ADUR DISTRICT COUNCIL

ADUR LOCAL PLAN AND SHOREHAM HARBOUR

TRANSPORT STUDY

REPORT ADDENDUM

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Context and Purpose of Study

The main study and this addendum consider the transport impacts of strategic residential and commercial site allocations within Adur and Brighton & Hove in 2028 to inform the preparation of the Adur District Council Local Plan and the Shoreham Harbour Joint Area Action Plan (JAAP) that covers development in both Adur and Brighton & Hove. They follow on from a previous study by Parsons Brinckerhoff for Adur District Council (Adur Core Strategy and Shoreham Harbour Transport Study 2011) which tested strategic locations for development, and consider a number of further strategic housing and employment developments in Adur to assist with setting out the spatial and strategic vision for the district.

The purpose of the study is to identify the highway impacts of the site allocations and to explore appropriate mitigation measures. The study is important because the Council needs to ensure that impacts of future population and employment growth do not adversely affect the transport network within and around the district. The main activities in this study include:

- Produce a new 2028 reference case model using updated development information;
- Forecast travel demand from each of the proposed scenario site allocations;
- Identify transport impacts from site allocations in different scenarios on the local and strategic network, focusing on selected key junctions;
- Understand anticipated sustainable travel initiatives and recommend appropriate highway mitigation measures;
- Assess transport impacts from the above interventions; and
- Assess indicative costs of the proposed highway mitigation measures.

This addendum considers an additional development scenario. This additional scenario (referred to as Scenario B2) is a variant of Scenario B considered by the main report and takes account of the evolution in the development strategy for the Adur district. The principal changes incorporated into Scenario B2 are:

- The Hasler (West Beach) site has been excluded from the development scenario;
- Revised access arrangements for the West Sompting and Sompting North sites; and
- Highway improvements at the key junctions identified by the main report.

Scenario B2 represents the preferred strategy of Adur District Council for the submission Local Plan.

The impact of the site allocations and mitigation proposals were considered across the whole network in the main study. This addendum deals with the impacts across the network as a whole and at the following locations in particular:

- A27 / A283 Steyning Rd
- A259 Brighton Rd / A2025 South St
- A259 Brighton Rd / A283 Old Shoreham Rd

Summary of Modelling Results

The modelling revealed the following results:

- The reduced development allocation in Scenario B2 eases the expected traffic impact on the highway network compared with Scenario B. The demand reduction ensures that all the measures suggested for Scenario B remain effective in Scenario B2.
- Improvements in the journey time as a result of the mitigation are most noticeable at A27 / Grinstead lane junction, A27 / A283 Steyning Road junction and A259 / South Street junction. This results in improved journey times on average being no worse off than prior to the development along the A259 (eastbound and westbound), the A27 westbound A283 northbound and southbound and South Street / Grinstead Lane northbound and southbound.
- As a result of the reduced impact at the Steyning Road junction under Scenario B2, it has also been possible to reduce the cost of the mitigation at this junction by widening only the western side of the circulating carriageway, rather than widening around the whole of the junction.

Conclusions and Recommendations

The findings of the study indicate that overall the levels of development promoted through the preferred strategy for the Adur Local Plan and the emerging Shoreham Harbour JAAP can be accommodated in terms of their traffic impacts.

Proposed Junction Mitigation Summary

Junction	Main Report Proposal	Addendum Revised Proposal
1. A27 / Grinstead Lane (North Lancing Roundabout)	Replace existing roundabout with a signalised junction including a left turn slip from the A27 and widen all approaches.	
2. A27 Sussex Pad	Allow ahead and left turning vehicles to use nearside lane of A27 in both directions rather than left turning only.	
3. A27 / A283 Steyning Rd Roundabout	Fully signalise roundabout with a three lane circulatory and widen A283 north entry and exit, and A283 south entry.	Fully signalise roundabout widening the west portion of the circulating carriageway to three lanes. Widen A283 north entry and exit, and A283 south entry.
4. A259 Brighton Rd / A283 Old Shoreham Rd	Expand the roundabout and increase capacity westbound from the A259 High Street entry.	Proposal unchanged.
5. A259 Brighton Rd / A2025 South St	Widen the A259 west approach and enlarge circulatory as appropriate.	Proposal unchanged.
6. A27 / Busticle Lane	Provide a two lane to one lane funnel on the Busticle Lane exit and allow the right-turning lane from Halewick Lane to be available for right-turning and straight-on traffic.	
7. A27 Shoreham Bypass / Hangleton Link dumbbell (2 junctions)	Convert both north and south roundabouts into signalised junctions with appropriate amendment to flares at entries; upgrade the eastbound merge to the A27 from Type A to Type C.	
8. A259 Brighton Road / Western Road	No mitigation required.	
9. A270 Upper Shoreham Road / B2167 Kingston Lane	No mitigation required.	
10. A27 Sompting Bypass / Upper Brighton Road	Move or remove the central island to the right of traffic entering the junction from Upper Brighton Road to allow a two-lane exit for this arm with the left lane for straight-on and right-turning traffic and the right lane for right-turning traffic only.	
11. A270 Old Shoreham Road / A293 Hangleton Link signalled junction	No mitigation required.	
12. A270 Old Shoreham Road / A2038 Hangleton Road / B2194 Carlton Terrace	No mitigation required.	
13. A259 Wellington Road / B2194 Station Road	Amend the signal control so the Basin Road signal stage is only activated in one cycle when there is demand from that entry.	

Note: Shaded cells indicate a junction that was not considered by the Addendum analysis.

1 INTRODUCTION

1.1 Objectives

1.1.1 Parsons Brinckerhoff was commissioned by Adur District Council to undertake a transport study to inform the preparation of the updated Adur District Local Plan as well as the Shoreham Harbour Transport Strategy for the Joint Area Action Plan (JAAP). Shoreham Harbour was designated as a Strategic Development Area and its geographical area covers sites in both Adur and Brighton & Hove. The redevelopment and regeneration of Shoreham Harbour is a key element of the Adur District Local Plan and also of the Brighton & Hove City Plan. The final report from the transport study was published by Parsons Brinckerhoff in August 2013.

1.1.2 This transport study followed on from a previous study by Parsons Brinckerhoff for Adur District Council (Adur Core Strategy and Shoreham Harbour Transport Study 2011) which tested a variety of housing and employment numbers at strategic locations for development, including Shoreham Harbour where various housing and employment totals (varying from 2,000 homes and 1,800 jobs in 2026 to 12,000 homes and 10,000 jobs in 2036) were examined. The findings of the study indicated that the Core Strategy development scenarios and lower totals at Shoreham Harbour above were generally supportable albeit in that form there would be some residual issues at the A27 North Lancing and A259 / A283 Shoreham High Street junctions after mitigation strategies are applied. The new study therefore followed on from the findings of the 2011 study and considered a number of further strategic housing and employment site allocations in Adur, the sustainable measures and infrastructure improvements required to mitigate the impacts of these site allocations and the requirements of West Sussex County Council and the Highways Agency.

1.1.3 This report addendum considers the impacts of a further scenario (named B2 for the purposes of this report) as an extension to the Adur Local Plan and Shoreham Harbour Transport Study (ASHTS), published by Parsons Brinckerhoff in August 2013. This additional scenario excludes the previously proposed Hasler development site and contains access changes for other sites along with proposed highway improvements (listed in full in 1.3.3). Scenario B2 represents the preferred strategy of Adur District Council for the submission Local Plan.

1.2 Scope and Methodology

1.2.1 This study addendum aims to assess the impact of the strategic site allocation scenario B2 for Adur on the transport network. Scenario B2 is a variant of Scenario B from the main report (with the changes detailed in 1.3.3 below) and has been tested to recommend appropriate mitigations where appropriate in the form of infrastructure and sustainable transport initiatives to 2028, to assess the improvement on the transport network as a result of the proposed mitigation, and to assess the approximate costs of the proposed highway mitigation.

1.2.2 A 2028 reference case was produced in this study, as documented in the main ASHTS report, by replacing part of the forecasted traffic growth with travel demand from individual developments in Adur and its neighbouring areas comprising known committed developments and background growth, but without the large site allocations examined as part of that study. This report, an addendum to the main report, covers a revised development scenario which represents the preferred strategy of Adur District Council for the submission Local Plan.

1.2.3 The impact on the transport network of each scenario has been assessed over the whole network as well as in detail for individual junctions. Note that the junctions assessed in detail fall within the jurisdiction of West Sussex County Council other than the A27 Trunk Road junction which is under the jurisdiction of the Highways Agency. As part of this addendum, the following three junctions have been assessed as being those where the impacts of the revised development scenario B2 are most likely to differ significantly from the previous development scenario B.

- A27 / A283 Steyning Rd
- A259 Brighton Rd / A283 Old Shoreham Rd
- A259 Brighton Rd / A2025 South St

1.2.4 Where the development scenarios are seen to have a significant impact on the highway network, mitigation measures have been examined.

1.3 Scenario Modelling

1.3.1 The latest Shoreham Harbour Transport Model (SHTM) was employed for this study addendum, which consists of a variable demand model[1] and a highway assignment model. Running the two models together allows travellers the choice between modes of transport and the impact of transport improvements may lead to travellers switching from one mode of transport to another in order to make the same journey. The resultant highway traffic and its routes through the road network are predicted using the highway assignment model.

1.3.2 SHTM has a base year of 2008 and a future forecast year of 2028. There are two modelled time periods:

- AM peak 08:00 – 09:00; and
- PM peak 17:00 – 18:00.

[1] The OmniTRANS demand model is only focused on the mode choice response of travellers.

1.3.3 This additional scenario is based on Scenario B reported in ASHTS. The differences in Scenario B2 from the previously reported Scenario B are detailed below. The changes applied are:

- Removal of trips to or from the zone representing the Hasler (West Beach) development;
- Revision to West Sompting site access to join the network on West Street west of Street Barn;
- Revision to Sompting North site access to connect onto Dankton Lane just to the north of its junction with Rectory Farm Road;
- Increased capacity for the left in / left out at the A27 end of Dankton Lane to replicate the provision of acceleration / deceleration lanes;
- Junction coding changes to reflect the proposed mitigation for the Tranche 2 junctions of ASHTS at A27 / Busticle Lane, A27 / Hangleton Link and A27 / Upper Brighton Road. No mitigation was proposed at the other Tranche 2 junctions, so no network model coding changes were required at those locations.

1.3.4 Scenario B2 contains a combination of demand changes (the removal of the strategic allocation at Hasler) and network revisions (from design refinement and the previous AHTS work). The 'with mitigation' highway assignment model only has been prepared for this Addendum. The junction modelling reported in Sections 2 & 4 uses the same traffic demand for both the 'with mitigation' and 'without mitigation' models as a 'without mitigation' highway assignment model was excluded from the scope of this Addendum by the highway authority, West Sussex County Council. Due to the congested nature of the highway network, the 'without mitigation' highway assignment model was expected to only display slight variations from the 'with mitigation' model and therefore not materially impact the conclusions drawn from the analysis presented in this Addendum.

1.4 Report Structure

1.4.1 The remainder of the report includes the following sections

- Section 2 – Modelling Results
- Section 3 – Mitigation Measures
- Section 4 – Modelling Results with Mitigation
- Section 5 – Conclusion

2 MODELLING RESULTS – WITHOUT MITIGATON MEASURES

2.1 Overview of Findings

2.1.1 Model runs using the Shoreham Harbour Transport Model have been undertaken for the development scenario detailed in Section 1.3. Results from the SHTM were then fed into analysis of individual junctions in the study area. This section gives an overview of findings from the analysis of Scenario B from the main report and Scenario B2 from this Addendum, covering the aspects set out below:

<u>Network Performance</u>

2.1.2 The network-wide impacts previously reported in ASHTS are very similar across the four development scenarios, with a similar impact expected from Scenario B2. A number of analyses were undertaken as summarised below.

- **Network Statistics** – the increase in travel demand in the development scenarios in comparison to the reference case is clear but not substantial. The largest network-wide demand increase for the main report scenarios was less than 3% which occurred in Scenario B. With the introduction of additional trips, all scenarios from both the main report and this addendum result in higher congestion on the network as expected, and this is demonstrated by increased queuing and slower average speeds. The lower demand in Scenario B2, compared to Scenario B following the removal of the Hasler (West Beach) development, leads to a lower level of queuing and delay than was forecast for Scenario B in ASHTS.
- **Traffic Flow Volumes** – there are extensive variations in traffic volume throughout the network between the reference case and development scenarios due to traffic rerouting. In the study area to the west of the A283, increases in traffic for all forecast scenarios from both the main report and this addendum compared to the reference case mainly focus on the network at close vicinity to the three strategic development sites, namely New Monks Farm, West Sompting and Sompting North. To the east of the A283, it is also clear that the increases in traffic primarily originate from Shoreham Harbour.
- **Journey Time** – the aforementioned variation in traffic flow volumes is clearly demonstrated in changes in journey time on seven routes[2] throughout the study area. On eastbound/westbound routes, clear increases can be observed on sections of the A27 and A259. On northbound/southbound routes, large increase in journey time was found on the A283 Steyning Road / Old Shoreham Road.

[2] Seven journey time routes have been defined and agreed during the course of this study. They are set out in Section 0.

- **Development select link analysis** – distribution of traffic to and from individual development sites was examined. It is found that traffic impacts from individual sites are modest with limited number of junctions receiving over 30 trips from a single development. However, the collective impacts from all developments are significant as demonstrated in the journey time analysis.

2.1.3 Details on the above analyses are presented in Section 2.2 of this addendum.

Junction Performance

2.1.4 Given the changes in development between Scenario B and Scenario B2 it was evident that the main differences in flow on the road network would be noticeable at three junctions as follows

- A27 / A283 Steyning Rd
- A259 Brighton Rd / A283 Old Shoreham Rd
- A259 Brighton Rd / A2025 South St

2.1.5 Results from the junction analysis corroborate the findings in the network wide assessment for both Scenario B, as previously reported in the main report, and Scenario B2 reported in Section 2.3 below. The performance of all three junctions either significantly deteriorated or remained over congested in the previous development scenarios in comparison to the reference case. Details of individual analysis are presented in Section 2.3.

Air Quality Management Areas (AQMA) and Sompting Conservation Areas

2.1.6 The flows thorough both AQMAs and the Sompting Conservation area are higher in the B2 scenario models than the reference case in the AM and PM peaks. However, there is little difference in the flow between development scenarios. As a result, the queue and delay results are worse for the scenarios than the reference case but are very similar between the different development scenarios. The modelling results for the three areas are replicated and discussed in more detail in Section 4.4 along with Figure 4.8, Figure 4.9 and Figure 4.10 showing the location of each.

2.1.7 The travel demand and network changes from Scenario B which were incorporated in Scenario B2 (as outlined in Section 1.3) broadly return the queues and delays to the reference case level in the morning peak hour and slightly improve performance in the afternoon peak hour.

2.1.8 The remainder of this chapter sets out details on the analysis that corroborates the findings presented above.

2.2 Network Performance

Network Statistics

2.2.1 The global network statistics for the AM and PM peak models are shown below in Table 2.1 and Table 2.2 respectively.

Table 2.1: AM Peak Global Model Statistics

Statistic	Reference	Scenario B
Transient Queues (pcu-hrs / hr)	9,411	9,804
Over Cap Queue (pcu-hrs / hr)	7,872	9,744
Total Travel Time (pcu-hrs / hr)	41,291	44,063
Total Travel Distance (pcu-km / hr)	1,506,724	1,529,091
Average Speed (kph)	36.5	34.7

Table 2.2: PM Peak Global Model Statistics

Statistic	Reference	Scenario B
Transient Queues (pcu-hrs / hr)	12,579	13,210
Over Cap Queue (pcu-hrs / hr)	22,131	23,383
Total Travel Time (pcu-hrs / hr)	63,837	66,349
Total Travel Distance (pcu-km / hr)	1,857,323	1,883,728
Average Speed (kph)	29.1	28.4

2.2.2 Two types of queue are reported; transient queues and over-capacity queues. Over capacity queues are 'permanent' queues at an over capacity junction during the modelled peak hours. Transient queues are those that dissipate, for example the vehicles queuing at a red traffic signal which clear during the next green phase. Any remaining queuing vehicles at the end of the green which queue for a second red phase represent an over capacity queue. Hence, an increase in transient queues, as noted in Scenario B compared to the reference case, is not necessarily significant. An increase in over-capacity queues is of greater concern since it indicates an increase in congestion on the network. The increase in over-capacity queues is considerable in all scenarios reported in ASHTS compared to the reference, but is highest in Scenario B which increases by 1,872 pcu-hrs/hr in the AM peak and 1,252 pcu-hrs/hr in the PM peak when compared to the reference case.

2.2.3 Within the main ASHTS report it can be seen that all previous ASHTS scenarios without mitigation resulted in an increase in queues, travel time and travel distance compared to the reference case, and a decrease in average speed. This indicated an increase in congestion on the network, as is expected with the introduction of additional trips.

Journey Time

2.2.4 Seven journey time routes have been defined in order to assess the performance of key routes through the study area. The routes are listed below and are shown on a map in Appendix E.

- Western Road / Busticle Lane
- South Street / Grinstead Lane
- A283 Old Shoreham Road / Steyning Road
- B2194 Station Road / A293
- A27
- A27/A270
- A259

2.2.5 All development scenarios in the ASHTS report showed increases in journey time on sections of the above seven routes, as summarised below:

- A283 northbound from Upper Shoreham Road in both peaks
- A283 southbound entire route in both peaks
- A27 Westbound between A283 Steyning Road and Grinstead Lane in the PM peak
- A27 Eastbound between Busticle Lane and Grinstead Lane in the AM peak
- A259 Westbound between South Street and Ham Road in the AM peak
- A259 Westbound between Station Road and Old Shoreham Road in the PM peak
- A259 Eastbound gradual increase on the entire route from South Street in the AM

2.2.6 Chapter 4 (Section 4.3) of this report presents journey time comparisons for the Reference Case compared to Scenarios B & B2 in more detail.

Development select link analysis

2.2.7 In common with the other development scenarios in the main report, select link analysis for the individual development sites has been undertaken to demonstrate the distribution of traffic to and from these developments across the highway network in the study area. Illustration plots for Scenario B2 in the morning and afternoon peak hours are presented in Appendix G of this report. Similar trip distribution patterns were observed on all other development scenarios.

2.2.8 It can be observed that traffic impacts from individual sites on the network are modest in isolation. There are a very limited number of junctions receiving over 30 trips from a single development. Where this does happen, the point of access (the first junction where the development traffic hits the main roads in the highway network) is usually either one of the five key junctions in Tranche 1 or the eight junctions in Tranche 2, as identified by the main report. It should be noted that the collective traffic impacts from all developments are still significant as demonstrated in the journey time and congestion hotspot analyses presented in the ASHTS report. Given that Scenario B2 is similar to the previous Scenario B, this addendum is only concerned with the differences between those two scenarios. Therefore the impacts at most junctions are not expected to differ from Scenario B and so results for these junctions are not reported.

2.3 Junction Performance

2.3.1 The following paragraphs discuss the differences at each of the three junctions identified for analysis in this B2 scenario. The results presented for each model are expressed in terms of mean maximum queues in passenger car units (PCU), average delays per vehicle and ratio of flow to capacity (RFC) or degree of saturation (DoS).

2.3.2 The 2028 junction turning flows are presented in Appendix D. The modelled junctions are:

- A27 / A283 Steyning Road
- A259 Brighton Road / A283 Old Shoreham Road
- A259 Brighton Road / A2025 South Street

2.3.3 The turning flows used for the Scenario B2 junction models have been taken from the 'with mitigation' highway assignment model as no 'without mitigation' highway assignment model was prepared for this Addendum. In each case, the 'without mitigation' junction modelling results presented in this section use the existing layout and capacity of the respective junction and then apply the various traffic demand levels from the presented Reference Case, Scenario B and Scenario B2.

2.3.4 **The detailed junction performance reported below is based upon existing junction capacity and layouts**. The effects of junction improvements are discussed later in Sections 3.2 and 4.2. The Reference Case and Scenario B results have been replicated from the main ASHTS report for comparison.

<u>A27 / A283 Steyning Road</u>

2.3.5 Table 2.3 below shows the results from the roundabout ARCADY model for the A27 / A283 Steyning Road roundabout in each scenario. Cases where the modelled traffic demand arriving at the junction exceeds 85% of the calculated capacity for each entry have been highlighted in red.

Table 2.3: ARCADY Results for A27 / A283 Steyning Road

	AM			PM		
	Queue (PCU)	Delay (min)	RFC	Queue (PCU)	Delay (min)	RFC
Reference Case						
A283 South	46.08	1.84	1.05	401.83	25.89	1.39
A283 North	73.79	2.17	1.08	23.88	0.75	0.98
A27 Eastbound Slips	0.42	0.04	0.30	0.59	0.07	0.37
A27 Westbound Slips	5.42	0.27	0.85	242.23	9.64	1.42
Scenario B Flows (no mitigation)						
A283 South	121.98	4.32	1.19	191.04	10.29	1.30
A283 North	69.57	2.54	1.06	51.02	1.38	1.03
A27 Eastbound Slips	0.56	0.05	0.36	0.83	0.08	0.46
A27 Westbound Slips	6.55	0.32	0.88	419.11	23.04	1.88
Scenario B2 Flows (no mitigation)						
A283 South	55.72	1.97	1.06	185.96	9.72	1.28
A283 North	144.29	4.74	1.16	70.57	1.81	1.06
A27 Eastbound Slips	0.61	0.05	0.38	0.46	0.09	0.32
A27 Westbound Slips	3.40	0.18	0.78	840.63	32.75	1.64

2.3.6 Both A283 approaches to the roundabout are expected to operate above capacity in both peak periods in all tested scenarios. The A27 Westbound Off-Slip entry to the roundabout is significantly over capacity in the evening peak period in Scenario B2.

<u>A259 Brighton Road / A283 Old Shoreham Road</u>

2.3.7 Table 2.4 below shows the results from the ARCADY model for the A259 Brighton Road / A283 Old Shoreham Road roundabout in each scenario. Cases where the modelled traffic demand arriving at the junction exceeds 85% of the calculated capacity for that entry have been highlighted in red.

Table 2.4: ARCADY Results for A259 Brighton Road / A283 Old Shoreham Road

	AM			PM		
	Queue (PCU)	Delay (min)	RFC	Queue (PCU)	Delay (min)	RFC
Reference Case						
A259 Westbound	223.25	13.04	1.41	424.62	39.58	1.73
A259 Eastbound	898.42	48.65	1.87	221.30	11.50	1.31
A283 Old Shoreham Rd	4.46	0.43	0.83	292.92	21.45	1.48
Scenario B Flows (no mitigation)						
A259 Westbound	288.54	16.86	1.48	510.82	44.07	1.81
A259 Eastbound	1220.37	68.53	2.14	222.29	11.55	1.31
A283 Old Shoreham Rd	12.17	0.96	0.95	270.37	18.89	1.44
Scenario B2 Flows (no mitigation)						
A259 Westbound	136.74	7.50	1.25	385.06	31.63	1.62
A259 Eastbound	950.34	55.12	1.96	128.45	6.89	1.20
A283 Old Shoreham Rd	3.28	0.31	0.77	241.29	17.36	1.43

2.3.8 Both A259 approaches to the roundabout are expected to operate significantly above capacity in both peak periods in all tested scenarios. The traffic demand on A283 Old Shoreham Road entry is expected to exceed the calculated capacity in the evening peak in Scenario B2. A significant reduction in anticipated traffic demand or increase in junction capacity will be required to ensure this junction operates within capacity in the modelled future years.

A259 Brighton Road / A2025 South Street

2.3.9 Table 2.5 below shows the results from the ARCADY model for the A259 Brighton Road / A2025 South Street roundabout in each scenario. Cases where the modelled traffic demand arriving at the junction exceeds 85% of the calculated capacity for that entry have been highlighted in red.

Table 2.5: ARCADY Results for A259 Brighton Road / A2025 South Street

	AM			PM		
	Queue (PCU)	Delay (min)	RFC	Queue (PCU)	Delay (min)	RFC
	Reference Case					
A259 Westbound	283.95	28.68	1.57	398.87	43.04	1.76
A259 Eastbound	220.98	13.01	1.33	100.61	6.04	1.18
A2025 South St	387.38	51.29	1.93	452.89	51.32	1.96
	Scenario B Flows (no mitigation)					
A259 Westbound	240.62	23.37	1.49	452.02	48.14	1.84
A259 Eastbound	312.17	19.11	1.43	101.85	6.13	1.18
A2025 South St	401.43	59.59	2.04	471.43	54.13	2.00
	Scenario B2 Flows (no mitigation)					
A259 Westbound	557.98	55.30	1.97	962.06	108.04	2.72
A259 Eastbound	717.68	42.51	1.78	383.47	23.43	1.50
A2025 South St	305.74	40.10	1.74	370.20	38.61	1.73

2.3.10 All three approaches to this junction are expected to operate well above capacity in both peak periods in all tested scenarios. A significant reduction in anticipated traffic demand or increase in junction capacity will be required to ensure this junction operates within capacity in the modelled future years.

2.3.11 The performance of the A259 approaches is worse in Scenario B2 due to additional traffic demand which is attracted back to the main road from alternative routes by the inclusion of the mitigation measures suggested for the junction in the main report. The junction mitigation included in the SATURN models for Scenario B2 gives additional capacity at this junction and contributes to some reassignment of traffic compared to Scenario B as reported previously.

3 MITIGATION MEASURES

3.1 Introduction

3.1.1 The results outlined in section 2.3 above demonstrate that scenario B2, despite generating less traffic movements than scenario B, is still likely to lead to a worsening of queues and delays compared to a 2028 reference case. Mitigation measures have therefore been examined in order to alleviate the impacts of development compared to the reference case. Other measures based upon travel planning have also been included and this approach is consistent with the mitigation measures for the other development scenarios in the main report.

3.1.2 Additionally, at the present time, West Sussex County Council, working in collaboration with Brighton & Hove, is leading on the preparation of a Shoreham Harbour Transport Strategy to inform planning policies that support regeneration at Shoreham Harbour. The Strategy will include recommendations for improvements to the existing road network and measures to encourage the use of sustainable modes of transport. These measures will be comprised of infrastructure and behaviour change initiatives where these would be considered effective and appropriate. An emerging draft of this Transport Strategy has informed the consideration of mitigation measures.

3.2 Highway Mitigation Schemes

3.2.1 Initial proposals have already been developed for the three junctions in Section 2.3 after iterative discussion with West Sussex County Council and Brighton & Hove City Council based upon the Scenario B development assumptions (subject to further detailed study).. Consideration has also been given to the available land surrounding each junction and the costs of each proposal in comparison with other options. Further detailed study may be required to refine the junction designs.

3.2.2 It should also be noted that all cost estimates exclude land costs (including compensation), design and supervision, inflation, VAT or services. A contingency between 15% and 45% is included for each estimate depending on the perceived extent / difficulty of the works to be undertaken. This contingency takes account of uncertainty at the preliminary design stage and does not cover any of the exclusions set out above.

<u>A27 / A283 Steyning Road</u>

3.2.3 The highway mitigation proposal at the A27 / A283 Steyning Road junction involves full signalisation of the existing roundabout with three lanes on the west part of the circulatory between the A283 South entry and the A27 Eastbound exit. The proposals would also widen the entry and exit from A283 North to two lanes and increase the entry from A283 South to two lanes with a flare. A diagram of the proposal is shown in Figure 3.1.

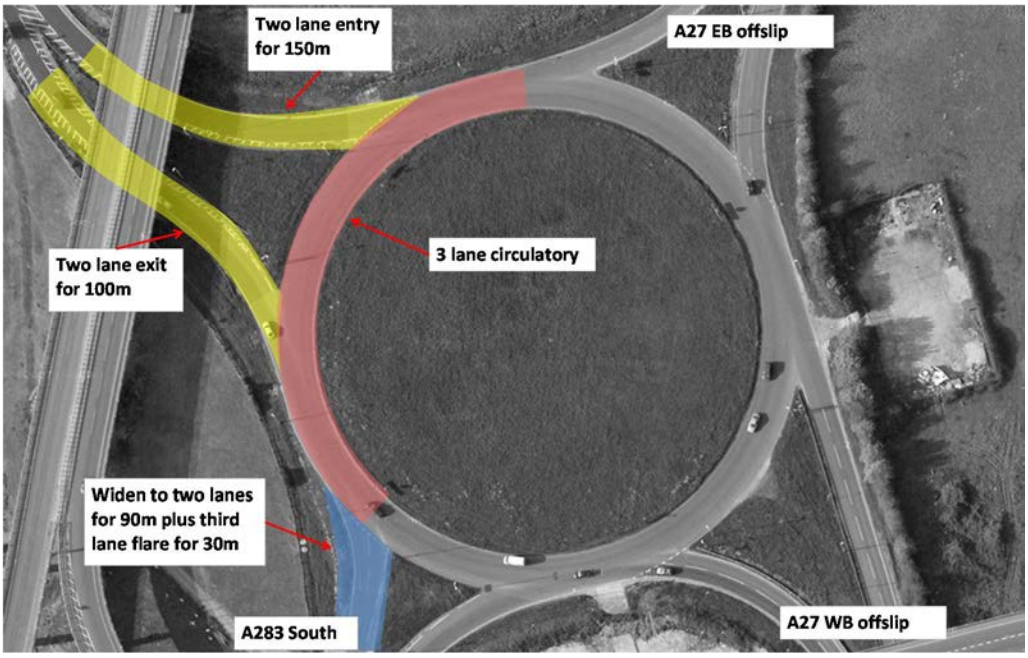

Figure 3.1: Highway Mitigation Proposal for A27 / A283 Steyning Road[3]

3.2.4 This highway mitigation is less extensive than the scheme proposed for this junction in the main report. The reduced development quantum in Scenario B2 compared to Scenario B allows for a reduction in the scale of capacity increase needed. The flares on the A283 North and A283 South entries have been shortened and the circulating carriageway would be widened between the A283 South entry and the A27 Eastbound exit, rather than the full circumference. These changes to the proposed mitigation have an impact on the estimated cost of the junction improvement.

3.2.5 Table 3.1 shows the cost estimates for the proposed improvements to the A27 / A283 roundabout. The estimates have been rounded and contain a contingency to take account of uncertainty at the preliminary design stage.

[3] Imagery ©2012 DigitalGlobe, GeoEye, GetMapping plc, Infoterra Ltd & Bluesky, taken from http://maps.google.co.uk

Table 3.1: Indicative Improvement Costs for A27 / A283 Roundabout

A27/A283 Roundabout	Costs (£)
Site Clearance	37,000
Fencing	0
Safety Fencing	30,500
Drainage	151,000
Earthworks	131,500
Pavement	189,500
Kerbs & Footways	58,000
Traffic Signs & Road Markings	54,500
Road Lighting Columns	55,500
Landscaping etc.	10,000
Total	**716,000**
Preliminaries 7.5%	54,000
Traffic Management 20%	143,500
Sub – Total	**912,500**
Contingency 45%	411,000
Total £	**1,323,000**

Note: Costs rounded up to nearest £500.
Cost base Q1 2014

A259 Brighton Road / A283 Old Shoreham Road

3.2.6 The mitigation proposal involves expanding the roundabout and increasing the capacity for the A259 High Street westbound entry.

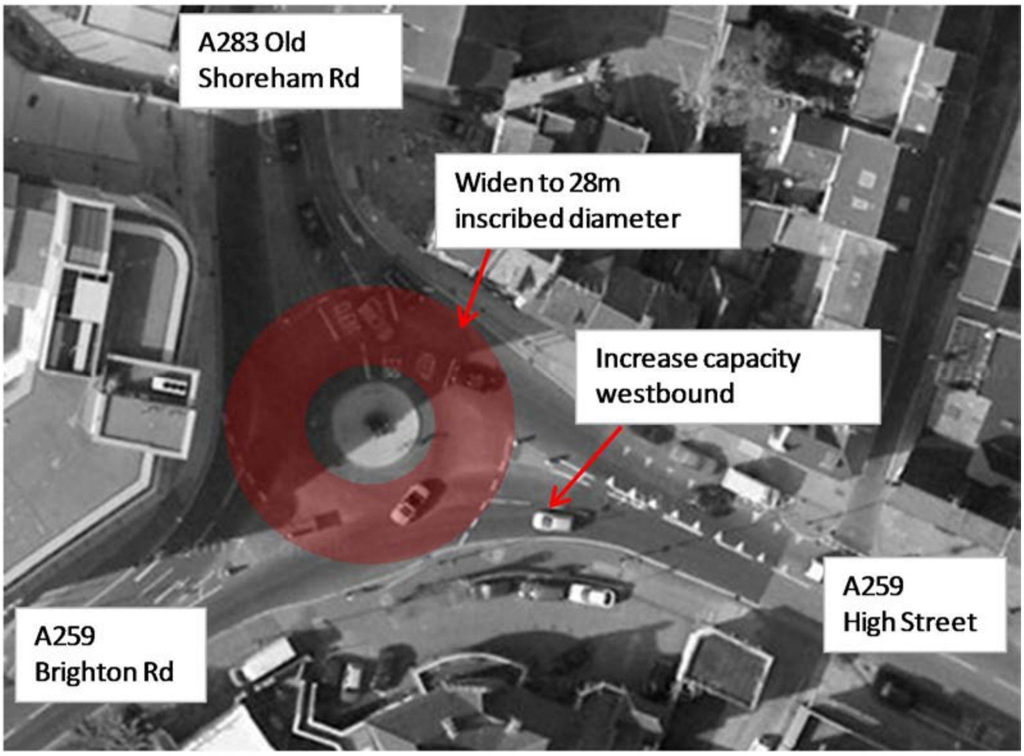

Figure 3.2: Highway Mitigation Proposal for A259 Brighton Road / A283 Old Shoreham Road

Table 3.2: Indicative Improvement Costs for A259 Brighton Road / A283 Old Shoreham Road

A259 Brighton Road / A283 Old Shoreham Road	Costs (£)
Site Clearance	214
Fencing	0
Safety Fencing /Pedestrian Guardrail	0
Drainage	0
Earthworks	1,137
Pavement	2,661
Kerbs & Footways	2,369
Traffic Signs & Road Markings	340
Road Lighting Columns	4,000
Total	**10,721**
Preliminaries 12%	1,287
Traffic Management	1,500
Sub - Total	**13,508**
Contingency 15%	2,026
Total £	**15,534**

A259 Brighton Rd / A2025 South Street

3.2.7 The highway mitigation proposal at the A259 Brighton Road / A2025 South Street is to widen the A259 west approach to provide a 50m flare and to enlarge the junction to a 30m diameter roundabout to accommodate this. A diagram of the proposal is shown in Figure 3.3.

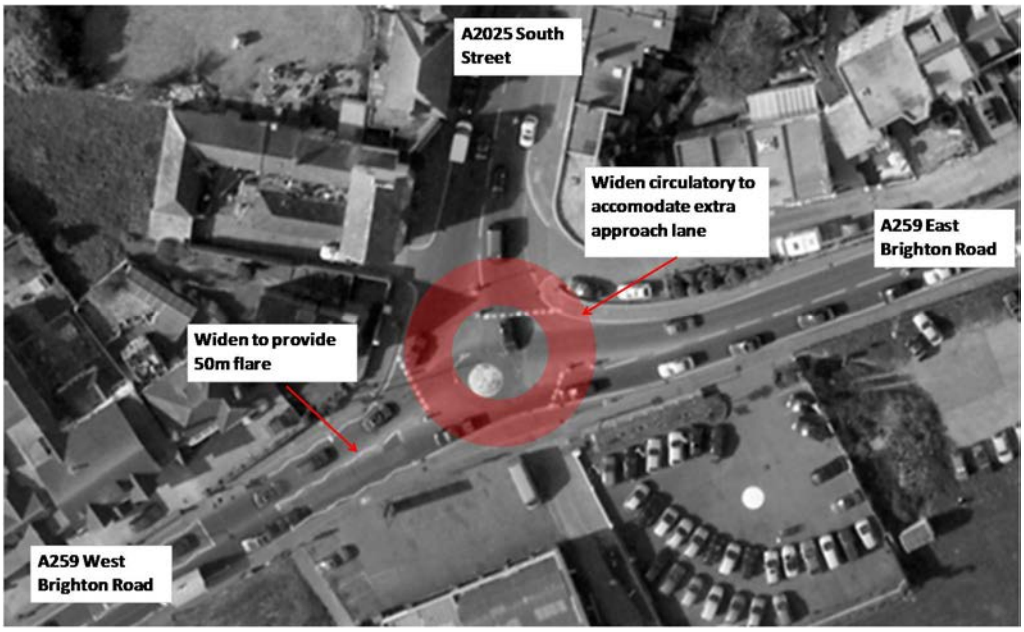

Figure 3.3: Highway Mitigation Proposal for A259 Brighton Road / A2025 South Street[4]

[4] Imagery ©2012 DigitalGlobe, GeoEye, GetMapping plc, Infoterra Ltd & Bluesky, taken from http://maps.google.co.uk

3.2.8 Table 3.3 shows the cost estimates for the proposed improvements to the A259 Brighton Road / A2025 South Street roundabout. The estimates have been rounded and contain a contingency to take account of uncertainty at the preliminary design stage.

Table 3.3: Indicative Improvement Costs for A2025/A259 Roundabout

A2025/A259 Roundabout	Costs (£)
Site Clearance	2,000
Fencing	5,000
Safety Fencing/Pedestrian Guardrail	0
Drainage	18,500
Earthworks	33,500
Pavement	36,500
Kerbs & Footways	6,500
Traffic Signs & Road Markings	4,000
Road Lighting Columns	6,000
Works to Existing Pedestrian Crossing	3,000
Retaining Wall	39,000
Accommodation Works/New Access etc	10,000
Total	**164,000**
Preliminaries 10%	16,500
Traffic Management 10%	16,500
Sub - Total	**197,000**
Contingency 45%	88,000
Total £	**285,000**

Notes: Allowance is made in the above estimate for filling to front of garages with retaining structure.
Costs rounded up to nearest £500.
Cost base Q4 2012

4 MODELLING RESULTS WITH MITIGATION MEASURES

4.1 Network Statistics

4.1.1 Following the identification of the mitigation measures, new model runs were undertaken using the Shoreham Harbour Transport Model (SHTM).

4.1.2 The revised demand for Scenario B2 was run in SHTM with the network which had been updated to reflect the mitigation proposed by ASHTS. This mitigation includes the schemes proposed for the Tranche 2 junctions in the main report.

4.1.3 The flows established by these model runs were then fed into individual junction models of key junctions in the study area. The results from the SHTM and the junction models are presented and discussed in this section.

4.1.4 The effect of the proposed sustainable travel initiatives and network mitigation measures on the global network statistics for each of the tested scenarios is examined in the following section. Table 4.1 shows a comparison of results from the AM peak models and Table 4.2 compares the network statistics from the evening peak models Please note that the results for scenario B only include the tranche 1 junctions and the sustainable transport mitigation measures from the main report as scenario B has not been re-run as part of this additional study.

Table 4.1: AM Peak Global Model Statistics Comparison

Statistic		Reference	Scenario B	Scenario B2
Transient Queues (pcu-hrs / hr)	Original Demand	9,411	9,804	
	After Mitigation		9,305	9,282
	Reduction		499	
Over Cap Queue (pcu-hrs / hr)	Original Demand	7,872	9,744	
	After Mitigation		8,660	7,947
	Reduction		1,084	
Total Travel Time (pcu-hrs / hr)	Original Demand	41,291	44,063	
	After Mitigation		42,232	41,461
	Reduction		1,831	
Total Travel Distance (pcu-km / hr)	Original Demand	1,506,724	1,529,091	
	After Mitigation		1,513,929	1,508,034
	Reduction		15,162	
Average Speed (kph)	Original Demand	36.5	34.7	
	After Mitigation		35.8	36.4
	Increase		1.1	

4.1.5 The global network statistics from the morning peak model demonstrate that the network improvements, along with demand reduction from sustainable travel measures and removing the Hasler (West Beach) development in Scenario B2, result in overall network performance which is comparable to the Reference Case network with the original demand forecasts. Therefore with the mitigation measures identified the proposed developments lead to a broadly neutral impact overall on the operation of the road network.

Table 4.2: PM Peak Global Model Statistics Comparison

Statistic		Reference	Scenario B	Scenario B2
Transient Queues (pcu-hrs / hr)	Original Demand	12,579	13,210	
	After Mitigation		12,839	12,734
	Reduction		371	
Over Cap Queue (pcu-hrs / hr)	Original Demand	22,131	23,383	
	After Mitigation		22,324	22,084
	Reduction		1,059	
Total Travel Time (pcu-hrs / hr)	Original Demand	63,837	66,349	
	After Mitigation		64,779	64,310
	Reduction		1,570	
Total Travel Distance (pcu-km / hr)	Original Demand	1,857,323	1,883,728	
	After Mitigation		1,869,362	1,863,906
	Reduction		14,366	
Average Speed (kph)	Original Demand	29.1	28.4	
	After Mitigation		28.9	29.0
	Increase		0.5	

4.1.6 The PM peak results follow a similar pattern to the AM peak statistics. The network capacity improvements, development traffic growth and sustainable travel demand reductions from the original Reference Case to Scenario B2 lead to an overall neutral impact on the modelled highway network.

4.2 Junction Performance

4.2.1 The following section discusses the changes in performance for each of the junctions following the implementation of the sustainable travel measures (see main report) and highway mitigations (Section 3.2). In each case, the Scenario B2 junction models contain the same traffic demand when comparing the existing and proposed junction layouts. The Scenario B results reproduced from the main report for the existing layout use the demand forecast without the mitigation measures proposed on the wider network, whilst the results for the proposed layout use the demand forecast with the sustainable transport measures and Tranche 1 improvements to the wider network proposed in the main report (see ASHTS Section 5).

4.2.2 As is often the case, capacity improvements lead to additional traffic on some parts of the road network as some drivers switch to an alternative route compared with the existing network. This effect has been included in the presented modelling. The changes in travel demand at individual junctions are reported in detail at Appendix D, while the improvements in junction performance are detailed in the rest of this section.

A27 / A283 Steyning Road

4.2.3 Table 4.3 and Table 4.4 below compare the results from the roundabout ARCADY models and traffic signalled junction LinSig models of the A27 / A283 Steyning Road roundabout in each scenario. The LinSig model results include the effects of junction mitigation and the anticipated highway trip reductions from sustainable travel measures. The ARCADY model results do not contain any mitigation and are reproduced from Table 2.3. Cases where the modelled traffic demand arriving at the junction exceeds 90% of the calculated capacity for that entry have been highlighted in red.

4.2.4 The Scenario B proposed layout results are reproduced from the main report and relate to the original mitigation scheme proposed there. The Scenario B2 proposed layout results relate to the scheme proposed above in Section 3.2.

Table 4.3: Junction Model AM Peak Results Comparison for A27 / A283 Steyning Road

	Existing Layout			Proposed Layout		
	Queue (PCU)	Delay (min)	RFC	Queue (PCU)	Delay (min)	DoS
Reference Case						
A283 South	46.08	1.84	1.05			
A283 North	73.79	2.17	1.08			
A27 Eastbound Slips	0.42	0.04	0.30			
A27 Westbound Slips	5.42	0.27	0.85			
Scenario B						
A283 South	121.98	4.32	1.19	9.0	0.30	0.69
A283 North	69.57	2.54	1.06	17.2	0.21	0.78
A27 Eastbound Slips	0.56	0.05	0.36	3.9	0.41	0.35
A27 Westbound Slips	6.55	0.32	0.88	8.3	0.33	0.54
Scenario B2						
A283 South	55.72	1.97	1.06	6.1	0.27	0.71
A283 North	144.29	4.74	1.16	13.6	0.22	0.82
A27 Eastbound Slips	0.61	0.05	0.38	3.8	0.33	0.49
A27 Westbound Slips	3.40	0.18	0.78	6.6	0.27	0.61

Note: RFC and DoS, although named differently in ARCADY and LINSIG, both measure the ratio between actual travel demand and the theoretical capacity at junctions.

Table 4.4: Junction Model PM Peak Results Comparison for A27 / A283 Steyning Road

	Existing Layout			Proposed Layout		
	Queue (PCU)	Delay (min)	RFC	Queue (PCU)	Delay (min)	DoS
Reference Case						
A283 South	401.83	25.89	1.39			
A283 North	23.88	0.75	0.98			
A27 Eastbound Slips	0.59	0.07	0.37			
A27 Westbound Slips	242.23	9.64	1.42			
Scenario B						
A283 South	191.04	10.29	1.30	6.3	0.31	0.63
A283 North	51.02	1.38	1.03	12.3	0.21	0.68
A27 Eastbound Slips	0.83	0.08	0.46	2.8	0.56	0.40
A27 Westbound Slips	419.11	23.04	1.88	10.7	0.32	0.66
Scenario B2						
A283 South	185.96	9.72	1.28	11.9	0.59	0.85
A283 North	70.57	1.81	1.06	11.7	0.16	0.65
A27 Eastbound Slips	0.46	0.09	0.32	3.1	0.69	0.53
A27 Westbound Slips	840.63	32.75	1.64	22.8	0.38	0.88

Note: RFC and DoS, although named differently in ARCADY and LINSIG, both measure the ratio between actual travel demand and the theoretical capacity at junctions.

4.2.5 The improvements to convert the A27 / A283 Steyning Road roundabout to traffic signal control on all four entry arms remove the over capacity issues previously seen in both modelled peak periods. The introduction of traffic signal control shares the delay experienced by vehicles on all approaches to the junction, resulting in a slight increase in delay for traffic from the A27 eastbound off-slip in all scenarios and the A27 westbound off-slip in the morning peak. The A283 entries to the roundabout (and the A27 westbound off-slip in the evening peak) operate within capacity with the improvements and all arms of the junction operate within capacity after mitigation in all scenarios.

4.2.6 In Scenario B2 model, the Proposed Layout is forecast to operate closer to the junction capacity than the Proposed Layout results for Scenario B. The lower development quantum proposed for Scenario B2 allowed a reduction in the additional capacity required from mitigation measures at this junction. The combined impact of lower traffic demand and lower capacity in Scenario B2 compared to Scenario B is a design that is forecast to operate closer to, but still within, the calculated capacity.

4.2.7 Without the proposed mitigation scheme, the anticipated long queue on the A27 westbound off-slip in the evening peak period is likely to obstruct the main carriageway by extending along the off-slip beyond the diverge point and onto the A27 itself. This would be considered both an operational and safety issue.

A259 Brighton Road / A283 Old Shoreham Road

4.2.8 Table 4.5 below compares the "with" and "without" mitigation results from the ARCADY models of the A259 Brighton Road / A283 Old Shoreham Road roundabout. The "without" mitigation results are reproduced from Table 2.4. Cases where the modelled traffic demand arriving at the junction exceeds 85% of the calculated capacity for that entry have been highlighted in red.

4.2.9 The Scenario B results have been reproduced from Table 6.11 of the main report. The report also contains the results from a sensitivity test looking at the impact of a change in the modelling methodology between the without mitigation and with mitigation models.

4.2.10 Currently this junction is a mini-roundabout with an inscribed diameter of 27m under the guidelines in 'TD16/07 – Geometric Design of Roundabouts' (DMRB Volume 6, Section 2, Part 3; August 2007). However, it would be classified as a normal roundabout (inscribed diameter increased to 28m) by altering the roundabout. Significant improvements were observed in the modelling results which could be attributed to the two types of roundabout being modelled in different ways by ARCADY. A sensitivity test was therefore undertaken by modelling the junction as a normal roundabout in both "with" and "without" mitigation scenarios. The results are repeated in Table 4.5 below for reference. As with the Scenario B results in the main report, Scenario B2 has been modelled as a mini-roundabout for the existing layout and as a normal roundabout for the proposed layout.

Table 4.5: ARCADY Results for A259 Brighton Road / A283 Old Shoreham Road

	AM			PM		
	Queue (PCU)	Delay (min)	DoS (%)	Queue (PCU)	Delay (sec)	DoS (%)
	Reference Case with Existing Layout (modelled as a mini-roundabout)					
A259 Westbound	223.25	13.04	1.41	424.62	39.58	1.73
A259 Eastbound	898.42	48.65	1.87	221.30	11.50	1.31
A283 Old Shoreham Rd	4.46	0.43	0.83	292.92	21.45	1.48
	Scenario B Existing Layout (modelled as a mini-roundabout)					
A259 Westbound	288.54	16.86	1.48	510.82	44.07	1.81
A259 Eastbound	1220.37	68.53	2.14	222.29	11.55	1.31
A283 Old Shoreham Rd	12.17	0.96	0.95	270.37	18.89	1.44
	Sensitivity test - Scenario B Existing Layout (modelled as a normal roundabout)					
A259 Westbound	45.49	1.87	1.05	194.77	11.42	1.40
A259 Eastbound	374.28	12.93	1.35	4.67	0.20	0.83
A283 Old Shoreham Rd	2.73	0.21	0.74	21.91	1.08	0.99
	Scenario B with Proposed Layout (modelled as a normal roundabout)					
A259 Westbound	4.05	0.18	0.81	27.02	1.30	1.01
A259 Eastbound	373.61	12.90	1.35	4.66	0.20	0.83
A283 Old Shoreham Rd	2.67	0.20	0.73	21.36	1.06	0.99
	Scenario B2 Existing Layout (modelled as a mini-roundabout)					
A259 Westbound	136.74	7.50	1.25	385.06	31.63	1.62
A259 Eastbound	950.34	55.12	1.96	128.45	6.89	1.20
A283 Old Shoreham Rd	3.28	0.31	0.77	241.29	17.36	1.43
	Scenario B2 Proposed Layout (modelled as a normal roundabout)					
A259 Westbound	2.63	0.13	0.73	13.24	0.73	0.95
A259 Eastbound	190.61	6.88	1.22	3.16	0.14	0.76
A283 Old Shoreham Rd	1.46	0.14	0.60	9.23	0.50	0.92

4.2.11 The design tested as the Proposed Layout is expected to fully mitigate the forecast future traffic increases, providing better junction performance than the existing layout in the Reference Case. The modelling results suggest that one arm (the A259 Eastbound approach) will be over capacity in the morning peak hour, with the other two arms operating close to capacity in the afternoon peak hour. A more extensive improvement has been identified by the Town Centre Study which could further address the capacity issues identified at this junction.

A259 Brighton Road / A2025 South Street

4.2.12 Table 4.6 and Table 4.7 below compare the "with" and "without" mitigation results from the ARCADY models of the A259 Brighton Road / A2025 South Street roundabout in each scenario. The "with" mitigation results include the effects of junction mitigation and the anticipated highway trip reductions from sustainable travel measures outlined in the main report. The "without" mitigation results are reproduced from Table 2.5. Cases where the modelled traffic demand arriving at the junction exceeds 85% of the calculated capacity for that entry have been highlighted in red.

Table 4.6: AM Peak Results Comparison for A259 Brighton Road / A2025 South Street

	Existing Layout			Proposed Layout		
	Queue (PCU)	Delay (min)	RFC	Queue (PCU)	Delay (min)	RFC
Reference Case						
A259 Westbound	283.95	28.68	1.57			
A259 Eastbound	220.98	13.01	1.33			
A2025 South St	387.38	51.29	1.93			
Scenario B						
A259 Westbound	240.62	23.37	1.49	56.75	2.71	1.09
A259 Eastbound	312.17	19.11	1.43	107.49	3.51	1.12
A2025 South St	401.43	59.59	2.04	5.87	0.5	0.87
Scenario B2						
A259 Westbound	557.98	55.30	1.97	64.79	3.08	1.11
A259 Eastbound	717.68	42.51	1.78	85.30	2.64	1.09
A2025 South St	305.74	40.10	1.74	6.71	0.56	0.89

4.2.13 The performance of all three arms at this roundabout has improved following the introduction of the proposed mitigation measures. In the morning peak model, both the eastbound and westbound A259 approaches to the junction are over capacity in Scenario B and B2. The demand on the third entry from South Street is below the calculated capacity in all tested scenarios, though above the 85% threshold for the reliable operation of give-way controlled junctions. The forecast traffic demand at this junction in Scenario B2 is similar to Scenario B, so no alternative mitigation options have been explored and the ASHTS junction improvement is retained.

4.2.14 Some congestion remains at this junction in this peak period, but the proposed layout has effectively mitigated this to be less congested than in the reference case.

Table 4.7: PM Peak Results Comparison for A259 Brighton Road / A2025 South Street

	Existing Layout			Proposed Layout		
	Queue (PCU)	Delay (min)	RFC	Queue (PCU)	Delay (min)	RFC
Reference Case						
A259 Westbound	398.87	43.04	1.76			
A259 Eastbound	100.61	6.04	1.18			
A2025 South St	452.89	51.32	1.96			
Scenario B						
A259 Westbound	452.02	48.14	1.84	311.09	17.81	1.55
A259 Eastbound	101.85	6.13	1.18	11.12	0.48	0.93
A2025 South St	471.43	54.13	2.00	4.85	0.31	0.84
Scenario B2						
A259 Westbound	962.06	108.04	2.72	301.62	17.02	1.53
A259 Eastbound	383.47	23.43	1.50	9.73	0.42	0.92
A2025 South St	370.20	38.61	1.73	4.62	0.30	0.83

4.2.15 The performance of all three approaches to this roundabout has improved following the introduction of the proposed mitigation measures. In the evening peak model, one approach to the roundabout (westbound A259) is over capacity in Scenario B although the delays are well below those in the reference case with no junction improvements. The demand on the eastbound A259 is below the calculated capacity, though above the 85% threshold for the reliable operation of give-way controlled junctions. The third entry is expected to operate within capacity in all tested scenarios during the evening peak period. The forecast traffic demand at this junction in Scenario B2 is similar to Scenario B, so no alternative mitigation options have been explored and the ASHTS junction improvement is retained. . Some congestion remains at this junction in this peak period, but the proposed layout has effectively mitigated this to be less congested than in the reference case.

4.3 Journey Times

4.3.1 Seven journey time routes have been defined in order to assess the performance of key routes through the study area. The routes are listed below and are shown on a map in Appendix E.

1. Western Road / Busticle Lane
2. South Street / Grinstead Lane
3. A283 Old Shoreham Road / Steyning Road
4. B2194 Station Road / A293
5. A27
6. A27/A270
7. A259

4.3.2 The journey times have been assessed in both directions along each route for the reference case, the initial scenario models and the with mitigation scenario models. The results of this analysis are shown below for Scenarios B and B2 compared to the Reference Case. Intersections with other roads are marked along the route for reference.

4.3.3 The journey time results for Scenarios B and B2 both refer to the respective 'with mitigation' networks. Tranche 2 junction mitigation has been added to the Scenario B2 'with mitigation' network during the work for this Addendum, but these junction changes have not been retrospectively applied to the Scenario B modelling results.

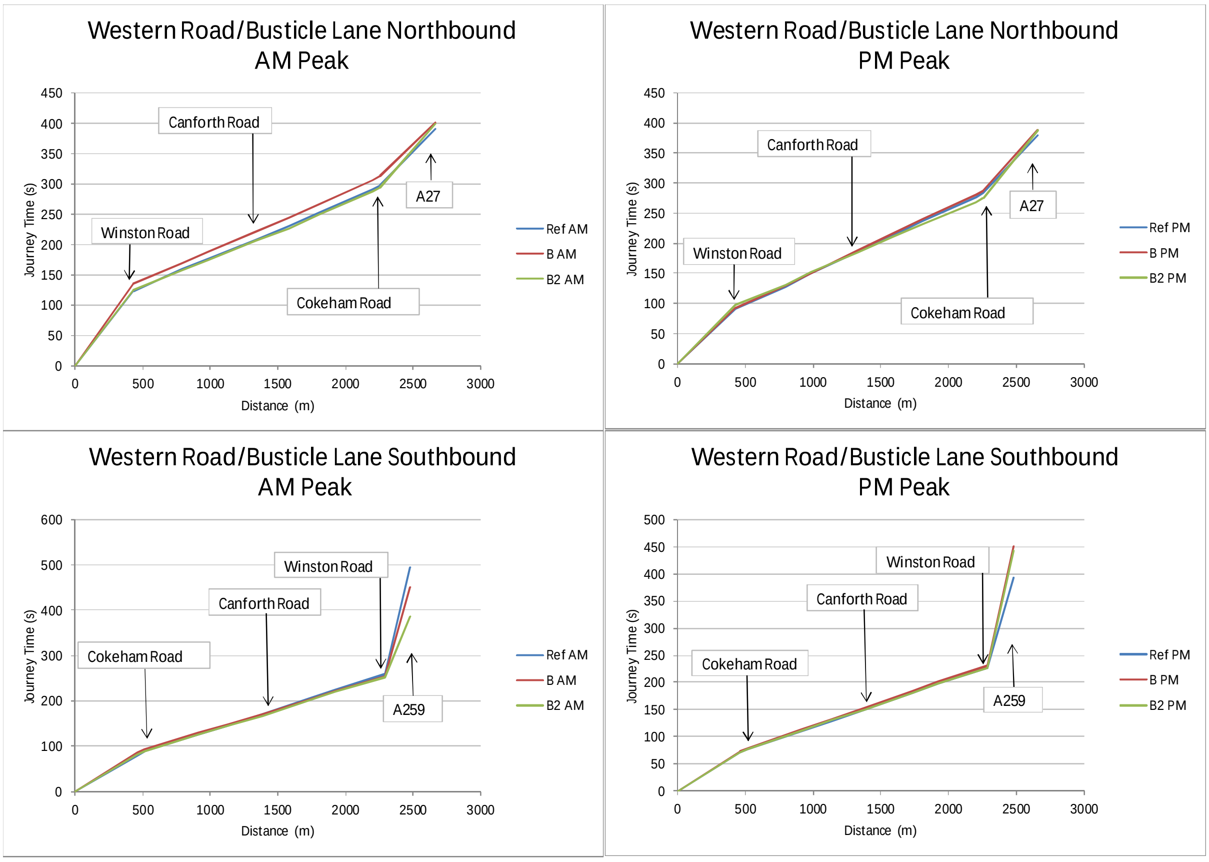

Figure 4.1: Route 1 - Western Road / Busticle Lane Journey Time Graphs

4.3.4 Along Western Road / Busticle Lane, the journey time in Scenarios B and B2 goes up marginally, although not materially, when compared with that in reference case as travel demand increases, except for southbound in the AM peak.

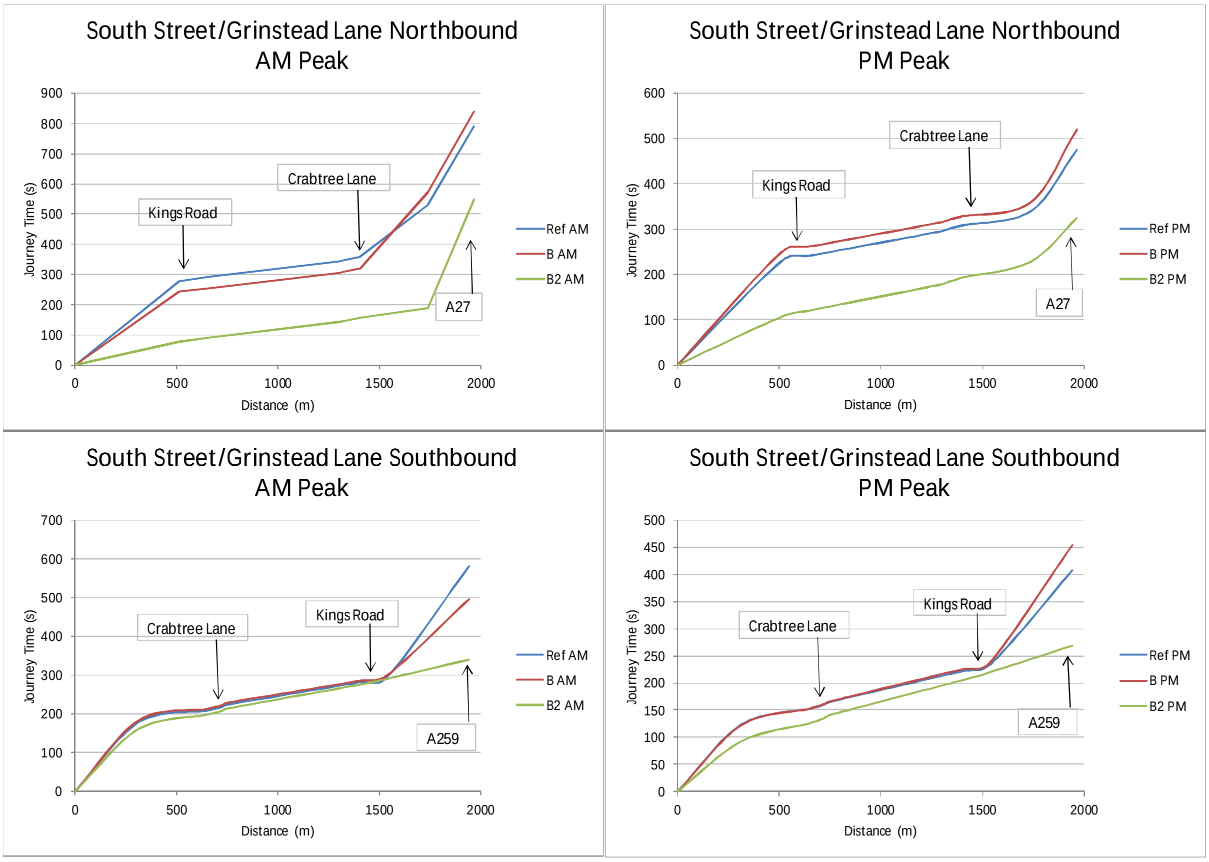

Figure 4.2: Route 2 - South Street / Grinstead Lane Journey Time Graphs

4.3.5 The increase in demand in scenario B leads to longer journey times along South Street / Grinstead Lane route when compared with reference case except southbound in the AM peak. The demand reductions from the removal of the Hasler development site and junction improvements identified during the assessments for Tranches 1 and 2, which are included in Scenario B2, produce a significant improvement in the modelled journey times along Route 2, especially in the northbound direction.

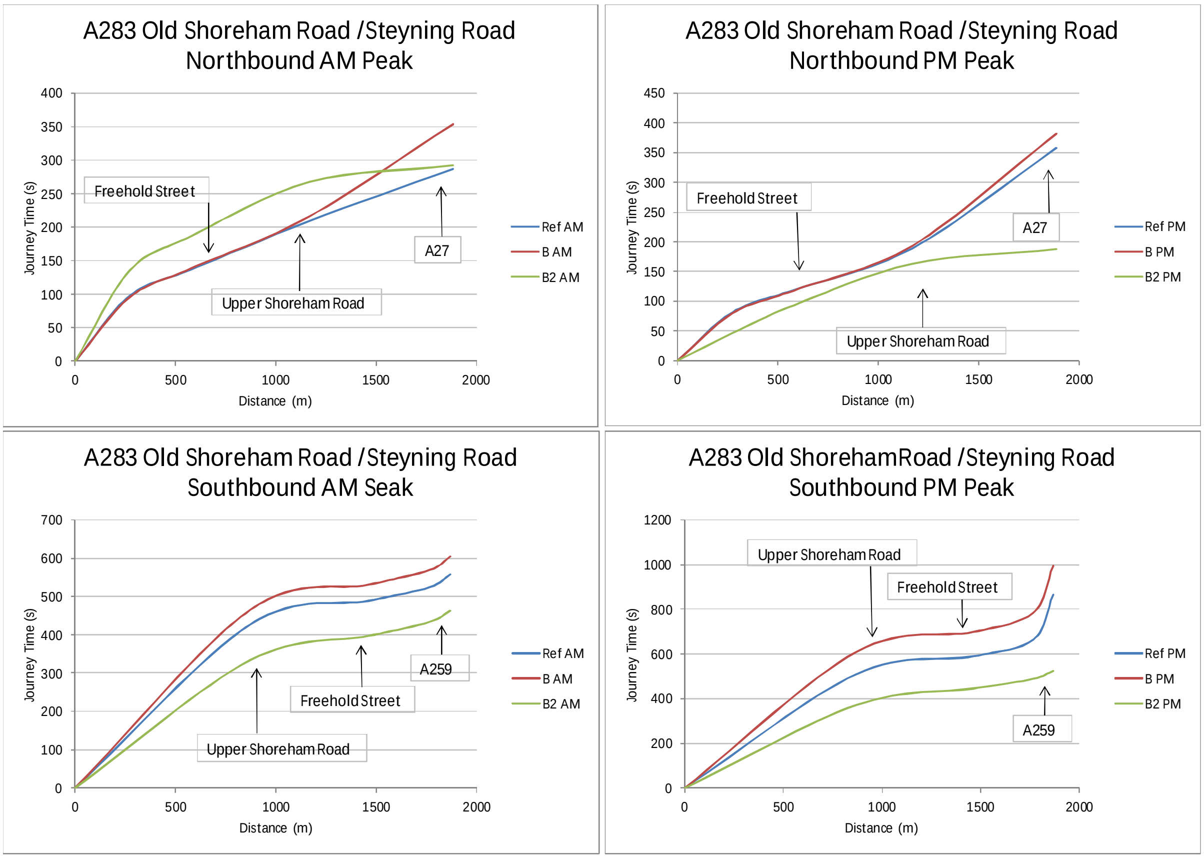

Figure 4.3: Route 3 - A283 Old Shoreham Road / Steyning Road

4.3.6 In each presented case, the journey time along Route 3 increases in Scenario B, compared to the Reference case, following the introduction of the additional demand from the proposed development sites. The changes in Scenario B2 lead to an improvement in the modelled journey time compared to the Reference case for three of the presented cases. The northbound journey time in the morning peak hour increases slightly in Scenario B2 compared to the reference case. This increase, given the removal of development at Hasler (West Beach) from the assessment, looks counter intuitive, but on closer inspection there is significant suppressed demand at the junction. Also of note is that the journey time route includes the approaches to the Ropetackle roundabout from Brighton Road and Shoreham High Street. In the B2 scenario without Hasler (West Beach) extra traffic is drawn into the junction and the heavier right turn from Shoreham High Street to Old Shoreham Road increases delays on the Brighton Road approach that are included in the northbound morning peak hour graph above.

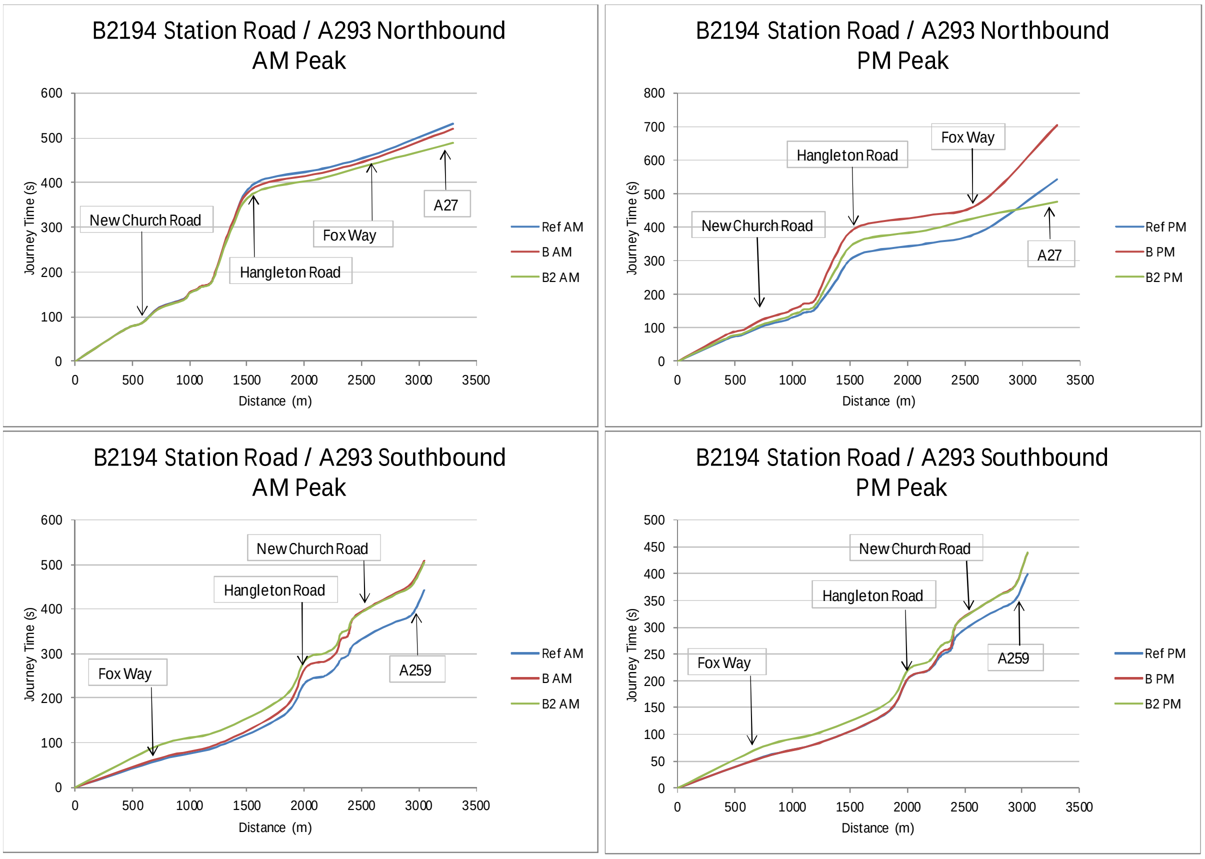

Figure 4.4: Route 4 - B2194 Station Road / A293

4.3.7 Northbound traffic along Route 4 in Scenario B2 benefits from a reduction in delay in both modelled peak hours compared to the reference case. Southbound traffic in both peaks for Scenario B2 has similar journey times to those previously reported for Scenario B, being marginally higher overall compared to the reference case.

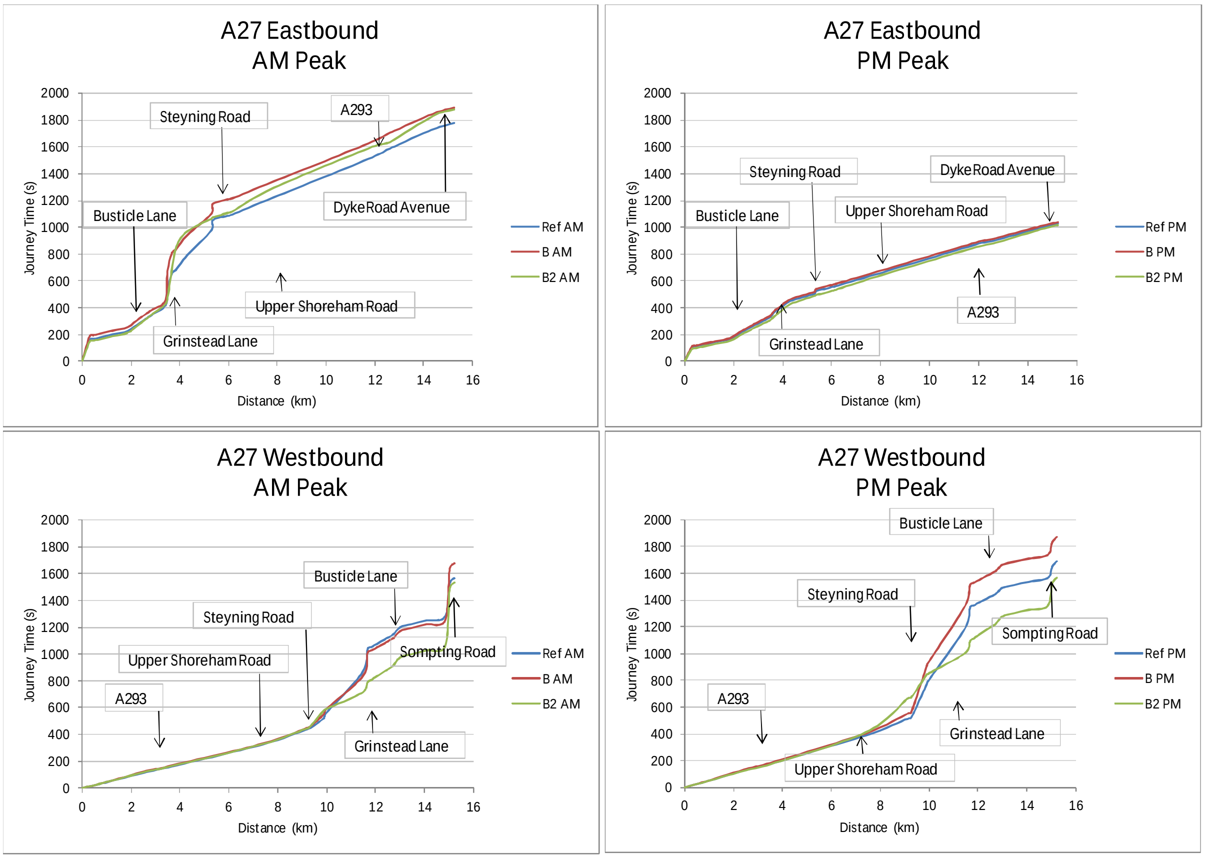

Figure 4.5: Route 5 - A27 Journey Time Graphs

4.3.8 The total eastbound journey time in the PM peak is noticeably less than in the AM peak. This is due to a high demand along the A27 in the AM peak that is not matched in the PM peak. Eastbound Scenarios B2 and B journey times are both similar to the reference case. The westbound modelled journey times for Scenario B2 are shorter than both the reference case and Scenario B in both peak hours.

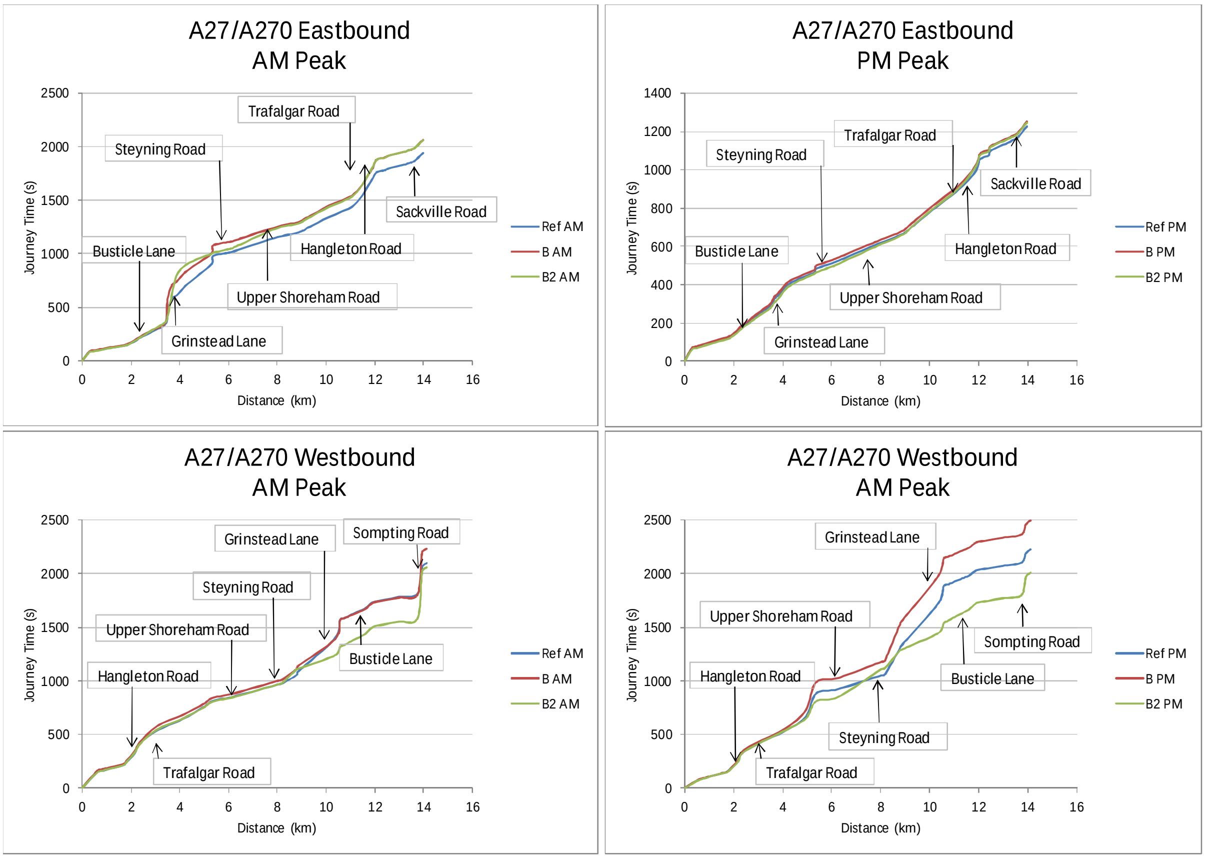

Figure 4.6: Route 6 - A27 / A270 Journey Time Graphs

4.3.9 As expected, this route shows very similar results to the A27 route. The increase in demand in scenario B leads to longer journey times along the A27 / A270 route when compared with the reference case. The demand reductions and junction improvements introduced in Scenario B2 produce an improvement in the modelled journey times along Route 6 in the westbound direction although there is little improvement in the eastbound direction.

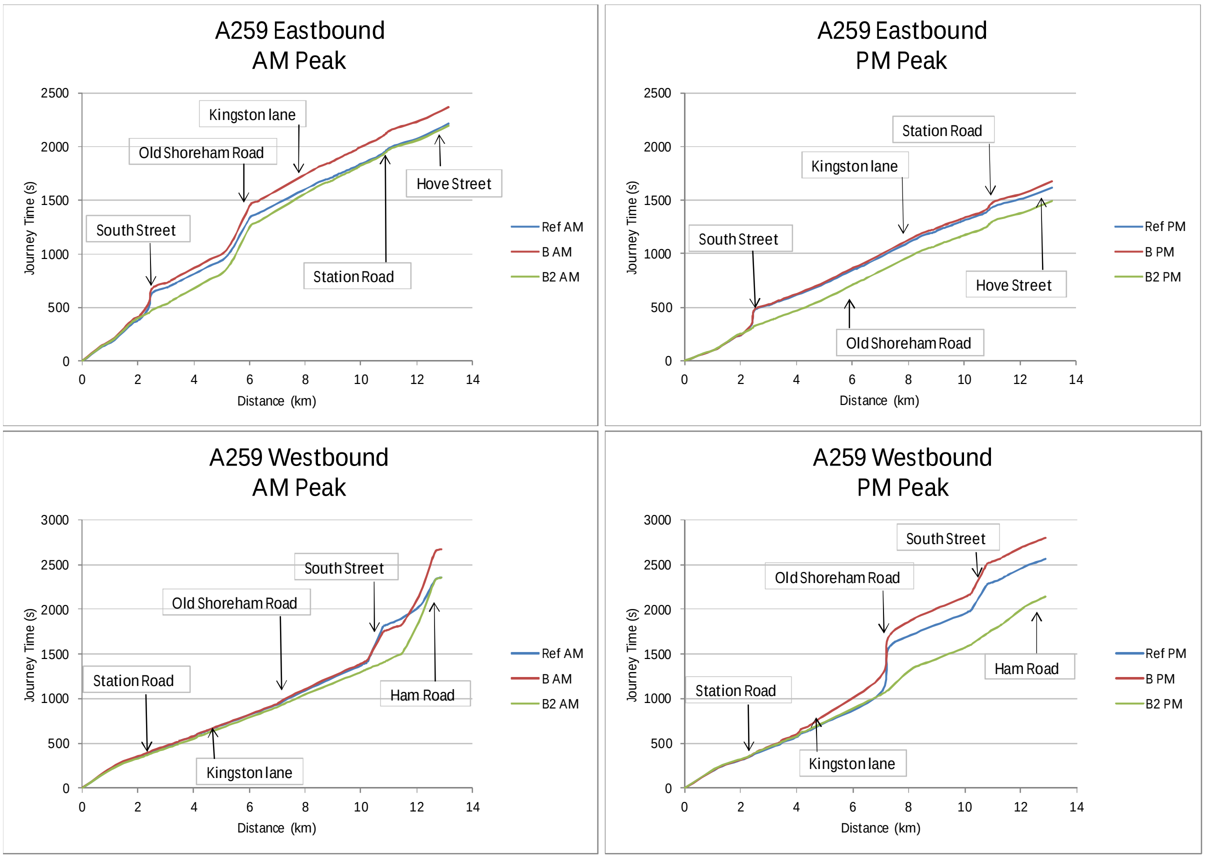

Figure 4.7: Route 7 - A259 Journey Time Graphs

4.3.10 The increased demand in Scenario B has increased the journey time along the A259. As with the other routes, the demand and network changes in Scenario B2 produce an improvement in modelled journey times compared to the reference case in both peak hours travelling in both directions.

4.4 Impact on Air Quality Management Area and Sompting Conservation Area

4.4.1 In addition to network statistics and individual junction assessment, traffic impacts on three local areas in Adur, where air quality is a major concern, were also investigated. These include two Air Quality Management Areas (AQMA) and one conservation area in the district as listed below:

- The A270 between the junctions with Kingston Lane and Lower Drive (Figure 4.8)
- The A259 between Ropetackle Roundabout and Surry Street (Figure 4.9)
- Sompting Conservation area, in particular a section of West Street, Sompting, between Church Lane and Lambley's Lane (Figure 4.10).

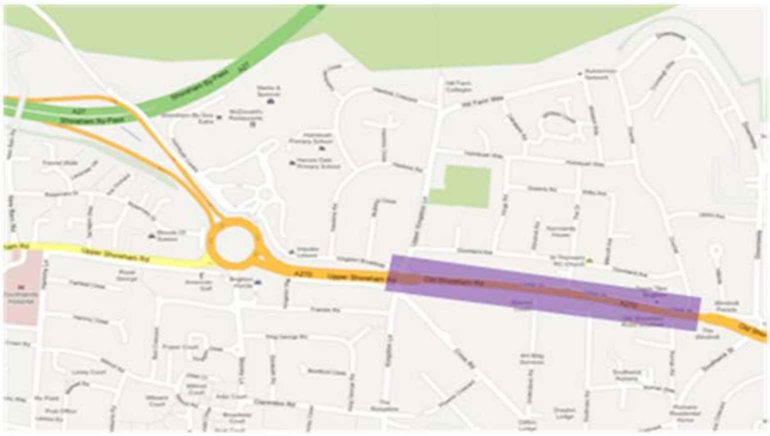

Figure 4.8: A270 Air Quality Management Area

Figure 4.9: A259 Air Quality Management Area

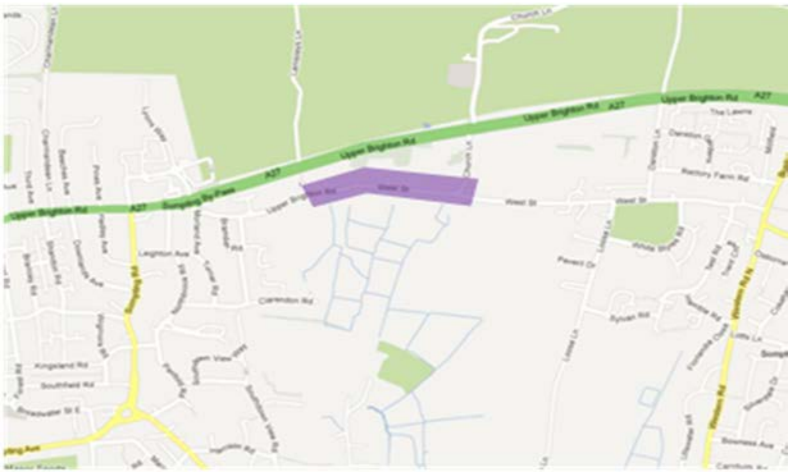

Figure 4.10: Sompting Conservation Area

4.4.2 The flow, queue and delay through the AQMAs and the Sompting Conservation area are shown in Table 4.8, Table 4.9 and Table 4.10. The Reference Case and Scenario B results have been reproduced from the main report for comparison. The results for the A259 High Street from Surry Street to Ropetackle roundabout differ from those reported previously due to a correction in the data processing methodology employed.

4.4.3 The modelling results for Scenarios B and B2 both refer to the respective 'with mitigation' networks. Tranche 2 junction mitigation has been added to the Scenario B2 'with mitigation' network during the work for this Addendum, but these junction changes have not been retrospectively applied to the Scenario B modelling results.

Table 4.8: Flow in pcu through AQMAs and Sompting Conservation Area

AQMAs			AM			PM		
Road	From	To	Ref	B	B2	Ref	B	B2
Old Shoreham Road	Kingston Lane junction	Lower Drive junction	1,187	1,248	1,284	1,008	1,022	1,094
	Lower Drive junction	Kingston Lane junction	1,455	1,407	1,404	1,528	1,569	1,568
A259 High Street	Ropetackle Roundabout	Surry Street	3,907	4,240	4,263	2,901	2,909	2,943
	Surry Street	Ropetackle Roundabout	4,065	4,379	4,028	3,742	4,256	4,264
Sompting Conservation Area								
West Street	Church Lane	Lambleys Lane	909	976	914	412	469	452
	Lambleys Lane	Church Lane	275	346	338	164	202	199

Table 4.9: Average Queue in Metres through AQMAs and Sompting Conservation Area

AQMAs			AM			PM		
Road	From	To	Ref	B	B2	Ref	B	B2
Old Shoreham Road	Kingston Lane junction	Lower Drive junction	0	0	0	0	0	0
	Lower Drive junction	Kingston Lane junction	9	8	8	9	23	9
A259 High Street	Ropetackle Roundabout	Surry Street	4	5	5	3	3	3
	Surry Street	Ropetackle Roundabout	2	4	1	83	105	70
Sompting Conservation Area								
West Street	Church Lane	Lambleys Lane	0	0	32	0	0	0
	Lambleys Lane	Church Lane	0	0	0	0	0	0

Table 4.10: Delay in seconds per PCU through AQMAs and Sompting Conservation Area

AQMAs			AM			PM		
Road	**From**	**To**	**Ref**	**B**	**B2**	**Ref**	**B**	**B2**
Old Shoreham Road	Kingston Lane junction	Lower Drive junction	8	9	10	6	6	7
	Lower Drive junction	Kingston Lane junction	50	44	44	71	114	52
A259 High Street	Ropetackle Roundabout	Surry Street	54	67	73	40	37	36
	Surry Street	Ropetackle Roundabout	46	57	42	560	577	396
Sompting Conservation Area								
West Street	Church Lane	Lambleys Lane	24	28	24	5	6	6
	Lambleys Lane	Church Lane	5	6	6	3	3	3

4.4.4 The flow thorough both AQMAs and the Sompting Conservation area are higher in the AM than the PM peak hour. The PM peak queue and delay reductions illustrate the improvement in westbound flow along Shoreham High Street following the proposed improvements to Ropetackle Roundabout.

4.4.5 There are some cases where no queue is reported but there is a delay. This is because the measure of delay includes transient delay (such as temporary queuing unrelated to junctions) and delays associated with heavy traffic flows that merely reduce vehicle speeds.

5 CONCLUSION

5.1 Summary

5.1.1 This addendum considers the transport impacts of an additional strategic residential and commercial site allocation scenario within Adur and Brighton & Hove in 2028 to inform the preparation of the Adur District Council Local Plan and Shoreham Harbour Joint Area Action Plan. It follows on from previous work for the Adur Local Plan and Shoreham Harbour Transport Study.

5.1.2 The principal changes incorporated into Scenario B2 are:

- The Hasler (West Beach) site has been excluded from the development scenario;
- Revised access arrangements for the West Sompting and Sompting North sites; and
- Highway improvements at the key junctions identified by the main report.

5.1.3 This additional scenario represents the preferred strategy of Adur District Council for the submission Local Plan.

5.2 Traffic Impact of Development

5.2.1 The scenario tested for this addendum is a variation of Scenario B from the previous study and yields an improvement on the forecast traffic impact due to the combined impact from a reduced quantum of proposed development and demand management from sustainable travel initiatives, alongside the inclusion of highway capacity improvements identified during previous work. The effect of the proposed development on three key junctions was examined, along with the effect on journey times along key corridors as a means of assessing any area-wide impacts.

5.2.2 The potential impact of the development proposals on the highway network was considered sufficient to investigate interventions to mitigate the anticipated effects. The demand and network differences from Scenario B contained in Scenario B2 reduce the traffic impact from the proposed development, but not sufficiently to remove the need for mitigation measures at the key junctions considered. Two of the junctions examined require the same mitigation proposals as previously identified for Scenario B, but at the Steyning Road junction it has been possible to reduce the scale and cost of the proposed mitigation layout, whilst enabling the junction to operate within capacity.

5.3 Traffic Impact Mitigation

5.3.1 Highway mitigation options were then explored for the three junctions through individual junction assessment. The proposals seek to increase the capacity of the junctions whilst avoiding land take wherever possible and with minimum physical changes, as detailed below:

- **A27 / A283 Steyning Road** – Fully signalise roundabout with part of the circulatory widened to three lanes. Widen A28 north entry and exit, and A283 south entry.
- **A259 Brighton Road / A283 Old Shoreham Road** – expand the roundabout and widen approach westbound.
- **A259 Brighton Road / A2025 South Street** – Widen the A259 west approach and enlarge circulatory.

5.3.2 The measures tested, in combination with reductions in overall travel demand, relieve the bottleneck effect of the junctions listed above to give a significant improvement in the individual junction performance and the journey times along key routes - such as the A27 and A259 corridors - through the study area. It is therefore concluded that the mitigation tested is generally sufficient to accommodate the increased traffic associated with all of the development scenarios examined.

5.3.3 It should be noted that the proposed junction improvements are initial concepts subject to further detailed study. A table listing the proposed mitigation at each of the junctions tested in both the main report and this addendum is presented in the Executive Summary at the front of this document.

5.4 Limitations of Study – Cost Estimates and Mitigation Phasing

5.4.1 The cost estimates presented are based on the concept diagrams presented and will need detailed designs to look at issues including potential alterations to the highway boundary, surrounding ground conditions, material and landscaping requirements etc. in greater detail. Until a detailed design process is completed, the costs presented may be subject to significant changes.

5.4.2 The study has not looked at any interim years between the present time and 2028 to better estimate when the implementation of mitigation measures will be required but has simply examined the “with” and “without” development scenarios in 2028.

5.4.3 Proper consideration of the time that mitigation will be required is not possible without better knowledge of when each of the site allocations are developed and the speed of development. These factors are currently not known. Some sites in reality would be completed in a short timescale whereas others might be developed over many years. The timing of required mitigation can only be based upon general qualitative rather than detailed quantitative information and judgement.

5.4.4 For any site allocation, sustainable mitigation measures usually need to be implemented shortly after the first occupation of residential and commercial sites and be sustained on an ongoing basis. However, it is also acknowledged that in some cases up-front mitigation / infrastructure may be required prior to new development commencing, subject to funding, so that these mitigation / infrastructure are in place when new residents move in. In both cases, investment will be required to implement and sustain these sustainable transport measures so the level of highway trip reduction assumed in this study can be achieved. Exact costs for these measures have not been included in this study.

5.4.5 Infrastructure improvements will be required at future year trigger points which will need to be determined as part of future planning applications. This will involve the assessment of when traffic resulting from any development is deemed to have a material impact upon queues and/or delays on the road network compared to a "without" development scenario. For each development site, the scope of the network under consideration will be proportional to the traffic generated. This practice is in line with current planning guidance, namely the National Planning Policy Framework (2012), DfT Guidance on Transport Assessments (2007) and Highways Agency Circular 02/2013.

APPENDICES

APPENDIX A

SHOREHAM HARBOUR TRANSPORT MODEL REVIEW AND UPDATE TECHNICAL NOTE

Technical Note

Subject: Review of the SHTM Model

Date: 10 August 2012

Reference: MB1202

Author: Martin Bach

Version: 1.0

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1 Introduction

The SHTM model was developed originally by Peter Brett/Minnerva in 2010, and passed to Parsons Brinkerhoff in 2012 for application on a study in the Adur/Shoreham region. When applied on this study, trips were being 'lost' unexpectedly during the iterative process. An initial audit of the processing job by PB identified an error in one of the modelling scripts, but when corrected this did not make any difference to the model results.

Minnerva was then asked to undertake a more detailed audit of the model to understand why trips were being 'lost'.

In addition, the model was designed so that outputs from the Saturn Highway Assignment runs were passed back to the OmniTRANS Public Transport model so that PT assignments could use these 'congested' highway speeds. An important component of the multi-modal modelling structure, this link had been disabled for these model runs, and needed to be re-established.

A detailed account of the audit process follows in subsequent sections, but a summary of the key findings is presented here:

1. The basis of the mode split model is that it calculates incremental changes to the trip matrices between the base and forecast scenarios using cost differences (by mode) between the scenarios.

2. As with all incremental models, if there are no trips in the base scenario for a given zone i-j pair, but there are non-zero trips in the forecast scenario, action must be taken to ensure that zero trips are not produced for the forecast.

3. With the scenario run tested in the audit this situation was detected, but for a set of different reasons:

    a. the error in the script as identified by PB, when corrected, required the 2008 Base scenario to be re-run. This had not been done, with the result that in a forecast scenario run there were non-zero trips in cells where there were corresponding zero cells in the Base.

    b. the forecast matrices, as derived for this model application, have trips in cells which do not have trips in corresponding cells in the base. This has been observed both for zones which were 'dummy' in the base but have been used in this model, but also for 'existing' zones where base i-j cells have changed from zero to non-zero trips

4. A potential third reason exists: an apparent import error for the forecast scenarios has switched Home Based Other and Home Based Employers Business trip matrices. This could also give rise to non-zero cells in the Forecast Matrices with corresponding zero filled cells in the Base matrices. [Note: this condition has to be confirmed by PB]

5. A couple of additional minor corrections were made to the scripts, but after corrective action for the items noted in paragraph 3 above were made, a detailed audit of trip totals through the various processing stages showed that 'mechanically' the process is now correct; that is, trips are not lost during the mode split process.

6. The link between Saturn and OmniTRANS PT has been re-established, so more realistic highway speeds are used by the PT assignment.

Although the model can be shown to be working correctly in a 'mechanical' sense, there are several issues which require consideration to ensure that the model is behaving as expected. These issues are discussed in later sections, and summarised in Section 8 , below.

2 Audit Strategy

The model as supplied was in OmniTRANS V5 format, and when originally developed required the use of set of utility classes (MvDataTools) developed by Minnerva to operate. PB does not have a licence for these classes, so changes were made by PB to the model scripts to avoid use of these classes. This gave rise to a divergent set of job scripts for running the model.

Whilst having no reason to think that any of the divergent scripts were not correctly amended, the audit was undertaken reverting to the original scripts, with the one exception of the change noted in 3.a (above); this correction was made to the original scripts. By reverting to the original job set one potential source of 'error' was removed; thus avoiding the need to check the amendments in the amended scripts.

To enable the model to run, copies of the relevant MvDataTools classes used by the SHTM model have been placed in the Local_Classes directory of the model. This will enable the model to be run by anyone who does not have a licence for MvDataTools (see discussion in Section 9 below).

Having removed one source of potential error, the Audit Strategy adopted was:

a) to re-run the 2008_Base_Network_wth_Base_Demand_Scenario. This to re-establish the 2008 Base, but also to check that the trip matrix totals, as the processing progresses through the disaggregation of the input matrices, were as expected

b) to take the 2008 input data (matrices and planning data) and set up a 'dummy' scenario to run against the 2008 Base. As the data was identical, the generated matrices for one iteration of the model run, through the post-mode split stage to the production of the combined vehicle/pt-fare/pt-no-fare for the next iteration, was expected to be identical to the 2008 base.

c) repeat (b), but with input data taken from for one of the 2028 (PB) forecast runs, and to see what happened.

To assist in this audit, several jobs were updated so they generated an output, tab separated text file containing matrix totals by the various (PMTU) categories, suitable for opening in Excel and so facilitate the audit. Some other changes were made to the job scripts, the main ones noted below:

0606 - Import Trip Matrices. A switch has been put in here that distinguishes between importing OmniTRANS binary matrices (.odm) and text .CSV files as created by PB. Base 2008 matrices are imported using the .odm format, forecast matrices prepared by PB are imported as .csv.

0611 - Initial Decomposition of Trip Matrices to CA-NCA and User Classes. Output analysis file added.

0621 - Aggregation of Trip Matrices for Assignment. Comparison statistics against the Base matrices added

0628 - Run Mode Split Model per User Class. Output analysis file added, plus other revisions discussed later

For all model runs, highway assignment trip matrices generated by OmniTRANS were passed to PB for running in Saturn with the resulting loaded network and skim matrices passed back for processing.

It should be noted that as part of this audit, no checks have been made on the network structures or content, highways or public transport.

3 2008 Base_Network_with_Base_Demand

This scenario was re-run so that each step of the processing could be checked to ensure that the expected matrix totals were being generated, as well as to establish a new base given the correction to one of the scripts noted in 3.a above.

The re-run comprised running jobs 0605 - 0611 and 0621 - 0628 (all jobs run manually, not from the Scenario Manager).

An audit trail of matrix totals is presented in spreadsheet "*Audit Trail 2008 Base.xlsx"* which is stored in the directory *..\Model_Data\Model_Outputs\2008_Base_Network_with_Base_Demand.*

The results are given for the AM period and the spreadsheet shows how the original, input matrices are disaggregated, by mode, through the various stages of processing. (PM results are not shown as the mechanical process is identical as that for the AM)

[Note: in this and other spreadsheets generated for this analysis, trip totals may differ by very small number of trips due to rounding/truncation in the spreadsheet as no decimal places are shown)

During the course of this analysis, it was noted that the global variable for setting the HGV PCU factor was missing from the modelling scripts, resulting in a default factor of 1.0 being available. To remedy this, the variable $hgv_pcu_factor = 2.0 was set in 'Get_Scenario.rb'

An examination of the spreadsheet *Audit Trail 2008 Base.xlsx* shows that the set of matrices produced post-mode split, and then re-aggregated into matrices ready for the 'next' iteration (which does not happen in the Base scenario) are identical to the starting matrices.

The conclusion from this was that the matrix processing for the Base Scenario was (mechanically) correct.

4 Dummy Forecast 2009_Base_Network_with_Base_Demand

Although re-running the 2008 Base showed that trip totals generated at the end of the run were as expected, this was not testing the code for a separate forecast scenario against the base, so a dummy forecast (for 2009) was set up, using the same input data as that for the 2008 base.

When run through one iteration, to the point of re-aggregating matrices for the next iteration, the same results were obtained as running the 2008 Base, so the indication from this was that when forecast data was supplied to the model in the expected form, the model was behaving as expected.

5 2028 Forecast Run - 2028_Base_Network_with_Ref_Demand

Taking data from the 2028_Base_Network_with_Ref_Demand scenario, the model was re-run. However, this time the aggregate matrices generated for the 'next' iteration were **not** as expected, and although the trip total differences were not as large as those reported by PB when they ran the model, the differences were such that something was not correct.

Investigation showed that the discrepancy was generated in job 0628 - Run Mode Split Model per User Class.rb, where the OtChoice incremental mode split is used. This works in the following manner:

a) trip matrices by mode (highway/pt) for the Base Year are used to generate, on a cell- by-cell i-j zone basis, probabilities of using each mode

b) these probabilities are then used with cost difference matrices (forecast year - base year; per mode), to generate forecast probability matrices per mode.

c) these forecast probability matrices are then applied to the forecast total trip matrices to derive the forecast mode split matrices.

The way in which this class works, ***if there are no observed trips in the base year for a given i-j zone pair, the probabilities are set to zero.*** Consequently, if there are non-zero trips in the forecast year for that i-j zone pair, zero trips will be generated.

Although some additional issues were noted in the use of this class, this was the prime reason for trips 'disappearing'. As reported earlier, this condition arose because:

a) the base had (originally) not been re-run with the amended script (although this condition had been addressed in this run, it was present when PB ran the model)

b) i-j zone pairs, with zero trips in the Base Scenario, had non-zero trips in the Forecast Scenario; specifically in the highway pcu matrix.

c) the switching of the HBO and HBEmpBuisness trip matrices in the Forecast run (to be confirmed)

The combined effect of these conditions was to give a significant number of trips in cells which had no observed trips in the base. Consequently, for the reasons described above, the forecast year trips were being set to zero.

Some other minor changes were made to this script to improve on the output trips totals; a check was introduced to ensure that the generated probabilities summed to 1.0 (in some cases this was not the case to several decimal places, resulting in a few trips being lost when the probabilities were applied). The forecast probabilities were also applied to the forecast total trip matrix and not the base, as implied by the example given by the OtChoice manual.

To deal the main issue, a method is required to deal with those zones where there are zero trips in the base, but non-zero in the forecast. The original design intention had been that any dummy zones in the base matrices would be 'seeded' with trip (rates) to provide an 'observed' mode split, off which the forecast could pivot. These could be derived from TEMPRO, or could be the presumed car/pt mode split in the data used to establish the car trip rates for the new developments (probably from TRICS. If 'green field' sites, expected base year values could be used to indicate what would be happening in the base, given the base network configuration.

This was not possible for these tests, so a **temporary** section of code has been inserted in this job which takes the *forecast number* of trips by mode as the base values, if there are zero trips in the base, to calculate the initial probabilities. This ensures that a non-zero set of probabilities are calculated and forecast trip are generated for these i-j pairs. Whilst this may be satisfactory for the forecast development zones, it may be incorrect for 'existing non-development' zones as the forecast mode split is being imposed rather than that for the base.

The status of this temporary amendment is discussed below in Section 8 below.

When these various amendments were applied, the aggregated matrices produced at the end of the first iteration, ready for the next, produced trips totals which were as expected.

However, it should be noted that there *will be* differences in trip matrix totals, per iteration, as trips move between highway/pt modes. This is due to the effect of car occupancy. For example, given a car occupancy rate of say, 1.5. if 100 person trips move from PT to car, this will result in 100/1.5 = 67 Vehicle trips appearing in the highway matrix, an apparent loss of 33 trips.

The audit trail for the analysis of this model run is given in spreadsheet:

Audit Trail 2028 Ref Demand.xlsx

which is in .../*Model_Data\Model_Outputs\2028_Base_Network_with_Ref_Demand*

This spreadsheet is similar to that for the 2008 base analysis, but has an additional section at the bottom showing the results of the mode split analysis, and trips changing mode per purpose group.

Given the modal shifts, and the different car occupancy factors per purpose, a commentary is give non how each set of figures is obtained.

As an additional test, the second iteration was run through manually to the generation of matrices post-mode split. The results were sensible and there were no unexpected loss of trips.

As can be seen in the *Audit Trail 2028 Ref Demand.xls,* the modal shift is not very high for the first iteration, although for the second iteration the change is larger (no documented here). It is difficult to comment on why his should be the case given the various input data items which need review (see Section 8 below) but it is likely that the initial iteration is making a 'base' adjustment, with subsequent iterations (of which only one has been done) seeing the modelling interactions really taking effect.

6 Mapping the Saturn and OmniTRANS networks

A key feature of the model is the interaction between the highway and pt networks; that is, for the OmniTRANS pt assignment to use the highway speeds generated by Saturn. By doing so, any congestion in the network forecast by Saturn would be reflected in the run time for buses, which in turn would affect the generated pt skim matrices. As the skim matrices from both the highway and public transport models are inputs to the mode split model (as described above), this interaction is a vital component of the model.

This feature was disabled in the PB amended jobs for the model, but was re-instated for this audit analysis, and must be maintained for any further model runs.

7 An overview of the mapping process

The OmniTRANS and Saturn networks are, for the most part, topographically different, but the requirement exists, as noted above, to transfer data from the Saturn network to the OmniTRANS network.

Topographical differences between the two networks occur because:

- The OmniTRANS network was built using an imported NAVTEQ digital network. This includes all 'minor' roads, not present in the Saturn network

- The Saturn network is very 'abstract' for the outer study area whereas the OmniTRANS network is more detailed

- Within the 'Study Area', the Saturn network contains many 'abstract' simplifications, which are not present in the OmniTRANS network.

In areas of the network where the networks are topographically similar, a single Saturn link between nodes 'a' and 'b' may be represented by a series of OmniTRANS links; the intermediate nodes representing intersections with the 'minor' roads not present in the Saturn network.

The two networks also differ in that different node numbers are used for the same 'pint' in the network.

The challenge is then to 'map' the two networks together, recognising that there may be sections of the network where this is not possible. However, the expectation is that mapping will be successful in the parts of the network which 'matter' - that is, where the bus routes operate.

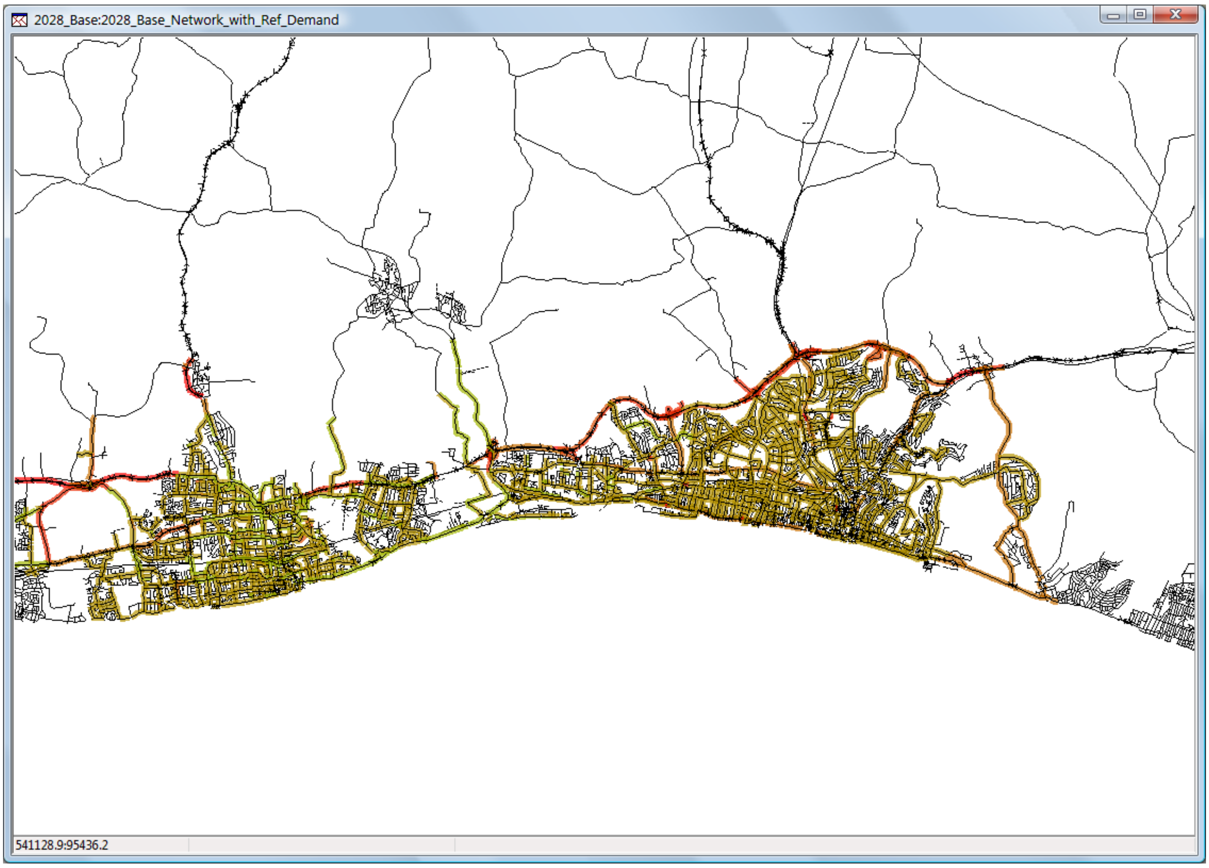
The mapping process is described as follows:

- first produce a node equivalence file between the two networks. Using grid coordinates, nodes in the two networks are 'mapped' to each other. When establishing a new forecast scenario, job *0605 - Map Forecast Year Saturn Network Nodes* **must** be run to establish the node equivalences, even if the Saturn network has not been changed from the base, or any other forecast run.

- using this node equivalence file, a link equivalence file is generated. For each link in the Saturn network, the equivalent single OmniTRANS link is found. If this does not exist, the shortest path between the two equivalent OmniTRANS nodes is built, and this set of links is equated to the Saturn link. This link equivalence file is used to transfer data from Saturn to OmniTRANS.

  When running the model, job *0624 - Import Saturn Link and Turn Times* does this mapping, and transfers both link and turn times from the loaded Saturn network to the OmniTRANS network; in turn these times are used by the pt assignment. Note that when this job is run, many apparent warning and error messages are generated. These relate to those parts of the network which cannot be mapped correctly.

  The image below shows the part of the network where speeds have been transferred across from Saturn to OmniTRANS:



[Bandwidth plot: SatDB Speeds [pmtu 1,1,21,24,1,1]

8 Conclusions and Recommendations

The audit of the model identified several issues which required addressing, and as stated, the model now appears to be running correctly in a 'mechanical' sense.

However, several issues have been noted relating to the data used for the 2028 forecasts, and it is recommended that these are reviewed. Specifically:

a. The input planning data spreadsheets appear to be identical to that for 2008. These spreadsheets contain Parking Costs and Car Availability Proportions by mode/purpose. Is it the intention that these are identical, especially parking costs?

b. Similarly, the proportion matrices used to split trips between pay/free|park/fare are identical. Is this intentional?

c. The initial input forecast vehicle pcu trip matrices should be reviewed to ensure that it is intended that there are i-j zone pairs which have non-zero trips in the forecast, but not in the base. (See job *Compare Base and PB 2028 matrices* which resides in *..\jobs\00_Utilities_Misc* to see which i-j pairs are found). If this is the intention, then action relating to the 'seeding' of the base matrices is required (discussed below)

d. The import of HBO and HBEmployers Business observed matrices. It would appear that these have been 'switched' (certainly for the 2028 forecast that was run). This needs checking.

e. Apparently the Saturn and OmniTRANS networks have not been changed from the base. Is this the intention, especially with reference to pt services which may (or indeed may not) be associated with the new developments?. If pt services, or network changes are intended for the forecast scenario then as currently stated, these will not be reflected in the mode split calculations.

A view needs to be taken on how to manage the seeding of i-j cells where there are zero trips in the base, but non-zero in the future. Options are:

a. where this occurs, to use the forecast trips to generate the base probabilities. This has been implemented as a pragmatic solution, but as discussed above could be argued to be technically incorrect in the case where more accurate base year values could be provided, based on TEMPRO/TRICS/Local trip rates. This leads to the next option:

b. to provide a mechanism that seeds candidate cells with data based on TEMPRO/TRICS/Local trip rates (by purpose, by time of day) which would give an accurate representation of potential mode split, were there trips for these zones. This could be done on a cell-by-cell basis, which might be onerous, or on a matrix wide basis using sets of 'default' rates.

c. re-organise the model structure, so that for each forecast year, a new reference base scenario is established. This would be similar in function to the 2008 Base in that any scenarios for that year would be pivoted off the base for the year. However, this only makes sense if there is no discrepancy between the matrices for the forecast year with zero/no-zero cells; otherwise we are back to the original problem.

Other than the implementation of (a), required to 'fix' the loss of trips, implementing options b or c are not achievable within the scope of this audit.

9 Model Requirements

The model in its current (post-audit) form is still in OmniTRANS V5 format, although as reported earlier it now includes the required MvDataTools classes for successful operation.

These classes are provided *gratis*, but no maintenance support is provided. Neither can they be used in any other model that PB or WSCC might construct.

If this model were to be used by any other organisation, they are unlikely to have (access to) OmniTRANS V5 and the model would have to be converted to OmniTRANS V6. It should be noted that this has several ramifications given changes between the two OmniTRANS versions:

- The Scenario Manager requires re-writing as the class used to construct it is no longer supported by Omnitrans International. It would have to be replaced by using WxRuby as the successful operation of the Scenario Manager cannot be guaranteed

- As well as using MvDataTools, the V5 model used the Model Parameters Manager as developed by Minnerva. This creates the Managed Model Parameters file used in the scripts. Although the absence of the Model Parameters Manager does not preclude the running of the model as it stands, new features provided in OmniTRANS V6 render the Model

Parameters Manager obsolete. Consequently, the handling of the model parameters needs re-casting.

APPENDIX B

SHOREHAM HARBOUR TRANSPORT MODELLING AREAS BOUNDARY MAP

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PARSONS BRINCKERHOFF

Parsons Brinckerhoff

Queen Victoria House,
Redland Hill, Bristol BS6 6US
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CLIENT/PROJECT
Adur District Council
Adur Local Plan and Shoreham Harbour Transport Study

TITLE
Indicative Shoreham Harbour Modelling Zones

DATE
27/08/2013

SCALE
Not to scale

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SP

APPROVED
NW

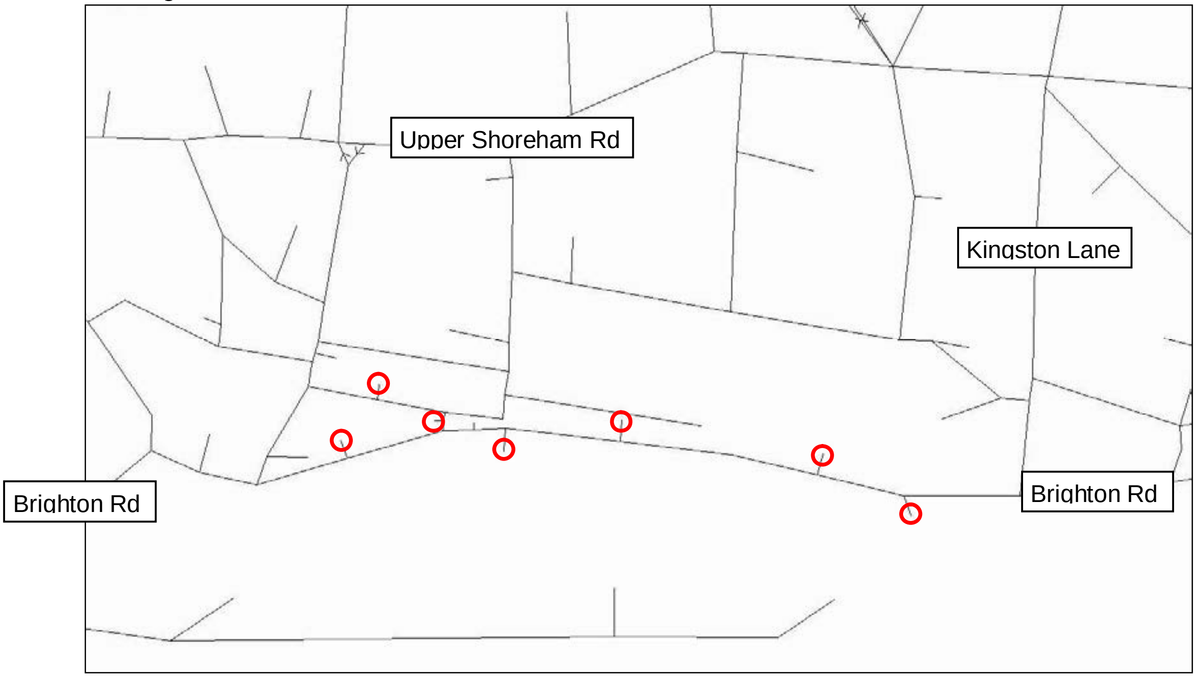
Appendix B

APPENDIX C

SHOREHAM HARBOUR SITE ALLOCATION TRIPS

Western Harbour Arm [1]

Loading Points



Note: Red circle(s) indicate development zone loading point(s).

Zone loading location	Estimate of current jobs (B2/B8)	Estimated new jobs			Total New jobs	Net increase in job number
		New office/light industrial B1	New B2/B8	New retail (A1)		
Western Arm	1279	1307	0	138	1445	166

Assumption: All existing jobs removed and replaced by new jobs

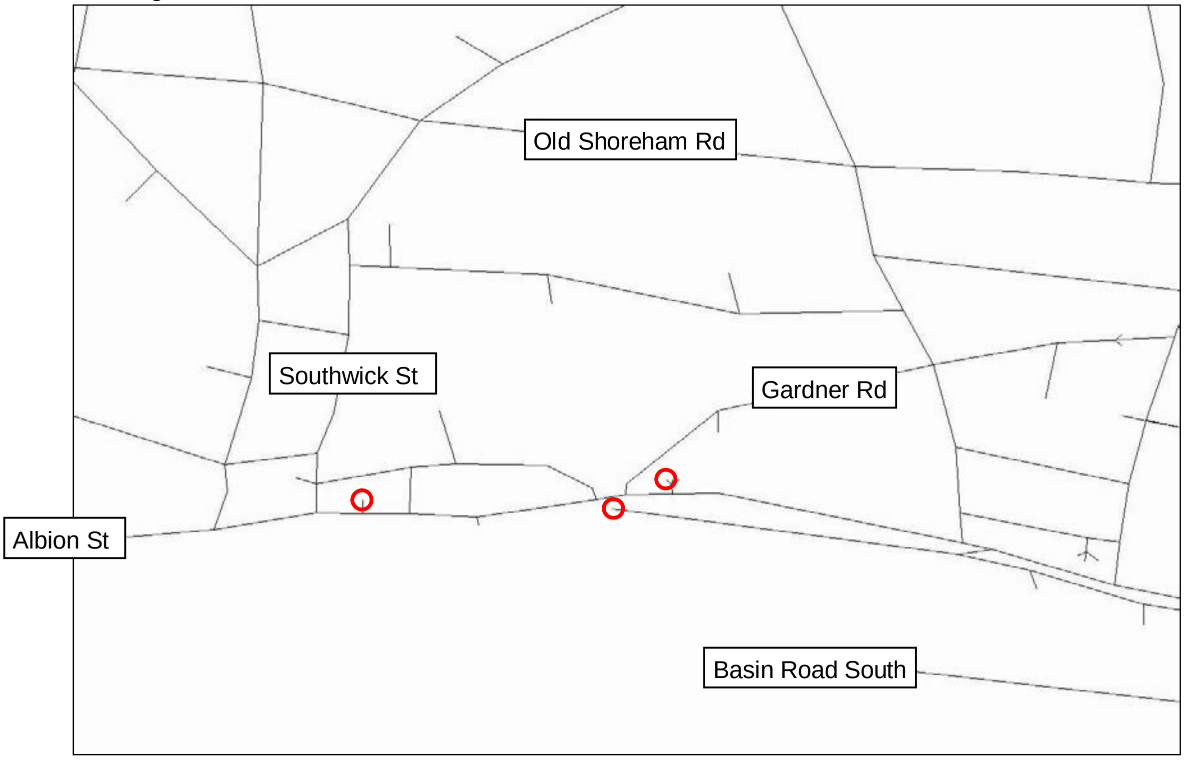
Departures (AM peak)
New departures: 571
Existing departures (to remove):260
Net increase in departures: 311

Arrivals (AM peak)
New arrivals:646
Existing arrivals (to remove):687
Net increase in arrivals: -41

Method
Existing trips will be removed from zones falling into the Shoreham Harbour sub area that currently contain trips. New trips will be added in to the selected zones.

Port Operational North [2]

Loading Points



Note: Red circle(s) indicate development zone loading point(s).

Zone loading location	Estimate of current jobs (B2/B8)	Estimated new jobs			Total New jobs	Net increase in job number
		New office/light industrial B1	New B2/B8	New retail (A1)		
Port Operational North	470	85	85	0	170	170

Assumption: New jobs additional to existing jobs

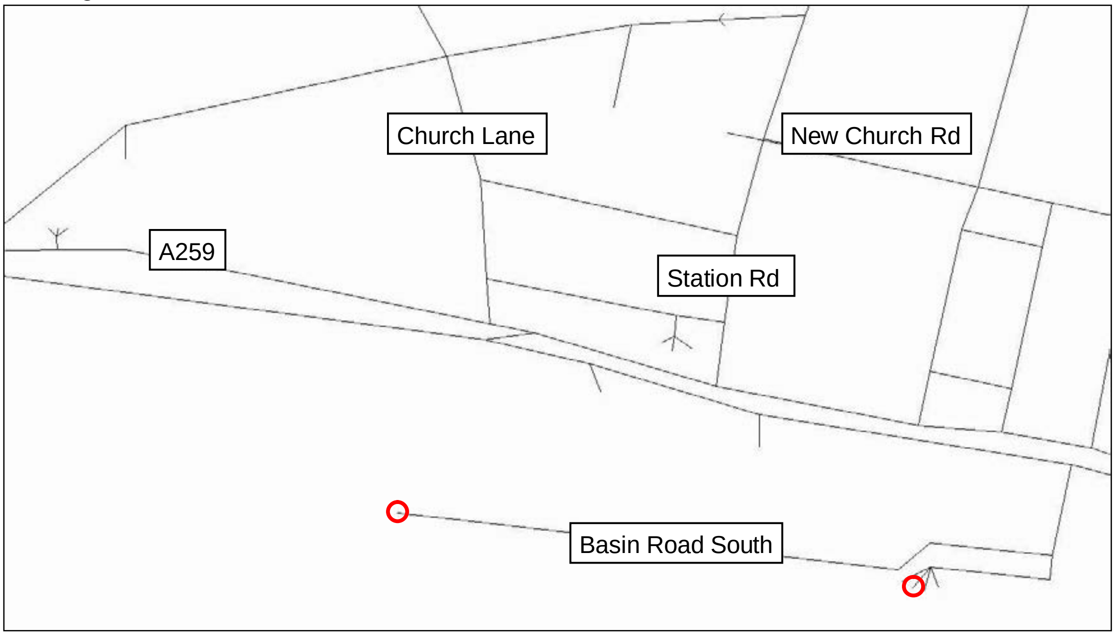
Departures (AM peak)
New departures: 20
Existing departures: 96
Net increase in departures: 20

Arrivals (AM peak)
New arrivals: 74
Existing arrivals: 252
Net increase in arrivals: 74

Method
New and existing trips will be added into the selected zones.

Port Operational South [3]

Loading Points



Note: Red circle(s) indicate development zone loading point(s).

Zone loading location	Estimate of current jobs (B2/B8)	Estimated new jobs			Total New jobs	Net increase in job number
		New office/light industrial B1	New B2/B8	New retail (A1)		
Port Operational South	470	82	83	0	165	165

Assumption: New jobs additional to existing jobs

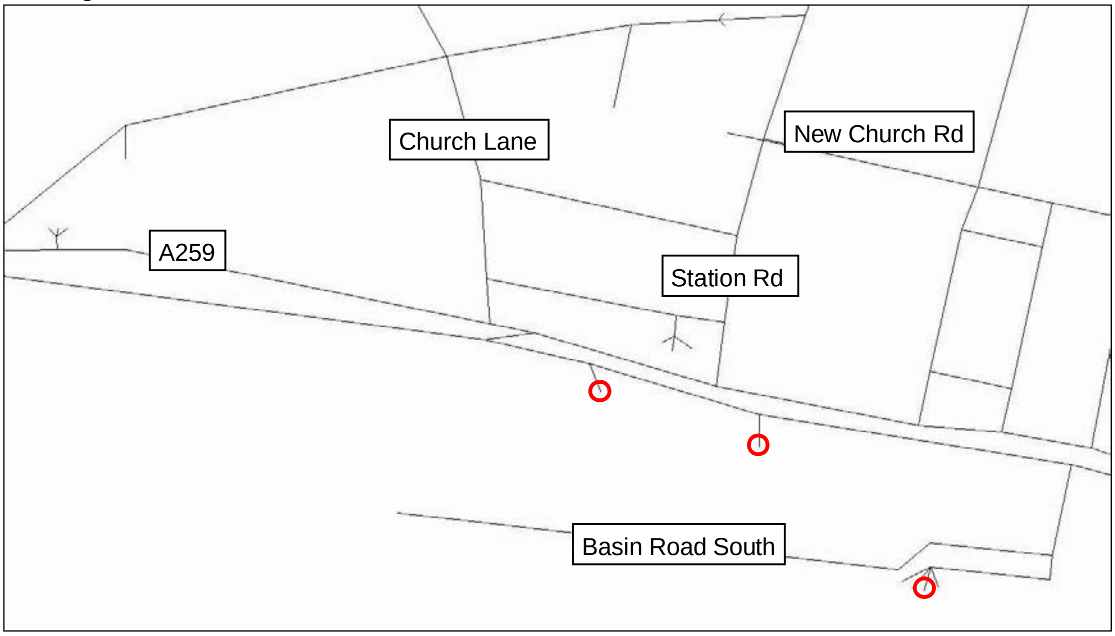
<u>Departures (AM peak)</u>
New departures: 20
Existing departures: 96
Net increase in departures: 20

<u>Arrivals (AM peak)</u>
New arrivals: 72
Existing arrivals: 252
Net increase in arrivals: 72

<u>Method</u>
New and existing trips will be added in to the selected zones.

Port Operational East [4]

Loading Points



Note: Red circle(s) indicate development zone loading point(s).

Zone loading location	Estimate of current jobs (B2/B8)	Estimated new jobs			Total New jobs	Net increase in job number
		New office/light industrial B1	New B2/B8	New retail (A1)		
Port Operational East	470	82	83	0	165	165

Assumption: New jobs additional to existing jobs

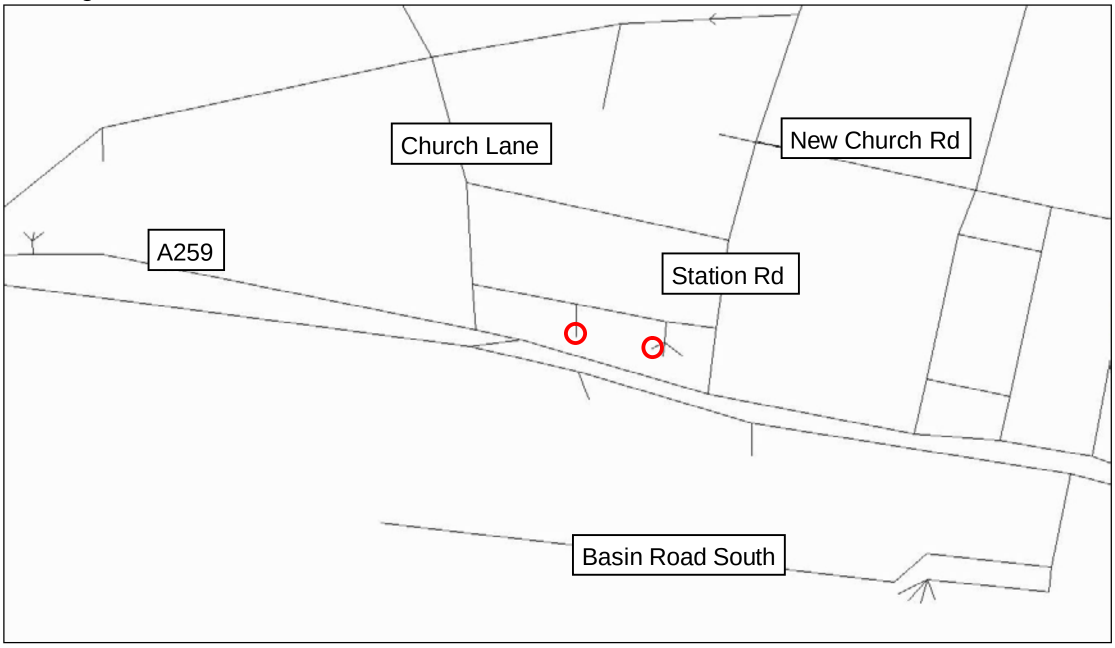
Departures (AM peak)
New departures: 20
Existing departures: 96
Net increase in departures: 20

Arrivals (AM peak)
New arrivals: 72
Existing arrivals: 252
Net increase in arrivals: 72

Method
New and existing trips will be added in to the selected zones.

South Portslade Industrial Estate [5]

Loading Points



Note: Red circle(s) indicate development zone loading point(s).

Zone loading location	Estimate of current jobs (B2/B8)	Estimated new jobs			Total New jobs	Net increase in job number
		New office/light industrial B1	New B2/B8	New retail (A1)		
South Portslade	728	2289	0	0	2289	1561

Assumption: All existing jobs removed and replaced by new jobs

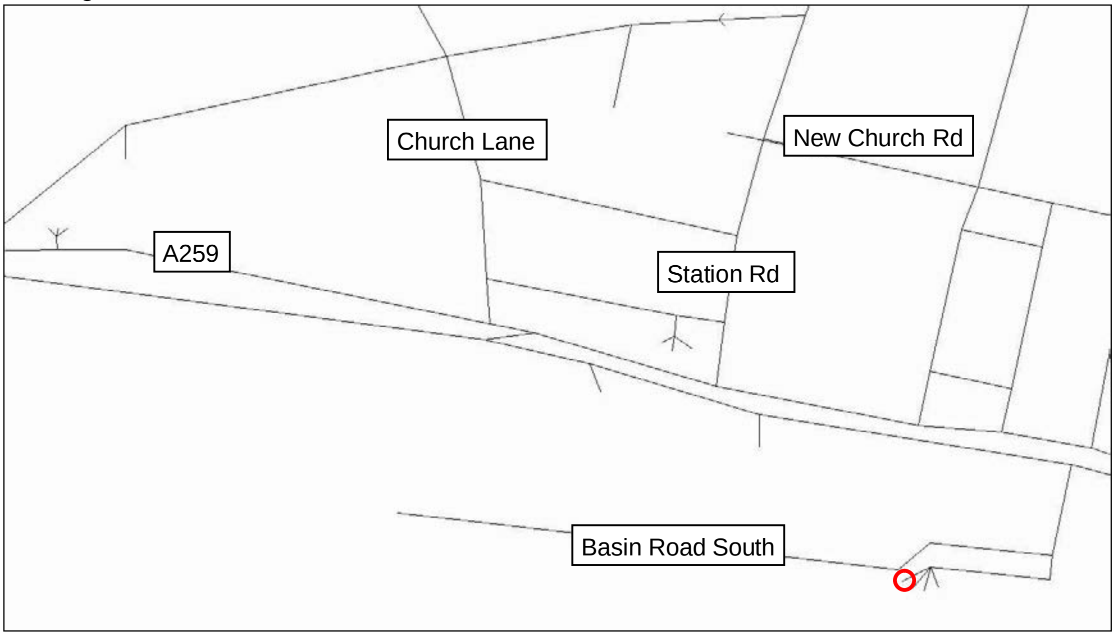
Departures (AM peak)
New departures: 144
Existing departures (to remove): 148
Net increase in departures: -4

Arrivals (AM peak)
New arrivals: 783
Existing arrivals (to remove): 391
Net increase in arrivals: 392

Method
Existing trips will be removed from zones falling into the Shoreham Harbour sub area that currently contain trips. New trips will be added in to the selected zones.

Aldrington Basin [6]

Loading Points



Note: Red circle(s) indicate development zone loading point(s).

Zone loading location	Estimate of current jobs (B2/B8)	Estimated new jobs			Total New jobs	Net increase in job number
		New office/light industrial B1	New B2/B8	New retail (A1)		
Aldrington Basin	391	1276	0	0	1276	885

Assumption: All existing jobs removed and replaced by new jobs

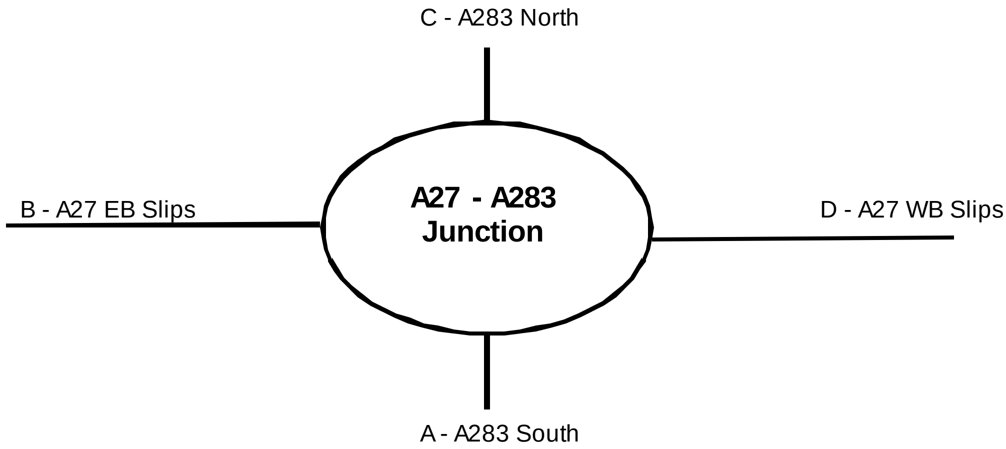
Departures (AM peak)
New departures: 110
Existing departures (to remove): 80
Net increase in departures: 31

Arrivals (AM peak)
New arrivals: 448
Existing arrivals (to remove): 210
Net increase in arrivals: 238

Method
Existing trips will be removed from zones falling into the Shoreham Harbour sub area that currently contain trips. New trips will be added in to the selected zones.

APPENDIX D

JUNCTION TURNING FLOWS



Reference Case

	A	B	C	D
A	0	514	480	243
B	353	0	160	0
C	345	1146	0	159
D	202	0	958	0

Initial Demands

Scenario B

	A	B	C	D
A	0	579	579	188
B	410	0	189	0
C	377	1142	0	174
D	225	0	921	0

Demands with Mitigation

Scenario B

	A	B	C	D
A	0	442	628	266
B	321	0	136	0
C	377	1163	0	260
D	209	0	794	0

Scenario B2

	A	B	C	D
A	0	475	652	251
B	438	0	169	0
C	382	1162	0	276
D	205	0	854	0

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Adur District Council
Transport Study of Strategic
Development Options in Adur

TITLE

AM Turning Flows -
A27- A283 Junction

DATE
2/5/2014

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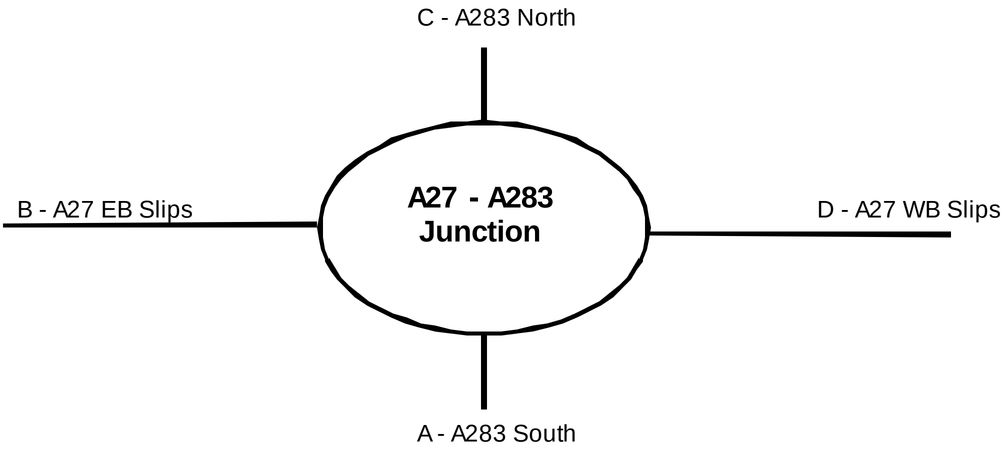
Figure D1



Reference Case

	A	B	C	D
A	0	314	1149	4
B	328	0	157	0
C	765	741	0	285
D	56	0	1401	0

Initial Demands

Scenario B

	A	B	C	D
A	0	315	1239	3
B	365	0	168	0
C	903	719	0	223
D	52	0	1311	0

Demands with Mitigation

Scenario B

	A	B	C	D
A	0	496	385	231
B	205	0	90	0
C	729	662	0	409
D	163	0	1179	0

Scenario B2

	A	B	C	D
A	0	406	663	219
B	206	0	91	0
C	718	706	0	482
D	344	0	1895	0

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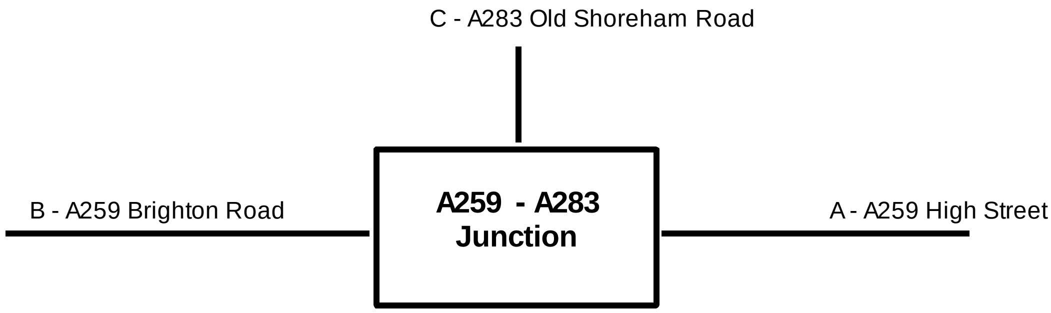
Figure D2



Reference Case

	A	B	C
A	0	1062	86
B	1285	0	529
C	80	514	0

Initial Demands

Scenario B

	A	B	C
A	0	1036	175
B	1334	0	603
C	207	482	0

Demands with Mitigation

Scenario B

	A	B	C
A	0	1033	0
B	1347	0	276
C	0	679	0

Scenario B2

	A	B	C
A	0	937	196
B	1249	0	528
C	201	394	0

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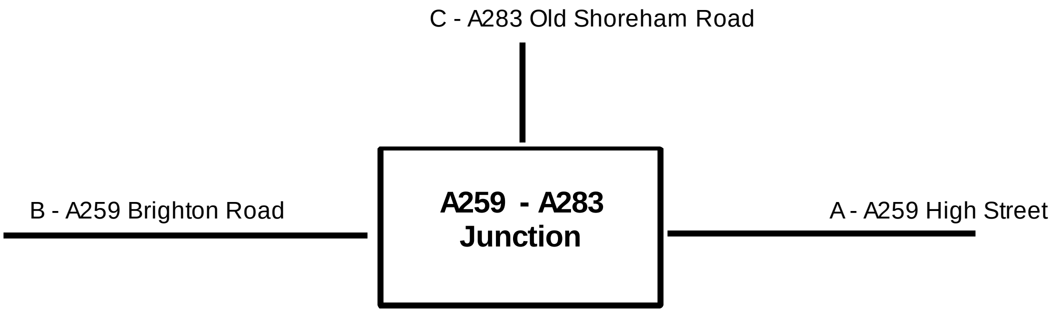
Figure D3



Reference Case

	A	B	C
A	0	982	0
B	760	107	450
C	3	1094	0

Initial Demands

Scenario B

	A	B	C
A	0	1061	0
B	805	0	454
C	21	1085	0

Demands with Mitigation

Scenario B

	A	B	C
A	0	1247	0
B	812	0	538
C	0	890	0

Scenario B2

	A	B	C
A	0	1051	0
B	792	0	425
C	56	1011	0

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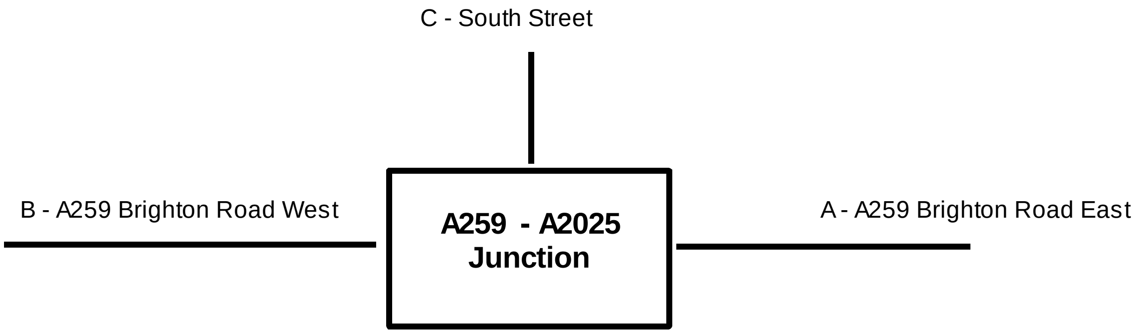
Figure D4



Reference Case

	A	B	C
A	0	836	0
B	997	0	180
C	0	758	0

Initial Demands

Scenario B

	A	B	C
A	0	815	0
B	1123	0	107
C	0	698	0

Demands with Mitigation

Scenario B

	A	B	C
A	0	1033	0
B	1347	0	276
C	0	679	0

Scenario B2

	A	B	C
A	0	1035	0
B	1299	0	283
C	0	702	0

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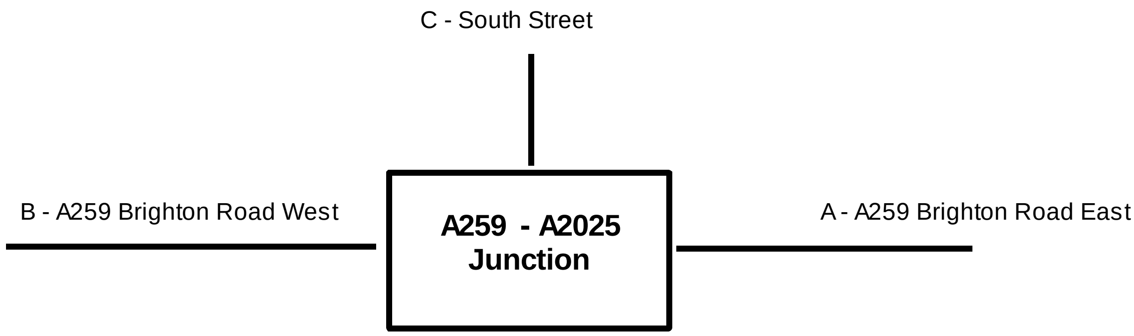
Figure D5



Reference Case

	A	B	C
A	0	860	0
B	749	0	296
C	0	890	0

Initial Demands

Scenario B

	A	B	C
A	0	869	0
B	752	0	281
C	0	893	0

Demands with Mitigation

Scenario B

	A	B	C
A	0	1247	0
B	812	0	538
C	0	890	0

Scenario B2

	A	B	C
A	0	1248	0
B	825	0	507
C	0	874	0

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Figure D6

APPENDIX E

JOURNEY TIME ROUTE MAPS

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TITLE
Journey Time Routes

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SCALE	**RH**
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	SP

Appendix E

APPENDIX F

GLOSSARY OF TERMS

Appendix F – Glossary of Terms

General Terms

The Passenger Car Unit (PCU) is a means of standardising traffic flow that considers the impact a mode of transport has compared to a single car. Larger vehicles such as buses and heavy goods vehicles are assigned multiple PCUs to reflect their increased length and so additional space required when using the highway network.

Actual flow is the number of vehicles observed passing through a junction or other given point in a network within the modelled period. Any vehicles heading to that point, but unable to complete the counted movement within the modelled period due to congestion or queuing upstream or at the junction itself are not counted in the actual flow.

Demand flow wanting to pass through a junction or other given point in a network within the modelled period. It can be equal to or higher than the actual flow depending on congestion within the network. If the network is free flowing, with no queuing, the demand flow will be equal to the actual flow. If congestion exists in the network that has delayed one or more vehicles upstream of the observation point, the demand flow will be higher.

Saturation flow is an expression of the volume of traffic (often expressed in PCU) that could be expected to pass a stop line (or observation point in the network) in normal free flowing conditions with no opposing traffic.

Capacity is the volume of traffic that can pass a stop line within the allocated green time (at traffic signal controlled junctions) or can enter a roundabout in the gaps left by circulating traffic during a given period.

Modal shift is an assessment of whether people travelling on one mode of transport (such as private cars, buses, cycling etc.) would change to an alternative mode in response to changes in the cost and journey time of one (or more) mode compared to the others available. Estimating the patronage of a new transport option, perhaps following the introduction of a new bus service, also relies on mode shift calculations when assessing the likelihood of travellers to switch onto it.

ARCADY Modelling

ARCADY is a piece of junction modelling software for estimating the capacity of give-way controlled roundabouts. The capacity of each entry to the circulatory is estimated from the geometric layout of the junction, based on academic research into driving behaviour at roundabouts. The expected vehicle demand is also entered and compared by the software to the calculated capacity of each entry.

The performance results are calculated for each time interval, usually 15 minute periods, with the highest values from the modelled hour reported. The main performance statistics reported are the ratio of flow to capacity (RFC), the average queue and delay per vehicle.

- Max RFC (ratio of flow to capacity). The RFC is the ratio of traffic flow to the calculated capacity of each entry to the roundabout. The normal practical maximum RFC value is 0.85, above which there is an increased risk of excessive queues and delays. The maximum RFC from each set of six results was recorded;
- Max Average Queues (PCUs). A predicted value for the expected queue length. The highest average queue from each of the modelled time intervals is recorded for each arm of the junction.

Furnessing

The Furness balancing technique is used when a travel demand matrix is to be factored to meet target row and column totals. In the context of this study, the targets are the forecasted total number of trips departing from or arriving at individual zones. These include existing traffic as well as new development-generated traffic. With Furness a factor is applied to match row totals, then the variation against column targets is used to apply a factor to match those. This continues in a sequential process until both the row and column totals match the targets.

LinSig Modelling

LinSig is a piece of junction modelling software for estimating the capacity of traffic signal controlled junctions. The capacity of each lane of all modelled stop lines can be entered directly from survey data or estimated from the geometric layout. Traffic signal set-up information such as the phases, staging, intergreens, phase delays etc. is entered for use in calculating the capacity of each stop line over the modelled period. The expected vehicle demand is also entered and compared by the software to the calculated capacity of each entry.

The performance results are calculated for the whole modelled period, usually an hour, with the reported results representing the average for the whole period. The main performance statistics reported are:

- Degree of saturation (DoS). This is the ratio of the arriving traffic flow on a given link to the link's capacity, usually expressed as a percentage. A DoS value of 100% indicates that the demand flow exactly matches the capacity and no additional traffic could be accommodated. A DoS value of over 100% indicates that the link is over-saturated, and queues and delays will increase with time. In practice, a DoS value of 90% is normally used as the 'practical' upper threshold because, above this value, there is a higher risk of excessive queues and delays, mainly due to random fluctuations in vehicle arrival rates;
- Mean maximum queues (MMQs) in PCUs. The mean maximum queue is the average, over the modelled hour, of the maximum number of vehicles within a discharging queue, when the rearmost vehicle begins to move away. At high degrees of saturation, actual maximum queues on site, could be significantly longer than the average values predicted by LinSig (particularly later in the period);

- Average delay per PCU (in seconds). LinSig calculates an average value for the modelled hour. At high degrees of saturation, LinSig may significantly underestimate the actual maximum delays which could be experienced;
- Practical reserve capacity (PRC) is an indication of the potential spare capacity of a junction. The PRC value is the percentage change in traffic required to return the busiest stop line within the junction to 90% DoS. A positive PRC value indicates spare capacity, a value of zero no spare capacity and a negative value indicates that the junction has insufficient capacity. The PRC will be zero if the maximum DoS value on any of the links is 90%.

OmniTRANS Modelling

OmniTRANS is a transport modelling software platform allowing the integration of multiple transport modes (such as bus routes, rail services, walking and cycling) and a mode choice model into the assignment process. For this study, a mode choice model has been used to determine the shift of demand between car and public transport trips to estimate the likely level of future demand on the highway network in the study area.

SATURN Modelling

SATURN is a traffic modelling software platform focused on highway network assignment models. The highway travel demand from the OmniTRANS mode choice model was passed to SATURN to assess the likely route choice for each trip and the cumulative effect of all trips on traffic flow volumes, journey times, link and junction delays, total vehicle kilometres etc.

The highway assignment model in SATURN reports the V/C ratio for each modelled link and all allowed turns at the modelled junctions. This compares the traffic volume assigned to each link or turn (V) with the calculated capacity for that movement (C) and is similar to the RFC and DoS used in junction models.

TRANSYT Modelling

TRANSYT is also a piece of junction modelling software used for the assessment of capacity at traffic signal controlled junctions. It is produced by a rival software company to LinSig and is based on the same principles and research, producing directly comparable results.

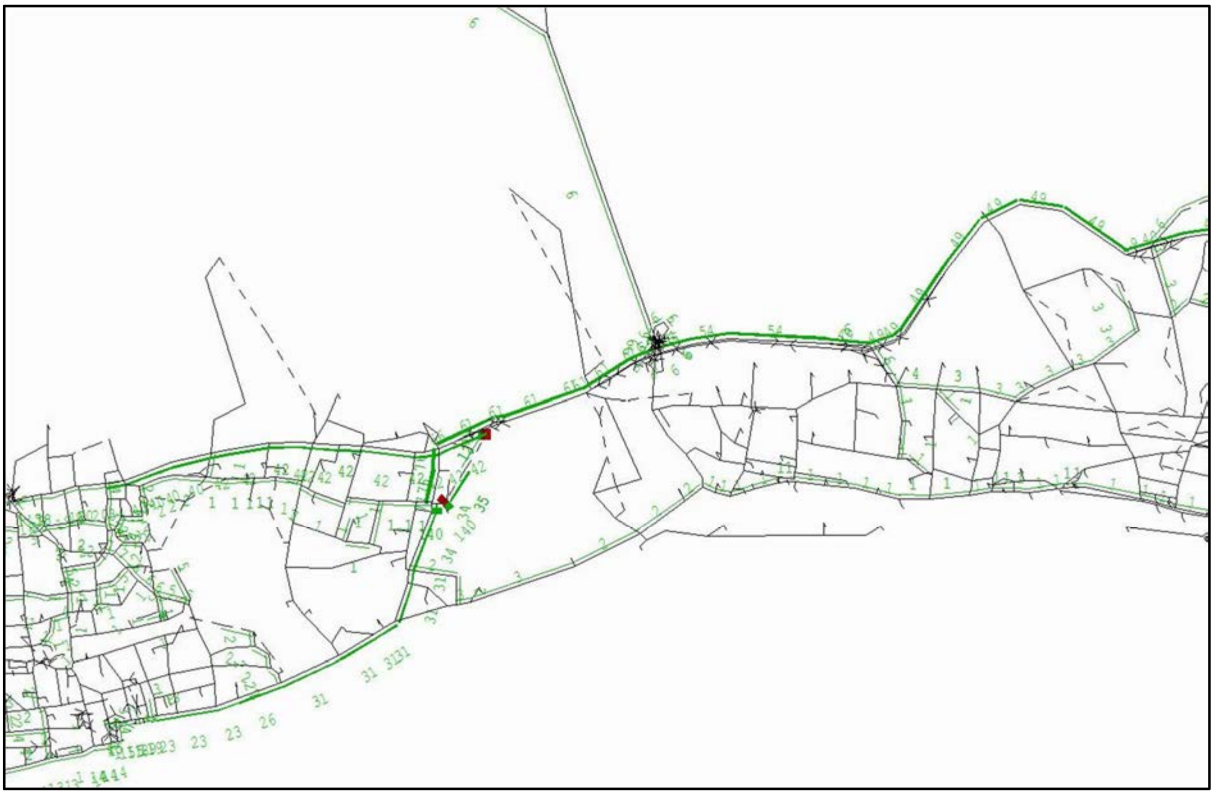
APPENDIX G

SELECT LINK PLOTS FOR SITE ALLOCATIONS

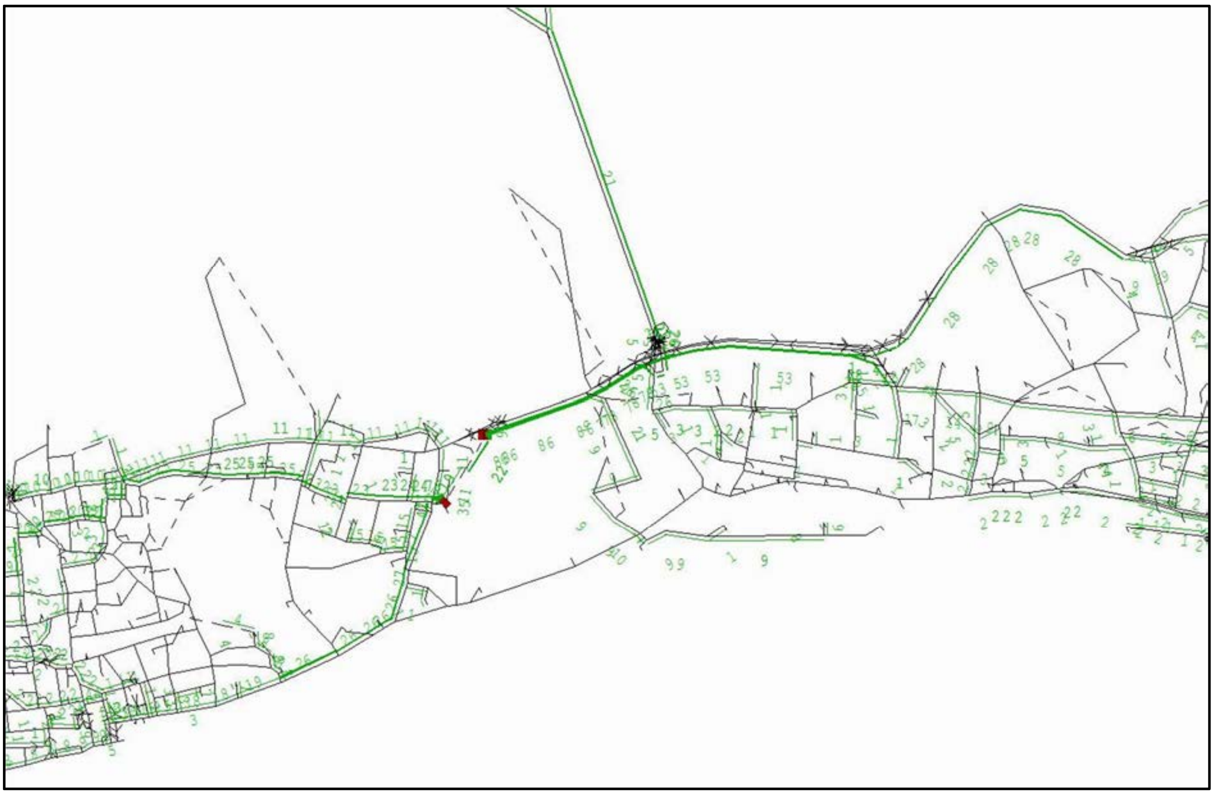
SCENARIO B2 ONLY

Key:

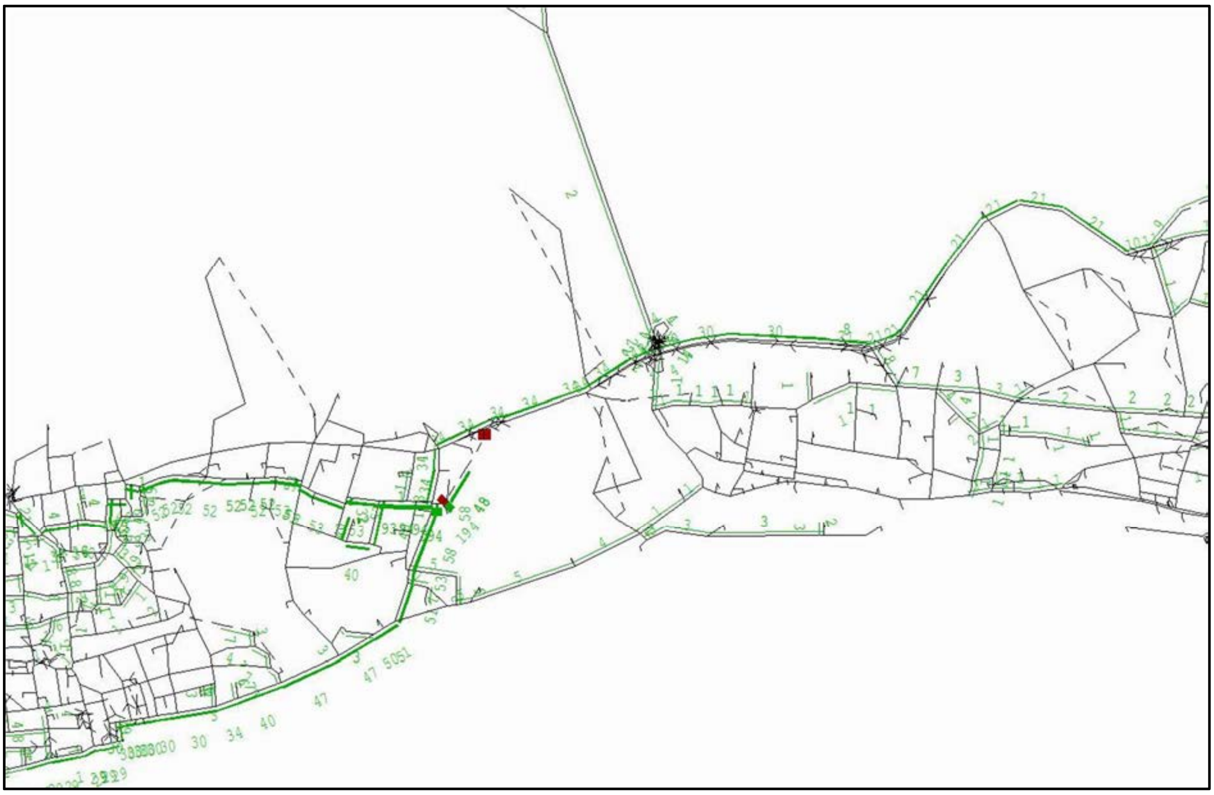
- The numbers on each plot relate to the number of vehicle trips to or from a specific development named in individual plots.
- The thickness of the green band next to each road increases as the volume of traffic on that road becomes greater.
- Red marks on each plot represent the key access / egress links relating to a specific development.



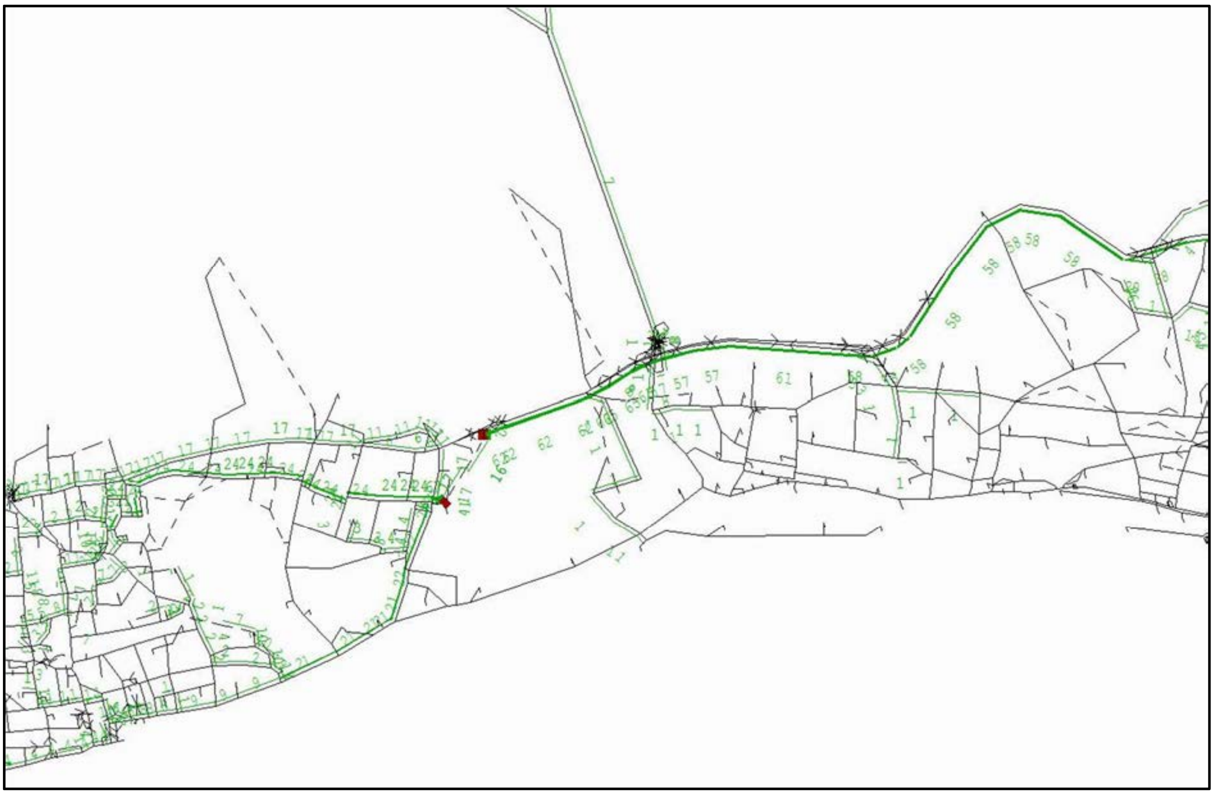
Trips from New Monks Farm, Scenario B2 AM



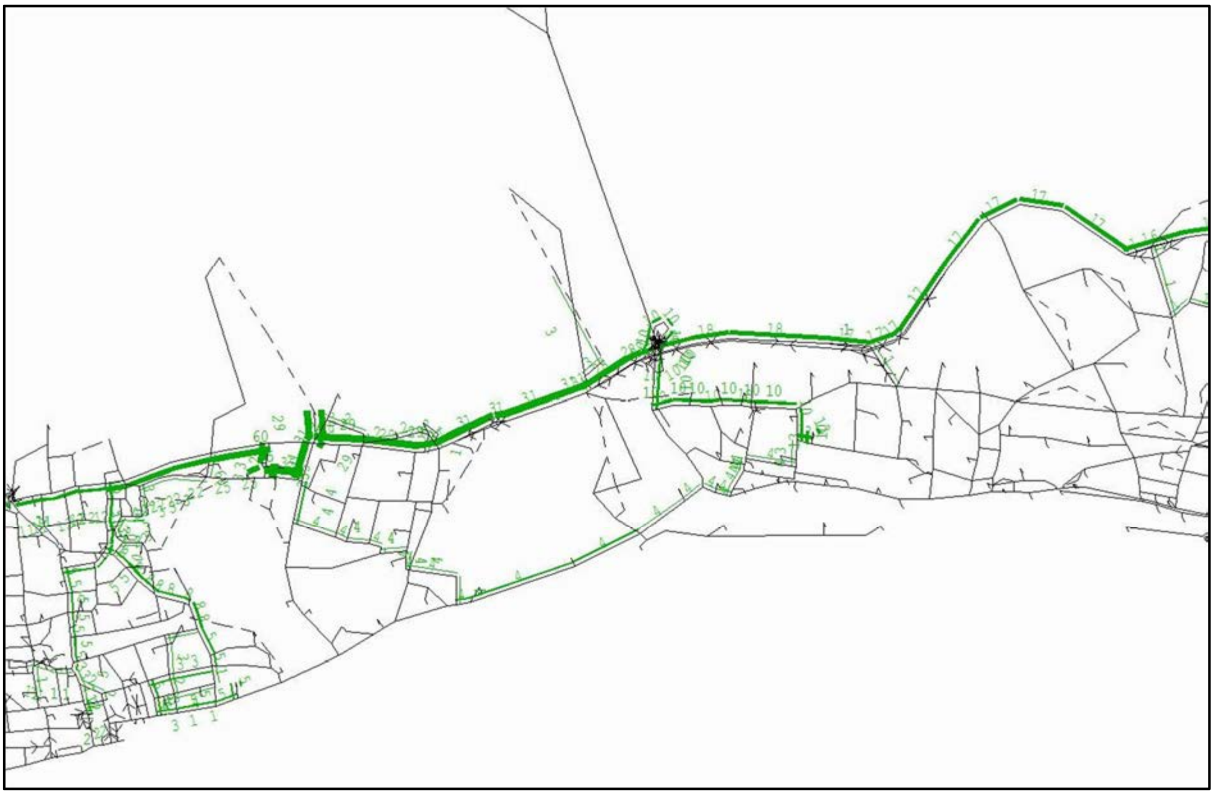
Trips to New Monks Farm, Scenario B2 AM



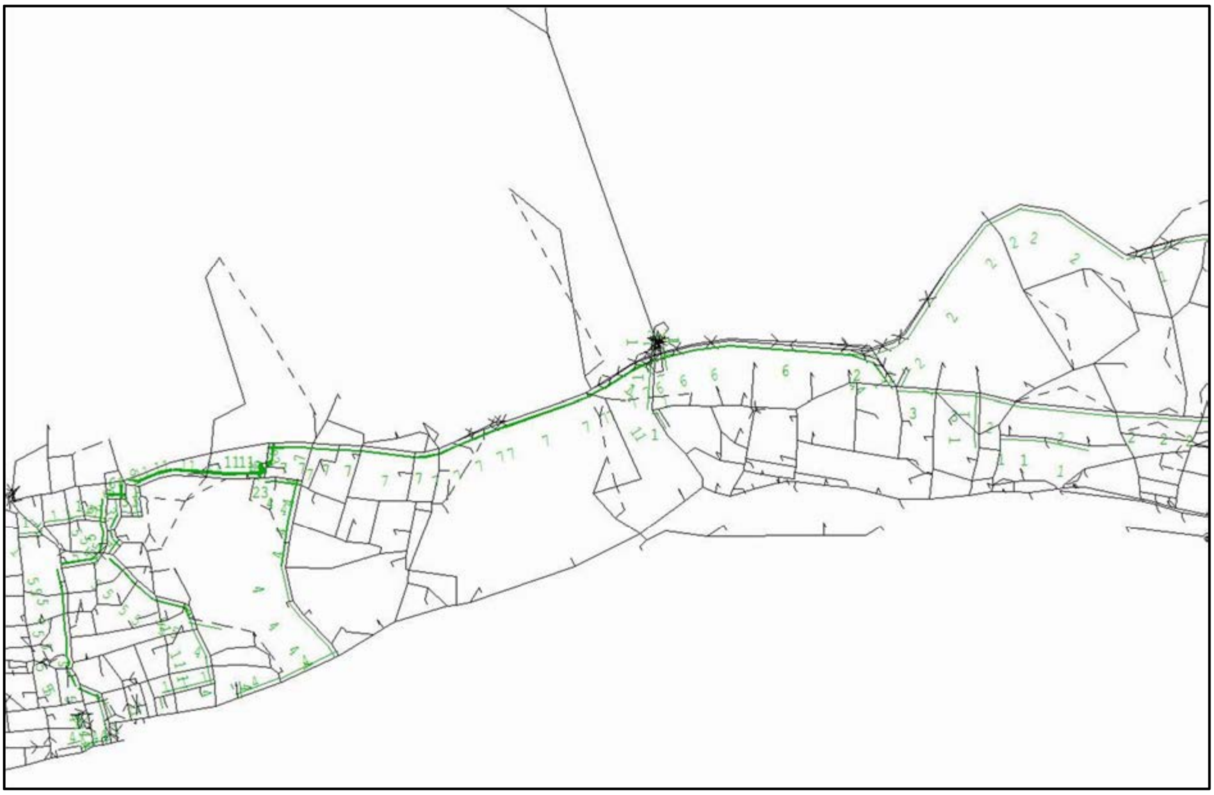
Trips from New Monks Farm, Scenario B2 PM



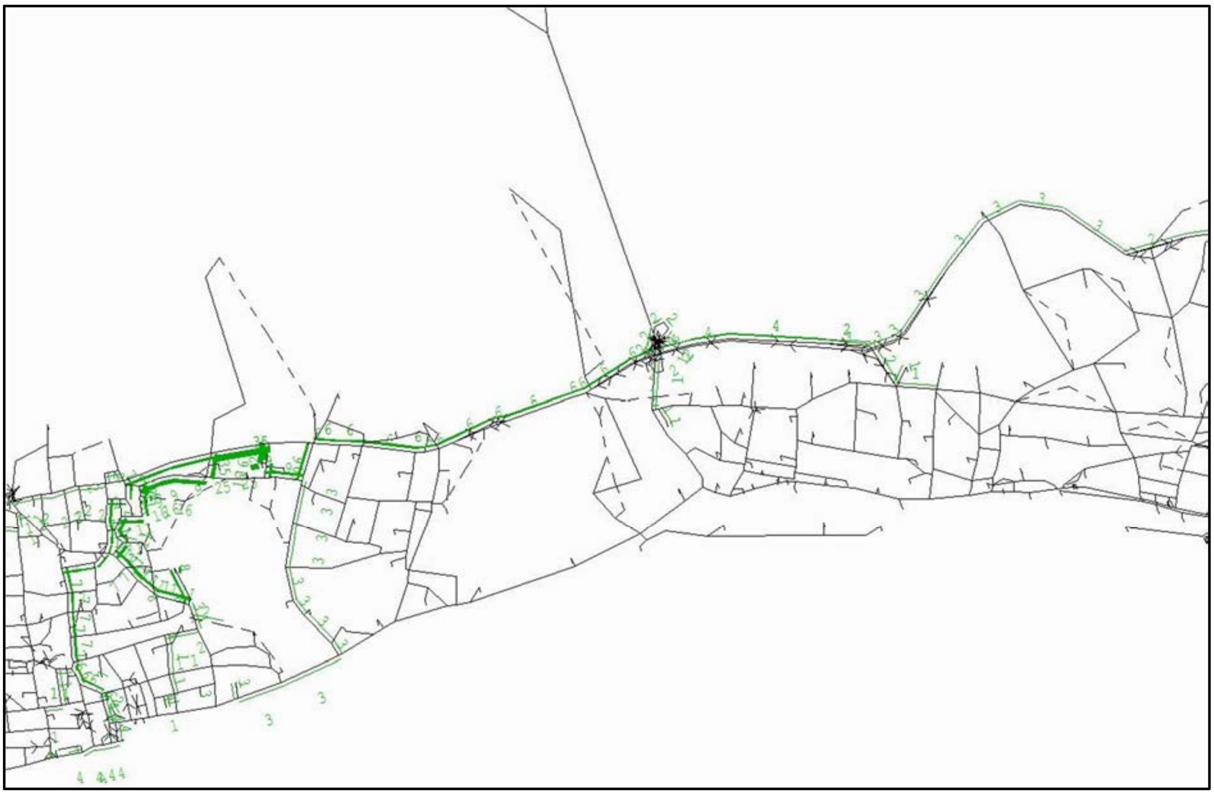
Trips to New Monks Farm, Scenario B2 PM



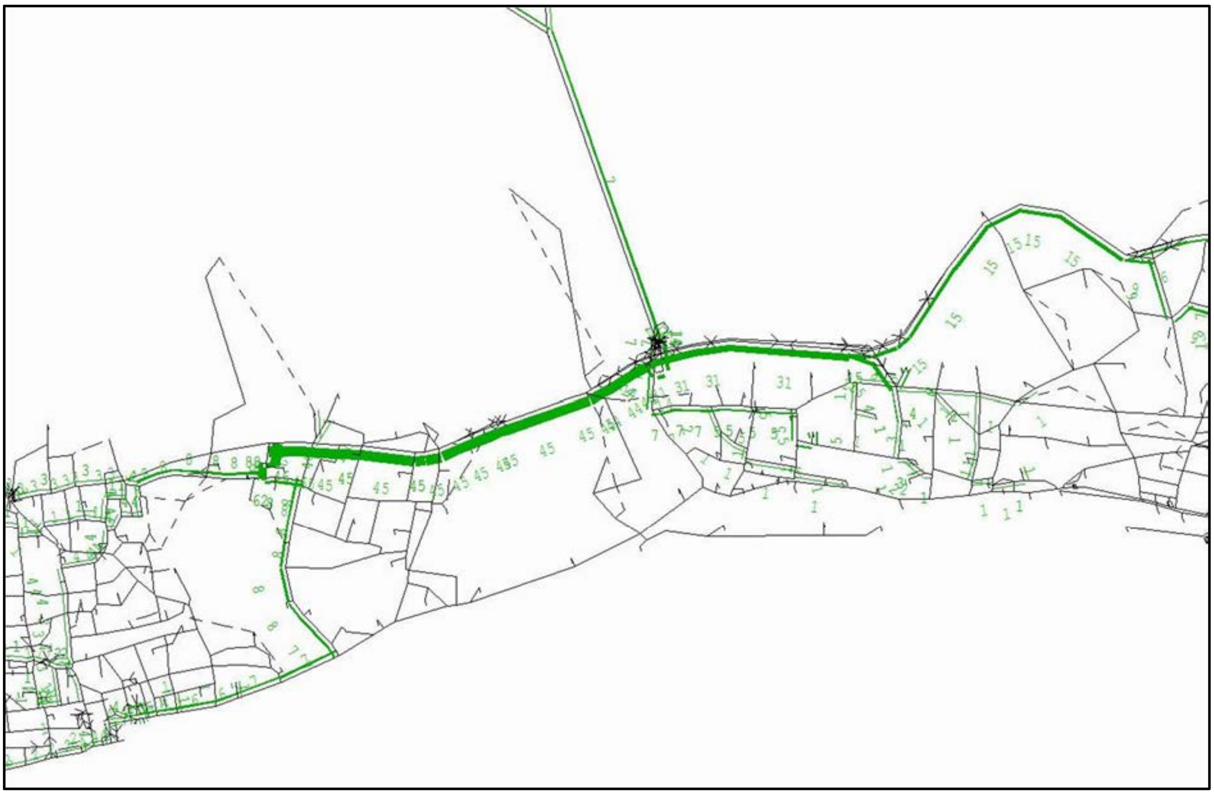
Trips from Sompting North, Scenario B2 AM



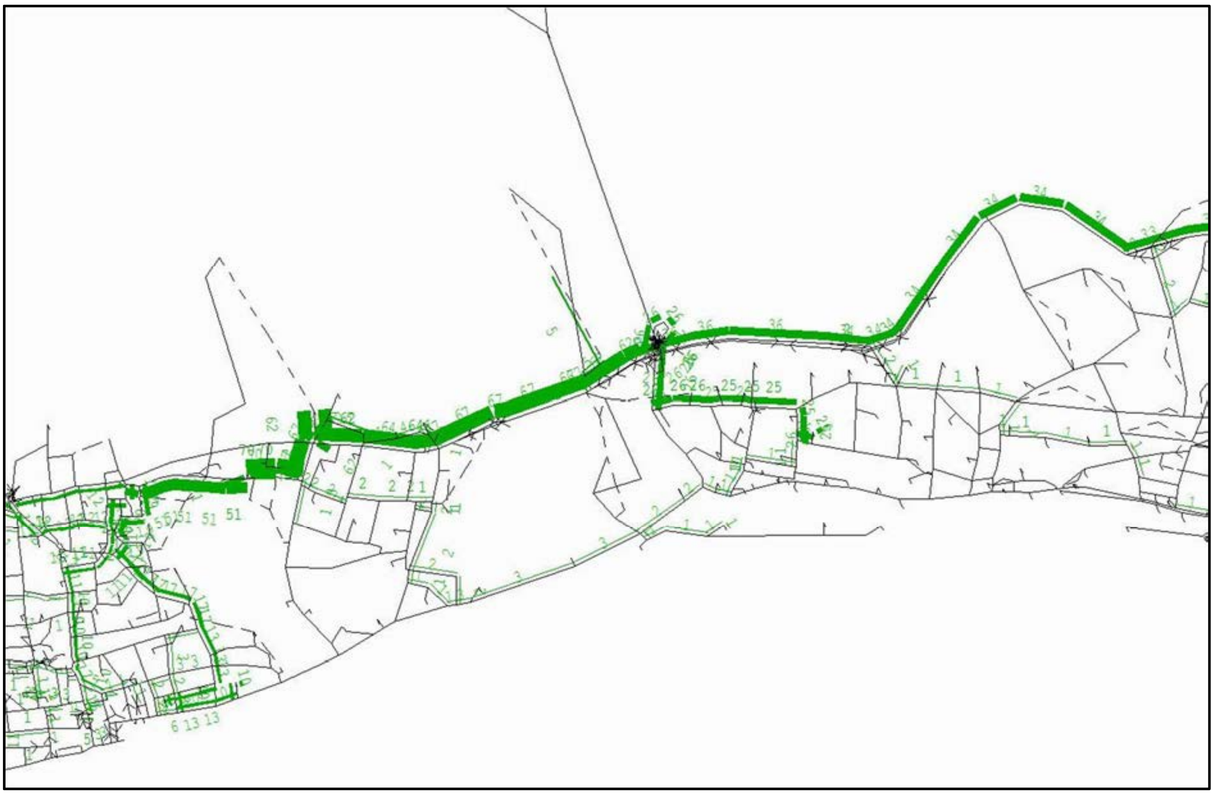
Trips to Sompting North, Scenario B2 AM



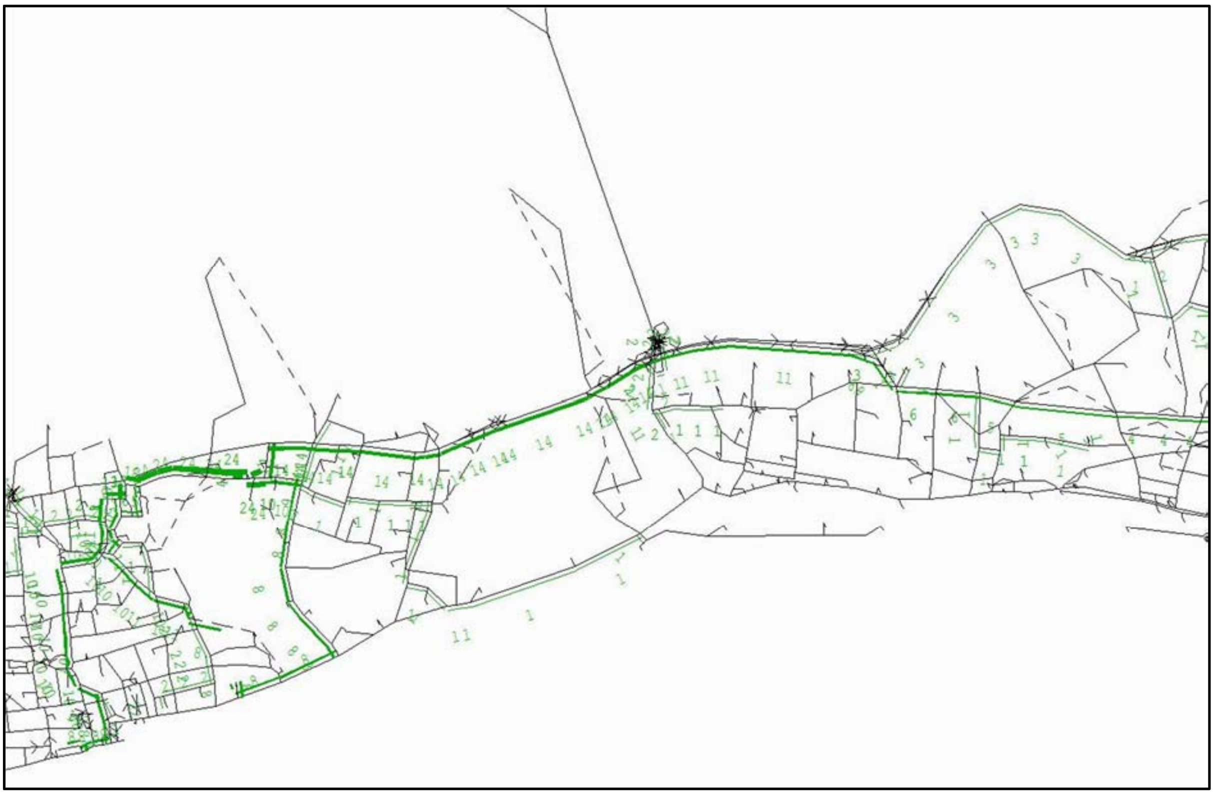
Trips from Sompting North, Scenario B2 PM



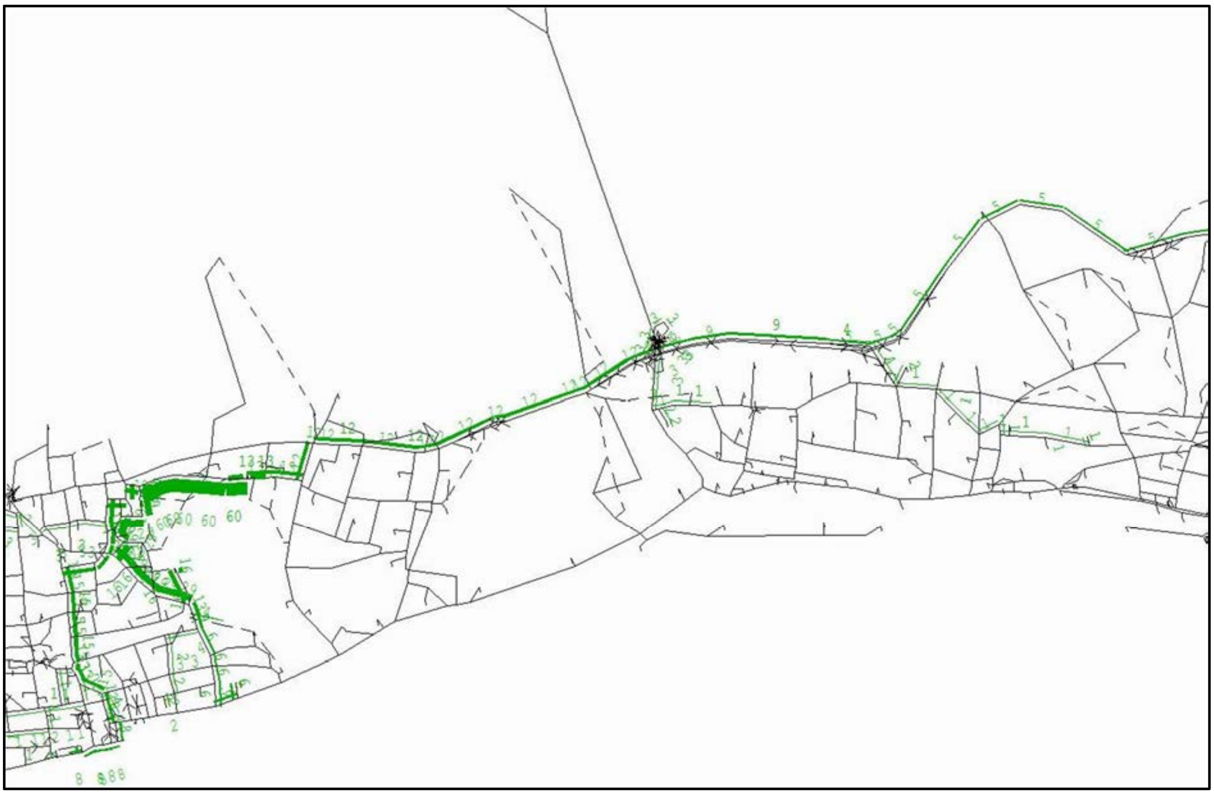
Trips to Sompting North, Scenario B2 PM



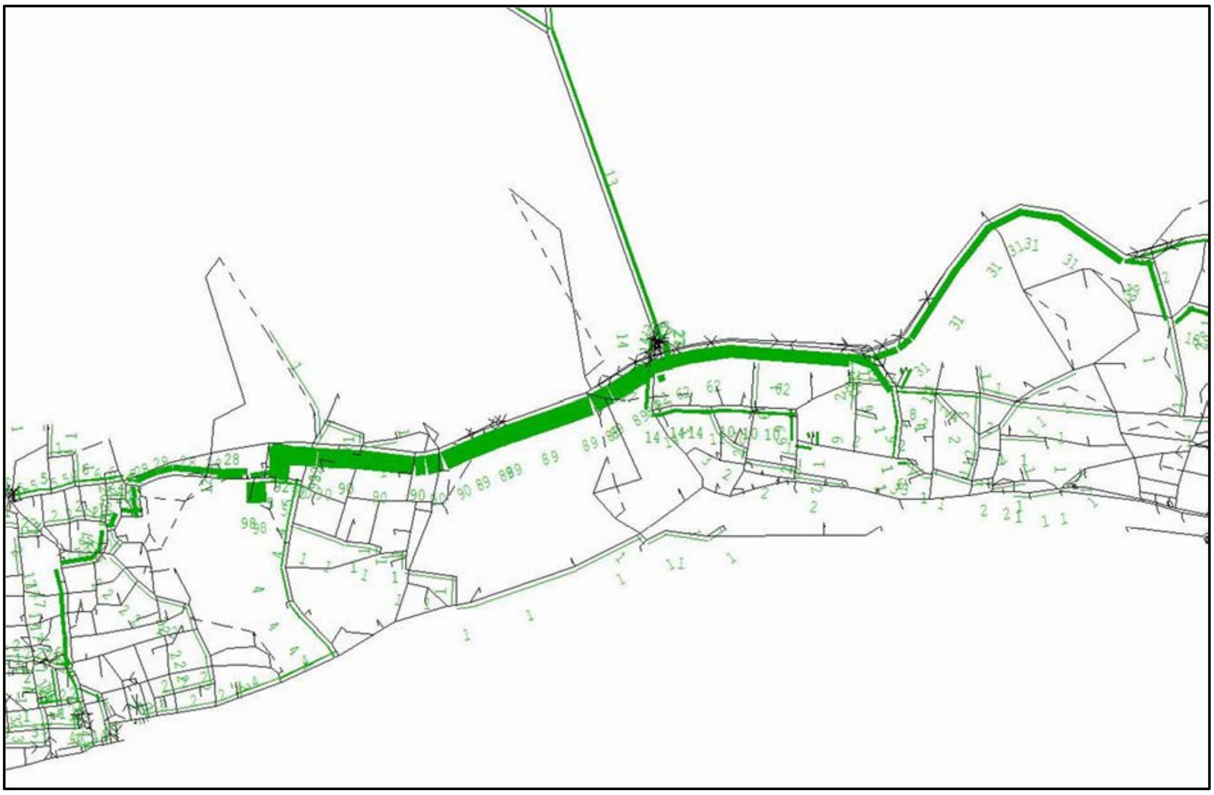
Trips from Sompting Fringe, Scenario B2 AM



Trips to Sompting Fringe, Scenario B2 AM

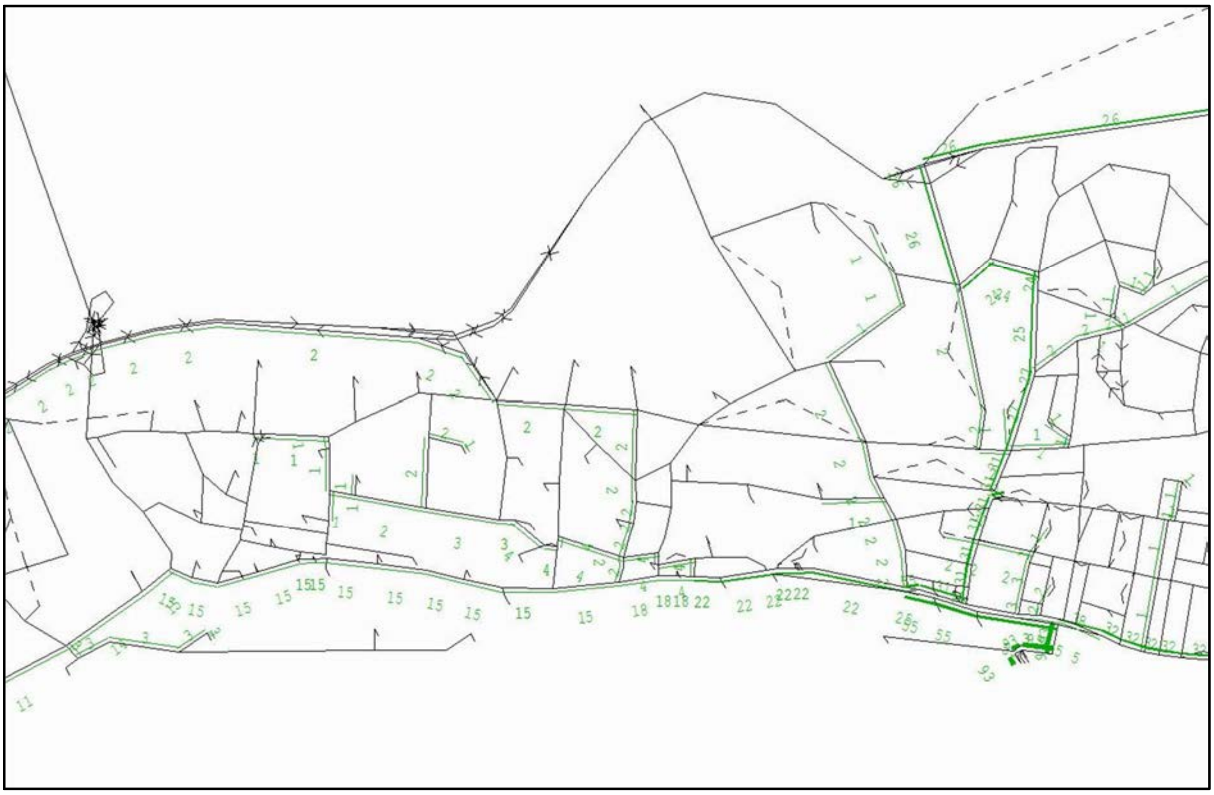


Trips from Sompting Fringe, Scenario B2 PM

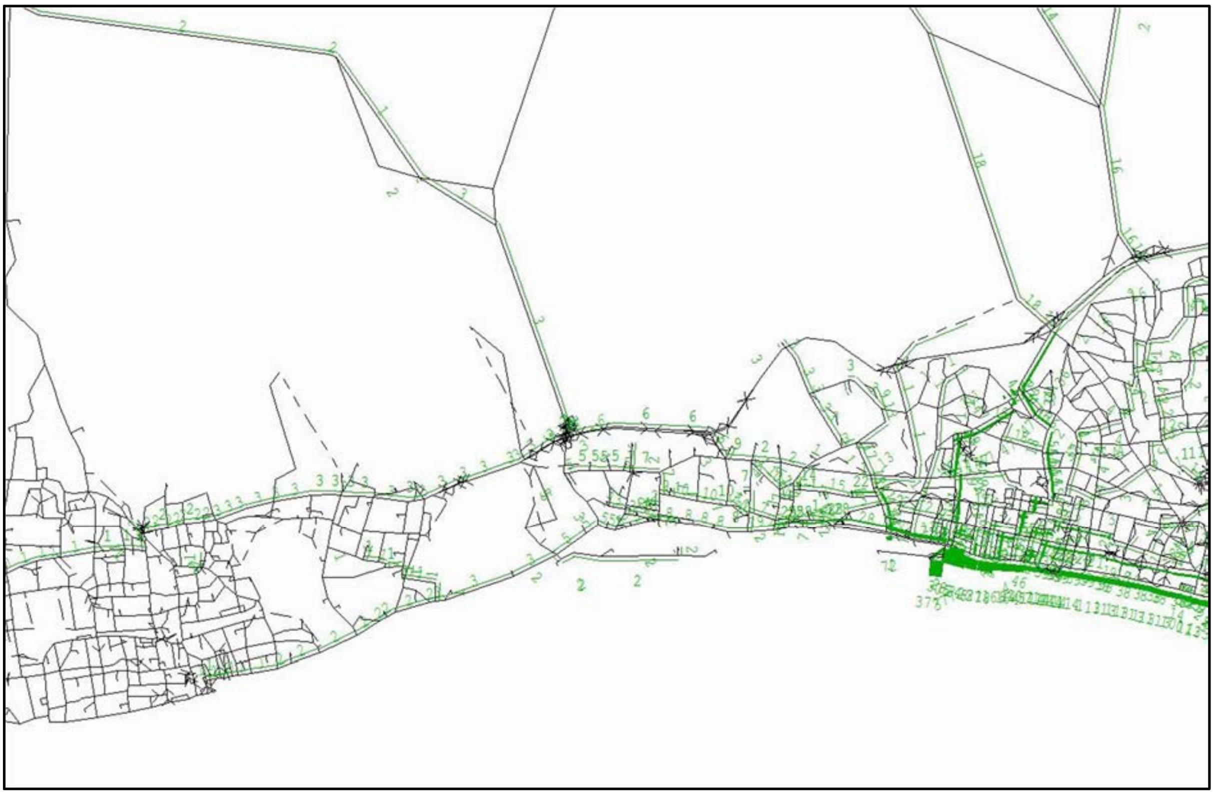


Trips to Sompting Fringe, Scenario B2 PM

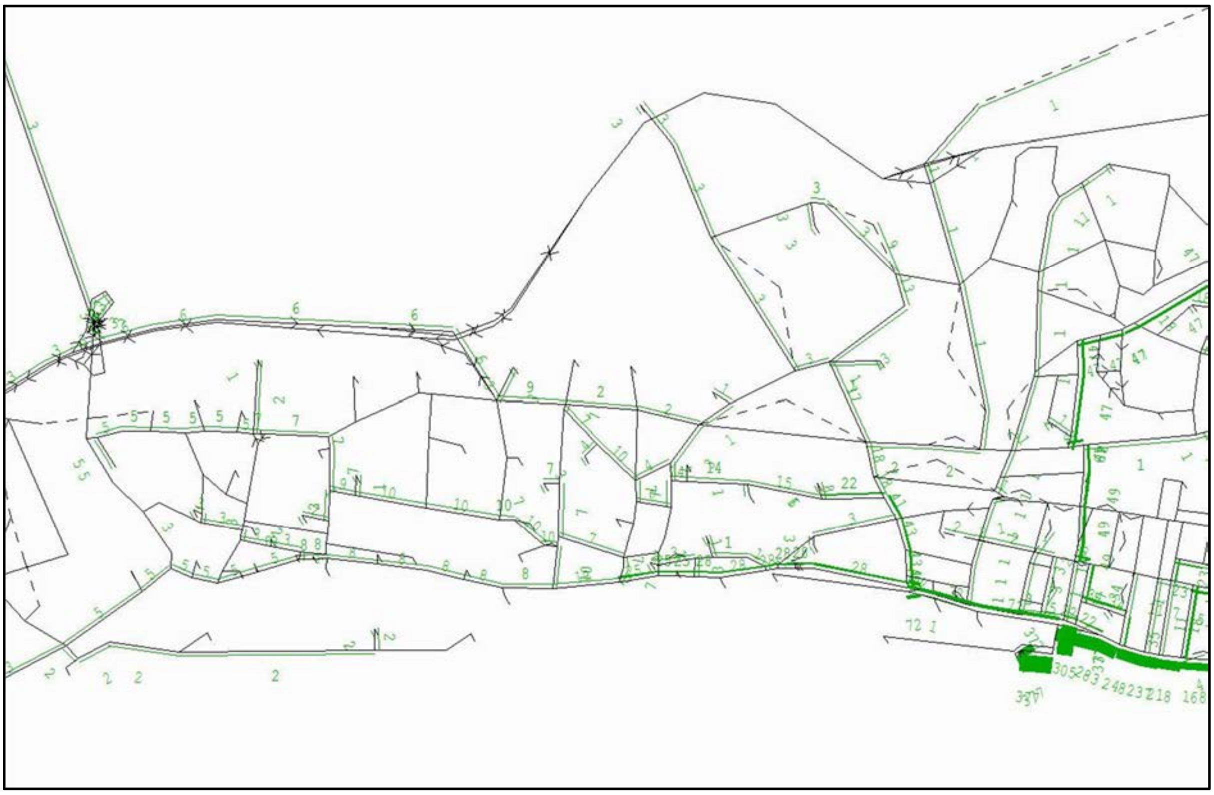
Trips from Aldrington Basin, Scenario B2 AM



Trips from Aldrington Basin, Scenario B2 AM

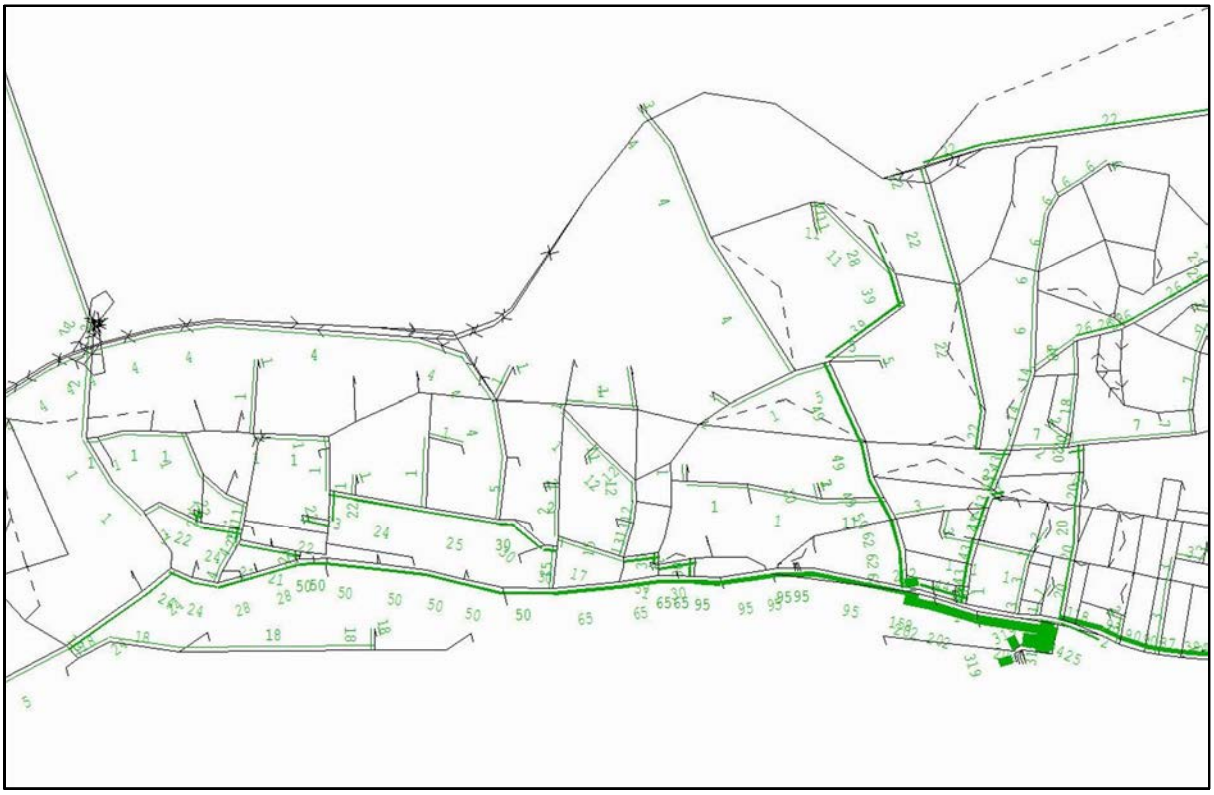


Trips to Aldrington Basin, Scenario B2 AM



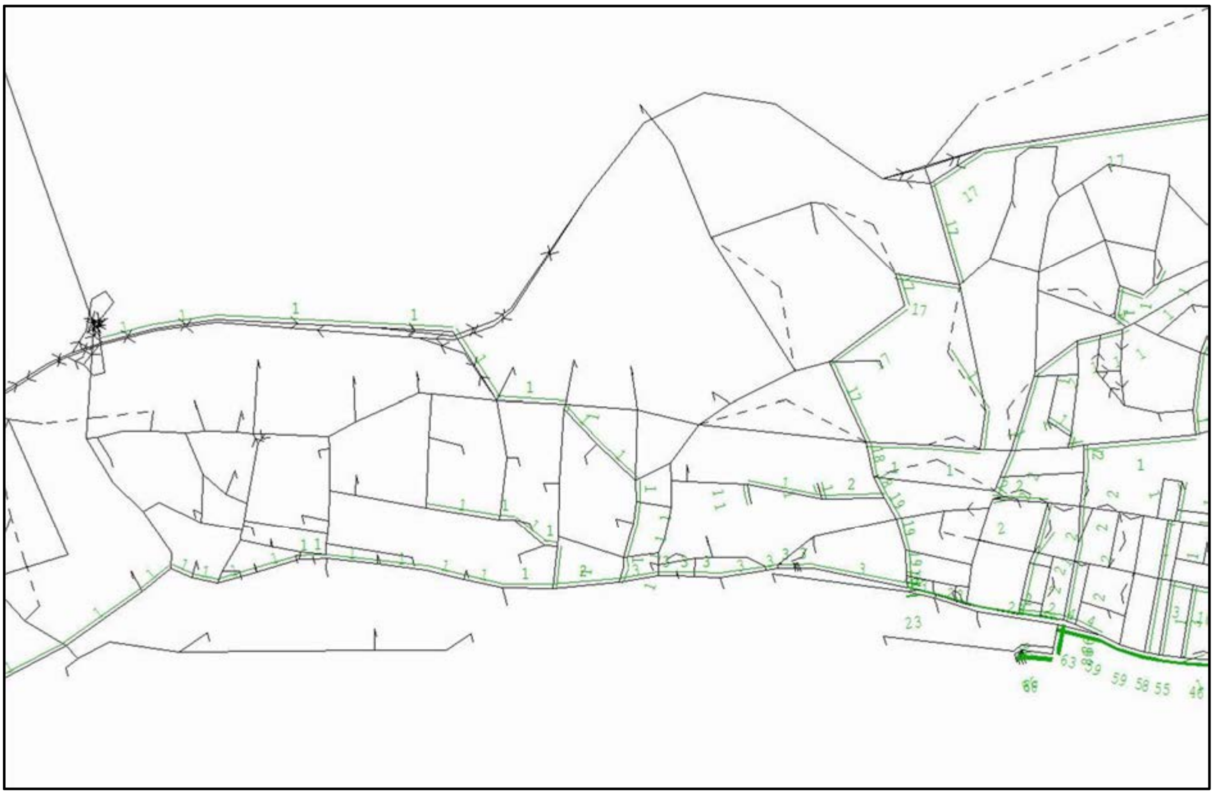
Trips to Aldrington Basin, Scenario B2 AM

Trips from Aldrington Basin, Scenario B2 PM



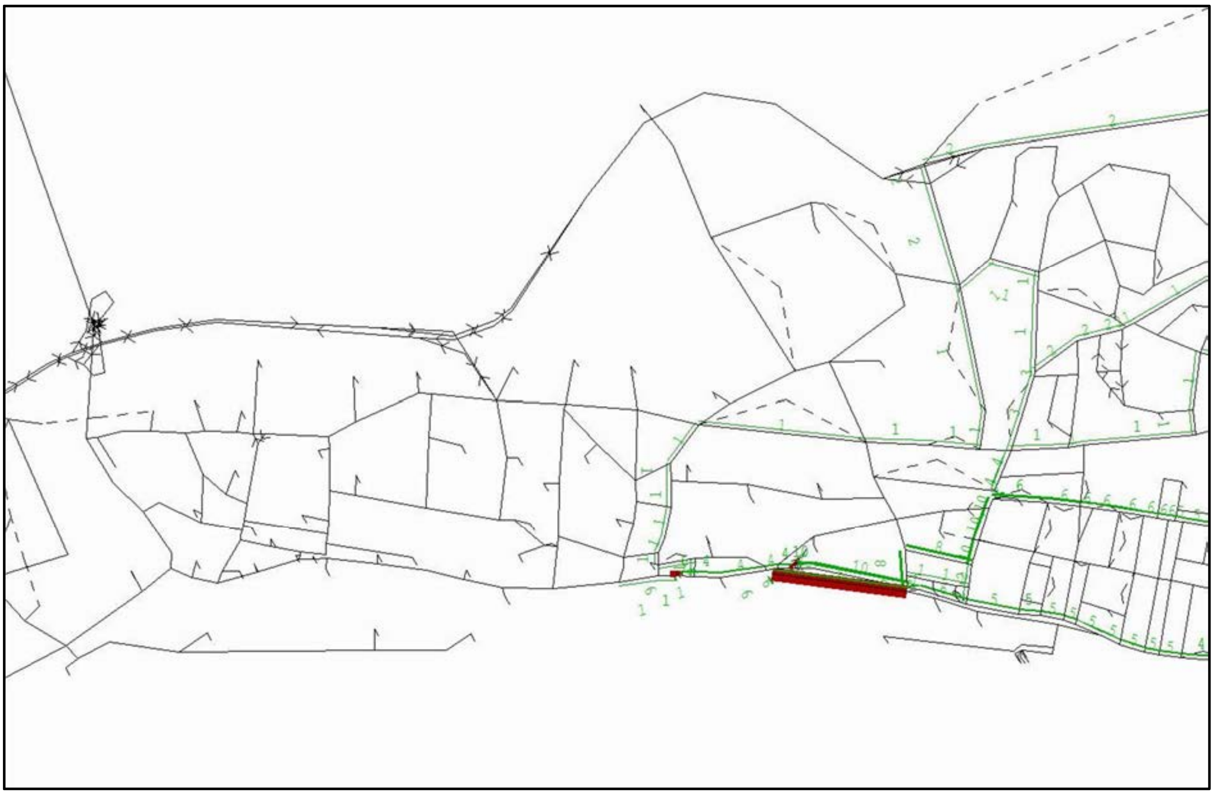
Trips from Aldrington Basin, Scenario B2 PM

Trips to Aldrington Basin, Scenario B2 PM

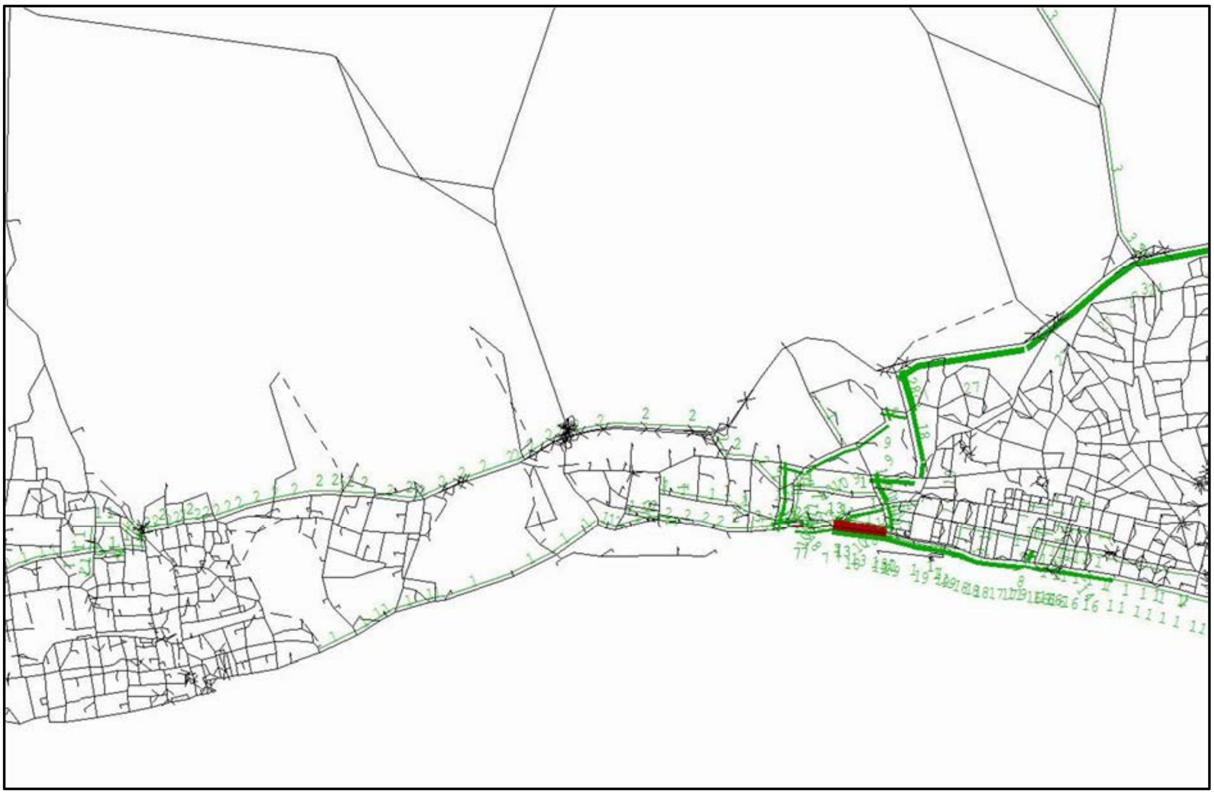


Trips to Aldrington Basin, Scenario B2 PM

Trips from Port Operational North, Scenario B2 AM



Trips from Port Operational North, Scenario B2 AM

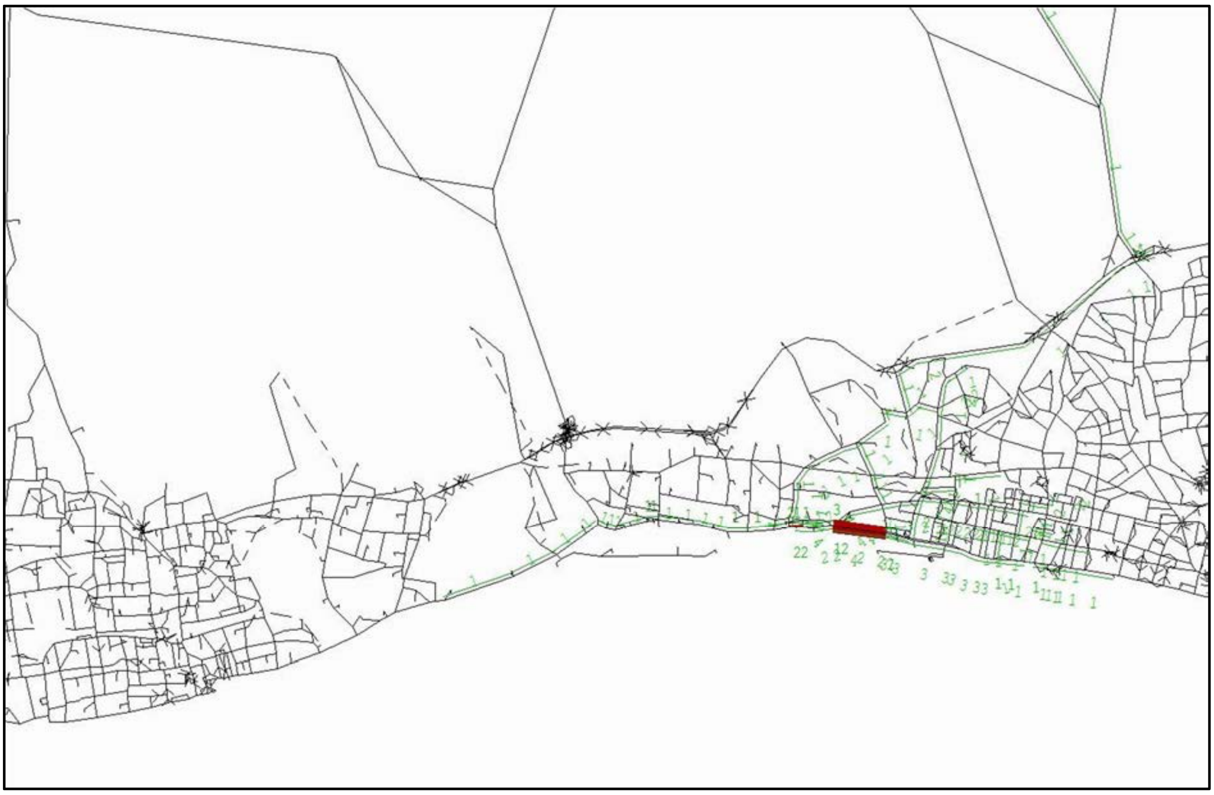


Trips to Port Operational North, Scenario B2 AM

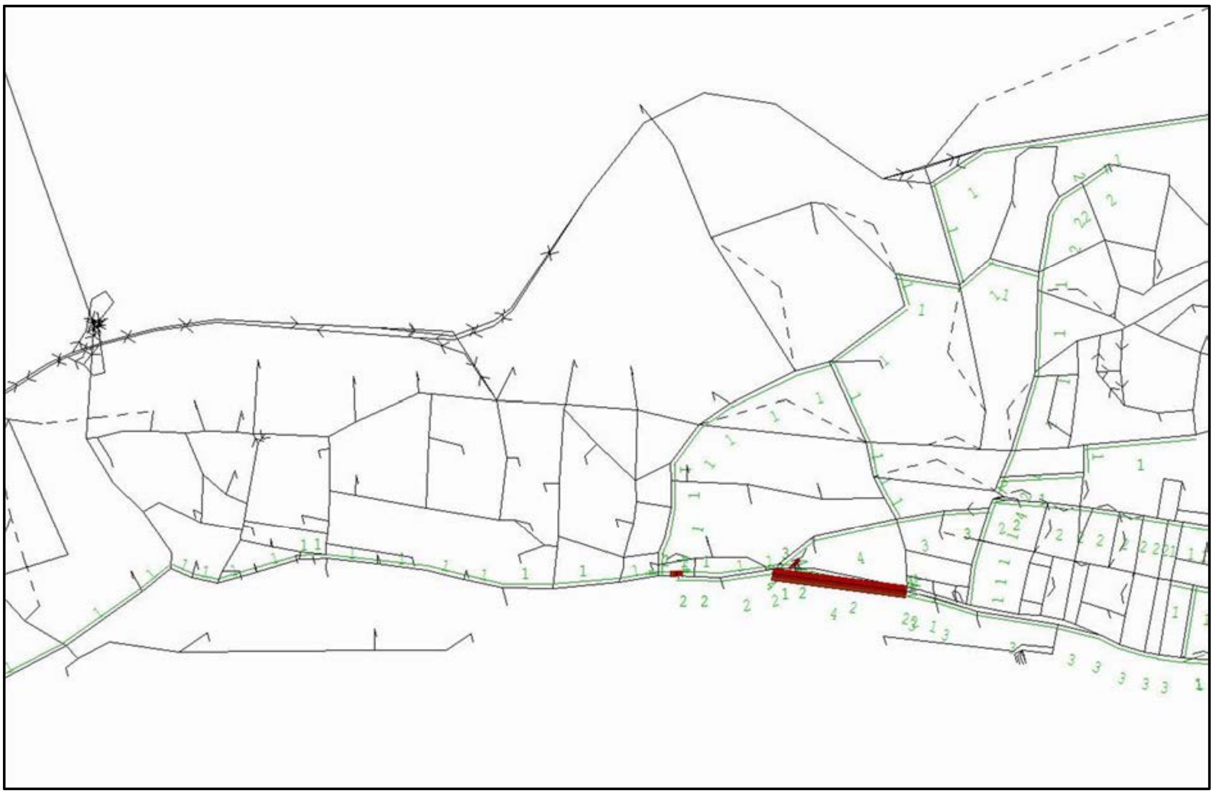
Trips to Port Operational North, Scenario B2 AM

Trips from Port Operational North, Scenario B2 PM

Trips from Port Operational North, Scenario B2 PM

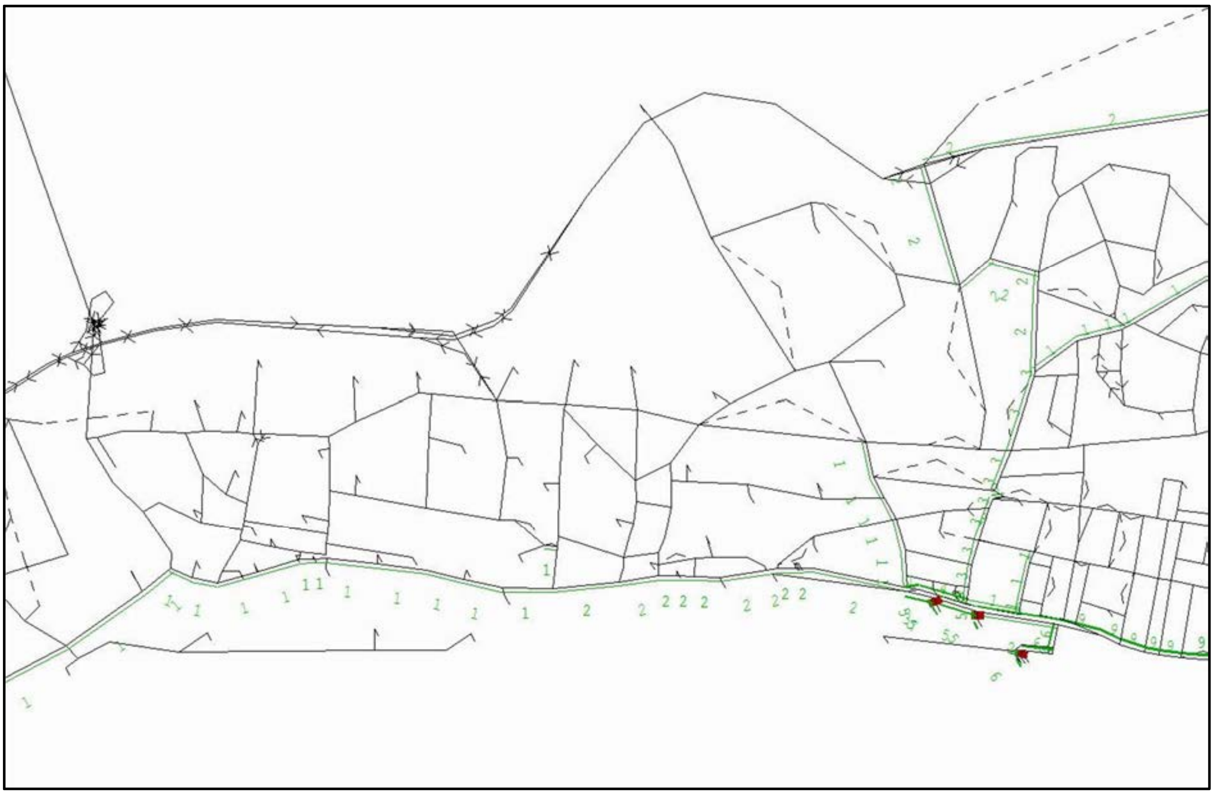


Trips to Port Operational North, Scenario B2 PM

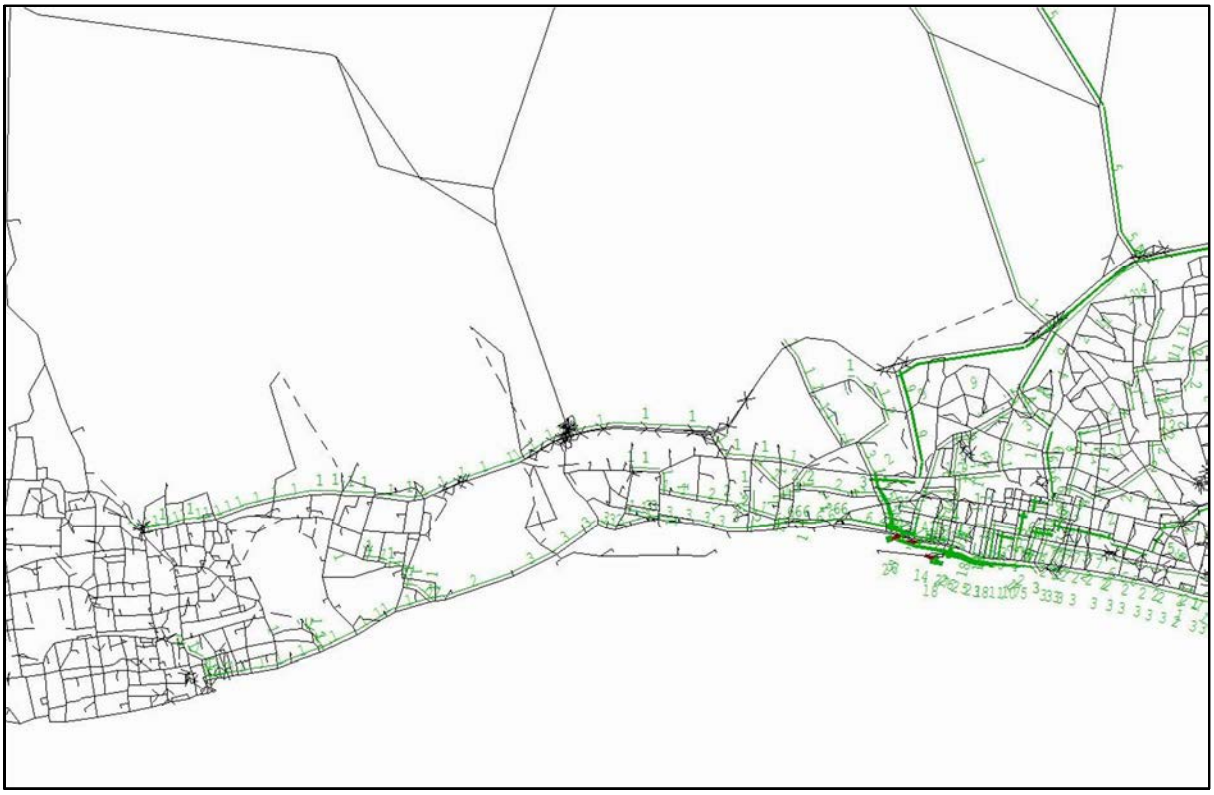


Trips to Port Operational North, Scenario B2 PM

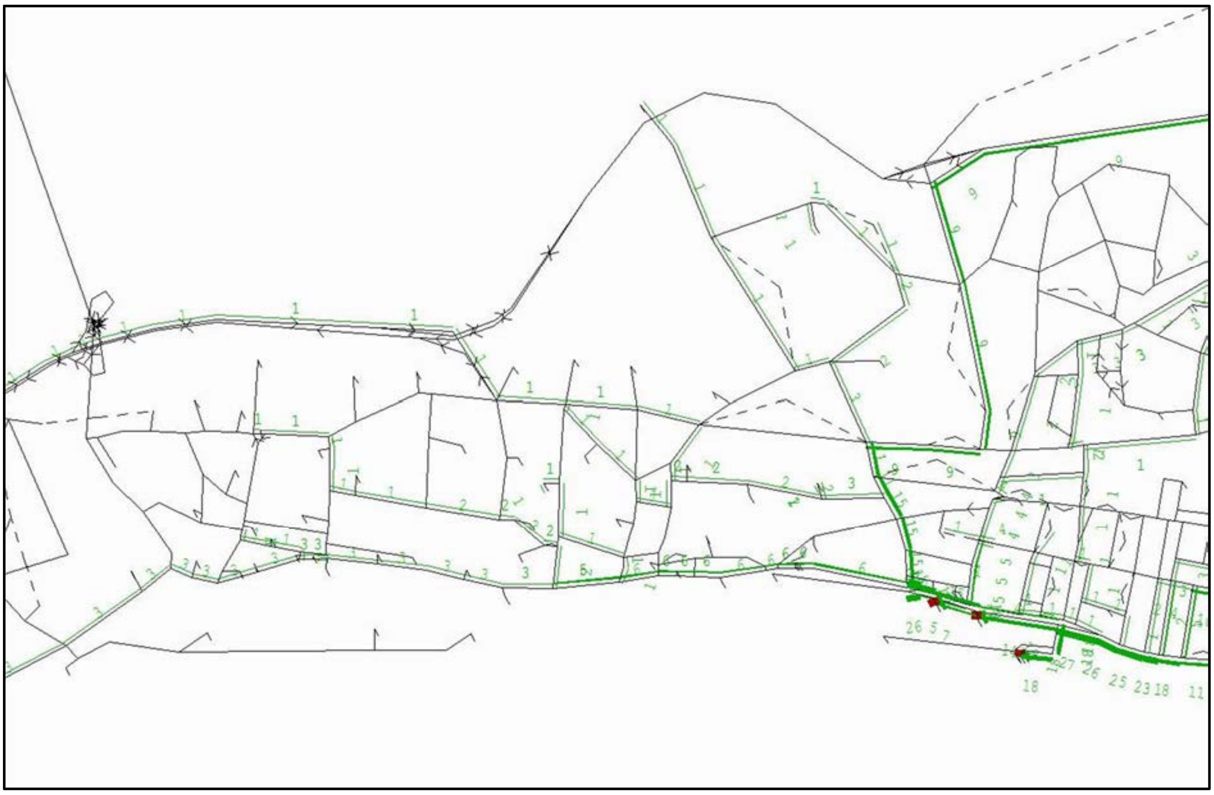
Trips from Port Operational East, Scenario B2 AM



Trips from Port Operational East, Scenario B2 AM

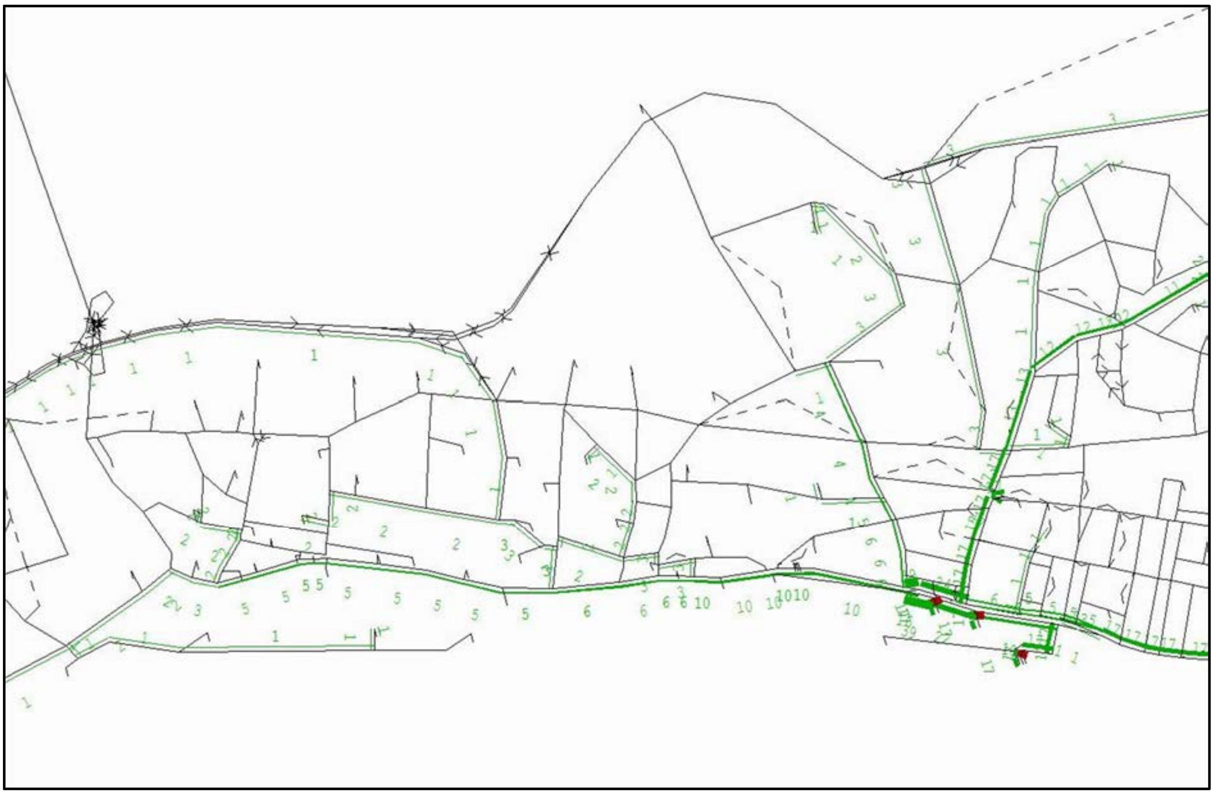


Trips to Port Operational East, Scenario B2 AM



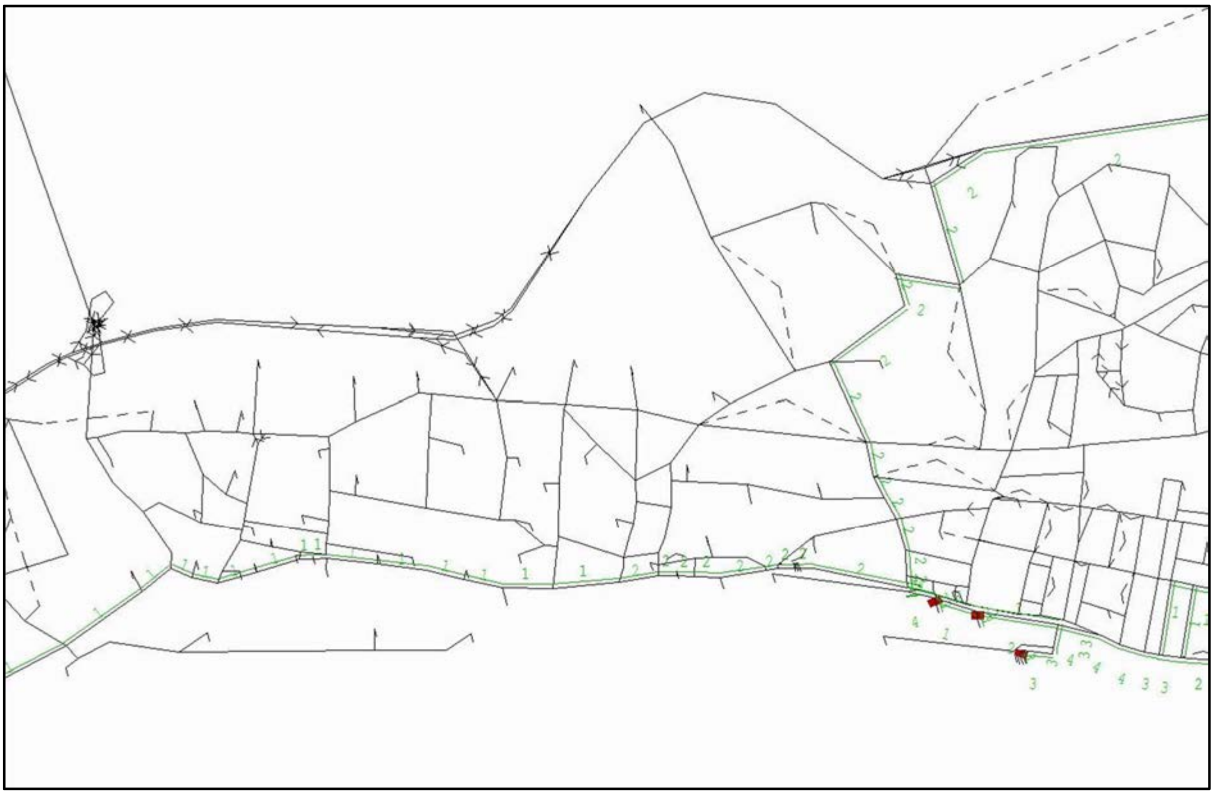
Trips to Port Operational East, Scenario B2 AM

Trips from Port Operational East, Scenario B2 PM



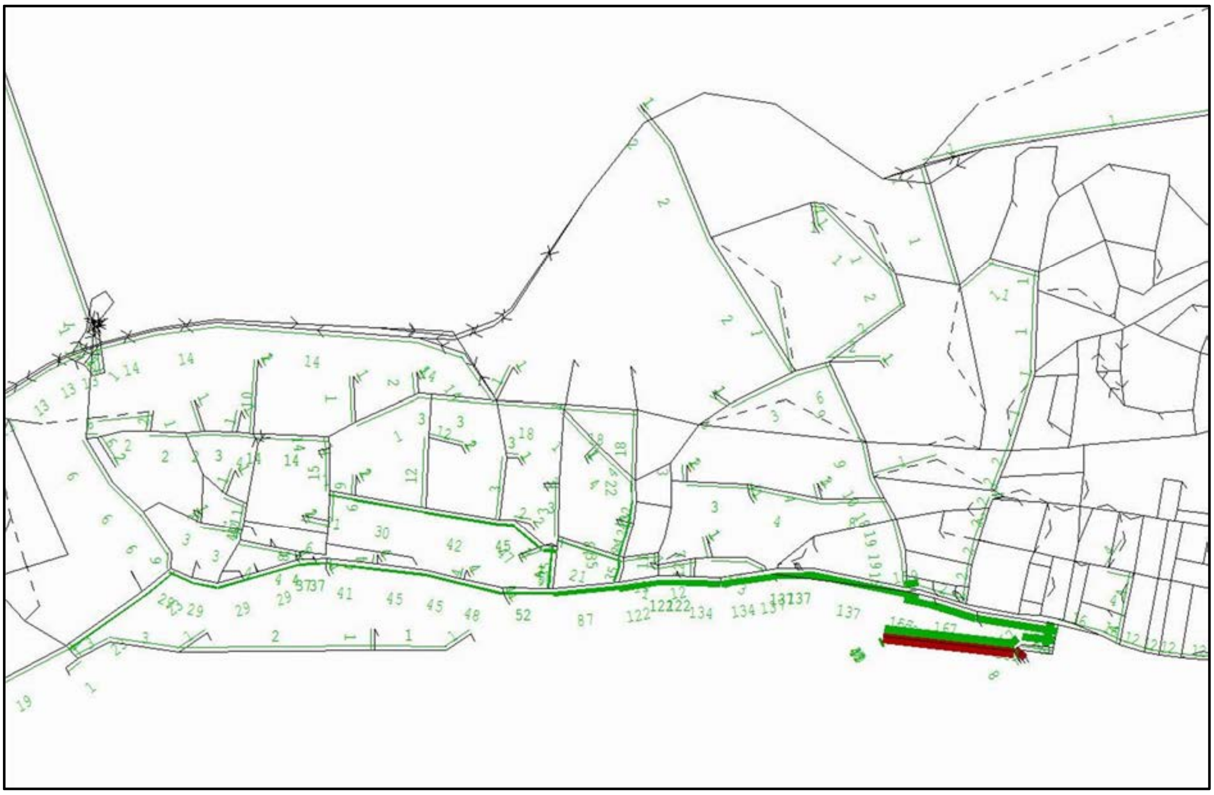
Trips from Port Operational East, Scenario B2 PM

Trips to Port Operational East, Scenario B2 PM



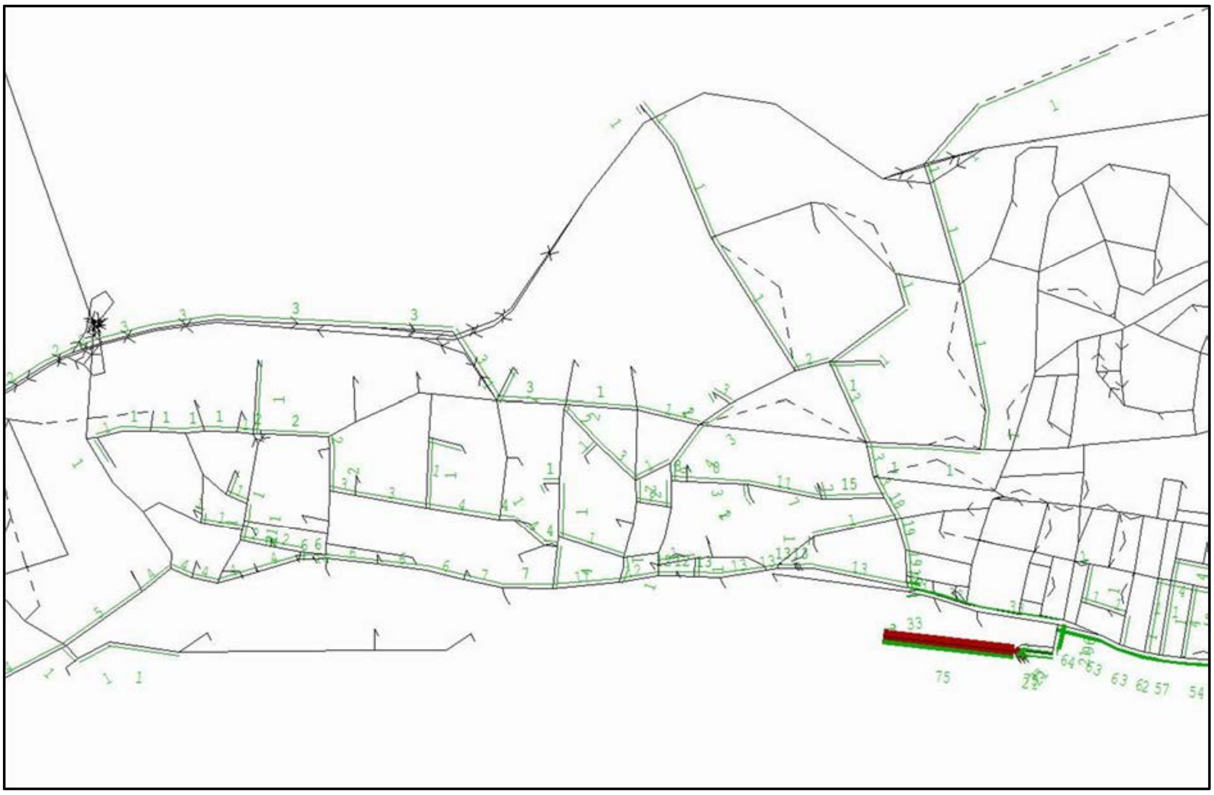
Trips to Port Operational East, Scenario B2 PM

Trips from Port Operational South, Scenario B2 AM



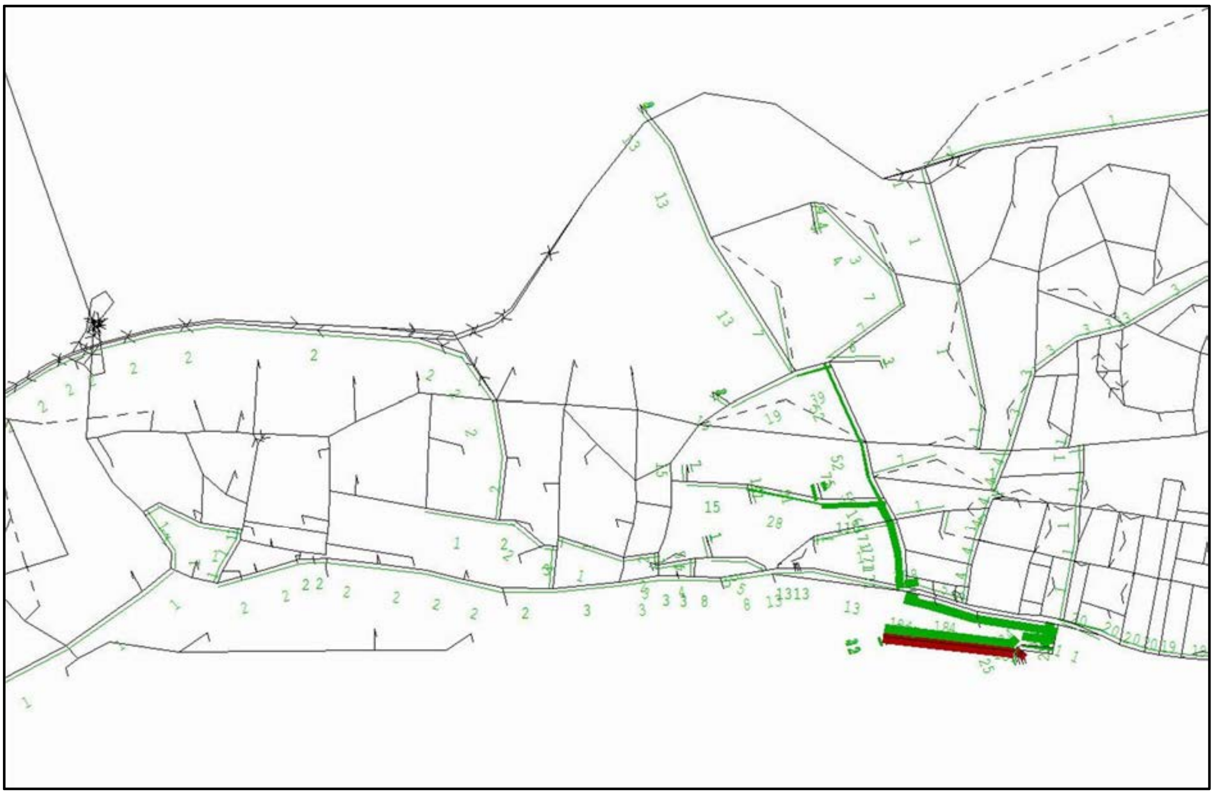
Trips from Port Operational South, Scenario B2 AM

Trips to Port Operational South, Scenario B2 AM



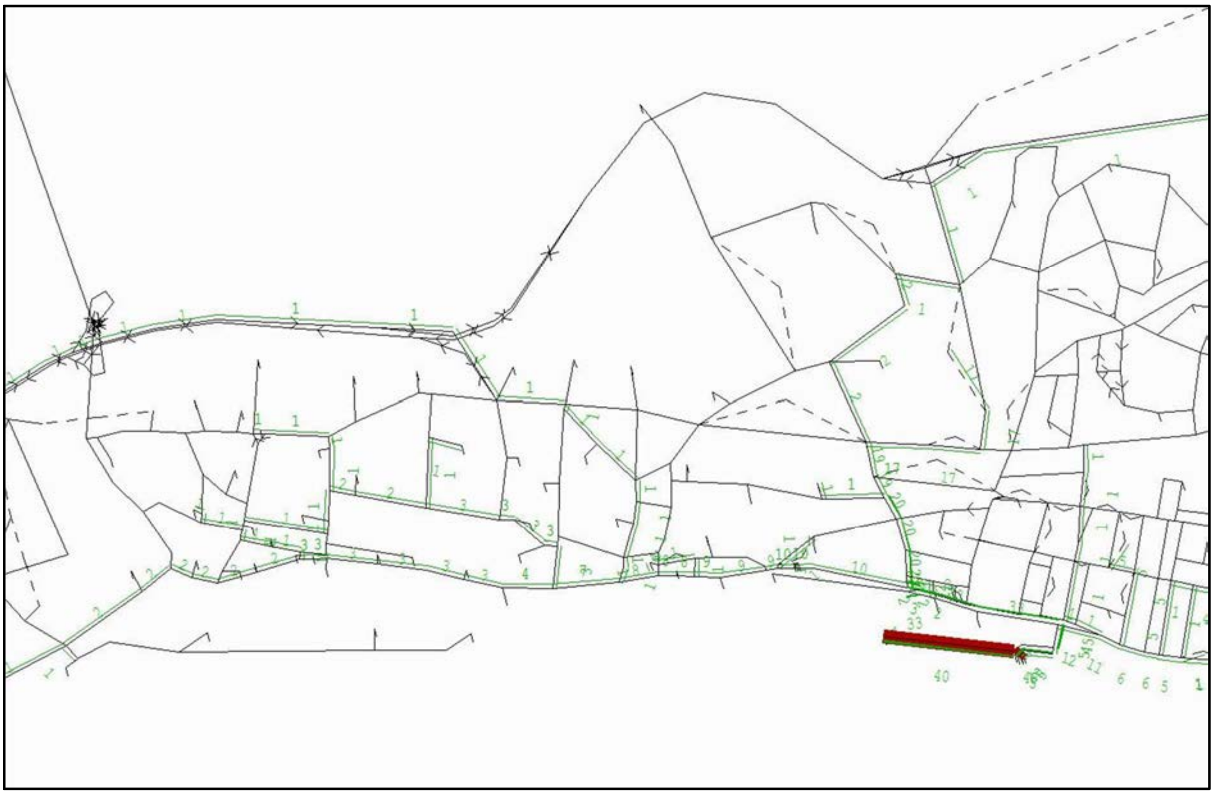
Trips to Port Operational South, Scenario B2 AM

Trips from Port Operational South, Scenario B2 PM

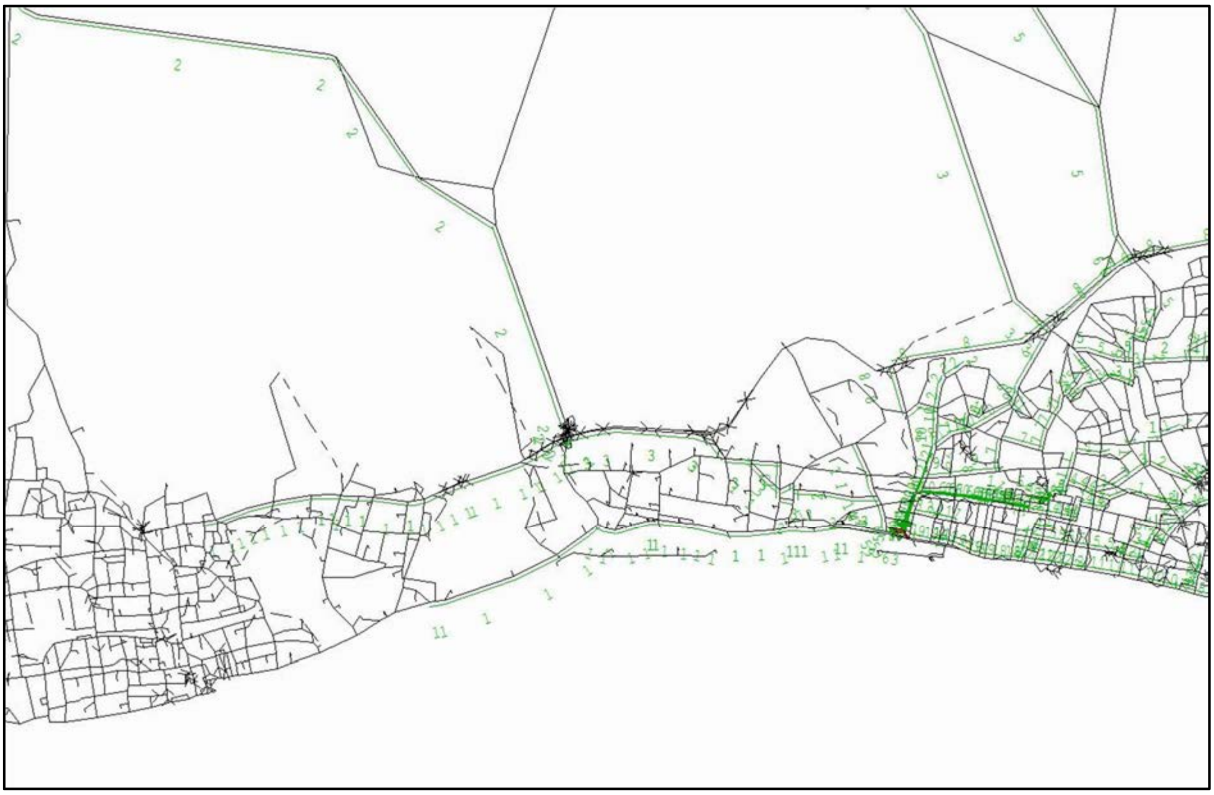


Trips from Port Operational South, Scenario B2 PM

Trips to Port Operational South, Scenario B2 PM

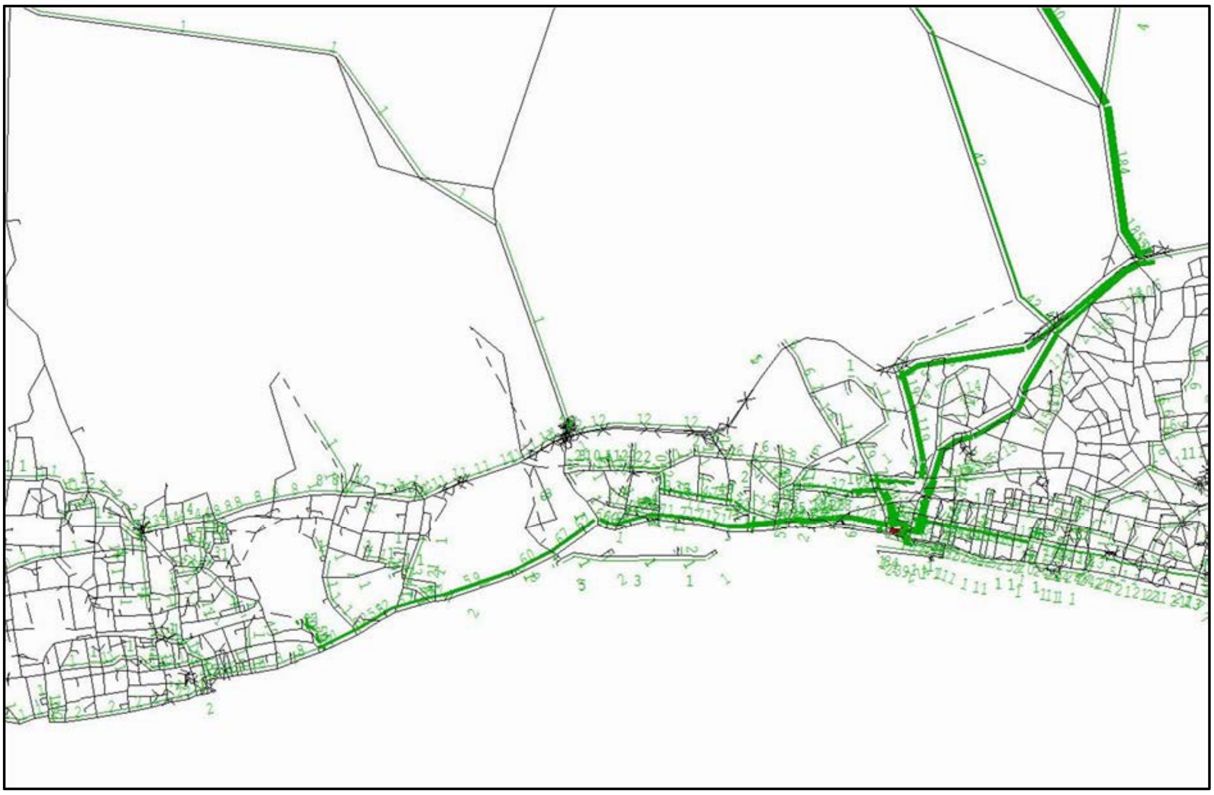


Trips to Port Operational South, Scenario B2 PM

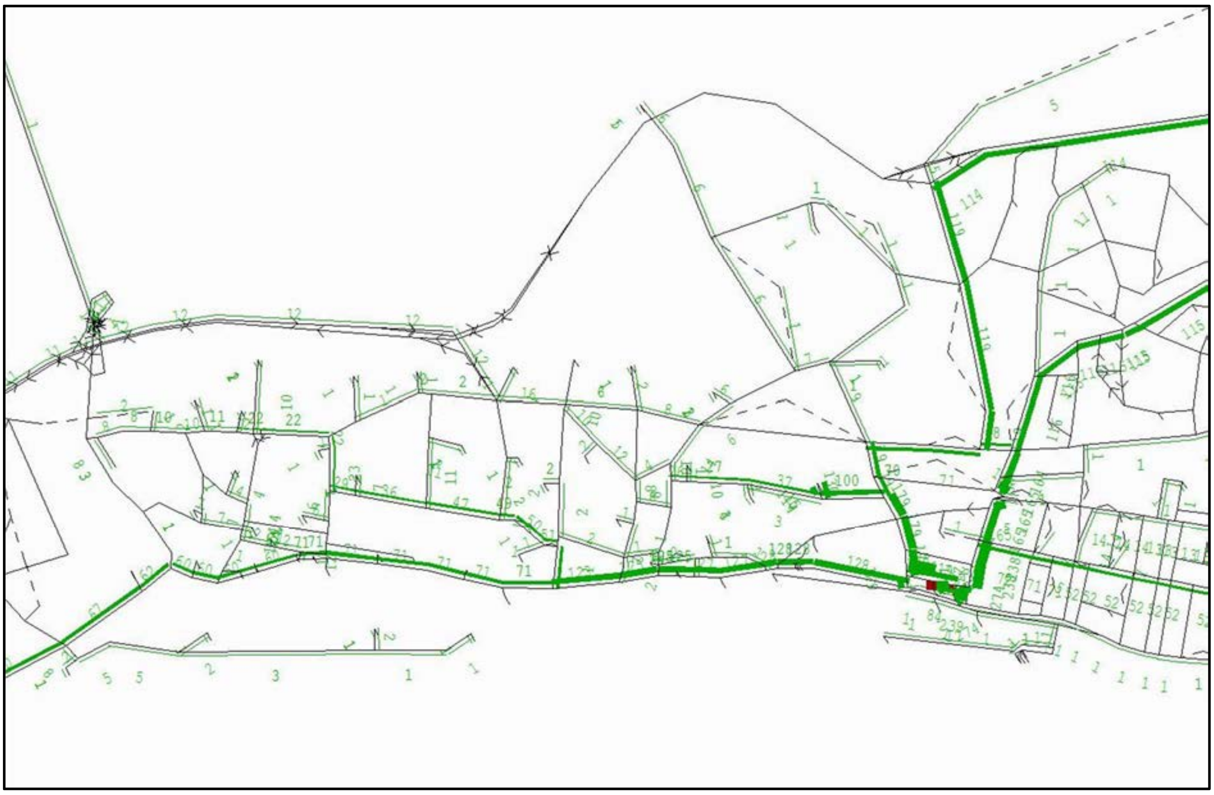


Trips from South Portslade, Scenario B2 AM

Trips from South Portslade, Scenario B2 AM

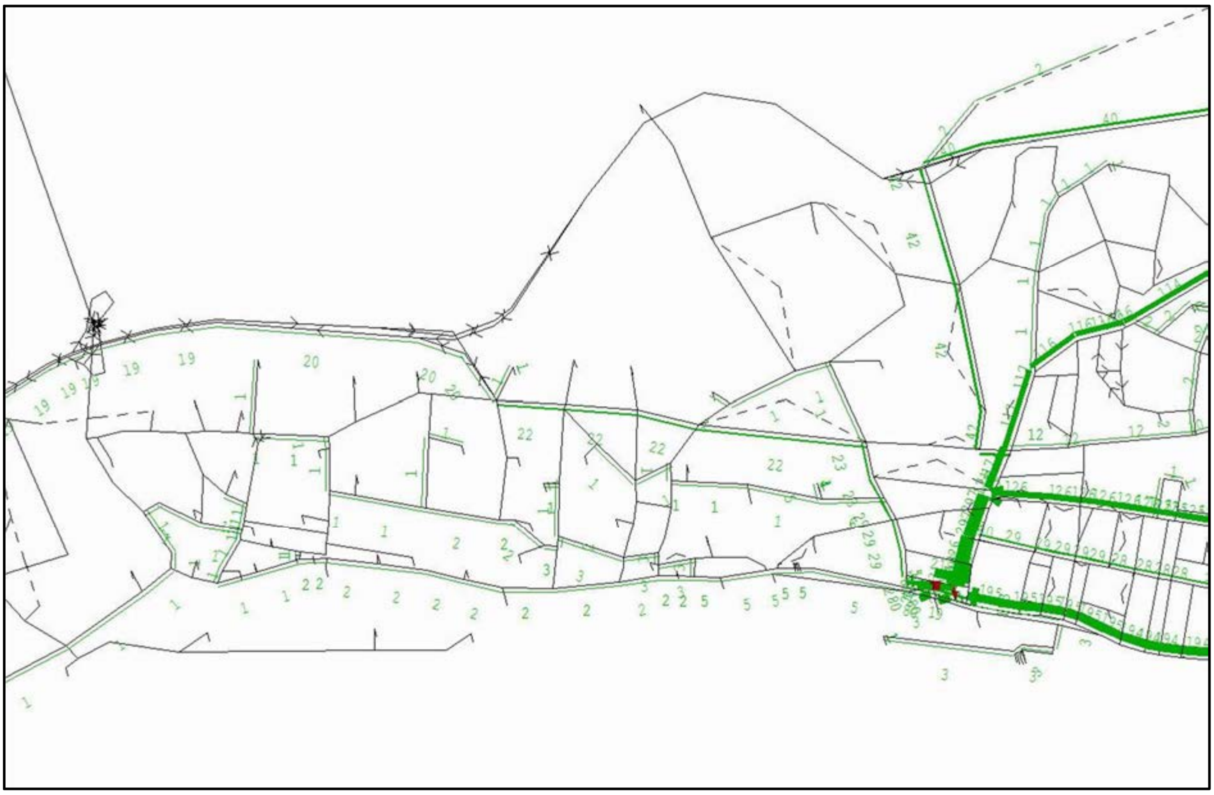


Trips to South Portslade, Scenario B2 AM



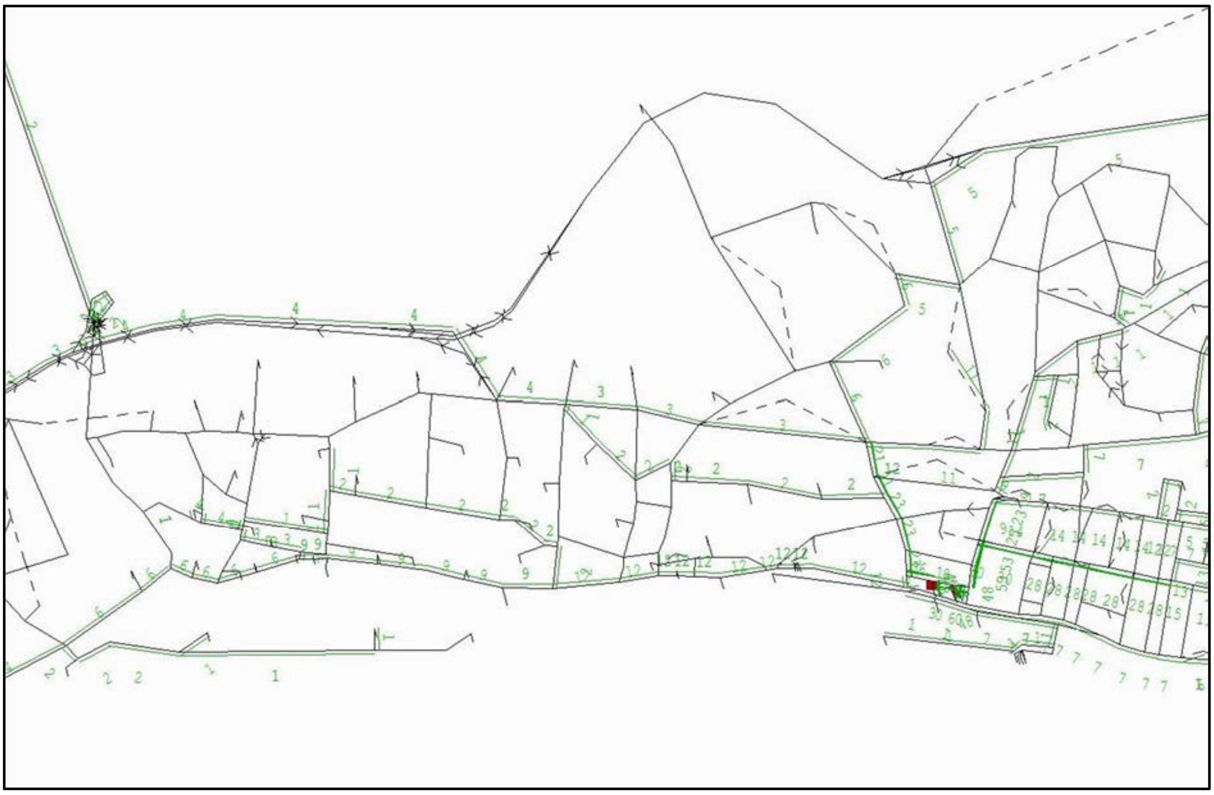
Trips to South Portslade, Scenario B2 AM

Trips from South Portslade, Scenario B2 PM



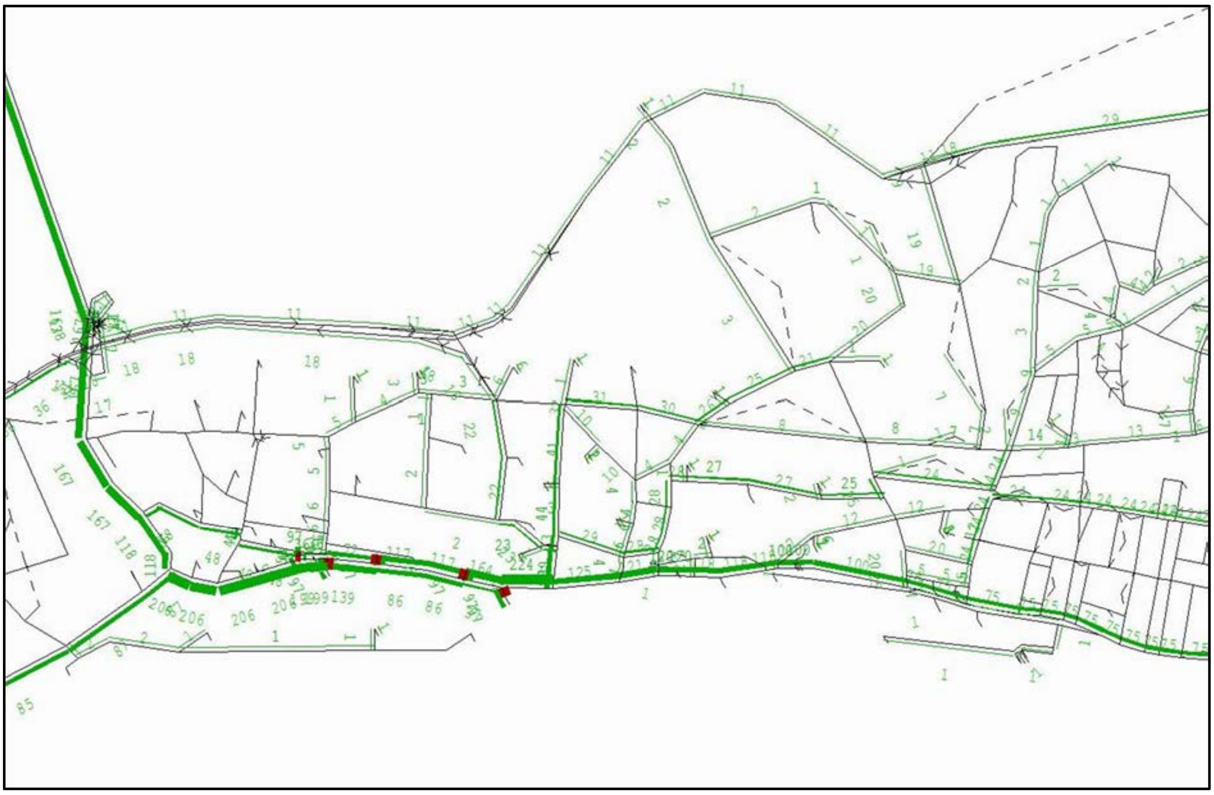
Trips from South Portslade, Scenario B2 PM

Trips to South Portslade, Scenario B2 PM



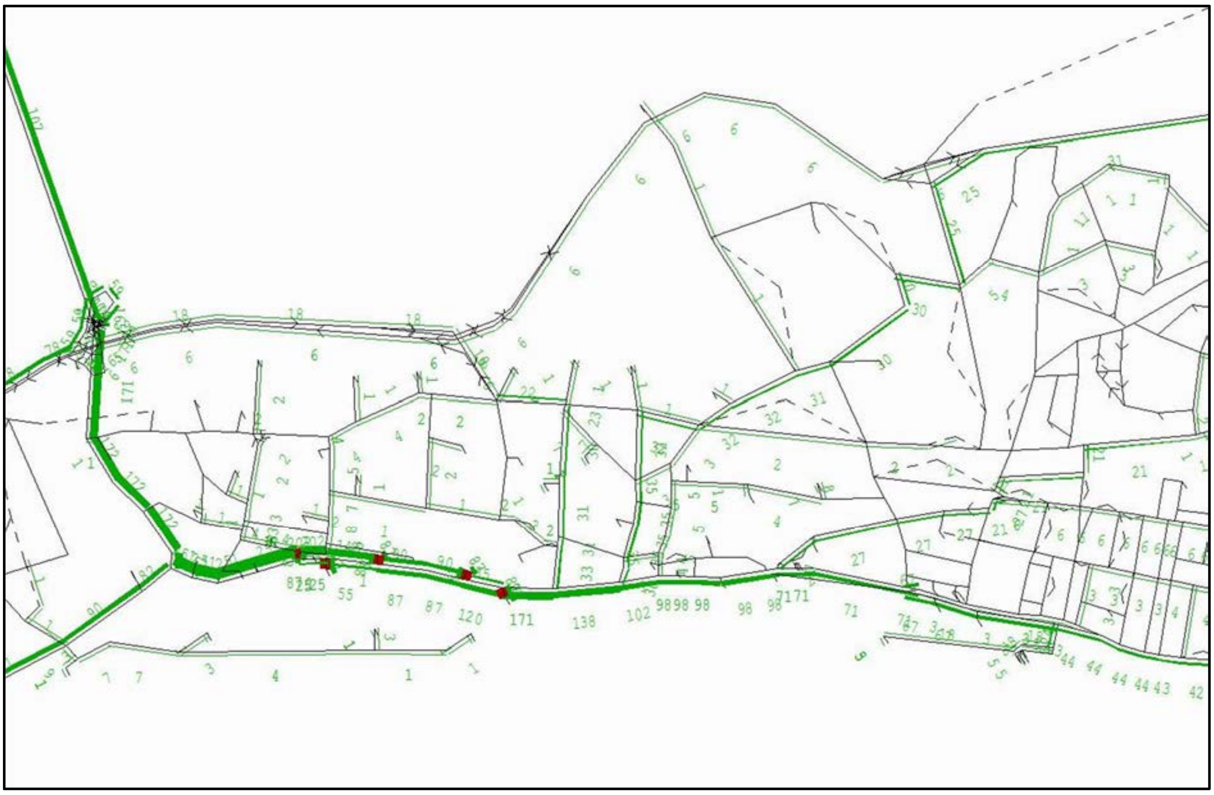
Trips to South Portslade, Scenario B2 PM

Trips from Western Arm, Scenario B2 AM



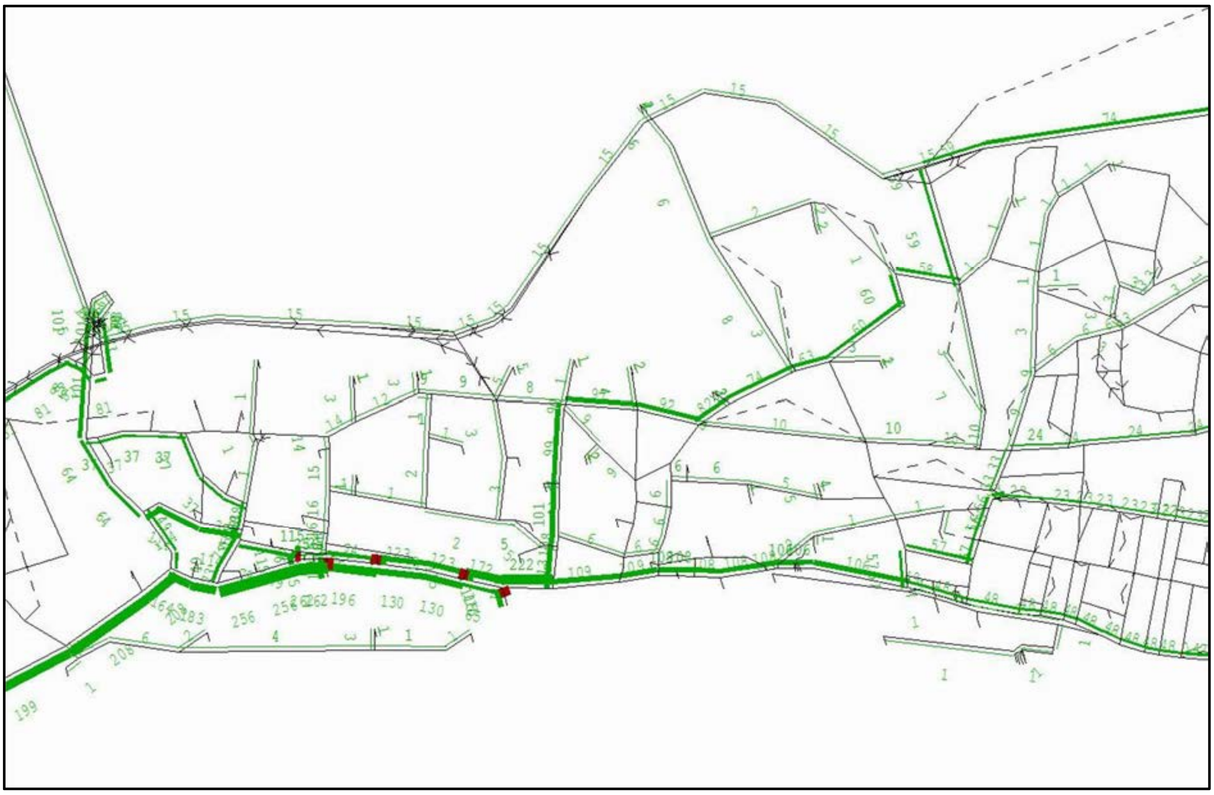
Trips from Western Arm, Scenario B2 AM

Trips to Western Arm, Scenario B2 AM

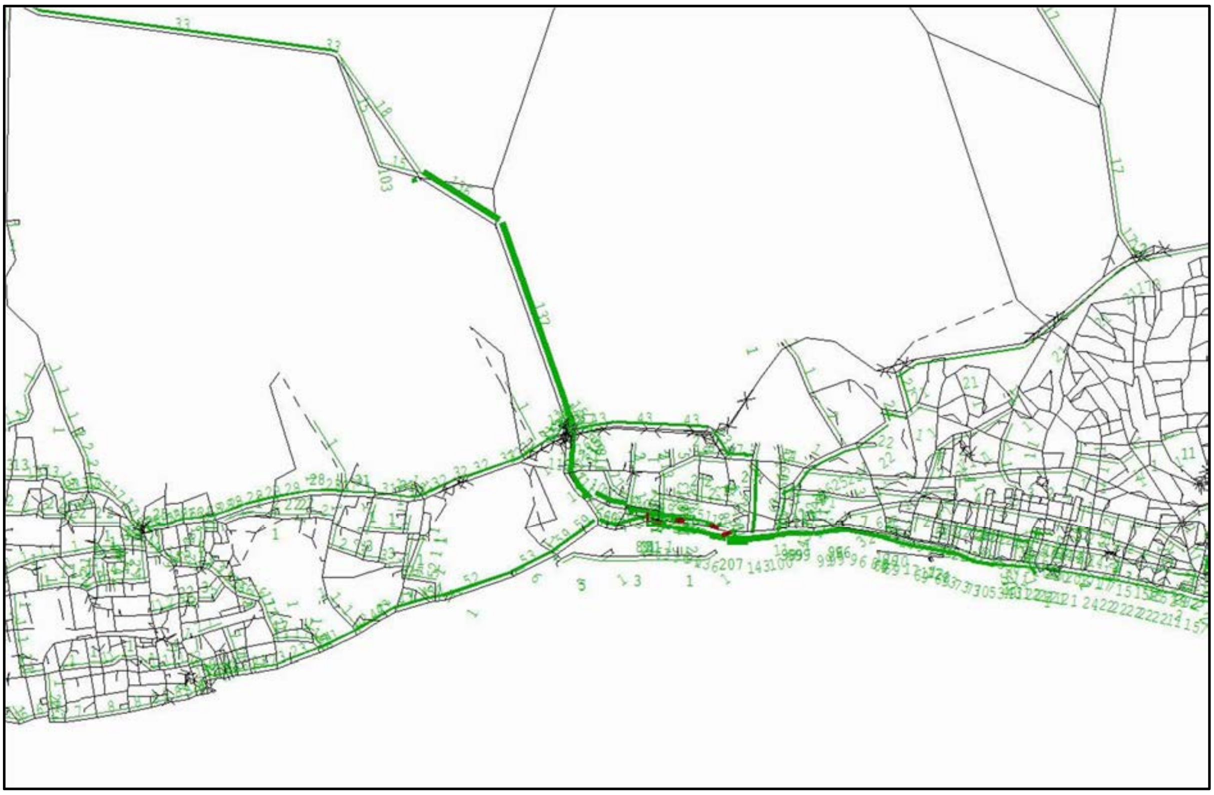


Trips to Western Arm, Scenario B2 AM

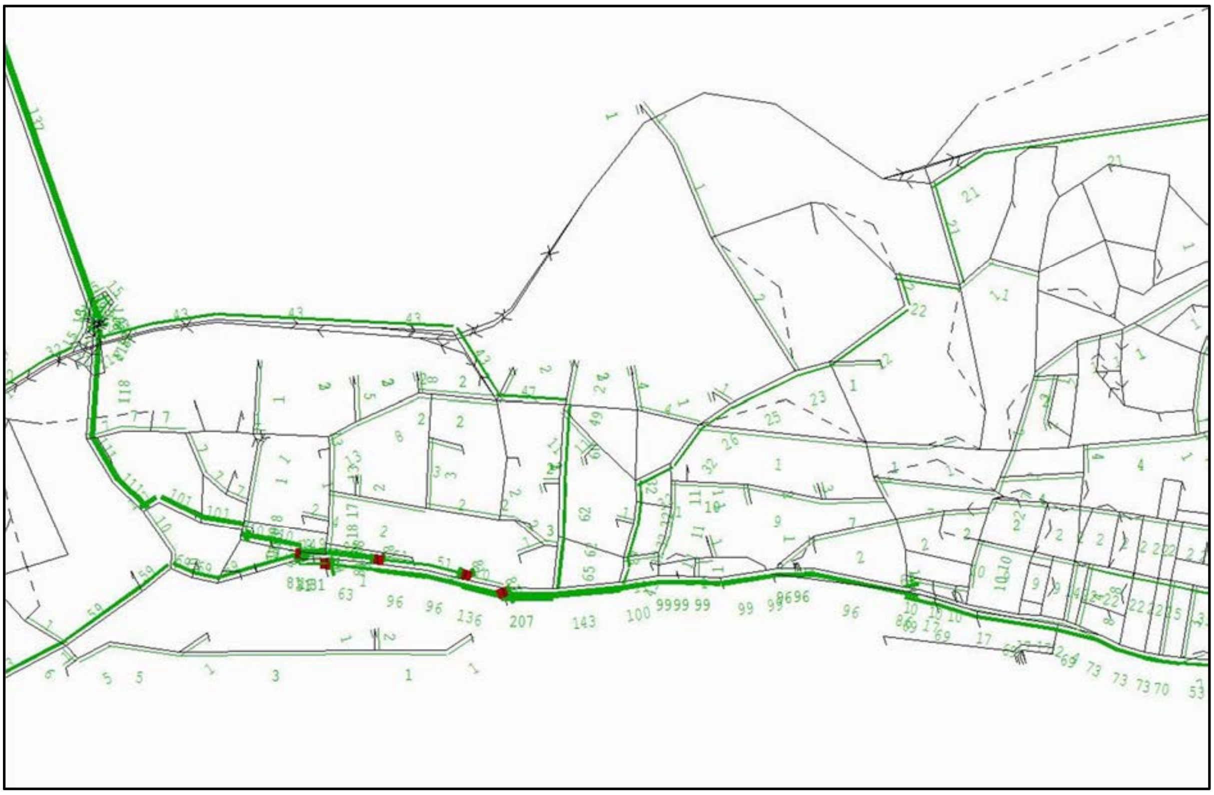
Trips from Western Arm, Scenario B2 PM



Trips from Western Arm, Scenario B2 PM



Trips to Western Arm, Scenario B2 PM



Trips to Western Arm, Scenario B2 PM