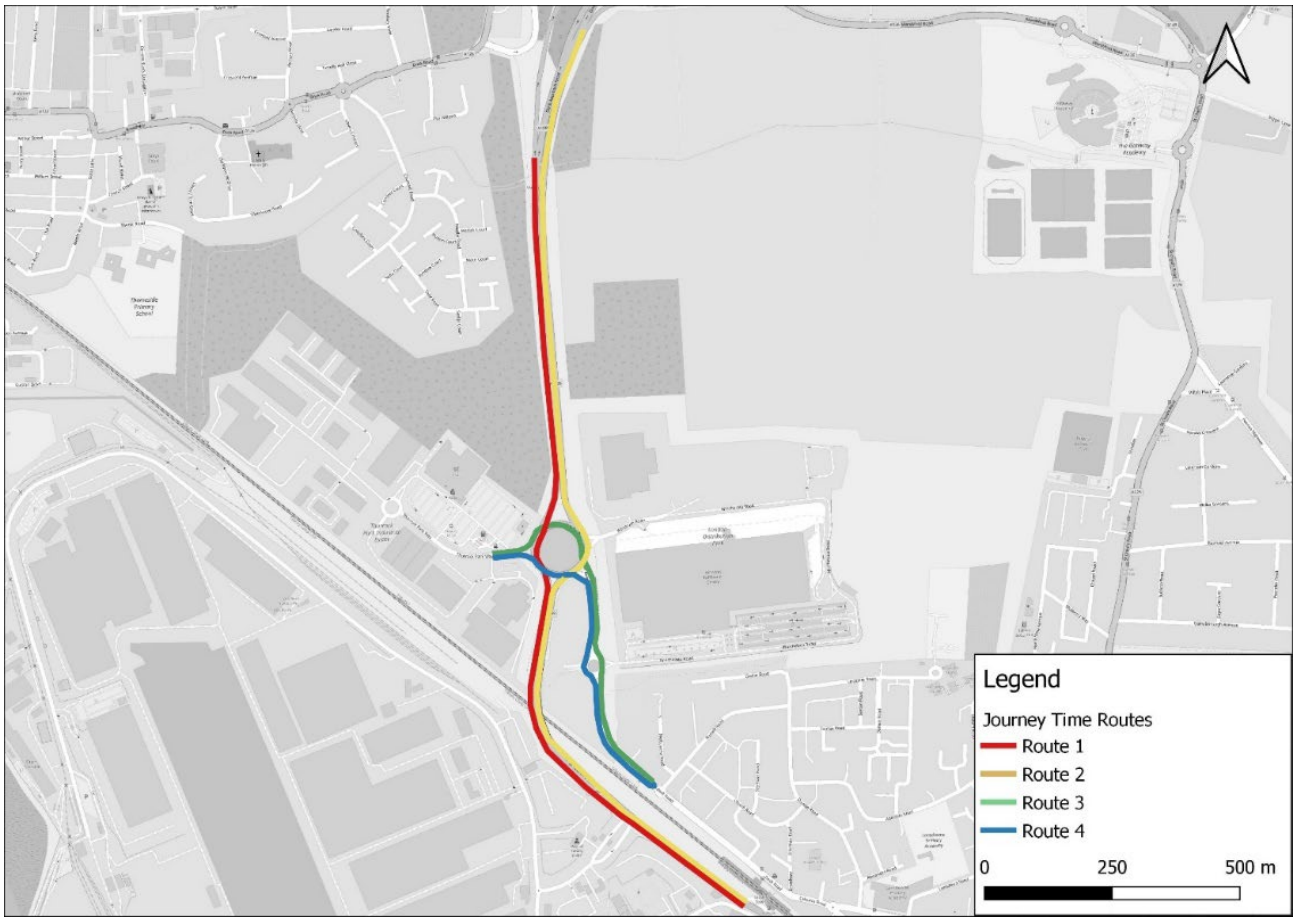
3.2.2 The journey time routes cover the two main corridors of the model shown in Plate 3.2:

a. Between A1089 Dock Road and A1089 St Andrew's Road – Route 1 and 2

b. Between Thurrock Park Way and Dock Road – Route 3 and 4

3.2.3 While the total route journey times were used for the model validation, the individual sections were also examined to make sure there is a good match between the observed and modelled journey times along each route, ensuring that the delays are replicated at the appropriate locations.

Plate 3.2 Journey time routes



3.2.4 Table 3.1, Table 3.2 and Table 3.3 show the observed journey times in the AM Peak 07:00-08:00 (AM1) and 08:00-09:00 (AM2), and the PM Peak 17:00-18:00 respectively.

Table 3.1 Observed journey times AM1 (07:00 – 08:00)

Peak	Route	Name	Distance (m)	Journey time (seconds)	Average speed (mph)
AM1 07:00-08:00	**1**	A1089 St Andrew's Rd to A1089 Dock Rd	1,669	105	35.4
	2	A1089 Dock Rd to A1089 St Andrew's Rd	1,889	106	39.8
	3	Thurrock Park Way to Dock Road	738	69	24.1
	4	Dock Road to Thurrock Park Way	661	70	21.1

Table 3.2 Observed journey times AM2 (08:00 – 09:00)

Peak	Route	Name	Distance (m)	Journey time (seconds)	Average speed (mph)
AM2 08:00-09:00	**1**	A1089 St Andrew's Rd to A1089 Dock Rd	1,669	108	34.5
	2	A1089 Dock Rd to A1089 St Andrew's Rd	1,889	104	40.6
	3	Thurrock Park Way to Dock Road	738	74	22.4
	4	Dock Road to Thurrock Park Way	661	67	22.2

Table 3.3 Observed journey times PM (17:00 – 18:00)

Peak	Route	Name	Distance (m)	Journey time (seconds)	Average speed (mph)
PM 17:00-18:00	**1**	A1089 St Andrew's Rd to A1089 Dock Rd	1,669	95	39.3
	2	A1089 Dock Rd to A1089 St Andrew's Rd	1,889	91	46.3
	3	Thurrock Park Way to Dock Road	738	84	19.7
	4	Dock Road to Thurrock Park Way	661	67	22.0

4 Technical guidelines

4.1.1 The traffic modelling on the Project complies with the requirements set out in National Highways' technical documentation and Department for Transport's Transport Appraisal Guidance (TAG). Guidance on methodology and reporting relevant for micro-simulation models can be found in the following documents:

a. Design Manual for Roads and Bridges (DMRB) – Traffic Appraisal of Road Schemes (Volume 12).

b. Guidelines for the Use of Microsimulation Software, Highways Agency (now withdrawn).

4.1.2 A new issue of the DMRB was released early 2020. This issue of the DMRB no longer includes the Traffic Appraisal of Road Schemes (Volume 12). Instead, most of the guidance on transport modelling is now available in the TAG.

4.1.3 TAG has little guidance specific to microsimulation models and the key chapters in the previous DMRB date from the early 1990s. Therefore, in accordance with industry best practice, this document references the Transport for London (TfL) modelling guidelines which cover microsimulation models, in particular:

a. Traffic Modelling Guidelines, TfL, Version 4.0 (September 2021)

b. Model Auditing Process (MAP) – Traffic Schemes in London Urban Network, TfL, Version 3.5 (March 2017).

5 Model development

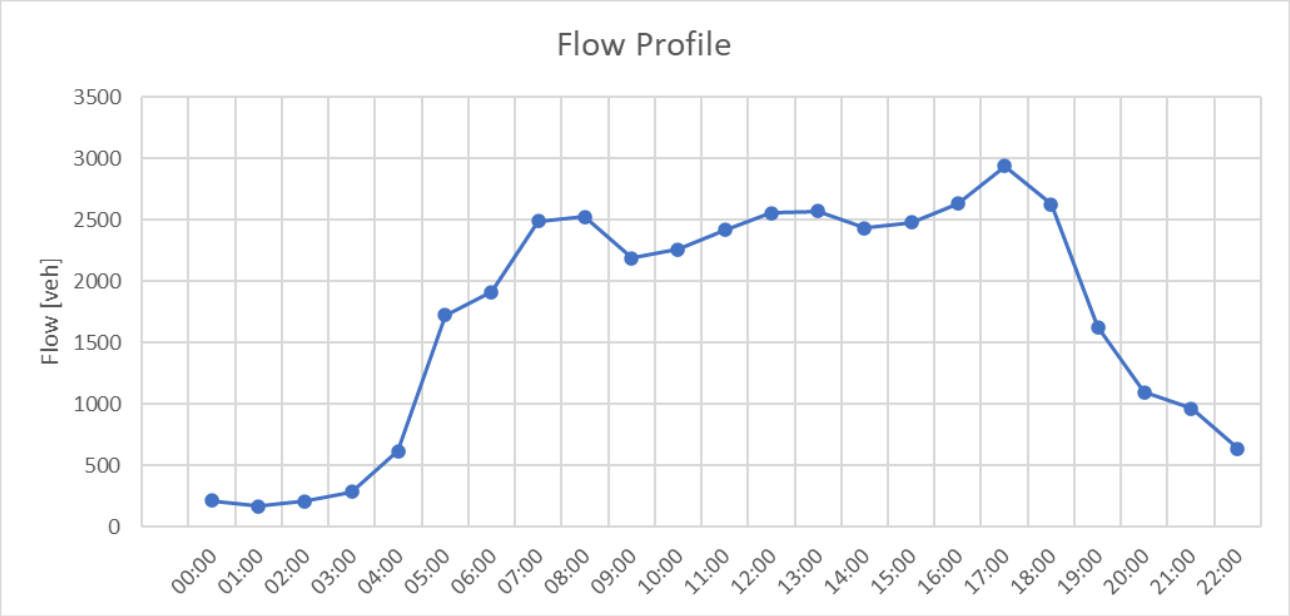
5.1 Flow profile & peak hour identification

5.1.1 An analysis of the observed traffic volume was undertaken to determine the hour with the busiest total traffic flows for each peak period. The analysis of the 2018 observed counts (illustrated in Table 5.1 and Plate 5.1) shows that the busiest hours at the junction are 07:00 to 09:00 (the AM peak) and 17:00 to 18:00 (the PM peak).

Table 5.1 AM / PM peak hour analysis

Hour starting	Total flows 16 May 2018	Total flows 17 May 2018	Peak hour
06:00	1,906	1,918	-
07:00	2,545	2,430	AM
08:00	2,648	2,398	AM
09:00	2,185	2,191	-
10:00	2,391	2,124	-
11:00	2,620	2,220	-
12:00	2,753	2,356	-
13:00	2,667	2,475	-
14:00	2,492	2,379	-
15:00	2,536	2,425	-
16:00	2,707	2,554	-
17:00	3,054	2,820	PM
18:00	2,658	2,593	-
19:00	1,614	1,639	-

Plate 5.1 Average flow profile



5.1.2 The modelling peak periods are as follows:

a. Weekday AM Peak (07:00 to 09:00)

b. Weekday PM Peak (17:00 to 18:00)

5.1.3 A 15-minute warm-up period has been added before the start of the modelling peak period, therefore the start time in the model is 06:45 in the AM and 16:45 in the PM. The simulation always starts with an empty network and the warm-up period is used to preload traffic, ensuring there is realistic amount of traffic on the roundabout at the start of the modelled hours.

5.2 Network

5.2.1 The network structure (such as link lengths, lane connectors, number of lanes and lane utilisation) has been coded to match the road layout. The main data source was Ordnance Survey Base AutoCAD drawings supplemented by online mapping.

5.2.2 Reduced speed areas were set up in the VISSIM model on all turning movements, with tighter turns having lower reduced speed values. Desired speed decisions were used to set desired speeds on entry to the network and where there is a change in the posted speed limit. Vehicles attempt to travel in the model at this constant desired speed and will only adjust this speed if they approach a queue or are performing a lane change.

5.2.3 Priority rules have been used where one traffic movement has to give way to another traffic movement at priority junctions. The default values of a five-metre headway and three-second gap time were used. Gap time and headway values were reviewed and updated as part of the model calibration process to replicate conditions on site and these were then adjusted based upon considerations of geometry, position and the types of vehicles stopping.

5.3 Traffic signals

5.3.1 Signals within the VISSIM base models were coded using Vehicle Actuated Programming (VAP) control. All relevant PUA (interstage) files and VAP (controller logic) files accompany the VISSIM models.

5.3.2 There is only one set of signals in the study area which is the pedestrian crossing on Thurrock Park Way by Asda. According to online mapping, this crossing was not in operation in 2018, therefore these signals have been deactivated in the base model.

5.4 Traffic demand matrices

5.4.1 The Asda VISSIM model applies traffic demand in 15-minute intervals to capture the build-up and cool-down of congestion. 15-minute matrices have been prepared using the available traffic data described in Chapter 3 for the following vehicle classes:

a. Cars

b. LGVs

c. HGVs

5.5 Public transport

5.5.1 The following bus routes have been included in the model:

a. 77 / 77A

b. 66

c. Z4

d. Z2

e. 27

f. Z1

g. 51

h. 99

5.5.2 Bus routes were coded separately from general traffic. They were coded using the VISSIM public transport lines feature, with a public transport line set up for each bus route. Bus route and frequency information was derived from publicly available bus timetable information.

5.5.3 A summary of the modelled bus routes and their frequency is presented in Table 5.2.

Table 5.2 Modelled bus routes and frequency

Bus Route	AM (07:00-08:00)	AM (08:00-09:00)	PM (17:00-18:00)
66 (EB)	1 per hour	2 per hour	2 per hour
66 (WB)	2 per hour	2 per hour	2 per hour
77 (EB)	0	0	0
77 (WB)	1 per hour	0	0
Z1 (WB)	2 per hour	0	0
Z1 (EB)	0	0	0
Z2 (SB)	4 per hour	0	2 per hour
Z2 (NB)	0	1 per hour	0
Z4 (SB)	2 per hour	0	0
Z4 (NB)	0	0	0
51 (WB)	0	0	1 per hour
51 (EB)	1 per hour	0	0
99	2 per hour	2 per hour	2 per hour
27	1 per hour	0	0

5.5.4 Bus routes 77/ 77A do not operate from the Asda Tilbury or Amazon Tilbury bus stops during the modelled peak hours.

5.6 Convergence

5.6.1 Convergence is determined by the level of stability of the model whereby trip routing does not change significantly between iterations of the same model. Before any results from a traffic model are used to inform a decision, it should be confirmed that the model has reached an acceptable level of stability.

5.6.2 A high level of convergence for the highway assignment is particularly important because inadequate convergence is likely to result in unstable and unreliable forecasts.

5.6.3 According to Transport for London (TfL) Traffic Modelling Guidelines on VISSIM modelling, convergence is deemed to have been satisfactorily achieved when the following criteria have been met over the modelled peak hour:

a. 95% of travel times on all paths change by less than 20% for at least four consecutive runs

b. 95% of all path traffic volumes change by less than 5% for at least four consecutive runs.

5.6.4 The convergence performance can be seen in Plate 5.2 to Plate 5.5 for both AM and PM peaks.

Plate 5.2 AM base model journey time convergence

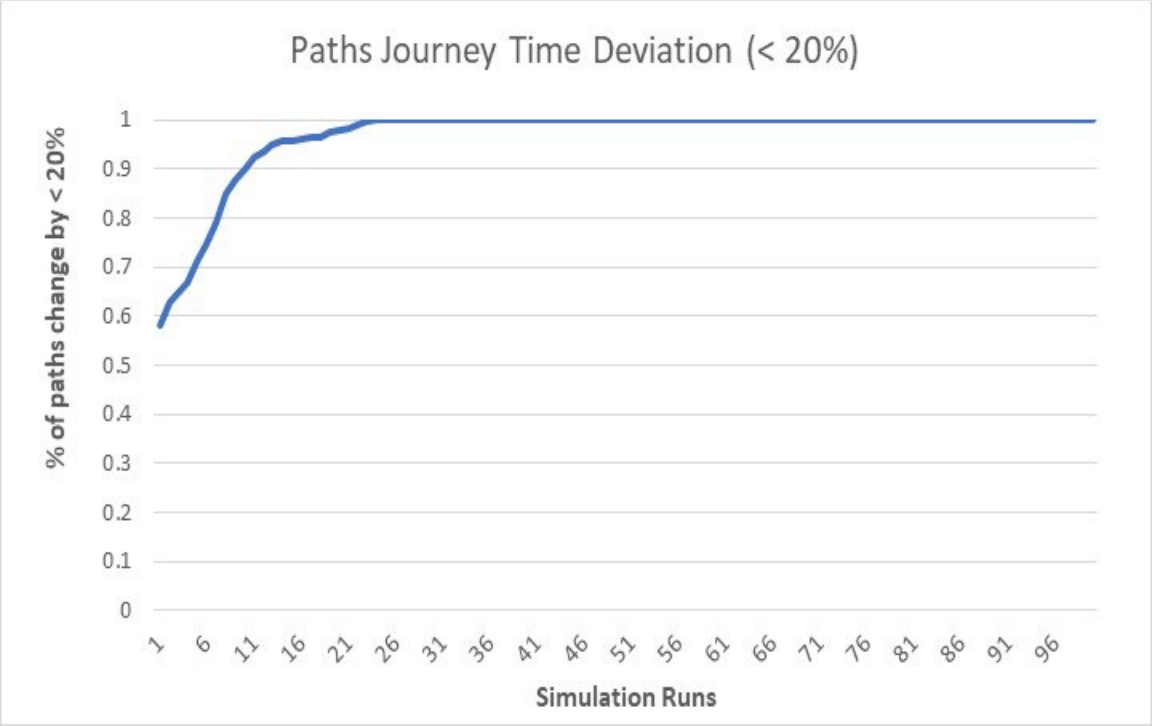


Plate 5.3 AM base model traffic volume convergence

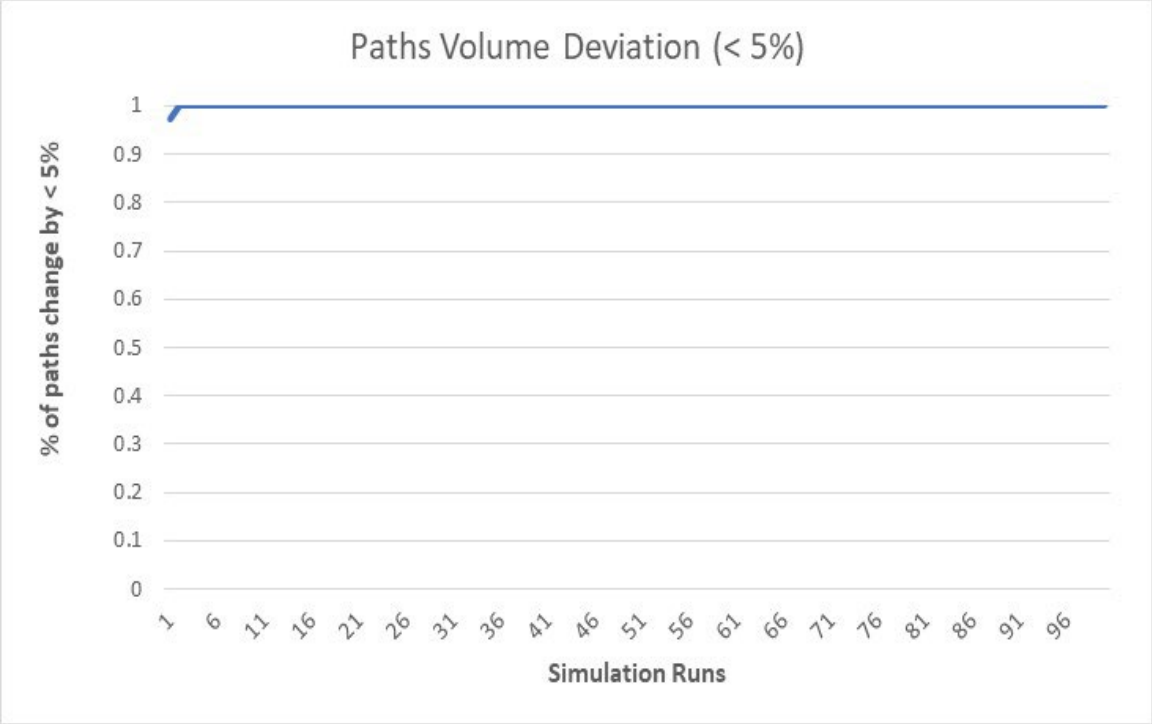


Plate 5.4 PM base model journey time convergence

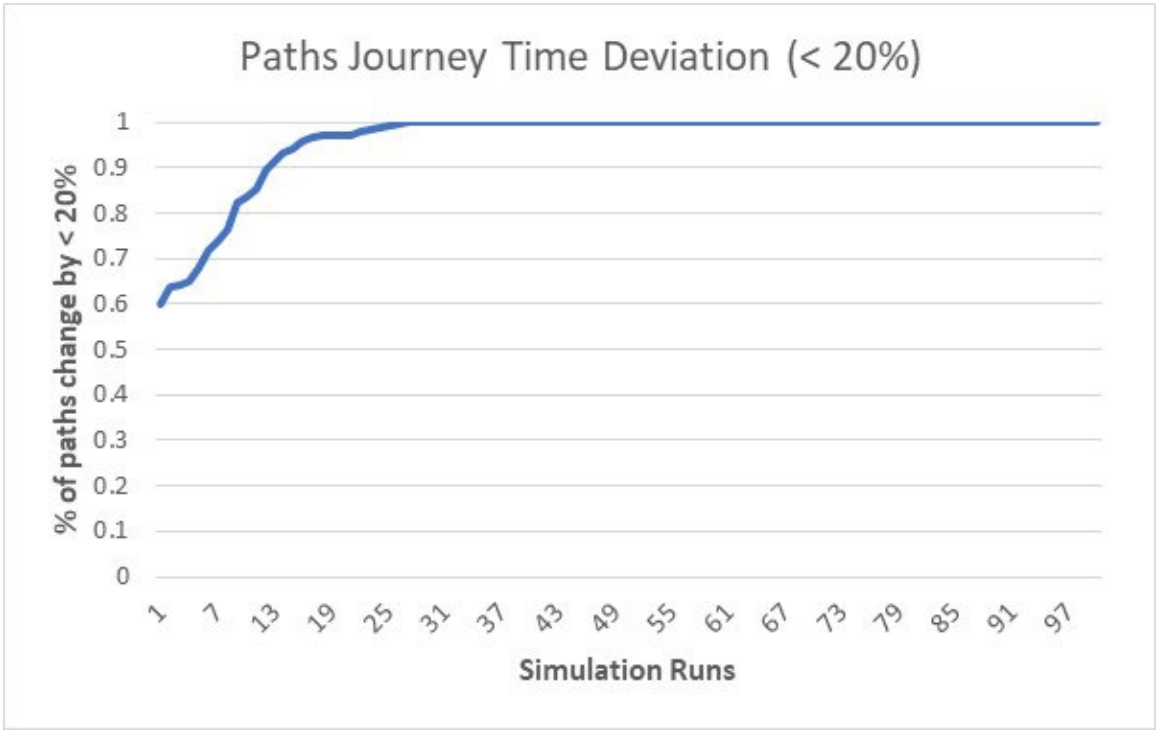
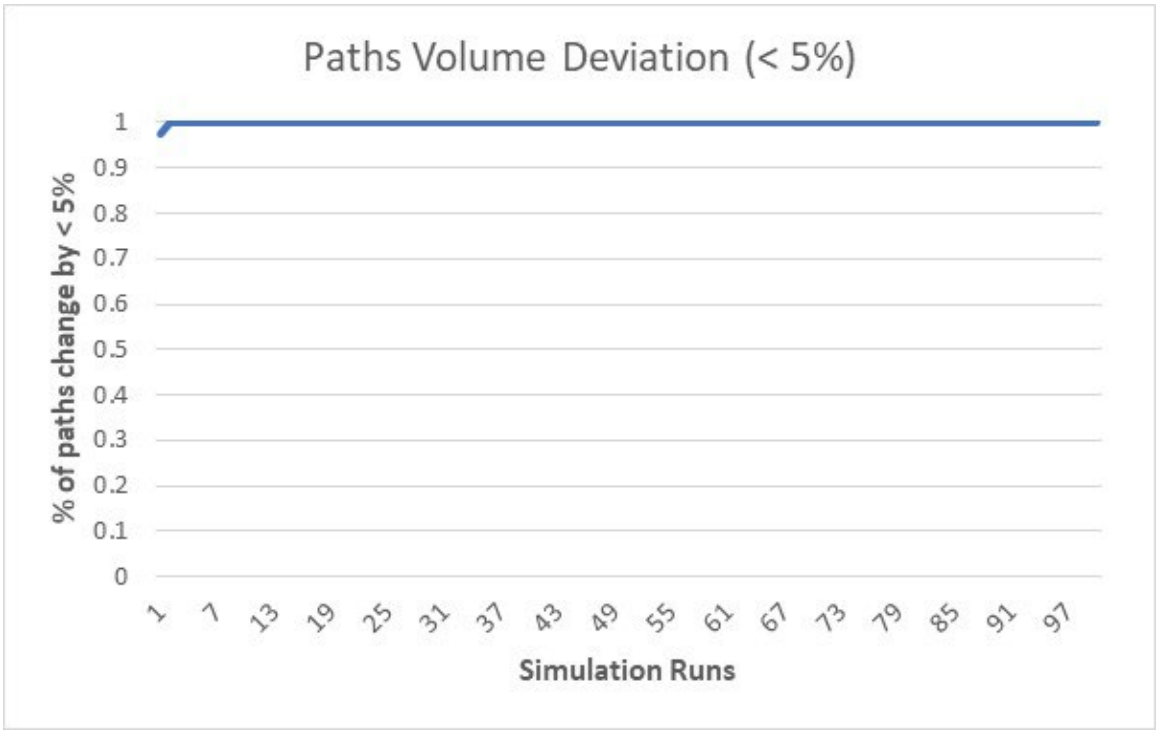


Plate 5.5 PM base model traffic volume convergence



5.6.5 As can be seen on the plates above, the convergence criteria of journey time changes were met well. The percentages of journey times which have less than a 20% difference are high and stable at 100% in both AM and PM peaks. These figures show that the journey time changes are relatively small for at least four consecutive model runs, which indicates that the models are stable.

The plates also show that the models are producing stable traffic flow results with volume deviation of less than 5% on all paths after the first run.

5.6.6 The convergence performance indicates that the models are suitable to test the scheme as they are producing stable results.

5.6.7 Table 5.3 and Table 5.4 present the convergence results for the last 10 runs in the AM peak and PM peak models respectively and shows the convergence criteria on journey time and traffic volume were met on all paths.

Table 5.3 AM base model traffic volume convergence – last 10 runs

Run	20% journey time deviation	5% Volume deviation
91	1.00	1.00
92	1.00	1.00
93	1.00	1.00
94	1.00	1.00
95	1.00	1.00
96	1.00	1.00
97	1.00	1.00
98	1.00	1.00
99	1.00	1.00
100*	1.00	1.00

** Cost and path files were taken from the last run (ID 100)*

Table 5.4 PM base model traffic volume convergence – last 10 runs

Run	20% journey time deviation	5% Volume deviation
91	1.00	1.00
92	1.00	1.00
93	1.00	1.00
94	1.00	1.00
95	1.00	1.00
96	1.00	1.00
97	1.00	1.00
98	1.00	1.00
99	1.00	1.00
100*	1.00	1.00

** Cost and path files were taken from the last run (ID 100)*

5.7 Number of random seed records

5.7.1 Traffic conditions on the road are variable and this affects the following:

a. **Overall traffic volumes**, accounted for in VISSIM by selecting a representative peak hour.

b. **Traffic flow profiles**, corresponding to the variation in short-term flow rate within a modelled period, accounted for in VISSIM by profiling the traffic inputs into 15-minute time periods.

c. **Random Driver Behaviours.** Traffic conditions vary day-to-day as a result of random driver behaviours such as speed selection, lane changing, route choice and bus dwell times. The stochastic microsimulation traffic model in VISSIM attempts to replicate this day-to-day random variability by altering individual driver decisions based on random numbers. The set of random numbers is generated from an initial 'seed' value specified at the start of a simulation run. A single set of random numbers, generated by a single seed value, therefore represents one potential outcome, or one particular day of traffic operation. The actual value of the seed has no significance; however, the seeds for different runs must be different from each other in order to produce different outcomes. Based on UK modelling guidelines, the recommended number of random seed runs is:

i. A minimum of 20 (TfL Traffic Modelling Guidelines, Version 4.0)

ii. Typically recommended being 10 (Section 5.5.2 - Guidelines for the Use of Microsimulation Software, Highways Agency).

5.7.2 The number of runs specified in the guidelines is indicative and the number of random seeds should be set based on the variability of the travel time results.

5.7.3 Model outputs based on 20 runs with different random seeds were considered adequate for the Asda roundabout VISSIM model. This is also consistent with the other VISSIM models developed for the Project.

6 Model calibration and validation results

6.1 Traffic flow calibration

6.1.1 For the calibration process, each model time period has been run 20 times using a different random seed for each run. This method is representative of the variation that is observed on a day-to-day basis. The final model output data used in the validation tables are the averages of all 20 seed runs, and this has been compared against observed data.

6.1.2 The scope of the traffic flow comparison process is to verify that the total flows and traffic movements generated by the model are comparable with the observed flows.

6.1.3 For VISSIM, TfL's traffic modelling guidelines recommend the use of the GEH statistic to demonstrate that the traffic flows within the model match observed counts to an acceptable level of accuracy. The GEH statistic gives greater weighting to higher flows, highlighting differences that are more significant. This statistic is a derivative of the Chi-squared statistic, and is defined as:

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

where: GEH is the GEH statistic;

M is the modelled flow; and

C is the observed flow.

6.1.4 Modelled flows should be averaged over multiple runs with different seeds. It is recommended that for a model to be considered validated, the GEH statistic for turns/links should be:

a. Less than five for at least 85% of turns/ links

b. Less than three for all important/critical links.

6.1.5 TAG also recommends modelled link flows should:

a. Be within 100 vehicles per hour of observed flows, where those observed flows are less than 700 vehicles per hour

b. Be within 15% of observed flows where those observed flows are between 700 vehicles per hour and 2,700 vehicles per hour

c. Be within 400 vehicles per hour of observed flows where those observed flows are greater than 2,700 vehicles per hour

6.1.6 The modelled flows are extracted from VISSIM using Node Evaluation for turns and data collection points on links. They are available separately by vehicle type. Table 6.1 provides a summary of the percentage of movements meeting the above criteria. It demonstrates that all 25 turning movements in the

model pass the required validation thresholds. Appendix B provides a more detailed summary of the validation status of each turning movement.

Table 6.1 Asda Roundabout GEH Flow Validation

Peak	Number of counts	% of movements within a GEH<5	% of movements within a GEH<3	% Satisfying TAG flow criteria
AM 07.00–08.00	25	100%	100%	100%
AM 08.00–09.00	25	100%	100%	100%
PM 17.00–18.00	25	100%	100%	100%

6.1.7 The results show that 100% of AM and PM turning counts satisfy both GEH criteria and TAG criteria.

6.2 Journey time validation

6.2.1 Validation of the Asda roundabout VISSIM model was also carried out following TAG and TfL's traffic modelling guidelines for journey times.

6.2.2 For the validation process, each model time period was run 20 times with 20 different random seeds. The final journey time output data used in the validation tables are the averages of all 20 seed runs.

6.2.3 For VISSIM TfL's modelling guidelines and TAG it is recommended that modelled journey times should be within 15% of surveyed values or within one minute for routes longer than 3km. All of the journey time routes in the model are less than 3km.

6.2.4 Journey time measurements have been undertaken within the models along the same route sections as those extracted from the Trafficmaster data. Table 6.2 summarises the journey time validation and shows that journey times in the AM and PM, when compared with Trafficmaster data, satisfy the validation criteria of validating to within 15% of observed values for 85% of routes as all (100%) of the routes shown in Plate 3.2 achieved the validation criteria. The one-minute criterion was not applied because the routes were shorter than 3km. Tables showing the full journey time validation for each route are shown in Appendix C.

6.2.5 More detailed journey time results, with each route broken down into a number of timing points along each route and presented in the form of cumulative distance and time graphs, are provided in Appendix D.

Table 6.2 Journey time summary table

	Validation (all routes)	Average speed (mph)	
Peak	<15%	Observed	Modelled
AM 07:00-08:00	100%	27.7	29.4
AM 08:00-09:00	100%	28.2	29.4
PM 17:00-18:00	100%	28.8	30.4

6.2.6 The graphs contained in Appendix D show a graphical comparison between Trafficmaster data and modelled VISSIM travel time results. Each graph shows the 'error bar' within 15% above and down of the observed value.

6.2.7 For both AM (07:00–08:00 and 08:00–09:00) and PM (17:00–18:00) hours, all routes shown in Plate 3.2 validated within the 15% threshold.

6.2.8 Overall, the journey time validation demonstrates a good match against the observed data and the model is considered to provide a good representation of traffic conditions in 2018.

6.3 Queue length analysis

6.3.1 Queue length is not a validation criterion for VISSIM due to the subjective nature of queue measurement, but the models have been visually sense-checked to ensure that the model is accurately reflecting location-specific delays and capacity bottlenecks. This was further confirmed by breaking down the journey time routes in shorter segments, as shown in Appendix D and the relative delay plots in Appendix E, ensuring the location-specific delays are replicated accurately.

6.4 Error logs

6.4.1 Following a review of the error log files no significant errors were identified.

6.5 Network performance

6.5.1 In addition to the flow calibration and journey time validation results, some general statistics are also provided. These are not part of the calibration / validation process but supply some general metrics about the network performance which are a good baseline to compare against when evaluating the future year models. Table 6.3 summarises the network performance statistics for the modelled network.

Table 6.3 Network performance statistics

	AM (07:00-08:00)	AM (08:00-09:00)	PM (17:00-18:00)
Average delay (seconds)	13	13	13
Average stops	0	0	0
Average speed (km/h)	56	56	57
Total distance (km)	4,472	4,210	4,772
Total travel time (hours)	80	76	83
Total vehicles	2,479	2,363	2,709
Latent delay (hours)	0	0	0
Latent demand (vehicles)	0	0	0

6.5.2 Table 6.3 indicates that the average delay is 13 seconds per vehicle in the AM and PM peak hours.

6.5.3 Latent demand is the number of vehicles not able to deploy in the network within the evaluation period because of congestion and is typically the total difference between the demand flow and the modelled flow on all the entry links. All the vehicles were able to deploy in both peak periods of the Asda base model.

7 Conclusions

7.1.1 The calibration and validation processes show a good correlation between the modelled and observed traffic flows and journey times within the study area.

7.1.2 Given this the models are considered fit-for-purpose in providing a robust representation of the existing situation at the Asda roundabout and can be used to test the performance of the network with future traffic forecasts.

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Glossary

Term	Explanation
ANPR	Automatic Number Plate Recognition
ATC	Automatic Traffic Count
DCO	Development Consent Order - Means of obtaining permission for developments categorised as Nationally Significant Infrastructure Projects (NSIPs)
DfT	Department for Transport
DMRB	Design Manual for Roads and Bridges: A comprehensive manual which contains requirements, advice and other published documents relating to works on motorway and all-purpose trunk roads for which one of the Overseeing Organisations (National Highways, Transport Scotland, the Welsh Government or the Department for Regional Development (Northern Ireland)) is the highway authority. For the Lower Thames Crossing, the Overseeing Organisation is National Highways.
Do Minimum	A future year scenario which includes changes to the road network and planned development that is forecast to go ahead, but not the Lower Thames Crossing.
Do Something	A future year scenario which includes changes to the road network and planned development that is forecast to go ahead, and the Lower Thames Crossing.
EB	Eastbound
GEH	A formula used to compare two traffic volumes, named after its originator, Geoff E. Havers. It is similar to a chi-squared test.
HGV	Heavy Goods Vehicle
LGV	Light Goods Vehicle
LMVR	Local Model Validation Report
NB	Northbound
OS	Ordnance Survey
PTV	German for Planning Transport and Traffic Software package
Random Seed	This value initialiszes a random number generator. The use of random seeds allows for stochastic variations of traffic arrivals in VISSIM, which helps account for variations in real-world traffic conditions. If two or more simulation runs in the same VISSIM network each use different random seeds, then the stochastic functions in VISSIM will be assigned a different value sequence in each simulation run. This consequently changes the traffic flow and operational attributes (e.g., speed, travel time, delay) in the network from seed to seed.
SATURN	Simulation and Assignment of Traffic to Urban Networks
SB	Southbound
TAG	Transport Analysis Guidance published by DfT
TfL	Transport for London - The integrated body responsible for London's transport system
VISSIM	Micro-simulation software developed by PTV. Verkehr In Städten - SIMulationsmodell (German for "Traffic in cities - simulation model)
WB	Westbound

Appendix A – Flow diagrams

Plate A.1 Flow diagram (07:00–08:00), vehicles

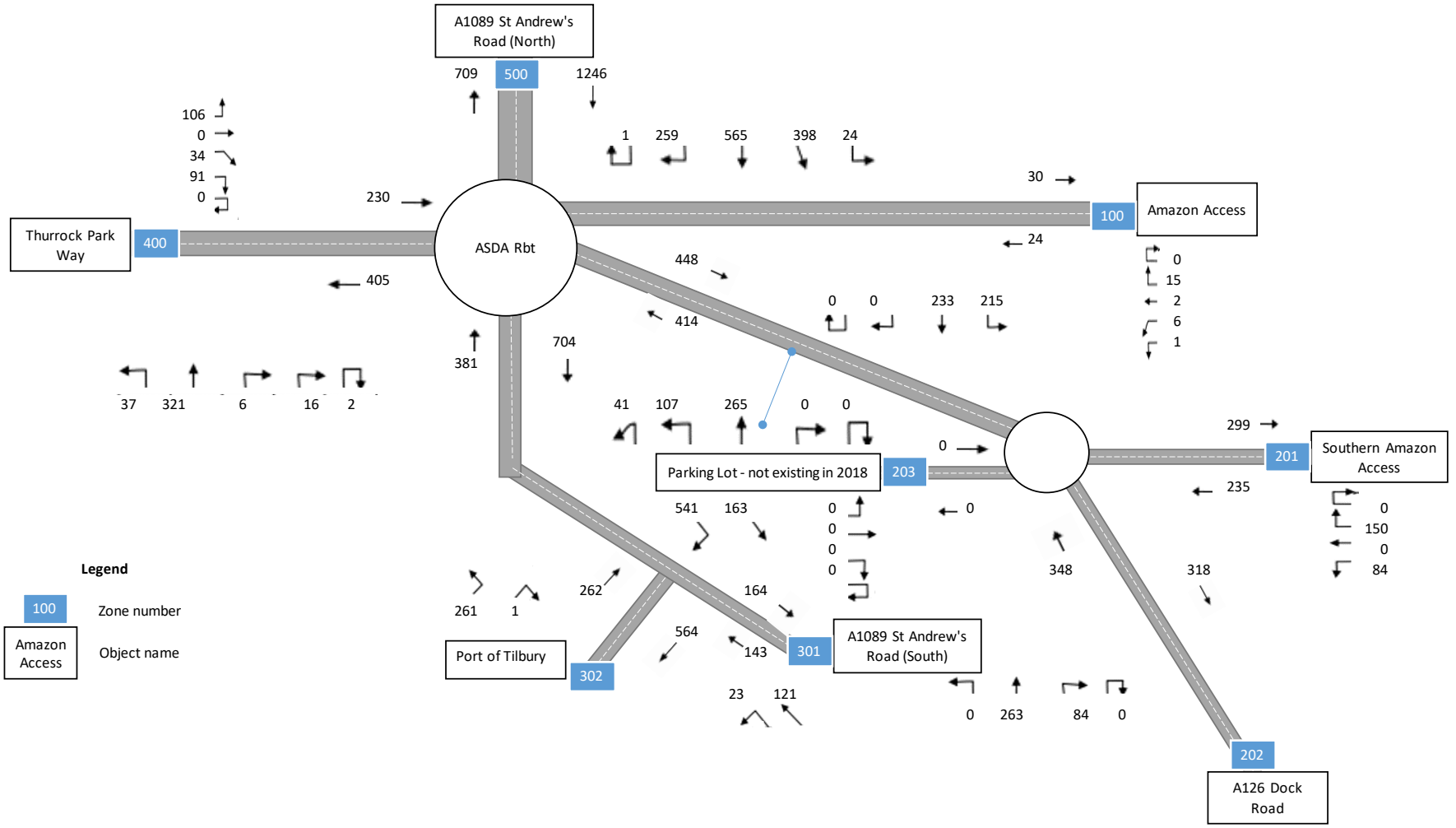


Plate A.2 Flow diagram (08:00–09:00), vehicles

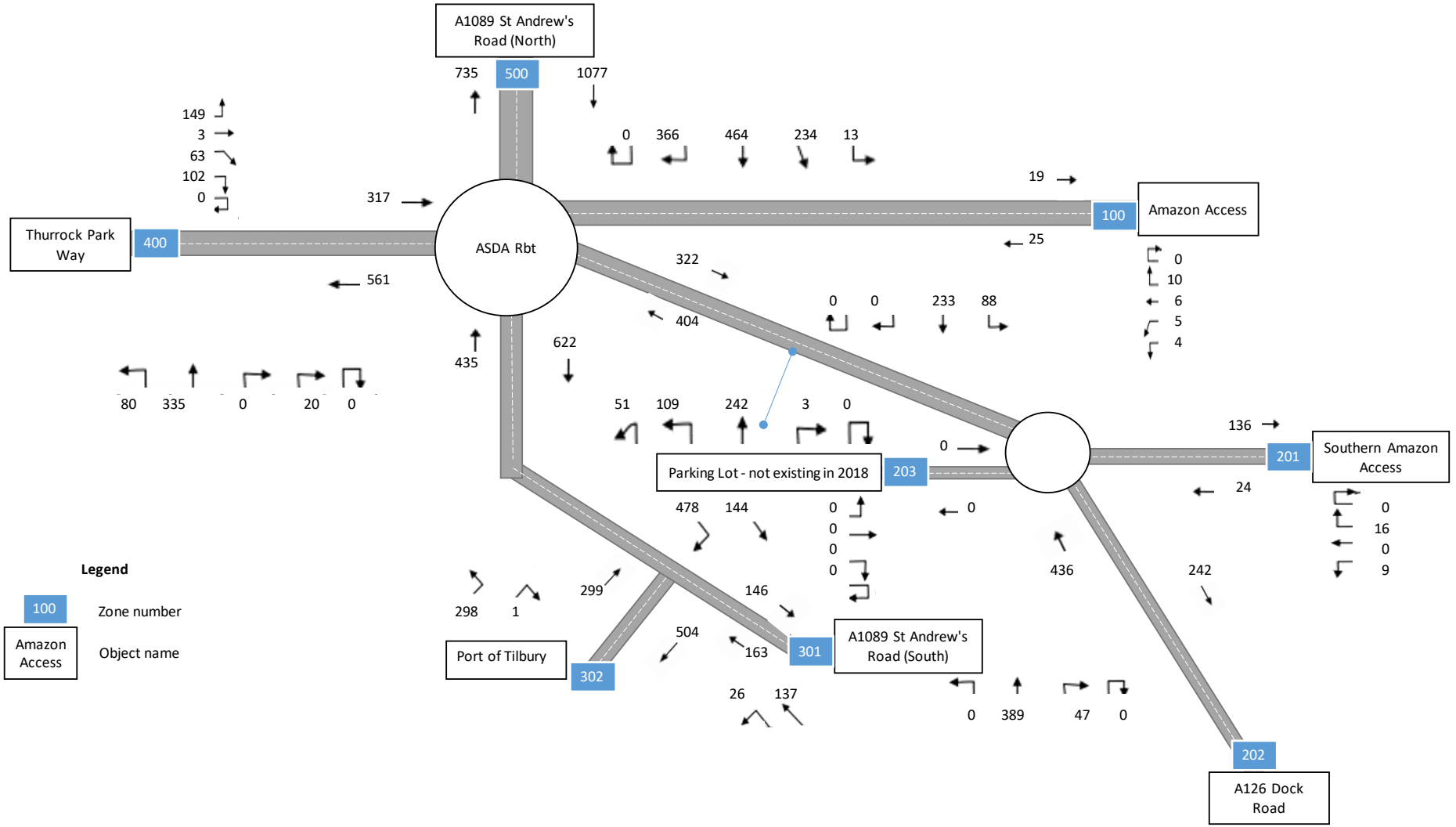
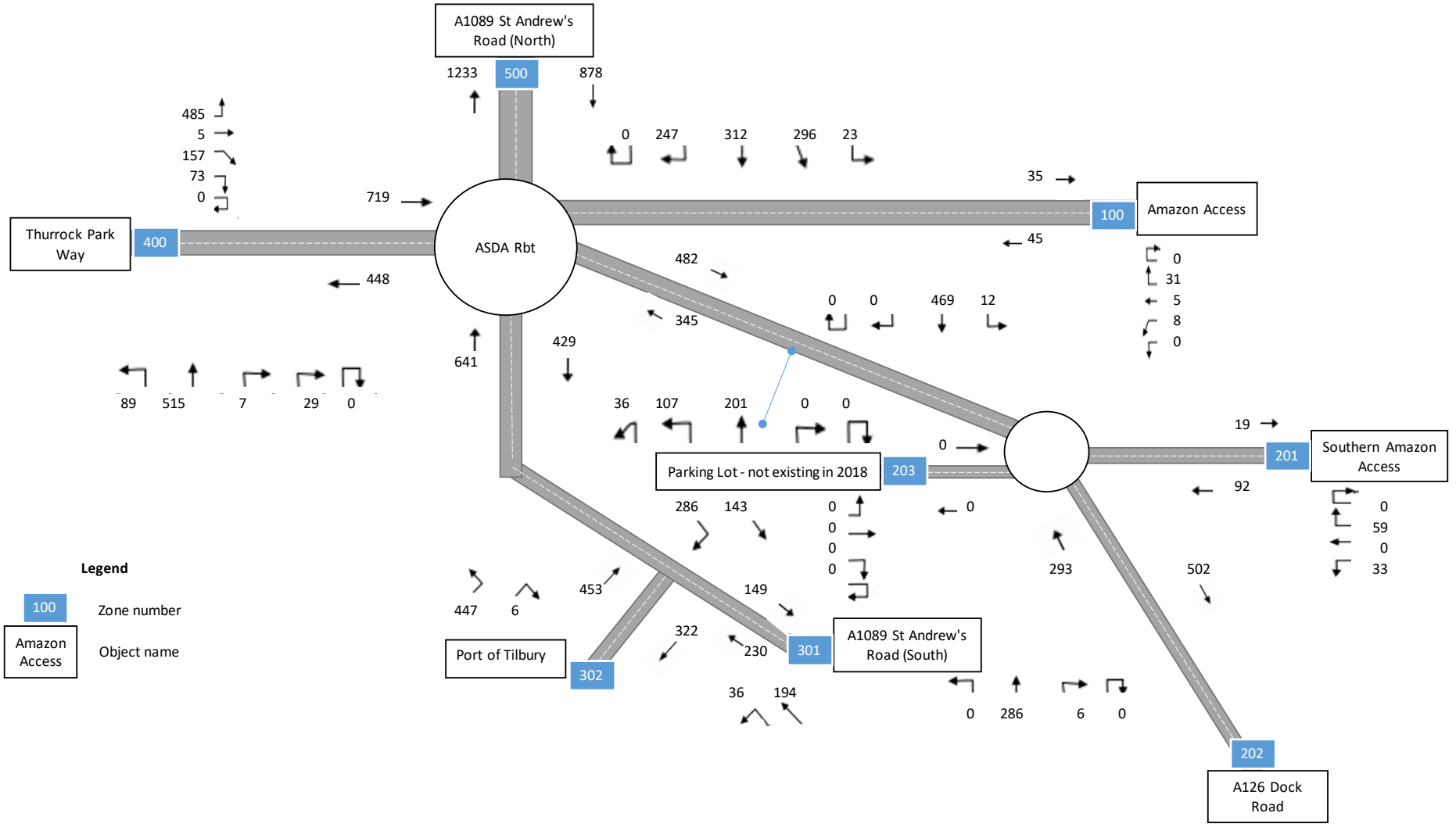


Plate A.3 Flow diagram (17.00–18.00), vehicles



Appendix B – Traffic flow comparison

Table B.1 AM 07:00–08:00 flow comparison

Approach	To	Observed (vehicles)				Modelled (vehicles)				GEH < 5				FC
		Car	LGV	HGV	Total	Car	LGV	HGV	Total	Car	LGV	HGV	Total	
A1089 Dock Road (North)	Amazon Entry (East)	13	1	10	24	14	0	11	25	0	2	0	0	PASS
	A126 Dock Road	338	46	13	398	331	47	12	397	0	0	0	0	PASS
	A1089 St Andrew's Road (South)	299	55	210	565	300	57	212	569	0	0	0	0	PASS
	Thurrock Park Way	210	26	23	259	209	25	23	257	0	0	0	0	PASS
	A1089 Dock Road (North)	0	1	0	1	0	0	0	0	0	1	0	1	PASS
Amazon Entry (East)	A126 Dock Road	0	1	0	1	0	0	0	0	0	1	0	1	PASS
	A1089 St Andrew's Road (South)	0	0	6	6	0	0	6	6	0	0	0	0	PASS
	Thurrock Park Way	0	0	2	2	0	0	2	2	0	0	0	0	PASS
	A1089 Dock Road (North)	8	0	8	15	8	0	8	16	0	0	0	0	PASS
	Amazon Entry (East)	0	0	0	0	0	0	0	0	0	0	0	0	PASS
A126 Dock Road	A1089 St Andrew's Road (South)	30	6	5	41	32	5	5	41	0	1	0	0	PASS
	Thurrock Park Way	96	10	1	107	94	9	1	106	0	0	0	0	PASS
	A1089 Dock Road (North)	212	45	8	265	213	44	8	268	0	0	0	0	PASS
	Amazon Entry (East)	0	0	0	0	0	0	0	0	0	0	0	0	PASS
	A126 Dock Road	0	0	0	0	0	0	0	0	0	0	0	0	PASS
A1089 St Andrew's Road (South)	Thurrock Park Way	19	13	5	37	19	14	4	37	0	0	0	0	PASS
	A1089 Dock Road (North)	60	15	247	321	61	14	248	323	0	0	0	0	PASS
	Amazon Entry (East)	0	2	4	6	0	0	4	4	0	2	0	1	PASS

Approach	To	Observed (vehicles)				Modelled (vehicles)				GEH < 5				FC
		Car	LGV	HGV	Total	Car	LGV	HGV	Total	Car	LGV	HGV	Total	
	A126 Dock Road	14	0	2	16	14	0	0	15	0	0	2	0	PASS
	A1089 St Andrew's Road (South)	2	0	0	2	0	0	0	0	2	0	0	2	PASS
Thurrock Park Way	A1089 Dock Road (North)	68	17	22	106	67	17	22	106	0	0	0	0	PASS
	Amazon Entry (East)	0	0	0	0	0	0	0	0	0	0	0	0	PASS
	A126 Dock Road	29	4	1	34	30	2	0	33	0	1	2	0	PASS
	A1089 St Andrew's Road (South)	76	8	7	91	76	5	8	89	0	1	0	0	PASS
	Thurrock Park Way	0	0	0	0	0	0	0	0	0	0	0	0	PASS

Table B.2 AM 08:00–09:00 flow comparison

Approach	To	Observed (vehicles)				Modelled (vehicles)				GEH < 5				FC
		Car	LGV	HGV	Total	Car	LGV	HGV	Total	Car	LGV	HGV	Total	
A1089 Dock Road (North)	Amazon Entry (East)	4	3	6	13	5	4	4	13	0	1	1	0	PASS
	A126 Dock Road	191	29	15	234	199	29	16	244	1	0	0	1	PASS
	A1089 St Andrew's Road (South)	244	38	182	464	245	38	181	464	0	0	0	0	PASS
	Thurrock Park Way	326	30	10	366	325	31	11	367	0	0	0	0	PASS
	A1089 Dock Road (North)	0	0	0	0	0	0	0	0	0	0	0	0	PASS
Amazon Entry (East)	A126 Dock Road	4	0	0	4	4	0	0	4	0	0	0	0	PASS
	A1089 St Andrew's Road (South)	0	0	5	5	0	0	5	5	0	0	0	0	PASS
	Thurrock Park Way	3	1	2	6	3	1	1	5	0	0	1	0	PASS
	A1089 Dock Road (North)	0	0	10	10	0	0	10	10	0	0	0	0	PASS
	Amazon Entry (East)	0	0	0	0	0	0	0	0	0	0	0	0	PASS

Approach	To	Observed (vehicles)				Modelled (vehicles)				GEH < 5				FC
		Car	LGV	HGV	Total	Car	LGV	HGV	Total	Car	LGV	HGV	Total	
A126 Dock Road	A1089 St Andrew's Road (South)	43	5	3	51	45	4	1	50	0	1	1	0	PASS
	Thurrock Park Way	101	6	2	109	102	6	2	110	0	0	0	0	PASS
	A1089 Dock Road (North)	202	30	9	242	202	32	9	243	0	0	0	0	PASS
	Amazon Entry (East)	3	0	0	3	4	0	0	4	1	0	0	1	PASS
	A126 Dock Road	0	0	0	0	0	0	0	0	0	0	0	0	PASS
A1089 St Andrew's Road (South)	Thurrock Park Way	56	7	17	80	56	7	16	79	0	0	0	0	PASS
	A1089 Dock Road (North)	55	14	265	335	56	14	265	335	0	0	0	0	PASS
	Amazon Entry (East)	0	0	0	0	0	0	0	0	0	0	0	0	PASS
	A126 Dock Road	17	3	0	20	16	0	0	16	0	2	0	1	PASS
	A1089 St Andrew's Road (South)	0	0	0	0	0	0	0	0	0	0	0	0	PASS
Thurrock Park Way	A1089 Dock Road (North)	109	22	18	149	109	21	18	148	0	0	0	0	PASS
	Amazon Entry (East)	0	0	3	3	0	0	4	4	0	0	0	0	PASS
	A126 Dock Road	57	6	0	63	55	8	0	63	0	1	0	0	PASS
	A1089 St Andrew's Road (South)	75	12	15	102	75	12	14	101	0	0	0	0	PASS
	Thurrock Park Way	0	0	0	0	0	0	0	0	0	0	0	0	PASS

Table B.3 PM 17:00–18:00 flow comparison

Approach	To	Observed (vehicles)				Modelled (vehicles)				GEH < 5				FC
		Car	LGV	HGV	Total	Car	LGV	HGV	Total	Car	LGV	HGV	Total	
A1089 Dock	Amazon Entry (East)	10	0	13	23	10	0	14	24	0	0	0	0	PASS
	A126 Dock Road	266	27	3	296	268	25	4	297	0	0	1	0	PASS

Approach	To	Observed (vehicles)				Modelled (vehicles)				GEH < 5				FC
		Car	LGV	HGV	Total	Car	LGV	HGV	Total	Car	LGV	HGV	Total	
Road (North)	A1089 St Andrew's Road (South)	117	20	174	312	118	20	175	313	0	0	0	0	PASS
	Thurrock Park Way	192	36	18	247	192	35	18	245	0	0	0	0	PASS
	A1089 Dock Road (North)	0	0	0	0	0	0	0	0	0	0	0	0	PASS
Amazon Entry (East)	A126 Dock Road	0	0	0	0	0	0	0	0	0	0	0	0	PASS
	A1089 St Andrew's Road (South)	4	1	3	8	4	0	1	5	0	1	1	1	PASS
	Thurrock Park Way	4	1	0	5	4	1	0	5	0	0	0	0	PASS
	A1089 Dock Road (North)	18	3	11	31	19	1	10	30	0	1	0	0	PASS
	Amazon Entry (East)	0	0	0	0	0	0	0	0	0	0	0	0	PASS
A126 Dock Road	A1089 St Andrew's Road (South)	30	3	4	36	29	0	4	33	0	2	0	1	PASS
	Thurrock Park Way	101	6	1	107	100	6	0	106	0	0	2	0	PASS
	A1089 Dock Road (North)	172	26	3	201	172	27	4	203	0	0	0	0	PASS
	Amazon Entry (East)	0	0	0	0	0	0	0	0	0	0	0	0	PASS
	A126 Dock Road	0	0	0	0	0	0	0	0	0	0	0	0	PASS
A1089 St Andrew's Road (South)	Thurrock Park Way	73	10	5	89	73	11	4	88	0	0	0	0	PASS
	A1089 Dock Road (North)	349	40	127	515	349	39	128	516	0	0	0	0	PASS
	Amazon Entry (East)	2	0	6	7	0	0	4	4	2	0	1	1	PASS
	A126 Dock Road	28	1	0	29	29	0	0	29	0	2	0	0	PASS
	A1089 St Andrew's Road (South)	0	0	0	0	2	0	4	6	2	0	3	3	PASS
Thurrock Park Way	A1089 Dock Road (North)	407	60	19	485	407	60	19	486	0	0	0	0	PASS
	Amazon Entry (East)	4	1	0	5	4	0	0	4	0	1	0	0	PASS
	A126 Dock Road	133	21	3	157	133	22	3	158	0	0	0	0	PASS

Approach	To	Observed (vehicles)				Modelled (vehicles)				GEH < 5				FC
		Car	LGV	HGV	Total	Car	LGV	HGV	Total	Car	LGV	HGV	Total	
	A1089 St Andrew's Road (South)	59	10	3	73	60	9	2	71	0	0	1	0	PASS
	Thurrock Park Way	0	0	0	0	0	0	0	0	0	0	0	0	PASS

Appendix C – Journey time validation

Table C.1 AM 07:00–08:00 journey time validation

Route ID	Route	Direction	Distance (m)		Journey Time (seconds)		Difference		Validation	Average Speed (mph)	
			Observed	Modelled	Observed	Modelled	Total (seconds)	%	<15%	Observed	Modelled
1	A1089 St Andrew's Road to A1089 Dock Road	NB	1,669	1,669	114	103	-11	-9%	PASS	32.8	36.1
2	A1089 Dock Road to A1089 St Andrew's Road	SB	1,889	1,891	112	104	-7	-7%	PASS	37.8	40.5
3	Thurrock Park Way to Dock Road	SB	738	738	77	77	0	0%	PASS	21.5	21.5
4	Dock Road to Thurrock Park Way	NB	661	662	80	77	-3	-3%	PASS	18.6	19.3

Table C.2 AM 08:00–09:00 journey time validation

Route ID	Route	Direction	Distance (m)		Journey Time (seconds)		Difference		Validation	Average Speed (mph)	
			Observed	Modelled	Observed	Modelled	Total (seconds)	%	<15%	Observed	Observed
1	A1089 St Andrew's Road to A1089 Dock Road	NB	1,669	1,669	113	105	-7	-7%	PASS	33.1	35.5
2	A1089 Dock Road to A1089 St Andrew's Road	SB	1,889	1,891	109	103	-5	-5%	PASS	38.9	41.0
3	Thurrock Park Way to Dock Road	SB	738	738	79	76	-3	-3%	PASS	21.0	21.7
4	Dock Road to Thurrock Park Way	NB	661	662	75	77	2	3%	PASS	19.7	19.3

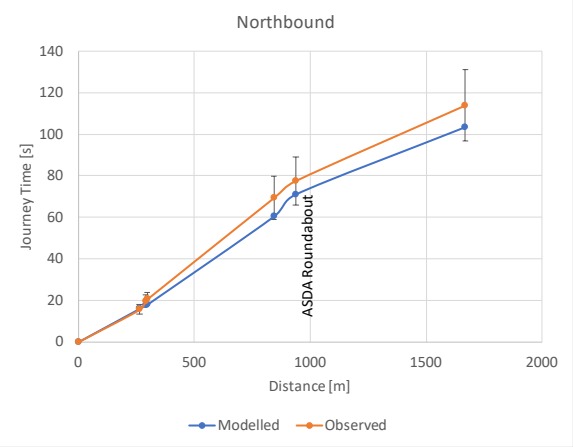
PM 17:00–18:00 journey time validation

Route ID	Route	Direction	Distance (m)		Journey Time (seconds)		Difference		Validation	Average Speed (mph)	
			Observed	Modelled	Observed	Modelled	Total (seconds)	%	<15%	Observed	Observed
1	A1089 St Andrew's Road to A1089 Dock Road	NB	1,669	1,669	114	99	-15	0	PASS	32.7	37.8
2	A1089 Dock Road to A1089 St Andrew's Road	SB	1,889	1,891	94	101	7	7%	PASS	44.9	42.0
3	Thurrock Park Way to Dock Road	SB	738	738	92	81	-11	-12%	PASS	17.9	20.4
4	Dock Road to Thurrock Park Way	NB	661	662	74	69	-5	-7%	PASS	19.9	21.3

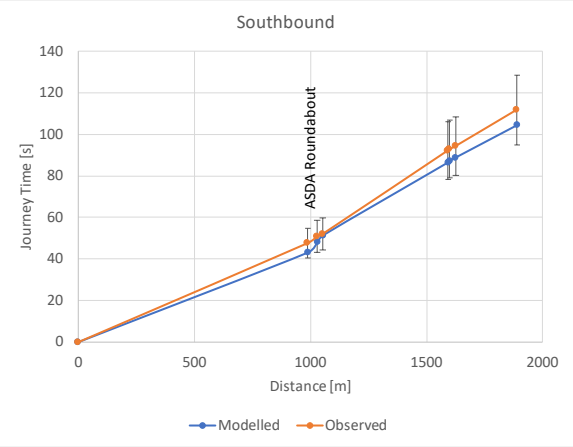
Appendix D – Journey time validation charts

Plate D.1 Journey time validation charts AM (07:00–08:00)

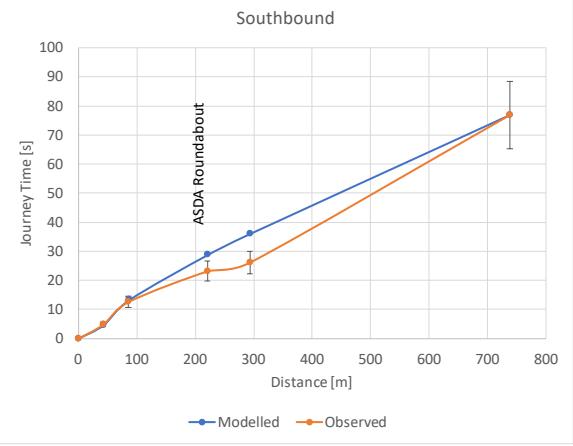
A1089 St Andrew's Road to A1089 Dock Road



A1089 Dock Road to A1089 St Andrew's Road



Thurrock Park Way to Dock Road



Dock Road to Thurrock Park Way

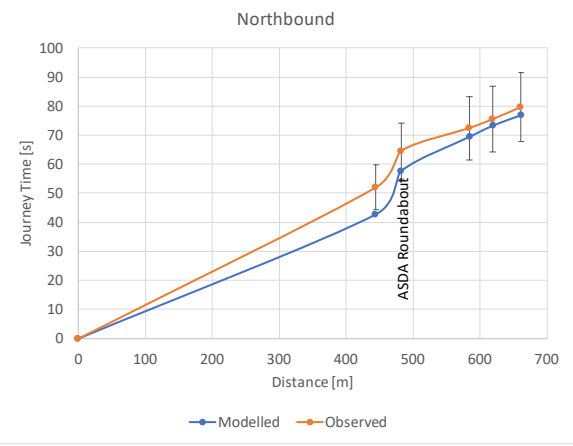
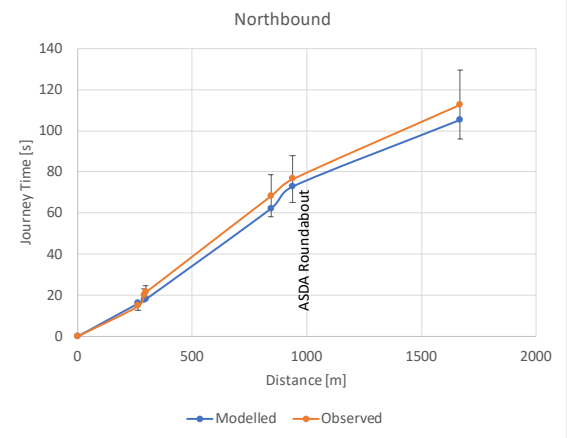
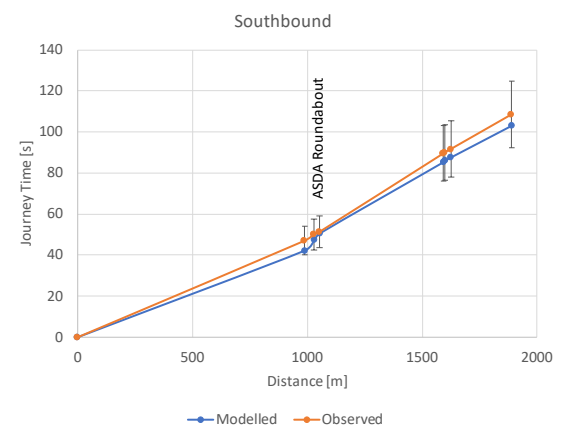


Plate D.2 Journey time validation charts AM (08:00–09:00)

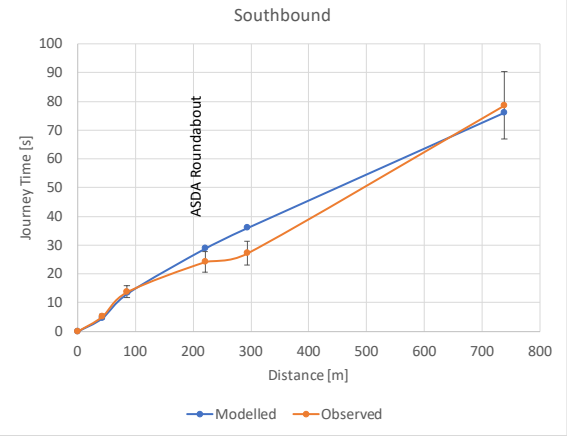
A1089 St Andrew's Road to A1089 Dock Road



A1089 Dock Road to A1089 St Andrew's Road



Thurrock Park Way to Dock Road



Dock Road to Thurrock Park Way

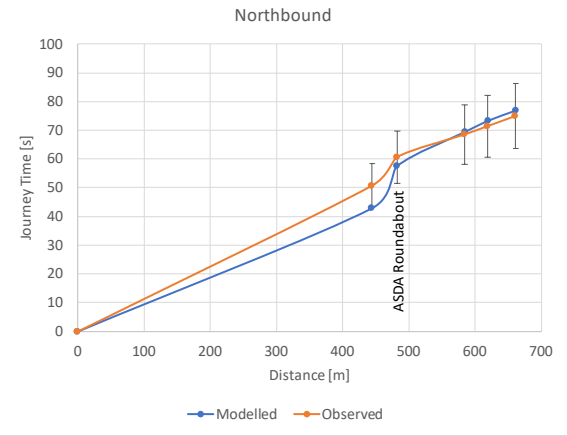
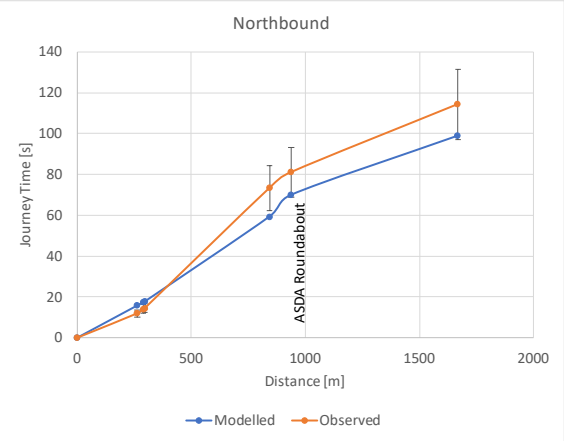
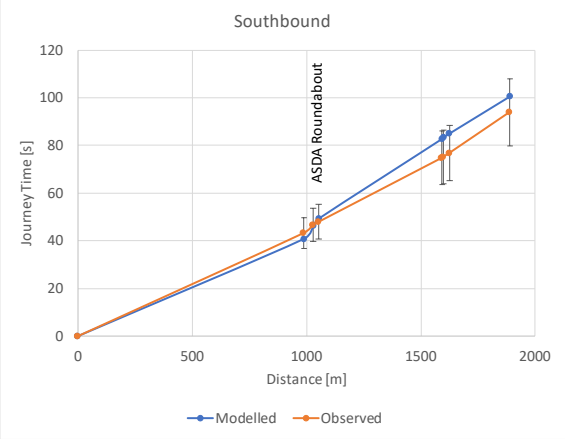


Plate D.3 Journey time validation charts PM (17:00–18:00)

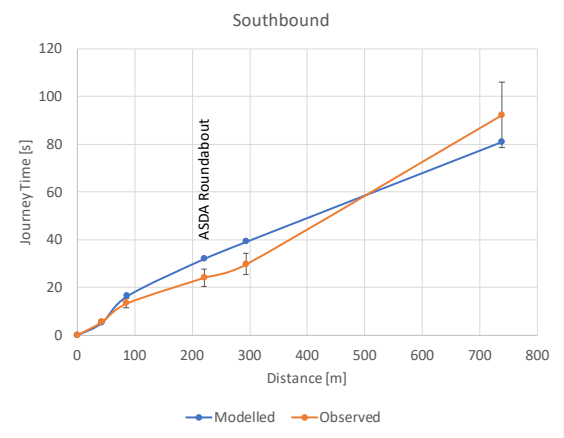
A1089 St Andrew's Road to A1089 Dock Road



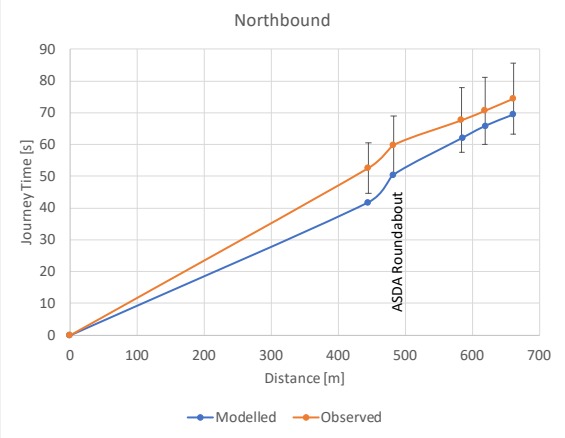
A1089 Dock Road to A1089 St Andrew's Road



Thurrock Park Way to Dock Road



Dock Road to Thurrock Park Way

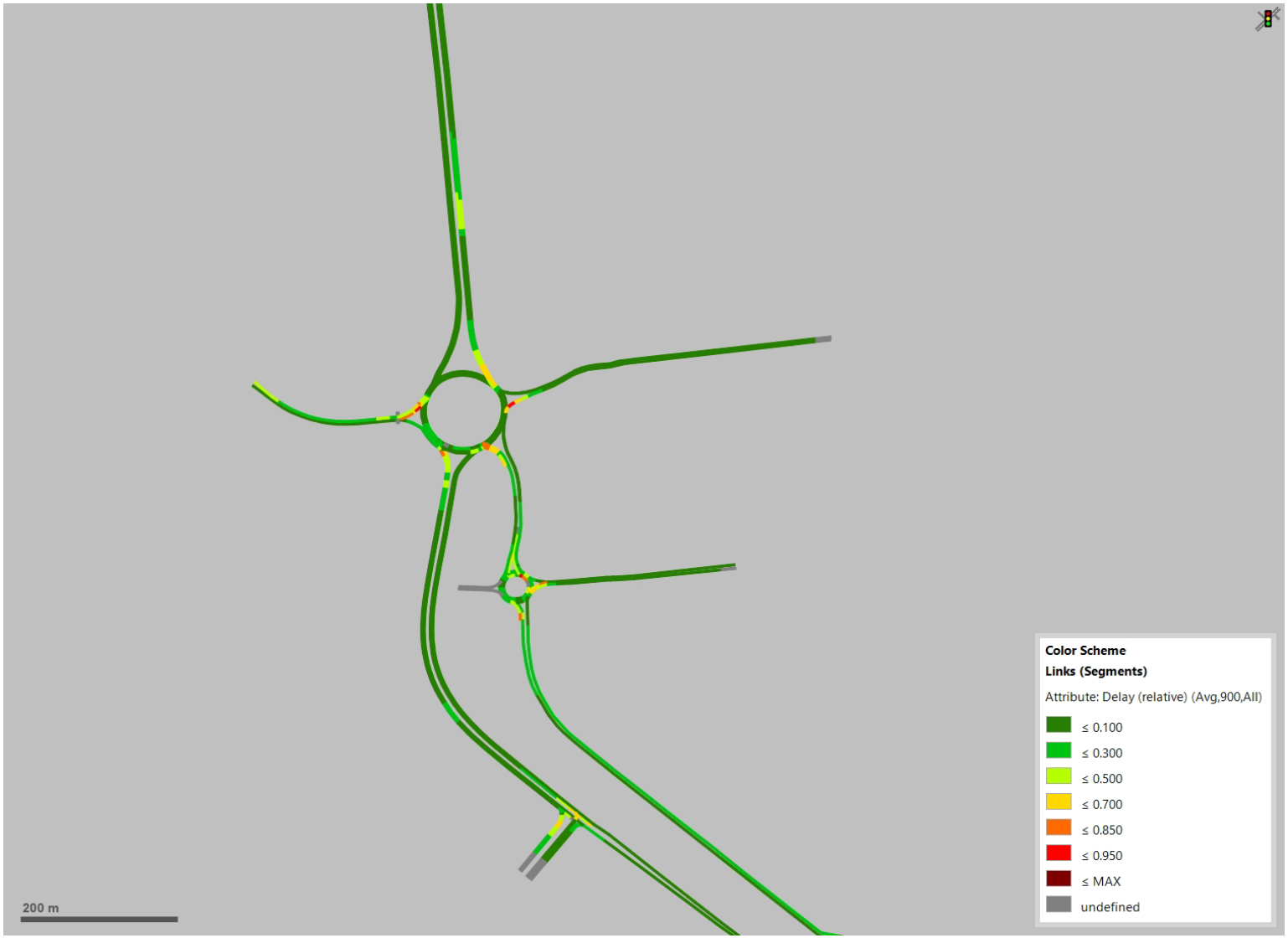


Appendix E – Relative Delay Plots

Plate E.1 Relative delay plot AM (07:00–08:00)

Plate E.2 Relative delay plot AM (08:00–09:00)

Plate E.3 Relative delay plot PM (17:00–18:00)



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