Hayling Island Microsimulation Modelling **26/11/2018**

Reference number GB01T17H90_MDR_5

BASE MODEL DEVELOPMENT

HAYLING ISLAND MICROSIMULATION MODELLING

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1. INTRODUCTION

1.1 Purpose of Report

SYSTRA was commissioned by Havant Borough Council (HBC) to develop a Paramics Discovery microsimulation model of Hayling Island in order to examine future year Local Plan impacts.

This report will discuss the development of the Hayling Island model and provide details of the calibration and validation.

2. DATA

2.1 Existing Data

A number of datasets were provided by HBC for the purpose of developing the model. These datasets are listed below.

- Six Classified Junction Counts, commissioned by HBC, undertaken on various dates in June 2017
  - A3023 Havant Rd/Technology Park – Tuesday 27/06/2017
  - A3023 Havant Rd/Northney Rd – Monday 19/06/2017
  - A3023 Havant Rd/West Lane – Monday 19/06/2017
  - A3023 Havant Rd/Copse Lane – Wednesday 28/06/2017
  - A3023 Havant Rd/Yew Tree Rd – Wednesday 28/06/2017
  - A3023 Havant Rd/Mill Rythe Rbt – Thursday 29/06/2017

- Classified Automatic Traffic Counts (ATC), undertaken by HBC (June 2017)
- Bluetooth Journey Time Surveys commissioned by Hampshire County Council. Two routes across the study area, undertaken over four weeks (1 - 19 June and 7 – 20 August 2017)
- Traffic signal timings for relevant junctions
- Data from the Strategic model *Solent Transport's Sub-Regional Transport Model* (SRTM), developed by SYSTRA, for use in the development of the zone system and traffic demands

2.2 Manual Classified Count Data

Manual Classified Count (MCC) surveys were undertaken by Streetwise Services on Tuesday 12 September 2017 from 07:00 – 19:00 at 25 junctions in the study area. Data was collected in 5min intervals and classified as follows:

- Car
- LGV
- OGV1
- OGV2
- PSV (public bus and private coach)

Surveys were undertaken by video, with the video files provided along with the count data. The MCC locations are shown in Figure 1. The list of locations is included in Table 1.

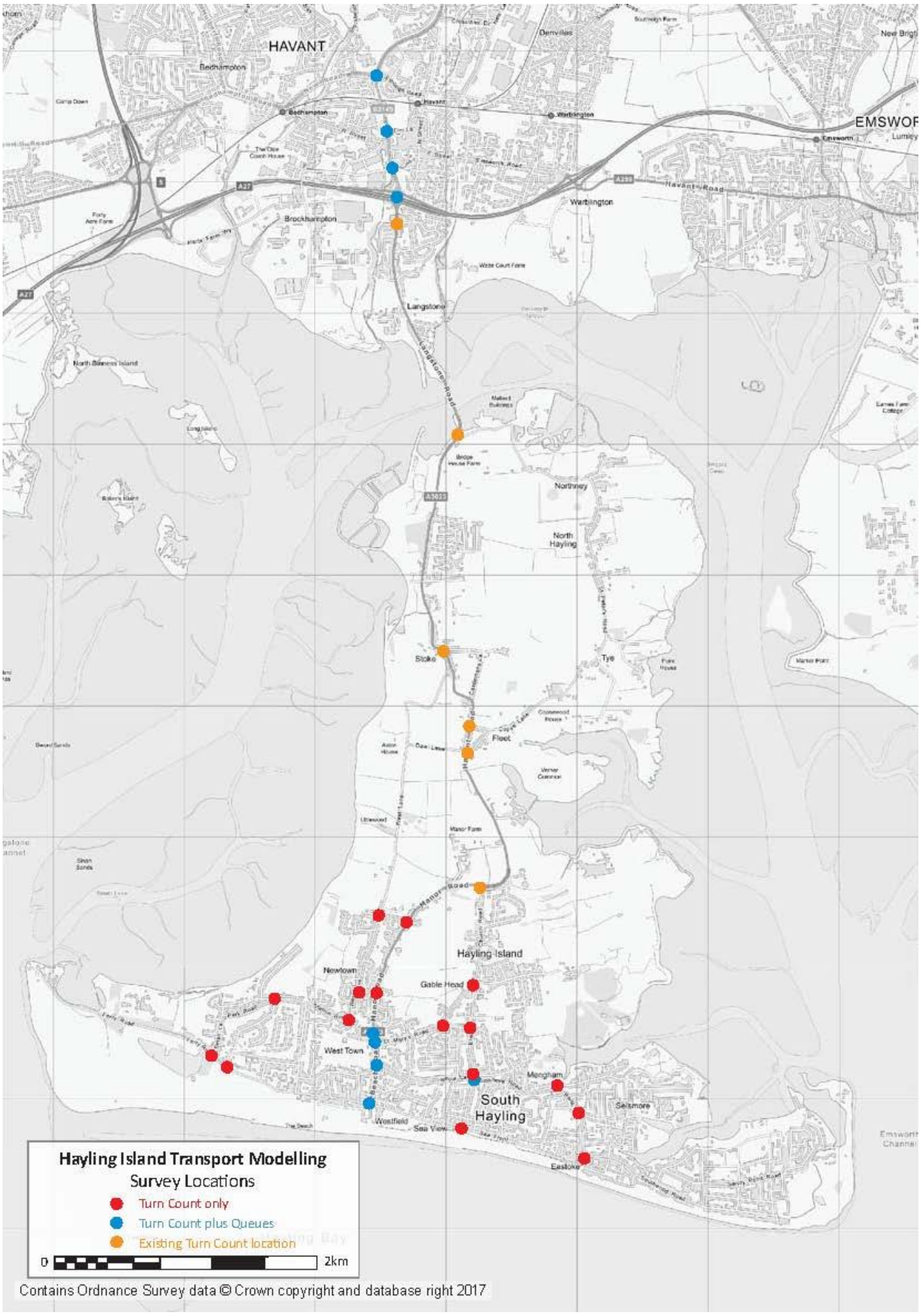

Figure 1. MCC and Queue Length Survey Locations

No.	Description	Type	Control
1	**B2149 Petersfield Road / Park Road North**	**4 arm roundabout**	**Priority**
2	**B2149 Park Road / Elm Lane / Park Way**	**4 arm junction**	**Signalised**
3	**B2149 Park Road / Solent Road**	**3 arm junction**	**Signalised**
4	**B2149 Park Road South / A27 Havant Bypass / A3023 Langstone Road**	**4 arm roundabout**	**Signalised**
5	West Lane / Brights Lane / Woodlands Lane	4 arm junction	Priority
6	A3023 Manor Road / Brights Lane / Higworth Lane	4 arm junction	Priority
7	A3023 Manor Road / Newtown Lane	3 arm junction	Priority
8	West Lane / Newtown Lane	3 arm junction	Priority
9	West Lane / Station Road	3 arm junction	Priority
10	Sinah Lane / St Catherines Road	3 arm junction	Priority
11	St Catherines Road / Sea Front	3 arm junction	Priority
12	Sinah Lane / Sea Front / Links Lane / Ferry Road	4 arm junction	Priority
13	**A3023 Beach Road / Sea Front (Beachlands Roundabout)**	**4 arm roundabout**	**Priority**
14	**A3023 Beach Road / Hollow Lane**	**3 arm junction**	**Priority**
15	**A3023 Manor Road / St Mary's Road / A3023 Beach Road**	**3 arm junction**	**Priority**
16	**A3023 Manor Road / Station Road**	**3 arm junction**	**Priority**
17	St Mary's Road / Cherrywood Gardens	3 arm junction	Priority
18	Church Road / Elm Grove / St Mary's Road	3 arm junction	Priority
19	Elm Grove / Cherrywood Gardens	3 arm junction	Priority
20	Elm Grove / Mengham Road / Sea Grove Avenue / Hollow Lane	4 arm junction	Priority
21	**Sea Grove Avenue / Selsmore Road**	**3 arm junction**	**Priority**
22	Sea Grove Avenue / Sea Front	3 arm junction	Priority
23	Rails Lane / Southwood Road	3 arm junction	Priority
24	Rails Lane / Fishery Lane	3 arm junction	Priority
25	Rails Lane / Salterns Lane / Selsmore Road	3 arm junction	Priority

Table 1. MCC Locations (Queue Survey Location in Bold)

2.3 Queue Length Surveys

Queue length data was collected at nine of the MCC locations, on the same date. Surveys were undertaken by Streetwise Services. The maximum queue length occurring in vehicles was collected in 5min intervals from 07:00 – 19:00 for each relevant junction approach.

Surveys were undertaken by video, with the video files provided along with the data. The locations of the queue length surveys are indicated by bold text in Table 1 above.

2.4 Journey Time Routes

Two journey time routes were surveyed as part of the September 2017 survey programme, and are shown in Figure 2. The figure also shows the two Bluetooth journey time routes provided by HBC (routes 3 and 4), discussed further in Section 5.4.

- Route 1: Beachlands Roundabout to Mill Rythe Roundabout via A3023 Manor Road
- Route 2: Sea Front/Sea Grove Avenue to Mill Rythe Roundabout via Church Road/Elm Grove
- Route 3: A3023 Woodbury Avenue to Mill Rythe Junior School via A3023, northbound and southbound
- Route 4: A3023 Woodbury Avenue to Brights Lane via West Lane, northbound and southbound

Figure 2. Journey Time Routes

The journey time information for routes 1 and 2 was gathered using the moving observer method, gathering GPS breadcrumb data over the length of the route. A minimum of 24 surveyed journey time runs were provided for each route and direction for the hours

07:00 – 10:00, 11:00 – 14:00, and 16:00 – 19:00. On board dash camera video footage was also provided.

The Bluetooth data was provided by HBC in 1min intervals. Data was also available for four route sections along the route, between the following timing points:

- Site 1/2 Woodbury Ave: Langstone Road on lamp column 3 and 4 (nbd/sbd)
- Site 3 Ship Inn: Langstone Road on lamp column 30
- Site 4 New Cut: A3023 at junction with New Cut
- Site 5 West Lane: A3023 at junction with West Lane, lamp column 62
- Site 6 North of School: A3023 north of Junior School, lamp column 14
- Site 7 Brights Road: West Lane just south of Brights Road, lamp column 27

The four route sections were:

- Route 3:
  - Section 1: Site 1/2 to Site 3 Woodbury Ave to Ship Inn
  - Section 2: Site 3 to Site 4 Ship Inn to New Cut
  - Section 3: Site 4 to Site 5 New Cut to West Lane
  - Section 4: Site 5 to Site 6 West Lane to Junior School
- Route 4:
  - Section 1: Site 1/2 to Site 3 Woodbury Ave to Ship Inn
  - Section 2: Site 3 to Site 4 Ship Inn to New Cut
  - Section 3: Site 4 to Site 5 New Cut to West Lane
  - Section 4: Site 5 to Site 7 West Lane to Brights Lane

SYSTRA extracted data for the first two weeks of June 2017, for weekdays Tuesday, Wednesday and Thursday, as these are considered neutral time periods. Interrogation of the data showed high variability in journey times on both routes, particularly Route 4. For example, some matched journeys were in excess of 15min when the majority were under 10min (indicating these were likely non-continuous journeys). The raw survey data was subsequently filtered and collated in 15min intervals to remove these non-continuous journeys.

For Routes 3 and 4, the filtering process involved:

- Determining a valid journey based on matching the vehicle ID at the start and finish Bluetooth monitoring station, and determining the journey time
- Grouping individual journeys by route direction into 15min time intervals, based on time of day at journey start
- Determining the average journey time for each 15min interval by route direction
- Determining the standard deviation for each 15min interval by route direction
- Removing individual journeys for the full route which were greater than the average journey time plus the standard deviation for that route and time interval.
  - For example, the average journey time for a given time interval may have been 498sec and the standard deviation 126sec. Any individual journey within that time interval which was greater than 624sec was removed from the analysis

- For the retained full route journeys, determining a new average journey time for each route section within the full route and counting the number of retained journeys for each 15min interval by route direction
- Determining an hourly average journey time for each route section for each direction by finding the weighted average of the 15min individual journey times (i.e. the average journey time for the hour based on the number of matches in each 15min period)
- Full route journey times were the sum of the average individual route sections

This process resulted in a realistic average journey time for each hour which does not include non-continuous route occurrences (i.e. vehicles stopping and starting again en route). The number of Bluetooth matches per hour (ie: the same vehicle recorded passing the journey route start and finish monitoring station) ranged from 66 to 821.

2.5 Additional Surveys

Following surveys undertaken earlier in the project, 8 video surveys were conducted at 4 sites between the Havant Bypass and the Northney Junction to observe traffic behaviour.

These 8 surveys captured flows of traffic north and south of 4 sites:

- Woodbury/A3023 Junction
- Langstone High Street/A3023 Junction
- The Ship Inn
- Northney Road/A3023 Junction

Surveys were undertaken by video, with the video files provided. These surveys were taken on Wednesday 31/10/2018 by Streetwise Services.

3. NETWORK DEVELOPMENT

A Paramics model covering the Hayling Island study area was created using Version 19 of Paramics Discovery to reflect normal weekday traffic conditions.

This chapter details the steps undertaken.

3.1 Study area

As defined by HBC in the study brief, the model covers the A3023 through Hayling Island, Church Road/Elm Grove, West Lane, Sea Front, and Ferry Road. On the mainland in Havant is the A3023 Langstone Road/Park Road North and the interchange with the A27.

The model study area is shown in Figure 3.

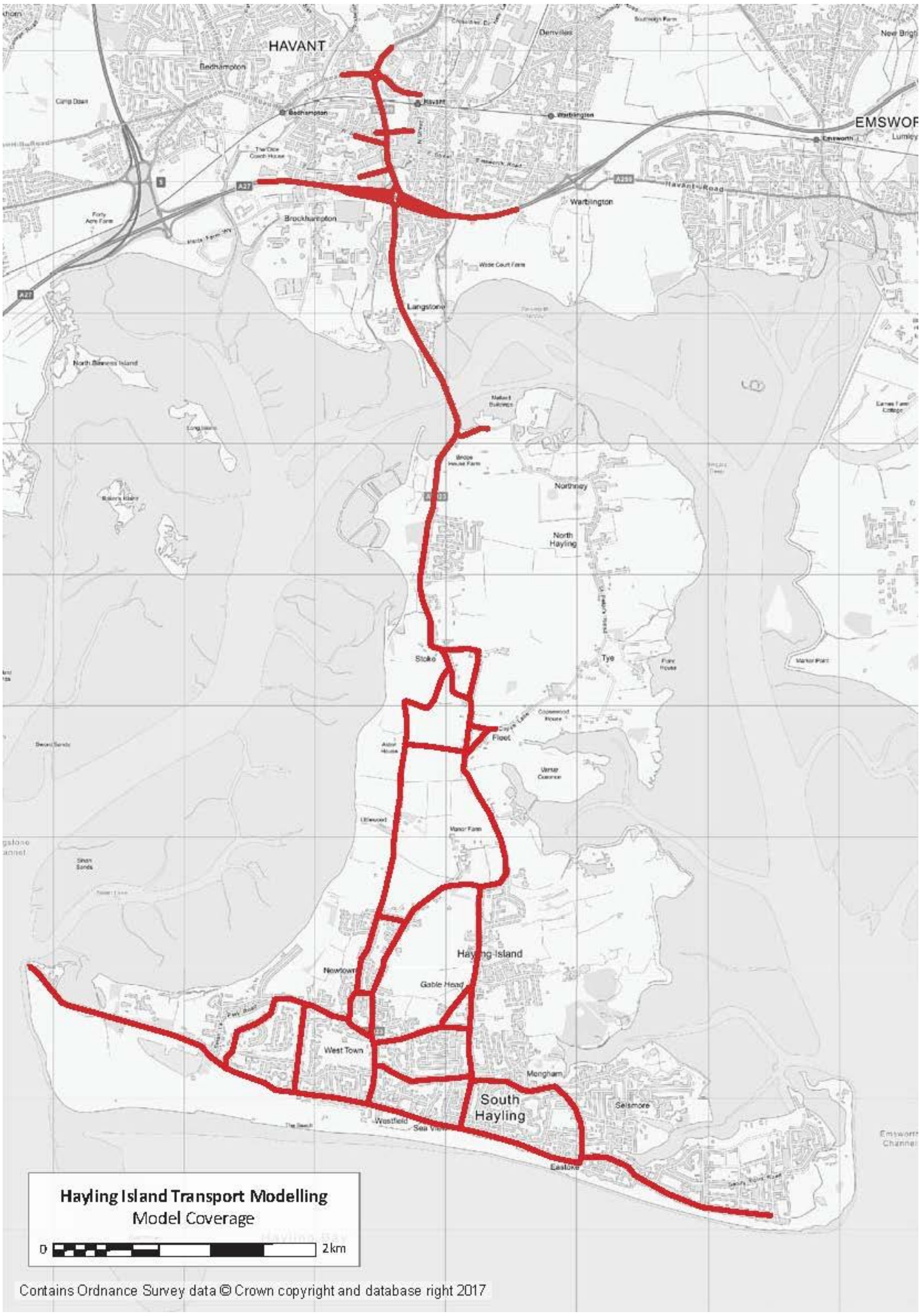

Figure 3. Hayling Island Study Area

3.2 Modelled Periods

The model reflects three time periods:

- AM Weekday 07:00 – 10:00 (3Hr)
- IP Weekday 10:00 – 16:00 (6Hr)
- PM Weekday 16:00 – 19:00 (3Hr)

3.3 Base Model Mapping

SYSTRA was supplied with background mapping of the existing road layout for the study area. This was used to code the basic network in terms of road alignments, lane widths, give way lines, etc.

3.4 Model Parameters

A number of model parameters were coded in line with SYSTRA's Microsimulation Consultancy Good Practice Guide:

- Visibility set to 30m on all relevant approaches to priority junctions.
- Look through applied to all short links adjacent to priority junctions and relevant links at signalised junctions.
- Gap acceptance (Lane Merge - 4 seconds; Lane Cross - 4 seconds; Path Cross - 3 seconds) at the default values at all locations but the following:
  - 1.5 second Lane Merge/Lane Cross applied on Petersfield Road approach at New Road/Park Road North roundabout to reflect observed behaviour

- Headway factor of 0.6 applied to the on slip merge links on the A27.
- Headway factor of 0.6 applied on Park Road North, northbound links on approach to the lane narrowing, north of Elm Lane.
- Headway factor of 0.6 applied to Petersfield Road approach at New Road/Park Road North roundabout
- Headway factor of 2.0 applied between Southbrook Avenue and Langstone Sailing club and between New Cut and West Lane , to reflect flow breakdown from courtesy behaviour associated with the minor junctions in these sections observed on the video survey
- Clear exit adherence applied to mainline movements between Southbrook Avenue and Langstone Sailing club and between New Cut and West Lane to reflect courtesy behaviour at the minor junctions in these sections observed on the video survey
- Hazard distance shortened at node 633 (Langstone Technology Park junction) to 52m, so southbound merge behaviour occurs after the bus layby

3.4.1 Vehicle Types

Five vehicle types are represented in the model;

- Car
- Light Goods Vehicle (LGV)
- Other Goods Vehicle 1 (OGV1)
- Other Goods Vehicle 2 (OGV2)

- Single Decker Bus – Fixed Route

Interrogation of the survey data and comparison with the junction count video footage showed that the majority of surveyed Public Service Vehicles (PSVs) were the fixed route Stagecoach buses and not private coaches. To avoid double counting of PSVs, coaches are not represented in the model.

Each vehicle type has individual dynamics, namely maximum speed and acceleration, which can be edited. During the calibration process no changes were made to the default settings. The top speeds applied to all vehicle types in the model are as follows:

- Car 100mph
- LGV 80mph
- OGV1 65mph
- OGV2 65mph
- Single Decker Bus 65mph

3.4.2 Link Characteristics

Routing within a Paramics model is foremost dependant on whether the roads on which a vehicle could travel are classified as either ‘major’ or ‘minor’. Figure 4 details the major and minor links.

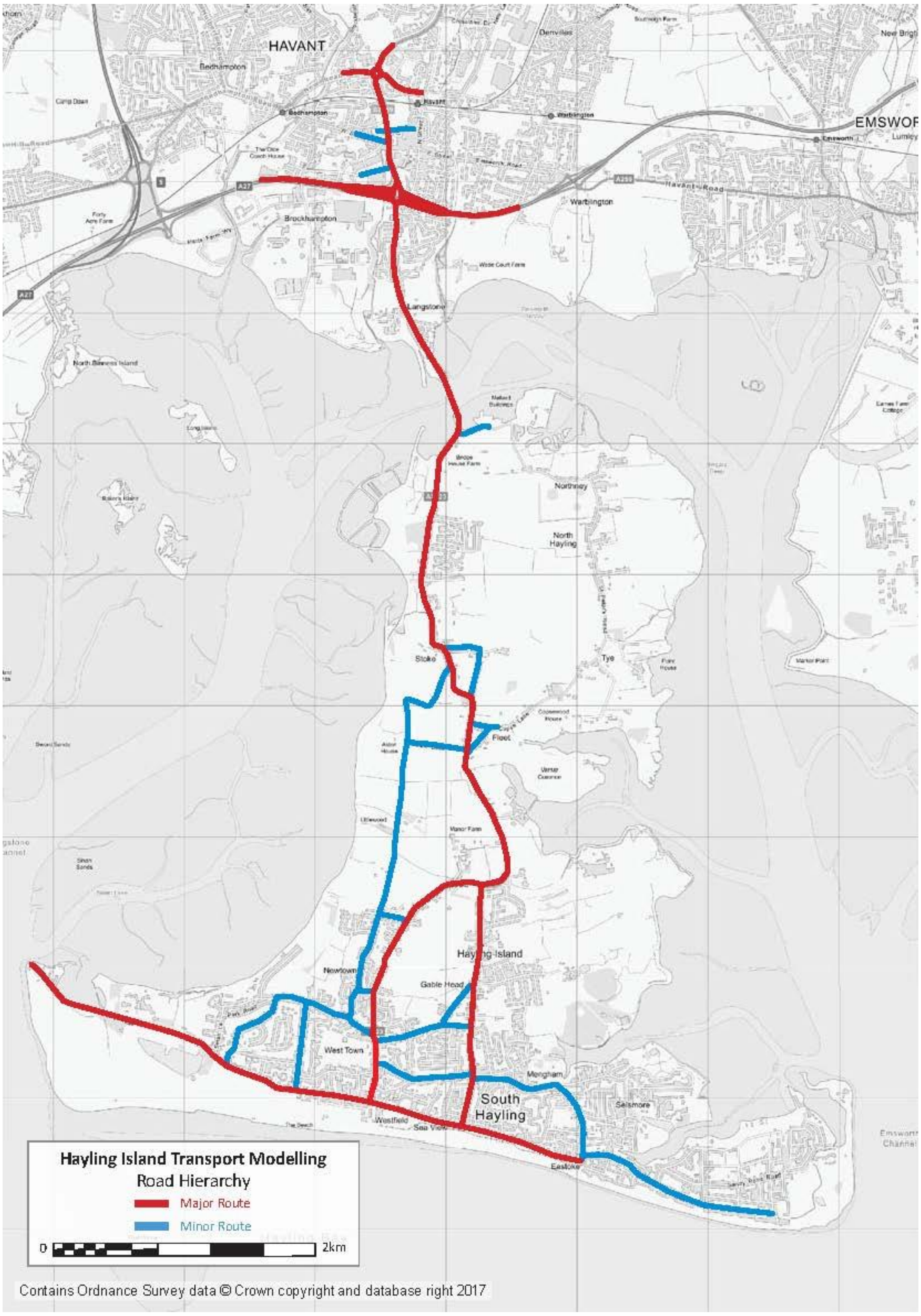

Figure 4. Link Hierarchy

3.5 Routing Parameters

3.5.1 Generalised Cost Equation

A Generalised Cost Equation (GCE) is used to determine the perceived cost of available routes within the model. Paramics Discovery uses the following GCE as a base cost for links:

$$GCE = A * t + 60 * B * d + C * p$$

Where:

- A= Time Coefficient
- t= Travel time in minutes
- B= Distance in minutes per mile
- d= Link length in miles
- C= Toll coefficient in minutes per monetary cost
- P= Toll price in monetary cost units

The route choice is not affected by any toll costs and therefore a toll cost coefficient was not applied to the GCE for this model.

For this study the GCE parameters were taken from the Strategic model (SRTM) which is being used to support the development of the base model and will also be utilised within the forecasting process. The Distance values were in kilometres, so the below values were converted to miles for use in the Paramics model. The GCE parameters were also supplied at a periodic level, AM, IP and PM, so GCE values were converted to a daily value by averaging across the three periods..

Individual vehicle types were given individual time and distance coefficients, detailed below:

- Car: A= 1.00, B=0.640
- LGV: A= 1.00, B= 0.980
- OGV1: A= 1.00. B= 3.481
- OGV2: A= 1.00. B= 3.481

3.5.2 Perturbation

Perturbation varies a vehicle's perception of the best route through the network. Perturbation of 5% was applied to all vehicle types.

3.5.3 Dynamic Feedback

Dynamic feedback has been enabled in the model, which allows familiar drivers to account for delays in their routing considerations. A feedback interval of 2 minutes and a feedback factor of 0.5 have been applied, in line with best practice.

3.5.4 Familiarity

The familiarity level affects the route a vehicle takes through the network, in conjunction with the Major and Minor road hierarchy. Familiar drivers see no difference in attractiveness between a major or minor road; unfamiliar drivers perceive a minor road to be less attractive than a major road. Familiarity is not strictly the "proportion of local drivers" but the proportion of drivers who will choose from all available routes (rat-runs or less attractive routes). These settings are consistent with those adopted in other models of a similar nature and are detailed below:

- Car & LGV 60%
- OGV1 and OGV2 10%

3.5.5 Cost Factors

Link Cost Factors, which are a multiplier of the basic route cost used to further refine the relative attractiveness of any given route, over and above the major/minor definition, were applied on particular links to better reflect local routing patterns.

- West Lane was increased to 1.2 due to its narrow width and tight/blind corners to discourage some traffic using it as an alternative route to head north/south as opposed to using the A3023.
- Daw Lane was increased to 1.3 to deter traffic from the north/south using it and to keep to West Lane.
- St Catherines Road was increased to 1.5 to discourage traffic using it as a rat run to the west of the island.
- Selsmore Road/Rails Lane was decreased to 0.9 to encourage some traffic from the east to use it as opposed to the Sea Front.

3.5.6 Defined Routes

Defined Routes are used in Paramics to remove the impact of perturbation, where alternate routes are available but not observed to be used. Several defined routes were included in the model to prevent unrealistic routes from being chosen by vehicles. Examples of these include through Elm Grove, to prevent northbound and southbound vehicles from routing around the Cherrywood Gardens/St Mary's Road triangle, and on Manor Road to prevent northbound and southbound vehicles from routing around Station Road/West Lane/Newtown Lane.

A list of the defined routes used in the model is shown in Table 2.

No.	Defined Route	Description
1	Elm Grove NB	prevents NB trips on Elm Grove from routeing via Cherrywood Gdns/St Mary's Rd
2	Elm Grove SB	prevents SB trips on Elm Grove from routeing via St Mary's Rd/Cherrywood Gdns
3	Manor Rd NB	prevents NB trips on Manor Rd from routeing via Station Rd/West Ln/Newton Ln
4	Manor Rd SB	prevents SB trips on Manor Rd from routeing via Newton Ln/West Ln/Station Rd
7	Yew Tree bypass NB	prevents NB trips on A3023 from routeing via Yew Tree Rd/Copse Ln
8	Yew Tree bypass SB	prevents SB trips on A3023 from routeing via Copse Ln/Yew Tree Rd
9	Northwood bypass NB	prevents NB trips on A3023 from routeing via Castlemanse Ln/Northwood Ln
10	Northwood bypass SB	prevents SB trips on A3023 from routeing via Northwood Ln/Castlemanse Ln
11	Northwood bypass 2 NB	prevents NB trips from West Ln to A3023 from routeing via Castlemanse Ln/Northwood Ln
12	Northwood bypass 2 SB	prevents SB trips from West Ln to A3023 from routeing via Northwood Ln/Castlemanse Ln
13	Daw Lane NB	prevents NB trips from Daw Ln to A3023 from routeing via Yew Tree Rd/Copse Ln
14	Daw Lane SB	prevents SB trips from Daw Ln to A3023 from routeing via Copse Ln/Yew Tree Rd
15	A27 EB	keeps A27 EB trips on the mainline, will not use the slips
16	A27 WB	keeps A27 WB trips on the mainline, will not use the slips
17	avoid Beach Rd rbt 1	prevents NB trips emerging from side roads on the A3023 Manor Rd between Beachlands Rbt and Hollow Ln (including Hollow Ln) from routeing via the roundabout
18	avoid Beach Rd rbt 2	
19	avoid Beach Rd rbt 3	
20	avoid Beach Rd rbt 4	
21	avoid A27 Rbt 1	prevents SB trips emerging from Langstone Technology Park, Woodbury Ave and Langbrook Cl from routeing via the A27 roundabout
22	avoid A27 Rbt 2	
23	avoid A27 Rbt 3	
24	West Lane NB	prevents NB trips from Station Rd west to West Ln from routeing via Station Rd east/Manor Rd/Newton Ln
25	West Lane SB	prevents SB trips from West Ln to Station Rd west from routeing via Newton Ln/Manor Rd/Station Rd east
26	avoid West Lane NB	to better calibrate to observed turn counts, trips to island north/mainland travelling NB on A3023 Manor Rd south of Station Rd will stick to A3023 and avoid West Ln
27	avoid West Lane SB	to better calibrate to observed turn counts, trips SB from island north/mainland and wishing to travel SB on A3023 Manor Rd south of Station Rd (to reach destination) will stick to A3023 and avoid West Ln
28	NB Manor Rd strategic trips 1	to better calibrate to observed turn counts, trips to island north/mainland travelling NB on A3023 Manor Rd south of Hollow Ln will stick to A3023 and avoid St Mary's Rd
29	NB Manor Rd strategic trips 2	to better calibrate to observed turn counts, trips to island north/mainland emerging from Hollow Ln west will stick to A3023 and avoid St Mary's Rd
30	NB Church Rd strategic trips 1	to better calibrate to observed turn counts, trips to island north/mainland travelling NB on Sea Grove Ave/Elm Grove or emerging from Hollow Ln east will not route via Cherrywood Gdns/St Mary's Rd
31	NB Church Rd strategic trips 2	
32	NB Church Rd strategic trips 3	
33	SB strategic trips to SE avoid West Ln	to better calibrate to observed turn counts, trips from island north/mainland to destinations south east of Sea Grove Ave/ Selsmore Rd junction will stick to A3023 and avoid West Ln

Table 2. List of Defined Routes

3.6 Hazard Overrides

The hazard override function in Discovery allows the user to alter lane usage of vehicles on approach to network hazards to better reflect observed behaviour.

Hazard overrides were used for southbound trips through the A27 interchange roundabout to ensure southbound trips utilised lane 1 and lane 2 of the circulating lanes.

3.7 Public Transport Coding

Paramics Discovery represents fixed route service buses through the definition of network bus stops, service routes, service timetables and bus dwell times.

The location of the bus stops in the model area was obtained using the NAPTAN dataset. Google Maps and Google Street View were used to check all the bus stops in the model and correct if necessary.

Service routes and associated timetables were extracted from the Traveline dataset and coded into the model.

In the model, buses are coded to dwell at stops allowing passengers to board and alight. A dwell time of 20s has been applied to all services stopping at all bus stops in the model.

3.8 Signalised Junctions

Signal timing data was provided by HBC for all signal junctions in the study area. This information was used to define the initial signal timings and intergreens for input into the model. However, during the model calibration these timings were refined to reflect observed timings from the traffic survey videos where required.

3.9 School Patrol Crossings

HBC provided a list of active school patrol crossing locations throughout the study area and their corresponding operational times. Only two locations were within the model boundary: Elm Grove at the Library and Havant Road adjacent to Mill Rythe Junior School (Sunshine Corner). For each location, the pedestrian phase has been coded to be called once every 90s while the crossing is in operation (08:15 – 09:00/15:00 – 15:45 and 08:10 – 09:10/14:45 – 15:45 respectively). As the crossings are at uncontrolled locations, temporary signals have been implemented to stop traffic during operational times only.

4. TRIP MATRIX DEVELOPMENT

4.1 Background

This section outlines the data sources and methodology employed in the development of the traffic demand matrices for the Hayling Island Base model.

The trip matrix for all zone to zone movements was developed using a Matrix Estimation (ME) process. This involved developing a prior (starter) matrix, a routeing file and a survey file for each modelled period for use in the Discovery built in ME module.

4.2 Data Sources

The ME process relied on the following data sources, each of which is discussed in more detail, as follows:

- Turn count and link flow dataset for the study area
- Cordon matrix for the study area from the Strategic model (SRTM)
- 2011 Census car ownership data at Output Area level, for the study area

4.3 Interface with SRTM

Consistency between SRTM and the Hayling Island model was maintained throughout the model development process in the following ways:

- Zoning System (the Paramics zoning system is based on a disaggregation of the SRTM zoning system, discussed below)
- Routeing parameters (discussed in Section 3.5.1)
- Matrix levels

4.4 Zoning System

Zones are used to control the release and destination of vehicles in the network. The network trip matrix is composed of the volume of vehicles travelling from zone to zone.

Zone portals can provide additional control over the release and destination of vehicles in zones which contain multiple access points, effectively producing a sub-zoning system.

The SRTM sub area zoning system for the study area was provided as a shapefile and loaded into MapInfo along with the 2011 Census Output Areas. A Paramics zoning system was developed by grouping relevant Output Areas within each SRTM zone, based on land use, proximity to links for loading onto the network or if an Output Area directly loaded onto a surveyed junction. There were also “external” zones identified at the cordon points around the study area, which are not associated with any Output Areas. The SRTM sub area zone system consisted of 16 zones. This disaggregation of the SRTM zones resulted in 54 Paramics zones in the model. A total of 97 zone portals were used to reflect the vehicle loading points within each zone, the proportion of each zone portal was determined based on an estimation of housing density or land use using Google aerial images.

4.5 Prior Matrix Development

A peak hour cordon matrix from SRTM was provided for the study area by time period and vehicle matrix level with the equivalent peak hour to peak period factors. This cordon matrix was expanded to peak period and disaggregated to the Paramics model zoning system for use as the start point for matrix development using the expansion factors provided by SYSTRA, detailed in Table 3.

Period	Factor
AM	2.45
IP	6.00
PM	2.63

Table 3. SRTM Peak Hour to Peak Period Factors

Three matrix levels were used to reflect the traffic demand in the model;

- Matrix 1: Car
- Matrix 2: LGV
- Matrix 3: OGV1 and OGV2

The split between OGV1 and OGV2 in Matrix 3 was calculated from turn count data collected during the survey programme. The proportions are shown in Table 4.

	Veh Type	AM	IP	PM
Matrix 1	Car	100%	100%	100%
Matrix 2	LGV	100%	100%	100%
Matrix 3	OGV 1	81%	82%	84%
	OGV 2	19%	18%	16%

Table 4. Vehicle Type Proportions

Each SRTM zone is associated with one or several Paramics zones (which were determined by aggregating Census Output Areas). For each SRTM zone, the associated Paramics zones were given a proportional value based on the 2011 Census Output Area Data relating to car ownership. These proportions then determined the proportion of the relevant SRTM zone to zone movement which was attributed to each Paramics zone to zone movement. By proportioning the SRTM zone trips, this allowed the SRTM cordon matrices to be "split out" to Paramics zone level by vehicle matrix and time period.

Where surveyed junction turn counts highlighted known zone to zone movements, these movements were inserted directly into the matrix by vehicle matrix and time period.

A number of turn count survey sites allowed zonal trip ends to be defined. Where this was possible the disaggregated matrix was adjusted to match the trip end totals. Comparison of surveyed trip ends and prior matrix zone totals showed that the existing totals for many of the zone origins or destinations as defined by SRTM or disaggregation of the SRTM matrix did not match the surveyed values. Generally the SRTM zone totals for zones on the mainland were too high and trips between zones on the island were underrepresented. Entire zone rows or columns were adjusted within the prior proportionally to meet the trip ends while maintaining the original SRTM distribution.

4.6 Matrix Estimation

When the prior was developed as far as possible, it was applied to the Paramics model to generate routeing information for each period. The output of this process consists of a set of routing PIJA files which estimate the proportion of trips travelling from points A to B that are theoretically assigned to each link and turn in the model.

The routeing files, survey information (turn count totals by period and matrix level), and prior were applied to the ME module in Paramics. ME was carried out with five iterations and the new demand files generated were assigned to the model and calibration checks undertaken.

The ME process continued, with further refinement to the prior and new routeing information collected each time. The ME process was deemed complete once satisfactory demand files were achieved for each period, based on consideration of the calibration checks.

The final matrix totals for each matrix level in each period are shown in Table 5.

	AM	IP	PM
Matrix 1	27,728	57,025	32,592
Matrix 2	3,691	7,167	3,832
Matrix 3	1,536	2,772	1,092
Total	32,955	66,963	37,516

Table 5. Matrix Totals (Vehs)

4.7 Traffic Demand Profiling

Paramics Discovery uses profiles to control the release of vehicles onto the network. Profiles may be specified by vehicle type for individual movements or general movements to/from zones. Each profile specifies the proportion of the total demand for the associated movements to be released in each 5min interval.

The observed turn count data was used to develop 70 profiles for the model. Profiles were developed for 'all vehicles' and for each modelled period.

The breakdown of the 70 profiles developed is as follows:

- 21 'From Zone' profiles applied to the AM demand
- 1 general AM 'mainland' profile
- 1 general AM 'island' profile
- 1 general AM 'mainland to island' profile
- 21 'From Zone' profiles applied to the IP demand
- 1 general IP 'mainland' profile
- 1 general IP 'island' profile
- 21 'From Zone' profiles applied to the PM demand
- 1 general PM 'mainland' profile
- 1 general PM 'island' profile

A general profile comprises an average of all of the surveyed turn counts in each 5min interval. General profiles were assigned to zones that are not directly related to a surveyed junction or where data is missing. A southbound "mainland to island" hourly profile issue was highlighted as a requirement during the matrix development so an extra profile was developed for the AM only to address this.

5. MODEL CALIBRATION AND VALIDATION

5.1 Introduction

The calibration process involves checking the network description, demand matrices, model inputs, and parameters to ensure the model achieves a satisfactory representation of traffic flows and conditions.

To determine whether the calibration is acceptable it is important to ensure that the model is fit for the purpose of the study, that decision makers understand the quality of the information with which they are working, and that inherent uncertainties are taken into account when reaching decisions.

The calibration of the model was undertaken by comparing modelled turn counts to the observed data set.

The guidelines set out in *WebTAG Unit M3.1* and the *Design Manual for Roads and Bridges (DMRB), Vol. 12 Section 2 Part 1)* have been used to undertake the calibration of the model. These guidelines are based on the comparison of modelled data to an independent set of data not used to develop the model, however, all available turn count data was used during the model calibration process, therefore, comparisons of the modelled turn counts cannot be considered a completely independent check. Comparisons are presented to indicate the degree of calibration of the model.

5.2 Base Model Calibration

Default stop line positions were altered where relevant throughout the model to better represent vehicle behaviour through junctions or along roads with on-street parking. Comparisons were made between survey videos provided and the model to ensure that the general behaviour of traffic reflected on site conditions.

Initial journey time comparisons showed that, in general, most modelled journey times were fast compared to those observed. This is not surprising, given the nature of the road network in the study area, as there are many network features such as parked vehicles, driveways and narrow hedged rural roads whose particular behavioural aspects are not explicitly modelled. In consideration of this, link speeds across the model were lowered by 15% from the signed speed limit to better reflect observed journey times.

5.3 Turn Count Calibration

Detailed comparisons of observed and modelled turn counts occurred throughout the model development process. Comparisons were made on both a periodic and hourly basis to ensure both the total demand and variation within the modelled time periods were robust.

The GEH statistic has been used to compare modelled and observed flows and is defined as:

$$GEH = \sqrt{(M - O)^2 / (0.5 \times (M + O))}$$

Where:
M = modelled flow
O = observed flow

The guidelines set out in *WebTag* and *DMRB* state that 85% of individual hourly flows, in this case turn counts, should have a GEH of less than 5 in order for a model to be considered acceptable.

Table 6 below shows the percentage of turn counts which achieve a GEH value of less than 3, 5 (the guidance value) and 7 in the AM and IP periods. In total, 252 turn count comparisons were made.

Period	Time (HH:MM)	Eligible Comparisons	GEH < 3 %	GEH < 5 %	GEH < 7 %
AM	07:00 - 08:00	252	83%	94%	98%
	08:00 - 09:00	252	79%	92%	96%
	09:00 - 10:00	252	75%	91%	99%
IP	10:00 - 11:00	252	83%	96%	99%
	11:00 - 12:00	252	86%	96%	98%
	12:00 - 13:00	252	87%	97%	99%
	13:00 - 14:00	252	89%	97%	99%
	14:00 - 15:00	252	85%	96%	99%
	15:00 - 16:00	252	74%	95%	100%
PM	16:00 - 17:00	252	80%	94%	99%
	17:00 - 18:00	252	76%	94%	98%
	18:00 - 19:00	252	81%	98%	99%

Table 6. Turn Count Comparison

The table shows that in all modelled hours, the model meets the *WebTAG* and *DMRB* criteria, with over 90% of the eligible comparisons having a GEH less than 5, and over 74% of the eligible comparisons having a GEH less than 3.

5.4 Journey Time Validation

Four journey routes were coded into the model to reflect the moving observer journey time surveys undertaken (Routes 1 and 2) and the Bluetooth journey time data provided by HBC (Routes 3 and 4), as shown in Figure 2. The model records journey times for vehicles completing these routes.

- Route 1: Beachlands Roundabout to Mill Rythe Roundabout via A3023 Manor Road, northbound and southbound
- Route 2: Sea Front/Sea Grove Avenue to Mill Rythe Roundabout via Church Road/Elm Grove, northbound and southbound
- Route 3: A3023 Woodbury Avenue to Mill Rythe Junior School via A3023, northbound and southbound
- Route 4: A3023 Woodbury Avenue to Brights Lane via West Lane, northbound and southbound

These datasets allow for an independent data validation between observed and modelled journey times. Comparison of the modelled journey times against the observed dataset has been made based on guidelines in *WebTAG* and *DMRB*. The criteria states that modelled journey times must be within the greater of 15% or 1 minute of the observed time. The journey time comparison for Routes 1 – 4 are detailed in Table 7 to Table 10.

Route	Direction	Hour	Observed (Ave)	Modelled (Ave)	Difference (mm:ss)	%	Meets WebTAG Criteria?
Route 1	NBD	7:00 AM	02:37	02:54	-00:17	-11%	✓
		8:00 AM	02:39	03:04	-00:25	-16%	✓
		9:00 AM	02:53	02:38	00:15	9%	✓
		11:00 AM	02:52	02:32	00:19	11%	✓
		12:00 PM	02:53	02:30	00:23	13%	✓
		1:00 PM	02:44	02:32	00:13	8%	✓
		4:00 PM	02:51	02:28	00:22	13%	✓
		5:00 PM	02:48	02:28	00:20	12%	✓
		6:00 PM	02:47	02:29	00:18	11%	✓
Route 1	SBD	7:00 AM	02:35	02:34	00:01	1%	✓
		8:00 AM	02:43	02:25	00:18	11%	✓
		9:00 AM	02:53	02:33	00:20	11%	✓
		11:00 AM	02:58	02:33	00:25	14%	✓
		12:00 PM	02:51	02:36	00:15	9%	✓
		1:00 PM	02:45	02:35	00:10	6%	✓
		4:00 PM	02:48	02:26	00:22	13%	✓
		5:00 PM	02:46	02:32	00:15	9%	✓
		6:00 PM	02:49	02:34	00:14	9%	✓

Table 7. Route 1 Journey Time Comparison

Route	Direction	Hour	Observed (Ave)	Modelled (Ave)	Difference (mm:ss)	%	Meets WebTAG Criteria?
Route 2	NBD	7:00 AM	02:44	02:40	00:04	2%	✓
		8:00 AM	03:38	02:48	00:49	23%	✓
		9:00 AM	02:54	02:39	00:15	9%	✓
		11:00 AM	03:06	02:39	00:28	15%	✓
		12:00 PM	03:00	02:38	00:21	12%	✓
		1:00 PM	02:53	02:38	00:15	9%	✓
		4:00 PM	02:51	02:38	00:13	7%	✓
		5:00 PM	02:48	02:38	00:10	6%	✓
		6:00 PM	02:39	02:36	00:03	2%	✓
Route 2	SBD	7:00 AM	02:51	02:40	00:11	6%	✓
		8:00 AM	03:06	02:47	00:18	10%	✓
		9:00 AM	03:09	02:41	00:27	15%	✓
		11:00 AM	03:06	02:44	00:22	12%	✓
		12:00 PM	03:18	02:43	00:35	17%	✓
		1:00 PM	02:57	02:44	00:13	7%	✓
		4:00 PM	03:02	02:47	00:15	8%	✓
		5:00 PM	03:05	02:46	00:19	10%	✓
		6:00 PM	02:51	02:41	00:10	6%	✓

Table 8. Route 2 Journey Time Comparison

Route	Direction	Hour	Observed (Ave)	Modelled (Ave)	Difference (mm:ss)	%	Meets WebTAG Criteria?
Route 3	NBD	7:00 AM	07:20	07:35	-00:15	-3%	✓
		8:00 AM	08:05	07:59	00:06	1%	✓
		9:00 AM	07:14	07:15	-00:02	0%	✓
		11:00 AM	07:21	07:09	00:11	3%	✓
		12:00 PM	07:13	07:13	-00:00	0%	✓
		1:00 PM	07:04	07:08	-00:04	-1%	✓
		4:00 PM	07:30	07:06	00:23	5%	✓
		5:00 PM	06:57	07:15	-00:18	-4%	✓
		6:00 PM	06:48	06:57	-00:09	-2%	✓
Route 3	SBD	7:00 AM	06:17	07:02	-00:45	-12%	✓
		8:00 AM	06:32	07:08	-00:36	-9%	✓
		9:00 AM	06:39	07:01	-00:22	-6%	✓
		11:00 AM	07:10	07:07	00:03	1%	✓
		12:00 PM	07:43	07:08	00:35	8%	✓
		1:00 PM	07:27	07:10	00:17	4%	✓
		4:00 PM	08:09	07:32	00:38	8%	✓
		5:00 PM	08:41	07:56	00:45	9%	✓
		6:00 PM	07:26	07:13	00:13	3%	✓

Table 9. Route 3 Journey Time Comparison

Route	Direction	Hour	Observed (Ave)	Modelled (Ave)	Difference (mm:ss)	%	Meets WebTAG Criteria?
Route 4	NBD	7:00 AM	07:34	07:44	-00:09	-2%	✓
		8:00 AM	08:29	08:09	00:21	4%	✓
		9:00 AM	07:38	07:21	00:17	4%	✓
		11:00 AM	07:24	07:11	00:13	3%	✓
		12:00 PM	07:21	07:16	00:05	1%	✓
		1:00 PM	07:24	07:10	00:14	3%	✓
		4:00 PM	07:28	07:06	00:22	5%	✓
		5:00 PM	07:13	07:12	00:02	0%	✓
		6:00 PM	07:04	06:59	00:06	1%	✓
Route 4	SBD	7:00 AM	06:51	07:02	-00:11	-3%	✓
		8:00 AM	06:50	07:12	-00:21	-5%	✓
		9:00 AM	07:03	07:00	00:03	1%	✓
		11:00 AM	07:42	07:03	00:39	8%	✓
		12:00 PM	07:40	07:04	00:36	8%	✓
		1:00 PM	07:36	07:04	00:33	7%	✓
		4:00 PM	08:05	07:27	00:38	8%	✓
		5:00 PM	08:59	07:48	01:11	13%	✓
		6:00 PM	07:42	07:06	00:36	8%	✓

Table 10. Route 4 Journey Time Comparison

The journey time results for Routes 1 and 2 in South Hayling show good validation for all periods. It is acknowledged that though the criteria is met, many of the modelled journey times are approaching and some are over 15% faster than the observed. The modelled journey times are likely faster because Paramics does not represent random driving characteristics, such as parking manoeuvres, which can cause delays on street. Also, the journey time videos often showed traffic in front of the moving observer vehicle speeding away, indicating the survey vehicle was not keeping pace with general traffic. It is generally the case with moving observer surveys that drivers are instructed not to break the speed limit, and so it is likely that the observed journey times are slower than general traffic on these routes.

Routes 3 and 4 are based on Bluetooth data. Bluetooth surveys have some drawbacks in that they cannot determine what occurs on a vehicle’s entire journey, only the start and end point. A journey may have included a stop at a service station (there are two along the A3023) or any other establishment along the route, or a delay due to parked vehicles/slower vehicles/slower cyclists, increasing the journey time. No video data is available to review why for certain hours of the day the journey takes longer. Considering the above commentary, which suggests a degree of uncertainty in the observed journey times resulting from the Bluetooth surveys, the modelled journey time results for Bluetooth Routes 3 and 4 are generally a good match to the observed and all routes meet WebTAG criteria, though modelled times are generally faster. It can be noted that the modelled journey times are fairly consistent throughout the day for both routes and the observed times are fairly consistent too but tend to increase southbound in the PM period.

During the calibration it was noted that sections 1 and 3 of Routes 3 & 4 (Woodbury Ave to Ship Inn and New Cut to West Lane) both northbound and southbound tend to have faster modelled journey times than the observed. Following video survey reviews, it is noted that although this is a high flow traffic route there is seen to be a lot of courtesy 'give way' behaviour as Right turning vehicles and minor arm traffic are given priority when they have been waiting. To model this behaviour an increased headway factor (increased spacing between moving vehicles) was applied between Southbrook Avenue and Langstone Sailing club and between New Cut and West Lane in order to mimic traffic slowing down over these sections. In addition to this, clear exit adherence was applied to major priority traffic on junctions along these sections, this is a feature of Paramics Discovery that replicates some of the courtesy 'give way' behaviour observed.

The sectional journey times allow for further analysis of where along the route modelled journey times start to differ from the observed. Time/Distance graphs are presented below to illustrate the full journey routes for the southbound direction at 17:00.

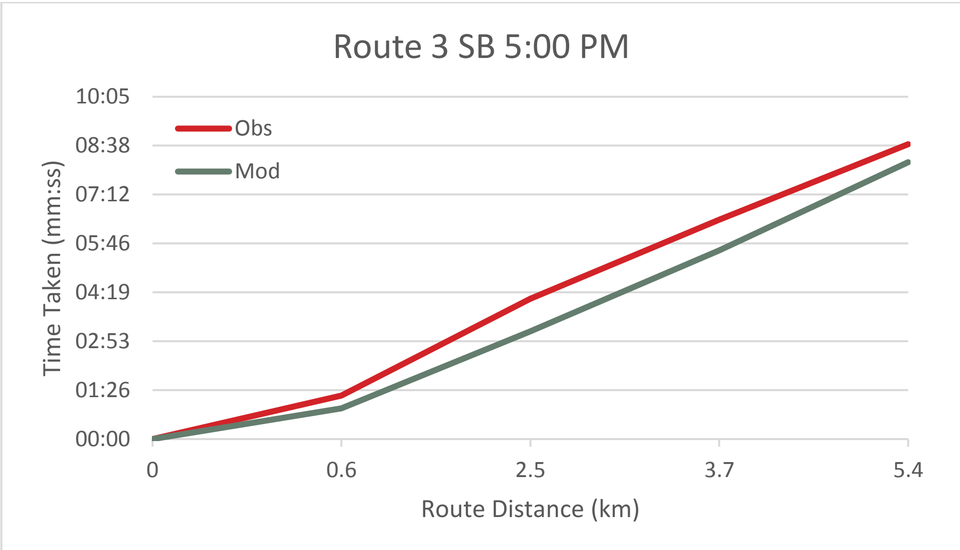

Figure 5. Time/Distance Plot Route 3 Sbd 17:00

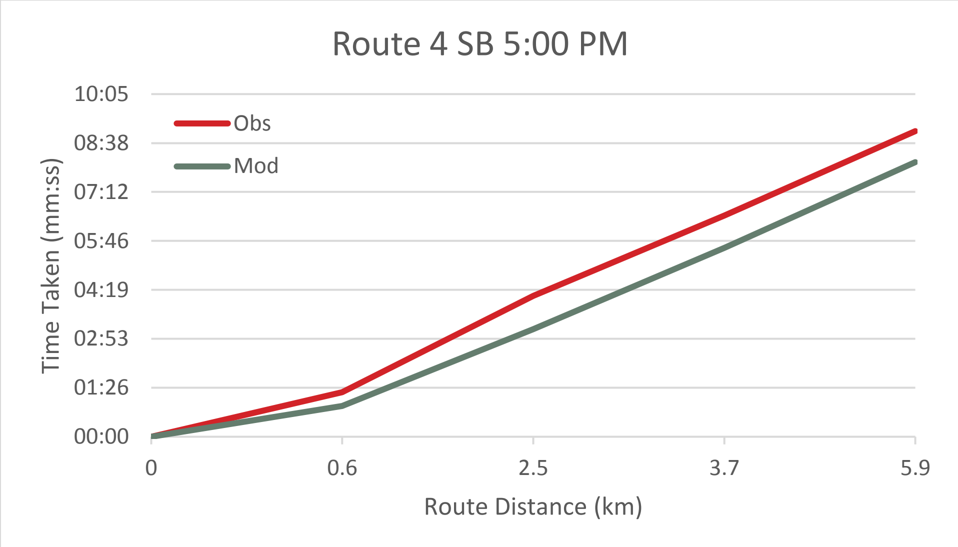

Figure 6. Time/Distance Plot Route 4 Sbd 17:00

The graphs illustrate that though these routes meet WebTAG criteria for 17:00. Figure 5 and Figure 6 show that sections 1 and 2 of these routes are where the differences occur. The combination of headway factors and clear exit adherence detailed in section 3.4 has been applied in order to minimise these differences.

5.5 Queue Length Comparison

There is no set criteria against which queue lengths can be validated due to the subjectivity of measuring queue lengths during surveys. The queue length data was analysed and only five of the nine survey sites showed significant queues worthy for comparison. These were the four junctions in Havant and the Selsmore Road arm of its junction with Sea Grove Avenue. Comparisons for these five surveyed junctions of observed versus modelled queue lengths are available to view within the accompanying spreadsheet (*Hayling Island queue comparison.xlsx*). The results of the comparisons showed in the majority of cases the model corresponds well to the surveyed queue lengths.

An example of the comparisons on the Selsmore Road approach is presented, as follows, to demonstrate that the model broadly corresponds to observed queue lengths.

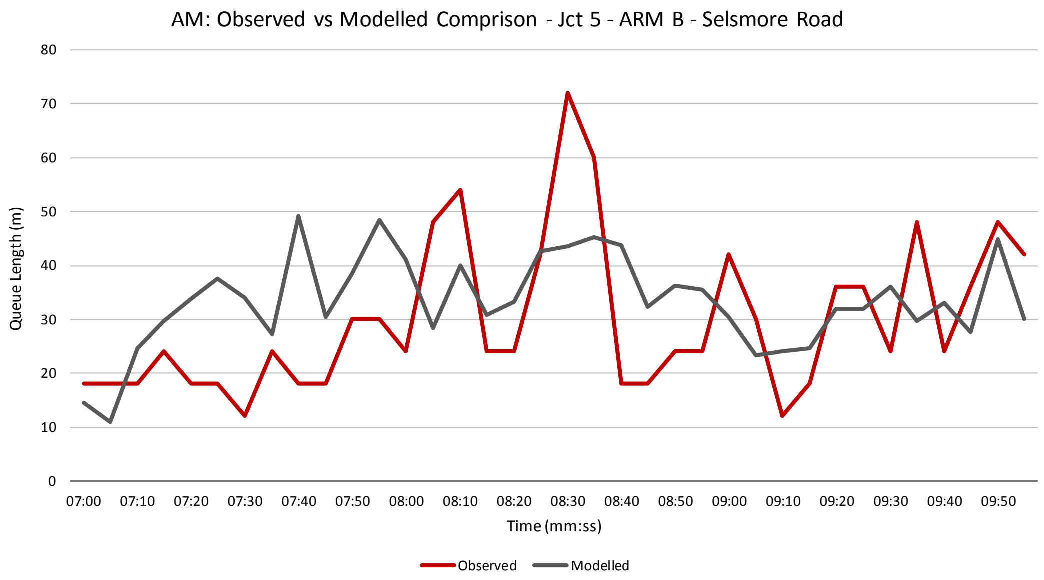

Figure 7. Queue Length Comparison – Selsmore Road, AM

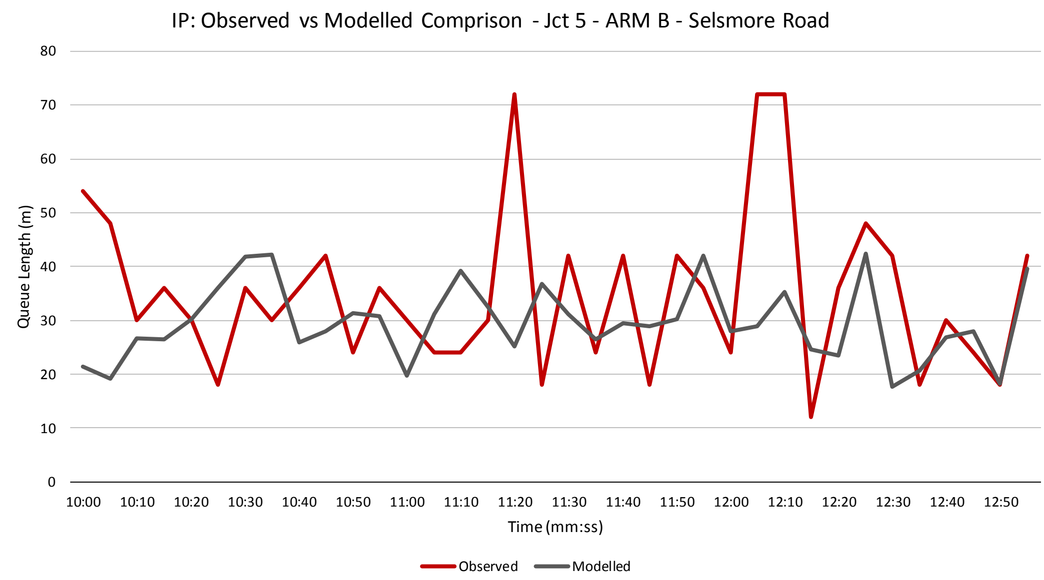

Figure 8. Queue Length Comparison – Selsmore Road, IP 10:00 – 13:00

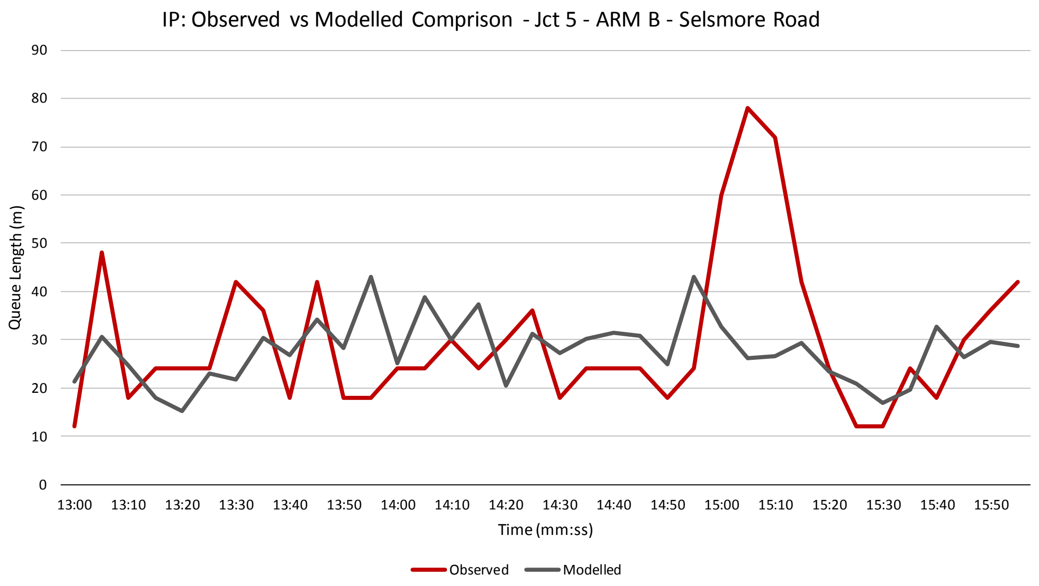

Figure 9. Queue Length Comparison – Selsmore Road, IP 13:00 - 16:00

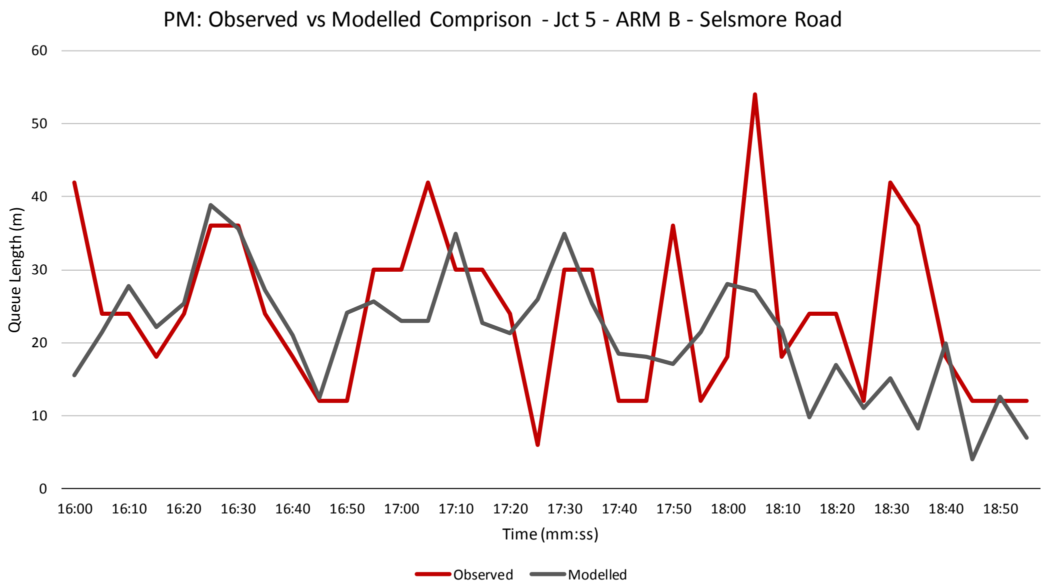

Figure 10. Queue Length Comparison – Selsmore Road, PM

The AM and PM comparisons show modelled queue lengths are generally in line with the observed, with peaks and troughs of queues building and dissipating represented well (around 8:30 and 16:30-17:00). In the IP, the modelled queue lengths around 15:00–15:20 are much shorter than observed, indicating the "General" profile used for most island zones (due to lack of survey data for on island zone loading locations) does not reflect the peak in "school run" traffic.

6. SUMMARY

6.1 Summary

SYSTRA has developed a Paramics Discovery microsimulation model of Hayling Island and the main route into Havant. The purpose of the model is to provide a platform for the testing of future Local Plan developments in the area.

The model represents three time periods:

- AM 07:00 - 10:00
- IP 10:00 – 16:00
- PM 16:00 – 19:00

Traffic surveys were undertaken in September 2017. This data was utilised to develop the model along with existing traffic data supplied by HBC.

Traffic demands for the model have been developed based on sub area matrices provided from the wide area SRTM, and refined using the survey dataset.

The model has been calibrated based on *WebTAG* and *DMRB* guidance and the *Microsimulation Consultancy Good Practice Guide.*

The model reflects the available count data very well in all periods. It meets the *WebTAG* and *DMRB* criteria on all journey time paths and the model was calibrated to provide a realistic representation of queueing, routing and vehicle behaviour on the network as observed during the survey programme.

SYSTRA provides advice on transport, to central, regional and local government, agencies, developers, operators and financiers.

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