Lower Thames Crossing

9.15 Localised Traffic Modelling Appendix G - Traffic Operational Appraisal –VISSIM Local Model Validation Report

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1 Introduction

1.1 Purpose of document

1.1.1 The traffic operational appraisal undertaken at Preliminary Design is composed of:

a. This report which details the VISSIM base local model validation report; and,

b. 9.15 Localised Traffic Modelling Appendix H - Traffic Operational Appraisal - VISSIM Forecasting Report.

1.1.2 The. purpose of this report is to present the local VISSIM model validation report for the A13 reference network from the Orsett Cock junction to the A1012, including the A13/ A1089 junction – it presents the calibration and validation of the VISSIM base model.

1.1.3 According to the Design Manual for Roads and Bridges (DMRB) Chapter 12, Section 1, Part 1, Chapter 13 Operational Appraisal, the purpose of a traffic operational technical investigation is to:

a. Ensure results from the higher tier macro-model are reasonable, especially in the early stages of the Project;

b. Describe the local impact of the scheme and suggest beneficial amendments to the design; and,

c. Describe the local impact and identify areas where complementary actions will be needed by statutory and other bodies such as local authorities.

1.2 Modelling software

1.2.1 Road traffic microsimulation models represent individual vehicles travelling within the road network, providing realistic driver behaviour such as lane changing and overtaking.

1.2.2 Microsimulation models are useful when modelling conditions where a network is forecast to operate in conditions where queues may affect performance. Most microsimulation software packages are capable of generating graphics with animated individual vehicles, providing excellent visual aid when presenting complex traffic phenomena. The software selected for Lower Thames Crossing is VISSIM.

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 NPSNN 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

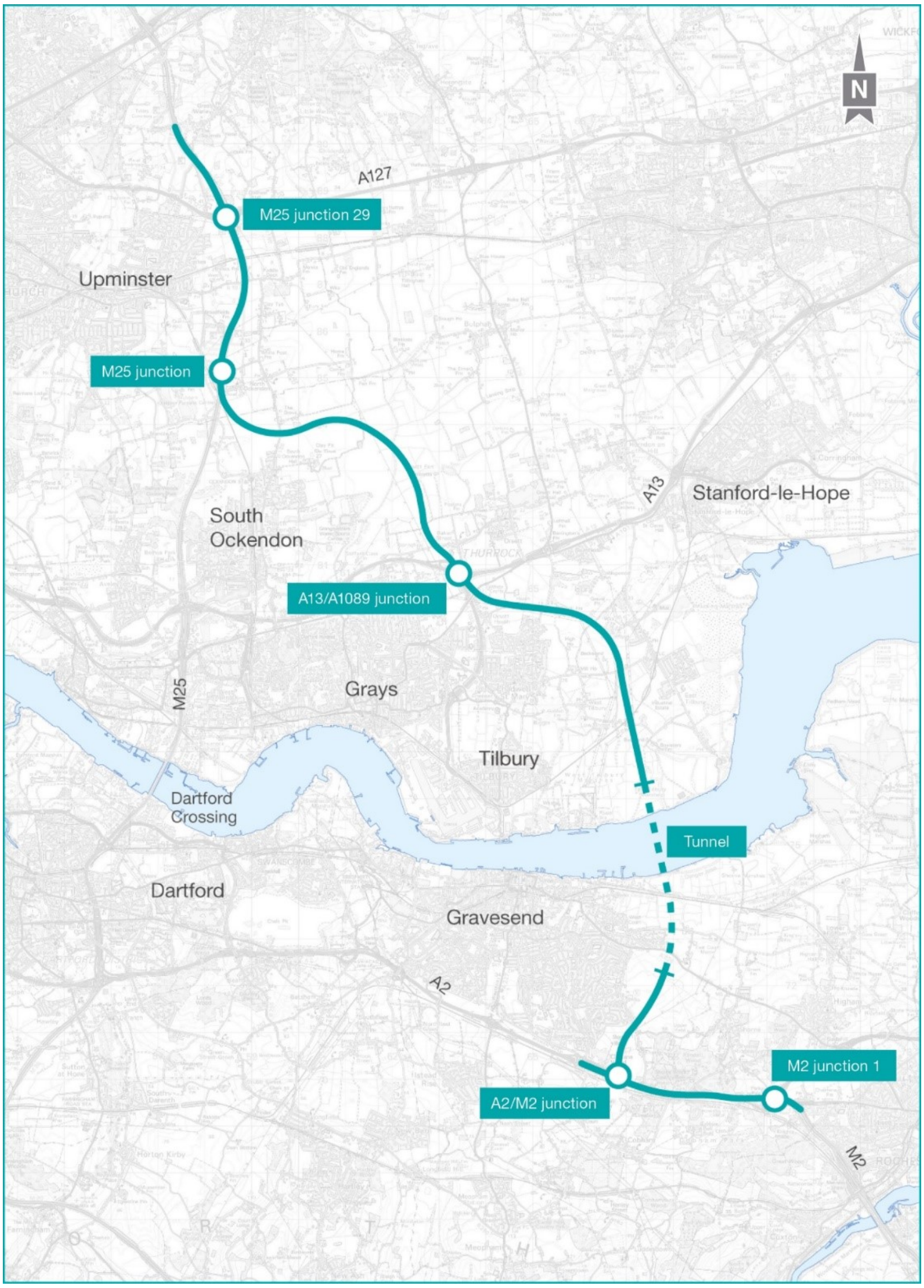
1.3.6 In common with most A-roads, the A122 would operate with no hard shoulder but would feature a 1m hard strip on either side of the carriageway. It would also feature technology including stopped vehicle and incident detection, lane control, variable speed limits and electronic signage and signalling. 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. Some of the measures adopted include landscaping, noise mitigation, green bridges, floodplain compensation, new areas of ecological habitat and two new parks.

Plate 1.1 Lower Thames Crossing route



1.4 Report structure

1.4.1 The remaining chapters of this report is composed of:

a. Chapter 2, presents the context of the Project’s VISSIM model;

b. Chapter 3, details the software selection;

c. Chapter 4, presents the base model study area;

d. Chapter 5, details the traffic data collection;

e. Chapter 6, presents the VISSIM parameters calibration;

f. Chapter 7, shows the traffic demand preparation;

g. Chapter 8, shows the model validation results; and,

h. Chapter 9, presents the conclusions to this report.

2 VISSIM in the context of the Project

2.1 Defining the need for VISSIM on the Project

2.1.1 To inform the development of the VISSIM model, the following considerations were made:

a. Technical best practice documentation;

b. Type of traffic analysis required using the VISSIM model;

c. The data exchange process between disciplines; and,

d. The type of outputs required.

2.2 Technical guidelines

2.2.1 The traffic modelling on the Project complies with the requirements set out in the Design Manual for Roads and Bridges and DfT's Transport Appraisal Guidance. 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).

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

2.2.2 A new issue of the DMRB was released early 2020. The new issue of the DMRB no longer includes the Traffic Appraisal of Roads Schemes (Volume 12). Instead, most of the guidance is now available in the Department for Transport's Transport Analysis Guidance (TAG).

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

a. Traffic Modelling Guidelines, TfL, Version 3.0 (September 2010); and

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

2.3 Type of traffic analysis with VISSIM

2.3.1 The Project area corresponds to a new road corridor. As specified in the National Highways Guidelines for the Use of Microsimulation Software section 2.6.3, in the context of motorways and trunk roads, "micro-simulation models do provide a mechanism to undertake analyses that cannot be realistically addressed using traditional packages". Specifically, for the Project, the focus is on studying:

a. Interactions between closely spaced junctions on a grade separated network and the effect of flow breakdown on network performance;

b. Signalised gyratories;

c. The impact of HGV platooning; and,

d. Technical visualisation.

2.3.2 The VISSIM model was built for use:

a. during the design development, typically to assess the interaction of closely spaced junctions or signalised gyratories; and,

b. At intervals to undertake a network wide assessment of proposed design.

2.3.3 It was therefore important for the model to be able to reliably assess the traffic behaviour and performance of a future section of the network which does not presently exist.

2.4 Data exchange process between disciplines

2.4.1 The data communication process established for the Project is based on the Design Manual for Roads and Bridges (DMRB) Volume 6 Section 2 Part 4 (TD 39/94) Figure 2/1: Design Methodology.

2.4.2 Plate 2.1 presents the detailed data exchange process followed. The traffic operations modelling, shown in orange, was structured as a series of smaller assessments characterised by:

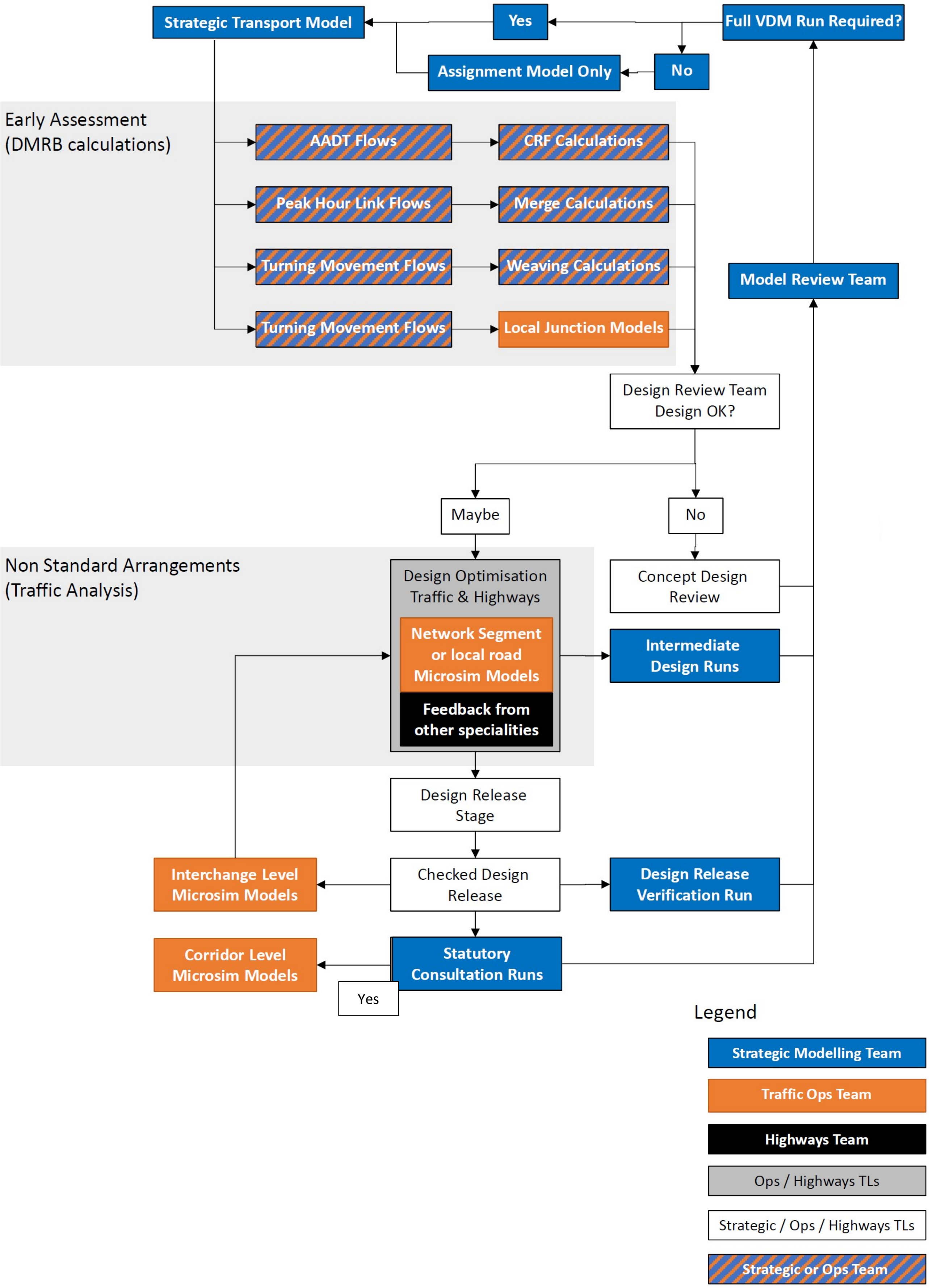
a. The progressive aggregation of network elements considered for the analysis. Initially, the Project network was studied road segment by road segment, then a series of nearby merges and diverges were studied as sub-networks, then the entire Project network was modelled using VISSIM; and,

b. DMRB early assessment methods were performed for isolated merge or diverge segments. For non-isolated merge or diverge segments, engineering judgment based on calculations and SATURN models were used before the development of VISSIM microsimulation model.

2.4.3 The above methodology closely follows the best practice recommendations in National Highways documentation, and it enabled a high level of pro-active interactions between the various disciplines employed on the design of the Project.

2.4.4 Based on the data exchange process described above, it was essential that the VISSIM model could be used reliably to analyse isolated sections of the network in suitable turnaround time to be part of the design process.

Plate 2.1 Lower Thames Crossing Design Process



2.5 Selection of suitable model outputs

2.5.1 To report on driving conditions consistency, performance and comfort for the road network with grade separated junctions, the available performance indicators are:

a. Traffic density; and,

b. Speed.

2.5.2 This was guided by the US Highway Capacity Manual 2010 (see Plate 2.2). Speed was selected to assess the Lower Thames Crossing forecast traffic conditions.

Plate 2.2 Highway Capacity Manual 2010 Service Measures

Exhibit 2-2
HCM Service Measures by System Element and Mode

System Element	HCM Chapter	Service Measure(s) Automobile	Pedestrian	Bicycle	Transit	Systems Analysis Measure
Freeway facility	10	Density	--	--	--	Speed
Basic freeway segment	11	Density	--	--	--	Speed
Freeway weaving segment	12	Density	--	--	--	Speed
Freeway merge and diverge segments	13	Density	--	--	--	Speed
Multilane highway	14	Density	--	LOS score[a]	--	Speed
Two-lane highway	15	Percent time-spent-following, speed	--	LOS score[a]	--	Speed
Urban street facility	16	Speed	LOS score[a]	LOS score[a]	LOS score[a]	Speed
Urban street segment	17	Speed	LOS score[a]	LOS score[a]	LOS score[a]	Speed
Signalized intersection	18	Delay	LOS score[a]	LOS score[a]	--	Delay
Two-way stop	19	Delay	Delay	--	--	Delay
All-way stop	20	Delay	--	--	--	Delay
Roundabout	21	Delay	--	--	--	Delay
Interchange ramp terminal	22	Delay	--	--	--	Delay
Off-street pedestrian–bicycle facility	23	--	Space, events[b]	LOS score[a]	--	Speed

Notes: [a] See Exhibit 2-3 for the LOS score components.
[b] Events are situations where pedestrians meet bicyclists.

2.5.3 Some of the Highway Capacity Manual speed and density statistics cannot be directly used in the UK as they correspond to the US policy on infrastructure investment. Level of Service letters (A, B, C, D, E, F), for example, have been excluded and traffic speed statistics have been classified to describe traffic conditions only. Plate 2.3 presents the interpretation of traffic density and corresponding travelling speed used on the Project.

2.5.4 Plate 2.3 details four types of traffic conditions within two broad categories:

a. **Free flow conditions**, corresponding to an environment where vehicles can freely choose their driving speed (that is they are not slowed down by another vehicle) and they can easily respect the UK Highway Code safety distance (interpreted as a two second interval); and,

b. **Non-free-flow conditions**, which are split into three types:

i. At capacity;

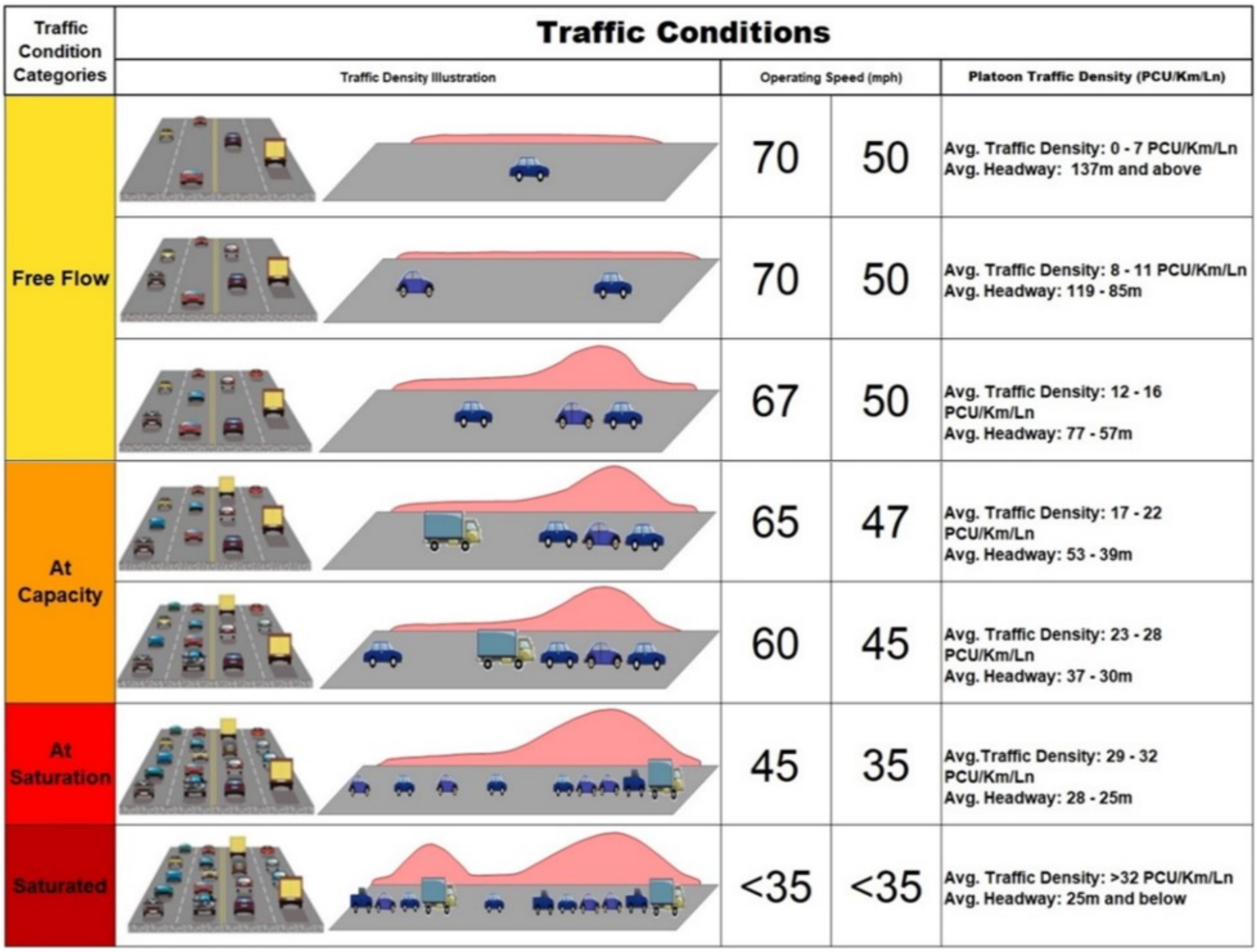
ii. At saturation; and,

iii. Saturated (characterised by a drop in traffic throughput, despite high traffic demand).

2.5.5 Using the above categories, the microsimulation model aims to assess traffic conditions in parts of the network with a significant amount of complex driving behaviour, like weaving segments or a succession of merges or diverges.

2.5.6 On an all-purpose trunk road the expected design year performance is that for each road segment the traffic speed is greater than 45mph with a density of no more than 28 PCU/Km/Ln.

Plate 2.3 Traffic Conditions Characterisation



Traffic Condition Categories	Traffic Conditions			
	Traffic Density Illustration	Operating Speed (mph)		Platoon Traffic Density (PCU/Km/Ln)
Free Flow		70	50	Avg. Traffic Density: 0 - 7 PCU/Km/Ln Avg. Headway: 137m and above
		70	50	Avg. Traffic Density: 8 - 11 PCU/Km/Ln Avg. Headway: 119 - 85m
		67	50	Avg. Traffic Density: 12 - 16 PCU/Km/Ln Avg. Headway: 77 - 57m
At Capacity		65	47	Avg. Traffic Density: 17 - 22 PCU/Km/Ln Avg. Headway: 53 - 39m
		60	45	Avg. Traffic Density: 23 - 28 PCU/Km/Ln Avg. Headway: 37 - 30m
At Saturation		45	35	Avg.Traffic Density: 29 - 32 PCU/Km/Ln Avg. Headway: 28 - 25m
Saturated		<35	<35	Avg. Traffic Density: >32 PCU/Km/Ln Avg. Headway: 25m and below

3 Software

3.1 VISSIM software version

3.1.1 The VISSIM software version used is 11.00-11. This was the latest software release available when the model was developed.

3.2 Number of random seed records

3.2.1 Traffic conditions on the road are variable and occur for:

a. **Overall traffic volumes**, accounted for in VISSIM by selected 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 minutes time periods; and,

c. **Vehicle interactions**, being the consequence of event sequences, accounted for in VISSIM by reporting on the average model run of several random seed values.

3.2.2 The Lower Thames Crossing VISSIM model has an all or nothing shortest path assignment, so there is no route choice variation in the model.

3.2.3 Based on UK modelling guidelines, the recommended number of random seed runs is:

a. A minimum of 5 *(V301 Validation Report - DTO Modelling Auditing Process, Modelling Auditing Engineer's Guide Traffic Schemes in London Urban Networks, Version 2.1);*

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

3.2.4 Model outputs based on 20 runs with different random seeds were used for the Lower Thames Crossing model.

4 Base model study area

4.1 Principle of a reference network

4.1.1 As the Project is composed of a set of new highway links, the key focus of the base model calibration has been on achieving representative modelling of traffic conditions with high levels of traffic demand between closely spaced junctions.

4.2 A13 reference network

4.2.1 The network used in the calibration of the VISSIM model is shown in Plate 4.1

4.2.2 Detailed traffic origin destination surveys were commissioned on the A13 for the purpose of the VISSIM calibration.

Plate 4.1 Base Model Study Area

4.2.3 The A13 validation network was selected for the following reasons:

a. It corresponds to a complex series of merges and diverges, similar to the cases where the VISSIM analysis is required on Lower Thames Crossing;

b. It is an isolated congested hotspot with a very regular frequency of congestion. Such a “Saturated” situation is ideal to identify saturated traffic conditions; and,

c. The network overlaps with the Project area and the local driving behaviour is expected to be comparable.

4.2.4 Based on the above definition of the study area, a traffic survey collection exercise was undertaken.

5 Traffic data collection

5.1 Background

5.1.1 Traffic surveys were commissioned along this section of the A13 and on local roads in Thurrock near the Port of Tilbury.

5.1.2 Details of the traffic data collection exercise are presented in the 7.7 Combined Modelling and Appraisal Report - Appendix A - Transport Data Package **[Application Document APP-519]**. A high-level description of the datasets used for the base VISSIM model is presented below.

5.1.3 Three types of data sources were collected:

a. Automatic Traffic Count (ATC) surveys;

b. Automatic Number Plate Recognition (ANPR) surveys, and,

c. Trafficmaster travel time.

Survey schedule

5.1.4 The survey schedule was as follows:

a. The ATC Surveys took place between 00:00-24:00 from Monday 14 May 2018 to Sunday 20 May 2018; and,

b. The ANPR surveys were undertaken in two packages. Package 1 surveys were scheduled between Wednesday 16 May 2018 and Sunday 20 May 2018 for 24 hours a day. Package 2 surveys were scheduled between Wednesday 16 May 2018 and Thursday 17 May 2018 between 05:00-21:00.

Incidents during the survey

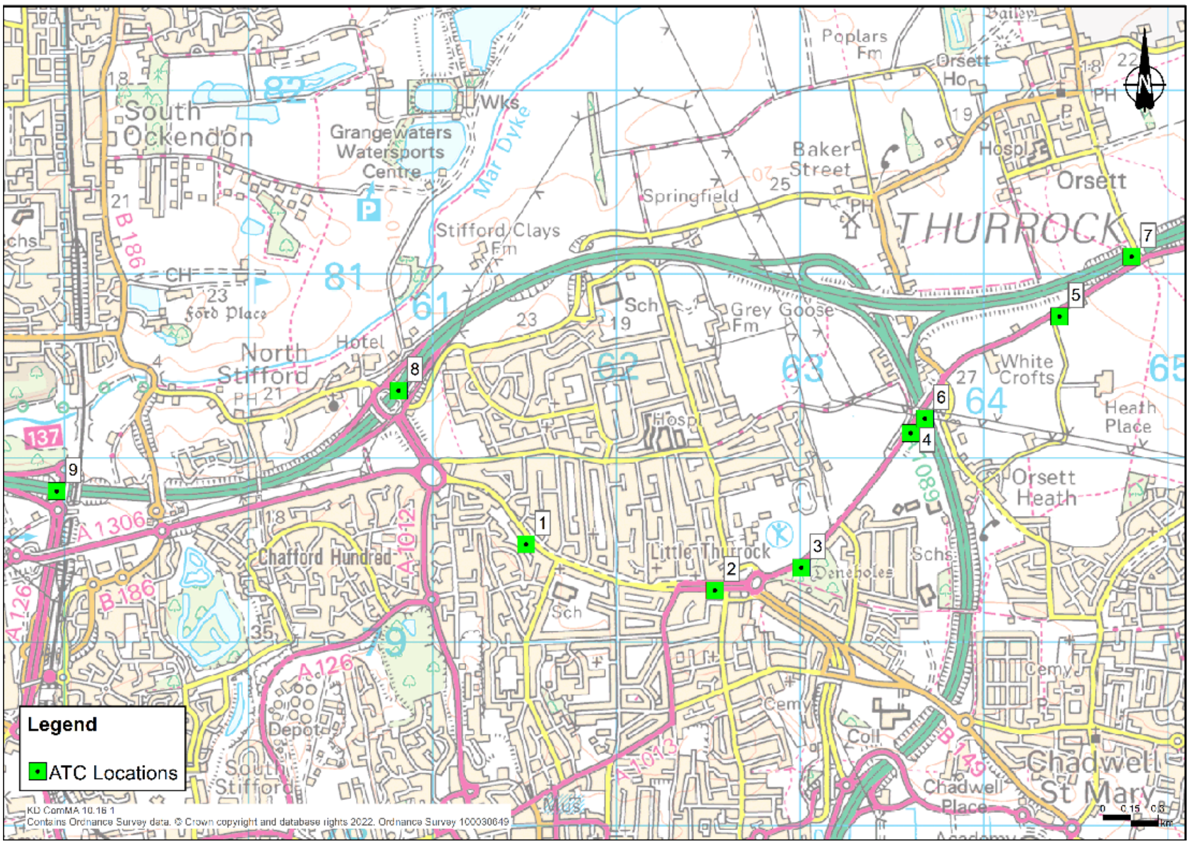
5.1.5 Several incidents impacted the traffic survey campaign. The detailed list is available in the 7.7 Combined Modelling and Appraisal Report - Appendix A - Transport Data Package **[Application Document APP-519]**.

5.1.6 With respect to the ANPR, data collected on 17 May 2018 was nearly free of disruptions at peak times and was therefore identified as the most representative day to be used for the analysis.

5.2 Automatic traffic counts

5.2.1 Plate 5.1 shows the location of the ATC data collection, including sites 7, 8 and 9 located on the A13 mainline.

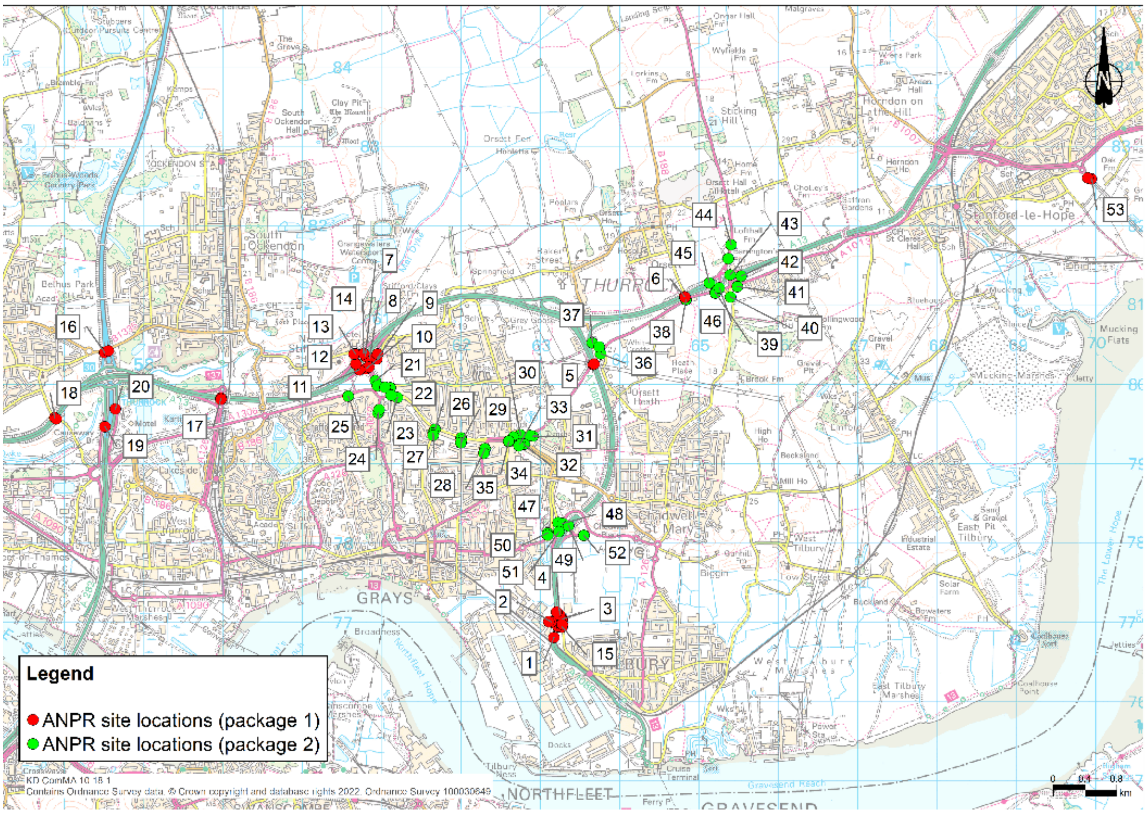
Plate 5.1 ATC Site Locations



5.3 Automatic Number Plate Recognition

5.3.1 The ANPR traffic survey was split into two packages. Plate 5.2 shows package 1 in red, covering the principal road network, and package 2, in green, covering the local road network. For the A13 base VISSIM model, data was used from packages 1 and 2.

Plate 5.2 ANPR Site Locations



ANPR survey match rate

5.3.2 An ANPR match rate corresponds to the difference between the total number of vehicles recorded by the survey cameras and the number of vehicles found in the number plate registration database.

5.3.3 On Thursday 17 May 2018, the match rate of the ANPR survey with the video camera count is considered excellent, typically with a 90% capture rate or above.

5.3.4 The data processing as part of the matrix development is detailed in section 7.4 of this report.

6 VISSIM calibration parameters

6.1 Background

6.1.1 The replication of accurate driving behaviour on the network is a complex enterprise. To calibrate driving behaviours in the Project wide VISSIM model the following approach was adopted:

a. **Calibrate the car-following model**, adjusting the way vehicles interact with other vehicles in front of them (In VISSIM, vehicles do not adjust their behaviour to vehicles behind them, except for lane change behaviour);

b. **Calibrate the vehicles' speed distribution**, to account for the fact that vehicles in VISSIM do not adjust their speed in reaction to vehicles situated behind them; and,

c. **Test and standardise the merge/diverge network coding**, to provide an accurate and consistent coding method throughout the model.

6.1.2 The selection of the parameters used in the final calibrated model was the result of numerous tests and based on experience gained from the calibration of VISSIM driving behaviours for other schemes.

6.1.3 Appropriate adjustments to the driving behaviour parameters in VISSIM, where required, were selected from the list provided in the Guidelines for Microsimulation (section 5.2.8), Highways Agency, July 2007.

6.2 Car following model - driving behaviour types

6.2.1 The driving behaviour types were used:

a. For the local road network, Wiedemann 74 driving behaviour;

b. For the grade separated road network, Wiedemann 99 driving behaviour;

6.2.2 The left-hand driving traffic regulation was adopted.

6.3 Car following model - standstill vehicle distance

6.3.1 For the urban network, the default value of 1.2m between vehicles was retained as the average standstill distance.

6.3.2 For the grade separated road network, the value of the standstill distance (CC0) was adjusted during the calibration process. The value of 6m provided the best results compared to the default value of 1.5m.

6.4 Speed distributions

6.4.1 Narrow desired speed bands were used to replicate the type of traffic conditions present within platoons of traffic. The adopted speed distributions are illustrated in Table 6.1 The speed distribution is uniform for all speed limits.

Table 6.1 VISSIM Desired Speed Distributions

Speed (mph)	Lower Bound (mph)	Upper Bound (mph)
70mph	57	77
60mph	47	67
50mph	37	57
40mph	27	47
30mph	17	37
20mph	12	22
15mph	7	17

6.4.2 As shown in Table 6.1 vehicles can have a desired speed above the speed limit in VISSIM, and the range of desired speed has been reduced to represent traffic conditions at capacity.

6.4.3 Plate 6.1 illustrates the national speed limits. This has been used to refer individual vehicle types to the speed distribution in Table 6.1.

Plate 6.1 National Speed Limits

National speed limits

Type of vehicle	Built-up areas mph (km/h)	Single carriageways mph (km/h)	Dual carriageways mph (km/h)	Motorways mph (km/h)
Cars, motorcycles, car-derived vans and dual-purpose vehicles	30 (48)	60 (96)	70 (112)	70 (112)
Cars, motorcycles, car-derived vans and dual-purpose vehicles when towing caravans or trailers	30 (48)	50 (80)	60 (96)	60 (96)
Motorhomes or motor caravans (not more than 3.05 tonnes maximum unladen weight)	30 (48)	60 (96)	70 (112)	70 (112)
Motorhomes or motor caravans (more than 3.05 tonnes maximum unladen weight)	30 (48)	50 (80)	60 (96)	70 (112)
Buses, coaches and minibuses (not more than 12 metres overall length)	30 (48)	50 (80)	60 (96)	70 (112)
Buses, coaches and minibuses (more than 12 metres overall length)	30 (48)	50 (80)	60 (96)	60 (96)
Goods vehicles (not more than 7.5 tonnes maximum laden weight)	30 (48)	50 (80)	60 (96)	70 (112) 60 (96) if articulated or towing a trailer
Goods vehicles (more than 7.5 tonnes maximum laden weight) in England and Wales	30 (48)	50 (80)	60 (96)	60 (96)
Goods vehicles (more than 7.5 tonnes maximum laden weight) in Scotland	30 (48)	40 (64)	50 (80)	60 (96)

Source: https://www.gov.uk/speed-limits

6.5 Network coding and driving behaviour

6.5.1 In VISSIM, the network is composed of links and connectors. Links and connectors in VISSIM are two very similar network objects, with a connector attaching two links.

6.5.2 In this context, a link can be split into two at any location to enable a more accurate representation of geometry (a change in the number of lanes, road marking, lane width etc). Typically, vehicle driving behaviour is the same between links and connectors.

6.5.3 However, some calculation modules of the driving behaviour in VISSIM, like the lane change behaviour, are partially determined by the network structure and network parameters.

6.5.4 In VISSIM, a vehicle can initiate a lane change for three reasons:

a. The vehicle could be banned from using the lane it is currently on and must try to move to an adjacent lane;

b. Overtaking or cooperative merging behaviour, which is controlled within the vehicles driving behaviour and depends on desired speed and surrounding traffic conditions; and,

c. Lane change for the purpose of changing direction. In VISSIM, vehicles have their path allocated to them prior to entering the network, they therefore follow a pre-defined list of links and connectors.

6.5.5 The lane change parameter described in c) above is a network connector attribute, not a vehicle attribute. As such, the network structure and lane change attribute are very significant for generating realistic driving behaviour in the model.

6.6 Network coding - Grade separated diverges

6.6.1 Grade separated diverge segments correspond to locations of the network where vehicles have the opportunity to exit the mainline. In VISSIM, the decision for a vehicle to move into the appropriate lane is dependent on the “lane change” parameter of the connectors at the diverge location.

6.6.2 The default VISSIM lane change parameter is 200 metres, which is fit for a typical urban environment but does not suit a grade separated environment. If a vehicle at motorway speed initiates its lane change sequence only 200 metres before the exit, it will find itself unable to complete even one lane change.

6.6.3 On the road, drivers can pre-select their exiting lanes in a number of ways, anticipating driving conditions and the road geometry. It remains difficult to observe such behaviour, even with modern survey methods. For the Lower Thames Crossing model, it was considered appropriate to code the lane change in line with directional signage.

6.6.4 Section 5.37 of DMRB volume 6, section 2, part 1 (TD 22/06) states: “For grade-separated junctions, two or three advance direction signs must be provided. These are to be located at the start of the diverging lane, 1/2 mile (1/3 mile in difficult circumstances) from the junction and additionally for motorways and some all-purpose roads 1 mile (2/3 mile in difficult circumstances) from the junction." If space permits, two or three direction signs must be provided, at a spacing of approximately 800m.

6.6.5 For the LTC VISSIM model, the grade separated diverge coding is as follows:

a. Ahead movement connector (change lane parameter with 2,000m value, or more if an auxiliary lane is longer); and,

b. Diverging movement (change lane parameter with 800m value, with the "per lane" option selected).

6.6.6 The justification for the ahead movement value selection is to ensure that vehicles stay on the mainline lanes. This is particularly important at locations where there is:

a. A lane drop situation, and vehicles staying on the mainline need to be in the correct lanes; and,

b. A widening of the mainline with an additional lane before the diverge. Typically, a vehicle staying on the mainline would not be expected to enter the exiting lane.

6.6.7 The justification for the 800m with "per lane" option activated is to replicate the DMRB direction sign locations.

6.6.8 On the A13 corridor, all the diverge segments in the base model have been coded following the description above.

6.7 Network coding - Grade separated merge

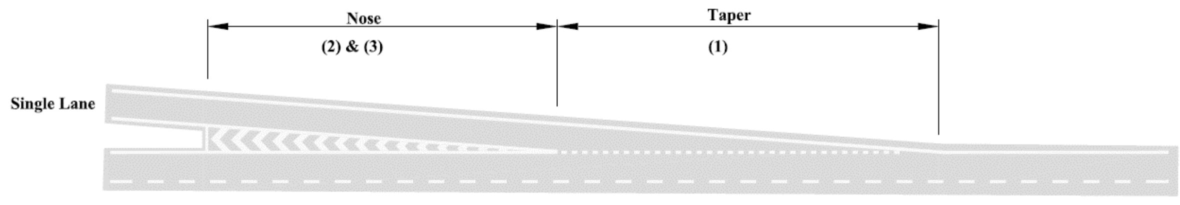
6.7.1 UK grade separated merges are a composite of three basic merge segment types. They deal with vehicle to vehicle interactions in different ways, typically to account for different traffic densities. The three types are:

a. A taper merge, as represented in Plate 6.2. This type of merge requires vehicles to adapt their speed in order to join the mainline using gaps between incoming vehicles. In VISSIM, this type of merge requires the coding of a conflict marker at the merge location, as the driving behaviour only consider vehicles ahead or adjacent on the same network, which is not the case for merging links;

b. A parallel merge, as shown in Plate 6.3 includes an auxiliary lane and a taper, enabling VISSIM driving behaviour to manage vehicle to vehicle interactions without the need to add for additional conflict markers; and,

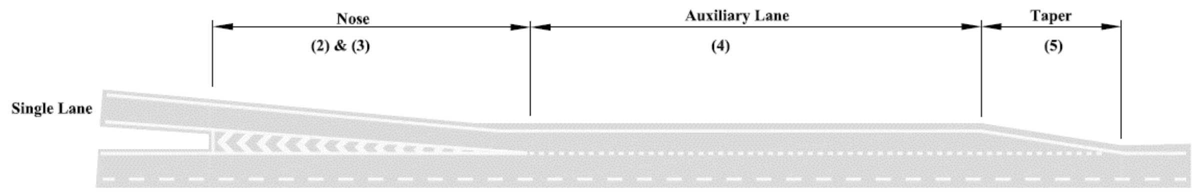
c. A lane gain, as shown in Plate 6.4, corresponds to a merge with an additional lane to the mainline, downstream of the merge.

Plate 6.2 Taper Merge



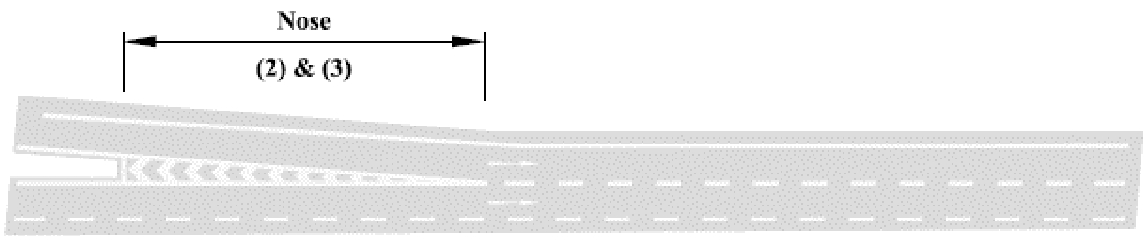
A - Taper Merge

Plate 6.3 Parallel Merge



B - Parallel Merge

Plate 6.4 Lane Gain



E - Lane Gain

6.7.2 In the case of a two-lane merge, each lane has its own conflict management setup, selected within the three types listed above.

The need for calibration

6.7.3 The merge taper illustrated in Plate 6.2 is particularly difficult to code in VISSIM. In the absence of a coding manual, the software provider PTV were contacted, who suggested a conflict area solution. However, there was no solution for a merge with both a taper merge and a lane gain (Type F merge) and no calibration of driving behaviour parameters available.

6.7.4 National Highways, as author of Guidelines for the Use of Microsimulation Software, confirmed no calibration values were available, nor a survey method to capture key driving behaviour.

6.7.5 In order to achieve an adequate level of accuracy for the Project, the operational modelling followed the recommendation of the Guidelines for the Use of Microsimulation Software and developed a calibration method.

6.7.6 Such a level of calibration goes beyond that which is typically undertaken for grade separated network microsimulation projects in the UK. The complexity of the proposed A13 interchange, however, required such a level of development. The following were developed:

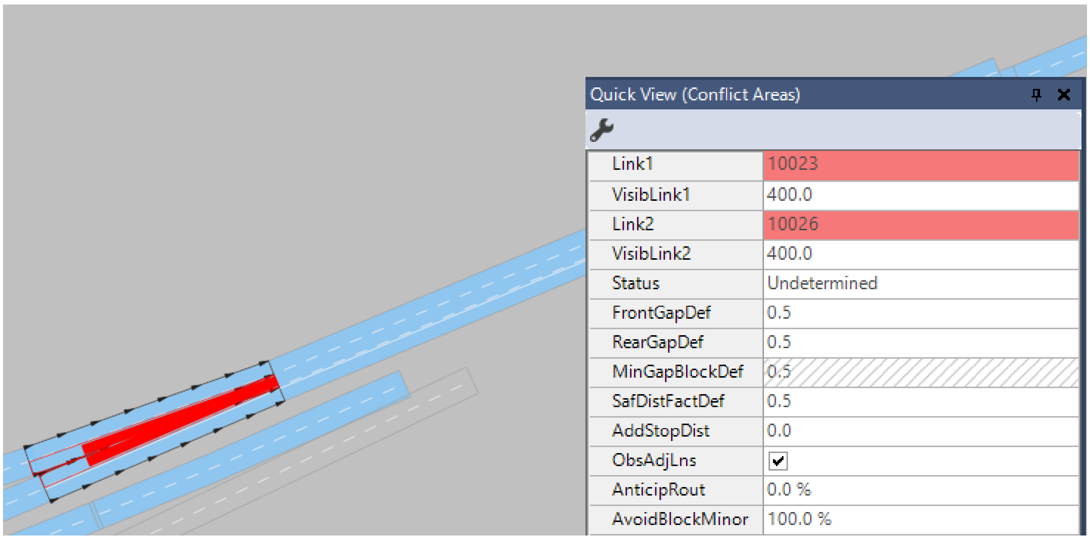
a. A network coding structure that could be systematically applied to the future network; and,

b. Driving behaviour overwrite values for both the grade separated and the local merge segment types.

Merge calibration outcome

6.7.7 As shown in Plate 6.5, the two-lane merge has been coded as a taper merge for one lane and a parallel merge for the other.

Plate 6.5 Merge Coding Example



6.7.8 The taper merge conflict between vehicles has been managed using a conflict area (in red in Plate 6.5). When the two VISSIM network sections at the merge location are both VISSIM connectors, the conflict area behaves like a merging segment. As per other VISSIM driving behaviour setups, default values are adjusted for an urban environment. The updated parameters used are as follow:

a. VisibLink1 and VisibLink2 from 100m to 400m (maximum distance a vehicle can see an incoming vehicle on the other link); and,

b. SatDistFactDef from 1.5 to 0.5 (safety distance factor that multiplies the distance calculation in the driving behaviour).

6.7.9 The justification for the first parameter value (VisibLink1 and VisibLink2) could be found in DMRB Volume 6, Section 1, Part 1 (TD 9/93), indicating that the full overtaking sight distance for a 100 kph design speed road is 400 metres. Google Street View was used to observe how far vehicles could see on the mainline and the merging slip on the A13. The distance of 400m was confirmed as not being obstructed by structures or vegetation, and incoming vehicles are visible.

6.7.10 The justification for the second parameter (SatDistFactDef) value is that this change was necessary to re-create the typical queuing dynamic observed on the A13 and A2. General observations on these roads indicate that drivers tend to accept a shorter gap between incoming vehicles when merging than when cruising on the mainline. The consequence of such a driving behaviour is that, as long as vehicles are cruising at a comparable speed, the shockwave from an increase in traffic density will take place once the merging vehicle has reached the mainline traffic. As a consequence, for a high-speed on-slip, the mainline road would be more affected by congestion than the on-slip.

7 Traffic demand preparation

7.1 Loading traffic onto a VISSIM network

7.1.1 In VISSIM traffic volumes can be loaded onto the network in two different ways:

a. By using matrices and a zoning system, as in a traditional traffic model; and,

b. By using vehicle inputs at the edge of links and routing decisions to guide vehicles through the network.

7.1.2 Method a. has been the main method used and the model includes a traditional matrix style traffic demand input.

7.2 Zoning system and vehicle inputs

7.2.1 The zoning system of the VISSIM base model is presented in Plate 7.1.

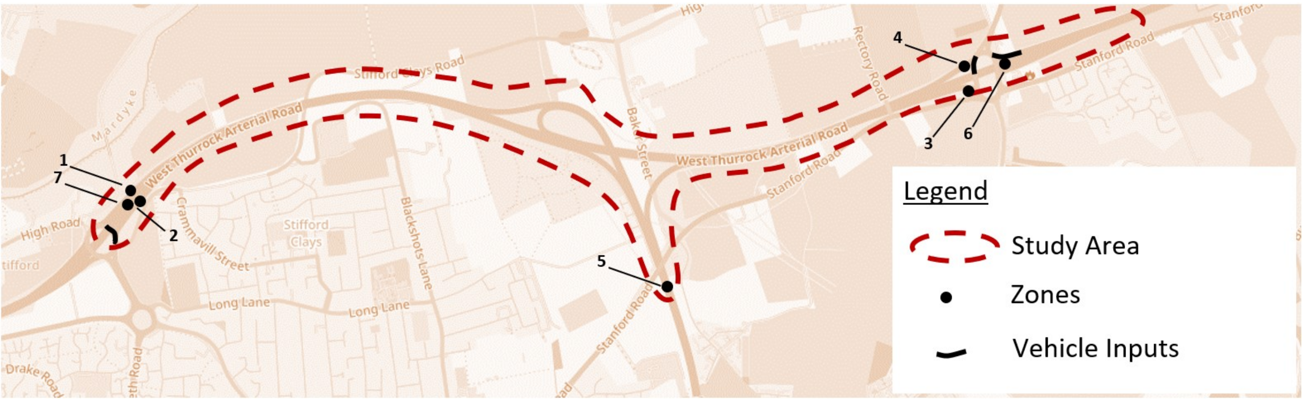
7.2.2 In order to remain consistent with the ANPR survey of package 1, it was decided to prepare a matrix focussing on movements matching the ANPR survey. At three locations, vehicles inputs were used instead of matrices:

a. A13 to A1012 roundabout circulating carriageway traffic;

b. A13 to A128 Orsett Cock circulating carriageway traffic; and,

c. A1012 to A13 eastbound merge.

Plate 7.1 Base VISSIM Model Zoning System



7.3 Traffic assignment type

7.3.1 The traffic assignment in the base model is simple as there is only one possible path between any two zones. It is, therefore, a shortest path, 'all or nothing', assignment type.

7.4 Flow profile & peak hour identification

7.4.1 For a microsimulation base model, it is important to capture the build-up and cool-down period of congestion. The return of traffic conditions from congested back to free-flowing is particularly sensitive.

7.4.2 The analysis of daily flow profiles on the A13 led to the selection of the following modelling time periods:

a. AM Peak: 07:00 to 08:00 (with an additional 30 min build up and cool down period before and after); and

b. PM Peak: 15:00 to 19:00 (with an additional 30 min build up and cool down period before and after).

7.5 Matrix development

ANPR survey processing

7.5.1 The ANPR data collection survey for the base model study area came from both package 1 and package 2 data sets. The individual camera records were re-processed following the zoning system presented in Plate 7.1.

7.5.2 The processing took place for two vehicles groups, HGV and general traffic (excluding HGV). The matrices were prepared for the following hours, and for each vehicle group:

a. 07:00 to 08:00;

b. 15:00 to 16:00;

c. 16:00 to 17:00;

d. 17:00 to 18:00; and,

e. 18:00 to 19:00.

7.5.3 The resulting hourly ANPR matrices were used as prior matrices to a matrix estimation process.

Matrix estimation

7.5.4 The purpose of the matrix estimation process was to develop hourly traffic matrices, which matched the traffic counts. As part of the ANPR survey, manually Classified Counts (MCC) were conducted on 17 May 2018 for a period of 24 hours with a 15 minute time interval.

7.5.5 The matrix estimation process was prepared, for HGV and general traffic (excluding HGV) using a specially developed Excel-based programme.

Vehicle inputs

7.5.6 The vehicle input data was prepared using the following traffic data from ANPR package 2 survey:

a. A13 to A1012 roundabout (15 minutes total traffic data and HGV% from the 2016 traffic survey);

b. A13 to A128 Orsett Cock junction (15 minutes total traffic data and HGV% the 2016 traffic survey); and,

c. A1012 to A13 eastbound merge (15 minutes total traffic data from 17 May 2018, HGV% from the 2016 traffic survey).

15 minute profiling

7.5.7 The traffic input profiling for each of the15 minute intervals of the modelled hours (matrices and inputs) was based on traffic count data.

8 Model validation results

8.1 VISSIM volumes accuracy requirement

8.1.1 For VISSIM Traffic Modelling Guidelines, TfL Traffic Manager and Network Performance Best Practices, Version 3.0, section 5.4.2.2 recommends the use of GEH statistic to demonstrate that traffic flows within the model match counts to an acceptable level of accuracy.

8.1.2 The GEH statistic is calculated as follows:

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

8.1.3 Where:

a. M = modelled flow; and,

b. C = counted (observed) flow.

8.1.4 Modelled flows should be averaged over multiple seeds. It is recommended that GEH statistics are:

a. Less than five for most links; and

b. Less than three for important/critical links.

8.1.5 Also, entry links into the network should be within 5% of the observed flows.

8.1.6 It is also recognised that a good level of accuracy for traffic counts is plus or minus 50 PCU per hour or within a GEH of two.

8.2 Traffic volumes GEH results

8.2.1 Table 8.1 to Table 8.5 show the traffic volumes comparison between the counts and VISSIM results. The key outcomes are:

a. All GEH values are below three; and,

b. Except for one entry link at 7%, all links are within the 5% accuracy criteria.

Table 8.1 AM Peak Flow Calibration 07:00 to 08:00

Zone ID	Count ID	Count Volumes (in veh.)	VISSIM Volumes (in veh.)	Percentage Difference	Absolute Difference (in veh.)	GEH
Zone 1 in	14E	1,017	1,090	7%	73	2.2
Zone 2 out	08W	1,036	995	-4%	-41	1.3
Zone 3 in	46W	781	799	2%	18	0.6
Zone 4 out	45E	482	502	4%	20	0.9
Zone 5 in	05N	1,038	1,081	4%	43	1.3
Zone 5 out	05S	1,368	1,322	-3%	-46	1.3
Zone 6 in	06W	4,088	4,142	1%	54	0.8
Zone 6 out	06E	3,086	3,131	1%	45	0.8
Zone 7 in	07E	2,164	2,179	1%	15	0.3
Zone 7 out	07W	3,128	3,052	-2%	-76	1.4

Table 8.2 PM Peak Flow Calibration 15:00 to 16:00

Zone ID	Count ID	Count Volumes (in veh.)	VISSIM Volumes (in veh.)	Percentage Difference	Absolute Difference (in veh.)	GEH
Zone 1 in	14E	1,334	1,397	5%	63	1.7
Zone 2 out	08W	763	749	-2%	-14	0.5
Zone 3 in	46W	423	419	-1%	-4	0.2
Zone 4 out	45E	709	724	2%	15	0.6
Zone 5 in	05N	980	1,010	3%	30	0.9
Zone 5 out	05S	958	918	-4%	-40	1.3
Zone 6 in	06W	2,286	2,269	-1%	-17	0.3
Zone 6 out	06E	3,929	3,958	1%	29	0.5
Zone 7 in	07E	2,831	2,882	2%	51	0.9
Zone 7 out	07W	1,854	1,794	-3%	-60	1.4

Table 8.3 PM Peak Flow Calibration 16:00 to 17:00

Zone ID	Count ID	Count Volumes (in veh.)	VISSIM Volumes (in veh.)	Percentage Difference	Absolute Difference (in veh.)	GEH
Zone 1 in	14E	1,249	1,304	4%	55	1.5
Zone 2 out	08W	915	906	-1%	-9	0.3
Zone 3 in	46W	488	493	1%	5	0.2
Zone 4 out	45E	881	917	4%	36	1.2
Zone 5 in	05N	1,038	1,060	2%	22	0.7
Zone 5 out	05S	982	954	-3%	-28	0.9
Zone 6 in	06W	2,744	2,710	-1%	-34	0.7
Zone 6 out	06E	4,161	4,143	0%	-18	0.3
Zone 7 in	07E	3,042	3,116	2%	74	1.3
Zone 7 out	07W	2,157	2,144	-1%	-13	0.3

Table 8.4 PM Peak Flow Calibration 17:00 to 18:00

Zone ID	Count ID	Count Volumes (in veh.)	VISSIM Volumes (in veh.)	Percentage Difference	Absolute Difference (in veh.)	GEH
Zone 1 in	14E	1,120	1,090	-3%	-30	0.9
Zone 2 out	08W	879	863	-2%	-16	0.6
Zone 3 in	46W	368	363	-1%	-5	0.3
Zone 4 out	45E	853	879	3%	26	0.9
Zone 5 in	05N	1,102	1,098	0%	-4	0.1
Zone 5 out	05S	1,155	1,127	-2%	-28	0.8
Zone 6 in	06W	2,843	2,829	0%	-14	0.3
Zone 6 out	06E	3,933	4119	5%	186	2.9
Zone 7 in	07E	3,195	3,165	-1%	-30	0.5
Zone 7 out	07W	2,208	2,171	-2%	-37	0.8

Table 8.5 PM Peak Flow Calibration 18:00 to 19:00

Zone ID	Count ID	Count Volumes (in veh.)	VISSIM Volumes (in veh.)	Percentage Difference	Absolute Difference (in veh.)	GEH
Zone 1 in	14E	1,104	1,126	2%	22	0.7
Zone 2 out	08W	800	811	1%	11	0.4
Zone 3 in	46W	323	332	3%	9	0.5
Zone 4 out	45E	762	795	4%	33	1.2
Zone 5 in	05N	954	985	3%	31	1.0
Zone 5 out	05S	982	960	-2%	-22	0.7
Zone 6 in	06W	2,215	2,197	-1%	-19	0.4
Zone 6 out	06E	3,721	3,752	1%	31	0.5
Zone 7 in	07E	2,743	2,840	4%	97	1.8
Zone 7 out	07W	1,735	1,744	1%	9	0.2

8.3 VISSIM travel time accuracy requirement

8.3.1 For VISSIM Traffic Modelling Guidelines, TfL Traffic Manager and Network Performance Best Practices, Version 3.0, section 5.4.2.4 modelled journey times should be within 15% of surveyed values.

8.4 Travel time results

8.4.1 The travel time observed data comes from the ANPR survey.

8.4.2 Table 8.6 to Table 8.15 shows the zone to zone travel time for each modelled hour of the simulation. For each hour, one table represents travel times in seconds, and the other the percentage difference between the survey and VISSIM travel time.

8.4.3 The generally observed pattern is:

a. AM peak – 07:00 to 08:00: all travel time records are at or within 15%;

b. PM peak – 15:00 to 16:00: all travel time records are at or within 15%;

c. PM peak – 16:00 to 17:00: three travel time records are slightly over the 15% criteria, the sign of a slightly strong eastbound queue;

d. PM peak – 17:00 to 18:00: three travel time records are slightly under the 15% criteria, the sign of a slightly shorter eastbound queue; and

e. PM peak – 18:00 to 19:00: four travel time records are slightly under the 15% criteria, the sign of a shorter eastbound queue.

8.4.4 In the PM peak, traffic congestion tends to develop sooner in the model than on site and dissipates sooner as well. This type of output on queues at grade separated junctions is likely to indicate slightly aggressive acceleration and deceleration behaviour. Acceleration and deceleration data was not available, and the calibration of such parameters goes beyond the expected requirement of a road project.

8.4.5 The travel time validation shows:

a. Good travel time match in free-flow conditions;

b. Good queuing dynamic, with congestion taking place and being dissipated autonomously at the correct location and of the correct intensity, while being in a succession of close-by merges and diverges; and,

c. Queues form faster and then dissipate faster.

8.4.6 For the Project’s design assessment, these results demonstrate a good level of accuracy. Bottlenecks have been correctly identified and congestion is developing with a very good level of accuracy.

Table 8.6 AM Peak Travel Time Survey 07:00 to 08:00 (in sec.)

	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7
Zone 1	-	-	-	189	139	157	-
Zone 2	-	-	-	-	-	-	-
Zone 3	-	192	-	-	91	-	180
Zone 4	-	-	-	-	-	-	-
Zone 5	-	144	-	171	-	135	138
Zone 6	-	170	-	-	71	-	157
Zone 7	-	-	-	189	145	159	-

Table 8.7 AM Peak Travel Time Validation 07:00 to 08:00

	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7
Zone 1	-	-	-	-6%	0%	0%	-
Zone 2	-	-	-	-	-	-	-
Zone 3	-	-5%	-	-	-2%	-	-4%
Zone 4	-	-	-	-	-	-	-
Zone 5	-	5%	-	-15%	-	-4%	6%
Zone 6	-	-1%	-	-	5%	-	1%
Zone 7	-	-	-	-5%	0%	0%	-

Table 8.8 PM Peak Travel Time Survey 15:00 to 16:00 (in sec.)

	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7
Zone 1	-	-	-	194	142	162	-
Zone 2	-	-	-	-	-	-	-
Zone 3	-	185	-	-	88	-	171
Zone 4	-	-	-	-	-	-	-
Zone 5	-	145	-	160	-	131	138
Zone 6	-	161	-	-	70	-	148
Zone 7	-	-	-	194	152	158	-

Table 8.9 PM Peak Travel Time Validation 15:00 to 16:00

	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7
Zone 1	-	-	-	-4%	-1%	8%	-
Zone 2	-	-	-	-	-	-	-
Zone 3	-	-4%	-	-	-3%	-	-2%
Zone 4	-	-	-	-	-	-	-
Zone 5	-	3%	-	0%	-	11%	1%
Zone 6	-	2%	-	-	5%	-	4%
Zone 7	-	-	-	-3%	-3%	10%	-

Table 8.10 PM Peak Travel Time Survey 16:00 to 17:00 (in sec.)

	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7
Zone 1	-	-	-	297	141	277	-
Zone 2	-	-	-	-	-	-	-
Zone 3	-	188	-	-	88	-	175
Zone 4	-	-	-	-	-	-	-
Zone 5	-	141	-	244	-	218	131
Zone 6	-	163	-	-	69	-	147
Zone 7	-	-	-	293	149	273	-

Table 8.11 PM Peak Travel Time Validation 16:00 to 17:00

	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7
Zone 1	-	-	-	8%	18%	18%	-
Zone 2	-	-	-	-	-	-	-
Zone 3	-	-1%	-	-	-2%	-	-3%
Zone 4	-	-	-	-	-	-	-
Zone 5	-	10%	-	-14%	-	-3%	7%
Zone 6	-	6%	-	-	6%	-	5%
Zone 7	-	-	-	10%	12%	23%	-

Table 8.12 PM Peak Travel Time Survey 17:00 to 18:00 (in sec.)

	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7
Zone 1	-	-	-	382	137	314	-
Zone 2	-	-	-	-	-	-	-
Zone 3	-	207	-	-	85	-	169
Zone 4	-	-	-	-	-	-	-
Zone 5	-	159	-	315	-	235	128
Zone 6	-	183	-	-	68	-	144
Zone 7	-	-	-	378	146	320	-

Table 8.13 PM Peak Travel Time Validation 17:00 to 18:00

	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7
Zone 1	-	-	-	-5%	8%	-17%	-
Zone 2	-	-	-	-	-	-	-
Zone 3	-	-8%	-	-	1%	-	-1%
Zone 4	-	-	-	-	-	-	-
Zone 5	-	1%	-	-7%	-	-19%	8%
Zone 6	-	-3%	-	-	8%	-	7%
Zone 7	-	-	-	-3%	5%	-16%	-

Table 8.14 PM Peak Travel Time Survey 18:00 to 19:00 (in sec.)

	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7
Zone 1	-	-	-	222	138	211	-
Zone 2	-	-	-	-	-	-	-
Zone 3	-	180	-	-	89	-	167
Zone 4	-	-	-	-	-	-	-
Zone 5	-	139	-	190	-	170	127
Zone 6	-	158	-	-	66	-	142
Zone 7	-	-	-	221	143	208	-

Table 8.15 PM Peak Travel Time Validation 18:00 to 19:00

	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7
Zone 1	-	-	-	-13%	0%	-20%	-
Zone 2	-	-	-	-	-	-	-
Zone 3	-	2%	-	-	-6%	-	-1%
Zone 4	-	-	-	-	-	-	-
Zone 5	-	10%	-	-16%	-	-21%	7%
Zone 6	-	8%	-	-	9%	-	7%
Zone 7	-	-	-	-13%	-1%	-19%	-

8.5 Queueing accuracy requirements

8.5.1 In the VISSIM Traffic Modelling Guidelines, TfL Traffic Manager and Network Performance Best Practices, Version 3.0, section 5.4.2.5, queuing measurements are not a validation criteria. It is however useful when determining bottlenecks. It can also support the performance assessment of a scheme when comparing various scenarios.

8.6 Queueing dynamics

8.6.1 The queueing observations have been prepared using Trafficmaster data. Due to sample size issues, the data had to be prepared as follows:

a. Only the A13 mainline was considered;

b. The entire month of May 2018 was considered;

c. Tuesdays, Wednesdays and Thursdays have been retained, with other days and bank holidays excluded;

d. Trafficmaster vehicle categories were merged into car, LGV, HGV categories;

e. Records have been averaged to hourly periods; and,

f. Remaining gaps in the data were updated using other data as far as possible.

8.6.2 Plate 8.1 to Plate 8.25 show Trafficmaster hourly queue and VISSIM traffic conditions (representing Thursday 17 May 2018, an average of 20 VISSIM runs).

8.6.3 The colour banding selected corresponds to traffic conditions and are:

a. Grey = Insufficient traffic records;

b. Green >60 mph (free-flow traffic conditions);

c. Yellow = 60 to 45 mph (at capacity traffic conditions);

d. Red = 45 to 35 mph (saturated traffic conditions); and,

e. Dark Red < 35 mph (more saturated traffic conditions).

8.6.4 In VISSIM, the selection of the speed bands above means that on/off slips and the local road network appear yellow or red. This can be a reflection of low speeds due to geometric road constraints, such as a sharp turn, or the approach to a roundabout.

Plate 8.1 AM Peak Trafficmaster 07:00 to 08:00

Plate 8.2 AM Peak VISSIM 07:00 to 07:15

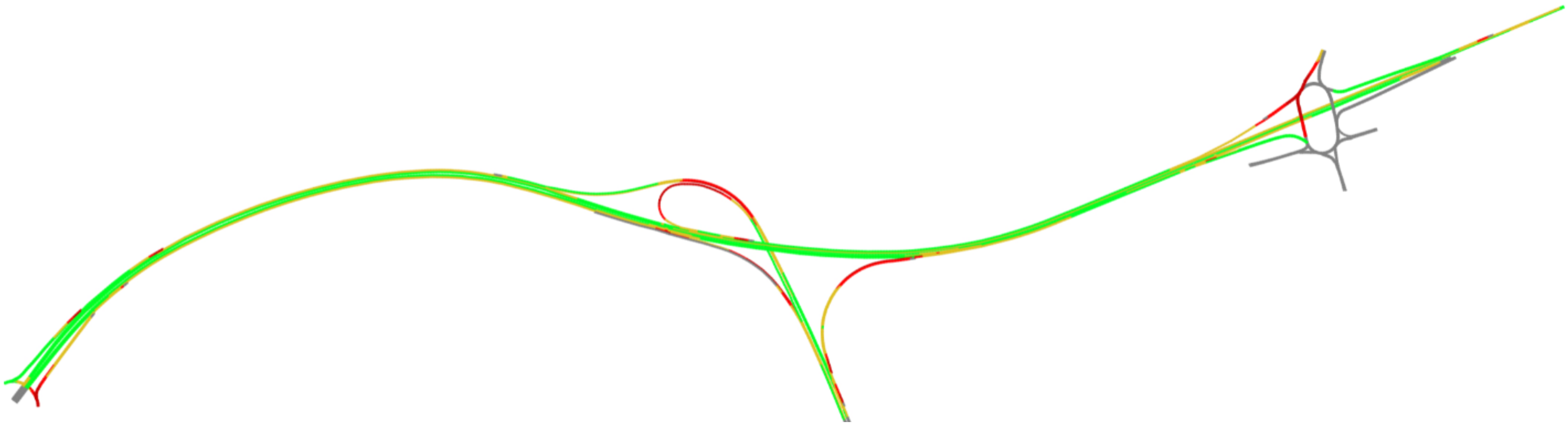


Plate 8.3 AM Peak VISSIM 07:15 to 07:30

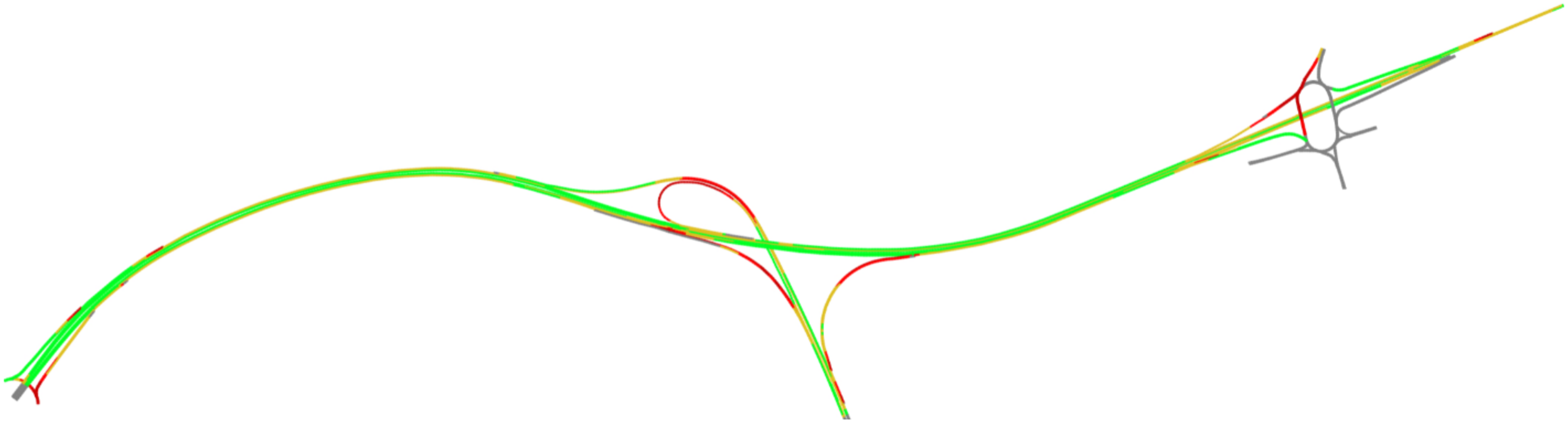


Plate 8.4 AM Peak VISSIM 07:30 to 07:45

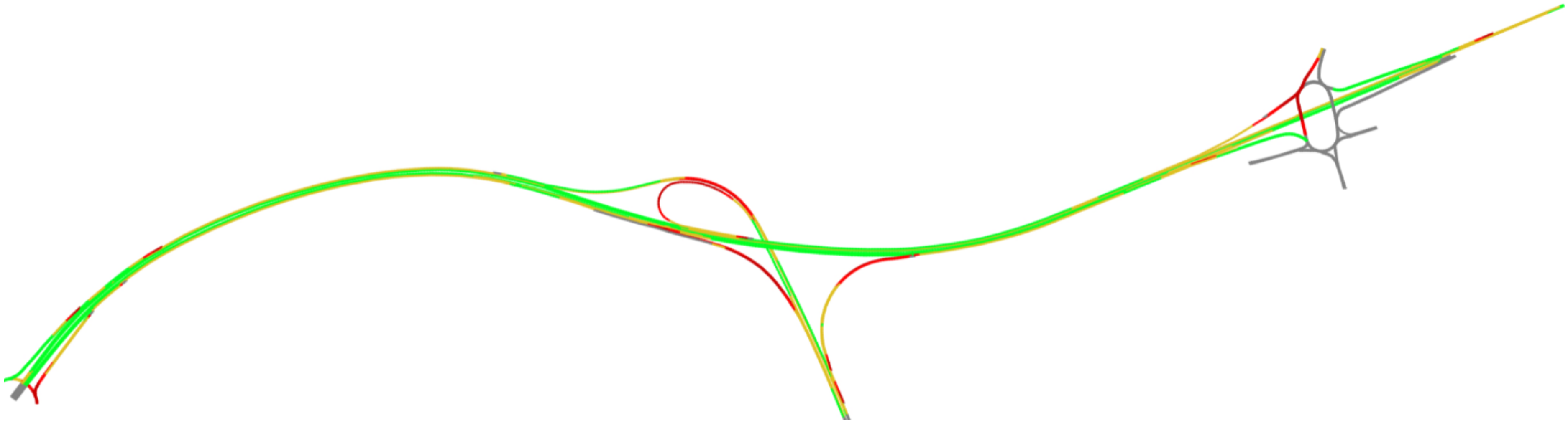


Plate 8.5 AM Peak VISSIM 07:45 to 08:00

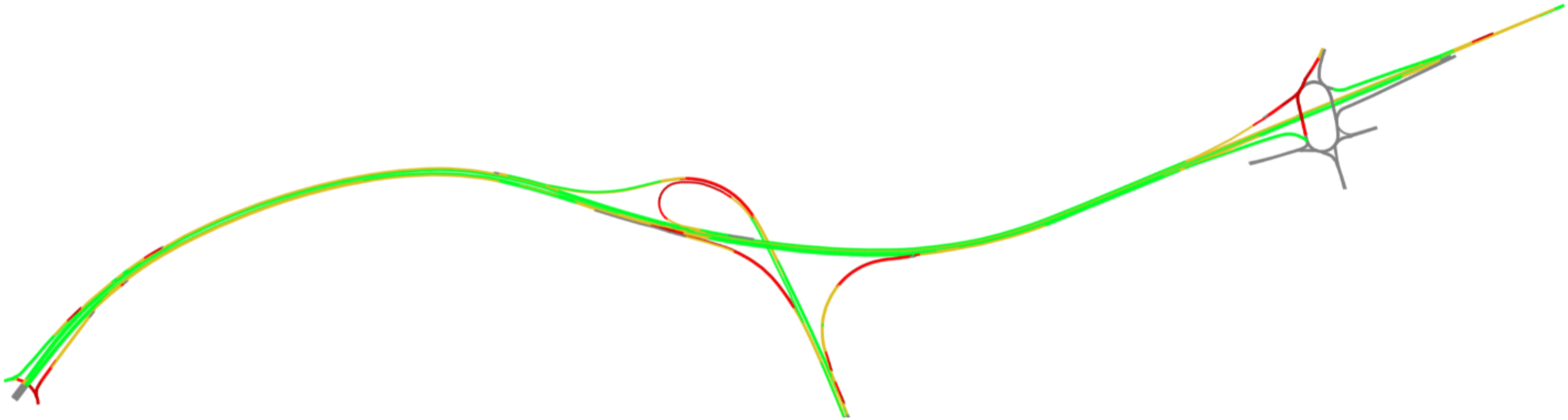


Plate 8.6 PM Peak Trafficmaster 15:00 to 16:00

Plate 8.7 PM Peak VISSIM 15:00 to 15:15

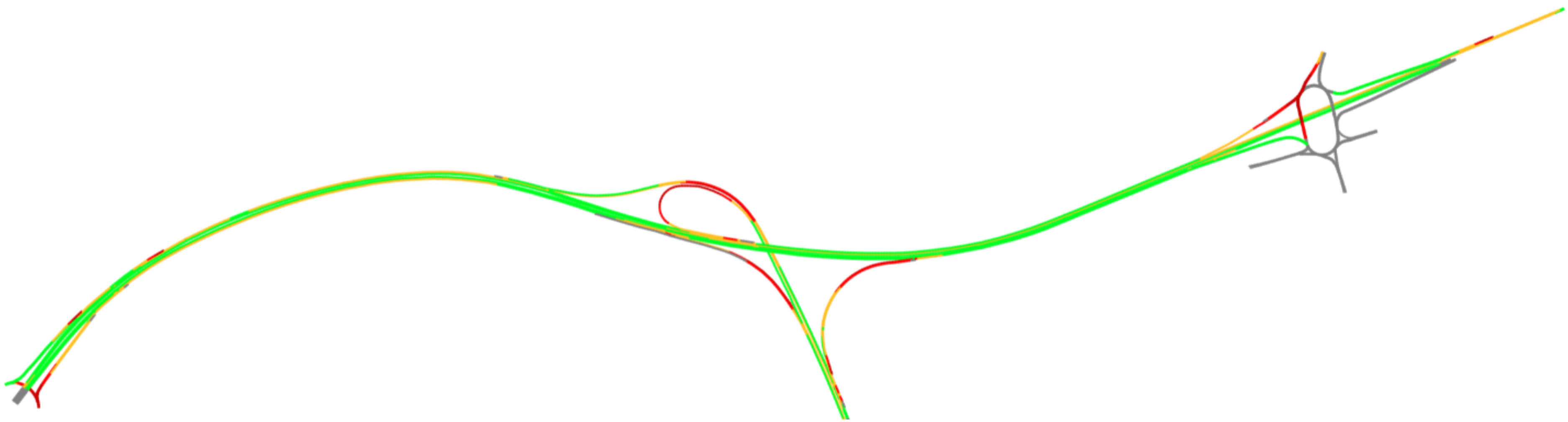


Plate 8.8 PM Peak VISSIM 15:15 to 15:30

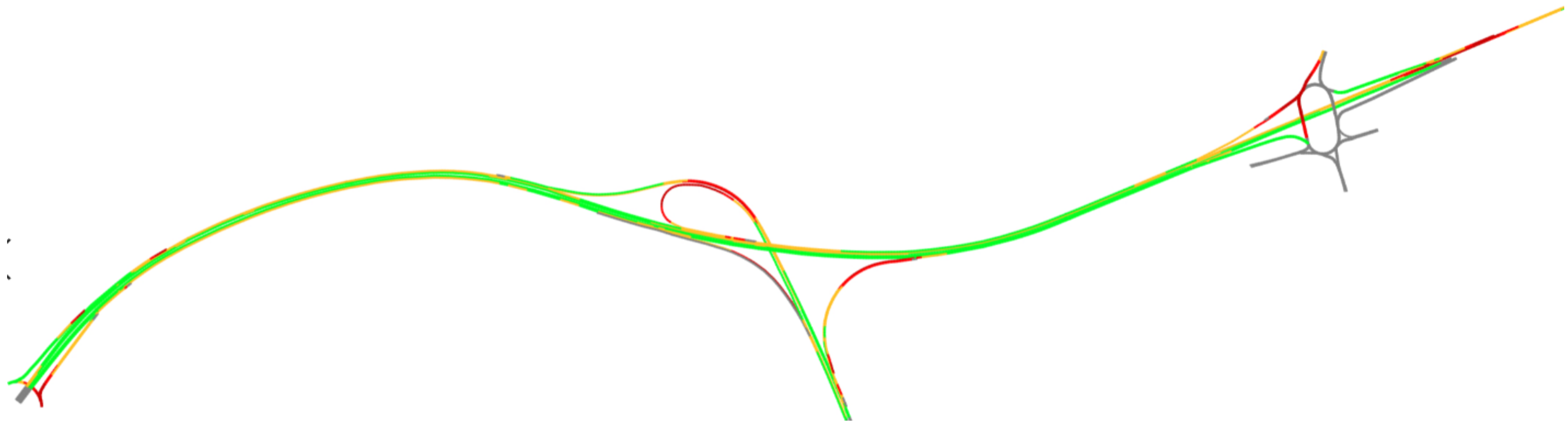


Plate 8.9 PM Peak VISSIM 15:30 to 15:45

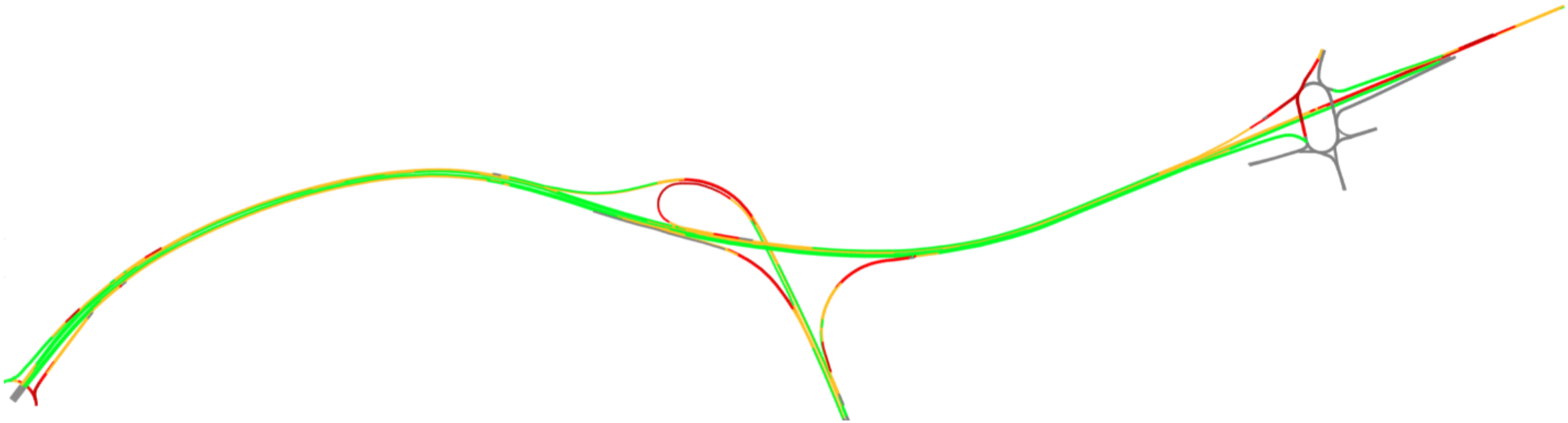


Plate 8.10 PM Peak VISSIM 15:45 to 16:00

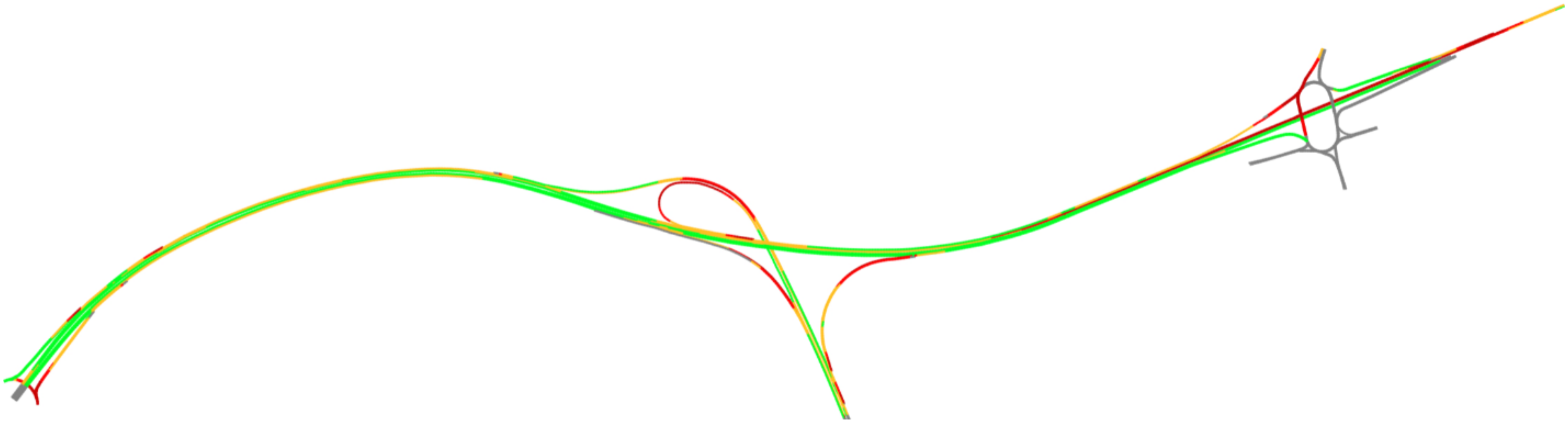


Plate 8.11 PM Peak Trafficmaster 16:00 to 17:00

Plate 8.12 AM Peak VISSIM 16:00 to 16:15

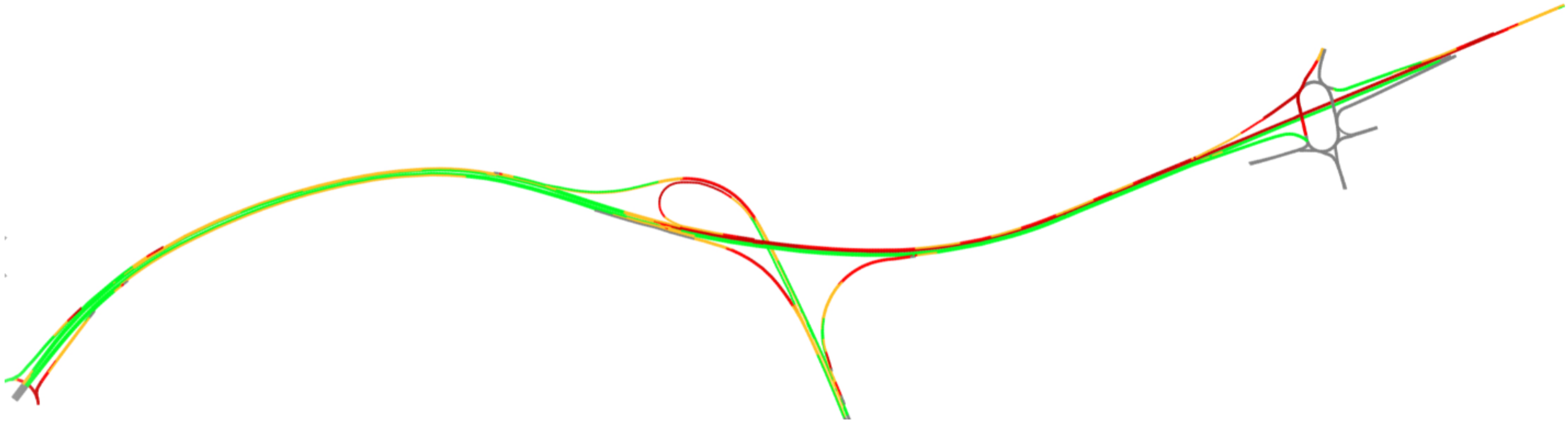


Plate 8.13 PM Peak VISSIM 16:15 to 16:30

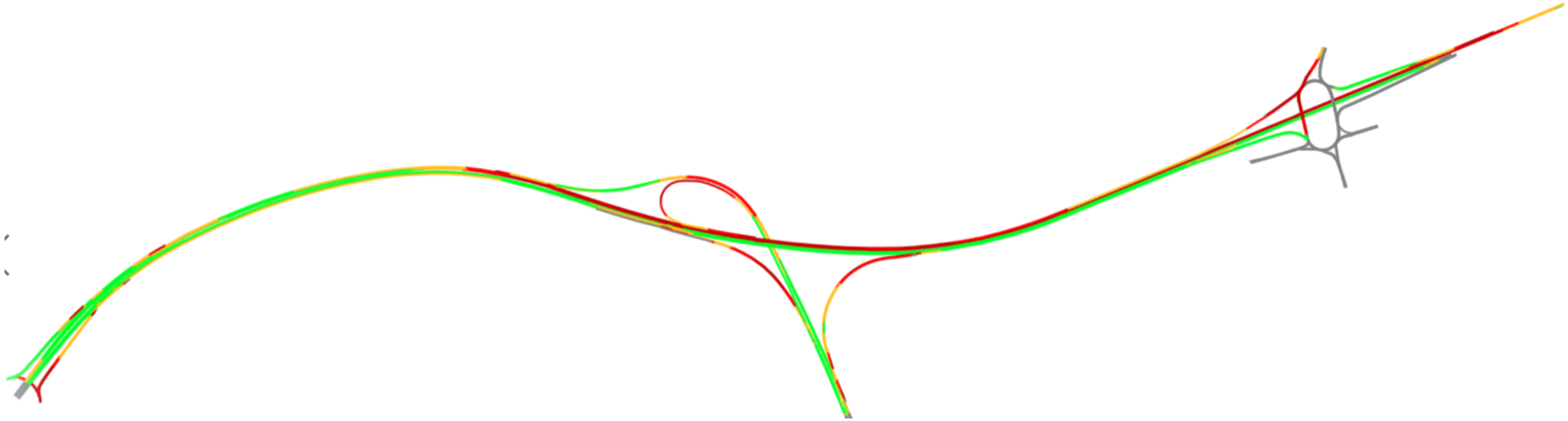


Plate 8.14 PM Peak VISSIM 16:30 to 16:45

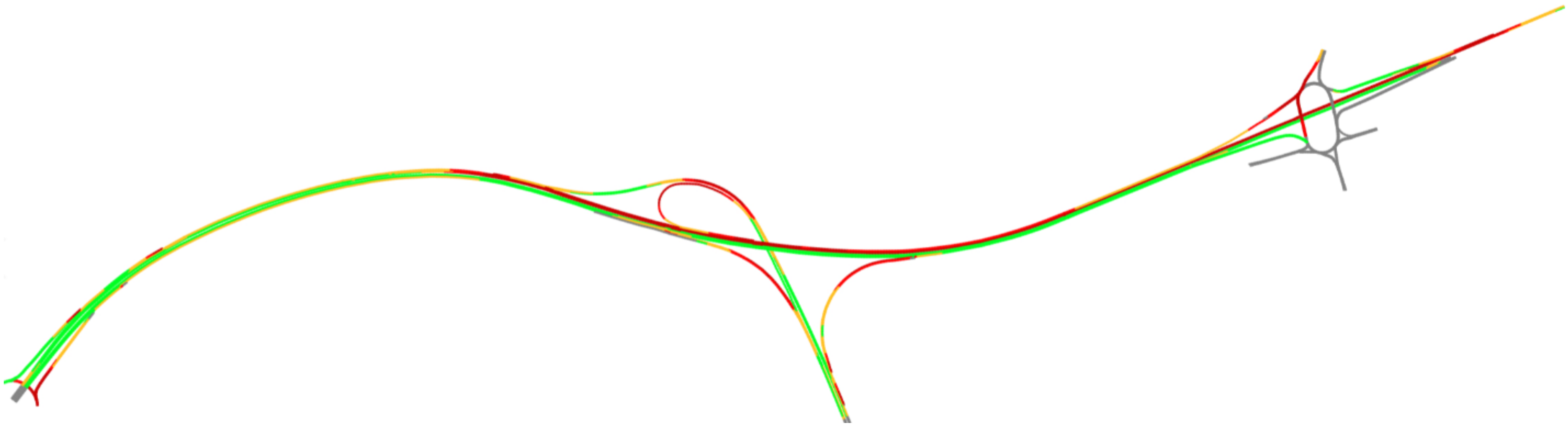


Plate 8.15 PM Peak VISSIM 16:45 to 17:00

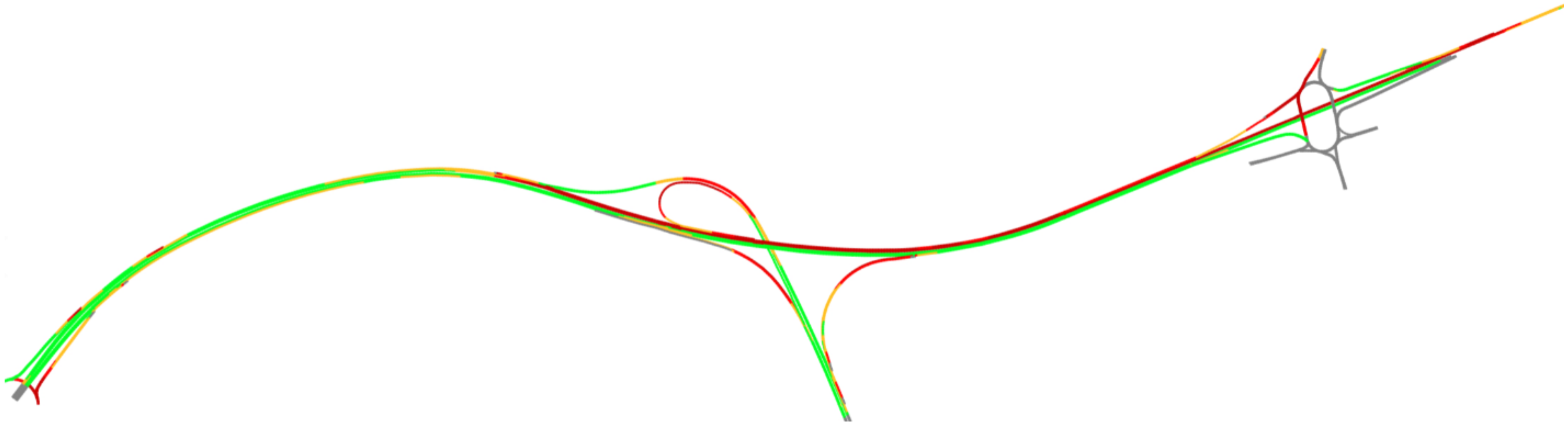


Plate 8.16 PM Peak Trafficmaster 17:00 to 18:00

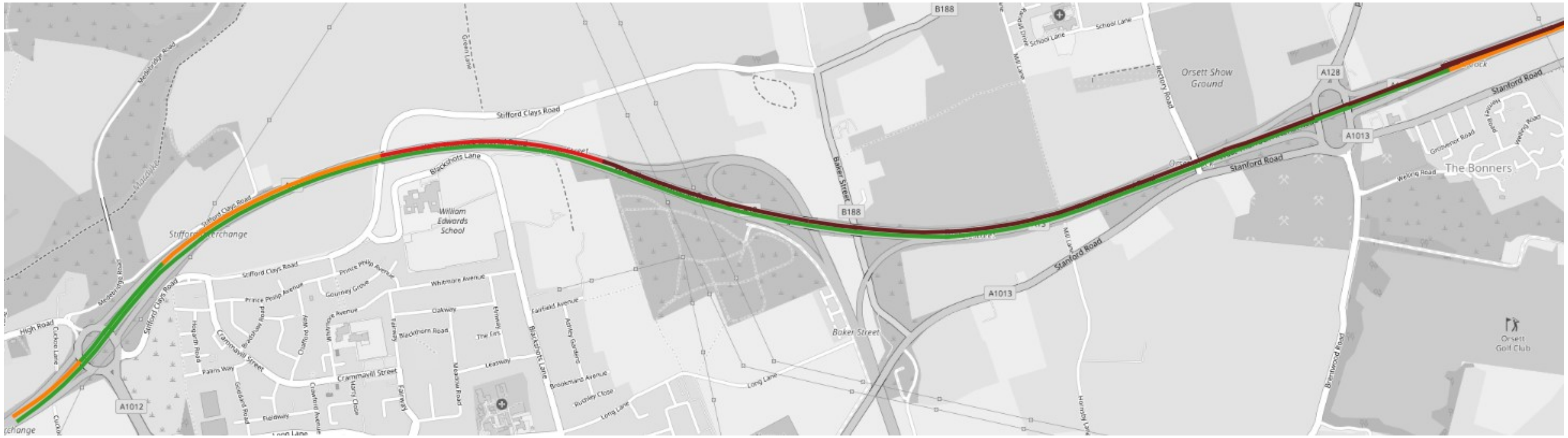


Plate 8.17 PM Peak VISSIM 17:00 to 17:15

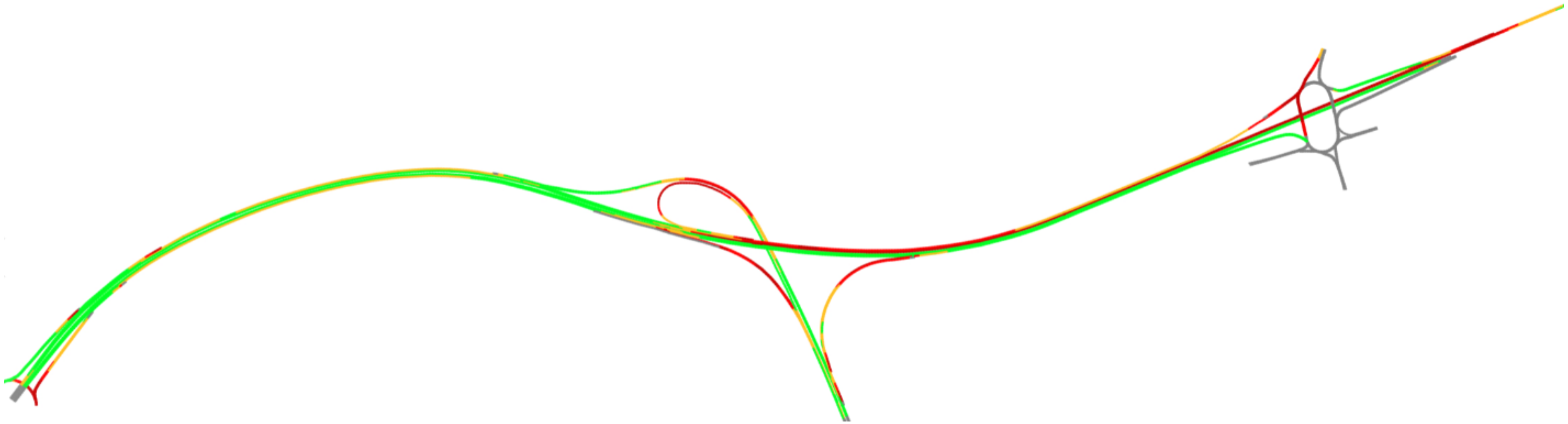


Plate 8.18 PM Peak VISSIM 17:15 to 17:30

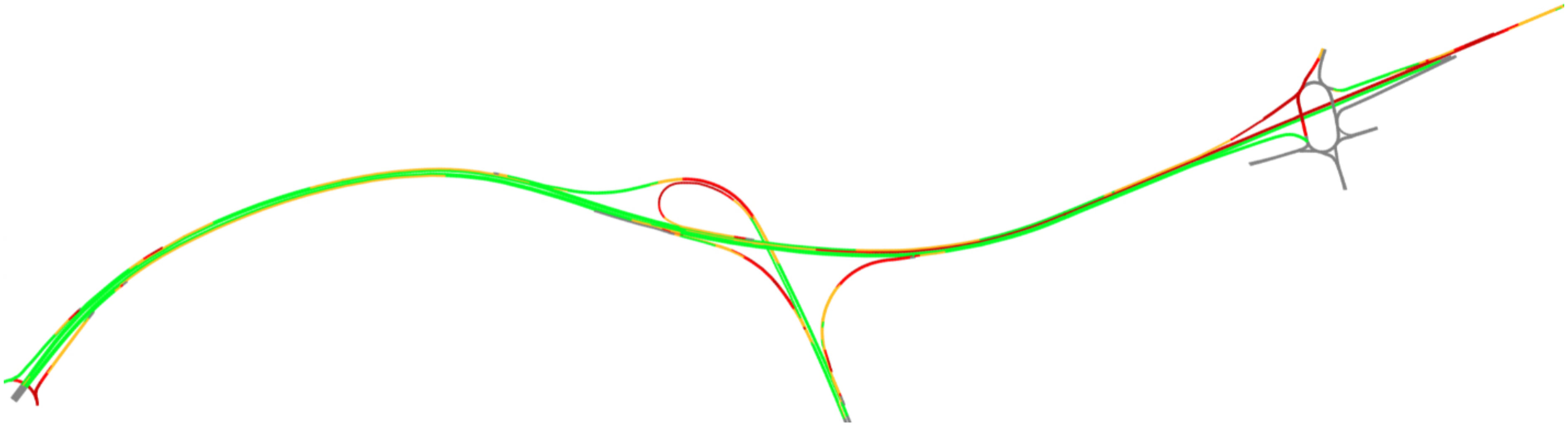


Plate 8.19 PM Peak VISSIM 17:30 to 17:45

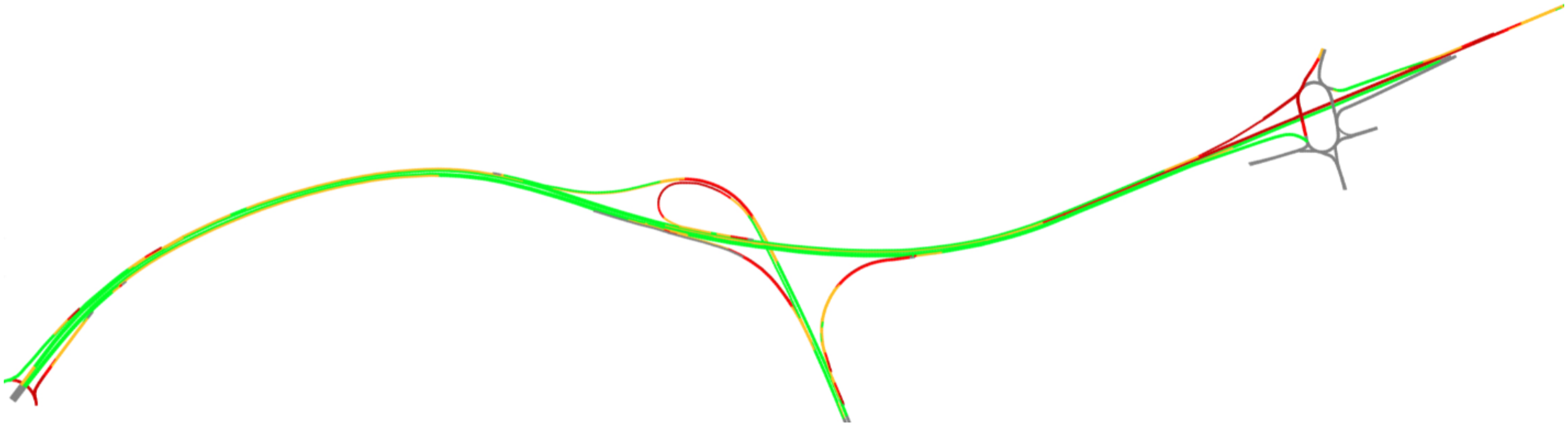


Plate 8.20 PM Peak VISSIM 17:45 to 18:00

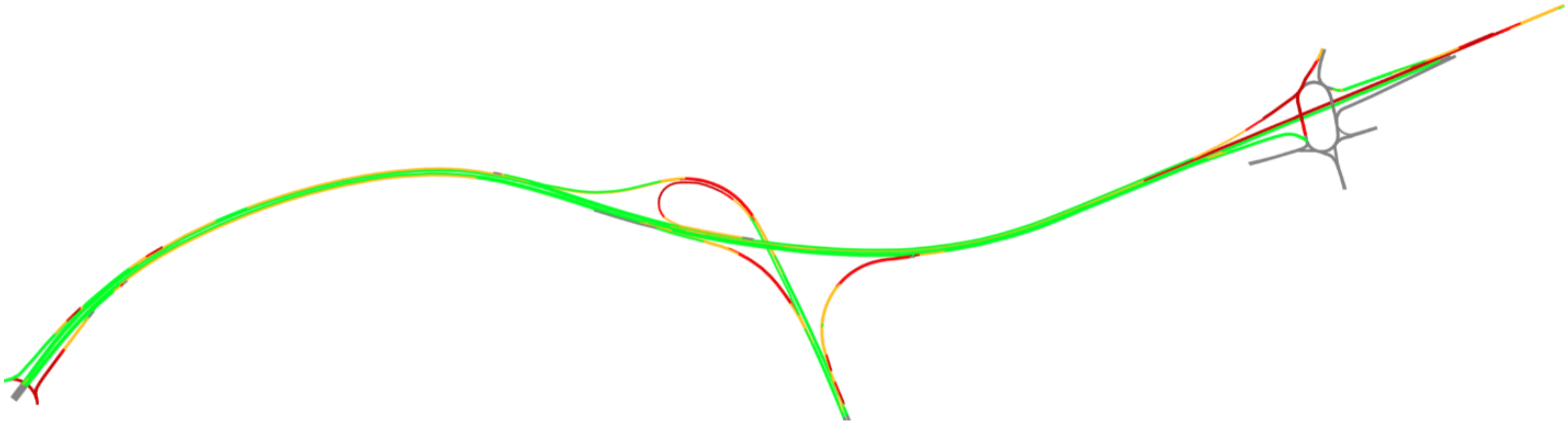


Plate 8.21 PM Peak Trafficmaster 18:00 to 19:00

Plate 8.22 PM Peak VISSIM 18:00 to 18:15

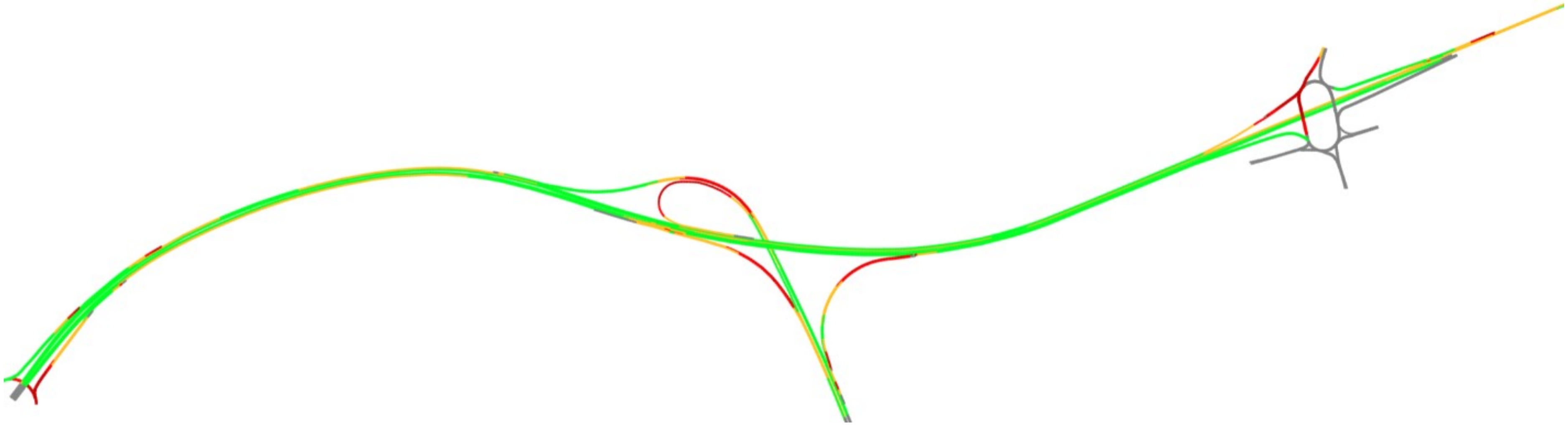


Plate 8.23 PM Peak VISSIM 18:15 to 18:30

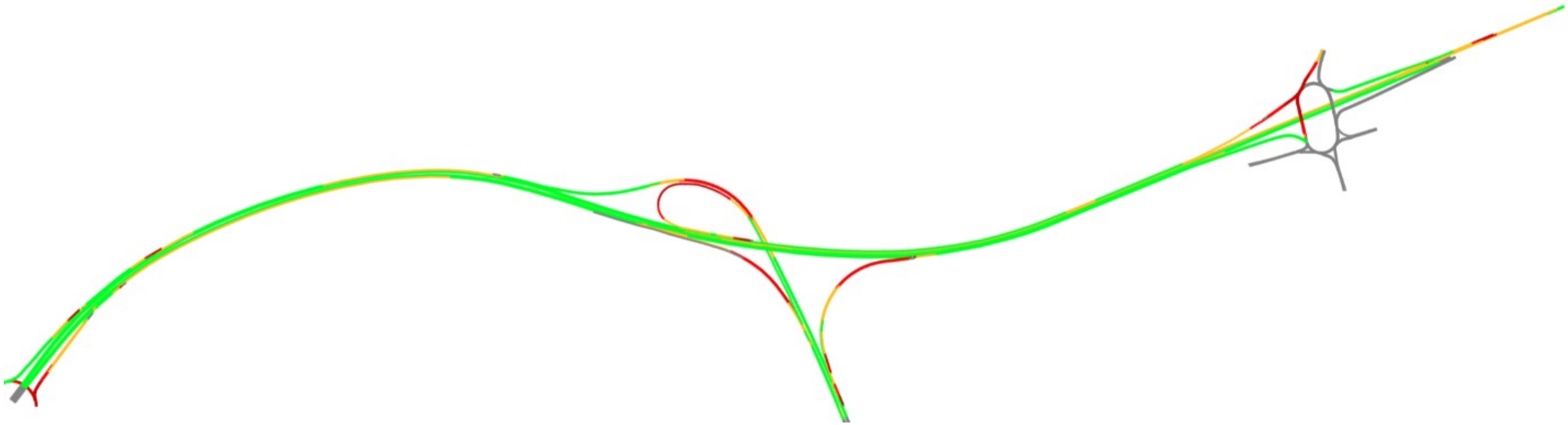


Plate 8.24 PM Peak VISSIM 18:30 to 18:45

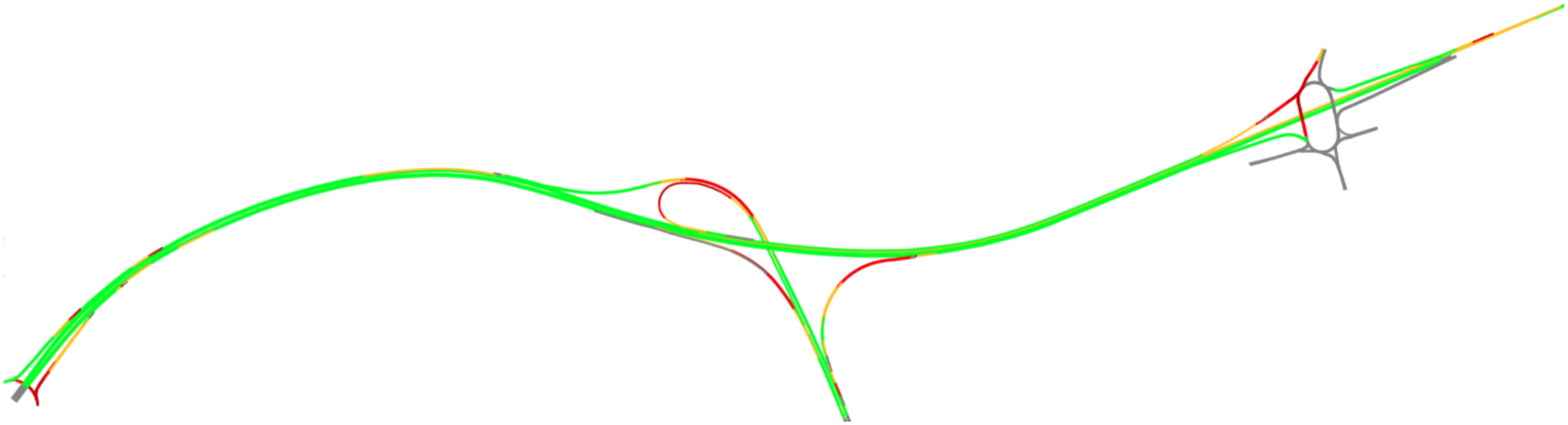
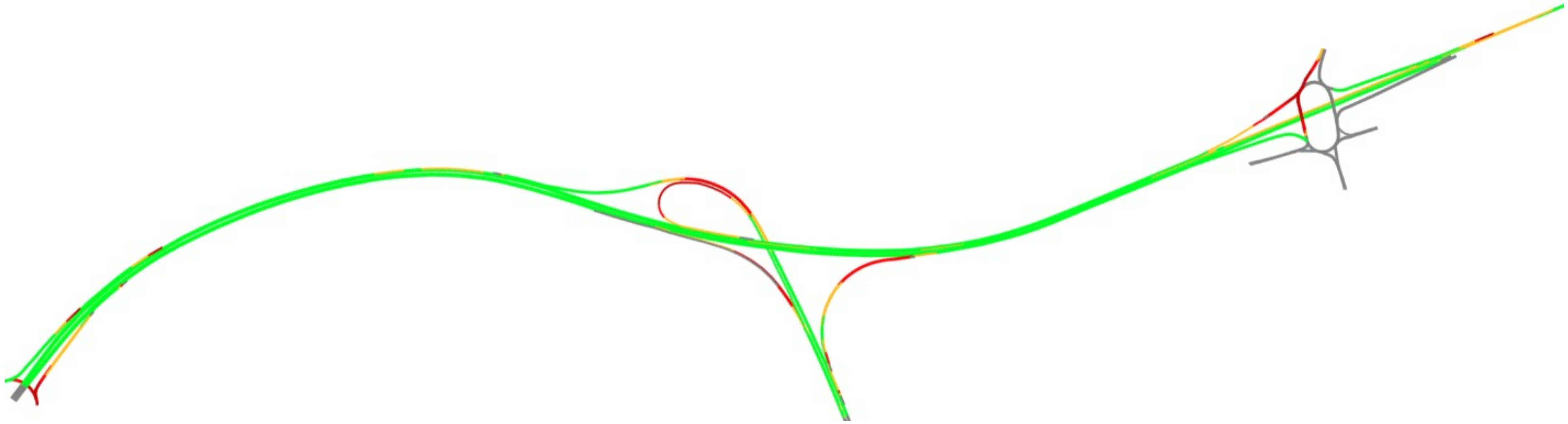


Plate 8.25 PM Peak VISSIM 18:45 to 19:00



9 Conclusion

9.1 Conclusion

9.1.1 In conclusion, the validation of the reference network shows that the model is fit for purpose to assess traffic conditions for complex sub-network segments.

9.1.2 The network coding method replicated overall traffic conditions, both in free-flow conditions and in saturated circumstances in line with guidance.

References

Transport for London (September 2010). Traffic Modelling Guidelines Version 3.0

Transport for London (March 2017). Model Auditing Process (MAP) Version 3.5. Engineer Guide for Design Engineer (DE), Checking Engineer (CE) and Model Auditing Engineer (MAE)

Highways Agency (July 2007) - Guidelines for the Use of Microsimulation Software

Transportation Research Board of the National Academies of Sciences, Engineering, and Medicine, United States (2010) – Highway Capacity Manual

Glossary

Term	Explanation
AADT	Annual Average Daily Traffic
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.
HCM	Highway Capacity Manual, published by the Transportation Research Board of the National Academies of Sciences, Engineering, and Medicine in the United States
HGV	Heavy Goods Vehicle
LGV	Light Goods Vehicle
LMVR	Local Model Validation Report
LTC	Lower Thames Crossing
MCC	Manual Classified Counts
NB	Northbound
OS	Ordnance Survey
PCU	Passenger car unit - A metric to allow different vehicle types within a traffic model to be assessed in a consistent manner.
PTV	German for Planning Transport and Traffic Software package
SATURN	Simulation and Assignment of Traffic to Urban Networks

Term	Explanation
SB	Southbound
TAG	Transport Analysis Guidance published by DfT
TfL	Transport for London - The integrated body responsible for London's transport system
UC	User Class
VDM	Variable Demand Model
VISSIM	Micro-simulation software developed by PTV. Verkehr In Städten - SIMulationsmodell (German for "Traffic in cities - simulation model)
WB	Westbound

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