ADUR DISTRICT COUNCIL

ADUR LOCAL PLAN AND SHOREHAM HARBOUR

TRANSPORT STUDY

FINAL REPORT

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EXECUTIVE SUMMARY

Context and Purpose of Study

This study considers 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. It follows 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 considers 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.

Future Development Scenarios Tested

The latest Shoreham Harbour Transport Model (SHTM) was employed for this study, which consists of a variable demand model[1] in OmniTRANS and a highway assignment model in SATURN. SHTM covers morning and afternoon peak hours with a base year of 2008 and a forecasting year of 2028.

Four strategic development scenarios from the Draft Adur Local Plan were tested, varying in size and location of development. Varying quantities of residential development were included in the tested scenarios at the following sites:

- New Monks Farm;
- Sompting Fringe;
- Sompting North; and
- Hasler.

In addition to the development detailed above each tested scenario also included residential and employment allocations at Shoreham Harbour and employment development at Shoreham Airport.

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

The impact of the site allocations and mitigation proposals were considered across the whole network, but with particular focus on two tranches of key junctions. Location of these junctions is shown in Appendix K of this report.

Junctions in Tranche 1 were examined in the 2011 study and are currently considered to (or are thought likely to) experience the worst congestion in Adur district. Note that all of these junctions fall within the jurisdiction of West Sussex County Council Highway Authority other than A27 Trunk Road junctions which are under the jurisdiction of the Highways Agency.

Tranche 1 Junctions:

- 1. A27 / Grinstead Lane (North Lancing Roundabout)
- 2. A27 Sussex Pad
- 3. A27 / A283 Steyning Rd
- 4. A259 Brighton Rd / A283 Old Shoreham Rd
- 5. A259 Brighton Rd / A2025 South St

Another eight junctions that would operate over capacity were identified based on initial modelling results. These were included in Tranche 2 junction assessment. Note that junctions 7,11,12 and 13 fall within the jurisdiction of Brighton & Hove City Council Highway Authority other than A27 Trunk Road junctions which are under the jurisdiction of the Highways Agency. Junction 10 falls within Worthing Borough Council area but is still under the jurisdiction of West Sussex County Council Highway Authority.

Tranche 2 Junctions:

- 6. A27 / Busticle Lane
- 7. A27 Shoreham Bypass / Hangleton Link dumbbell (2 junctions)
- 8. A259 Brighton Road / Western Road
- 9. A270 Upper Shoreham Road / B2167 Kingston Lane
- 10. A27 Sompting Bypass / Upper Brighton Road
- 11. A270 Old Shoreham Road / A293 Hangleton Link signalled junction
- 12. A270 Old Shoreham Road / A2038 Hangleton Road / B2194 Carlton Terrace
- 13. A259 Wellington Road / B2194 Station Road

The increase in travel demand from both background growth and the specific allocations included in this study means many junctions within the study area would operate over capacity in both the 2028 reference case and all four tested scenarios. As multiple approaches to each of the 13 key junctions listed above were identified as being over capacity in both modelled peak hours, mitigation measures such as sustainable transport initiatives and highway network improvements were considered to alleviate the transport impact of the predicted growth in travel demand.

Mitigation Measures Proposed

Demand management measures in the form of sustainable transport initiatives were explored as the first part of mitigation, for example including:

- Sustainable measures focused on site allocations and their immediate vicinity;
- Area-wide travel awareness campaigns, cycling and walking facility improvements; and
- Public transport improvements on specific services.

The combined impact of these sustainable measures is equivalent to approximately 2% reduction in the overall highway travel demand based upon empirical evidence from other studies[2] in the UK. The actual reductions will vary across the study area, being greatest in and around the site allocations where the measures are targeted.

Highway mitigation measures were explored for 13 key junctions but subject to further study. 9 junctions were mitigated with proposals seeking to increase the capacity of the junctions whilst avoiding land take wherever possible and with minimum physical changes, as detailed below:

- **1. A27 / Grinstead Lane -** 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 Roundabout -** Fully signalise roundabout with a three lane circulatory and widen A283 north entry and exit, and A283 south entry.
- **4. A259 Brighton Road / A283 Old Shoreham Road** – Expand the roundabout and increase capacity westbound from the A259 High Street entry.
- **5. A259 Brighton Road / A2025 South Street -** Widen the A259 west approach and enlarge circulatory as appropriate.
- **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** – 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.
- **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.
- **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.

[2] Sloman L, Cairns S, Newson C, Anable J, Pridmore A & Goodwin P (2010), *The Effects of Smarter Choices Programmes in Sustainable Travel Towns; Research Report*

For the remaining 4 junctions, it was confirmed in junction assessment that these junctions would be operating within capacity so no mitigation was required. These are:

- 8. A259 Brighton Road / Western Road
- 9. A270 Upper Shoreham Road / B2167 Kingston Lane
- 11. A270 Old Shoreham Road / A293 Hangleton Link signalled junction
- 12. A270 Old Shoreham Road / A2038 Hangleton Road / B2194 Carlton Terrace

It is noted that 4 of the key junctions assessed fall within Brighton & Hove. Junction 7 has also been modelled as part of the Brighton & Hove Submission City Plan (part One) 2013, Strategic Transport Assessment. Further joint working between the local authorities will take place to take forward the appropriate mitigation measures.

Summary of Modelling Results

The modelling revealed the following results:

- All four development scenarios without mitigation result in a clear increase in travel demand which is demonstrated in deteriorated performance of key junctions and an increase in journey times along the A259 and A27 (eastbound and westbound).
- The performance of the four development scenarios assessed is similar across all parts of the network, including the 13 junctions assessed.
- Traffic impacts from individual sites are modest but the combination of developments in each scenario has enough impact to require mitigation of the key junctions.
- Scenario B has the greatest number of development trips and so the junctions consistently perform worse with this demand.
- The difference in journey times between development scenarios is minimal.
- 9 of the 13 junctions (5 in Tranche 1 and 4 in Tranche 2) assessed would be operating over capacity in the future development scenarios.
- The proposed sustainable transport initiatives and the highway mitigation measures have improved the performance of all 9 junctions where mitigations were required and enabled them to accommodate the predicted demand.
- 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.

Conclusions and Recommendations

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

For the 13 key junctions that were assessed in this study, 4 were found to be operating within capacity in the future while the other 9 would experience deteriorated traffic congestion exceeding their current capacity. Mitigation measures were tested to reduce overall travel demand and relieve the bottleneck effect of the problematic junctions. These measures are able 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. For some of the individual highway mitigation scenarios proposed in this study, it may be possible with further detailed design work to identify scaled down, more cost effective solutions.

1 INTRODUCTION

1.1 Objectives

1.1.1 Adur District Council is preparing an updated Local Plan to replace the 1996 version, which will set out the spatial and strategic vision for the district. 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 area (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.

1.1.2 This transport study follows 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 scenario 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. This new study therefore commences from the findings of the 2011 study and will consider 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.

1.2 Scope and Methodology

1.2.1 The study aims to assess the impact of the strategic site allocation scenarios for Adur on the transport network, to recommend appropriate mitigations 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 model was previously developed based upon the National Trip End Model TEMPRO Dataset 6.2. This model includes traffic growth from all developments in Adur and around to 2028 but the specific development locations were largely unknown. A new reference case is produced in this study 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 this study. This update reflects more up-to-date understanding of the quantum and location of strategic sites and is undertaken based on future land use assumptions provided by relevant planning authorities. Other sites in Adur that are in addition to the aforementioned growth form four strategic development scenarios, varying in size and location of development.

1.2.3 The impact on the transport network of each scenario is assessed over the whole network as well as in detail for individual junctions included in two tranches. Note that all the junctions assessed within Tranche 1 fall within the jurisdiction of West Sussex County Council other than A27 Trunk Road junctions which are under the jurisdiction of the Highways Agency. Junctions 7, 11, 12 and 13 in Tranche 2 fall within Brighton & Hove City Council area. The location of these junctions is shown in Appendix K of this report.

Tranche 1 Junctions:

- 1. A27 / Grinstead Lane (North Lancing Roundabout)
- 2. A27 Sussex Pad
- 3. A27 / A283 Steyning Rd
- 4. A259 Brighton Rd / A283 Old Shoreham Rd
- 5. A259 Brighton Rd / A2025 South St

Tranche 2 Junctions:

- 6. A27 / Busticle Lane
- 7. A27 Shoreham Bypass / Hangleton Link dumbbell;
- 8. A259 Brighton Road / Western Road;
- 9. A270 Upper Shoreham Road / B2167 Kingston Lane;
- 10. A27 Sompting Bypass / Upper Brighton Road;
- 11. A270 Old Shoreham Road / A293 Hangleton Link signalled junction;
- 12. A270 Old Shoreham Road / A2038 Hangleton Road / B2194 Carlton Terrace;
- 13. A259 Wellington Road / B2194 Station Road

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 Modelling Tools

1.3.1 The latest Shoreham Harbour Transport Model (SHTM) was employed for this study, which consists of a variable demand model[3] 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.

1.3.3 Appendix A of this report documents a recent update to the SHTM, which has been taken on board during the course of this study.

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

1.4 Report Structure

1.4.1 The remainder of the report includes the following sections

- Section 2 – Land Use Assumptions
- Section 3 – Traffic Forecasting
- Section 4 – Initial Modelling Results
- Section 5 – Mitigation Measures
- Section 6 – Modelling Results with Mitigation
- Section 7 – Conclusion

2 LAND USE ASSUMPTIONS

2.1 Modelled Scenarios

2.1.1 This section sets out full detail of the land use assumptions made for the updated reference case and four development scenarios in 2028.

2.2 2028 Reference Case

2.2.1 An initial reference case model that included expected levels of development spread across the model area in Adur and around (but not reflecting development at specific sites) was provided at the start of this study as a starting point for the development of a more detailed reference case scenario. A list of committed and proposed site allocations in Adur and the Shoreham Harbour JAAP area and its neighbouring areas was taken on board during this process. This land use information was received from local planning authorities at Adur, Worthing and Brighton & Hove.

2.2.2 The forecast of the 2028 reference case travel demand follows the principle set out in Paragraph 1.2.2. Traffic to and from individual future year developments identified for a more realistic reference case (i.e. with specific new development to 2028 modelled explicitly) is incorporated in such a way that the total traffic travelling to and from each of four regions (Adur, Worthing, Brighton & Hove and the remainder of the study area) remains the same as their counterparts in the existing 2028 reference demand matrix for the SHTM. This was achieved by deducting the same amount of traffic growth from selected zones when trips relating to each new site allocation are added in order to avoid double counting and ensure the overall and regional matrix totals remain the same during this process. Specific known and assumed site allocations outside Adur have been modelled to make the 2028 reference case as realistic as possible.

2.2.3 The developments included in the 2028 reference case scenario are shown below by area.

Table 2.1: Proposed and committed future development sites – Adur District Council area[4]

Location within Adur District	Number of Dwellings
Lancing	75
Sompting	15
Shoreham-by-Sea	516
Southwick	27
Other SHLAA - Adur district-wide small sites (less than 5 dwellings)	95
Total	730

Source: Correspondence with Adur District Council, 24 Oct 2012

[4] Excluding Shoreham Harbour developments which are detailed in Table 2.6.

Table 2.2: Proposed and committed future development sites – Worthing Borough Council area

Location within Worthing Borough	Development Type	Quantum Included in All Modelled Scenarios
West Durrington off Fulbeck Avenue	Mainly Residential	700 dwellings
		1 School
		Various other community facilities etc.
Teville Gate Broadwater Rd	Mixed Use	260 flats
		88 bedroom hotel
		B1 Office (2,780 sqm)
		9 screen multiplex cinema (3,520 sqm)
		A3 food and drink uses (4,000 sqm)
		Food store (8,510 sqm)
		Conference and exhibition centre (3,435 sqm)
		Health and fitness club (1,385 sqm)
Aquarena Brighton Rd	Mixed Use	120 dwellings
		A1 retail & A3 units (1,000 sqm)
The Causeway Durrington Station	Residential & Commercial	120 flats
		Retail (2,000 sqm)
The Warren Hill Barn Lane	Mainly Residential	36 dwellings (student accommodation)
		College/University (2000 pupils)
Worthing Sixth Form College Bolsover Road	Mainly Residential	265 dwellings
Sea Place Eirene Road	Mainly Residential	95 dwellings
Northbrook College Littlehampton Road	Mainly Residential	120 dwellings
		Car salesroom (assumed 3,050 sqm)[1]
		Care home (not modelled)
Union Place, High Street	Residential & Commercial	60 dwellings
		Retail (1,000 sqm)
Grafton Site, Marine Parade	Mainly Residential	100 dwellings
The Beach Hotel, Marine Parade	Mixed Use	49 flats
		76 bedroom hotel
		Restaurant (assumed 2,800 sqm) & spa facilities

Source: Correspondence with Worthing Borough Council, 07 Feb 2012

Table 2.3: Proposed and committed future development sites – Brighton & Hove City Council area[5]

Location within Brighton & Hove	Development Type	Quantum Included in All Modelled Scenarios
Amex	Commercial	B1 office (1,620 sqm)
Block K, Brighton Station	Commercial	B1 office (3,554 sqm)
Block J, Brighton Station	Mixed Use	Leisure (734 sqm)
		Retail (424 sqm)
GB Liners	Commercial	B1 office (3,327 sqm)
Sackville Trading Estate	Mixed Use	B1 office (5,287 sqm)
		Retail (6,907 sqm)
Brighton Marina	Mixed Use	Business Park (5,000 sqm)
		Leisure (3,500 sqm)
Preston Road	Commercial	B1 Office (15,378 sqm)
Black Rock site	Leisure	Leisure (7,000 sqm)
Circus Street Site	Mixed use	B1 Office (3,200 sqm)
		School (3,800 sqm)
Conway Street Industrial Area	Commercial	B1 Office (3,000 sqm)
Edward Street Quarter	Commercial	B1 Office (30,000 sqm)
Freshfield Road Business Park and Gala Bingo Hall	Commercial	B1 Office (18,500 sqm)
		B8 Warehouse (18,500 sqm)
Gas Works site	Commercial	B1 Office (4,000 sqm)
New Brighton Centre and expansion of Churchill Square.	Mixed Use	Retail (20,000 sqm)
		B1 Office (25,000 sqm)
Preston Barracks and Brighton University (Mithras House and Watts/Cockcroft Site)	Commercial	B1 Office (10,600 sqm)
Toad's Hole Valley	Mixed Use	B1 Office (25,000 sqm)
		School (50,000 sqm)
Woollards Field South	Commercial	B1 Office (5,000 sqm)
St Marys Hall Eastern Road Brighton	Commercial	B1 Office (5,168 sqm)
Land adjacent to Amex House fronting John Street Carlton Hill Mighell Street and land adjacent to 31 White Street Brighton	Commercial	B1 Office (34,750 sqm)
ASDA Stores Ltd 1 Crowhurst Road Brighton	Retail	Retail (1,676 sqm)
Sussex Education Centre Nevill Avenue Hove	Commercial	B1 Office (1,566 sqm)
Sussex County Cricket Club Eaton Road Hove	Leisure	Leisure (1,353 sqm)
Travis Perkins Baltic Wharf Wellington Road Portslade	Commercial	B1 Office (326 sqm)
		B8 Warehouse (1,348 sqm)
Woodingdean Business Park Sea View Way Bexhill Road Woodingdean	Commercial	B1 Office (2,668 sqm)
		B8 Warehouse (1,942 sqm)
Residential		7470 dwellings

Source: Correspondence with Brighton & Hove City Council, 04 Oct 2012

[5] Excluding Shoreham Harbour developments which are detailed in Table 2.6.

2.3 Adur District Development Scenarios

2.3.1 Strategic site allocations in Adur were included in the future year models for four different development scenarios. They mainly include mixed-use residential and employment development proposed in Adur. The size of each potential development included in the four tested scenarios is detailed in Table 2.4 and Table 2.5.

Table 2.4: Adur Strategic Residential Site Allocations

Development Site	Number of Dwellings			
	Scenario A1	Scenario A2	Scenario A3	Scenario B
New Monks Farm	450	450	450	600
Sompting Fringe	250		420	420
Sompting North				210
Hasler	300	450		600
Total	**1000**	**900**	**870**	**1830**

Source: Correspondence with Adur District Council, 16 July 2012

Table 2.5: Adur Strategic Employment Site Allocations

Development Site	Estimated Number of Jobs		
	B1	B2	B8
New Monks Farm*	333	143	0
Shoreham Airport*	832	278	143

Source: Correspondence with Adur District Council, 27 July 2012
* The allocated figures are identical across four development scenarios

2.3.2 In addition to the strategic allocations listed in Table 2.4 and Table 2.5. Further allocations at Shoreham Harbour are also included in all development scenarios. They have been split into 6 areas for use in discussion and modelling. The allocations and the anticipated sizes of each are listed in Table 2.6 below. The location of each area is shown in Appendix B.

Table 2.6: Proposed and committed future development sites - Shoreham Harbour

Development Site	Number of Dwellings	Estimated Number of Jobs		
		B1	B2	B8
Shoreham Harbour - Western Arm	1530	482	482	482
Shoreham Harbour - Aldrington Basin	200	425	425	425
Shoreham Harbour - South Portslade	200	763	763	763
Shoreham Harbour - Port Operational North		57	57	57
Shoreham Harbour - Port Operational South		55	55	55
Shoreham Harbour - Port Operational East		55	55	55
Total	**1930**	**1837**	**1837**	**1837**

Source: Correspondence with Adur District Council and Shoreham Harbour regeneration partnership, 27 July 2012 & 14 Nov 2012

2.3.3 The Shoreham Harbour sites contain existing land uses that are equivalent to the number of jobs detailed in Table 2.7 below.

Table 2.7: Estimated Number of Existing Jobs in Shoreham Harbour

Site	Estimated Number of Jobs	
	B2	B8
Shoreham Harbour - Western Arm	640	640
Shoreham Harbour - Aldrington Basin	196	196
Shoreham Harbour - South Portslade	364	364
Shoreham Harbour - Port Operational North	235	235
Shoreham Harbour - Port Operational South	235	235
Shoreham Harbour - Port Operational East	235	235
Total	**1905**	**1905**

* NB.: An upper level estimate based on amount of floorspace rather than employment survey

2.3.4 In the first three areas of Shoreham Harbour (Western Arm, Aldrington Basin and South Portslade) for the purposes of the model, it has been assumed that the existing employment floor space will be replaced by new employment floor space development. For the other three areas of Shoreham Harbour (Port Operational North, South and East) the estimated number of new jobs is assumed to be additional to the number of existing jobs. It should be noted that the existing and future job figures at the harbour are based on estimates only for the purpose of generating upper level model assumptions.

2.3.5 In the absence of an accurate employment survey at the time and in order to establish the number of trips associated with the existing jobs it was assumed that the current land use is split equally between B2 (General Industrial) and B8 (Storage and Distribution) land uses in order to apply appropriate trip rates. In reality this split is more complex and also includes employment in the other use classes, in particular B1, A uses and suit generis. Appendix C details the estimated number of existing and new jobs included for each of the Shoreham Harbour development areas, and the resulting net number of trips included in the AM model.

3 TRAFFIC FORECASTING

3.1 Trip Generation

3.1.1 In order to determine the number of highway trips from each site, trip rates were established for appropriate land use types. Corresponding person trip rates were used to determine the number of public transport trips. Where possible, trip rates have been taken from the previous studies and elsewhere new rates have been established from TRICS. The selected trip rates are shown in Table 3.1 and Table 3.2 below.

Table 3.1: AM Peak Trip Rates

			AM 08:00 - 09:00			
FINAL TRIP RATES		Unit	Highway		Public Transport	
			Arrivals	Departures	Arrivals	Departures
Residential	TC Mixed	dwelling	0.137	0.341	0.003	0.021
	Non-TC Mixed	dwelling	0.137	0.341	0.003	0.021
	Flats	dwelling	0.072	0.164	0.002	0.041
	Houses (Non-Flats)	dwelling	0.135	0.322	0.004	0.020
Commercial	Office (B1)	100 sqm	1.703	0.170	0.180	0.000
		job	0.330	0.033	0.033	0.000
	Industrial Unit (B2)	100 sqm	0.989	0.143	0.000	0.000
		job	0.159	0.022	0.000	0.000
	Warehouse (Commercial) (B8)	100 sqm	0.387	0.101	0.018	0.018
		job	0.915	0.385	0.042	0.042
Shopping	Car Saleroom	100 sqm	0.867	0.241	0.000	0.000
	Local shops	100 sqm	4.456	4.028	0.057	0.057
	Local shops city centre	100 sqm	4.226	4.226	0.000	0.000
	Shopping centre	100 sqm	0.176	0.079	0.123	0.095
	Food Superstore	100 sqm	2.718	1.802	0.032	0.032
Education	Nursery	100 sqm	7.850	7.850	0.000	0.000
	Primary School	100 sqm	8.513	6.171	0.063	0.063
	Secondary School	100 sqm	2.320	1.728	0.438	0.438
	College / University (Pupils)	100 sqm	0.095	0.021	0.057	0.057
Leisure	Fitness Club	Ha	15.854	30.081	0.000	0.000
	Leisure Centre	Ha	21.595	18.482	0.584	0.584
	Sports Pitch / Greenspace	100 sqm	0.446	0.338	0.000	0.000
	Cinema	100 sqm	0.000	0.000	0.000	0.000
	Restaurant	100 sqm	0.000	0.000	0.000	0.000
	Hotel	beds	0.111	0.180	0.008	0.008
	Community facilities	Ha	6.667	2.667	0.000	0.000
	Conference / Exhibition Centre	100 sqm	0.101	0.008	0.171	0.171

Table 3.2: PM Peak Trip Rates

FINAL TRIP RATES		Unit	PM 17:00 18:00			
			Highway		Public Transport	
			Arrivals	Departures	Arrivals	Departures
Residential	TC Mixed	dwelling	0.351	0.211	0.021	0.017
	Non-TC Mixed	dwelling	0.351	0.211	0.021	0.017
	Flats	dwelling	0.187	0.105	0.041	0.013
	Houses (Non-Flats)	dwelling	0.336	0.213	0.020	0.016
Commercial	Office (B1)	100 sqm	0.123	1.335	0.000	0.004
		job	0.024	0.269	0.000	0.001
	Industrial Unit (B2)	100 sqm	0.068	0.762	0.000	0.006
		job	0.010	0.123	0.000	0.001
	Warehouse (Commercial) (B8)	100 sqm	0.112	0.358	0.000	0.000
		job	0.267	0.849	0.000	0.000
Shopping	Car Saleroom	100 sqm	0.723	1.108	0.000	0.000
	Local shops	100 sqm	4.754	4.726	0.028	0.057
	Local shops city centre	100 sqm	4.602	4.314	0.000	0.000
	Shopping centre	100 sqm	0.187	0.356	0.102	0.082
	Food Superstore	100 sqm	5.269	5.297	0.004	0.032
Education	Nursery	100 sqm	4.266	5.973	0.171	0.171
	Primary School	100 sqm	0.475	0.823	0.000	0.000
	Secondary School	100 sqm	0.036	0.213	0.000	0.000
	College / University (Pupils)	100 sqm	0.023	0.048	0.004	0.004
Leisure	Fitness Club	Ha	60.569	35.772	0.000	0.000
	Leisure Centre	Ha	36.983	27.022	0.195	2.367
	Sports Pitch / Greenspace	100 sqm	2.062	1.297	0.000	0.141
	Cinema	100 sqm	1.011	0.797	0.000	0.289
	Restaurant	100 sqm	0.896	0.896	0.000	0.169
	Hotel	beds	0.144	0.084	0.011	0.007
	Community facilities	Ha	25.532	19.149	0.000	0.000
	Conference / Exhibition Centre	100 sqm	0.020	0.099	0.025	0.118

3.2 Reference Case Demand

3.2.1 The trip rates described in the previous section were used to determine the trips associated with each site, and appropriate development zones were identified in the model. For each development zone the relevant trips were added to the 2008 base year origin and destination totals (trip ends). For non-development zones the trip ends from the 2028 TEMPRO reference case matrix were maintained. The total trip ends per region (Adur, Worthing, Brighton & Hove, rest of the UK) were controlled to match the total in the original reference case matrix by factoring the non-development zone trip ends.

3.2.2 The distribution of the development site trips was determined using a furnessing process with the TEMPRO-based reference case matrix as the prior matrix. Before furnessing, the appropriateness of the distribution of the selected zone was assessed. The distribution was not considered to be appropriate in cases where the development zone had a very small number of trips in the base matrix, or the main land use was different from the site allocation. In these cases the trips were manually added into the prior matrix before furnessing using the distribution from a more suitable zone. This manual method was only applied for two sites.

3.3 Scenario Case Demand

3.3.1 The demand for each scenario case was developed based upon the reference case matrix. The trips associated with the existing development at Shoreham Harbour were removed from existing zones at or near Shoreham Harbour. Then the trips associated with the proposed Shoreham Harbour development, Shoreham Airport and the scenario specific trips were added to the matrix using the distribution from proxy zones. The proxy zones were selected based on their land use and location.

3.3.2 It was understood that some of the scenario trips are already included in the TEMPRO forecasts. The estimated number of 'double-counted' trips was therefore removed using an appropriate factor before the scenario development trips were added.

3.4 Summary

3.4.1 The process described in this section results in a pair of demand matrices for each model, one containing the highway trip volumes and one containing the initial public transport demand. These are fed into the demand model which predicts the potential transfer between private car and public transport trips based on the relative generalised costs of each option.

3.4.2 Table 3.3 below shows the highway trip matrix totals produced by the traffic forecasting process described in this section.

Table 3.3: Highway Matrix Totals for Mode Choice Model Input

	Reference	Scenario A1	Scenario A2	Scenario A3	Scenario B
AM	69,714	70,965	70,928	70,861	71,321
PM	76,156	77,463	77,422	77,343	77,883

Note: All values expressed in passenger car units (pcu)

4 INITIAL MODELLING RESULTS – WITHOUT MITIGATON MEASURES

4.1 Overview of Findings

4.1.1 Model runs have been undertaken for the four development scenarios detailed in Section 2.3 and the reference case. Results from the SHTM were then fed into analysis of individual junctions in the study area. This section gives an overview of findings from this analysis that cover the aspects set out below:

Network Performance

4.1.2 The network-wide impacts are very similar across the four development scenarios. A number of analyses were undertaken as summarised below, which led to subsequent detailed assessment of 13 key junctions in two tranches.

- **Network Statistics** – the increase in travel demand in the development scenarios in comparison to the reference case is clear but not substantial. The highest demand increase is less than 3% which occurred in Scenario B. With the introduction of additional trips, all scenarios result in higher congestion in the network as expected, and this is demonstrated by increased queuing and slower average speeds.
- **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 mainly focus on the network at close vicinity to the four strategic development sites, namely New Monks Farm, Sompting Fringe, Sompting North and Hasler. 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[6] 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. These increases in journey time are likely to be caused by increased congestion at junctions as revealed in the analysis summarised below.
- **Congestion hotspots** – this analysis examines the Volume over Capacity Ratio (V/C) on entry arms for each individual junction in the study area. Findings suggested that the five key junctions identified in the brief for this study would indeed experience exacerbated congestions in the future development scenarios. They were subsequently brought into Tranche 1 of the junction analysis which was also reported in this chapter. Another eight junctions were also identified as being overcapacity in the future. They were assessed and reported in Tranche 2 analysis.

[6] Seven journey time routes have been defined and agreed during the course of this study. They are set out in Section 4.2.

- **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 aforementioned journey time and congestion hotspot analyses.

4.1.3 Details on the above analyses are presented in Section 4.2 of this chapter.

Junction Performance

4.1.4 13 key junctions (as illustrated in Appendix K) were brought into individual junction analysis in two tranches following findings in the network performance analysis. They include:

Tranche 1 Junctions:

- 1. A27 / Grinstead Lane (North Lancing Roundabout)
- 2. A27 Sussex Pad
- 3. A27 / A283 Steyning Rd
- 4. A259 Brighton Rd / A283 Old Shoreham Rd
- 5. A259 Brighton Rd / A2025 South St

Tranche 2 Junctions:

- 6. A27 / Busticle Lane
- 7. A27 Shoreham Bypass / Hangleton Link dumbbell;
- 8. A259 Brighton Road / Western Road;
- 9. A270 Upper Shoreham Road / B2167 Kingston Lane;
- 10. A27 Sompting Bypass / Upper Brighton Road;
- 11. A270 Old Shoreham Road / A293 Hangleton Link signalled junction;
- 12. A270 Old Shoreham Road / A2038 Hangleton Road / B2194 Carlton Terrace;
- 13. A259 Wellington Road / B2194 Station Road

4.1.5 Results from the junction analysis corroborate the findings in the network wide assessment. The performance of all 13 junctions either significantly deteriorates or remains over congested in the development scenarios in comparison to the reference case. Details of individual analysis are presented in Section 4.3.

Air Quality Management Areas (AQMA) and Sompting Conservation Areas

4.1.6 The flows thorough both AQMAs and the Sompting Conservation area are higher in the 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 development scenarios.

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

4.2 Network Performance

Network Statistics

4.2.1 The total travel demand extracted from the SHTM for each of the 2028 development scenarios is shown in Table 4.1 below. The values show the expected volume of highway traffic, including goods vehicles, following the inclusion of development trips and the effects of the mode choice module within SHTM.

Table 4.1: Output Highway Matrix Totals from Mode Choice Model

		Reference	Scenario A1	Scenario A2	Scenario A3	Scenario B
AM	Input	69,755	71,045	71,005	70,950	71,390
	Output	69,714	70,965	70,928	70,861	71,321
	Difference	41	80	77	89	69
PM	Input	75,849	77,640	77,600	77,526	78,059
	Output	76,156	77,463	77,422	77,343	77,883
	Difference	-307	177	178	183	176

Note: All values expressed in passenger car units (pcu)

4.2.2 The global network statistics for the AM and PM peak models are shown below in Table 4.2 and Table 4.3 respectively.

Table 4.2: AM Peak Global Model Statistics

Statistic	Reference	Scenario A1	Scenario A2	Scenario A3	Scenario B
Transient Queues (pcu-hrs / hr)	9,411	9,713	9,710	9,694	9,804
Over Cap Queue (pcu-hrs / hr)	7,872	9,304	9,470	9,440	9,744
Total Travel Time (pcu-hrs / hr)	41,291	43,404	43,548	43,474	44,063
Total Travel Distance (pcu-km / hr)	1,506,724	1,522,608	1,522,253	1,520,462	1,529,091
Average Speed (kph)	36.5	35.1	35.0	35.0	34.7

Table 4.3: PM Peak Global Model Statistics

Statistic	Reference	Scenario A1	Scenario A2	Scenario A3	Scenario B
Transient Queues (pcu-hrs / hr)	12,579	13,046	13,102	13,074	13,210
Over Cap Queue (pcu-hrs / hr)	22,131	23,108	23,145	23,019	23,383
Total Travel Time (pcu-hrs / hr)	63,837	65,777	65,866	65,662	66,349
Total Travel Distance (pcu-km / hr)	1,857,323	1,877,693	1,877,416	1,875,324	1,883,728
Average Speed (kph)	29.1	28.5	28.5	28.6	28.4

4.2.3 Two types of queue are reported; transient queues and over-capacity queues. Over capacity queues are 'permanent' queues at an over capacity junction. 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 all scenarios compared to the reference case, is not concerning. An increase in over-capacity queues is more concerning since it indicates an increase in congestion on the network. The increase in over-capacity queues is considerable in all scenarios 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.

4.2.4 All scenarios result in an increase in queues, travel time and travel distance compared to the reference case, and a decrease in average speed. This indicates an increase in congestion on the network, as is expected with the introduction of additional trips.

<u>Traffic Flow Volumes</u>

4.2.5 In comparison with the Reference Case, the development scenarios add little traffic to the overall modelled highway traffic within the modelled area of Adur and surrounding areas. The increases are typically 1.7% for Scenarios A1 and A2, 1.6% for Scenario A3 and 2.3% for Scenario B. These increases are common to both the morning and evening peak hours.

<u>Journey Time</u>

4.2.6 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 F.

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

- A27/A270
- A259

4.2.7 Increase in journey time on sections of the above seven routes was observed across all development scenarios 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

4.2.8 Chapter 6 (Section 6.4) of this report presents journey time comparisons for the Reference Case compared to scenarios with the site allocations and Shoreham Harbour developments in more detail.

Congestion hotspots

4.2.9 After examination of the Volume over Capacity Ratio (V/C) on entry arms for each individual junction in the study area, findings suggested that the five key junctions listed in the original brief would indeed experience exacerbated congestions in all future development scenarios. They have been brought into Tranche 1 junction analysis and reported in Section 4.3 of this report.

4.2.10 Furthermore, another eight junctions were identified as congestion hotspots in the future network that would require individual analysis. These junctions were also assessed in this study and reported in Tranche 2 junction analysis in Section 4.4. Table 4.4 below outlines these eight junctions.

Table 4.4: Additional Junctions Investigated in Tranche 2

Junction map reference	Junction Name	Junction Form	Observations
6	A27 / Busticle Lane	Signalised crossroads	AM V/C rises to over 90 for A27W (eastbound). Within capacity in PM
7	A27 Shoreham By-Pass / A293 Hangleton Link dumbbell	Grade separated dumbbell layout	A293 V/C increases in both peaks to over 100.
8	A259 Brighton Road / Western Road	Signalised junction, three arms	A259 eastbound V/C rises to nearly 100 in both peaks. Congestion on westbound A259 from Western Road into Worthing
9	A270 Upper Shoreham Road / B2167 Kingston Lane	Signalised crossroads with pedestrian footbridge	A270 westbound approaching junction increases to approximately 100 v/c in both peaks
10	A27 Sompting Bypass / Upper Brighton Road	Signalised junction with priority control for left turn from minor arms	Overcapacity on both approaches from the A27
11	A270 Old Shoreham Road / A293 Hangleton Link signalled junction	Signals Junction, three arms	A270 eastbound congestion reduces. A270 westbound increases to near 100 V/C in both peaks
12	A270 Old Shoreham Road / A2038 Hangleton Road / B2194 Carlton Terrace	Signals crossroads Junction	A270 westbound V/C reduces in both periods. B2194 approach is over capacity in AM and PM
13	A259 Wellington Road / B2194 Station Road	Signals junction	A259 eastbound remains congested in AM with significant increase in congestion in PM.

Development select link analysis

4.2.11 Select link analysis for individual development site was undertaken to demonstrate the distribution of traffic to and from these developments across the highway network in the study area. Illustration plots for Scenario B in the morning and afternoon peak hours are presented in Appendix J of this report. Similar trip distribution patterns were observed on all other development scenarios.

4.2.12 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 (Table 4.4). It should be noted that the collective traffic impacts from all developments are still significant as demonstrated in the aforementioned journey time and congestion hotspot analyses in this section.

4.3 Junction Performance – Tranche 1

4.3.1 The following sub-sections discuss the problems at each of the five key junctions in Tranche 1 and report the results from additional junction models of each junction. They have been modelled using ARCADY or TRANSYT as appropriate. The results presented for each model are mean max queue in passenger car units (PCU), average delay per vehicle and ratio of flow to capacity (RFC) or degree of saturation (DoS).

4.3.2 Turning flows brought into individual junction models were presented in Appendix D. A junction capacity map is produced in Appendix E, which gives an overview of the RFC or DoS for each arm of the following five junctions:

- 1. A27 / Grinstead Lane (North Lancing Roundabout)
- 2. A27 Sussex Pad
- 3. A27 / A283 Steyning Road
- 4. A259 Brighton Road / A283 Old Shoreham Road
- 5. A259 Brighton Road / A2025 South Street

4.3.3 Detailed junction performance reported in this section do not consider the potential impact of any demand management or highway improvement measures, which are discussed later in Sections 5.2 and 5.3.

<u>Junction 1 - A27 / Grinstead Lane</u>

4.3.4 Table 4.5 below shows the results from the ARCADY model for the A27/Grinstead Lane 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 4.5: ARCADY Results for Junction 1 - A27/Grinstead Lane (North Lancing Roundabout)

	AM			PM		
	Queue (PCU)	Delay (min)	RFC	Queue (PCU)	Delay (min)	RFC
	Reference Case					
A27 Old Shoreham Road	817.63	22.06	1.49	2039.81	56.33	1.99
A2025 Grinstead Lane	48.33	2.89	1.09	14.30	1.09	0.97
A27 Upper Brighton Road	1285.00	43.36	1.86	313.40	10.37	1.33
Manor Road	1.37	0.43	0.59	0.41	0.23	0.29
	Scenario A1					
A27 Old Shoreham Road	884.54	23.70	1.51	2277.54	62.75	2.08
A2025 Grinstead Lane	88.09	6.17	1.18	14.37	1.11	0.97
A27 Upper Brighton Road	1605.62	56.98	2.02	362.24	11.76	1.36
Manor Road	1.81	0.54	0.66	0.59	0.26	0.37
	Scenario A2					
A27 Old Shoreham Road	879.31	23.57	1.51	2247.41	62.07	2.07
A2025 Grinstead Lane	85.77	5.93	1.17	15.36	1.17	0.97
A27 Upper Brighton Road	1581.54	56.27	2.01	371.66	12.07	1.37
Manor Road	1.91	0.57	0.67	0.56	0.26	0.36
	Scenario A3					
A27 Old Shoreham Road	863.63	23.17	1.50	2276.71	62.50	2.07
A2025 Grinstead Lane	93.29	6.53	1.19	12.52	1.00	0.96
A27 Upper Brighton Road	1615.99	57.56	2.03	343.49	11.17	1.34
Manor Road	1.98	0.58	0.68	0.58	0.26	0.37
	Scenario B					
A27 Old Shoreham Road	898.43	24.04	1.52	2370.71	65.57	2.12
A2025 Grinstead Lane	109.98	7.89	1.22	16.94	1.27	0.98
A27 Upper Brighton Road	1648.68	58.94	2.04	380.34	12.27	1.37
Manor Road	1.96	0.58	0.67	0.64	0.27	0.39

4.3.5 The ARCADY modelling results in Table 4.5 show that three arms of the roundabout are expected to operate at or above their calculated capacity in both peak periods in all tested scenarios. The modelling results suggest that significant levels of queuing and delay will be experienced on the eastbound A27 approach (Upper Brighton Road) in the morning peak and the westbound A27 approach (Old Shoreham Road) to the roundabout in the evening peak period. The expected impact on the roundabout is consistent in all tested development scenarios, with Scenario B showing the greatest impact as expected due to that scenario containing the most new dwellings and therefore the highest travel demand.

Junction 2 - A27 Sussex Pad

4.3.6 The A27 Sussex Pad is made up of two signalised junctions; A27 Shoreham Bypass / Coombes Road and A27 Shoreham Bypass / Old Shoreham Road. The TRANSYT results for the two junctions are shown below in Table 4.6 and Table 4.7. Cases where the modelled traffic demand arriving at the junction exceeds 90% of the calculated capacity for that entry have been highlighted in red.

Table 4.6: TRANSYT Results for Junction 2 - A27 / Coombes Road

	AM				PM			
	Actual Flow	Queue (PCU)	Delay (min)	DoS (%)	Actual Flow	Queue (PCU)	Delay (min)	DoS (%)
	Reference Case							
A27 Eastbound	2816	140	1.05	102	2566	17	0.18	93
A27 Westbound ahead lane 1	83	1	0.10	6	212	2	0.12	15
A27 Westbound ahead lane 2	2642	89	0.47	96	2444	66	0.30	89
A27 Westbound right turn	37	1	1.28	32	76	3	1.67	67
Coombes Road	14	0	1.12	10	87	4	1.52	65
Practical Reserve Capacity	-12%				-3%			
	Scenario A1							
A27 Eastbound	2768	122	0.67	100	2541	9	0.15	92
A27 Westbound ahead lane 1	57	1	0.10	4	196	2	0.12	14
A27 Westbound ahead lane 2	2652	90	0.50	96	2448	66	0.32	89
A27 Westbound right turn	38	1	1.30	33	98	6	2.37	86
Coombes Road	54	2	1.25	40	106	5	1.87	79
Practical Reserve Capacity	-10%				-2%			
	Scenario A2							
A27 Eastbound	2763	120	0.65	100	2549	9	0.17	93
A27 Westbound ahead lane 1	66	1	0.10	5	203	2	0.12	14
A27 Westbound ahead lane 2	2644	89	0.48	96	2432	65	0.30	88
A27 Westbound right turn	38	1	1.30	33	100	6	2.48	88
Coombes Road	51	2	1.25	38	108	5	1.92	81
Practical Reserve Capacity	-10%				-3%			
	Scenario A3							
A27 Eastbound	2769	122	0.68	101	2528	9	0.15	92
A27 Westbound ahead lane 1	57	1	0.10	4	176	2	0.12	12
A27 Westbound ahead lane 2	2648	90	0.48	96	2461	68	0.32	89
A27 Westbound right turn	38	1	1.30	33	99	6	2.42	87
Coombes Road	52	2	1.25	39	108	5	1.92	81
Practical Reserve Capacity	-11%				-2%			
	Scenario B							
A27 Eastbound	2764	121	0.65	100	2544	9	0.15	92
A27 Westbound ahead lane 1	71	1	0.10	5	205	2	0.12	14
A27 Westbound ahead lane 2	2642	89	0.47	96	2435	65	0.30	88
A27 Westbound right turn	38	1	1.30	33	98	6	2.37	86
Coombes Road	47	2	1.23	35	107	5	1.90	80
Practical Reserve Capacity	-10%				-2%			

4.3.7 The A27 east and westbound approaches to the Coombes Road junction both operate close to their calculated capacity during the AM peak period for all scenarios including the Reference Case. The A27 eastbound approach is also operating close to the calculated capacity in the PM peak period.

Table 4.7: TRANSYT Results for Junction 2 - A27 / Old Shoreham Road

	AM				PM			
	Actual Flow	Queue (PCU)	Delay (min)	DoS (%)	Actual Flow	Queue (PCU)	Delay (min)	DoS (%)
Reference Case								
A27 Eastbound left turn	99	1	0.10	7	11	0	0.10	1
A27 Eastbound ahead	2730	109	0.72	99	2482	69	0.33	90
A27 Eastbound right turn	94	5	2.18	82	26	1	1.23	23
A27 Westbound ahead	2652	14	0.27	96	2454	6	0.12	89
A27 Westbound left turn	83	0	0.05	6	215	1	0.05	17
Old Shoreham Road	92	3	1.05	34	98	3	1.05	36
Practical Reserve Capacity	-9%				0%			
Scenario A1								
A27 Eastbound left turn	142	1	0.10	10	11	0	0.10	1
A27 Eastbound ahead	2739	112	0.77	99	2541	75	0.37	92
A27 Eastbound right turn	103	6	2.68	90	26	1	1.23	23
A27 Westbound ahead	2662	17	0.30	97	2460	9	0.13	89
A27 Westbound left turn	97	1	0.07	7	196	1	0.05	15
Old Shoreham Road	45	1	1.00	17	16	1	0.98	6
Practical Reserve Capacity	-9%				-2%			
Scenario A2								
A27 Eastbound left turn	140	1	0.10	10	11	0	0.10	1
A27 Eastbound ahead	2734	110	0.73	99	2544	75	0.37	92
A27 Eastbound right turn	103	6	2.68	90	27	1	1.25	24
A27 Westbound ahead	2654	16	0.27	96	2444	9	0.12	89
A27 Westbound left turn	103	1	0.07	8	203	1	0.05	16
Old Shoreham Road	46	2	1.00	17	18	1	0.98	7
Practical Reserve Capacity	-9%				-2%			
Scenario A3								
A27 Eastbound left turn	144	1	0.10	10	11	0	0.10	1
A27 Eastbound ahead	2734	110	0.73	99	2528	74	0.35	92
A27 Eastbound right turn	102	6	2.62	89	26	1	1.23	23
A27 Westbound ahead	2658	16	0.28	96	2474	9	0.13	90
A27 Westbound left turn	95	1	0.07	7	176	1	0.05	14
Old Shoreham Road	52	2	1.00	19	15	0	0.98	6
Practical Reserve Capacity	-9%				-2%			
Scenario B								
A27 Eastbound left turn	144	1	0.10	10	11	0	0.10	1
A27 Eastbound ahead	2737	110	0.75	99	2544	75	0.37	92
A27 Eastbound right turn	102	6	2.62	89	26	1	1.23	23
A27 Westbound ahead	2652	16	0.28	96	2448	9	0.12	89
A27 Westbound left turn	104	1	0.07	8	205	1	0.05	16
Old Shoreham Road	47	2	1.00	17	16	1	0.98	6
Practical Reserve Capacity	-9%				-2%			

4.3.8 The A27 east and westbound approaches to the Shoreham Road junction both operate close to their calculated capacity during the AM peak period for all scenarios including the Reference Case. The A27 eastbound approach is also operating close to the calculated capacity in the PM peak period when the Adur sites are introduced in Scenarios A1 to A3 and B.

Junction 3 - A27 / A283 Steyning Road

4.3.9 Table 4.8 below shows the results from the 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 that entry have been highlighted in red.

Table 4.8: ARCADY Results for Junction 3 - 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 A1						
A283 South	94.39	3.34	1.14	217.67	12.33	1.34
A283 North	75.18	2.80	1.07	58.26	1.54	1.04
A27 Eastbound Slips	0.54	0.05	0.35	0.77	0.08	0.44
A27 Westbound Slips	5.19	0.26	0.85	388.38	20.88	1.77
Scenario A2						
A283 South	103.57	3.66	1.15	204.29	11.35	1.32
A283 North	76.76	2.92	1.07	48.58	1.33	1.03
A27 Eastbound Slips	0.54	0.05	0.35	0.82	0.08	0.45
A27 Westbound Slips	5.35	0.27	0.85	399.90	21.49	1.83
Scenario A3						
A283 South	84.73	3.04	1.12	235.76	13.73	1.36
A283 North	65.17	2.11	1.06	41.35	1.17	1.02
A27 Eastbound Slips	0.53	0.05	0.35	0.81	0.08	0.45
A27 Westbound Slips	4.82	0.24	0.83	379.89	19.77	1.80
Scenario B						
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

4.3.10 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 approaching capacity in the morning peak period and significantly over capacity in the evening peak period in all tested scenarios.

Junction 4 - A259 Brighton Road / A283 Old Shoreham Road

4.3.11 Table 4.9 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 4.9: ARCADY Results for Junction 4 - 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 A1					
A259 Westbound	285.90	16.62	1.47	451.56	39.19	1.74
A259 Eastbound	1103.81	62.54	2.06	181.64	9.61	1.27
A283 Old Shoreham Rd	11.82	0.95	0.95	240.01	16.54	1.40
	Scenario A2					
A259 Westbound	285.13	16.62	1.48	404.37	35.91	1.69
A259 Eastbound	1122.90	63.29	2.07	162.23	8.69	1.25
A283 Old Shoreham Rd	11.52	0.92	0.95	213.40	14.34	1.37
	Scenario A3					
A259 Westbound	269.85	15.04	1.45	440.31	38.54	1.73
A259 Eastbound	1035.78	59.29	2.01	161.33	8.65	1.24
A283 Old Shoreham Rd	10.42	0.86	0.94	236.33	16.13	1.40
	Scenario B					
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

4.3.12 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 approach the calculated capacity in the morning peak period and exceed it in the evening peak. 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.

Junction 5- A259 Brighton Road / A2025 South Street

4.3.13 Table 4.10 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 4.10: ARCADY Results for Junction 5 - 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 A1					
A259 Westbound	216.90	21.14	1.46	418.12	44.79	1.79
A259 Eastbound	300.65	18.34	1.42	110.68	6.76	1.20
A2025 South St	381.95	57.16	2.01	451.39	51.62	1.96
	Scenario A2					
A259 Westbound	237.11	22.92	1.48	418.99	44.90	1.79
A259 Eastbound	294.43	17.93	1.41	104.35	6.30	1.19
A2025 South St	403.68	60.77	2.06	455.50	52.05	1.97
	Scenario A3					
A259 Westbound	218.77	21.31	1.46	415.69	44.67	1.79
A259 Eastbound	305.87	18.69	1.43	102.47	6.17	1.18
A2025 South St	391.18	58.60	2.03	449.50	51.17	1.95
	Scenario B					
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

4.3.14 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.

4.4 Junction Performance – Tranche 2

4.4.1 Similar to the previous section, the following sub-sections discuss the performance of each of the eight junctions in Tranche 2 in 2028 and reports the results from additional junction models of each junction. They have been modelled using ARCADY or Linsig as appropriate. The results presented for each model are mean maximum queue in passenger car units (PCU), average delay per vehicle and ratio of flow to capacity (RFC) or degree of saturation (DoS).

- 6. A27 / Busticle Lane
- 7. A27 Shoreham Bypass / Hangleton Link dumbbell
- 8. A259 Brighton Road / Western Road
- 9. A270 Upper Shoreham Road / B2167 Kingston Lane
- 10. A27 Sompting Bypass / Upper Brighton Road
- 11. A270 Old Shoreham Road / A293 Hangleton Link signalled junction
- 12. A270 Old Shoreham Road / A2038 Hangleton Road / B2194 Carlton Terrace

- 13. A259 Wellington Road / B2194 Station Road

4.4.2 Detailed junction performance reported in this section do not consider the potential impact of any demand management or highway improvement measures, which are discussed later in Sections 5.2 and 5.3.

4.4.3 Travel demand for each turning movement at the following junctions is included in Appendix D.

Junction 6 - A27 / Busticle Lane

4.4.4 This is a 4 arm signalised junction located on the A27 dual carriageway. The two side arms consist of Busticle Lane from the south and Halewick Lane from the north. Both A27 arms have right turn flares while the side arms have right turn flares in addition to segregated left turns which give-way to A27 traffic. There is a large sized waiting area in the central reservation for right turning vehicles from the side roads. The junction was modelled in LinSig 3.2.8.0.

4.4.5 The results of the modelling of the existing layout for the Reference Case and Scenario B flows are shown in Table 4.11.

Table 4.11: LinSig results for Junction 6 - A27 / Busticle Lane

	AM			PM		
	Queue (PCU)	Delay (sec)	DoS (%)	Queue (PCU)	Delay (sec)	DoS (%)
	Reference Case					
Halewick Lane Left Ahead	11.6	51.0	87	2.7	30.8	32
Halewick Lane Right	2.9	47.6	40	0.8	55.5	15
A27 East (WB) Left Ahead	23.8	30.2	86	18.7	22.1	70
A27 East (WB) Right Ahead	25.9	30.6	87	20.6	23.7	72
Busticle Lane Ahead Left	6.6	27.8	66	10.1	47.3	74
Busticle Lane Right	2.9	72.5	62	4.7	56.1	53
A27 West (EB) Left Ahead	24.7	31.1	87	18.9	22.1	70
A27 West (EB) Ahead Right	28.7	34.5	89	21.4	26.4	75
Practical Reserve Capacity	0.6%			19.7%		
	Scenario B					
Halewick Lane Left Ahead	17.6	66.9	92	3.0	29.0	39
Halewick Lane Right	3.3	50.3	39	0.7	49.0	17
A27 East (WB) Left Ahead	25.9	30.8	84	16.8	22.7	78
A27 East (WB) Right Ahead	28.2	31.5	85	18.4	23.4	79
Busticle Lane Ahead Left	7.8	29.8	60	9.9	48.4	82
Busticle Lane Right	3.1	100.5	70	2.9	43.6	45
A27 West (EB) Left Ahead	34.2	43.7	93	17.3	23.1	79
A27 West (EB) Ahead Right	37.4	47.5	94	19.3	26.1	82
Practical Reserve Capacity	-5.0%			8.6%		

4.4.6 It can be see that while the junction is operating acceptably in the PM peak, in the AM the junction is only just operating at an acceptable level in the Reference Case and in Scenario B has two arms operating at over 90% saturation. The two critical movements in the AM are the traffic from Halewick Lane and eastbound A27 traffic.

Junction 7 - A27 Shoreham, By-pass / Hangleton Link dumbbell

4.4.7 This is a grade-separated dumbbell junction between the A27 and A293 Hangleton Link Road that falls within Brighton & Hove City Council area. Both roundabouts, one north and the other south of the A27, are give-way controlled with single lane entries from each link.

4.4.8 The southern roundabout consists of the entry and exit to the A27 westbound carriageway, the A293 to the south and the link to the northern roundabout.

4.4.9 The northern roundabout consists of the entry and exit to the A27 eastbound carriageway, the link to the southern roundabout and an entrance to a golf club to the north.

4.4.10 The existing layouts were modelled in Arcady 8.0.1.305 while the proposed mitigations were modelled in LinSig 3.2.8.0.

4.4.11 The results of the modelling of the existing layout for the Reference Case and Scenario B flows are shown in Table 4.12 for the south roundabout and in Table 4.13 for the north roundabout.

Table 4.12: ARCADY Results for Junction 7 - A27 Shoreham By-pass / Hangleton Link Road South Roundabout without mitigation

	AM			PM		
	Queue (PCU)	Delay (sec)	DoS (%)	Queue (PCU)	Delay (sec)	DoS (%)
	Reference Case					
North Roundabout Link	0.4	3.7	30	.3	3.4	24
A27 Westbound Offslip	7.5	26.9	89	1.9	8.6	65
A293 Hangleton Link	442.2	1007.9	120	589.6	1349.4	127
Practical Reserve Capacity	-41%			-49%		
	Scenario B					
North Roundabout Link	0.4	3.6	28	0.4	3.5	27
A27 Westbound Offslip	34.2	108.8	99	1.8	8.7	65
A293 Hangleton Link	431.6	985.2	120	698.4	1599.2	132
Practical Reserve Capacity	-56%			-55%		

Table 4.13: ARCADY Results for Junction 7 - A27 Shoreham By-pass / Hangleton Link Road North Roundabout without mitigation

	AM			PM		
	Queue (PCU)	Delay (sec)	DoS (%)	Queue (PCU)	Delay (sec)	DoS (%)
	Reference Case					
Golf Course	0.1	49.1	12	0.5	20.5	34
South Roundabout Link	16.2	46.4	95	3.95	13.0	80
A27 Eastbound Offslip	457	2943.0	160	1.06	11.8	51
Practical Reserve Capacity	-88%			6%		
	Scenario B					
Golf Course	0.1	49.7	12	0.6	25.1	39
South Roundabout Link	15.1	43.5	95	4.2	13.6	81
A27 Eastbound Offslip	482.4	3086.2	163	1.6	14.9	61
Practical Reserve Capacity	-92%			6%		

4.4.12 It is clear that both roundabouts will operate with flows well above capacity in both scenarios, only the southern roundabout in the PM peak is operating within capacity.

4.4.13 An analysis of the merges and diverges to and from the A27 for this junction was also undertaken in line with the guidance in DMRB TD22/06 on the recommended layouts of grade separated junctions.

4.4.14 The current layout consists of Type A merges and Type A diverges in both directions (merge / diverge types are defined in DMRB TD 22/06). This analysis shows that both diverges and the westbound merge will continue to operate comfortably in the future scenarios. However, the current layout of the eastbound merge is deemed not sufficient for the predicted flows following the guidance set out in the DMRB. This will require some improvements, which is detailed in the mitigation section of this report. Note that this junction has also been assessed within the Transport Assessment underpinning the Brighton & Hove Submission City Plan (Part One), 2013.

Junction 8 - A259 Brighton Road / Western Road

4.4.15 This is a 3 arm signalised junction between A259 Brighton Road and Western Road. Both arms of the A259 have very extended flares and funnels particularly to the west of the junction. Additionally the East arm flares to 3 lanes with a separate lane for right turning traffic into Western Road. Western Road has a flare to two lanes. The junction was modelled in LinSig 3.2.8.0.

4.4.16 The results of the modelling of the existing layout for the Reference Case and Scenario B flows are shown in Table 4.14 below.

Table 4.14: LinSig results for Junction 8 - A259 Brighton Road / Western Road Junction

	AM			PM		
	Queue (PCU)	Delay (sec)	DoS (%)	Queue (PCU)	Delay (sec)	DoS (%)
	Reference Case					
A259 East Ahead	5.8	6.8	48	6.0	7.8	53
A259 East Ahead/Right	6.8	6.8	50	6.9	7.9	55
A259 West Ahead/Left	16.5	24.3	84	9.8	21.3	75
A259 West Ahead	19.3	24.4	86	11.5	20.8	77
Western Rd Left/Right	7.0	53.5	85	4.2	40.2	69
Practical Reserve Capacity	5.0%			17.2%		
	Scenario B					
A259 East Ahead	5.1	6.3	43	5.8	7.6	54
A259 East Ahead/Right	5.7	6.3	45	6.4	7.6	55
A259 West Ahead/Left	17.1	24.3	84	10.0	22.4	78
A259 West Ahead	20.1	24.4	86	11.8	22.1	80
Western Rd Left/Right	6.5	55.9	83	4.7	48.3	77
Practical Reserve Capacity	4.5%			12.5%		

4.4.17 Although the junction was deemed problematic after examination of the modelling results from SATURN, further investigation using junction modelling suggests that the junction coding in the original SATURN model may not be totally accurate or that the accuracy of the SATURN modelling at the junction may be beyond its capacities. The junction modelling results presented above demonstrate that the junction will operate at acceptable levels in both scenarios with the highest DoS observed at 86%. The two critical movements in the AM are the traffic from Western Road and eastbound A259 traffic.

Junction 9 - A270 Upper Shoreham Road / B2167 Kingston Lane

4.4.18 This is a 4 arm signalised junction between A270 Shoreham Road and Kingston Lane. Both of the A270 approaches are two lane dual carriageways. The West arm flares to 3 lanes with a separate lane for right turning traffic into Kingston Lane. Both Kingston Lane entries are flared to allow two lanes of traffic at the stop line, though only one wide lane is marked on street. The junction was modelled in LinSig 3.2.8.0.

4.4.19 The results of the modelling of the existing layout for the Reference Case and Scenario B flows are shown in Table 4.15.

Table 4.15: LinSig results for Junction 9 - A270 Upper Shoreham Road / B2167 Kingston Lane Junction

	AM			PM		
	Queue (PCU)	**Delay (sec)**	**DoS (%)**	**Queue (PCU)**	**Delay (sec)**	**DoS (%)**
	Reference Case					
Upper Kingston Lane	2.0	59.0	46.8%	0.8	45.9	26.7%
A270 East Left/Ahead	18.4	36.9	86.5%	12.1	19.4	75.4%
A270 East Ahead	16.8	31.0	80.6%	11.4	17.3	70.4%
Kingston Lane	3.5	50.9	64.4%	4.0	39.5	69.6%
A270 West Left/Ahead	4.5	5.1	38.5%	3.4	5.8	34.5%
A270 West Ahead/Right	12.7	25.9	88.4%	4.5	17.2	71.6%
Practical Reserve Capacity	5.0%			17.2%		
	Scenario B					
Upper Kingston Lane	2.7	86.4	64.4%	1.0	49.9	23.6%
A270 East Left/Ahead	21.0	45.0	88.7%	21.2	38.0	88.0%
A270 East Ahead	18.8	36.9	82.2%	19.3	31.5	82.1%
Kingston Lane	4.1	60.8	69.9%	8.6	61.6	86.0%
A270 West Left/Ahead	4.7	4.6	38.3%	4.2	6.9	32.4%
A270 West Ahead/Right	17.4	28.2	89.5%	11.4	35.4	89.5%
Practical Reserve Capacity	4.5%			12.5%		

4.4.20 Although the junction was deemed problematic after examination of the modelling results from SATURN, it appears that this relates to the accuracy of the SATURN modelling rather than any potential capacity issue. The junction modelling results presented above demonstrate that the junction will operate at acceptable levels in both Scenarios with the highest DoS observed at just under 90%. The critical movements in the PM peak are the east, west and south approaches to the junction (A270 East, A270 West and Kingston Lane respectively).

Junction 10 – A27 Sompting By-pass / Upper Brighton Road

4.4.21 This is a 4 arm signalised junction located on the dual carriageway A27. The two side arms consist of Upper Brighton Road from the south and Lyons Way from the north. The A27 Arms have segregated right turn lanes while the side have segregated left turns which give-way to A27 traffic. Upper Brighton Road has a single wide lane for straight on and right turning traffic and Lyons Way flares to three lanes, one for straight on traffic and two for right turners. The junction was modelled in LinSig 3.2.8.0.

4.4.22 The results of the modelling of the existing layout for the Reference Case and Scenario B flows are shown in the Table 4.16.

Table 4.16: LinSig results for Junction 10 - A27 Sompting Bypass / Upper Brighton Road Junction

	AM			PM		
	Queue (PCU)	Delay (sec)	DoS (%)	Queue (PCU)	Delay (sec)	DoS (%)
	Reference Case					
A27 West Ahead Left	35.4	60.2	95	19.1	30.0	69
A27 West Ahead	35.8	60.0	95	19.4	29.9	70
A27 West Right	0.0	0.0	0	1.6	77.2	35
Upper Brighton Rd Left GW	1.0	7.0	28	0.5	7.4	13
Upper Brighton Rd	18.4	69.1	92	11.3	52.5	77
Lyons Way Ahead	0.0	0.0	0	0.0	0.0	0
Lyons Way Right	1.5	62.9	30	4.9	82.3	77
Lyons Way Left	0.9	14.6	8	2.2	8.9	19
A27 East Ahead Left	31.2	60.3	94	21.6	34.8	78
A27 East Ahead	34.5	59.7	94	23.7	34.8	79
A27 East Right	7.6	149.0	91	1.6	78.7	37
Practical Reserve Capacity	-5.3%			14.2%		
	Scenario B					
A27 West Ahead Left	36.4	60.6	95	21.7	33.0	75
A27 West Ahead	36.8	60.4	95	22.0	33.0	75
A27 West Right	0.0	0.0	0	1.7	77.9	37
Upper Brighton Rd Left GW	1.0	7.4	30	0.6	6.6	15
Upper Brighton Rd	24.3	110.0	99	12.2	54.4	80
Lyons Way Ahead	0.0	0.0	0	0.1	64.3	2
Lyons Way Right	1.3	62.2	26	5.2	78.0	76
Lyons Way Left	1.6	15.8	13	2.4	10.7	20
A27 East Ahead Left	40.5	87.1	99	22.6	37.0	80
A27 East Ahead	45.8	88.5	100	24.6	36.9	81
A27 East Right	8.7	152.7	93	0.9	73.4	21
Practical Reserve Capacity	-10.7%			11.1%		

4.4.23 It can be seen that while the junction is operating acceptably in the PM peak, in the AM peak the junction is congested in the Reference Case with three arms over 90% DoS. With Scenario B demand the junction is at capacity with two arms at 99/100% DoS and one at 95%. The critical movements in the AM are both directions on the A27 traffic and the traffic from Upper Brighton Road.

<u>Junction 11 – A270 Old Shoreham Road / A293 Hangleton Link signalled junction</u>

4.4.24 This is a 3 arm traffic signal controlled junction between the A270 Old Shoreham Road and the A293 Hangleton Link Road that falls within Brighton & Hove City Council area. Old Shoreham Road has two lanes for traffic in both directions. The stop lines for all six possible movements at the junction are separated from each other and can run independently in any proposed signal plan. The left turn from A270 Old Shoreham Road West is give-way controlled on entry to the Hangleton Link Road. The junction features a series of controlled pedestrian crossings, providing access to all sides. The junction was modelled in LinSig 3.2.8.0.

4.4.25 The results of the modelling of the existing layout for the Reference Case and Scenario B flows are shown in the table below.

Table 4.17: LinSig results for Junction 11 - A270 Old Shoreham Road / A293 Hangleton Link

	AM			PM		
Hangleton Link Road	Queue (PCU)	Delay (sec)	DoS (%)	Queue (PCU)	Delay (sec)	DoS (%)
	Reference Case					
A270 Old Shoreham Road West Ahead, Left Lane	13.7	43.9	68.3%	6.8	41.7	43.3%
A270 Old Shoreham Road West Ahead, Right Lane	15.5	44.8	71.6%	7.9	42.0	46.6%
A270 Old Shoreham Road West Left Turn, Ped Xing	1.5	2.4	19.2%	2.0	2.6	34.0%
A270 Old Shoreham Road West Left Turn, Give-Way Left Lane	1.0	2.0	24.9%	1.5	1.9	26.6%
A270 Old Shoreham Road West Left Turn, Give-Way Right Lane	0.2	3.2	3.9%	1.0	2.0	23.7%
A293 Hangleton Link Road Left Turn	10.9	17.5	47.9%	9.8	13.9	44.9%
A293 Hangleton Link Road Right Turn, Left Lane	5.9	50.3	47.4%	2.1	46.8	19.2%
A293 Hangleton Link Road Right Turn, Right Lane	6.6	50.3	49.4%	2.5	46.8	21.6%
A270 Old Shoreham Road East Ahead, Left Lane	1.0	3.8	26.6%	0.4	2.3	35.6%
A270 Old Shoreham Road East Ahead, Right Lane	1.1	3.5	32.3%	0.5	2.3	42.6%
A270 Old Shoreham Road East Right Turn	9.9	36.7	56.7%	1.0	9.6	20.6%
Practical Reserve Capacity	25.7%			93.0%		
	Scenario B					
A270 Old Shoreham Road West Ahead, Left Lane	14.0	45.8	70.6%	6.6	44.7	45.2%
A270 Old Shoreham Road West Ahead, Right Lane	17.2	48.9	77.6%	7.9	45.4	50.0%
A270 Old Shoreham Road West Left Turn, Ped Xing	1.5	2.4	18.9%	2.2	2.7	37.9%
A270 Old Shoreham Road West Left Turn, Give-Way Left Lane	1.0	2.0	25.1%	1.8	1.9	28.2%
A270 Old Shoreham Road West Left Turn, Give-Way Right Lane	0.2	2.8	2.9%	1.4	2.0	26.5%
A293 Hangleton Link Road Left Turn	12.5	17.8	52.5%	9.7	12.5	45.1%
A293 Hangleton Link Road Right Turn, Left Lane	7.8	48.3	54.6%	2.2	43.7	18.7%
A293 Hangleton Link Road Right Turn, Right Lane	8.7	48.3	56.3%	2.6	43.7	20.7%
A270 Old Shoreham Road East	1.3	5.1	26.7%	0.5	2.4	35.6%

Ahead, Left Lane						
A270 Old Shoreham Road East Ahead, Right Lane	1.5	4.7	32.3%	0.7	2.6	48.3%
A270 Old Shoreham Road East Right Turn	8.6	35.0	58.6%	0.6	7.5	14.5%
Practical Reserve Capacity	16.0%			80.1%		

4.4.26 This junction was deemed problematic after examination of the modelling results from SATURN. Further investigation suggests that the capacity of the A270 Old Shoreham Road East and West approaches to the junction are restricted in the SATURN model by the link speed-flow curve coding, highlighting these links as approaching or exceeding capacity.

4.4.27 The junction modelling results indicate that the junction will operate at acceptable levels in both scenarios with the highest DoS observed at just over 80%. This junction is busier and therefore closer to capacity in the morning peak hour. The critical movements are the three conflicting movements in the centre of the junction, the straight ahead traffic from A270 Old Shoreham Road West and the right turns from A270 Old Shoreham Road East and A293 Hangleton Link Road.

Junction 12 - A270 Old Shoreham Road / A2038 Hangleton Road / B2194 Carlton Terrace

4.4.28 This is a four arm traffic signal controlled junction connecting the A270 Old Shoreham Road with Carlton Terrace and Hangleton Road that falls within Brighton & Hove City Council area. Old Shoreham Road has two lanes for traffic in both directions. The left turn from A270 Old Shoreham Road West is give-way controlled on entry to Hangleton Road. The junction was modelled in LinSig 3.2.8.0

4.4.29 The results of the modelling of the existing layout for the Reference Case and Scenario B flows are shown in the Table 4.18.

Table 4.18: LinSig results for Junction 12 - A270 Old Shoreham Road / A2038 Hangleton Road / B2194 Carlton Terrace Junction

	AM			PM		
	Queue (PCU)	Delay (sec)	DoS (%)	Queue (PCU)	Delay (sec)	DoS (%)
	Reference Case					
A270 Old Shoreham Road West Ahead	15.9	38.8	79.3%	7.8	31.8	54.9%
A270 Old Shoreham Road West Ahead/Right Turn	16.4	39.7	81.9%	10.8	34.3	66.9%
A270 Old Shoreham Road West Left Turn Give-Way	0.1	1.0	14.8%	0.1	0.9	8.9%
Hangleton Road	12.0	69.9	84.0%	13.1	62.5	84.3%
A270 Old Shoreham Road East Left Turn/Ahead	15.5	51.1	77.7%	17.4	55.5	82.8%
A270 Old Shoreham Road East Ahead/Right Turn	17.5	54.0	82.4%	19.0	56.0	84.3%
Carlton Terrace Left Turn/Ahead, Left Lane	12.9	61.2	79.7%	13.1	67.2	82.0%
Carlton Terrace Left Turn/Ahead, Left Lane	14.9	60.5	81.3%	13.5	67.0	82.2%
Carlton Terrace Ahead/ Right Turn, Right Lane	15.9	38.8	79.3%	7.8	31.8	54.9%
Practical Reserve Capacity	7.2%			6.7%		
	Scenario B					
A270 Old Shoreham Road West Ahead	17.8	50.0	86.9%	8.7	32.0	58.2%
A270 Old Shoreham Road West Ahead/Right Turn	20.5	45.1	87.1%	11.0	34.7	68.4%
A270 Old Shoreham Road West Left Turn Give-Way	0.1	1.0	16.3%	0.1	1.0	8.0%
Hangleton Road	13.7	71.4	85.9%	12.6	65.7	85.1%
A270 Old Shoreham Road East Left Turn/Ahead	15.9	52.2	79.1%	18.4	58.3	85.2%
A270 Old Shoreham Road East Ahead/Right Turn	18.0	54.9	83.4%	20.0	58.8	86.6%
Carlton Terrace Left Turn/Ahead, Left Lane	13.8	69.0	84.2%	14.4	66.0	83.3%
Carlton Terrace Left Turn/Ahead, Left Lane	15.5	67.7	85.1%	15.0	66.0	83.9%
Carlton Terrace Ahead/ Right Turn, Right Lane	17.8	50.0	86.9%	8.7	32.0	58.2%
Practical Reserve Capacity	3.3%			3.9%		

4.4.30 This junction was deemed problematic after examination of the modelling results from SATURN. After extending the cycle time at this junction to reduce the proportion of green time lost to stage changes, the junction operates within capacity in all four tested scenarios.

4.4.31 The junction modelling results presented above indicate that the junction will operate at acceptable levels in both scenarios with the highest DoS observed at just below 90%. This junction is busier and therefore closer to capacity in the evening peak hour. The critical movements are the right turns from A270 Old Shoreham Road West and the north Hangleton Road entry.

Junction 13 – A259 Wellington Road / B2194 Station Road

4.4.32 This is a four arm traffic signal controlled junction on the A259 near the eastern end of Shoreham harbour that lies within Brighton & Hove City Council area. The junction connects the A259, Kingsway to the east and Wellington Road to the west, with the B2194 Station Road and Basin Road. The Basin Road approach to the junction is one-way out from the harbour. The junction was modelled in LinSig 3.2.8.0.

4.4.33 The results of the modelling of the existing layout for the Reference Case and Scenario B flows are shown in the table below.

Table 4.19: LinSig results for Junction 13 - A259 Wellington Road / B2194 Station Road Junction

	AM			PM		
	Queue (PCU)	Delay (sec)	DoS (%)	Queue (PCU)	Delay (sec)	DoS (%)
	Reference Case					
Station Road	6.6	60.2	63.3%	2.0	45.2	25.5%
A259 Kingsway	11.1	89.8	95.7%	6.2	21.0	67.2%
Basin Road	0.0	0.0	0.0%	0.0	0.0	0.0%
A259 Wellington Road	46.8	53.8	96.7%	22.1	24.2	76.8%
Practical Reserve Capacity	-7.5%			17.2%		
	Scenario B					
Station Road	5.5	56.7	55.9%	5.7	63.2	61.3%
A259 Kingsway	10.3	69.1	93.9%	5.4	14.0	42.9%
Basin Road	0.0	0.0	0.0%	0.0	0.0	0.0%
A259 Wellington Road	43.0	47.4	95.2%	27.5	25.4	82.3%
Practical Reserve Capacity	-5.8%			9.4%		

4.4.34 It can be seen that while the junction is operating acceptably in the PM peak, in the AM peak the junction has two arms approaching the calculated capacity. In both the Reference Case and Scenario B the A259 Kingsway and A259 Wellington Road entries are above the 90% DoS threshold.

4.5 Impact on Air Quality Management Area and Sompting Conservation Area

4.5.1 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 4.1)
- The A259 between Ropetackle Roundabout and Surry Street (Figure 4.2)

- Sompting Conservation area, in particular a section of West Street, Sompting, between Church Lane and Lambley's Lane (Figure 4.3).

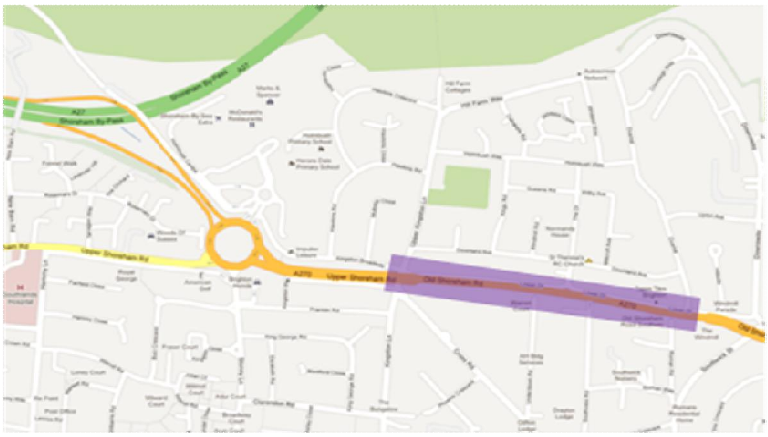


Figure 4.1: A270 Air Quality Management Area

Figure 4.2: A259 Air Quality Management Area

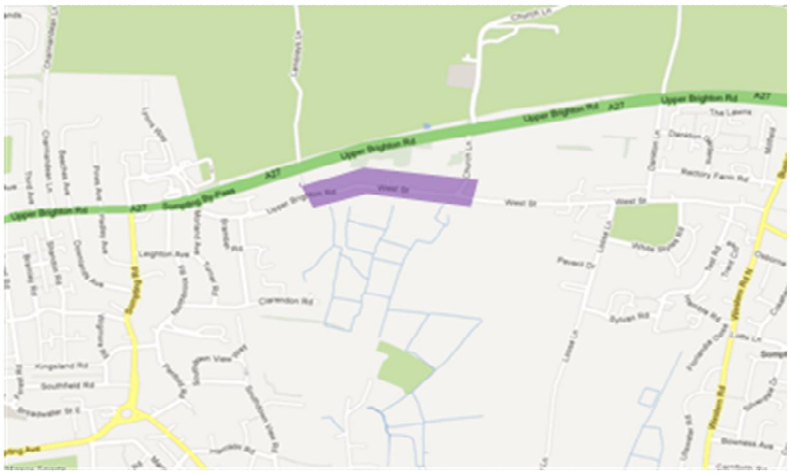


Figure 4.3: Sompting Conservation Area

4.5.2 The flow, queue and delay through the AQMAs and the Sompting Conservation area are shown in Table 4.20, Table 4.21 and Table 4.22.

Table 4.20: Flow in pcu through AQMAs and Sompting Conservation Area

AQMAs			AM					PM				
Road	**From**	**To**	**Ref**	**A1**	**A2**	**A3**	**B**	**Ref**	**A1**	**A2**	**A3**	**B**
Old Shoreham Road	Kingston Lane junction	Lower Drive junction	1,187	1,253	1,256	1,256	1,248	1,008	1,030	1,034	1,026	1,022
	Lower Drive junction	Kingston Lane junction	1,455	1,403	1,398	1,391	1,407	1,528	1,569	1,568	1,568	1,574
A259 High Street	Ropetackle Roundabout	Surry Street	3,907	4,288	4,276	4,324	4,240	2,901	2,909	2,943	2,862	2,954
	Surry Street	Ropetackle Roundabout	3,907	4,288	4,276	4,324	4,240	2,901	2,909	2,943	2,862	2,954
Sompting Conservation Area												
West Street	Church Lane	Lambleys Lane	909	976	914	870	986	412	469	452	483	498
	Lambleys Lane	Church Lane	275	346	338	331	356	164	202	199	202	232

Table 4.21: Average Queue in Metres through AQMAs and Sompting Conservation Area

AQMAs			AM					PM				
Road	**From**	**To**	**Ref**	**A1**	**A2**	**A3**	**B**	**Ref**	**A1**	**A2**	**A3**	**B**
Old Shoreham Road	Kingston Lane junction	Lower Drive junction	0	0	0	0	0	0	0	0	0	0
	Lower Drive junction	Kingston Lane junction	9	8	8	8	8	9	20	20	20	23
A259 High Street	Ropetackle Roundabout	Surry Street	4	5	5	5	5	3	3	3	3	3
	Surry Street	Ropetackle Roundabout	4	5	5	5	5	3	3	3	3	3
Sompting Conservation Area												
West Street	Church Lane	Lambleys Lane	0	0	0	0	0	0	0	0	0	0
	Lambleys Lane	Church Lane	0	0	0	0	0	0	0	0	0	0

Table 4.22: Delay in seconds per PCU through AQMAs and Sompting Conservation Area

AQMAs			AM					PM				
Road	**From**	**To**	**Ref**	**A1**	**A2**	**A3**	**B**	**Ref**	**A1**	**A2**	**A3**	**B**
Old Shoreham Road	Kingston Lane junction	Lower Drive junction	8	9	9	9	9	6	6	6	6	6
	Lower Drive junction	Kingston Lane junction	50	44	43	42	44	71	108	105	106	114
A259 High Street	Ropetackle Roundabout	Surry Street	54	70	71	71	67	40	37	37	36	37
	Surry Street	Ropetackle Roundabout	54	70	71	71	67	40	37	37	36	37
Sompting Conservation Area												
West Street	Church Lane	Lambleys Lane	24	28	24	22	28	5	6	6	7	7
	Lambleys Lane	Church Lane	5	6	6	6	6	3	3	3	3	4

4.5.3 The flow thorough both AQMAs and the Sompting Conservation area are higher in the AM than the PM peak hour. There is little difference in the flow between development scenarios in either the AM or the PM peaks. As a result, the queue and delay results are also very similar between development scenarios. 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 MITIGATION MEASURES

5.1 Introduction

5.1.1 Mitigation measures have been considered across the study area in order to alleviate traffic impacts from site allocations in particular. This also includes some spin-offs further afield. It was agreed in this study that a package of complementary measures needs to be identified through improvements to the highway network, parking provision, public transport improvement and promoting the usage of non-motorised modes. The following two sections of this chapter present some early thoughts on these interventions and explain how they have been considered in the study. Funding sources for improvement measures are listed in Appendix I.

5.1.2 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.

5.2 Sustainable Transport Measures

5.2.1 Sustainable transport measures will be promoted to reduce demand for travel by private car in innovative ways. These may include:

- Personal travel planning
- School travel planning
- Workplace travel planning
- Cycling and walking promotion
- Public transport information and marketing
- Car clubs

5.2.2 Collectively these sustainable transport measures are expected to reduce the highway traffic demand in the network.

5.2.3 Experience from the Sustainable Travel Towns (Worcester, Peterborough and Darlington) saw a reduction of 9% in car driver trips in 2008 compared to 2004[7]. The same study found the following reductions in car use based upon distance travelled;

- Less than 1km = 22% reduction;
- 1km – 3km = 14% reduction;
- 3km – 5km = 10% reduction;
- 5km – 10km = 6% reduction;
- 10km – 50km = 3% reduction;
- Over 50km = No reduction.

5.2.4 As the existing modelling tool does not capture travellers' responses to most of these sustainable transport measures, it was agreed that a suitable approach to reflect their impacts on reducing private car use is to reduce the number of trips for certain movements and trip purposes for individual movements based upon the likely reductions in paragraph 5.2.3 above. In order to ensure that this factoring process does not over-estimate the amount of highway trip reduction, it is also agreed that such factoring should be solely related to trips to or from the site allocations and their immediately surrounding areas (within ¼- ½ mile radius). This ensured that the scale of reduction is in proportion to the funding that may be available for Smarter Choices measures and also accounts for the fact that large-scale new development may provide more opportunities for the financing of such measures.

5.2.5 Prior to the application of these factors, an additional reduction in trips was applied to each of the scenarios to remove those trips that would start and end within the same development site (which was also the case in the pre-mitigation scenarios in Section 4 above). An internalisation factor of 10% was therefore agreed for large sites to account for commuting, shopping and educational escort trips starting and ending within the same site as per the pre-mitigation scenarios.

5.2.6 Although the impacts from sustainable transport measures were assumed to be focused on site allocation areas, it is believed a small group of these measures would still have a much wider impact. These measures are summarised in Table 5.1 below and their respective impacts were applied to the remaining area of Adur but without double counting any of the above reductions. The exact percentages of reductions were established based on information in the Yeovil Transport Strategy Review[8] which provides empirical evidence on the likely scale of reductions and greater breakdown on the effects of individual measures than in other studies.

[7] Sloman L, Cairns S, Newson C, Anable J, Pridmore A & Goodwin P (2010), *The Effects of Smarter Choices Programmes in Sustainable Travel Towns; Research Report*
[8] Walford S (2009), *Second Yeovil Transport Strategy Review; Non-Modellable Interventions*

Table 5.1: Adur District Sustainable Travel Measures

Measure	Trip Reduction	Application
Travel Awareness Campaigns	1.3%	Trips < 5km
Increase in Cycling	3.0%	Trips < 6 km
Increase in Walking	1.0%	Trips < 2km
Public Transport Improvements[9]	2.6%	Trips between zones within 500m of no. 2 and no. 700 services

5.2.7 All aforementioned trip reductions have been applied to the forecast travel demand and the overall reduction in each scenario is shown in Table 5.2 and Table 5.3 below. The values show the expected volume of highway traffic, including goods vehicles, following the inclusion of site allocation trips and the effects of the network improvements, travel demand changes and mode choice module within SHTM. It is recognised that the reduction in overall car vehicle kilometres is likely to be somewhat lower than this percentage reduction since many of the trips removed are short distance trips.

5.2.8 The results reported in Section 4 with no mitigation are compared with the modelling results which include the effects of the network improvements and travel demand changes from the sustainable travel measures identified.

Table 5.2: AM Peak Demand Matrix Comparison

	Reference	Scenario A1	Scenario A2	Scenario A3	Scenario B
Original Demand	69,196	70,496	70,456	70,402	70,841
After Sustainable Measures	69,053	69,133	69,102	69,047	69,416
Reduction	143	1,363	1,354	1,355	1,425

Note: All values expressed in PCUs.

Table 5.3: PM Peak Demand Matrix Comparison

	Reference	Scenario A1	Scenario A2	Scenario A3	Scenario B
Original Demand	75,380	77,162	77,122	77,048	77,581
After Sustainable Measures	75,246	75,874	75,844	75,771	76,215
Reduction	134	1,288	1,278	1,277	1,366

Note: All values expressed in PCUs.

5.2.9 The overall size of the demand matrices after the implementation of sustainable measures has reduced when compared to the original model runs, indicating a reduction in highway trips during the modelled peak periods. As the sustainable travel measures have the greatest impact on the development zones and immediately surrounding areas, it was expected that the greatest reduction in highway trips would be in Scenario B where the greatest volume of trips are generated.

[9] This reduction is restricted to trips relating to the particular bus services that are anticipated to be improved as part of the Shoreham Harbour Transport Strategy.

5.2.10 The sustainable measures have resulted in an overall reduction in each scenario of approximately 2.0% in the AM peak and 1.7% in the PM peak. The difference in reduction in each peak period is due to differences in travel demand for individual O/D movements and the variety of trip length.

5.2.11 Table 5.4 and Table 5.5 below use Scenario B as an example to demonstrate how each of these measures contributes to the total reduction in trips from the sustainable travel initiatives. Note that the figures relate to the whole of the modelled study area that includes Adur and surrounding areas, not just the District.

Table 5.4: Sustainable Measures Impact Example – Scenario B AM Peak

	Matrix Total	Reduction	% Reduction
Original Demand	70,841		
Internalisation		454	0.64%
Development focused sustainable transport measures		756	1.07%
District wide measures (Travel Awareness Campaigns, Cycling and Walking)		115	0.16%
Public Transport Improvements		100	0.14%
Total Reductions		1,425	2.01%
After Sustainable Measures	69,416		

Note: Matrix totals extracted from SATURN highway assignment models.
Intrazonal (zone A to zone A) movements excluded.
All values expressed in PCUs.

Table 5.5: Sustainable Measures Impact Example – Scenario B PM Peak

	Matrix Total	Reduction	% Reduction
Original Demand	77,581		
Internalisation		436	0.56%
Development focused sustainable transport measures		727	0.94%
District wide measures (Travel Awareness Campaigns, Cycling and Walking)		104	0.13%
Public Transport Improvements		98	0.13%
Total Reductions		1,365	1.76%
After Sustainable Measures	76,215		

Note: Matrix totals extracted from SATURN highway assignment models.
Intrazonal (zone A to zone A) movements excluded.
All values expressed in PCUs.

5.2.12 It can be seen in Table 5.4 and Table 5.5 that the largest reduction in highway trips is produced by sustainable transport measures focused around the sites. These measures have the largest trip reduction factors, especially for shorter trips, so would be expected to produce the greatest trip reduction.

5.3 Highway Mitigation Schemes

5.3.1 Highway mitigations were required for 9 out of the 13 key junctions that were assessed in sections 4.3 and 4.4. Initial proposals have been developed for these 9 junctions after iterative discussion with West Sussex County Council and Brighton & Hove City Council (subject to further detailed study):

- 1. A27 / Grinstead Lane (North Lancing Roundabout)
- 2. A27 / Sussex Pad
- 3. A27 / A283 Steyning Road
- 4. A259 Brighton Road / A283 Old Shoreham Road
- 5. A259 Brighton Road / A2025 South Street
- 6. A27 / Busticle Lane
- 7. A27 Shoreham Bypass / Hangleton Link dumbbell
- 10. A27 Sompting Bypass / Upper Brighton Road
- 13. A259 Wellington Road / B2194 Station Road

5.3.2 The proposals seek to increase the capacity of the junctions and therefore improve the performance. Consideration has also been given to the available land surrounding the junction and the relative cost of each proposal in comparison with other options. Further detailed study may be required to refine the junction designs.

5.3.3 It should also be noted that the 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. The cost base for all estimates presented in this section is Q4 2012.

5.3.4 Junction 1 - A27 / Grinstead Lane (North Lancing Roundabout)The highway mitigation proposal for the A27 / A2025 Grinstead Lane is to turn the existing roundabout into a signalised junction with a left turn slip lane from the A27 east and widened approaches. The A27 east approach would be widened to accommodate two full lanes with a flare either side, the A27 west approach have an additional offside flare, Manor road would have a nearside flare and Grinstead Lane would have one full lane with a flare either side. A diagram of the proposal is shown in Figure 5.1.

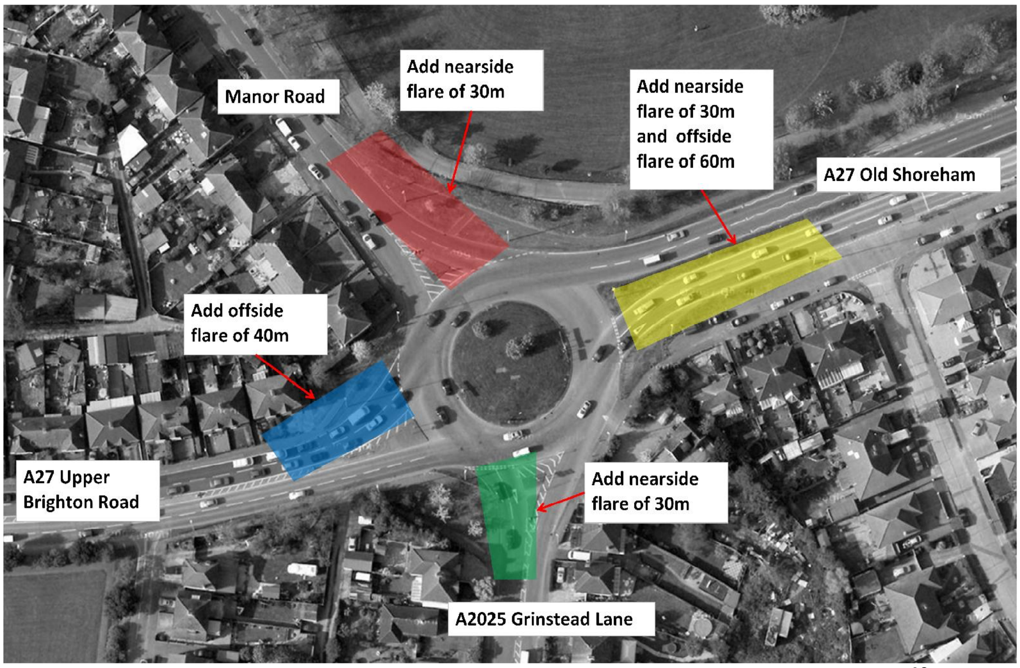


Figure 5.1: Highway Mitigation Proposal for A27 / A2025 Grinstead Lane[10]

5.3.5 Table 5.6 shows the cost estimates for the proposed improvements to the A27 / A2025 Grinstead Lane roundabout. The estimates have been rounded and contain a contingency to take account of uncertainty at the preliminary design stage.

Table 5.6: Indicative Improvement Costs for A27 / A2025 Grinstead Lane

A27/A2025 Roundabout	Costs (£)
Site Clearance	2,500
Fencing	0
Safety Fencing/Pedestrian Guardrail	30,000
Drainage	47,000
Earthworks	52,500
Pavement	78,000
Kerbs & Footways	55,500
Traffic Signs & Road Markings	8,500
Road Lighting Columns	12,500
Total	**286,500**
Preliminaries 10%	28,500
Traffic Management 20%	57,000
Sub - Total	**372,000**
Contingency 45%	166,500
Total £	**538,500**

Note: Costs rounded up to nearest £500.

5.3.6 No assessment of potential land take for the expansion of this junction outside of the existing highway boundary has been undertaken at this preliminary design stage.

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

Junction 2 - A27 / Sussex Pad

5.3.7 The mitigation proposal at the Sussex Pad junction is to allow ahead and left turning vehicles to use the nearside lane of the A27 in both directions, rather than left turning vehicles only. A diagram of the proposal is shown in Figure 5.2.

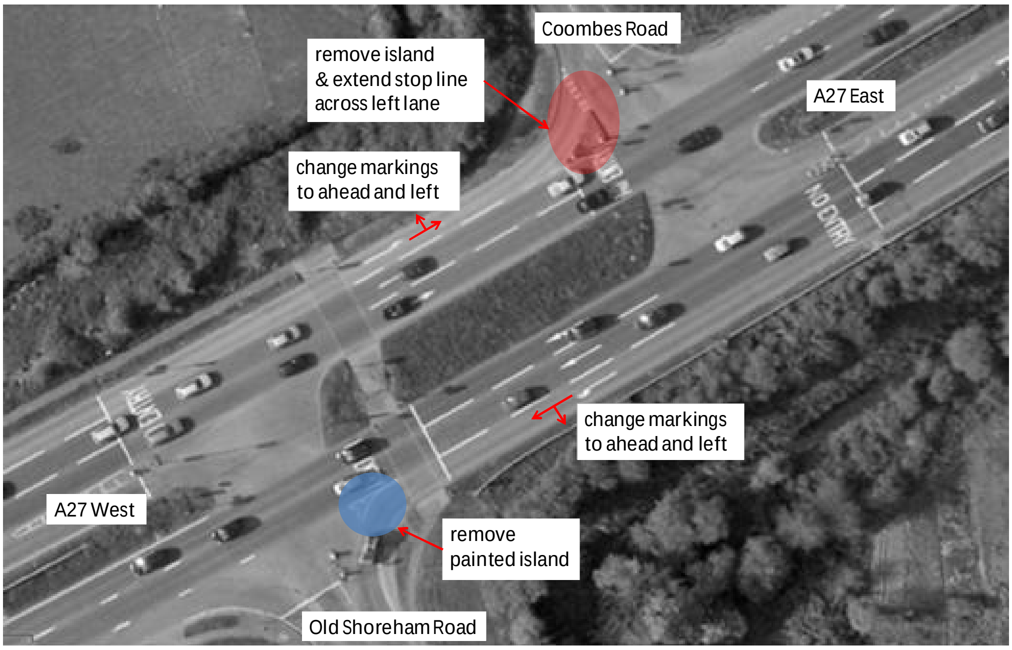


Figure 5.2: Highway Mitigation Proposal for A27 / Sussex Pad[11]

5.3.8 Table 5.7 shows the cost estimates for the proposed improvements to the A27 / Sussex Pad junction. The estimates have been rounded and contain a contingency to take account of uncertainty at the preliminary design stage.

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

Table 5.7: Indicative Improvement Costs for A27 / Sussex Pad

A27/Old Shoreham Road/Coombes Road Junction	Costs (£)
Site Clearance	500
Fencing	0
Safety Fencing/Pedestrian Guardrail	0
Drainage	0
Earthworks	1000
Pavement	3,500
Kerbs & Footways	0
Traffic Signs & Road Markings	500
Road Lighting Columns	0
Total	**5,500**
Preliminaries	1,000
Traffic Management	2,500
Sub - Total	**9,000**
Contingency 25%	2,000
Total	**11,000**

Notes: Contingency changed to 25% in this estimate to reflect simplicity of works
Costs rounded up to nearest £500.

Junction 3 - A27 / A283 Steyning Road

5.3.9 The highway mitigation proposal at the A27 / A283 Steyning Road junction is to fully signalise the roundabout with a three lane circulatory, to 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 5.3.

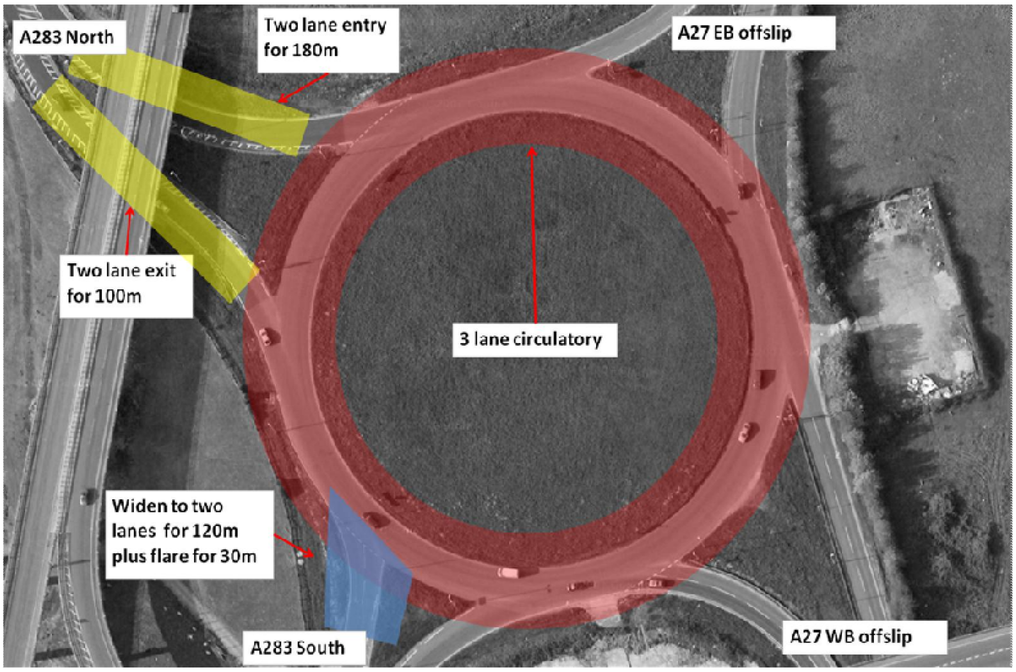


Figure 5.3: Highway Mitigation Proposal for A27 / A283 Steyning Road[12]

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

5.3.10 Table 5.8 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.

Table 5.8: Indicative Improvement Costs for A27 / A283 Roundabout

A27/A283 Roundabout	Costs (£)
Site Clearance	20,500
Fencing	50,500
Safety Fencing	26,500
Drainage	251,500
Earthworks	365,000
Pavement	565,000
Kerbs & Footways	77,500
Traffic Signs & Road Markings	8,000
Road Lighting Columns	84,500
Total	**1,449,000**
Preliminaries 10%	145,000
Traffic Management 15%	217,500
Sub - Total	**1,811,500**
Contingency 45%	814,500
Total £	**2,626,000**

Note: Costs rounded up to nearest £500.

5.3.11 In light of the significant cost of the recommended mitigation measure, alternative options that are cheaper to implement have been explored. One alternative involves only partially signalising the roundabout (A283 North entry remains as give-way) and maintaining its circulatory carriageway as two-lane. This would save some of the cost for signalisation, circulatory carriageway widening and A283 South entry widening. However, this alternative does not meet the mitigation criteria in all modelled time period with both the A283 North and South entries operating at overcapacity in the afternoon peak.

Junction 4 - A259 Brighton Road / A283 Old Shoreham Road

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

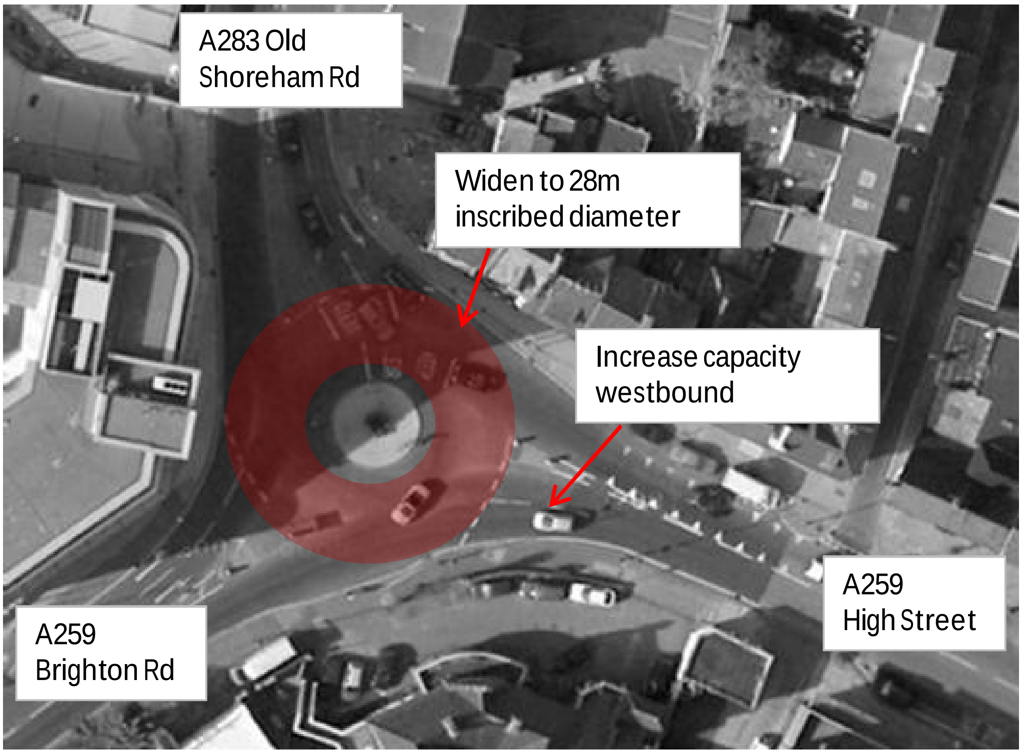


Figure 5.4: Highway Mitigation Proposal for A259 Brighton Road / A283 Old Shoreham Road

Table 5.9: 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**

Note: -

Junction 5 - A259 Brighton Rd / A2025 South Street

5.3.13 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 5.5.

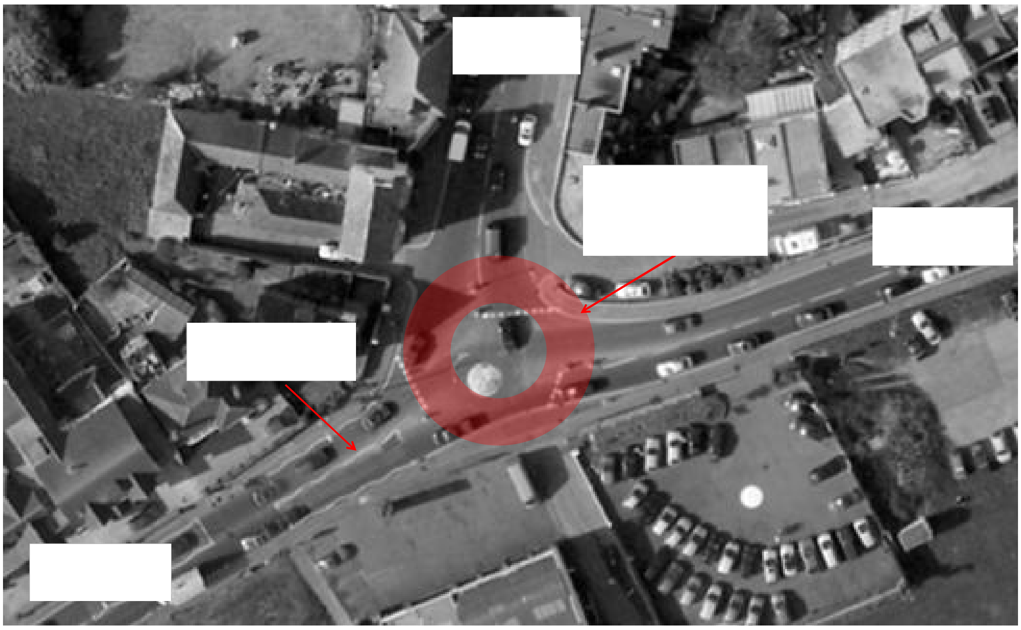


Figure 5.5: Highway Mitigation Proposal for A259 Brighton Road / A2025 South Street[13]

5.3.14 Table 5.10 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.

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

Table 5.10: 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.

Junction 6 - A27 / Busticle Lane

5.3.15 Given the infeasibility and expense of widening the A27 entry and exit to allow 3 lanes of ahead traffic via a funnel arrangement, the proposed mitigation is to provide a 2 lane to 1 lane funnel on the Busticle Lane exit, allowing the right turn lane from Halewick Lane to also be used for straight on traffic. The proposed mitigation is illustrated in Figure 5.6.

5.3.16 This would require some land take from the verge on Busticle Lane and adjustment of the central waiting area markings.

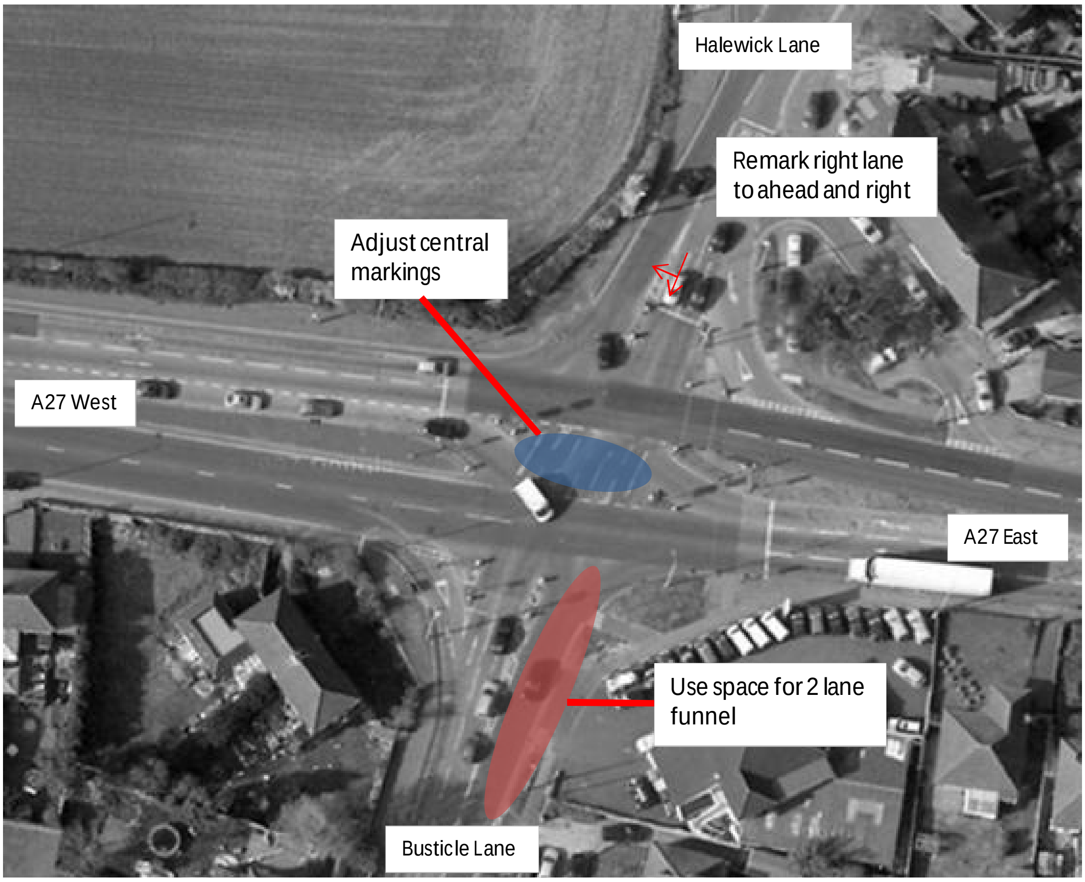


Figure 5.6: Highway Mitigation Proposal for A27 / Busticle Lane

5.3.17 Table 5.11 shows the cost estimates for the proposed improvements to the junction. The estimates have been rounded and contain a contingency to take account of uncertainty at the preliminary design stage.

Table 5.11: Indicative Improvement Costs for A27 / Busticle Lane

A27 / Busticle Lane	Costs (£)
Site Clearance	897
Fencing	0
Safety Fencing/Pedestrian Guardrail	0
Drainage	3,193
Earthworks	8,133
Pavement	8,341
Kerbs & Footways	10,215
Traffic Signs & Road Markings	6,399
Road Lighting Columns	2,000
Total	**39,178**
Preliminaries 10%	3,918
Traffic Management	5,000
Sub - Total	**48,096**
Contingency / Risk 25%	12,024
Total £	**60,120**

Notes: -

Junction 8 - A27 Shoreham Bypass / Hangleton Link dumbbell

5.3.18 The proposed mitigation is to convert both roundabouts into signalised junctions. The south junction would have flares added to the A27 offslip and Hangleton Link Road arms and operate as three stages: 1) Hangleton Link and North Roundabout Link; 2) Hangleton Link and A27 Offslip left filter; and 3) A27 Offslip all movements. Signals should be variable, particularly as stage 3 is unlikely to be needed other than for trips heading to the golf course and those who've erroneously left the A27 so will not be called every cycle.

5.3.19 The north junction would similarly have a long flare added to the A27 offslip and a short flare for the south roundabout link arm. The signal plan consists of three stages with each entry arm receiving green in turn. As with the south junction, the signals will need to respond to demand as it is unlikely the golf course exit will need a green on every cycle.

5.3.20 The proposed mitigation is illustrated in Figure 5.7 and Figure 5.8.

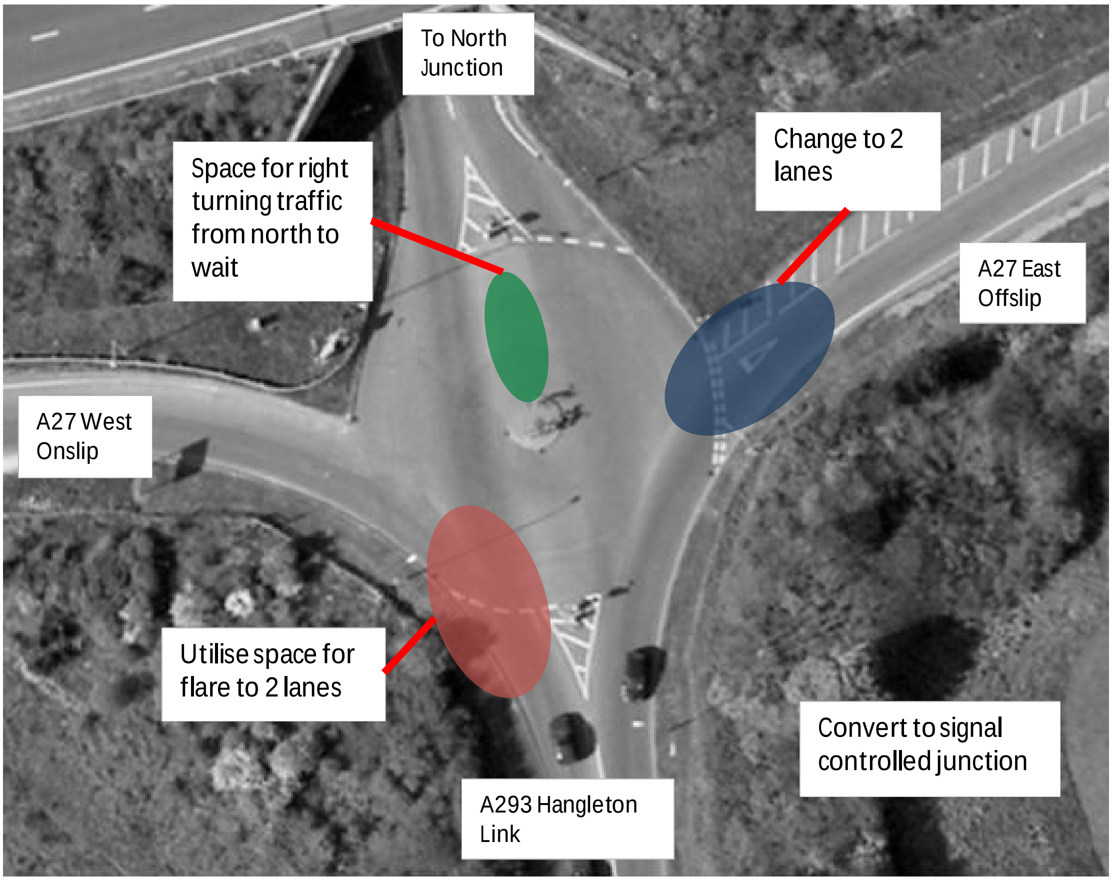


Figure 5.7: Mitigation Proposals for A27 / Hangleton Link Road South Roundabout

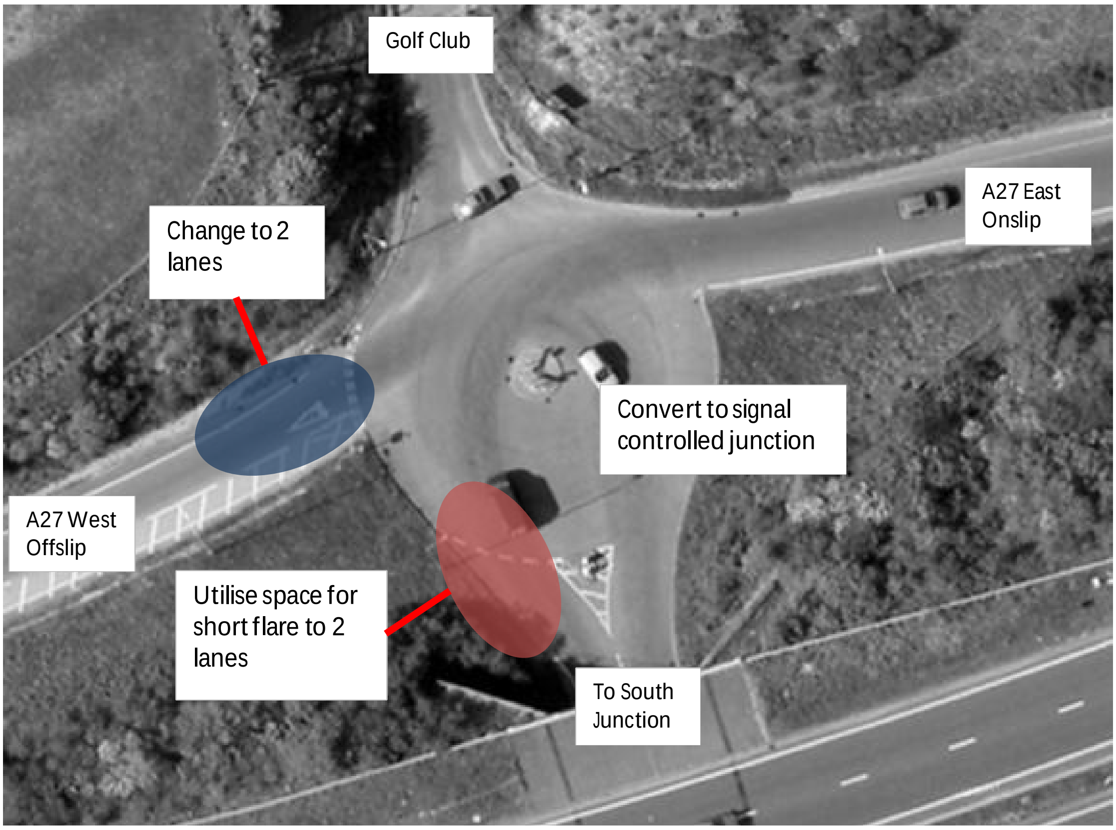


Figure 5.8: Mitigation Proposals for A27 / Hangleton Link Road North Roundabout

5.3.21 The proposed mitigation also includes upgrading the existing eastbound merge from Type A to Type C as shown in Figure 5.9 below following discussion with the HA.

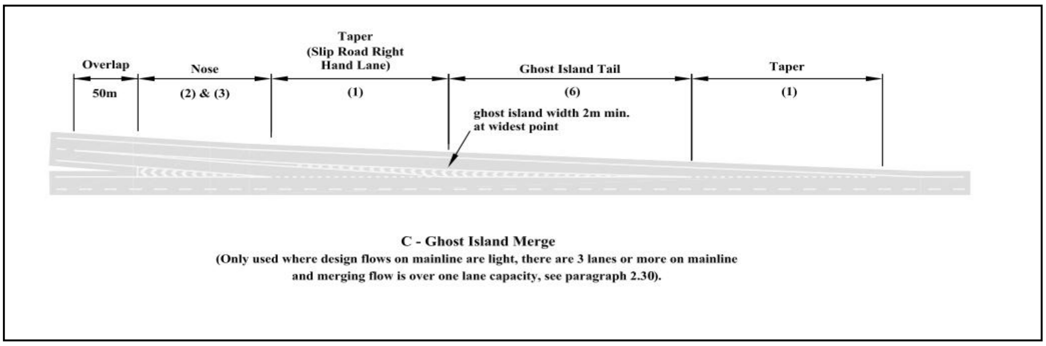


Figure 5.9: Mitigation Proposals for A27 / Hangleton Link Road North Roundabout

5.3.22 Table 5.12 and Table 5.13 show the cost estimates for the proposed improvements to the junction. The estimates have been rounded and contain a contingency to take account of uncertainty at the preliminary design stage.

Table 5.12: Indicative Improvement Costs for A27 Shoreham Bypass / Hangleton Link dumbbell – Roundabout Improvements

A27 Shoreham Bypass / Hangleton Link dumbbell	Costs (£)
Site Clearance	1,927
Fencing	1,200
Safety Fencing/Pedestrian Guardrail	0
Drainage	7,480
Earthworks	4,148
Pavement	24,054
Kerbs & Footways	5,153
Traffic Signs & Road Markings	16,167
Road Lighting Columns	2,000
Traffic Signals	117,000
Total	**179,129**
Preliminaries 7.5%	13,435
Traffic Management	25,000
Sub - Total	**217,564**
Contingency / Risk 25%	54,391
Total £	**271,955**

Notes: -

Table 5.13: Indicative Improvement Costs for A27 Shoreham Bypass / Hangleton Link dumbbell – Eastbound Merge Improvements

A27 Shoreham Bypass / Hangleton Link dumbbell	Costs (£)
Site Clearance	21,651
Fencing	23,850
Safety Fencing	16,500
Drainage	55,500
Earthworks	200,353
Pavement	188,805
Kerbs & Footways	0
Traffic Signs & Road Markings	11,263
Road Lighting Columns	0
Works to Structure	500,000
Total	**1,017,922**
Preliminaries 12.5%	127,240
Traffic Management 25%	254,481
Sub - Total	**1,399,643**
Contingency / Risk 35%	489,875
Total £	**1,889,518**

Notes: Work to structure assumes total replacement of deck plus new abutment/pier at one end; Demolition of parts of existing structure is included here; Traffic Management assumes that contra-flow working will be required plus overnight/weekend closures for demolition of bridge

5.3.23 This junction is also assessed within the Brighton & Hove Submission City Plan (Part One), 2013 Strategic Transport Assessment as it falls within the jurisdiction of Brighton & Hove City Council as the Highways Authority. Further joint working between relevant local authorities will take place to take forward the appropriate mitigation measures.

Junction 10 - A27 Sompting Bypass / Upper Brighton Road

5.3.24 The proposed mitigation is to 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 marked for ahead and right turning traffic and the right lane for right turning traffic only. The mitigation proposal is illustrated in Figure 5.10.

5.3.25 Some land take from the east verge of Upper Brighton Road may help the layout but the works would primarily consist of moving or removing the island on Upper Brighton Road and remarking of the road space.

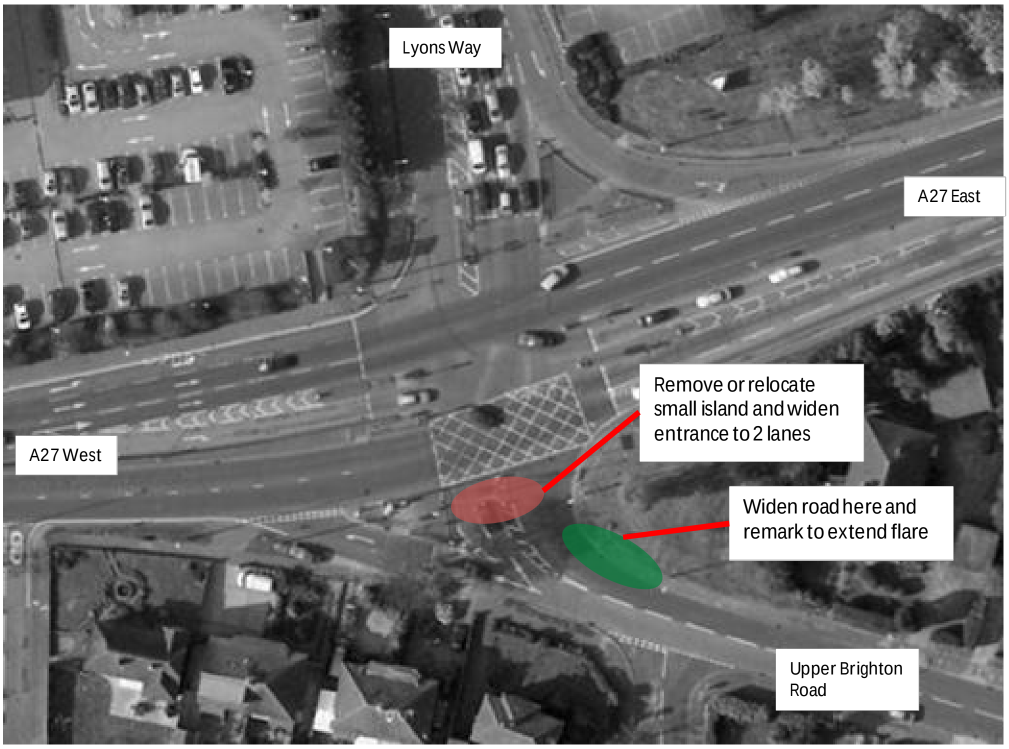


Figure 5.10: Mitigation Proposal for A27 Sompting Bypass / Upper Brighton Road

5.3.26 Table 5.14 shows the cost estimates for the proposed improvements to the junction. The estimates have been rounded and contain a contingency to take account of uncertainty at the preliminary design stage.

Table 5.14: Indicative Improvement Costs for A27 Sompting Bypass / Upper Brighton Road

A27 Sompting Bypass / Upper Brighton Road	Costs (£)
Site Clearance	1,677
Fencing	0
Safety Fencing/Pedestrian Guardrail	2,100
Drainage	6,153
Earthworks	2,604
Pavement	5,319
Kerbs & Footways	1,531
Traffic Signs & Road Markings	2,537
Road Lighting Columns	2,000
Traffic Signals	1,500
Total	**25,421**
Preliminaries 7.5%	1,907
Traffic Management	4,000
Sub - Total	**31,328**
Contingency / Risk 25%	7,832
Total £	**39,159**

Notes: -

Junction 11 - A259 Wellington Road / B2194 Station Road

5.3.27 The results presented in Section 4.4 incorporate the Basin Road signal stage running alone and in every cycle. The limited demand on that approach suggests the junction would benefit from vehicle demand dependent operation[14] of the Basin Road entry. By allowing the junction to only run the stage for the Basin Road entry when vehicles arrive, it was concluded that performance will improve to an acceptable level.

5.3.28 No explicit cost estimate has been produced for this proposal as it is only related to amendment of the signal operation at the current junction.

5.3.29 This junction falls within Brighton & Hove City Council area and further joint working between the local authorities will take place to take forward the appropriate mitigation measures.

[14] Vehicle demand dependent operation means vehicle actuated signal control which only turns green at the presence of vehicles approaching the stopline.

6 MODELLING RESULTS WITH MITIGATION MEASURES

6.1 Network Statistics

6.1.1 Following the identification of the mitigation measures, new model runs were undertaken using the Shoreham Harbour Transport Model (SHTM). It should be noted that 5 out of the 9 junction mitigations documented in the previous section were proposed after the network model runs had been undertaken, so their impacts are not reflected in the network statistics reported here. These 5 junctions include all 4 junctions mitigated in Tranche 2 and the A283 / A259 junction in Tranche 1. Further congestion relief, in addition to what is reported, is expected if all proposed mitigation measures are included.

6.1.2 Each of the five scenarios detailed in Section 2.3 was run in SHTM with the updated network and travel demand information. 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.

6.1.3 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 6.1 shows a comparison of results from the AM peak models and Table 6.2 compares the network statistics from the evening peak models.

Table 6.1: AM Peak Global Model Statistics Comparison

Statistic		Reference	Scenario A1	Scenario A2	Scenario A3	Scenario B
Transient Queues (pcu-hrs / hr)	Original Demand	9,411	9,713	9,710	9,694	9,804
	After Mitigation	9,249	9,276	9,290	9,254	9,305
	Reduction	162	437	420	440	499
Over Cap Queue (pcu-hrs / hr)	Original Demand	7,872	9,304	9,470	9,440	9,744
	After Mitigation	7,456	8,367	8,276	8,212	8,660
	Reduction	416	937	1,194	1,228	1,084
Total Travel Time (pcu-hrs / hr)	Original Demand	41,291	43,404	43,548	43,474	44,063
	After Mitigation	40,793	41,804	41,724	41,594	42,232
	Reduction	498	1,600	1,824	1,880	1,831
Total Travel Distance (pcu-km / hr)	Original Demand	1,506,724	1,522,608	1,522,253	1,520,462	1,529,091
	After Mitigation	1,505,381	1,508,514	1,508,180	1,506,581	1,513,929
	Reduction	1,343	14,094	14,073	13,881	15,162
Average Speed (kph)	Original Demand	36.5	35.1	35.0	35.0	34.7
	After Mitigation	36.9	36.1	36.1	36.2	35.8
	Increase	0.4	1.0	1.1	1.2	1.1

6.1.4 The important numbers to consider are the "after mitigation" criteria for each of the four development scenarios compared to the "original demand" figures for the reference case. This is a comparison of the impacts of development after they have been mitigated by travel demand measures and junction improvements. In the morning peak period all tested scenarios show a reduction in queues, travel time and distance, combined with an increase in average speed, all of which are indicative of reduced congestion within the network after mitigation, compared to the reference case with no mitigation. Not unexpectedly, the marginal differences between each development scenario relate to the differences in the levels of development in each scenario and the amount of traffic generated by each.

6.1.5 The differences between each scenario and the reference case at this level are small in both absolute and relative terms. The large site allocations add little to the reference case scenario prior to mitigation (4-5% growth in trips throughout Adur and surrounding areas depending on scenario). Following mitigation these increases are less than 3% in all scenarios. The global impacts of each scenario are therefore marginal, falling to insignificance after mitigation and varying little by scenario.

Table 6.2: PM Peak Global Model Statistics Comparison

Statistic		Reference	Scenario A1	Scenario A2	Scenario A3	Scenario B
Transient Queues (pcu-hrs / hr)	Original Demand	12,579	13,046	13,102	13,074	13,210
	After Mitigation	12,521	12,725	12,759	12,715	12,839
	Reduction	58	321	343	359	371
Over Cap Queue (pcu-hrs / hr)	Original Demand	22,131	23,108	23,145	23,019	23,383
	After Mitigation	21,657	22,066	22,113	22,014	22,324
	Reduction	474	1,042	1,032	1,005	1,059
Total Travel Time (pcu-hrs / hr)	Original Demand	63,837	65,777	65,866	65,662	66,349
	After Mitigation	63,491	64,284	64,369	64,175	64,779
	Reduction	346	1,493	1,497	1,487	1,570
Total Travel Distance (pcu-km / hr)	Original Demand	1,857,323	1,877,693	1,877,416	1,875,324	1,883,728
	After Mitigation	1,857,243	1,863,884	1,864,184	1,861,737	1,869,362
	Reduction	80	13,809	13,232	13,587	14,366
Average Speed (kph)	Original Demand	29.1	28.5	28.5	28.6	28.4
	After Mitigation	29.3	29.0	29.0	29.0	28.9
	Increase	0.2	0.5	0.5	0.4	0.5

6.1.6 Similar to the AM peak hour, in the evening peak period all tested scenarios show a reduction in queues, travel time and distance, combined with an increase in average speed, all of which are indicative of reduced congestion within the network with mitigation. This is expected following the reduction in highway trip volumes from the anticipated effects of the proposed sustainable measures.

6.1.7 The differences between each scenario and the reference case at this level are small in both absolute and relative terms. The large site allocations add little to the reference case scenario (3-4% growth in trips throughout Adur and surrounding areas depending on scenario).

6.2 Junction Performance – Tranche 1

6.2.1 The following section discusses the changes in performance for each of the five key junctions in Tranche 1 following the implementation of the sustainable travel measures outlined in Section 5.2 and highway mitigations set out in Section 5.3. As before in Section 4, results from additional junction models of each location are presented. They have again been modelled using ARCADY 7, TRANSYT 12 and LinSig 3 as appropriate. The results for each junction are the mean max queue in passenger car units (PCU), the average delay per vehicle and ratio of flow to capacity (RFC) or degree of saturation (DoS) as appropriate.

6.2.2 A junction capacity map is produced in Appendix E, which gives an overview of the RFC or DoS for each arm of the following five junctions:

- 1. A27 / Grinstead Lane (North Lancing Roundabout)
- 2. A27 Sussex Pad
- 3. A27 / A283 Steyning Road
- 4. A259 Brighton Road / A283 Old Shoreham Road
- 5. A259 Brighton Road / A2025 South Street

6.2.3 The proposed mitigation measures have been identified using the flows and initial modelling results detailed in Section 4. It is therefore expected that some approaches to the targeted junctions will remain close to or over capacity as additional traffic would be attracted by the additional capacity and reductions in queuing and delay after the highway improvements are implemented. The changes in travel demand at individual junctions are reported in detailed at Appendix D, while the improvements in junction performance are detailed in the rest of this section.

Junction 1 - A27 / Grinstead Lane (North Lancing Roundabout)

6.2.4 Table 6.3 and Table 6.4 below show the results from the ARCADY model for the A27 / Grinstead Lane roundabout with no mitigation along with the LinSig model results including the proposed changes. The LinSig results include the effects of junction mitigation and the anticipated highway trip changes from the sustainable travel measures outlined in Section 5.2. Cases where the modelled traffic demand arriving at the junction exceeds 90% of the calculated capacity for that entry have been highlighted in red.

Table 6.3: Junction Model AM Peak Results Comparison for Junction 1 - A27 / Grinstead Lane

	Original Demand			With Mitigation		
	Queue (PCU)	Delay (min)	RFC	Queue (PCU)	Delay (min)	RFC
	Reference Case					
A27 Old Shoreham Road	817.63	22.06	1.49	252.4	6.27	1.22
A2025 Grinstead Lane	48.33	2.89	1.09	60.9	5.58	1.17
A27 Upper Brighton Road	1285.00	43.36	1.86	139.3	4.95	1.16
Manor Road	1.37	0.43	0.59	37.9	6.79	1.22
	Scenario A1					
A27 Old Shoreham Road	884.54	23.70	1.51	258.4	6.46	1.24
A2025 Grinstead Lane	88.09	6.17	1.18	81.6	7.41	1.25
A27 Upper Brighton Road	1605.62	56.98	2.02	181.1	6.38	1.23
Manor Road	1.81	0.54	0.66	42.6	7.48	1.26
	Scenario A2					
A27 Old Shoreham Road	879.31	23.57	1.51	257.9	6.46	1.24
A2025 Grinstead Lane	85.77	5.93	1.17	79.7	7.41	1.24
A27 Upper Brighton Road	1581.54	56.27	2.01	175.7	6.20	1.22
Manor Road	1.91	0.57	0.67	42.1	7.41	1.25
	Scenario A3					
A27 Old Shoreham Road	863.63	23.17	1.50	258.9	6.47	1.24
A2025 Grinstead Lane	93.29	6.53	1.19	80.2	7.33	1.25
A27 Upper Brighton Road	1615.99	57.56	2.03	183.8	6.46	1.23
Manor Road	1.98	0.58	0.68	42.6	7.48	1.26
	Scenario B					
A27 Old Shoreham Road	898.43	24.04	1.52	274.9	6.98	1.26
A2025 Grinstead Lane	109.98	7.89	1.22	77	7.02	1.22
A27 Upper Brighton Road	1648.68	58.94	2.04	204.3	7.25	1.27
Manor Road	1.96	0.58	0.67	43.7	7.64	1.27

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.

6.2.5 Following the proposed conversion of this junction to traffic signal control, all approaches are operating above capacity with significant reductions in delays in all tested scenarios, particularly with a significant improvement in the predicted levels of queuing and delay for A27 traffic.

6.2.6 The optimisation of the traffic signals in the With Mitigation models results in additional capacity compared to the existing roundabout, with the length of delay roughly equal for each of the approaches. The physical restraints surrounding the junction prevent the improvements from fully accommodating the anticipated demand in the morning peak period. The differences in queues and delays in all scenarios are small. Scenario B has slightly higher delays for A27 approaches but these are significantly lower than for the reference case with no junction improvements.

Table 6.4: Junction Model PM Peak Results Comparison for Junction 1 - A27 / Grinstead Lane

	Original Demand			With Mitigation		
	Queue (PCU)	Delay (min)	RFC	Queue (PCU)	Delay (min)	RFC
	Reference Case					
A27 Old Shoreham Road	2039.81	56.33	1.99	479.2	9.86	1.42
A2025 Grinstead Lane	14.30	1.09	0.97	101.7	9.31	1.36
A27 Upper Brighton Road	313.40	10.37	1.33	12.9	0.34	0.73
Manor Road	0.41	0.23	0.29	0.9	0.90	0.20
	Scenario A1					
A27 Old Shoreham Road	2277.54	62.75	2.08	493.6	10.07	1.44
A2025 Grinstead Lane	14.37	1.11	0.97	112.5	9.68	1.38
A27 Upper Brighton Road	362.24	11.76	1.36	12.9	0.32	0.72
Manor Road	0.59	0.26	0.37	1.0	0.98	0.22
	Scenario A2					
A27 Old Shoreham Road	2247.41	62.07	2.07	487.1	9.95	1.43
A2025 Grinstead Lane	15.36	1.17	0.97	112.0	9.62	1.38
A27 Upper Brighton Road	371.66	12.07	1.37	12.9	0.32	0.73
Manor Road	0.56	0.26	0.36	1.0	0.95	0.21
	Scenario A3					
A27 Old Shoreham Road	2276.71	62.50	2.07	493.7	10.09	1.44
A2025 Grinstead Lane	12.52	1.00	0.96	111.8	9.62	1.37
A27 Upper Brighton Road	343.49	11.17	1.34	12.5	0.32	0.72
Manor Road	0.58	0.26	0.37	0.9	0.99	0.22
	Scenario B					
A27 Old Shoreham Road	2370.71	65.57	2.12	519.4	10.55	1.47
A2025 Grinstead Lane	16.94	1.27	0.98	119.6	10.11	1.40
A27 Upper Brighton Road	380.34	12.27	1.37	13.0	0.33	0.73
Manor Road	0.64	0.27	0.39	1.0	1.01	0.22

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.

6.2.7 As in the morning peak, the proposed conversion of this junction to traffic signal control results in a significant improvement to the predicted levels of queuing and delay for A27 traffic in the evening peak period. Two approaches to the junction remain over capacity, again a product of the physical restraints surrounding the junction preventing the improvements from fully accommodating the anticipated demand. The differences after mitigation between scenarios are insignificant.

Junction 2 - A27 Sussex Pad

6.2.8 The A27 Sussex Pad is made up of two signalised junctions; A27 Shoreham Bypass / Coombes Road and A27 Shoreham Bypass / Old Shoreham Road. The TRANSYT results for the two junctions are shown below in Table 6.5 to Table 6.8. These results include the effects of junction mitigation and the anticipated highway trip reductions from the sustainable travel measures outlined in Section 5.2. Cases where the modelled traffic demand arriving at the junction exceeds 90% of the calculated capacity for that entry have been highlighted in red.

Table 6.5: TRANSYT Results AM Peak Comparison for Junction 2 - A27 / Coombes Road Junction

	Original Demand				With Mitigation			
	Actual Flow	Queue (PCU)	Delay (min)	DoS (%)	Actual Flow	Queue (PCU)	Delay (min)	DoS (%)
	Reference Case							
A27 Eastbound	2816	140	1.05	102	2981	15	0.12	89
A27 Westbound ahead lane 1	83	1	0.10	6	2981	140	1.08	102
A27 Westbound ahead lane 2	2642	89	0.47	96				
A27 Westbound right turn	37	1	1.28	32	36	1	1.28	32
Coombes Road	14	0	1.12	10	15	1	1.12	11
Practical Reserve Capacity	-12%				-12%			
	Scenario A1							
A27 Eastbound	2768	122	0.67	100	2921	12	0.10	87
A27 Westbound ahead lane 1	57	1	0.10	4	2950	130	0.88	101
A27 Westbound ahead lane 2	2652	90	0.50	96				
A27 Westbound right turn	38	1	1.30	33	37	1	1.30	32
Coombes Road	54	2	1.25	40	32	1	1.17	24
Practical Reserve Capacity	-10%				-11%			
	Scenario A2							
A27 Eastbound	2763	120	0.65	100	2914	11	0.10	87
A27 Westbound ahead lane 1	66	1	0.10	5	2953	131	0.90	101
A27 Westbound ahead lane 2	2644	89	0.48	96				
A27 Westbound right turn	38	1	1.30	33	37	1	1.30	32
Coombes Road	51	2	1.25	38	32	1	1.17	24
Practical Reserve Capacity	-10%				-11%			
	Scenario A3							
A27 Eastbound	2769	122	0.68	101	2921	12	0.10	87
A27 Westbound ahead lane 1	57	1	0.10	4	2954	131	0.90	101
A27 Westbound ahead lane 2	2648	90	0.48	96				
A27 Westbound right turn	38	1	1.30	33	37	1	1.28	32
Coombes Road	52	2	1.25	39	26	1	1.15	19
Practical Reserve Capacity	-11%				-11%			
	Scenario B							
A27 Eastbound	2764	121	0.65	100	2919	12	0.10	87
A27 Westbound ahead lane 1	71	1	0.10	5	2981	140	1.08	102
A27 Westbound ahead lane 2	2642	89	0.47	96				
A27 Westbound right turn	38	1	1.30	33	37	1	1.28	32
Coombes Road	47	2	1.23	35	27	1	1.15	20
Practical Reserve Capacity	-10%				-12%			

Note: A27 Westbound ahead lanes 1 and 2 were combined into a single link for the mitigation models.

Table 6.6: TRANSYT Results PM Peak Comparison for Junction 2 - A27 / Coombes Road Junction

	Original Demand				With Mitigation			
	Actual Flow	Queue (PCU)	Delay (min)	DoS (%)	Actual Flow	Queue (PCU)	Delay (min)	DoS (%)
	Reference Case							
A27 Eastbound	2566	17	0.18	93	2587	8	0.08	77
A27 Westbound ahead lane 1	212	2	0.12	15	2867	102	0.53	98
A27 Westbound ahead lane 2	2444	66	0.30	89				
A27 Westbound right turn	76	3	1.67	67	12	0	1.18	11
Coombes Road	87	4	1.52	65	23	1	1.15	17
Practical Reserve Capacity	-3%				-8%			
	Scenario A1							
A27 Eastbound	2541	9	0.15	92	2555	8	0.07	76
A27 Westbound ahead lane 1	196	2	0.12	14	2835	95	0.45	97
A27 Westbound ahead lane 2	2448	66	0.32	89				
A27 Westbound right turn	98	6	2.37	86	14	1	1.18	12
Coombes Road	106	5	1.87	79	23	1	1.15	17
Practical Reserve Capacity	-2%				-7%			
	Scenario A2							
A27 Eastbound	2549	9	0.17	93	2557	8	0.07	76
A27 Westbound ahead lane 1	203	2	0.12	14	2838	95	0.47	97
A27 Westbound ahead lane 2	2432	65	0.30	88				
A27 Westbound right turn	100	6	2.48	88	14	1	1.18	12
Coombes Road	108	5	1.92	81	23	1	1.15	17
Practical Reserve Capacity	-3%				-7%			
	Scenario A3							
A27 Eastbound	2528	9	0.15	92	2554	8	0.07	76
A27 Westbound ahead lane 1	176	2	0.12	12	2834	95	0.45	97
A27 Westbound ahead lane 2	2461	68	0.32	89				
A27 Westbound right turn	99	6	2.42	87	14	1	1.18	12
Coombes Road	108	5	1.92	81	24	1	1.15	18
Practical Reserve Capacity	-2%				-7%			
	Scenario B							
A27 Eastbound	2544	9	0.15	92	2568	8	0.07	77
A27 Westbound ahead lane 1	205	2	0.12	14	2867	102	0.53	98
A27 Westbound ahead lane 2	2435	65	0.30	88				
A27 Westbound right turn	98	6	2.37	86	14	1	1.18	12
Coombes Road	107	5	1.90	80	23	1	1.15	17
Practical Reserve Capacity	-2%				-8%			

Note: A27 Westbound ahead lanes 1 and 2 were combined into a single link for the mitigation models.

6.2.9 The results show improved performance and vehicle throughput for eastbound A27 traffic in both peak periods following the mitigation measures. The proposed improvements allow a larger vehicle throughput for westbound A27 traffic, though the degree of saturation, queuing and delay are higher following the changes. However, the increased delay is small and not considered material compared to the reference case without the junction improvements (up to 12 seconds in Scenario B is the maximum increase). Differences between scenarios are insignificant in terms of delay.

Table 6.7: TRANSYT Results AM Peak Comparison for Junction 2 - A27 / Old Shoreham Road Junction

	Original Demand				With Mitigation			
	Actual Flow	Queue (PCU)	Delay (min)	DoS (%)	Actual Flow	Queue (PCU)	Delay (min)	DoS (%)
Reference Case								
A27 Eastbound left turn	99	1	0.10	7	2868	96	0.45	97
A27 Eastbound ahead	2730	109	0.72	99				
A27 Eastbound right turn	94	5	2.18	82	72	3	1.60	63
A27 Westbound ahead	2652	14	0.27	96	2945	10	0.07	84
A27 Westbound left turn	83	0	0.05	6				
Old Shoreham Road	92	3	1.05	34	123	4	1.08	46
Practical Reserve Capacity	-9%				-7%			
Scenario A1								
A27 Eastbound left turn	142	1	0.10	10	2872	97	0.47	97
A27 Eastbound ahead	2739	112	0.77	99				
A27 Eastbound right turn	103	6	2.68	90	85	4	1.87	74
A27 Westbound ahead	2662	17	0.30	97	2961	20	0.07	84
A27 Westbound left turn	97	1	0.07	7				
Old Shoreham Road	45	1	1.00	17	67	2	1.02	25
Practical Reserve Capacity	-9%				-7%			
Scenario A2								
A27 Eastbound left turn	140	1	0.10	10	2867	96	0.45	97
A27 Eastbound ahead	2734	110	0.73	99				
A27 Eastbound right turn	103	6	2.68	90	85	4	1.87	74
A27 Westbound ahead	2654	16	0.27	96	2961	20	0.07	84
A27 Westbound left turn	103	1	0.07	8				
Old Shoreham Road	46	2	1.00	17	65	2	1.02	24
Practical Reserve Capacity	-9%				-7%			
Scenario A3								
A27 Eastbound left turn	144	1	0.10	10	2866	97	0.45	97
A27 Eastbound ahead	2734	110	0.73	99				
A27 Eastbound right turn	102	6	2.62	89	83	4	1.82	73
A27 Westbound ahead	2658	16	0.28	96	2955	9	0.07	84
A27 Westbound left turn	95	1	0.07	7				
Old Shoreham Road	52	2	1.00	19	73	2	1.03	27
Practical Reserve Capacity	-9%				-7%			
Scenario B								
A27 Eastbound left turn	144	1	0.10	10	2871	97	0.47	97
A27 Eastbound ahead	2737	110	0.75	99				
A27 Eastbound right turn	102	6	2.62	89	83	4	1.82	73
A27 Westbound ahead	2652	16	0.28	96	2956	9	0.07	84
A27 Westbound left turn	104	1	0.07	8				
Old Shoreham Road	47	2	1.00	17	67	2	1.02	25
Practical Reserve Capacity	-9%				-7%			

Note: A27 left turn and ahead lanes were combined into a single link for the mitigation models.

Table 6.8: TRANSYT Results PM Peak Comparison for Junction 2- A27 / Old Shoreham Road Junction

	Original Demand				With Mitigation			
	Actual Flow	Queue (PCU)	Delay (min)	DoS (%)	Actual Flow	Queue (PCU)	Delay (min)	DoS (%)
Reference Case								
A27 Eastbound left turn	11	0	0.10	1	2574	61	0.23	87
A27 Eastbound ahead	2482	69	0.33	90				
A27 Eastbound right turn	26	1	1.23	23	35	1	1.28	31
A27 Westbound ahead	2454	6	0.12	89	2879	6	0.07	82
A27 Westbound left turn	215	1	0.05	17				
Old Shoreham Road	98	3	1.05	36	45	2	1.00	17
Practical Reserve Capacity	0%				3%			
Scenario A1								
A27 Eastbound left turn	11	0	0.10	1	2555	59	0.23	86
A27 Eastbound ahead	2541	75	0.37	92				
A27 Eastbound right turn	26	1	1.23	23	47	2	1.35	41
A27 Westbound ahead	2460	9	0.13	89	2847	5	0.05	81
A27 Westbound left turn	196	1	0.05	15				
Old Shoreham Road	16	1	0.98	6	32	1	0.98	12
Practical Reserve Capacity	-2%				5%			
Scenario A2								
A27 Eastbound left turn	11	0	0.10	1	2557	59	0.23	86
A27 Eastbound ahead	2544	75	0.37	92				
A27 Eastbound right turn	27	1	1.25	24	48	2	1.37	42
A27 Westbound ahead	2444	9	0.12	89	2850	5	0.05	81
A27 Westbound left turn	203	1	0.05	16				
Old Shoreham Road	18	1	0.98	7	32	1	0.98	12
Practical Reserve Capacity	-2%				5%			
Scenario A3								
A27 Eastbound left turn	11	0	0.10	1	2554	59	0.23	86
A27 Eastbound ahead	2528	74	0.35	92				
A27 Eastbound right turn	26	1	1.23	23	42	2	1.32	37
A27 Westbound ahead	2474	9	0.13	90	2847	5	0.05	81
A27 Westbound left turn	176	1	0.05	14				
Old Shoreham Road	15	0	0.98	6	32	1	0.98	12
Practical Reserve Capacity	-2%				5%			
Scenario B								
A27 Eastbound left turn	11	0	0.10	1	2568	61	0.23	87
A27 Eastbound ahead	2544	75	0.37	92				
A27 Eastbound right turn	26	1	1.23	23	51	2	1.38	45
A27 Westbound ahead	2448	9	0.12	89	2849	5	0.05	81
A27 Westbound left turn	205	1	0.05	16				
Old Shoreham Road	16	1	0.98	6	32	1	0.98	12
Practical Reserve Capacity	-2%				3%			

Note: A27 left turn and ahead lanes were combined into a single link for the mitigation models.

6.2.10 The results for the Old Shoreham Road junction (Table 6.7 and Table 6.8) show improved performance (reduced delay) and vehicle throughput for east and westbound A27 traffic in both peak periods following the mitigation measures. Marginal delay reductions are also shown for Old Shoreham Road. In the evening peak, the proposed infrastructure improvements and anticipated demand reductions from sustainable travel measures result in a small amount of spare capacity at the junction. There is a minor increase in delay for right turners from the A27 eastbound although at a maximum 0.15 minutes (9seconds) for the worst case Scenario B this is considered immaterial. Delay differences between scenarios after mitigation are insignificant.

<u>Junction 3 - A27 / A283 Steyning Road</u>

6.2.11 Table 6.9 and Table 6.10 below compare the results from the ARCADY models and 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 outlined in Section 5.2. The ARCADY model results do not contain any mitigation and are reproduced from Table 4.8. Cases where the modelled traffic demand arriving at the junction exceeds 90% of the calculated capacity for that entry have been highlighted in red.

Table 6.9: Junction Model AM Peak Results Comparison for Junction 3 - A27 / A283 Steyning Road

	Original Demand			With Mitigation		
	Queue (PCU)	Delay (min)	RFC	Queue (PCU)	Delay (min)	DoS
	Reference Case					
A283 South	46.08	1.84	1.05	8.1	0.31	0.66
A283 North	73.79	2.17	1.08	17.9	0.21	0.79
A27 Eastbound Slips	0.42	0.04	0.30	4.0	0.41	0.35
A27 Westbound Slips	5.42	0.27	0.85	7.8	0.31	0.52
	Scenario A1					
A283 South	94.39	3.34	1.14	9.3	0.30	0.69
A283 North	75.18	2.80	1.07	17.2	0.21	0.78
A27 Eastbound Slips	0.54	0.05	0.35	4.0	0.41	0.36
A27 Westbound Slips	5.19	0.26	0.85	8.2	0.33	0.54
	Scenario A2					
A283 South	103.57	3.66	1.15	9.6	0.32	0.71
A283 North	76.76	2.92	1.07	17.6	0.21	0.78
A27 Eastbound Slips	0.54	0.05	0.35	4.0	0.41	0.36
A27 Westbound Slips	5.35	0.27	0.85	8.3	0.33	0.54
	Scenario A3					
A283 South	84.73	3.04	1.12	9.3	0.30	0.69
A283 North	65.17	2.11	1.06	18.4	0.22	0.79
A27 Eastbound Slips	0.53	0.05	0.35	4.4	0.51	0.45
A27 Westbound Slips	4.82	0.24	0.83	8.0	0.31	0.53
	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

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 6.10: Junction Model PM Peak Results Comparison for Junction 3 - A27 / A283 Steyning Road

	Original Demand			With Mitigation		
	Queue (PCU)	Delay (min)	RFC	Queue (PCU)	Delay (min)	DoS
Reference Case						
A283 South	401.83	25.89	1.39	6.6	0.38	0.67
A283 North	23.88	0.75	0.98	11.7	0.20	0.67
A27 Eastbound Slips	0.59	0.07	0.37	2.8	0.53	0.38
A27 Westbound Slips	242.23	9.64	1.42	10.5	0.26	0.64
Scenario A1						
A283 South	217.67	12.33	1.34	6.6	0.36	0.66
A283 North	58.26	1.54	1.04	11.7	0.20	0.67
A27 Eastbound Slips	0.77	0.08	0.44	2.8	0.56	0.39
A27 Westbound Slips	388.38	20.88	1.77	10.6	0.29	0.65
Scenario A2						
A283 South	204.29	11.35	1.32	6.6	0.36	0.66
A283 North	48.58	1.33	1.03	12.3	0.21	0.68
A27 Eastbound Slips	0.82	0.08	0.45	2.8	0.56	0.39
A27 Westbound Slips	399.90	21.49	1.83	10.6	0.29	0.65
Scenario A3						
A283 South	235.76	13.73	1.36	6.1	0.35	0.64
A283 North	41.35	1.17	1.02	11.7	0.20	0.67
A27 Eastbound Slips	0.81	0.08	0.45	2.8	0.56	0.40
A27 Westbound Slips	379.89	19.77	1.80	10.6	0.29	0.65
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

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.

6.2.12 The proposals 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 evens out 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) are brought within capacity by the proposed changes and all arms of the junction operate well within capacity after mitigation in all scenarios and for all scenarios the resultant impacts upon each arm are very similar with insignificant differences.

6.2.13 Without the proposed mitigation, the 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.

Junction 4 - A259 Brighton Road / A283 Old Shoreham Road

6.2.14 Following discussion with West Sussex County Council, a junction assessment was undertaken in ARCADY to explore the effect of expanding the roundabout and increasing the capacity at the A259 High Street westbound entry.

6.2.15 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. As the two types of roundabout are modelled in different ways in ARCADY, significant improvements as a result of this change adjustment were observed in the modelling results. This is presented in the table below.

Table 6.11: ARCADY Results for Junction 4 - A259 Brighton Road / A283 Old Shoreham Road

	AM			PM		
	Queue (PCU)	Delay (min)	DoS (%)	Queue (PCU)	Delay (sec)	DoS (%)
	Scenario B without Mitigation (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 without Mitigation (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 Mitigation (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

6.2.16 However, it was considered that the significant improvement on all entries shown above is mainly attributed to impacts from modelling the roundabout simply by changing the designation from a mini roundabout to a normal roundabout. In reality, such a small alteration to the junction geometry is unlikely to yield as much improvement as suggested by these results. A sensitivity test was therefore undertaken by modelling the junction as a normal roundabout in both "with" and "without" mitigation scenarios. The results are reported in the same table above, which clearly suggest the improvement from the proposed mitigation is mainly focused on the A259 Westbound entry. This is likely due to increasing capacity westbound.

Junction 5 - A259 Brighton Road / A2025 South Street

6.2.17 Table 6.12 and Table 6.13 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 Section 5.2. The "without" mitigation results are reproduced from Table 4.10. 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 6.12: AM Peak Results Comparison for Junction 5 - A259 Brighton Road / A2025 South Street

	Original Demand			With Mitigation		
	Queue (PCU)	Delay (min)	RFC	Queue (PCU)	Delay (min)	RFC
	Reference Case					
A259 Westbound	283.95	28.68	1.57	129.78	6.99	1.25
A259 Eastbound	220.98	13.01	1.33	14.49	0.61	0.95
A2025 South St	387.38	51.29	1.93	9.71	0.72	0.93
	Scenario A1					
A259 Westbound	216.90	21.14	1.46	50.92	2.47	1.08
A259 Eastbound	300.65	18.34	1.42	95.97	3.00	1.10
A2025 South St	381.95	57.16	2.01	5.65	0.49	0.86
	Scenario A2					
A259 Westbound	237.11	22.92	1.48	60.4	2.87	1.10
A259 Eastbound	294.43	17.93	1.41	84.77	2.62	1.09
A2025 South St	403.68	60.77	2.06	5.99	0.51	0.87
	Scenario A3					
A259 Westbound	218.77	21.31	1.46	40.32	2.03	1.05
A259 Eastbound	305.87	18.69	1.43	101.42	3.24	1.11
A2025 South St	391.18	58.60	2.03	5.6	0.49	0.86
	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

6.2.18 The performance of all three approaches to this roundabout has improved following the introduction of the proposed mitigation measures. In the morning peak model, only one approach to the roundabout (westbound A259) is over capacity in the reference case. With the additional of the proposed development traffic, the eastbound A259 approach to the junction is also over capacity in the four tested scenarios (A1 – A3 and B) with the highest delay in Scenario B and the lowest in Scenario A2 which differ by nearly 1 minute. For the westbound direction, Scenario A3 has the lowest delay (2 minutes) and Scenario A2 the highest (nearly 3 minutes). All delays are significantly below the reference case prior to junction improvements (over 28 minutes). 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.

Table 6.13: PM Peak Results Comparison for Junction 5 - A259 Brighton Road / A2025 South Street

	Original Demand			With Mitigation		
	Queue (PCU)	Delay (min)	RFC	Queue (PCU)	Delay (min)	RFC
	Reference Case					
A259 Westbound	398.87	43.04	1.76	267.5	14.68	1.48
A259 Eastbound	100.61	6.04	1.18	9.45	0.41	0.92
A2025 South St	452.89	51.32	1.96	3.86	0.25	0.80
	Scenario A1					
A259 Westbound	418.12	44.79	1.79	303.95	17.24	1.53
A259 Eastbound	110.68	6.76	1.20	10.23	0.44	0.92
A2025 South St	451.39	51.62	1.96	4.43	0.29	0.82
	Scenario A2					
A259 Westbound	418.99	44.90	1.79	285.23	16.25	1.51
A259 Eastbound	104.35	6.30	1.19	10.23	0.44	0.92
A2025 South St	455.50	52.05	1.97	4.43	0.29	0.82
	Scenario A3					
A259 Westbound	415.69	44.67	1.79	307.67	17.35	1.53
A259 Eastbound	102.47	6.17	1.18	9.66	0.42	0.92
A2025 South St	449.50	51.17	1.95	4.12	0.27	0.81
	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

6.2.19 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 all tested scenarios although the delays, which are similar for all scenarios are well below those in the reference case with no junction improvements. The demand on the eastbound A259 is below the calculated capacity in all tested scenarios, 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.

6.3 Junction Performance – Tranche 2

6.3.1 Similar to Section 6.2, this section presents the changes in performance for four out of the eight junctions in Tranche 2 after mitigation assessment. For the other four junctions, their performance under the future development scenarios was deemed satisfactory during the junction assessment (Section 4.4) and hence no highway mitigation proposals were necessary. The four junctions in Tranche 2 that have been assessed are:

- 6. A27 / Busticle Lane
- 7. A27 Shoreham Bypass / Hangleton Link dumbbell
- 10. A27 Sompting Bypass / Upper Brighton Road
- 13. A259 Wellington Road / B2194 Station Road

6.3.2 All junction assessment was undertaken in ARCADY or LinSig as appropriate. The results presented for each model are mean max queue in passenger car units (PCU), average delay per vehicle and ratio of flow to capacity (RFC) or degree of saturation (DoS).

<u>Junction 6 - A27 / Busticle Lane</u>

6.3.3 Table 6.14 below compares the “with” and “without” mitigation results from the LinSig model of the above junction under Scenario B which contains the highest development growth. The with mitigation results include the effects of junction mitigation and the anticipated highway trip reductions from sustainable travel measures outlined in Section 5.2. The without mitigation results in future Reference case and Scenario B are reproduced from Table 4.11. Cases where the modelled traffic demand for each turn exceeds 90% of the calculated capacity have been highlighted in red.

Table 6.14: LinSig results for Junction 6 - A27 / Busticle Lane Junction

	AM			PM		
	Queue (PCU)	Delay (sec)	DoS (%)	Queue (PCU)	Delay (sec)	DoS (%)
	Reference Case without Mitigation					
Halewick Lane Left Ahead	11.6	51.0	87	2.7	30.8	32
Halewick Lane Right	2.9	47.6	40	0.8	55.5	15
A27 East (WB) Left Ahead	23.8	30.2	86	18.7	22.1	70
A27 East (WB) Right Ahead	25.9	30.6	87	20.6	23.7	72
Busticle Lane Ahead Left	6.6	27.8	66	10.1	47.3	74
Busticle Lane Right	2.9	72.5	62	4.7	56.1	53
A27 West (EB) Left Ahead	24.7	31.1	87	18.9	22.1	70
A27 West (EB) Ahead Right	28.7	34.5	89	21.4	26.4	75
Practical Reserve Capacity	0.6%			19.7%		
	Scenario B without Mitigation					
Halewick Lane Left Ahead	17.6	66.9	92	3.0	29.0	40
Halewick Lane Right	3.3	50.3	39	0.7	49.0	17
A27 East (WB) Left Ahead	25.9	30.8	84	16.8	22.7	78
A27 East (WB) Right Ahead	28.2	31.5	85	18.4	23.4	79
Busticle Lane Ahead Left	7.8	29.8	60	9.9	48.4	83
Busticle Lane Right	3.1	100.5	70	2.9	43.6	45
A27 West (EB) Left Ahead	34.2	43.7	93	17.3	23.1	79
A27 West (EB) Ahead Right	37.4	47.5	94	19.3	26.1	83
Practical Reserve Capacity	-5.0%			8.6%		
	Scenario B with Mitigation					
Halewick Lane Left Ahead	14.1	60.4	89	3.0	29.0	39
Halewick Lane Right	5.5	55.9	56	0.7	55.2	23
A27 East (WB) Left Ahead	23.8	26.1	80	16.8	22.7	78
A27 East (WB) Right Ahead	25.9	26.7	81	18.4	23.4	79
Busticle Lane Ahead Left	8.6	36.2	69	9.9	48.4	82
Busticle Lane Right	3.1	100.5	69	2.9	43.6	45
A27 West (EB) Left Ahead	30.5	33.5	88	17.3	23.1	79
A27 West (EB) Ahead Right	32.2	35.8	89	19.3	26.1	82
Practical Reserve Capacity	0.3%			8.6%		

6.3.4 The proposed mitigation brings the DoS of the junction in Scenario B back to the level of the original Reference Case, with the highest degree or saturation at 89% but none over 90%.

Junction 7 – A27 Shoreham By-pass / Hangleton Link dumbbell

6.3.5 Table 6.15 and Table 6.16 below compare the "with" and "without" mitigation results from the LinSig model of the above junction under Scenario B which contains the highest development growth. The "with" mitigation results include the effects of junction mitigation and the anticipated highway trip reductions from sustainable travel measures outlined in Section 5.2. The "without" mitigation results in future Reference case and Scenario B are reproduced from Table 4.12 and Table 4.13. Cases where the modelled traffic demand for each turn exceeds 90% of the calculated capacity have been highlighted in red.

Table 6.15: ARCADY Results for Junction 7 - A27 / Hangleton Link Road South Roundabout without mitigation

	AM			PM		
	Queue (PCU)	**Delay (sec)**	**DoS (%)**	**Queue (PCU)**	**Delay (sec)**	**DoS (%)**
	Reference Case without Mitigation					
North Roundabout Link	0.4	3.7	30	.3	3.4	24
A27 Westbound Offslip	7.5	26.9	89	1.9	8.6	65
A293 Hangleton Link	442.2	1007.9	120	589.6	1349.4	127
Practical Reserve Capacity	-41%			-49%		
	Scenario B without Mitigation					
North Roundabout Link	0.4	3.6	28	0.4	3.5	27
A27 Westbound Offslip	34.2	108.8	99	1.8	8.7	65
A293 Hangleton Link	431.6	985.2	120	698.4	1599.2	132
Practical Reserve Capacity	-56%			-55%		
	Scenario B with Mitigation					
North Roundabout Link	12.4	67.5	86	9.3	42.8	65
A27 Westbound Offslip	27.6	23.6	89	13.1	15.6	65
A293 Hangleton Link	32.4	18.2	94	11.5	12.1	93
Practical Reserve Capacity	-4.4%			-3.3%		

Table 6.16: ARCADY Results for Junction 7 - A27 / Hangleton Link Road North Roundabout without mitigation

	AM			PM		
	Queue (PCU)	Delay (sec)	DoS (%)	Queue (PCU)	Delay (sec)	DoS (%)
	Reference Case without Mitigation					
Golf Course	0.1	49.1	12	0.5	20.5	34
South Roundabout Link	16.2	46.4	95	3.95	13.0	80
A27 Eastbound Offslip	457	2943.0	160	1.06	11.8	51
Practical Reserve Capacity	-88%			6%		
	Scenario B without Mitigation					
Golf Course	0.1	49.7	12	0.6	25.1	39
South Roundabout Link	15.1	43.5	95	4.2	13.6	81
A27 Eastbound Offslip	482.4	3086.2	163	1.6	14.9	61
Practical Reserve Capacity	-92%			6%		
	Scenario B with Mitigation					
North Roundabout Link	0.4	94.8	22	3.3	82.5	69
A27 Westbound Offslip	39.2	39.9	96	23.1	19.4	82
A293 Hangleton Link	22.3	70.8	97	9.1	52.3	80
Practical Reserve Capacity	-7.9%			9.4%		

6.3.6 The proposed mitigation brings the junctions within capacity although it is still operating at a level which is likely to cause noticeable delays to traffic. It is operating significantly better than the existing layouts and further mitigation would require more expensive measures due to the embankments surrounding the junctions and the width of the underbridge.

Junction 10 – A27 Sompting By-pass / Upper Brighton Road

6.3.7 Table 6.17 below compares the "with" and "without" mitigation results from the LinSig model of the above junction under Scenario B which contains the highest development growth. The "with" mitigation results include the effects of junction mitigation and the anticipated highway trip reductions from sustainable travel measures outlined in Section 5.2. The "without" mitigation results in future Reference case and Scenario B are reproduced from Table 4.16. Cases where the modelled traffic demand for each turn exceeds 90% of the calculated capacity have been highlighted in red.

Table 6.17: LinSig results for Junction 10 - A27 Sompting By-pass / Upper Brighton Road Junction

	AM			PM		
	Queue (PCU)	Delay (sec)	DoS (%)	Queue (PCU)	Delay (sec)	DoS (%)
	Reference Case without Mitigation					
A27 West Ahead Left	35.4	60.2	95	19.1	30.0	69
A27 West Ahead	35.8	60.0	95	19.4	29.9	70
A27 West Right	0.0	0.0	0	1.6	77.2	35
Upper Brighton Rd Left GW	1.0	7.0	28	0.5	7.4	13
Upper Brighton Rd	18.4	69.1	92	11.3	52.5	77
Lyons Way Ahead	0.0	0.0	0	0.0	0.0	0
Lyons Way Right	1.5	62.9	30	4.9	82.3	77
Lyons Way Left	0.9	14.6	8	2.2	8.9	19
A27 East Ahead Left	31.2	60.3	94	21.6	34.8	78
A27 East Ahead	34.5	59.7	94	23.7	34.8	79
A27 East Right	7.6	149.0	91	1.6	78.7	37
Practical Reserve Capacity	-5.3%			14.2%		
	Scenario B without Mitigation					
A27 West Ahead Left	36.4	60.6	95	21.7	33.0	75
A27 West Ahead	36.8	60.4	95	22.0	33.0	75
A27 West Right	0.0	0.0	0	1.7	77.9	37
Upper Brighton Rd Left GW	1.0	7.4	30	0.6	6.6	15
Upper Brighton Rd	24.3	110.0	99	12.2	54.4	80
Lyons Way Ahead	0.0	0.0	0	0.1	64.3	2
Lyons Way Right	1.3	62.2	26	5.2	78.0	76
Lyons Way Left	1.6	15.8	13	2.4	10.7	20
A27 East Ahead Left	40.5	87.1	99	22.6	37.0	80
A27 East Ahead	45.8	88.5	100	24.6	36.9	81
A27 East Right	8.7	152.7	93	0.9	73.4	21
Practical Reserve Capacity	-10.7%			11.1%		
	Scenario B with Mitigation					
A27 West Ahead Left	27.2	31.9	82	19.2	26.2	68
A27 West Ahead	27.4	31.8	82	19.5	26.2	68
A27 West Right	0.0	0.0	0	1.7	77.9	37
Upper Brighton Rd Left GW	3.9	14.1	30	1.4	8.9	16
Upper Brighton Rd	1.0	2.1	13	0.5	2.0	6
Lyons Way Ahead	9.6	83.3	86	7.3	61.8	70
Lyons Way Right	0.0	0.0	0	0.1	62.1	2
Lyons Way Left	1.3	62.2	26	4.7	70.0	68
A27 East Ahead Left	1.7	15.2	16	2.2	9.9	23
A27 East Ahead	26.5	36.1	85	19.9	28.8	72
A27 East Right	29.8	35.3	85	21.9	28.7	73
Practical Reserve Capacity	5.2%			23.0%		

6.3.8 The proposed mitigation brings the DoS of each stop line at the junction in both scenarios below 90% with two arms in Scenario B at 86% DoS.

Junction 13 – A259 Wellington Road / B2194 Station Road

6.3.9 Table 6.18 below compares the "with" and "without" mitigation results from the LinSig model of the above junction under Scenario B which contains the highest development growth. The "with" mitigation results include the effects of junction mitigation and the anticipated highway trip reductions from sustainable travel measures outlined in Section 5.2. The "without" mitigation results in future Reference case and Scenario B are reproduced from Table 4.19. Cases where the modelled traffic demand for each turn exceeds 90% of the calculated capacity have been highlighted in red.

Table 6.18: LinSig results for Junction 13 - A259 Wellington Road / B2194 Station Road Junction

	AM			PM		
	Queue (PCU)	Delay (sec)	DoS (%)	Queue (PCU)	Delay (sec)	DoS (%)
	Reference Case without Mitigation					
Station Road	6.6	60.2	63.3%	2.0	45.2	25.5%
A259 Kingsway	11.1	89.8	95.7%	6.2	21.0	67.2%
Basin Road	0.0	0.0	0.0%	0.0	0.0	0.0%
A259 Wellington Road	46.8	53.8	96.7%	22.1	24.2	76.8%
Practical Reserve Capacity	-7.5%			17.2%		
	Scenario B without Mitigation					
Station Road	5.5	56.7	55.9%	5.7	63.2	61.3%
A259 Kingsway	10.3	69.1	93.9%	5.4	14.0	42.9%
Basin Road	0.0	0.0	0.0%	0.0	0.0	0.0%
A259 Wellington Road	43.0	47.4	95.2%	27.5	25.4	82.3%
Practical Reserve Capacity	-5.8%			9.4%		
	Scenario B with Mitigation					
Station Road	5.2	49.8	48.1%	5.7	63.2	61.3%
A259 Kingsway	6.8	37.5	82.2%	3.4	10.7	42.9%
Basin Road	0.0	0.0	0.0%	0.0	0.0	0.0%
A259 Wellington Road	29.3	20.9	82.5%	17.6	11.5	68.6%
Practical Reserve Capacity	9.1%			31.1%		

6.3.10 The 'without mitigation' results presented above incorporate the Basin Road signal stage running alone and in every cycle. The limited demand on that approach suggests the junction would benefit from vehicle demand dependent operation of the Basin Road entry. By allowing the junction to only run the stage for the Basin Road entry when vehicles arrive, the junction performance is improved as shown in 'with mitigation' results in the table above. By converting the stage controlling the Basin Road entry to vehicle demand dependent operation, the capacity of the other arms is improved sufficiently to accommodate the expected levels of future traffic demand.

6.4 Journey Times

6.4.1 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 F.

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

6.4.2 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 scenario B. Intersections with other roads are marked along the route for reference. Similar analysis for all scenarios along the A27 and A259 (routes 5 and 7) can be found in Appendix G.

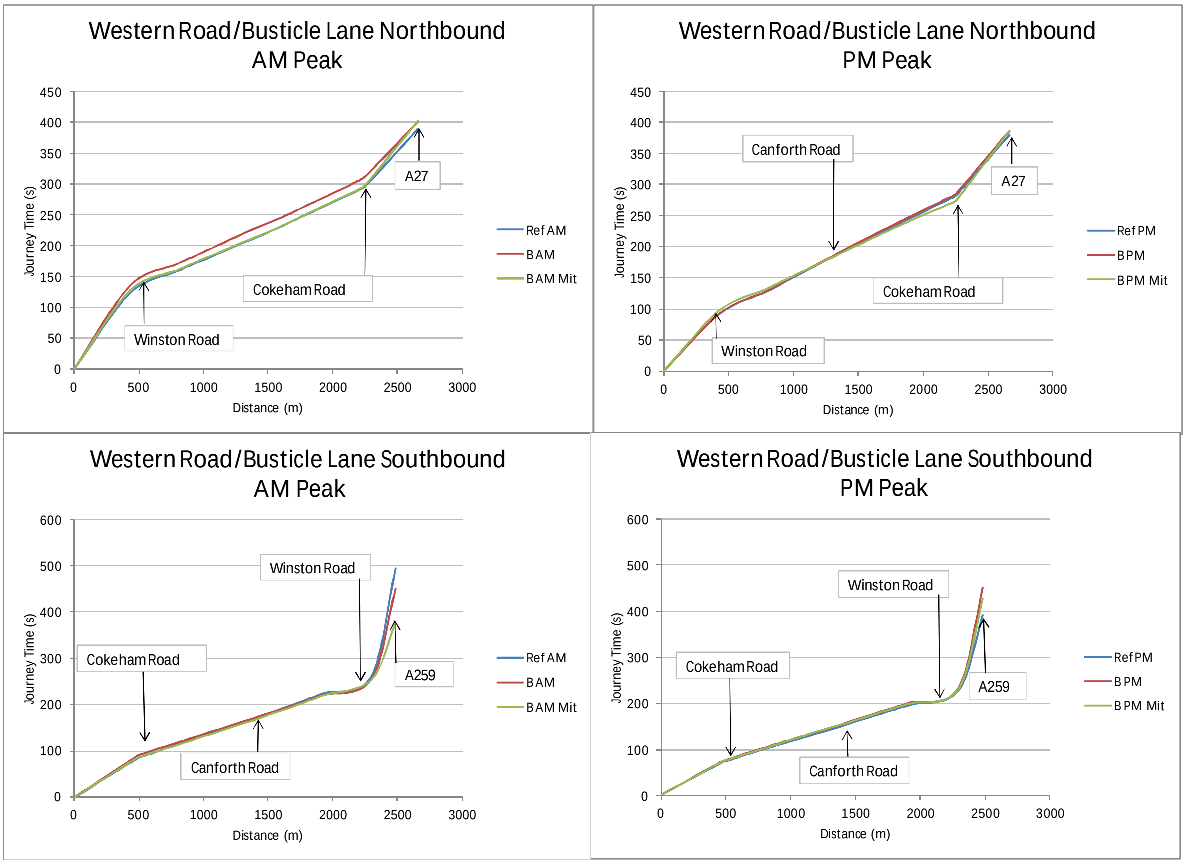


Figure 6.1: Route 1 - Western Road / Busticle Lane Journey Time Graphs

6.4.3 Along Western Road / Busticle Lane, the journey time in scenario B goes up marginally when compared with that in reference case as travel demand increases, except for southbound in the AM peak. However, the mitigation measures improve the journey time, reducing it to approximately the same level as the reference case models. The differences in journey times in all three cases are however unlikely to be perceivable.

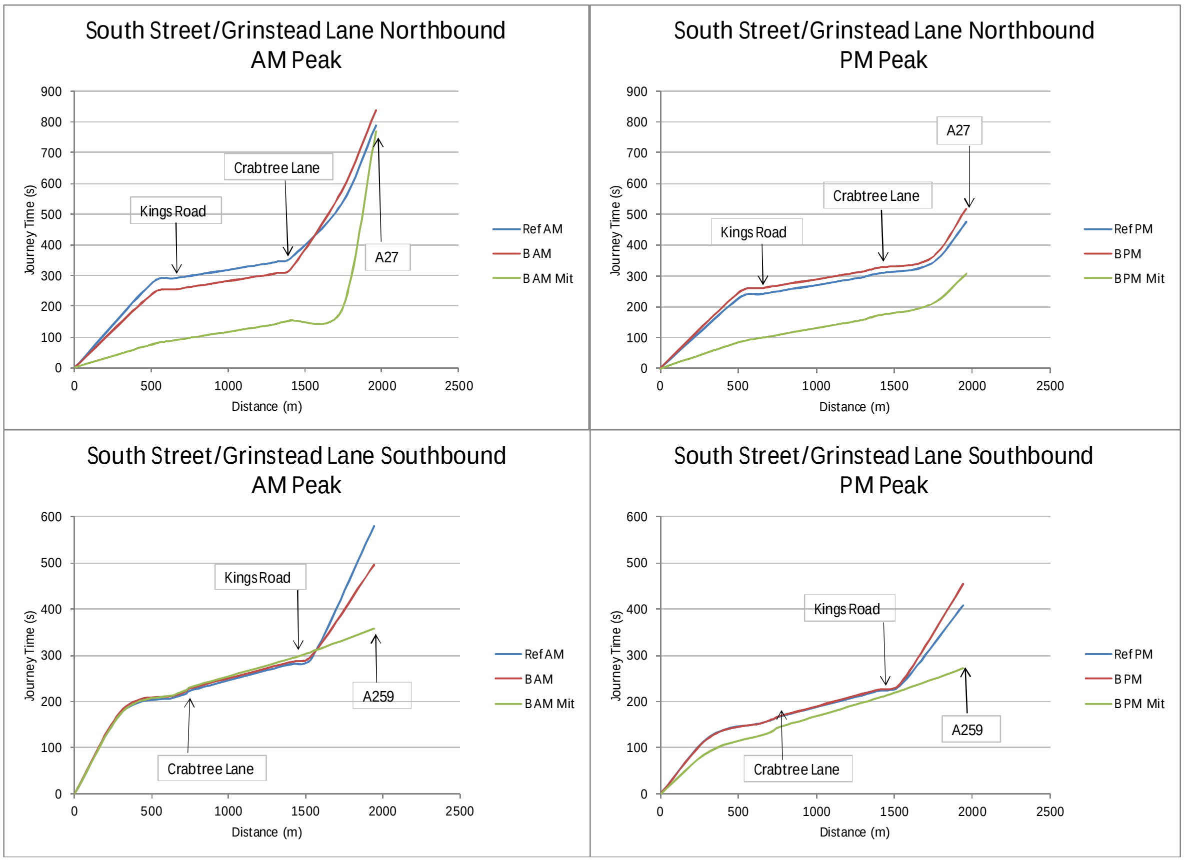


Figure 6.2: Route 2 - South Street / Grinstead Lane Journey Time Graphs

6.4.4 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. However, the mitigation at the A259 / South Street junction improves the northbound and southbound journey times significantly along most of the route, particularly northbound in both time periods with a time saving of around 3 minutes, However, in the AM peak, the benefit of this is counteracted by the additional delay at the A27 / Grinstead Lane junction which is still overcapacity although improved with signalisation.

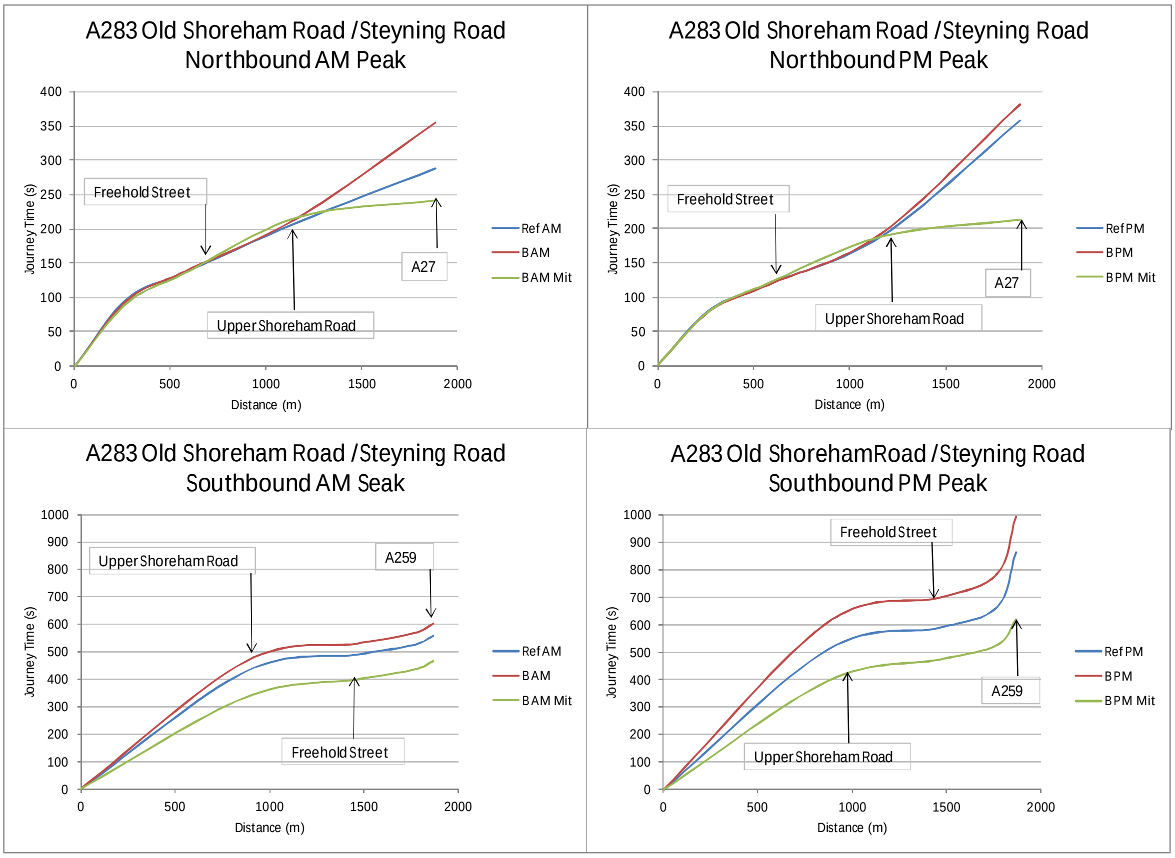


Figure 6.3: Route 3 - A283 Old Shoreham Road / Steyning Road

6.4.5 Southbound on Old Shoreham Road / Steyning Road the mitigation measures reduce the journey time by a noticeable amount, one to four minutes over the whole 2km length depending upon time period, less than the reference case journey time. Northbound journey times are similar compared to the reference case both with and without mitigation, with benefits north of the Upper Shoreham Road junction. The signalisation of the roundabout has successfully reduced the delay for movements to the A283 northbound and southbound as have improvements at the A27

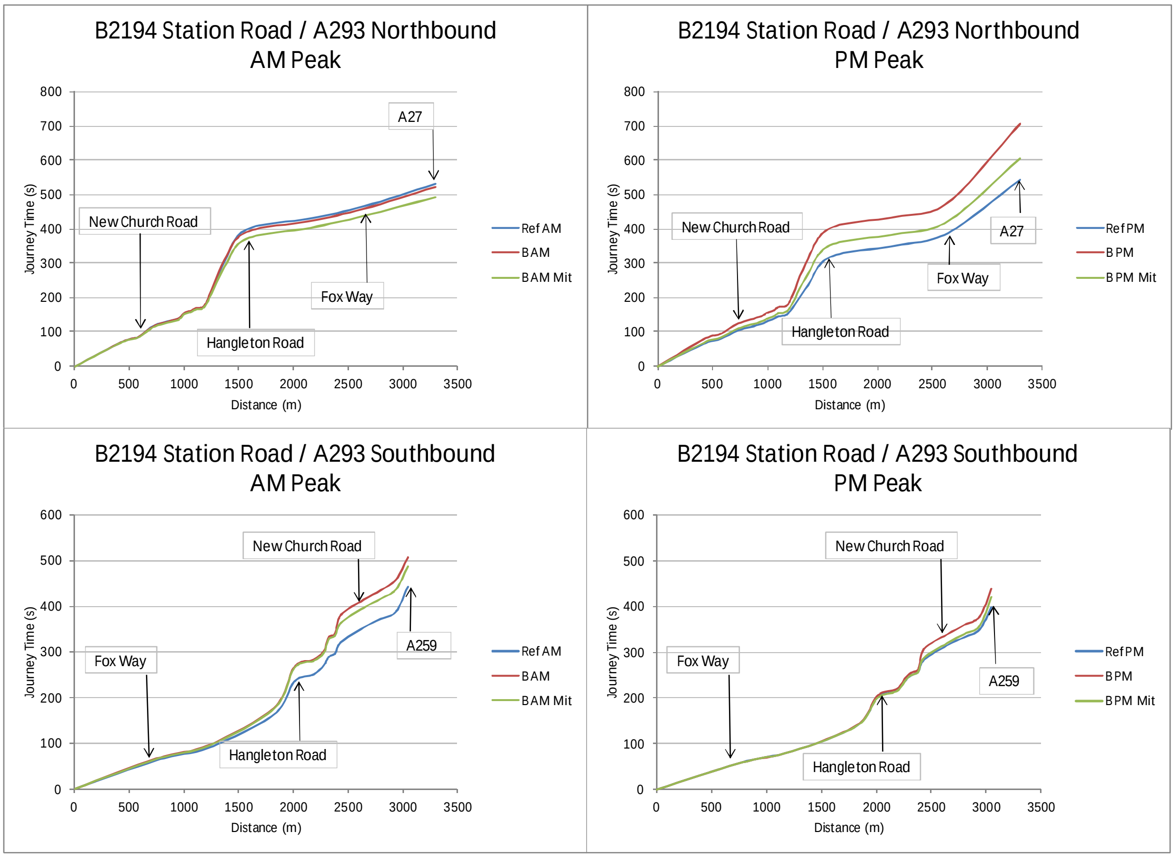


Figure 6.4: Route 4 - B2194 Station Road / A293

6.4.6 The junctions along this route do not receive any direct mitigation. The improvement in journey time in the with mitigation models is due to reassignment of flows to routes that were mitigated. Overall, there are very minor improvements over the full length of the route northbound compared to the reference case without mitigation in the AM peak, However there are minor journey time increases in the PM peak and southbound in both time periods compared to the reference case without mitigation, the worst being approximately one minute over the 5km route length.

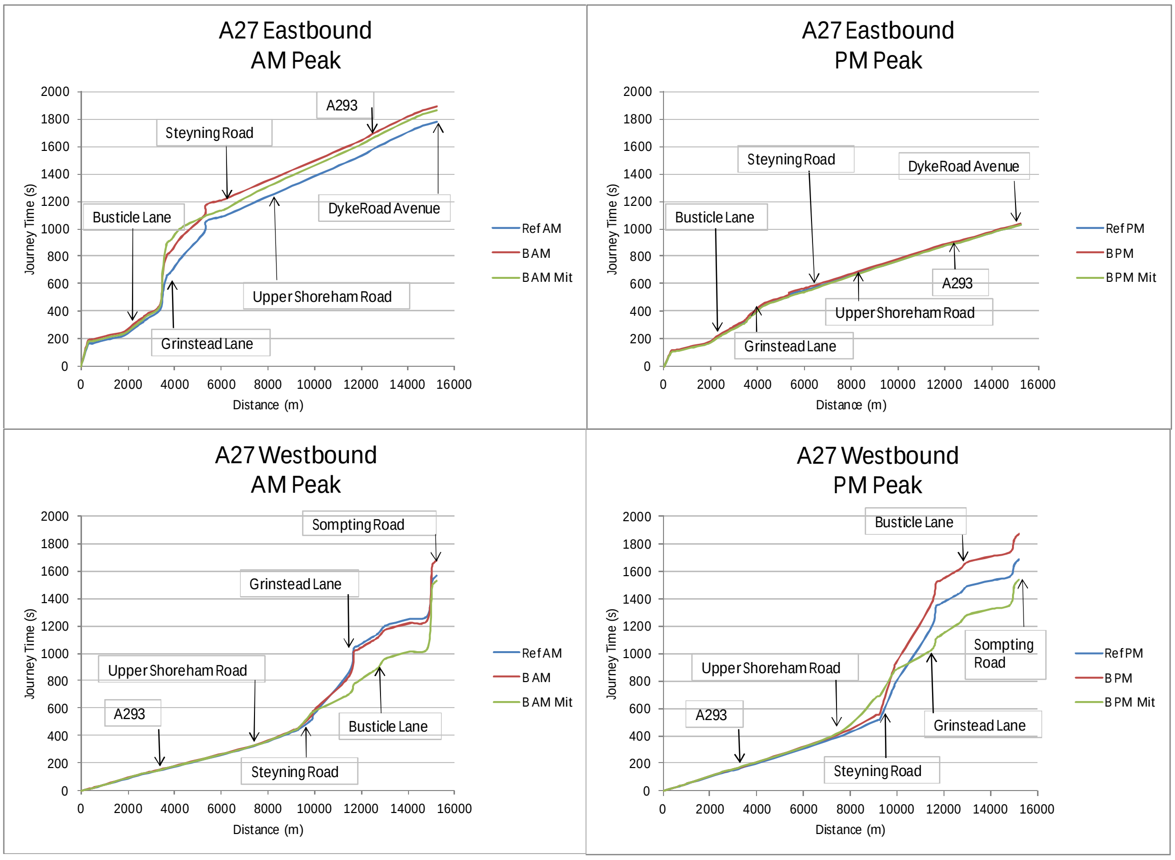


Figure 6.5: Route 5 - A27 Journey Time Graphs

6.4.7 The eastbound journey time is improved slightly by the introduction of the mitigation measures in the morning peak but still has time increases of 1-2 minutes east of Grinstead Lane. In the evening peak there are no differences. However, the improvement to the westbound journey time is more noticeable between Steyning Road and Sompting Road where improvements of up to 3 minutes can be seen along some sections of this route, and reducing it to below the reference case journey time without mitigation in the AM and PM peaks. The improvement is due to the mitigation of the junction with Grinstead Lane on the westbound route and the Steyning Road junction on the eastbound route.

6.4.8 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.

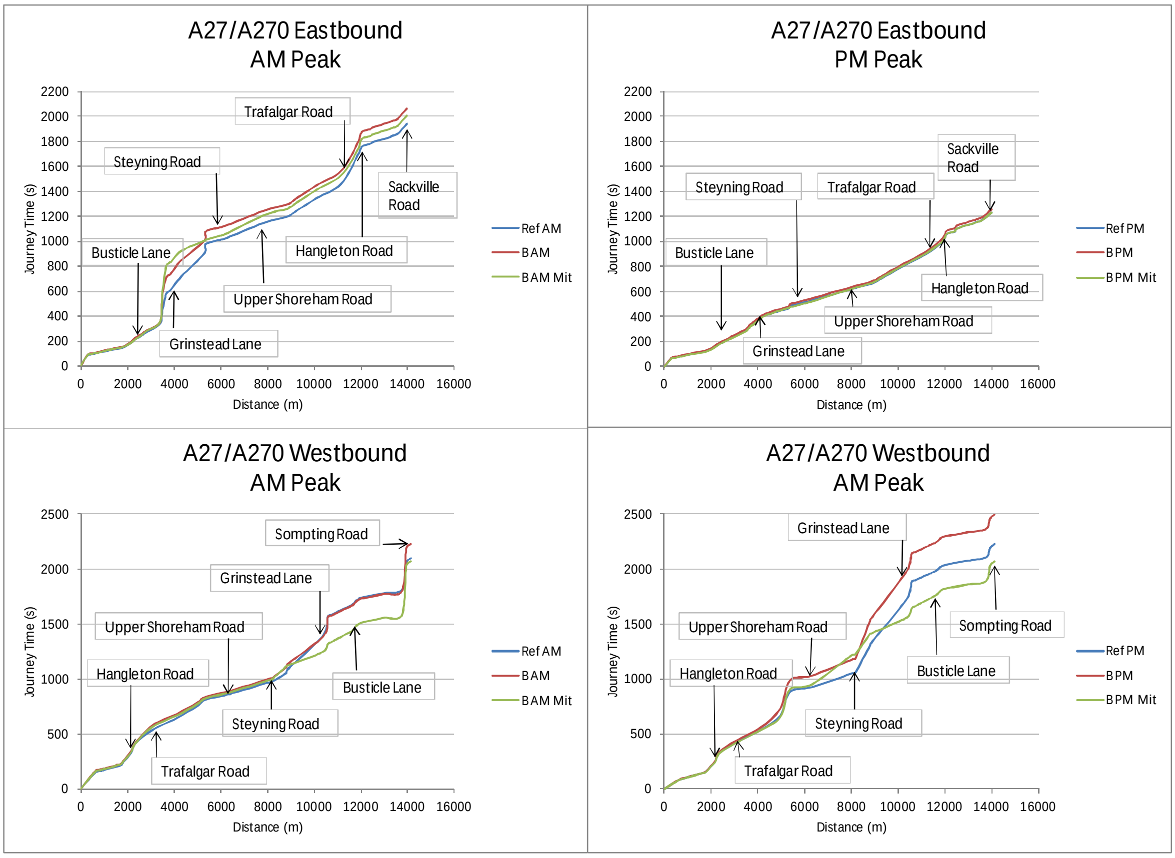


Figure 6.6: Route 6 - A27 / A270 Journey Time Graphs

6.4.9 As expected, this route shows very similar results to the A27 route. Mitigation of the junction with Grinstead Road improves the westbound journey time to less than the reference case journey time overall by around 3 minutes along the whole route in both time periods, and mitigation of the Steyning Road junction also produces an improvement in the eastbound journey time in the morning peak period but is still around 1 minute higher than in the reference case with no mitigation (although this is over the whole 14km route length and therefore not seen as significant overall). The mitigation has little impact on the journey time on the A270 which indicates that traffic is not re-routing to the A270 instead of the A27 as a result of the scenario development.

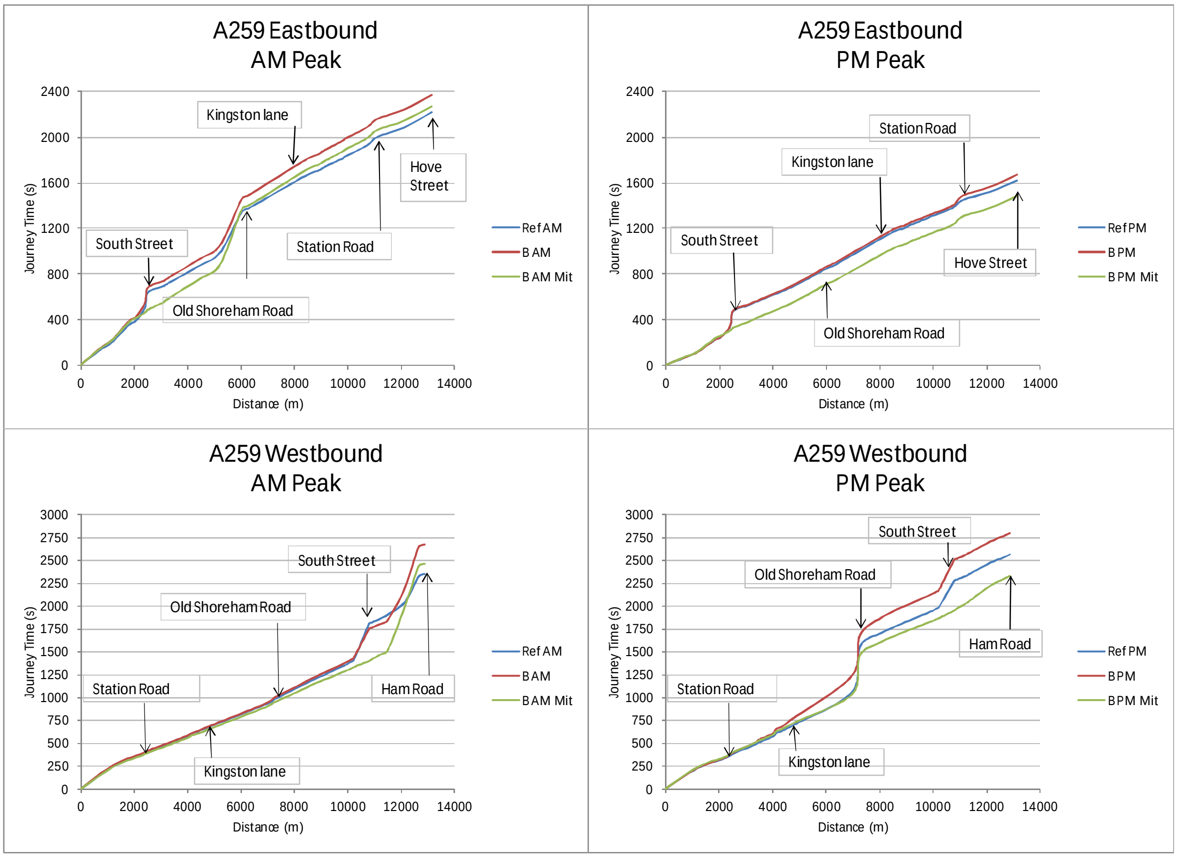


Figure 6.7: Route 7 - A259 Journey Time Graphs

6.4.10 The increased demand in Scenario B has increased the journey time along the A259. However, the mitigation at the South Street / A259 junction has a noticeable impact on the eastbound and westbound journey time in both peaks. The PM peak hour shows benefits of up to four minutes westbound and 3 minutes eastbound over the 14km length in comparison with the reference case with no mitigation. In the AM peak the journey times are similar, although the South Street junction improvements are cancelled out over the 14km route length leading to small increases of up to 2 minutes at the end of each route on top or a journey time of approximately 35-40 minutes which is not significant.

6.5 Impact on Air Quality Management Area and Sompting Conservation Area

6.5.1 An important aspect of assessing the environmental impacts from any proposed development is air quality. Motor vehicles are one of the largest sources of air pollution and slow moving traffic emits more pollution than when cars move at higher speed. By comparing the traffic volumes, queues and delays on key highway links that go through the AQMAs and the Sompting conservation area before and after the proposed mitigation measures, it is able to demonstrate whether the mitigation is capable of reducing the traffic volume and congestion in the relevant areas and hence leads to lower air pollutant emissions. These results are presented in Table 6.19 to Table 6.24.

Table 6.19: AM Peak Flow (PCU) Comparison through AQMAs and Sompting Conservation Area

AQMA			Initial Results					With Mitigation			
Road	From	To	Ref	A1	A2	A3	B	A1	A2	A3	B
Old Shoreham Road	Kingston Lane junction	Lower Drive junction	1,187	1,253	1,256	1,256	1,248	1,248	1,248	1,256	1,249
	Lower Drive junction	Kingston Lane junction	1,455	1,403	1,398	1,391	1,407	1,410	1,414	1,410	1,408
A259 High Street	Ropetackle Roundabout	Surry Street	3,907	4,288	4,276	4,324	4,240	4,215	4,197	4,244	4,146
	Surry Street	Ropetackle Roundabout	3,907	4,288	4,276	4,324	4,240	4,215	4,197	4,244	4,146
Sompting Conservation Area											
West Street	Church Lane	Lambleys Lane	909	976	914	870	986	1,026	1,017	1,022	1,037
	Lambleys Lane	Church Lane	275	346	338	331	356	335	346	349	333

Table 6.20: AM Peak Average Queue (metres) Comparison through AQMAs and Sompting Conservation Area

AQMA			Initial Results					With Mitigation			
Road	From	To	Ref	A1	A2	A3	B	A1	A2	A3	B
Old Shoreham Road	Kingston Lane junction	Lower Drive junction	0	0	0	0	0	0	0	0	0
	Lower Drive junction	Kingston Lane junction	9	8	8	8	8	8	8	8	8
A259 High Street	Ropetackle Roundabout	Surry Street	4	5	5	5	5	5	5	5	5
	Surry Street	Ropetackle Roundabout	4	5	5	5	5	5	5	5	5
Sompting Conservation Area											
West Street	Church Lane	Lambleys Lane	0	0	0	0	0	13	9	11	18
	Lambleys Lane	Church Lane	0	0	0	0	0	0	0	0	0

Table 6.21: AM Peak Delay (seconds per PCU) Comparison through AQMAs and Sompting Conservation Area

AQMA			Initial Results					With Mitigation			
Road	From	To	Ref	A1	A2	A3	B	A1	A2	A3	B
Old Shoreham Road	Kingston Lane junction	Lower Drive junction	8	9	9	9	9	9	9	9	9
	Lower Drive junction	Kingston Lane junction	50	44	43	42	44	44	45	44	44
A259 High Street	Ropetackle Roundabout	Surry Street	54	70	71	71	67	73	73	73	67
	Surry Street	Ropetackle Roundabout	54	70	71	71	67	73	73	73	67
Sompting Conservation Area											
West Street	Church Lane	Lambleys Lane	24	28	24	22	28	75	60	68	95
	Lambleys Lane	Church Lane	5	6	6	6	6	6	6	6	6

6.5.2 The flow through both AQMA's is slightly reduced in the mitigation models; however there is an increase in flow through the Sompting conservation area in both directions. This results in an increase in delay and average queue.

Table 6.22: PM Peak Flow (PCU) Comparison through AQMAs and Sompting Conservation Area

AQMA			Initial Results					With Mitigation			
Road	From	To	Ref	A1	A2	A3	B	A1	A2	A3	B
Old Shoreham Road	Kingston Lane junction	Lower Drive junction	1,008	1,030	1,034	1,026	1,022	976	978	975	975
	Lower Drive junction	Kingston Lane junction	1,528	1,569	1,568	1,568	1,574	1,497	1,497	1,498	1,504
A259 High Street	Ropetackle Roundabout	Surry Street	2,901	2,909	2,943	2,862	2,954	2,925	2,914	3,072	2,818
	Surry Street	Ropetackle Roundabout	2,901	2,909	2,943	2,862	2,954	2,925	2,914	3,072	2,818
Sompting Conservation Area											
West Street	Church Lane	Lambleys Lane	412	469	452	483	498	633	617	645	640
	Lambleys Lane	Church Lane	164	202	199	202	232	189	182	188	208

Table 6.23: PM Peak Average Queue (metres) Comparison through AQMAs and Sompting Conservation Area

AQMA			Initial Results					With Mitigation			
Road	From	To	Ref	A1	A2	A3	B	A1	A2	A3	B
Old Shoreham Road	Kingston Lane junction	Lower Drive junction	0	0	0	0	0	0	0	0	0
	Lower Drive junction	Kingston Lane junction	9	20	20	20	23	9	9	9	9
A259 High Street	Ropetackle Roundabout	Surry Street	3	3	3	3	3	3	3	3	3
	Surry Street	Ropetackle Roundabout	3	3	3	3	3	3	3	3	3
Sompting Conservation Area											
West Street	Church Lane	Lambleys Lane	0	0	0	0	0	0	0	0	0
	Lambleys Lane	Church Lane	0	0	0	0	0	0	0	0	0

Table 6.24: PM Peak Delay (seconds per PCU) Comparison through AQMAs and Sompting Conservation Area

AQMA			Initial Results					With Mitigation			
Road	From	To	Ref	A1	A2	A3	B	A1	A2	A3	B
Old Shoreham Road	Kingston Lane junction	Lower Drive junction	6	6	6	6	6	6	6	6	6
	Lower Drive junction	Kingston Lane junction	71	108	105	106	114	60	59	60	62
A259 High Street	Ropetackle Roundabout	Surry Street	40	37	37	36	37	36	36	38	35
	Surry Street	Ropetackle Roundabout	40	37	37	36	37	36	36	38	35
Sompting Conservation Area											
West Street	Church Lane	Lambleys Lane	5	6	6	7	7	12	11	12	12
	Lambleys Lane	Church Lane	3	3	3	3	4	3	3	3	4

6.5.3 There is a small increase in flows between the initial results and the with mitigation results through the A259 AQMA and the Sompting conservation area in the PM peak. In the A259 AQMA the increase is not sufficient to also increase the average queue and delay. However, the delay does increase on West Street between Church Lane and Lambleys Lane.

6.5.4 In light of the reported modelling results, a separate test was also undertaken to evaluate the impacts of converting West Street between Lambley's Lane and Church Lane to one-way eastbound in order to reduce through traffic in the Sompting Conservation area. A comparison of modelling results with and without the one-way conversion under travel demand from development Scenario B was undertaken during the test.

6.5.5 It was found that the closure of West Street to westbound traffic would cause significant displacement of traffic onto the surrounding network. The westbound traffic that used to use West Street would mainly divert to two alternative routes, the A27 Upper Brighton Road (400+ trips) and the A259 Brighton Road (200+ trips). Accordingly the diversion would put additional pressure on relevant junctions along the above two roads, which would particularly worsen the performance of the A27 Sompting Bypass / Upper Brighton Road junction. Modelling results show significant increases in queuing and delay for westbound movements at this junction.

6.5.6 Furthermore, the closure of West Street to westbound traffic would also reduce the number of available exits onto the wider network for local traffic such as vehicles from the Sompting Fringe and Sompting North sites. Accordingly this increases the demand at each of the remaining exits. Meanwhile the diverted westbound traffic would also increase the opposing traffic on the mainline (A27 and Busticle Lane) movement at these exits. The combination of these factors would result in significant delay for local traffic leaving from Dankton Lane and Church Lane exits to the A27 and from West Street exit onto Busticle Lane.

6.5.7 In light of the findings presented above, it was concluded that the closure of West Street to westbound traffic is not worth pursuing due to its significant adverse impacts on the surrounding highway network as well as local traffic from Sompting Fringe and Sompting North sites. However, there are still alternatives that can be considered in order to reduce through traffic on West Street, thus reducing traffic congestion in Sompting Conservation Area. Any of the following potential solutions or their combination may be considered:

- Formally making the speed limit to 20mph in the conservation area;
- Increasing the frequency of traffic calming measures (currently flat top humps) west of Lambleys Lane;
- Continuing traffic management measures east of Church Lane on West Street; and
- Adopting appropriate frontage and access junction design for the new development adjacent to West Street to discourage through traffic.

6.5.8 Further to the aforementioned potential solutions, Adur District Council and West Sussex County Council intend to address any remaining impacts on the AQMAs and conservation areas through the current Shoreham Town Centre study and traffic management, parking and non-motorised sustainable transport improvements. These measures are best assessed separately from this study as the modelling tools employed in this study do not explicitly reflect impacts from these measures, in particular their detailed impacts when implemented locally.

7 CONCLUSION

7.1 Summary

7.1.1 This study aimed to 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 Shoreham Harbour Joint Area Action Plan. It follows on from a previous study by Parsons Brinckerhoff for Adur District Council which tested strategic locations for development, and considers the impacts of a number of further strategic housing and employment site allocations in Adur to assist with setting out the spatial and strategic vision for the district.

7.1.2 Four strategic development scenarios for Adur were tested, varying in size and location of development. Each tested scenario also included proposed site allocations at Shoreham Harbour and Shoreham Airport, in addition to that contained in the reference case model.

7.2 Traffic Impact of Development

7.2.1 All four tested scenarios without mitigation added to the existing congestion on the highway network, as was expected with an increase in travel demand following the introduction of additional residential and commercial property in each. The effect of the increased demand on individual key junctions was examined, along with the effect on journey times along key corridors as a means of assessing any area-wide impacts of the potential development.

7.2.2 The potential impact of the development proposals on the highway network was considered sufficient to investigate interventions to mitigate the anticipated effects.

7.3 Traffic Impact Mitigation

7.3.1 Demand management measures in the form of sustainable transport initiatives were explored as the first part of mitigation. The combined impact of these measures was equivalent to approximately 2% reduction in the overall highway travel demand.

7.3.2 Highway mitigation options were then explored for 13 junctions through individual junction assessment undertaken in two tranches. The proposals seek to increase the capacity of the junctions whilst avoiding land take wherever possible and with minimum physical changes, as detailed below:

Tranche 1 Junctions:

- **1. A27 / Grinstead Lane** – 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 Road** – Fully signalise roundabout with a three lane circulatory and widen A28 north entry and exit, and A283 south entry.
- **4. A259 Brighton Road / A283 Old Shoreham Road** – expand the roundabout and widen approach westbound.
- **5. A259 Brighton Road / A2025 South Street** – Widen the A259 west approach and enlarge circulatory.

Tranche 2 Junctions:

- **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** – 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** – it was confirmed in junction assessment that this junction would be operating within capacity so no mitigation was required.
- **9. A270 Upper Shoreham Road / B2167 Kingston Lane** – it was confirmed in junction assessment that this junction would be operating within capacity so no mitigation was 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** – it was confirmed in junction assessment that this junction would be operating within capacity so no mitigation was required.
- **12. A270 Old Shoreham Road / A2038 Hangleton Road / B2194 Carlton Terrace** – it was confirmed in junction assessment that this junction would be operating within capacity so no mitigation was 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.

7.3.3 For Tranche 1 junctions, the highway interventions range from minor tweaks to the existing layout at the A27 Sussex Pad estimated at around £10k to more extensive engineering projects such as the signalisation of the A27 / A283 roundabout estimated at around £2.5m.

7.3.4 For Tranche 2 junctions, the highway interventions range from small adjustments to the current signal control at the A259 Wellington Road / B2194 Station Road junction at the minimum cost[15] to the more significant upgrade of the eastbound merge at the A27 Shoreham Bypass / Hangleton Link dumbbell junction (within Brighton & Hove) estimated at approximately £1.9m.

7.3.5 The measures tested, to reduce overall travel demand and relieve the bottleneck effect of the junctions listed above, combined 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 should also be noted that the reported network wide improvement in journey time does not include additional benefits from the five junction mitigation measures[16] that were not included in the network model runs. Therefore the reported improvement is not dependent on the deliverability of these five mitigations. Further congestion relief is expected if these five proposals are implemented, which will allow more journeys to be completed during the modelled peak hours. It is therefore concluded that the mitigation tested is sufficient to accommodate the increased traffic associated with all of the development scenarios examined.

7.3.6 It should be noted that the proposed junction improvements are initial concepts subject to further detailed study. These proposals have been developed after iterative discussion with West Sussex County Council and Brighton & Hove City Council.

7.4 Limitations of Study – Cost Estimates and Mitigation Phasing

7.4.1 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.

7.4.2 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.

[15] Subject to confirmation of the current form of signal control and its flexibility in allowing demand dependent operation of the Basin Road entry at this junction

[16] These 5 junctions include all 4 junctions mitigated in Tranche 2 and the A283 / A259 junction in Tranche 1.

7.4.3 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.

7.4.4 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 but their potential funding sources have been identified and listed in Appendix I.

7.4.5 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 02/2007.

7.5 Further Work

7.5.1 The journey time assessments of all of the major routes within the study area in Section 6.7 show that overall, with mitigation most routes within the study area will show either improvements or be no worse off under Scenario B, the highest development scenario. In addition, further benefits are likely if the five mitigation measures[17], which were proposed after the latest network model run with mitigation had been done, are implemented.

7.5.2 There may be possibilities to explore reduced levels of mitigation for individual scenarios. Some of the junction improvements examined may be scaled down for further assessment as the need to mitigate development may require lesser improvements than those examined.

[17] These 5 junctions include all 4 junctions mitigated in Tranche 2 and the A283 / A259 junction in Tranche 1.

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

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.

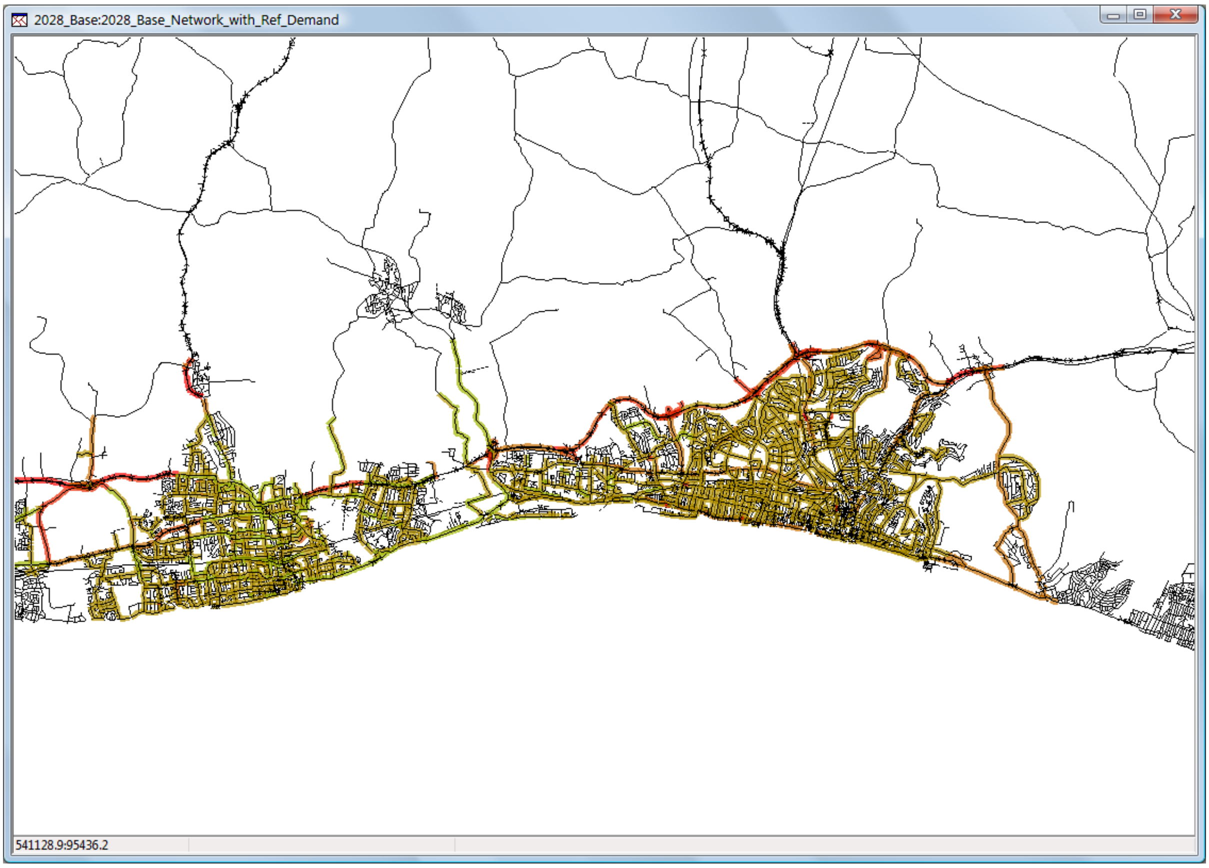
The mapping process is described as follows:

- 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:

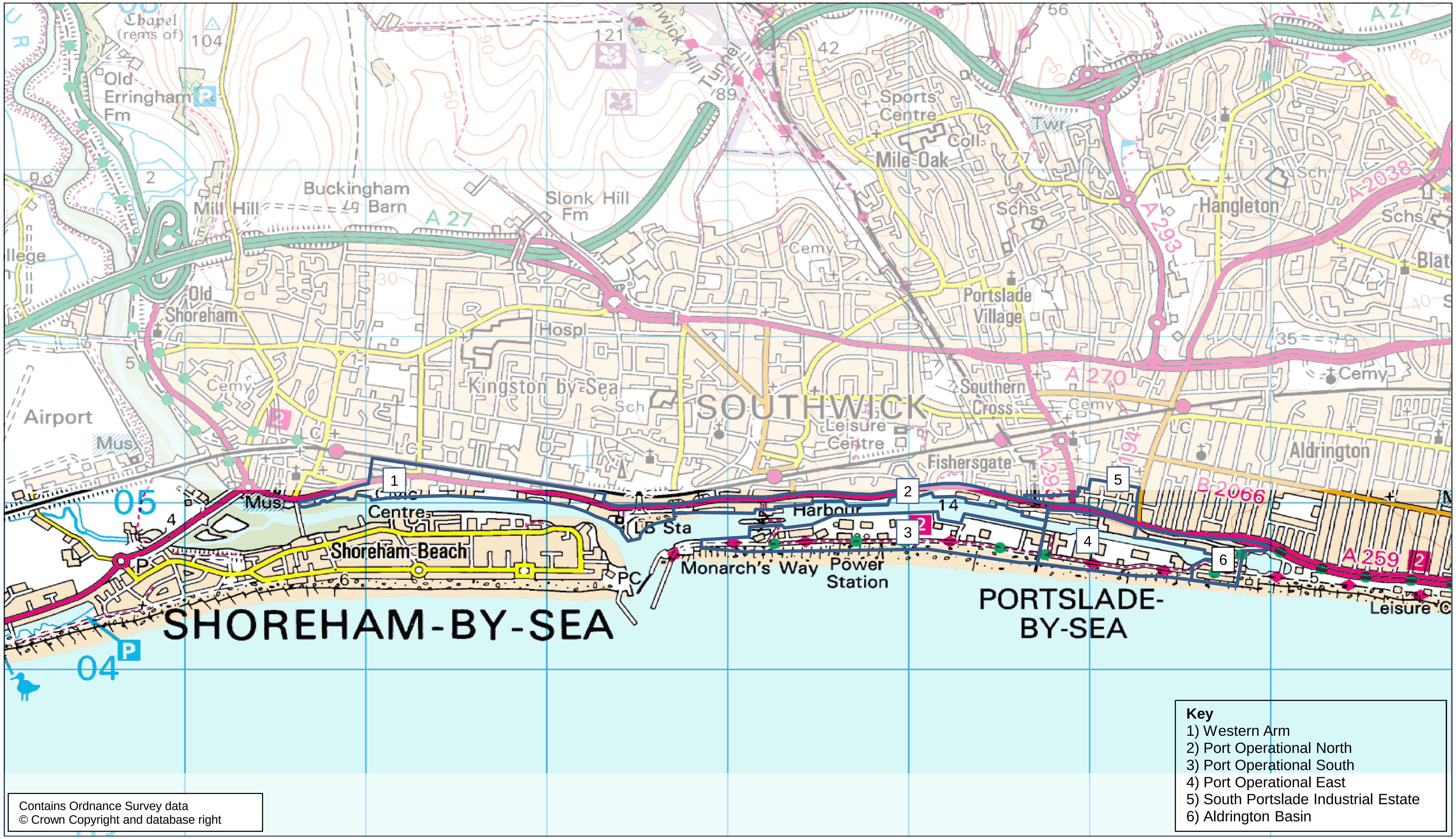
- The Scenario Manager requires re-writing as the class used to construct it is no longer supported by Omnitrans International. It would have to be replaced by using WxRuby as the successful operation of the Scenario Manager cannot be guaranteed

- 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 BOUNDARY MAP



PARSONS BRINCKERHOFF

Parsons Brinckerhoff
Queen Victoria House,
Redland Hill, Bristol BS6 6US
Tel: (0117) 933 9300
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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

PRODUCED
MSR

CHECKED
SP

APPROVED
NW

Appendix B

APPENDIX C

SHOREHAM HARBOUR DEVELOPMENT 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

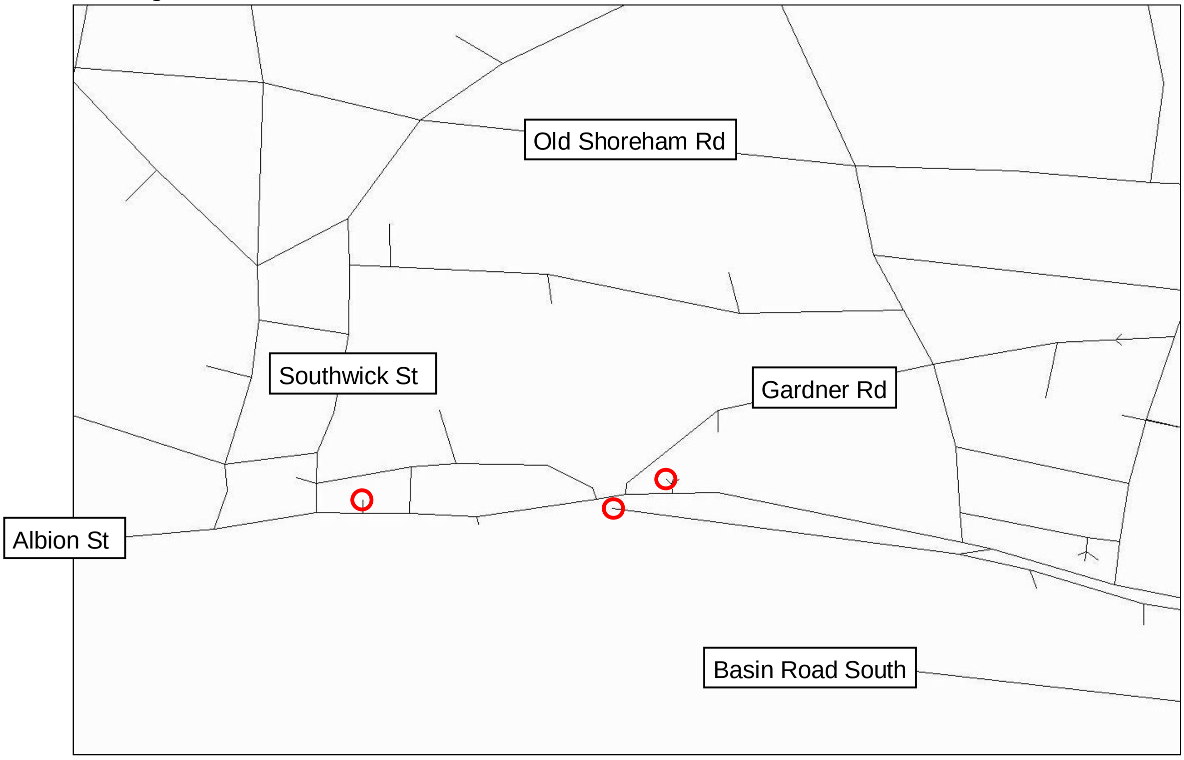
Departures (AM peak)
New departures: 571
Existing departures (to remove):260
Net increase in departures: 311

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

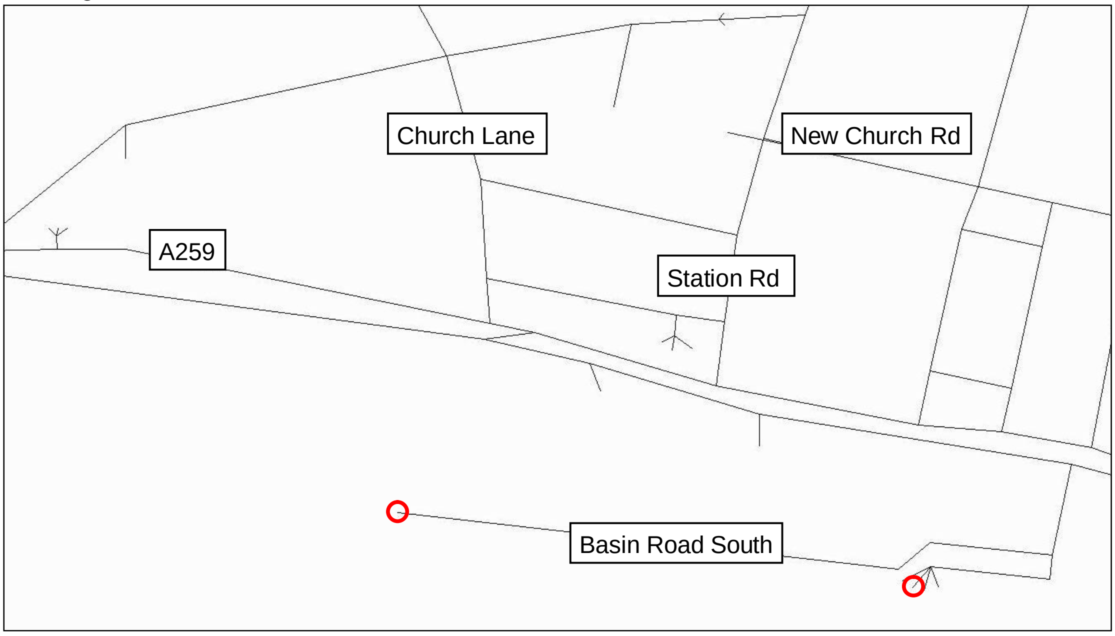
Departures (AM peak)
New departures: 20
Existing departures: 96
Net increase in departures: 20

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

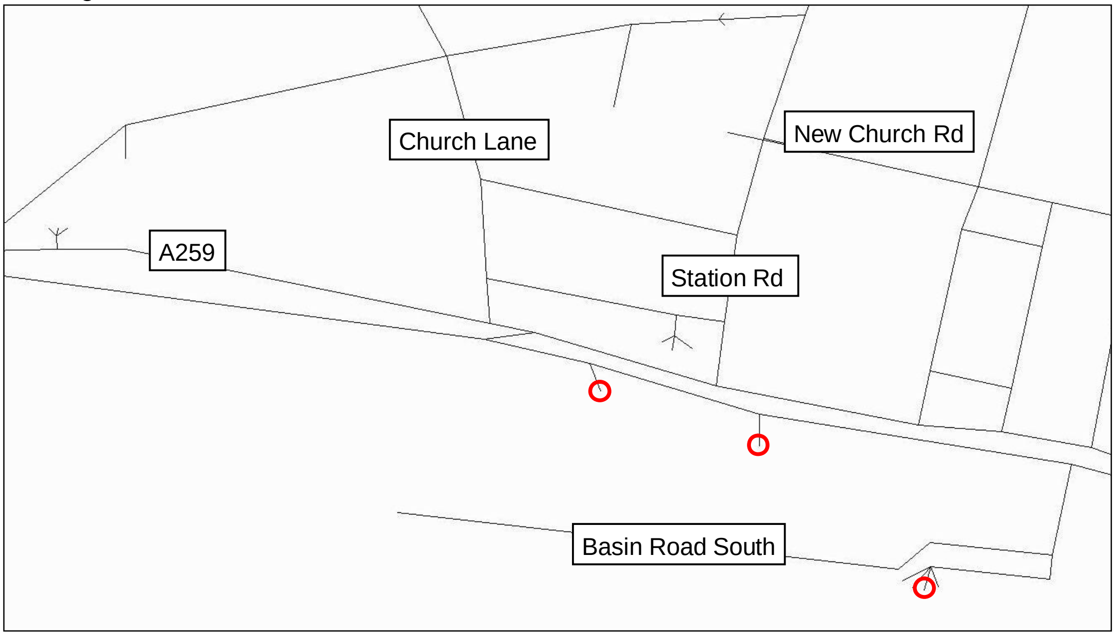
Departures (AM peak)
New departures: 20
Existing departures: 96
Net increase in departures: 20

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.

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

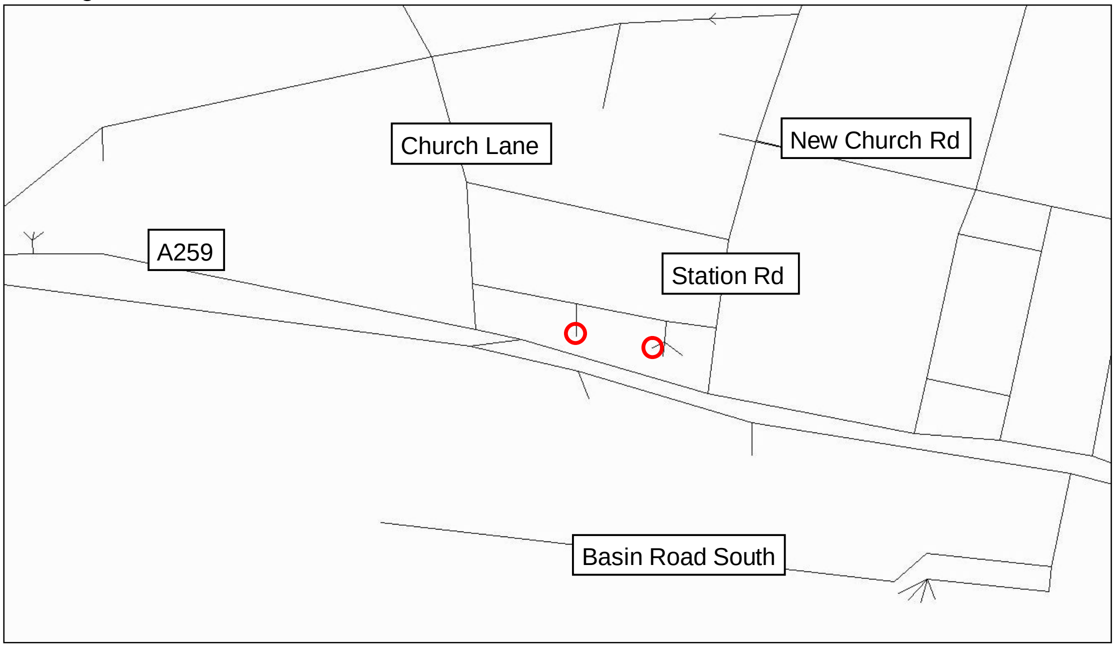
Departures (AM peak)
New departures: 20
Existing departures: 96
Net increase in departures: 20

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

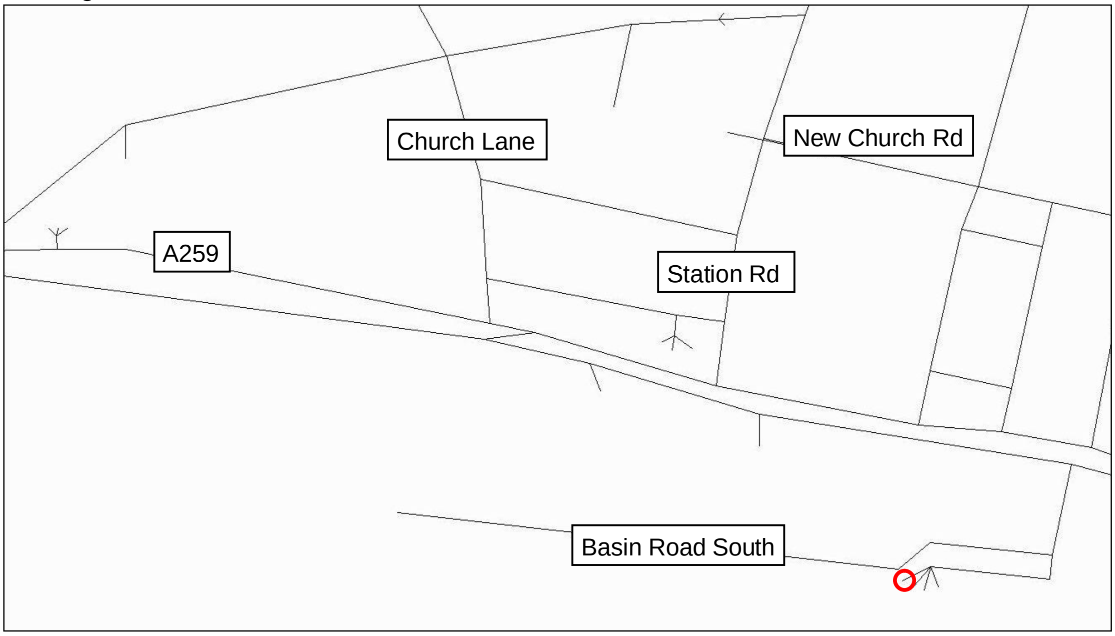
<u>Departures (AM peak)</u>
New departures: 144
Existing departures (to remove): 148
Net increase in departures: -4

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

<u>Method</u>
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

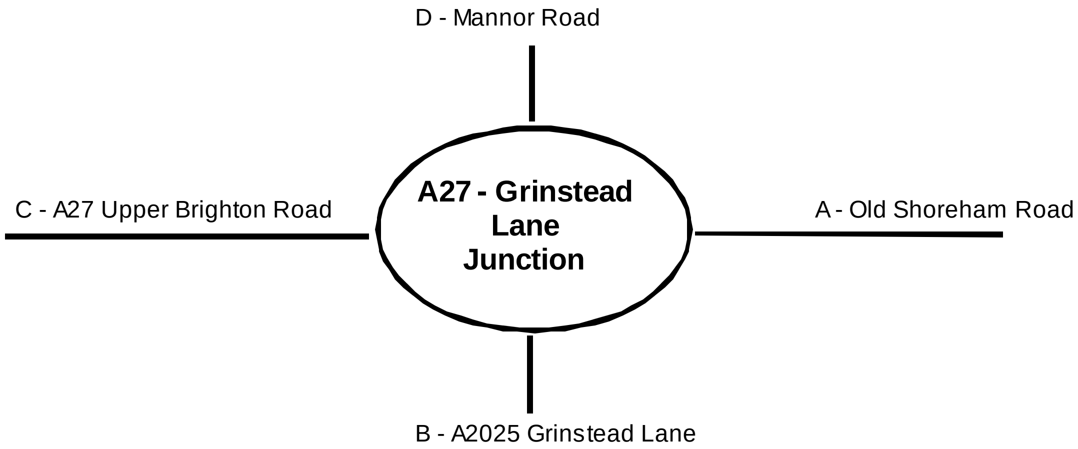
Departures (AM peak)
New departures: 110
Existing departures (to remove): 80
Net increase in departures: 31

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	36	683	2204	67
B	844	0	0	7
C	2754	8	0	0
D	175	3	0	0

Initial Demands

Scenario A1

	A	B	C	D
A	110	657	2176	66
B	866	0	0	0
C	2881	1	0	0
D	188	0	0	0

Scenario A2

	A	B	C	D
A	110	664	2168	66
B	864	0	0	0
C	2859	1	0	0
D	187	0	0	0

Scenario A3

	A	B	C	D
A	110	651	2178	66
B	866	0	0	0
C	2892	1	0	0
D	188	0	0	0

Scenario B

	A	B	C	D
A	128	652	2185	66
B	892	0	0	0
C	2904	1	0	0
D	189	0	0	0

Demands with Mitigation

Scenario A1

	A	B	C	D
A	0	889	2285	123
B	758	0	0	162
C	2950	0	0	0
D	309	100	18	0

Scenario A2

	A	B	C	D
A	0	891	2283	123
B	755	0	0	163
C	2931	0	0	0
D	308	101	18	0

Scenario A3

	A	B	C	D
A	0	887	2288	123
B	755	0	0	162
C	2960	0	0	0
D	309	98	18	0

Scenario B

	A	B	C	D
A	0	888	2296	121
B	785	0	0	168
C	2988	0	0	0
D	311	104	18	0

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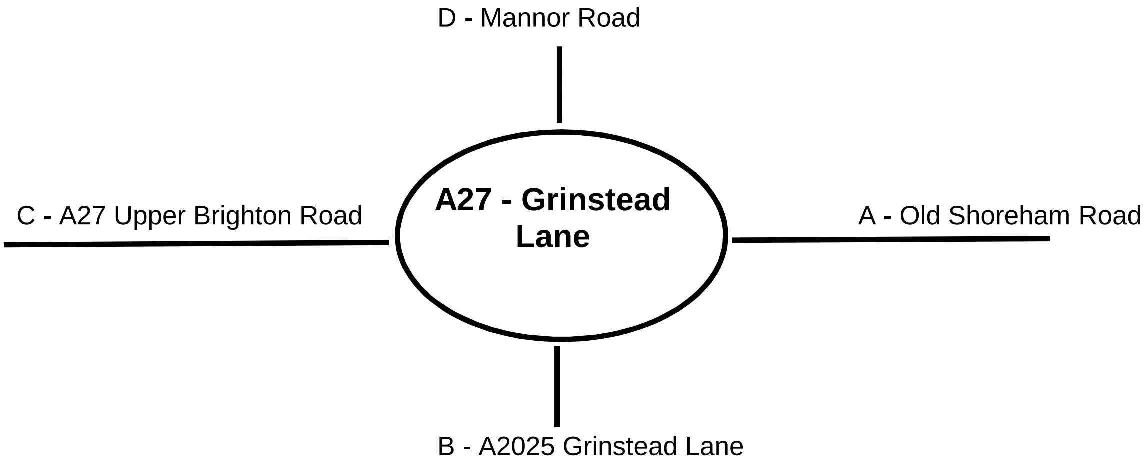
Figure D1



Reference Case

	A	B	C	D
A	1	699	2929	124
B	739	0	0	12
C	1807	196	10	0
D	66	12	17	0

Initial Demands

Scenario A1

	A	B	C	D
A	1	668	3038	132
B	709	0	6	11
C	1842	196	10	0
D	93	9	20	0

Scenario A2

	A	B	C	D
A	1	677	3007	130
B	714	0	8	11
C	1835	202	10	0
D	90	8	19	0

Scenario A3

	A	B	C	D
A	1	659	3059	135
B	697	0	1	11
C	1843	184	10	0
D	94	8	20	0

Scenario B

	A	B	C	D
A	1	678	3075	131
B	711	0	16	11
C	1852	211	10	0
D	98	9	20	0

Demands with Mitigation

Scenario A1

	A	B	C	D
A	0	1072	2988	162
B	897	0	52	82
C	1734	116	0	0
D	41	42	24	0

Scenario A2

	A	B	C	D
A	0	1072	2970	160
B	896	0	52	79
C	1736	118	0	0
D	41	41	24	0

Scenario A3

	A	B	C	D
A	0	1068	2993	162
B	895	0	53	82
C	1728	116	0	0
D	41	38	24	0

Scenario B

	A	B	C	D
A	0	1095	3043	170
B	913	0	59	82
C	1744	121	0	0
D	41	43	24	0

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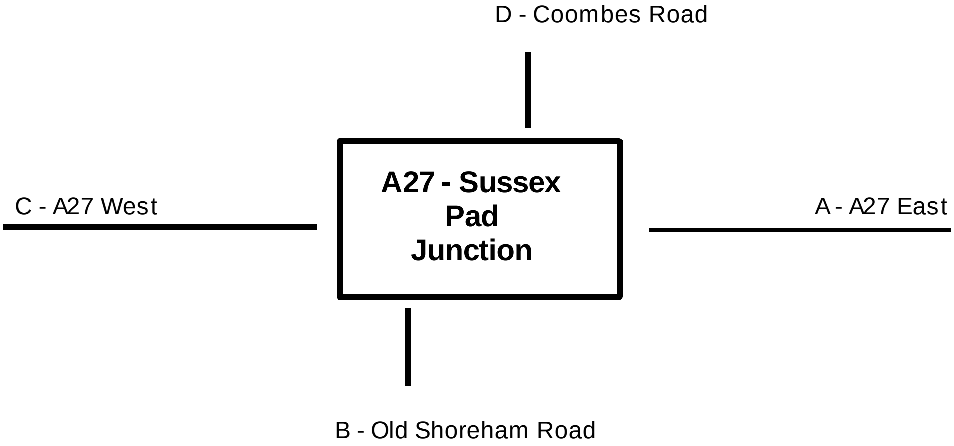
Figure D2



Reference Case

	A	B	C	D
A	0	77	2665	36
B	86	0	6	0
C	2736	97	0	98
D	6	0	9	0

Initial Demands

Scenario A1

	A	B	C	D
A	0	60	2647	37
B	33	0	15	0
C	2733	101	0	134
D	6	30	8	0

Scenario A2

	A	B	C	D
A	0	64	2644	37
B	36	0	15	0
C	2730	102	0	132
D	6	32	8	0

Scenario A3

	A	B	C	D
A	0	49	2649	37
B	41	0	15	0
C	2735	101	0	136
D	6	32	8	0

Scenario B

	A	B	C	D
A	0	58	2657	37
B	37	0	16	0
C	2728	100	0	136
D	6	30	8	0

Demands with Mitigation

Scenario A1

	A	B	C	D
A	0	23	2927	37
B	49	0	18	0
C	2757	85	0	115
D	6	17	9	0

Scenario A2

	A	B	C	D
A	0	24	2929	37
B	47	0	18	0
C	2754	85	0	113
D	6	17	9	0

Scenario A3

	A	B	C	D
A	0	23	2931	37
B	55	0	18	0
C	2755	83	0	111
D	6	11	9	0

Scenario B

	A	B	C	D
A	0	23	2937	37
B	48	0	19	0
C	2757	83	0	114
D	6	12	9	0

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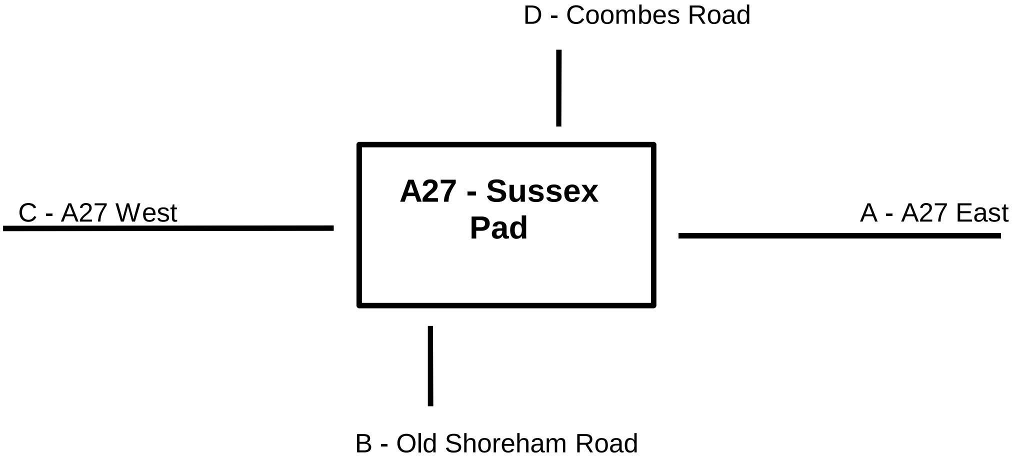
Figure D3



Reference Case

	A	B	C	D
A	0	196	2455	79
B	84	0	14	0
C	2486	26	0	11
D	77	1	11	0

Initial Demands

Scenario A1

	A	B	C	D
A	0	189	2448	94
B	11	0	14	0
C	2513	27	0	11
D	91	4	8	0

Scenario A2

	A	B	C	D
A	0	202	2450	94
B	11	0	14	0
C	2512	27	0	11
D	91	2	10	0

Scenario A3

	A	B	C	D
A	0	177	2477	95
B	11	0	14	0
C	2508	26	0	11
D	91	1	12	0

Scenario B

	A	B	C	D
A	0	194	2448	85
B	11	0	14	0
C	2532	26	0	11
D	92	1	11	0

Demands with Mitigation

Scenario A1

	A	B	C	D
A	0	65	2770	14
B	0	0	32	0
C	2544	47	0	11
D	11	0	12	0

Scenario A2

	A	B	C	D
A	0	66	2772	14
B	0	0	32	0
C	2546	48	0	11
D	11	0	12	0

Scenario A3

	A	B	C	D
A	0	62	2772	14
B	0	0	32	0
C	2543	42	0	11
D	11	0	13	0

Scenario B

	A	B	C	D
A	0	65	2772	14
B	0	0	32	0
C	2557	51	0	11
D	11	0	12	0

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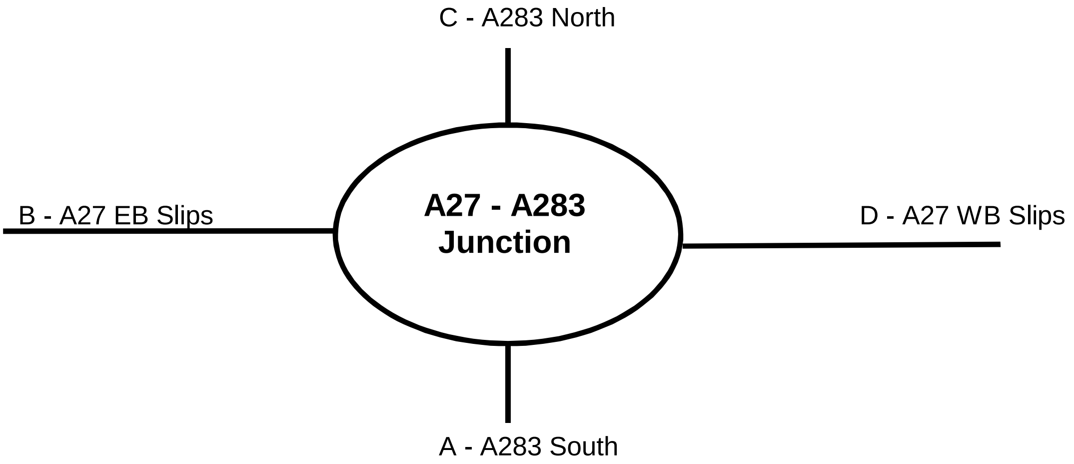
Figure D4



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 A1

	A	B	C	D
A	0	552	582	197
B	407	0	176	0
C	372	1143	0	179
D	219	0	919	0

Scenario A2

	A	B	C	D
A	0	567	570	194
B	404	0	183	0
C	375	1140	0	179
D	217	0	921	0

Scenario A3

	A	B	C	D
A	0	522	598	200
B	404	0	165	0
C	368	1151	0	175
D	222	0	909	0

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 A1

	A	B	C	D
A	0	466	614	260
B	321	0	141	0
C	377	1160	0	263
D	204	0	797	0

Scenario A2

	A	B	C	D
A	0	461	617	262
B	326	0	140	0
C	370	1166	0	264
D	207	0	803	0

Scenario A3

	A	B	C	D
A	0	457	615	268
B	324	0	136	0
C	349	1187	0	263
D	197	0	809	0

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

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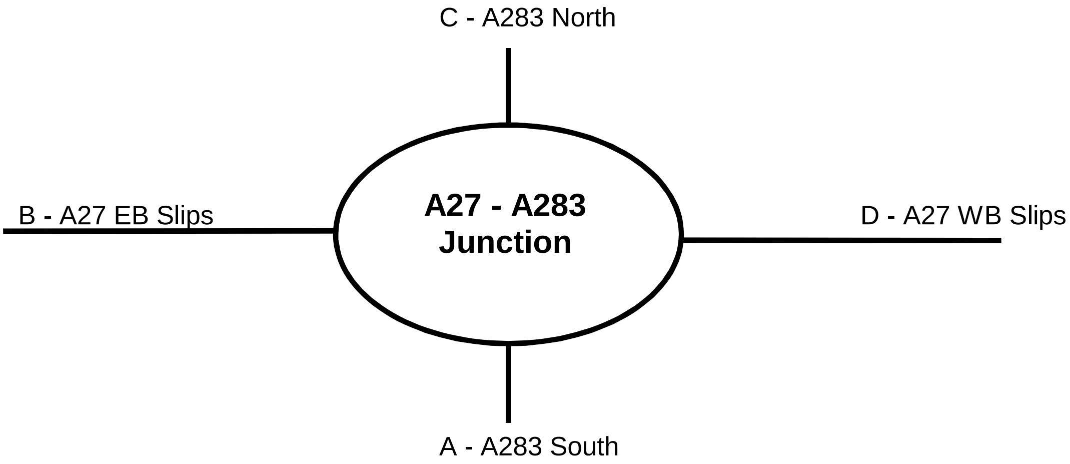
Figure D5



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 A1

	A	B	C	D
A	0	311	1227	3
B	359	0	167	0
C	884	722	0	235
D	53	0	1316	0

Scenario A2

	A	B	C	D
A	0	308	1230	3
B	358	0	164	0
C	889	728	0	228
D	50	0	1320	0

Scenario A3

	A	B	C	D
A	0	313	1217	3
B	359	0	174	0
C	875	728	0	225
D	53	0	1320	0

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 A1

	A	B	C	D
A	0	483	363	219
B	201	0	90	0
C	703	676	0	421
D	181	0	1214	0

Scenario A2

	A	B	C	D
A	0	491	362	215
B	200	0	90	0
C	717	671	0	412
D	182	0	1216	0

Scenario A3

	A	B	C	D
A	0	466	365	207
B	202	0	91	0
C	679	690	0	430
D	182	0	1211	0

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

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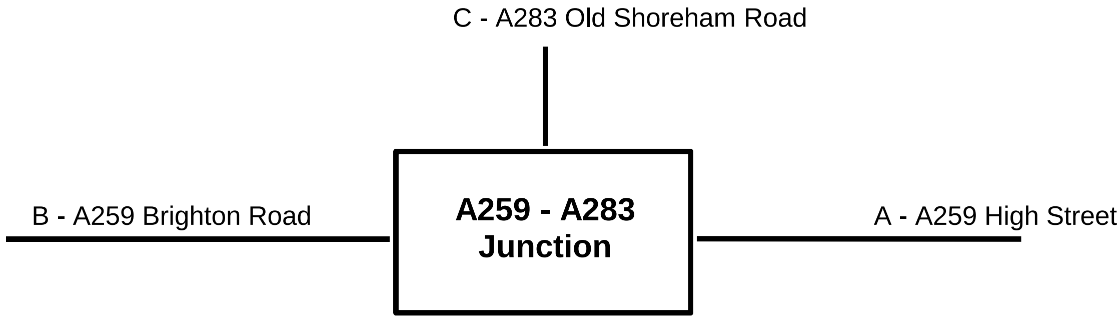
Figure D6

Note: This junction is not mitigated but travel demand would still change due to impacts from smarter choice initiatives and network mitigation elsewhere.



Reference Case

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

Initial Demands

Scenario A1

	A	B	C
A	0	1029	179
B	1289	0	570
C	206	465	0

Scenario A2

	A	B	C
A	0	1032	175
B	1291	0	587
C	206	474	0

Scenario A3

	A	B	C
A	0	1020	185
B	1273	0	539
C	207	455	0

Scenario B

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

Demands with Mitigation

Scenario A1

	A	B	C
A	0	1024	0
B	1332	0	270
C	0	674	0

Scenario A2

	A	B	C
A	0	1038	0
B	1311	0	270
C	0	683	0

Scenario A3

	A	B	C
A	0	1005	0
B	1351	0	261
C	0	667	0

Scenario B

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

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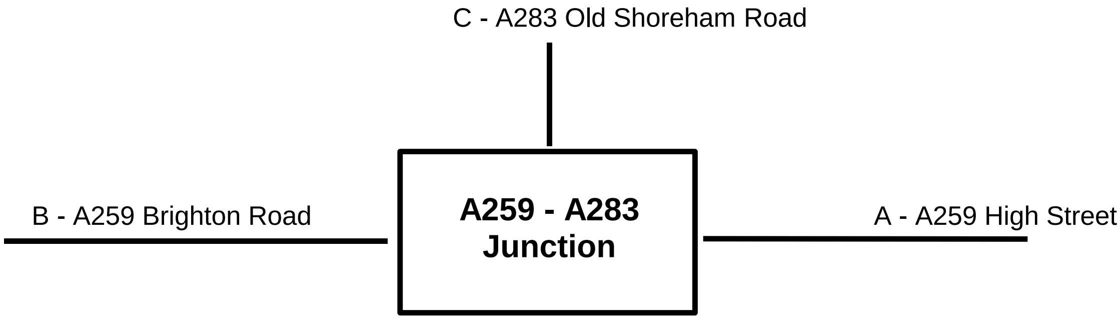
Figure D7

Note: This junction is not mitigated but travel demand would still change due to impacts from smarter choice initiatives and network mitigation elsewhere.



Reference Case

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

Initial Demands

Scenario A1

	A	B	C
A	0	1030	0
B	784	0	442
C	23	1064	0

Scenario A2

	A	B	C
A	0	1030	0
B	794	0	449
C	21	1061	0

Scenario A3

	A	B	C
A	0	1019	0
B	773	0	436
C	23	1064	0

Scenario B

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

Demands with Mitigation

Scenario A1

	A	B	C
A	0	1251	0
B	815	0	524
C	0	873	0

Scenario A2

	A	B	C
A	0	1232	0
B	816	0	524
C	0	891	0

Scenario A3

	A	B	C
A	0	1260	0
B	807	0	524
C	0	865	0

Scenario B

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

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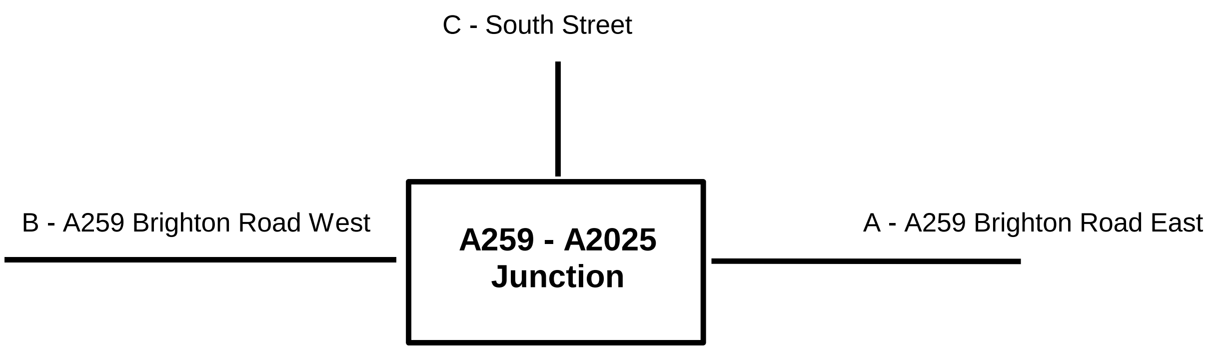
Figure D8



Reference Case

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

Initial Demands

Scenario A1

	A	B	C
A	0	812	0
B	1130	0	90
C	0	688	0

Scenario A2

	A	B	C
A	0	822	0
B	1129	0	89
C	0	695	0

Scenario A3

	A	B	C
A	0	802	0
B	1136	0	85
C	0	683	0

Scenario B

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

Demands with Mitigation

Scenario A1

	A	B	C
A	0	1024	0
B	1332	0	270
C	0	674	0

Scenario A2

	A	B	C
A	0	1038	0
B	1311	0	270
C	0	683	0

Scenario A3

	A	B	C
A	0	1005	0
B	1351	0	261
C	0	667	0

Scenario B

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

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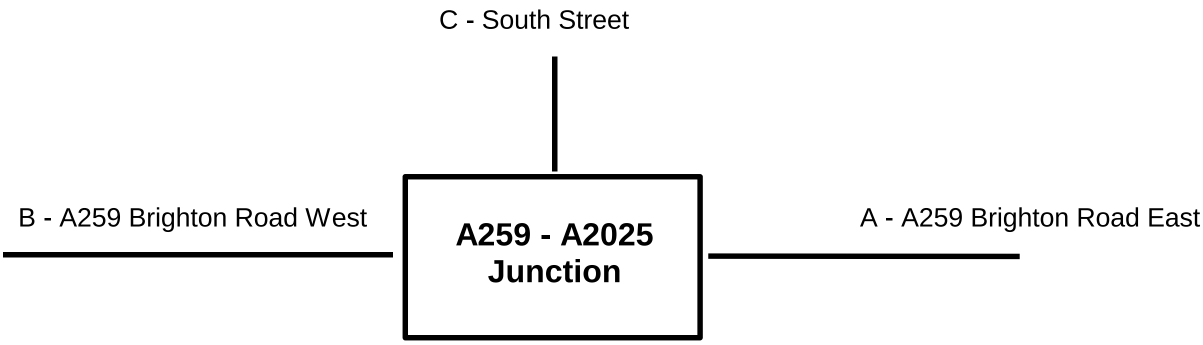
Figure D9



Reference Case

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

Initial Demands

Scenario A1

	A	B	C
A	0	856	0
B	752	0	284
C	0	890	0

Scenario A2

	A	B	C
A	0	855	0
B	759	0	290
C	0	889	0

Scenario A3

	A	B	C
A	0	851	0
B	751	0	289
C	0	886	0

Scenario B

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

Demands with Mitigation

Scenario A1

	A	B	C
A	0	1251	0
B	815	0	524
C	0	873	0

Scenario A2

	A	B	C
A	0	1232	0
B	816	0	524
C	0	891	0

Scenario A3

	A	B	C
A	0	1260	0
B	807	0	524
C	0	865	0

Scenario B

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

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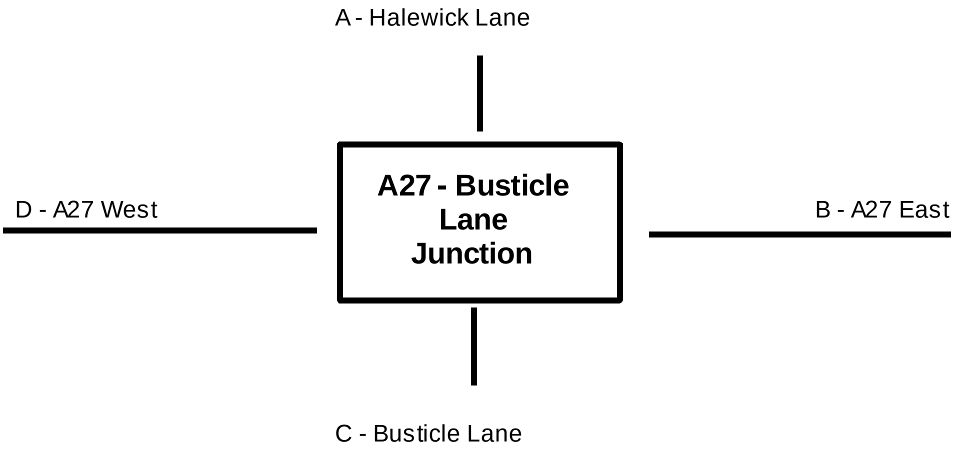
Figure D10



AM - Reference Case

	A	B	C	D
A	0	175	242	114
B	9	0	144	1746
C	149	96	0	197
D	6	1899	153	0

PM - Reference Case

	A	B	C	D
A	0	49	95	29
B	28	0	186	1441
C	207	152	0	132
D	71	1568	128	0

AM - Scenario B

	A	B	C	D
A	0	191	293	120
B	14	0	135	1730
C	160	81	0	186
D	52	1949	152	0

PM - Scenario B

	A	B	C	D
A	0	38	132	30
B	19	0	172	1523
C	266	128	0	109
D	103	1621	139	0

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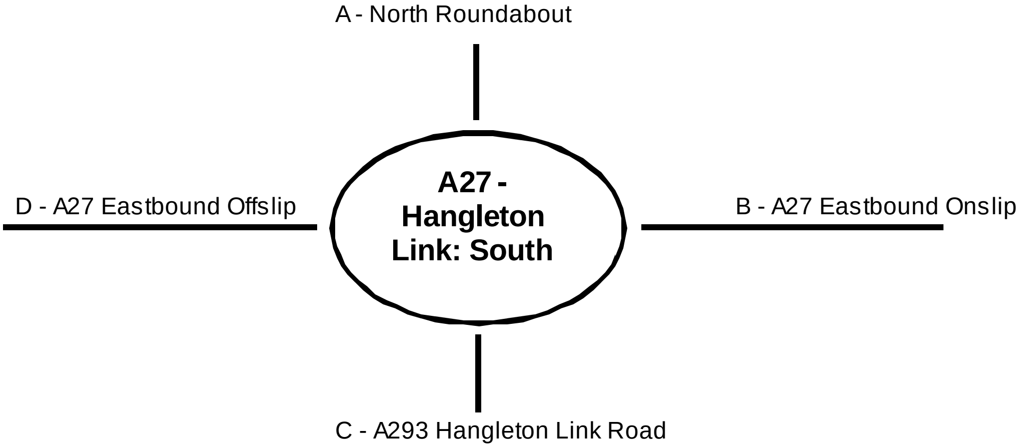
Figure D11



AM - Reference Case

	A	B	C	D
A	0	0	376	50
B	0	0	1027	0
C	1313	0	0	433
D	0	0	0	0

PM - Reference Case

	A	B	C	D
A	0	0	277	63
B	0	0	791	0
C	1157	0	0	680
D	0	0	0	0

AM - Scenario B

	A	B	C	D
A	0	0	347	53
B	0	0	1164	0
C	1308	0	0	429
D	0	0	0	0

PM - Scenario B

	A	B	C	D
A	0	0	320	66
B	0	0	767	0
C	1217	0	0	691
D	0	0	0	0

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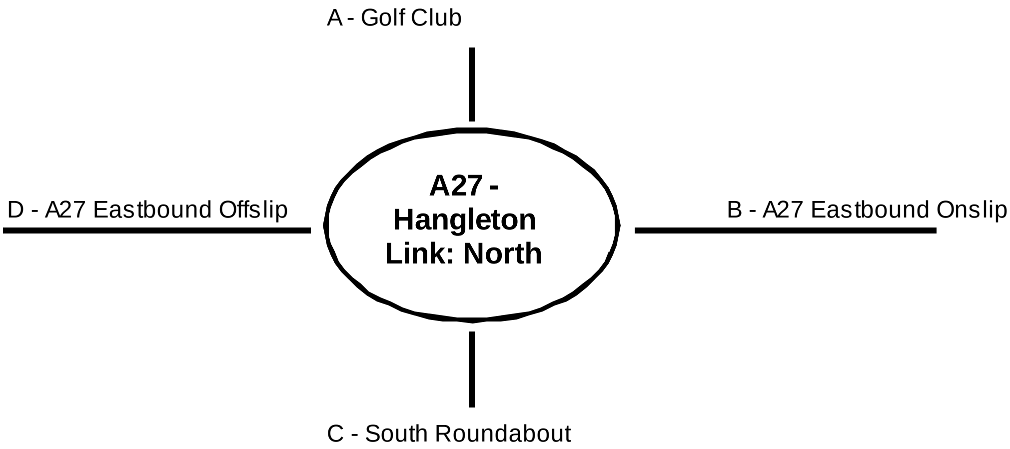
Figure D12



AM - Reference Case

	A	B	C	D
A	0	0	72	0
B	0	0	0	0
C	39	1274	0	0
D	93	374	355	0

PM - Reference Case

	A	B	C	D
A	0	7	83	0
B	0	0	0	0
C	14	1092	0	0
D	67	0	258	0

AM - Scenario B

	A	B	C	D
A	0	0	81	0
B	0	0	0	0
C	35	1272	0	0
D	94	429	319	0

PM - Scenario B

	A	B	C	D
A	0	7	86	0
B	0	0	0	0
C	9	1110	0	0
D	82	0	300	0

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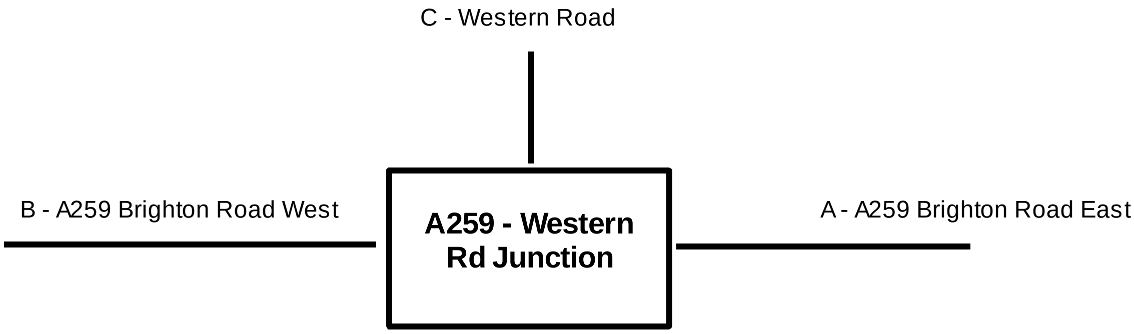
Figure D13



AM - Reference Case

	A	B	C
A	0	1369	0
B	1311	0	492
C	118	227	0

PM - Reference Case

	A	B	C
A	0	1426	0
B	831	0	533
C	19	206	0

AM - Scenario B

	A	B	C
A	0	1247	0
B	1279	0	565
C	72	217	0

PM - Scenario B

	A	B	C
A	0	1428	0
B	847	0	540
C	6	214	0

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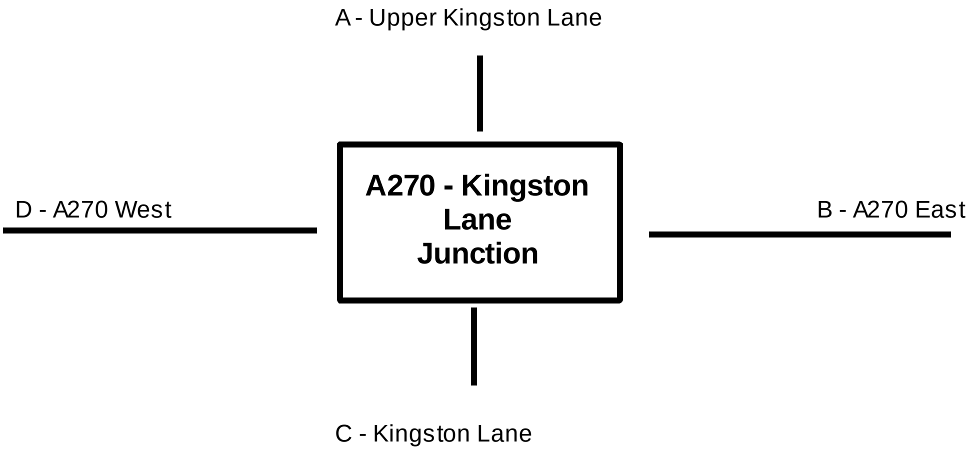
Figure D14



AM - Reference Case

	A	B	C	D
A	0	42	8	22
B	0	0	9	1446
C	74	24	0	117
D	4	1121	307	0

PM - Reference Case

	A	B	C	D
A	0	7	10	19
B	0	0	0	1528
C	71	103	0	134
D	16	898	190	0

AM - Scenario B

	A	B	C	D
A	0	42	7	24
B	0	0	40	1367
C	67	49	0	112
D	4	1156	337	0

PM - Scenario B

	A	B	C	D
A	0	8	9	22
B	0	0	0	1575
C	77	156	0	148
D	9	859	251	0

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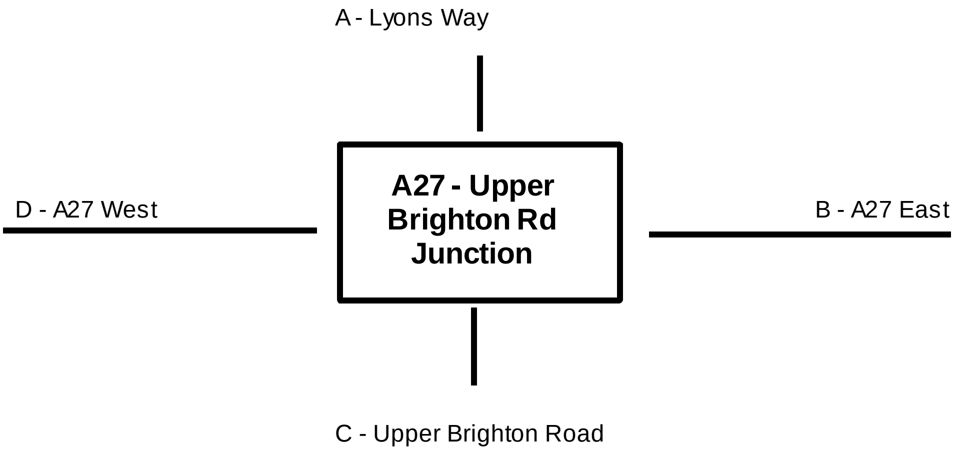
Figure D15



AM - Reference Case

	A	B	C	D
A	0	58	0	80
B	128	0	179	1487
C	45	233	0	210
D	0	1788	0	0

PM - Reference Case

	A	B	C	D
A	0	163	0	205
B	41	0	18	1494
C	59	200	0	91
D	0	1406	41	0

AM - Scenario B

	A	B	C	D
A	0	94	0	69
B	144	0	236	1549
C	28	250	0	216
D	0	1828	0	0

PM - Scenario B

	A	B	C	D
A	0	161	3	228
B	24	0	43	1481
C	53	208	0	109
D	0	1498	43	0

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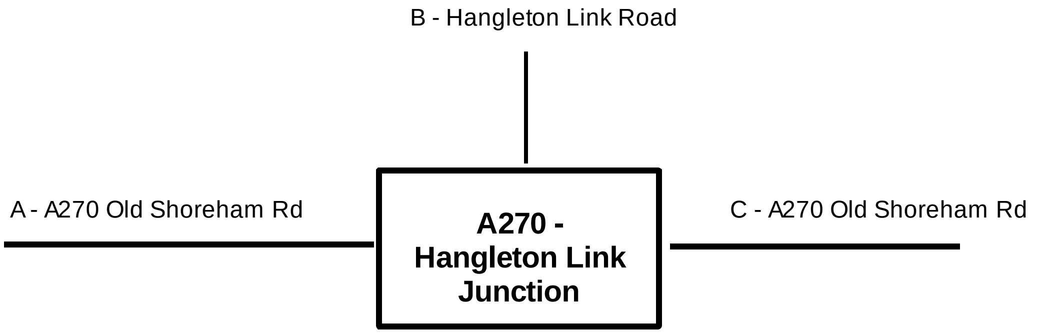
Figure D16



AM - Reference Case

	A	B	C
A	0	337	926
B	397	0	544
C	852	380	0

PM - Reference Case

	A	B	C
A	0	637	504
B	154	0	554
C	1157	163	0

AM - Scenario B

	A	B	C
A	0	331	956
B	527	0	605
C	813	366	0

PM - Scenario B

	A	B	C
A	0	715	485
B	168	0	579
C	1202	115	0

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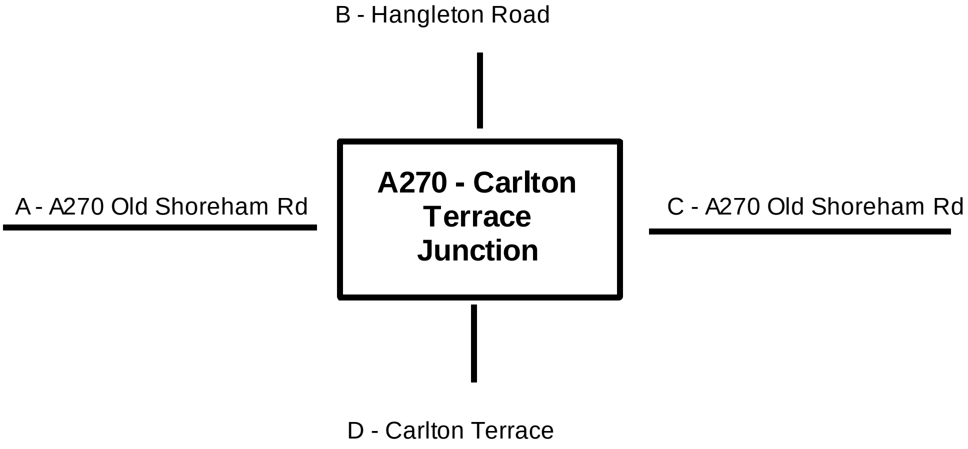
Figure D17



AM - Reference Case

	A	B	C	D
A	0	329	1008	133
B	84	0	0	276
C	905	85	0	39
D	243	330	195	0

PM - Reference Case

	A	B	C	D
A	0	198	723	137
B	277	0	0	205
C	1017	15	0	0
D	26	423	252	0

AM - Scenario B

	A	B	C	D
A	0	339	1057	165
B	60	0	0	318
C	918	86	0	40
D	201	371	188	0

PM - Scenario B

	A	B	C	D
A	0	171	754	139
B	263	0	0	197
C	1041	25	0	0
D	13	552	211	0

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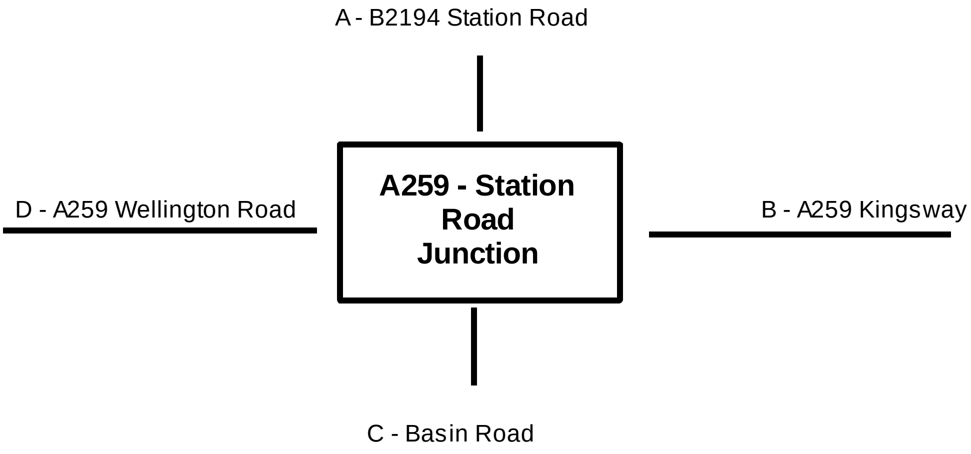
Figure D18



AM - Reference Case

	A	B	C	D
A	0	189	0	0
B	150	0	0	199
C	0	0	0	0
D	0	1167	0	0

PM - Reference Case

	A	B	C	D
A	0	74	0	0
B	94	0	0	434
C	0	0	0	0
D	0	899	0	0

AM - Scenario B

	A	B	C	D
A	0	165	0	6
B	146	0	0	273
C	0	0	0	0
D	45	1094	0	0

PM - Scenario B

	A	B	C	D
A	0	160	0	1
B	54	0	0	431
C	0	0	0	0
D	113	899	0	0

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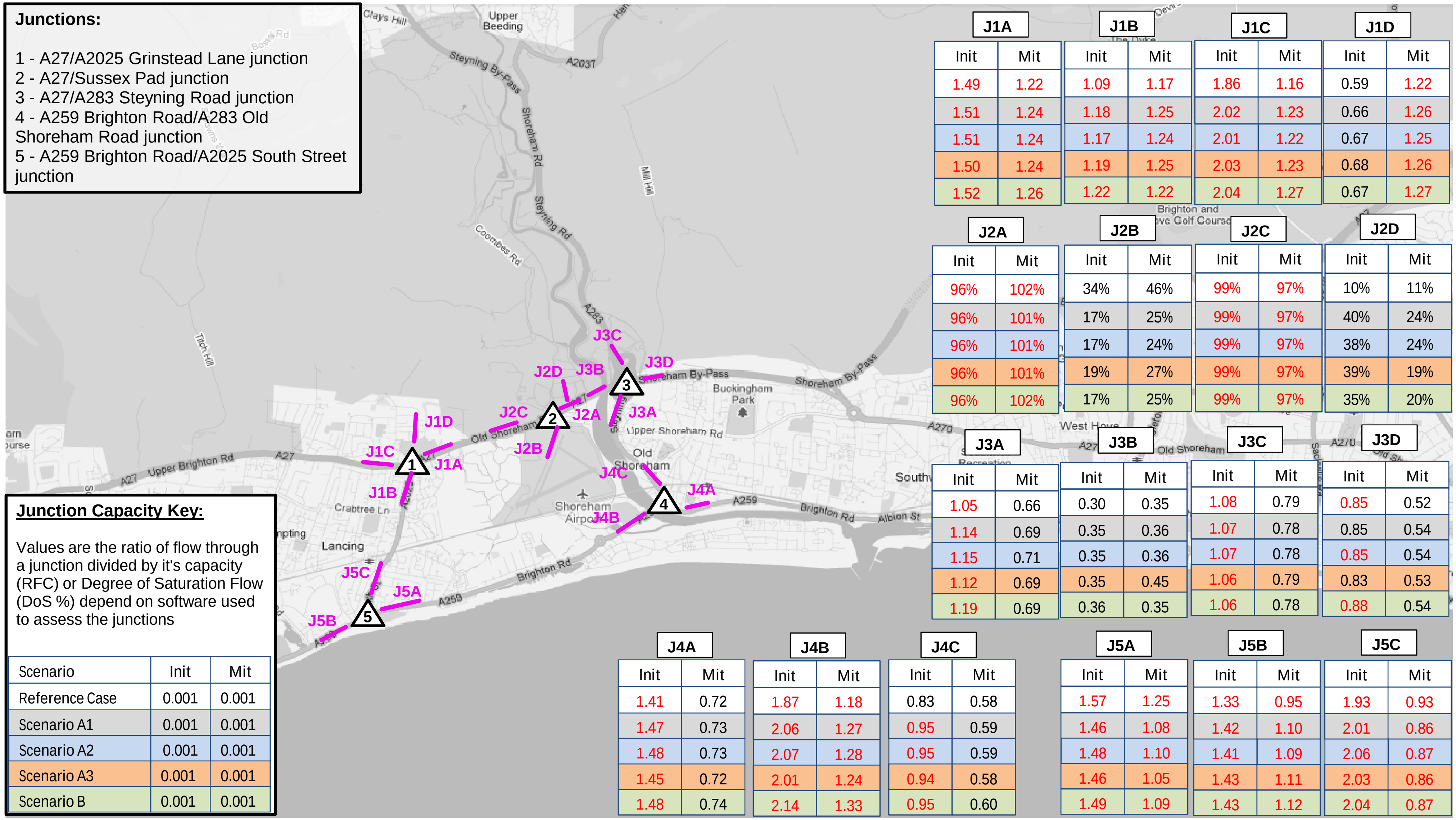
Figure D19

APPENDIX E

JUNCTION PERFORMANCE MAPS

Junctions:

1 - A27/A2025 Grinstead Lane junction
2 - A27/Sussex Pad junction
3 - A27/A283 Steyning Road junction
4 - A259 Brighton Road/A283 Old Shoreham Road junction
5 - A259 Brighton Road/A2025 South Street junction



J1A

Init	Mit
1.49	1.22
1.51	1.24
1.51	1.24
1.50	1.24
1.52	1.26

J1B

Init	Mit
1.09	1.17
1.18	1.25
1.17	1.24
1.19	1.25
1.22	1.22

J1C

Init	Mit
1.86	1.16
2.02	1.23
2.01	1.22
2.03	1.23
2.04	1.27

J1D

Init	Mit
0.59	1.22
0.66	1.26
0.67	1.25
0.68	1.26
0.67	1.27

J2A

Init	Mit
96%	102%
96%	101%
96%	101%
96%	101%
96%	102%

J2B

Init	Mit
34%	46%
17%	25%
17%	24%
19%	27%
17%	25%

J2C

Init	Mit
99%	97%
99%	97%
99%	97%
99%	97%
99%	97%

J2D

Init	Mit
10%	11%
40%	24%
38%	24%
39%	19%
35%	20%

J3A

Init	Mit
1.05	0.66
1.14	0.69
1.15	0.71
1.12	0.69
1.19	0.69

J3B

Init	Mit
0.30	0.35
0.35	0.36
0.35	0.36
0.35	0.45
0.36	0.35

J3C

Init	Mit
1.08	0.79
1.07	0.78
1.07	0.78
1.06	0.79
1.06	0.78

J3D

Init	Mit
0.85	0.52
0.85	0.54
0.85	0.54
0.83	0.53
0.88	0.54

J4A

Init	Mit
1.41	0.72
1.47	0.73
1.48	0.73
1.45	0.72
1.48	0.74

J4B

Init	Mit
1.87	1.18
2.06	1.27
2.07	1.28
2.01	1.24
2.14	1.33

J4C

Init	Mit
0.83	0.58
0.95	0.59
0.95	0.59
0.94	0.58
0.95	0.60

J5A

Init	Mit
1.57	1.25
1.46	1.08
1.48	1.10
1.46	1.05
1.49	1.09

J5B

Init	Mit
1.33	0.95
1.42	1.10
1.41	1.09
1.43	1.11
1.43	1.12

J5C

Init	Mit
1.93	0.93
2.01	0.86
2.06	0.87
2.03	0.86
2.04	0.87

Junction Capacity Key:

Values are the ratio of flow through a junction divided by it's capacity (RFC) or Degree of Saturation Flow (DoS %) depend on software used to assess the junctions

Scenario	Init	Mit
Reference Case	0.001	0.001
Scenario A1	0.001	0.001
Scenario A2	0.001	0.001
Scenario A3	0.001	0.001
Scenario B	0.001	0.001

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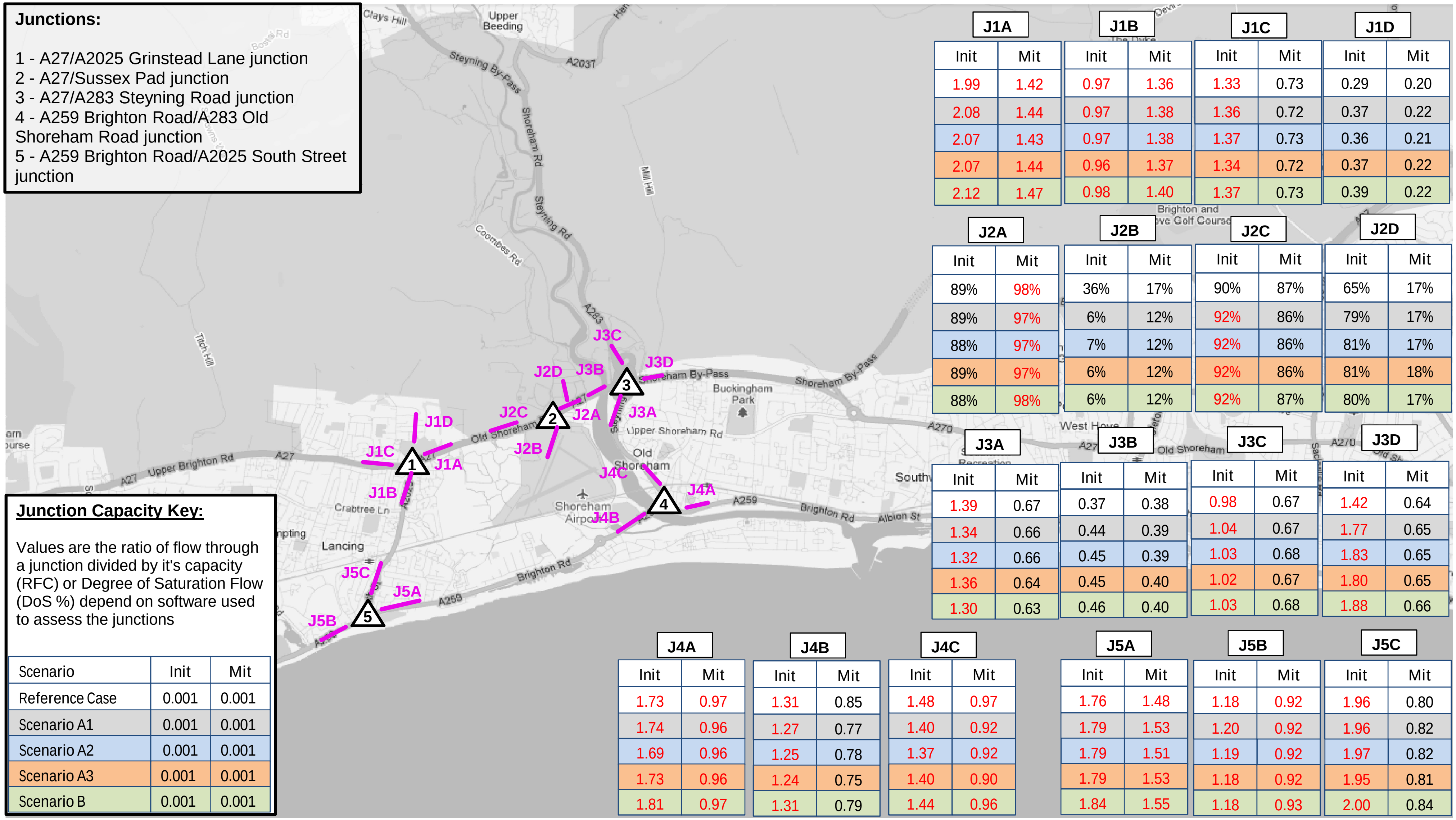
Appendix E1

Junctions:

1 - A27/A2025 Grinstead Lane junction
2 - A27/Sussex Pad junction
3 - A27/A283 Steyning Road junction
4 - A259 Brighton Road/A283 Old Shoreham Road junction
5 - A259 Brighton Road/A2025 South Street junction



J1A		J1B		J1C		J1D	
Init	Mit	Init	Mit	Init	Mit	Init	Mit
1.99	1.42	0.97	1.36	1.33	0.73	0.29	0.20
2.08	1.44	0.97	1.38	1.36	0.72	0.37	0.22
2.07	1.43	0.97	1.38	1.37	0.73	0.36	0.21
2.07	1.44	0.96	1.37	1.34	0.72	0.37	0.22
2.12	1.47	0.98	1.40	1.37	0.73	0.39	0.22

J2A		J2B		J2C		J2D	
Init	Mit	Init	Mit	Init	Mit	Init	Mit
89%	98%	36%	17%	90%	87%	65%	17%
89%	97%	6%	12%	92%	86%	79%	17%
88%	97%	7%	12%	92%	86%	81%	17%
89%	97%	6%	12%	92%	86%	81%	18%
88%	98%	6%	12%	92%	87%	80%	17%

J3A		J3B		J3C		J3D	
Init	Mit	Init	Mit	Init	Mit	Init	Mit
1.39	0.67	0.37	0.38	0.98	0.67	1.42	0.64
1.34	0.66	0.44	0.39	1.04	0.67	1.77	0.65
1.32	0.66	0.45	0.39	1.03	0.68	1.83	0.65
1.36	0.64	0.45	0.40	1.02	0.67	1.80	0.65
1.30	0.63	0.46	0.40	1.03	0.68	1.88	0.66

J4A		J4B		J4C	
Init	Mit	Init	Mit	Init	Mit
1.73	0.97	1.31	0.85	1.48	0.97
1.74	0.96	1.27	0.77	1.40	0.92
1.69	0.96	1.25	0.78	1.37	0.92
1.73	0.96	1.24	0.75	1.40	0.90
1.81	0.97	1.31	0.79	1.44	0.96

J5A		J5B		J5C	
Init	Mit	Init	Mit	Init	Mit
1.76	1.48	1.18	0.92	1.96	0.80
1.79	1.53	1.20	0.92	1.96	0.82
1.79	1.51	1.19	0.92	1.97	0.82
1.79	1.53	1.18	0.92	1.95	0.81
1.84	1.55	1.18	0.93	2.00	0.84

Junction Capacity Key:

Values are the ratio of flow through a junction divided by it's capacity (RFC) or Degree of Saturation Flow (DoS %) depend on software used to assess the junctions

Scenario	Init	Mit
Reference Case	0.001	0.001
Scenario A1	0.001	0.001
Scenario A2	0.001	0.001
Scenario A3	0.001	0.001
Scenario B	0.001	0.001

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Appendix E2

APPENDIX F

JOURNEY TIME ROUTE MAPS

Journey Time Routes:

1 - Western Road/Busticle Lane
2 - South Street/Grinstead Lane
3 - A283 Old ShorehamRoad /Steyning Road
4 - B2194 Station Road / A293
5- A27
6- A27/A270

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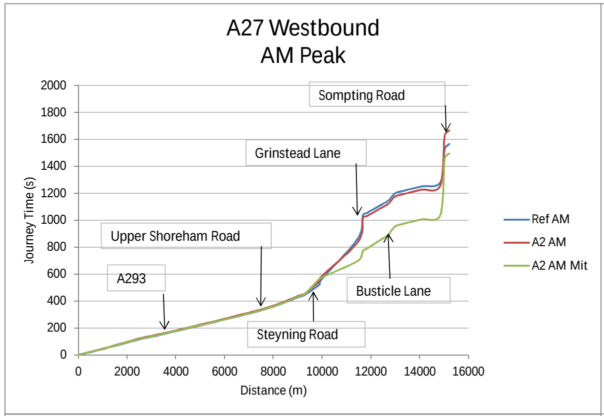
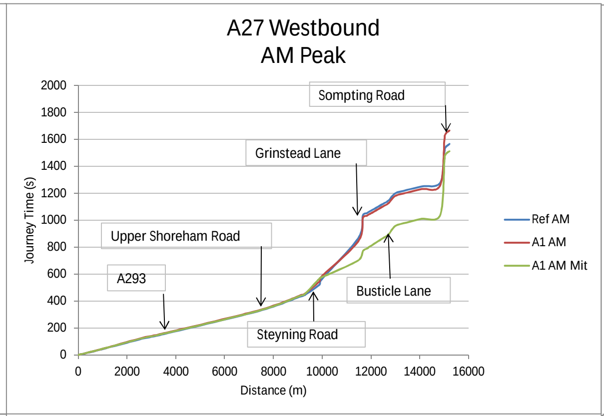
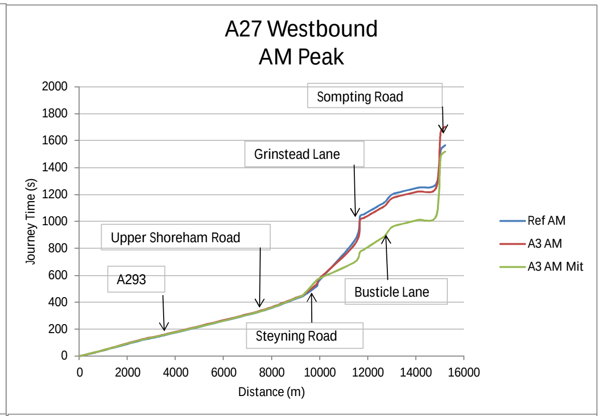
Appendix E

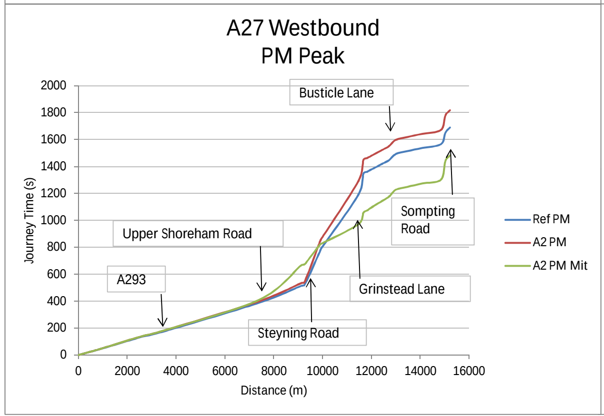
APPENDIX G

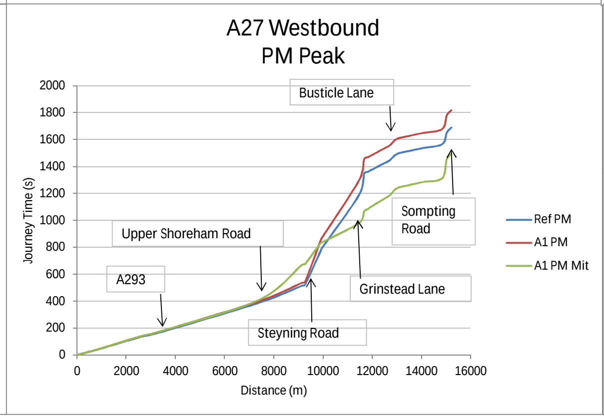
JOURNEY TIME PLOTS

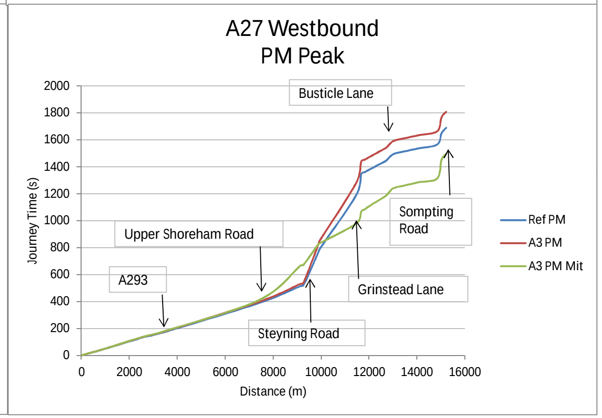












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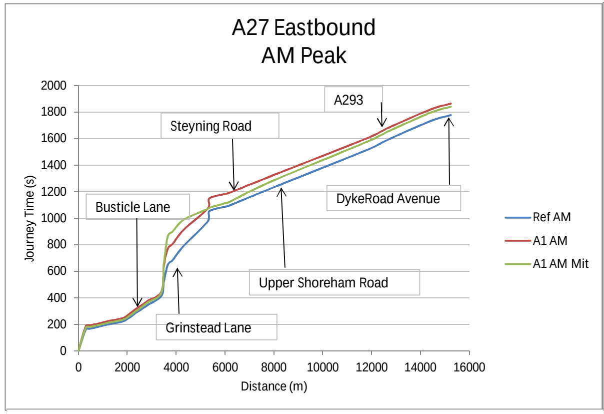

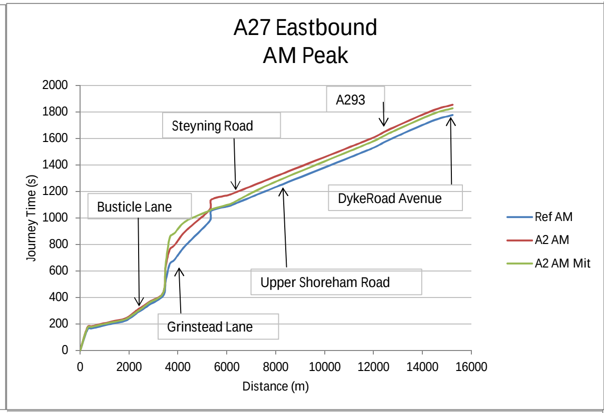

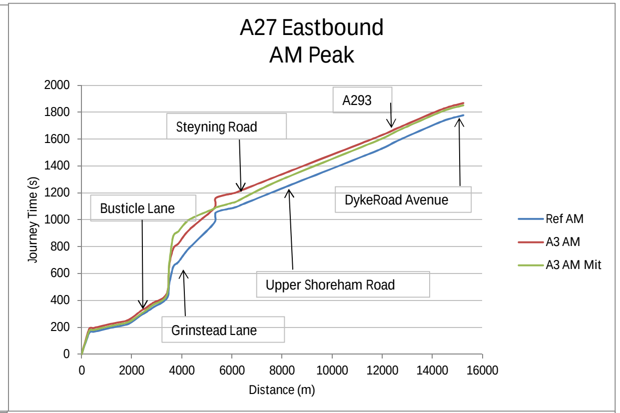

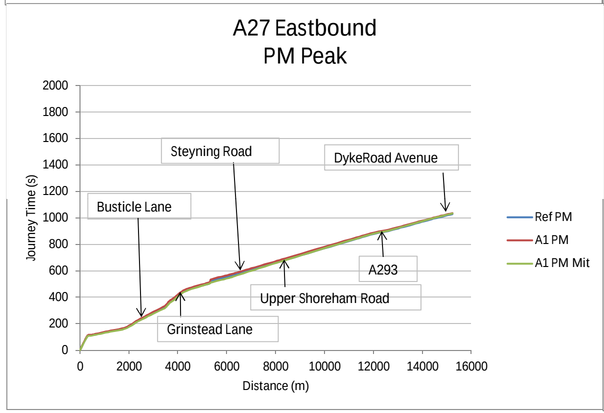

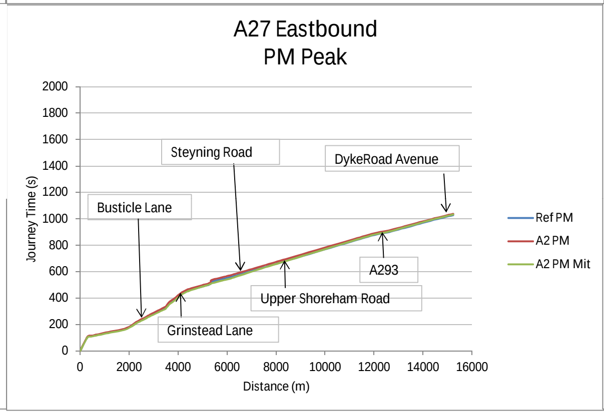

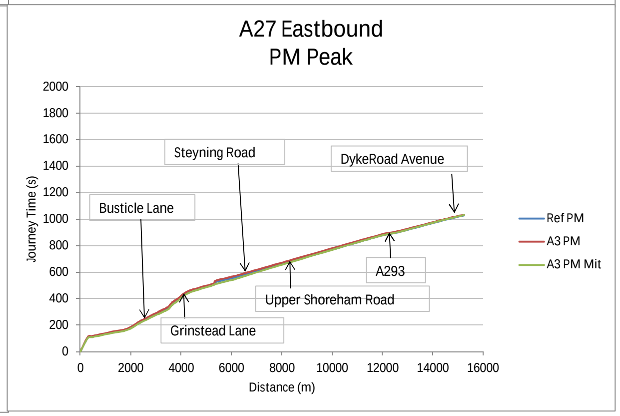

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CLIENT/PROJECT
Adur District Council
Transport Study of Strategic Development Options in Adur

TITLE
A27 Eastound Journey Time Graphs

DATE
20/12/2012

SCALE
Not to scale

PRODUCED
RH

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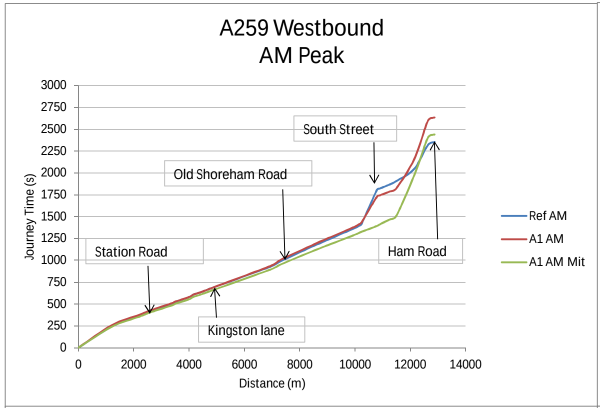
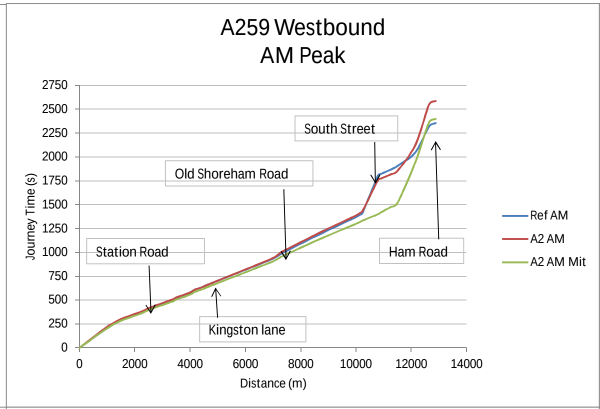
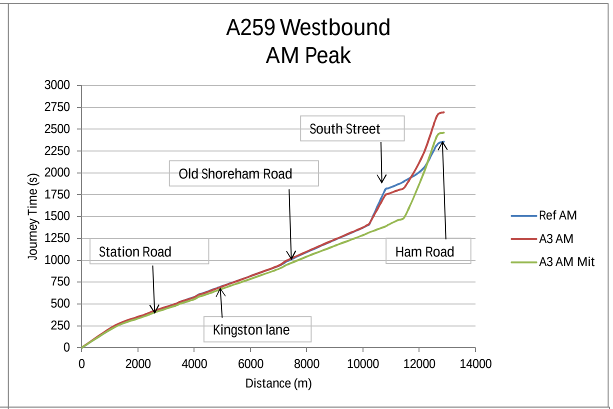
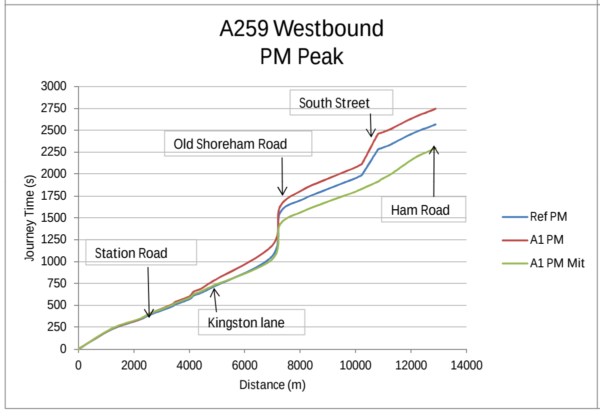
SP

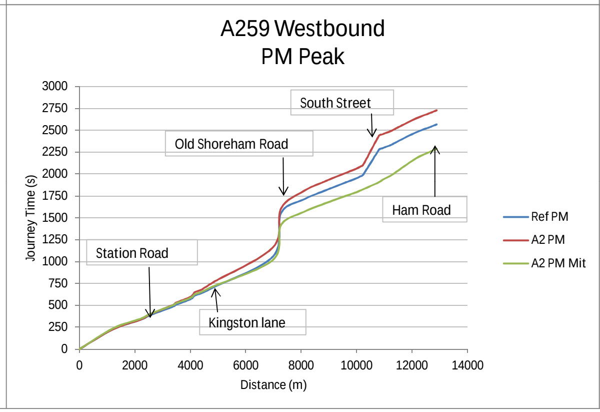
Appendix G2

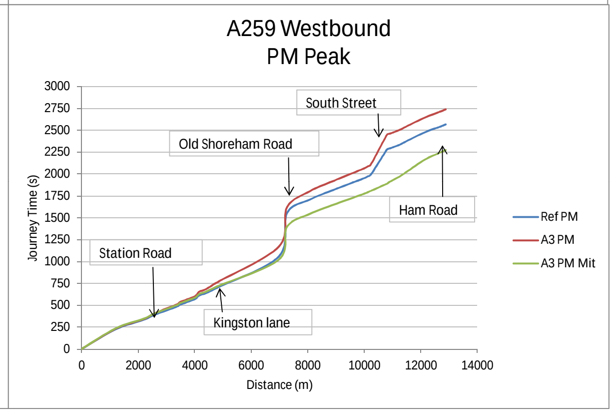












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CLIENT/PROJECT
Adur District Council
Transport Study of Strategic Development Options in Adur

TITLE
A259 Westbound Journey Time Graphs

DATE
20/12/2012

SCALE
Not to scale

PRODUCED
RH

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SP

APPROVED
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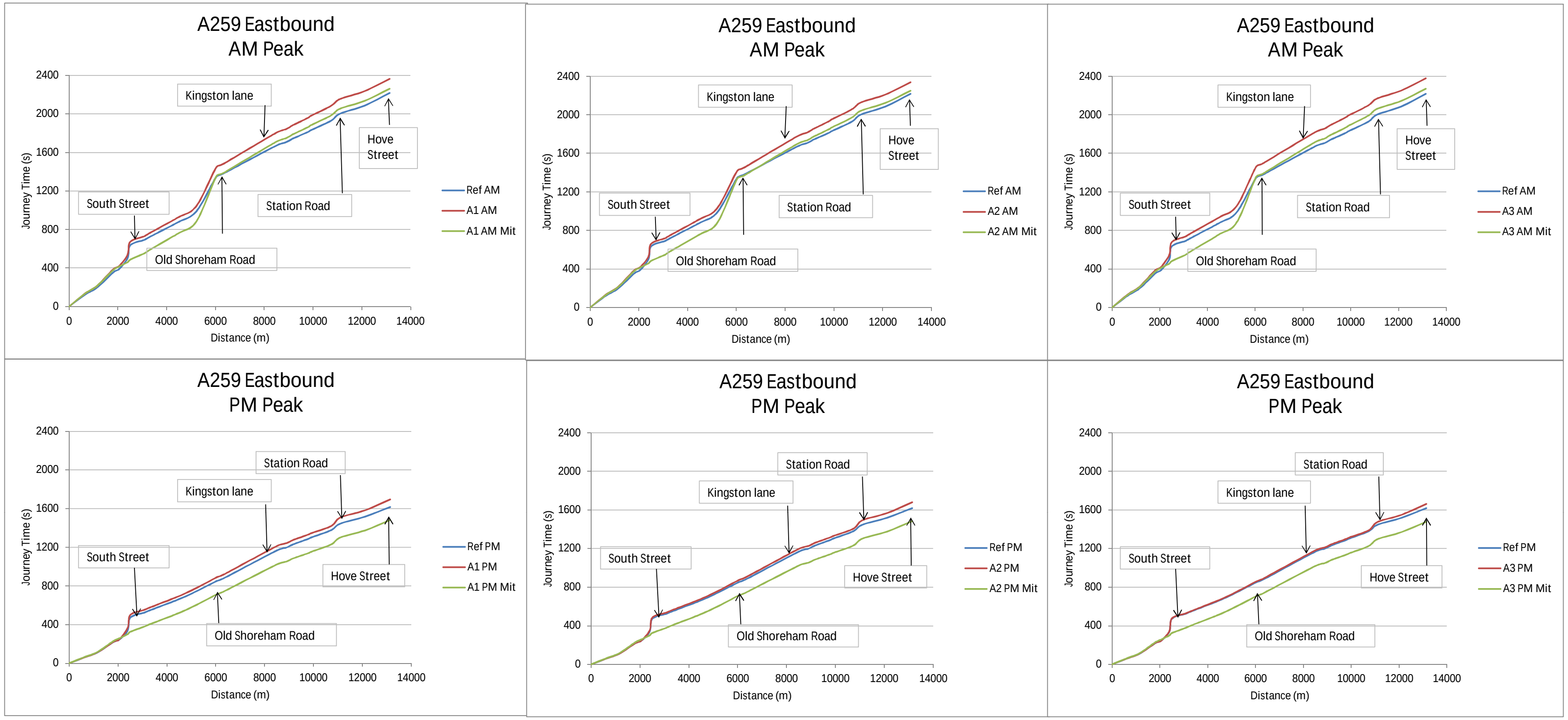
Appendix G3



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CLIENT/PROJECT
Adur District Council
Transport Study of Strategic Development Options in Adur

TITLE
A259 Eastbound Journey Time Graphs

DATE
20/12/2012

SCALE
Not to scale

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RH

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SP

Appendix G4

APPENDIX H

GLOSSARY OF TERMS

Appendix H – 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 I

SOURCES OF FUNDING FOR MITIGATION MEASURES

Sources of Funding for Mitigation Measures

The schemes identified will need to be delivered through a range of organisations and funding sources. The main sources are briefly summarised below:

- **Community Infrastructure Levy (CIL)** - Adur District Council has recently commissioned work to help develop a draft CIL charging schedule to be in place shortly after the adoption of the Adur Local Plan in 2015. Some transport schemes may be supported by an element of CIL if deemed appropriate through the current work. Brighton & Hove City Council are currently debating whether to adopt a CIL with a decision expected towards the end of 2013.

- **Department for Transport:** There are currently a number of funding streams available from the Department for Transport (DfT) that can be expected to help fund transport schemes in Adur for example:

  i.) Integrated Transport and Maintenance Capital Grants – which includes funds for smaller-scale transport improvements, including highway improvements, traffic management and accessibility schemes.
  ii.) Major Schemes Funding - for transport schemes currently over £2 million on packaged measures to support sustainable economic growth within Adur plus larger scale transport infrastructure. From 2015 onwards this will be delivered via the Coast to Capital LEP's Local Transport Body.

- **Adur DC Development Management Funds and Funds from development:** Transport contributions are secured in accordance with the County Council's Transport Contributions Policy, which is adopted within the District's 'Planning Obligations' Interim Planning Guidance Document.

- **Brighton & Hove funds from Development**
  Transport contributions can be sourced in accordance with their Developer Contributions Technical Guidance Document.

- **LEP Funding:** 'Growing Places' fund investment has been allocated for the LEP's Coast to Capital area, with remit for supporting economic growth and job creation, through funding transport schemes that help open up business and development opportunities.

- **Local Sustainable Transport Funding (LSTF) :** At the time of writing, funding from the scheme is now closed although there is likely to be a future variant of this scheme. A total of £600m was allocated through the scheme to support 96 projects nationally with an emphasis on sustainable economic development as a core requirement.

- **Local Pinch Point Fund** : This fund has recently been announced by the Department for Transport. The Fund is intended to secure immediate impacts on growth and is therefore aimed at those schemes that can be delivered quickly to 2015.

- **Local Infrastructure Fund:** This is currently available for large sites of 1500+ dwellings or Enterprise Zones for employment land, although criteria for funding may be subject to change.

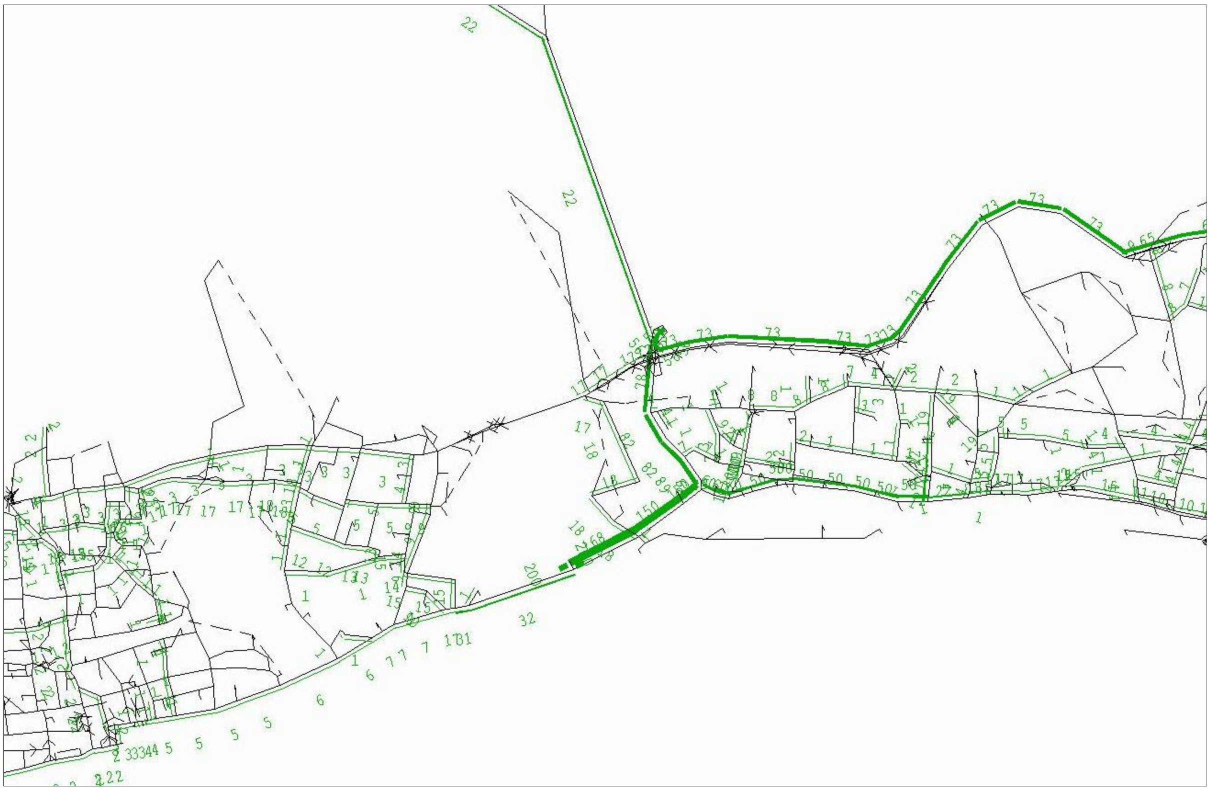
APPENDIX J

SELECT LINK PLOTS FOR SITE ALLOCATIONS

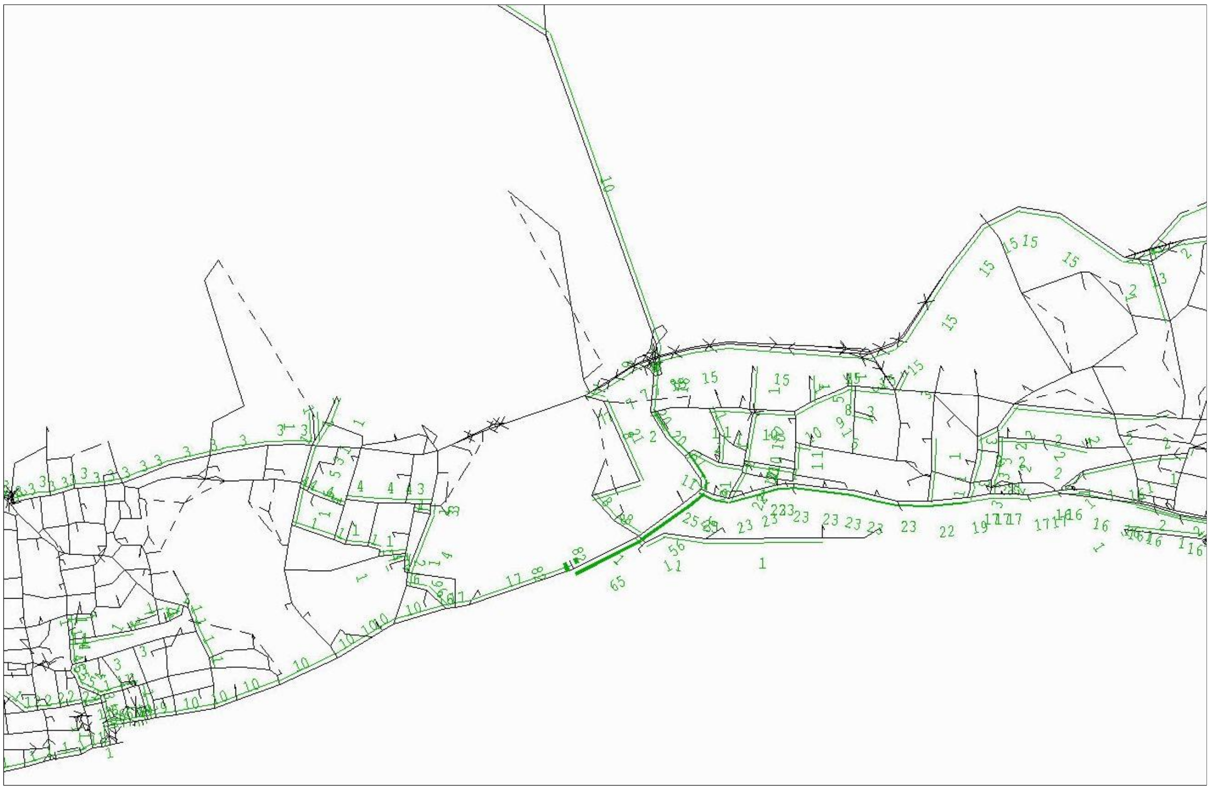
INITIAL MODELLING RESULTS – WITHOUT MITIGATON MEASURES

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 Hasler, Scenario B AM



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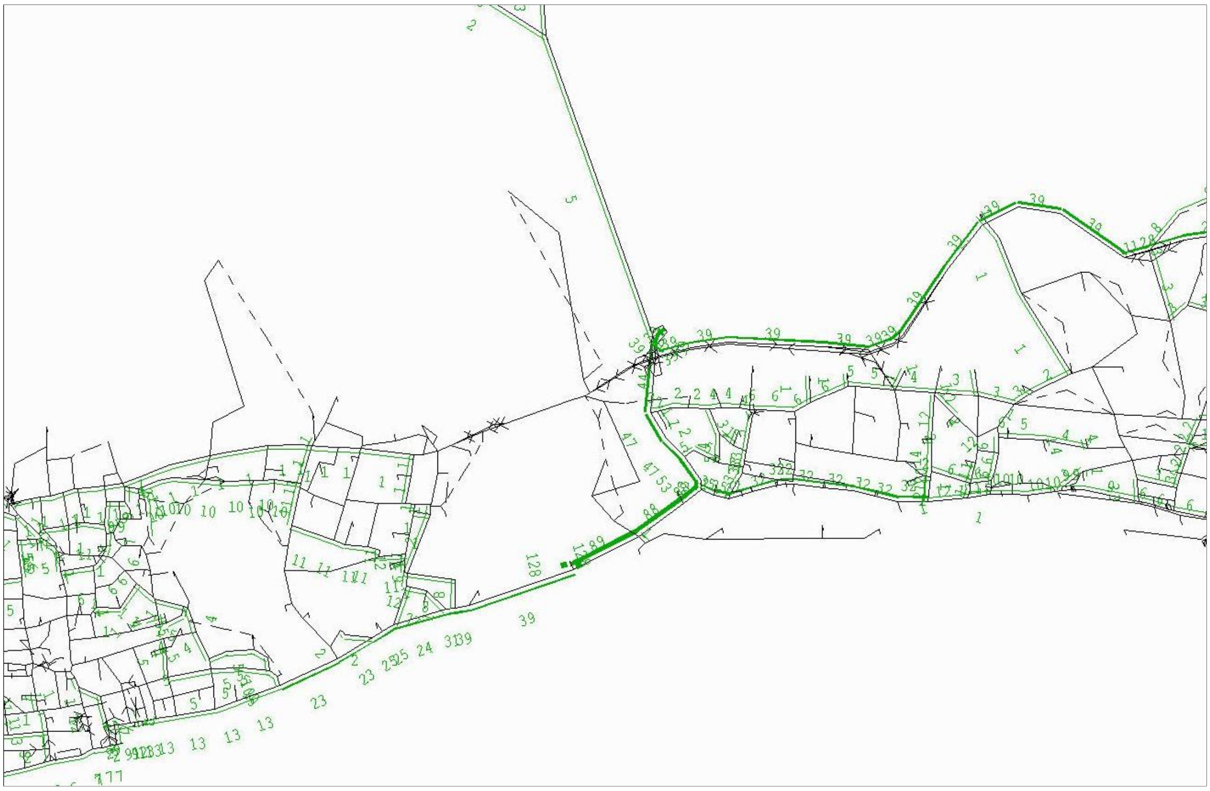

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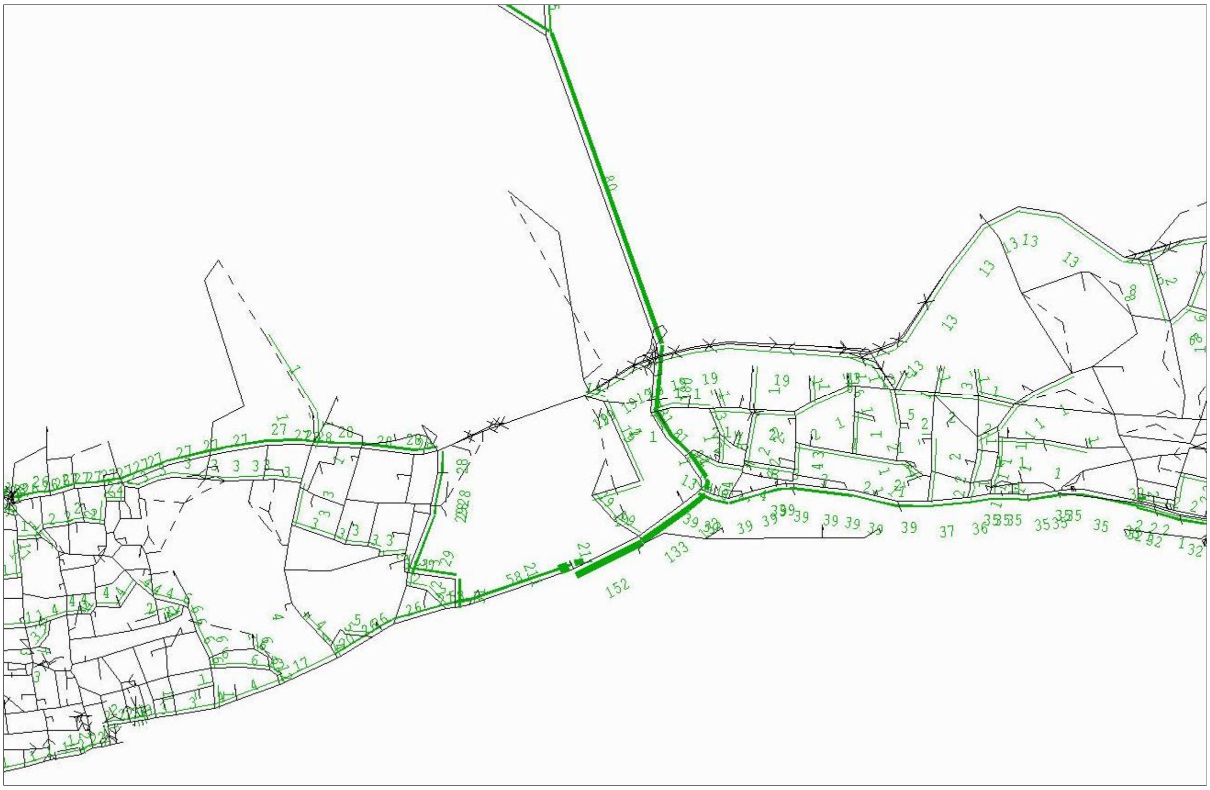

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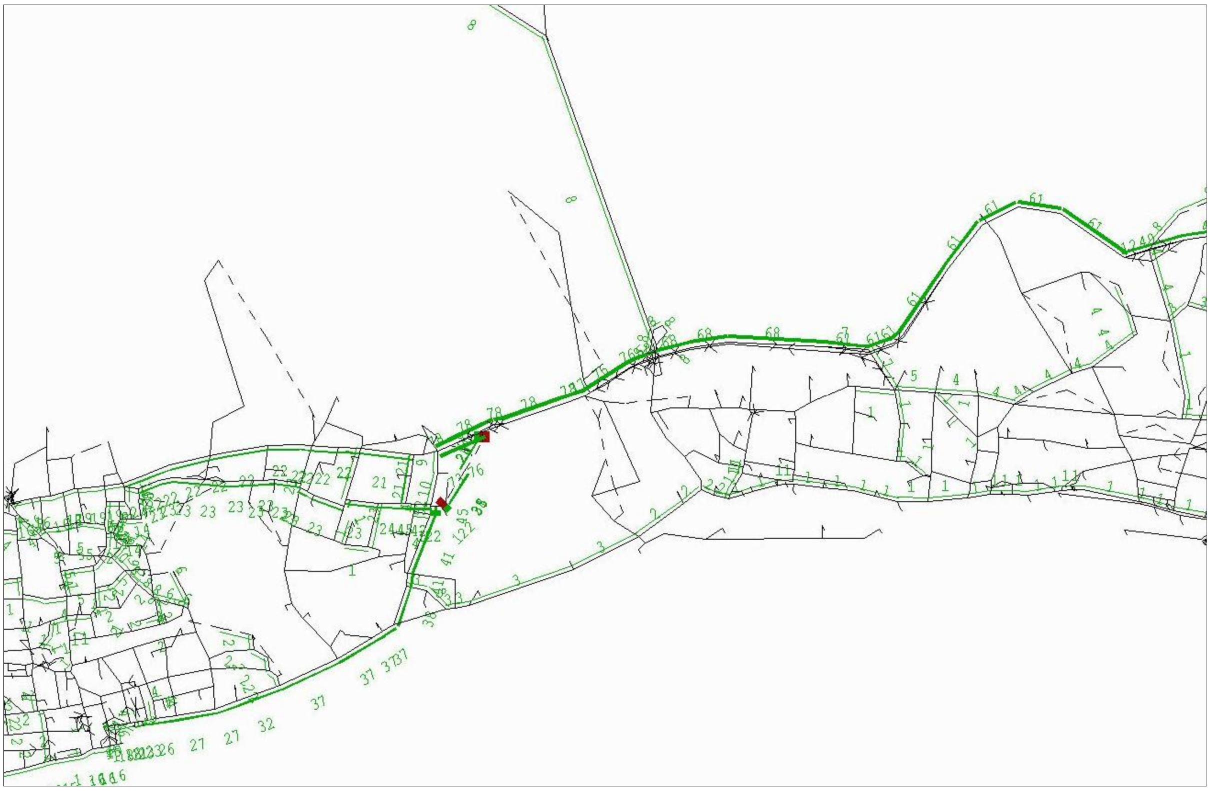
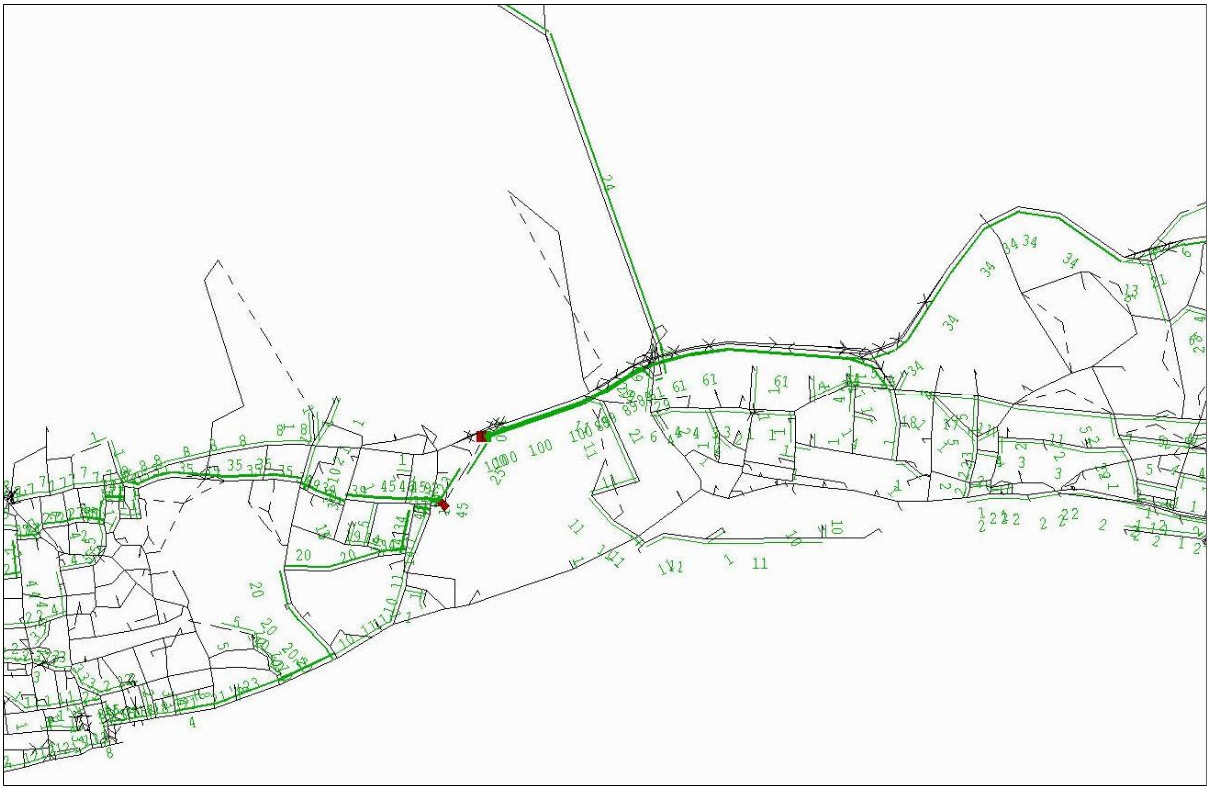


Trips from New Monks Farm, Scenario B AM



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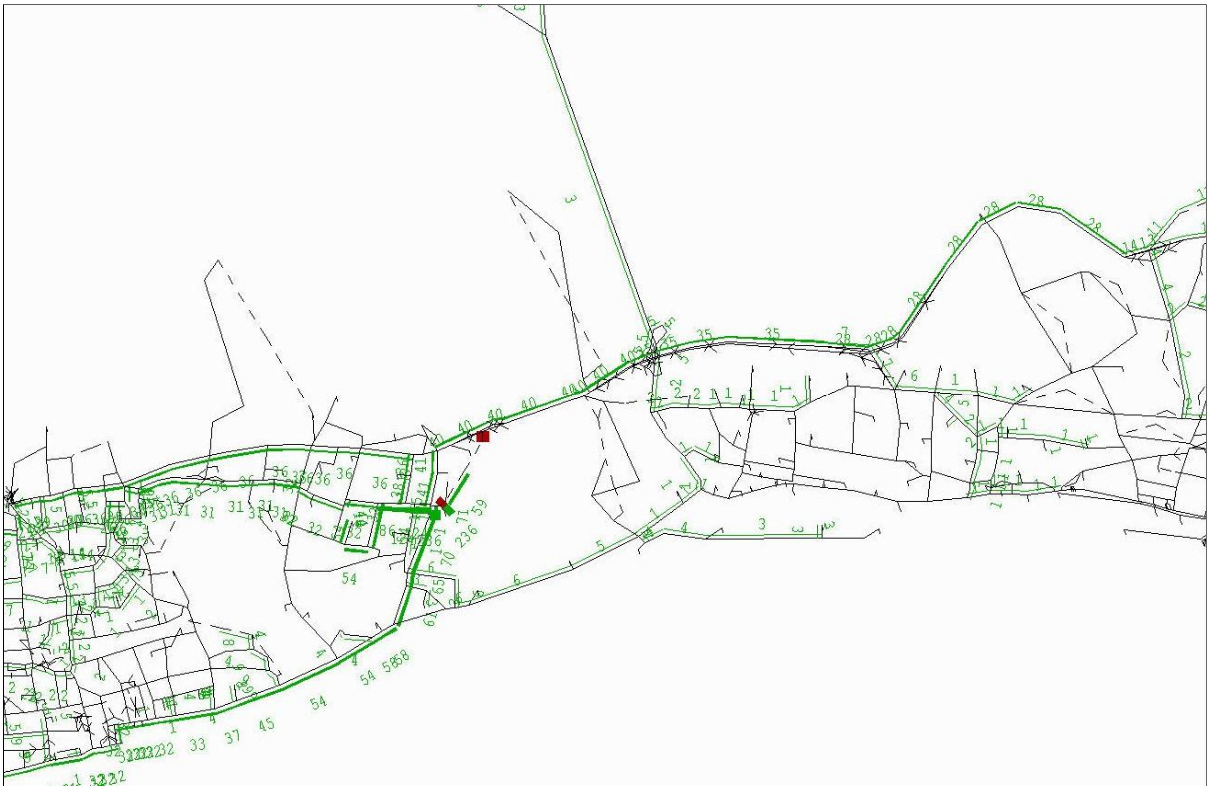

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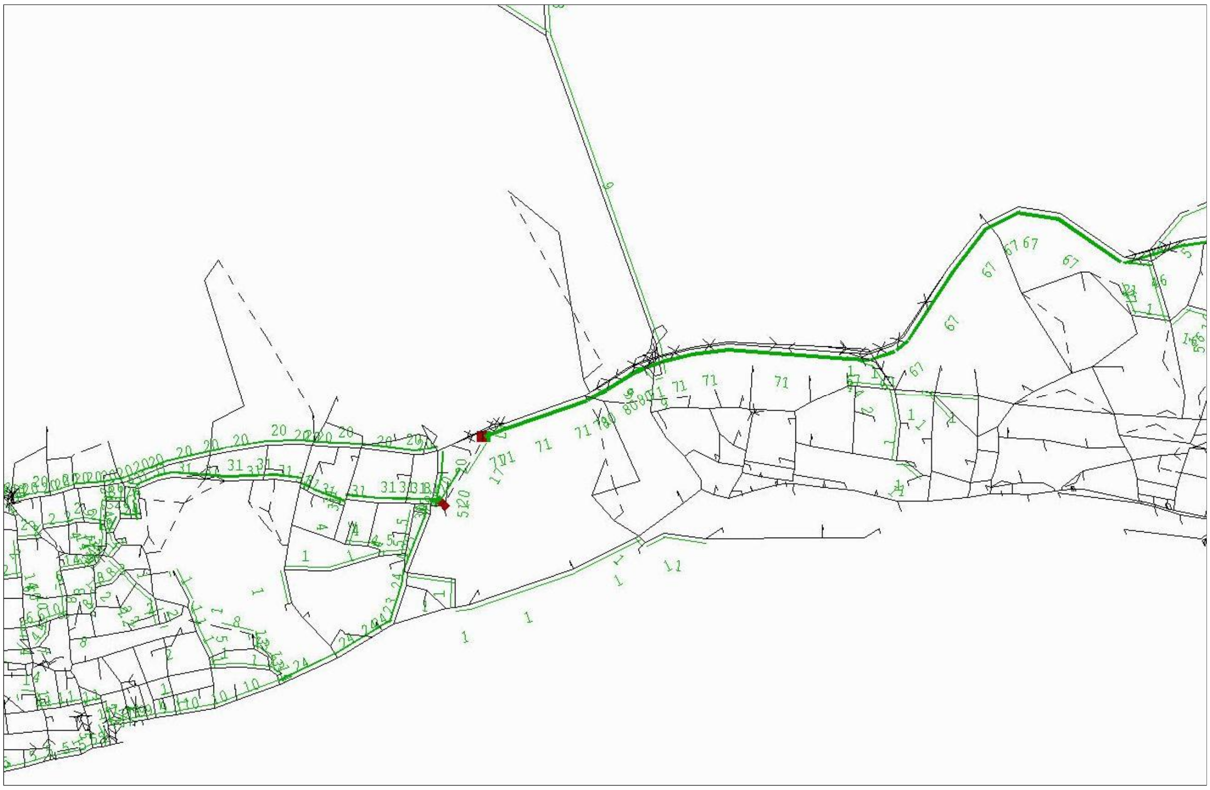

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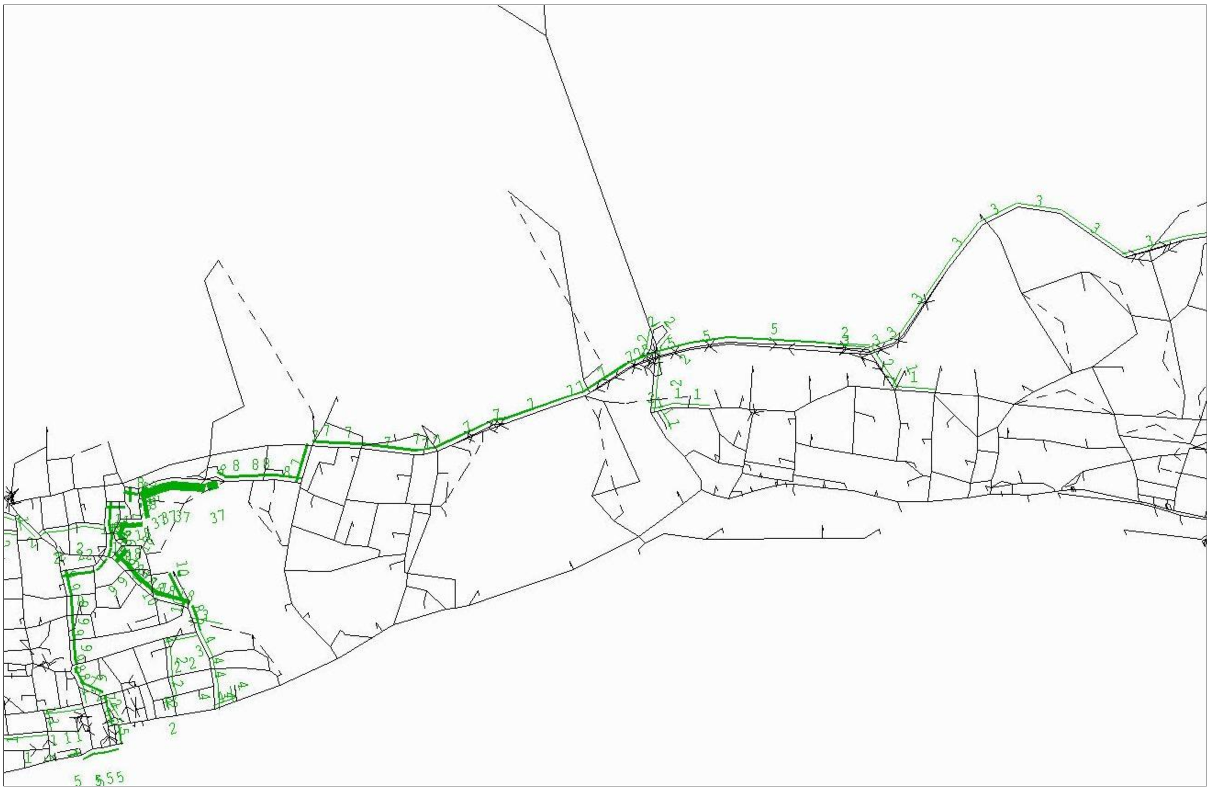
Trips from Sompting North, Scenario B AM

Trips to Sompting North, Scenario B AM



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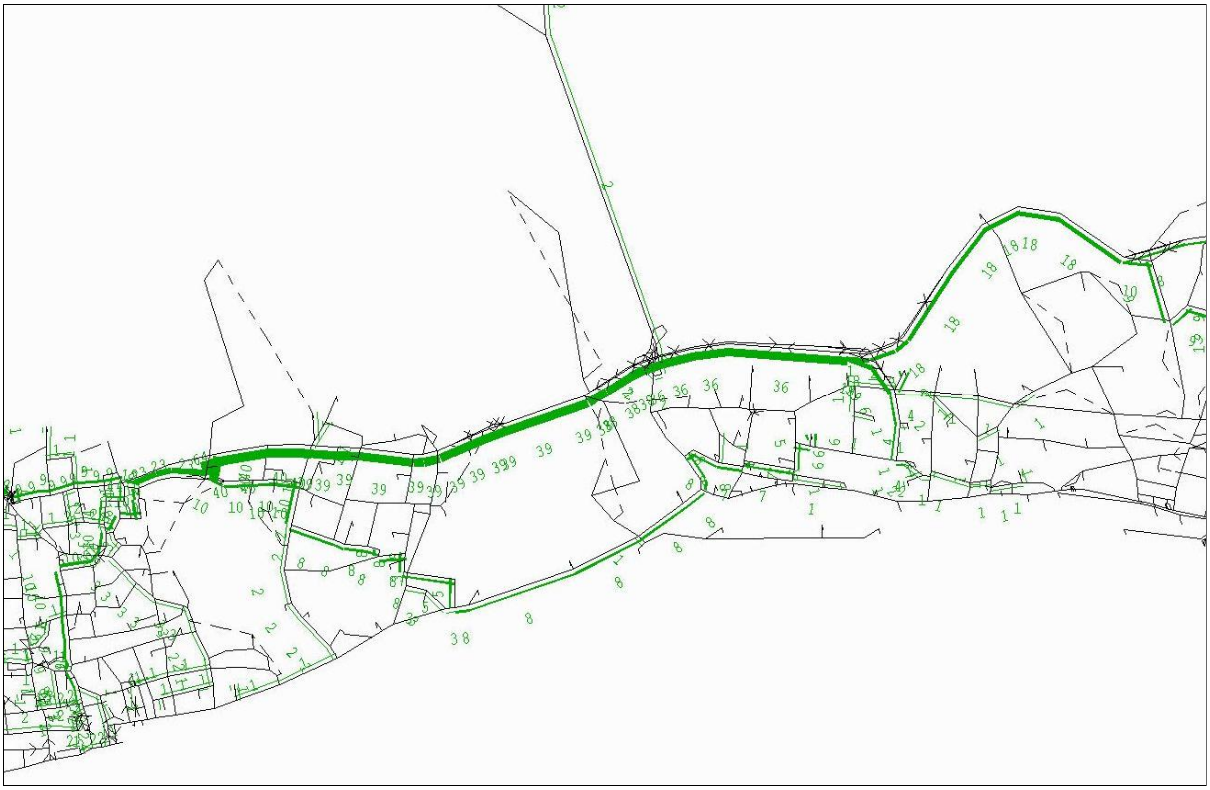

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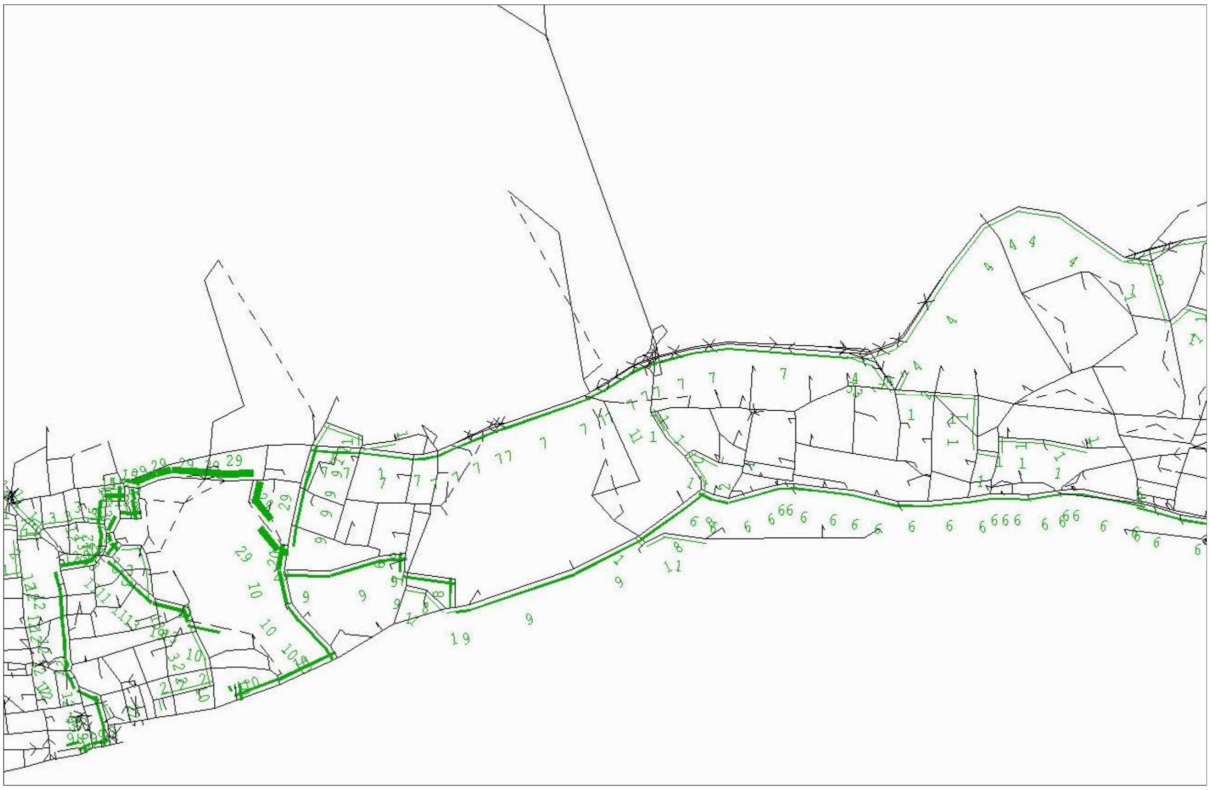
Trips from Sompting Fringe, Scenario B AM



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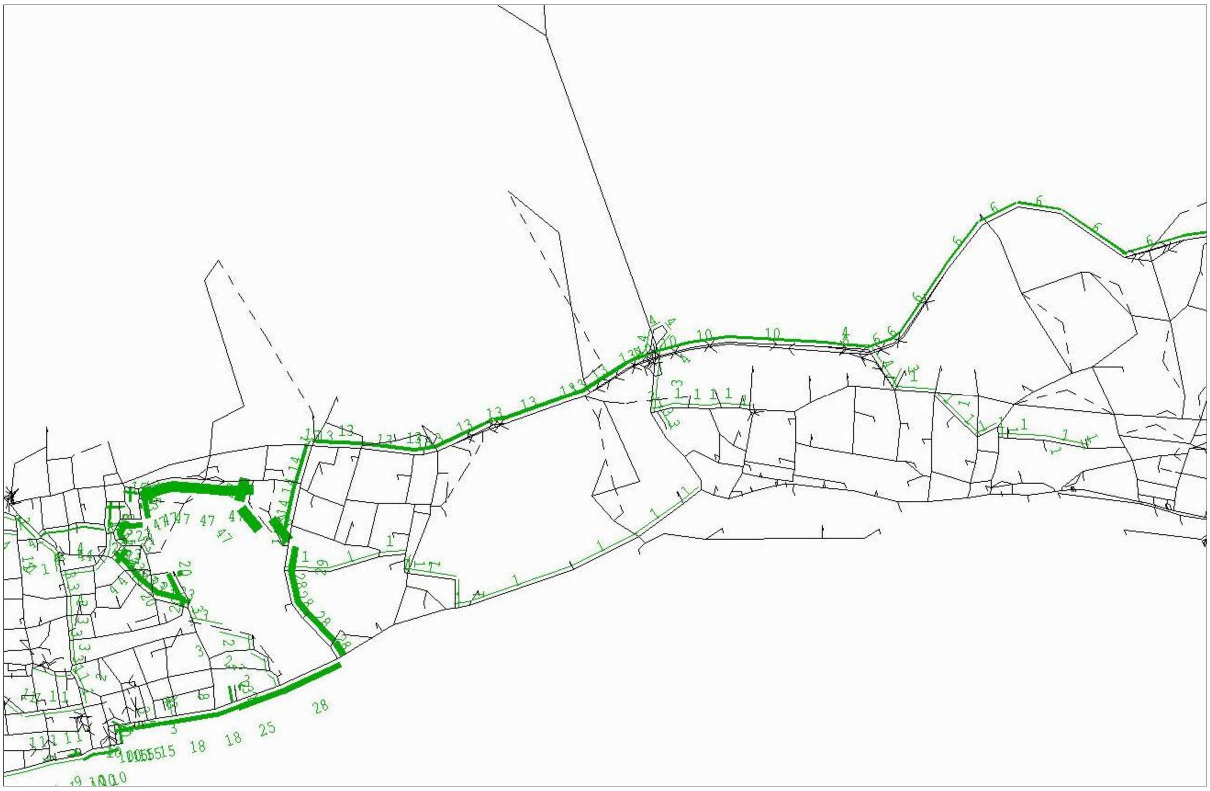

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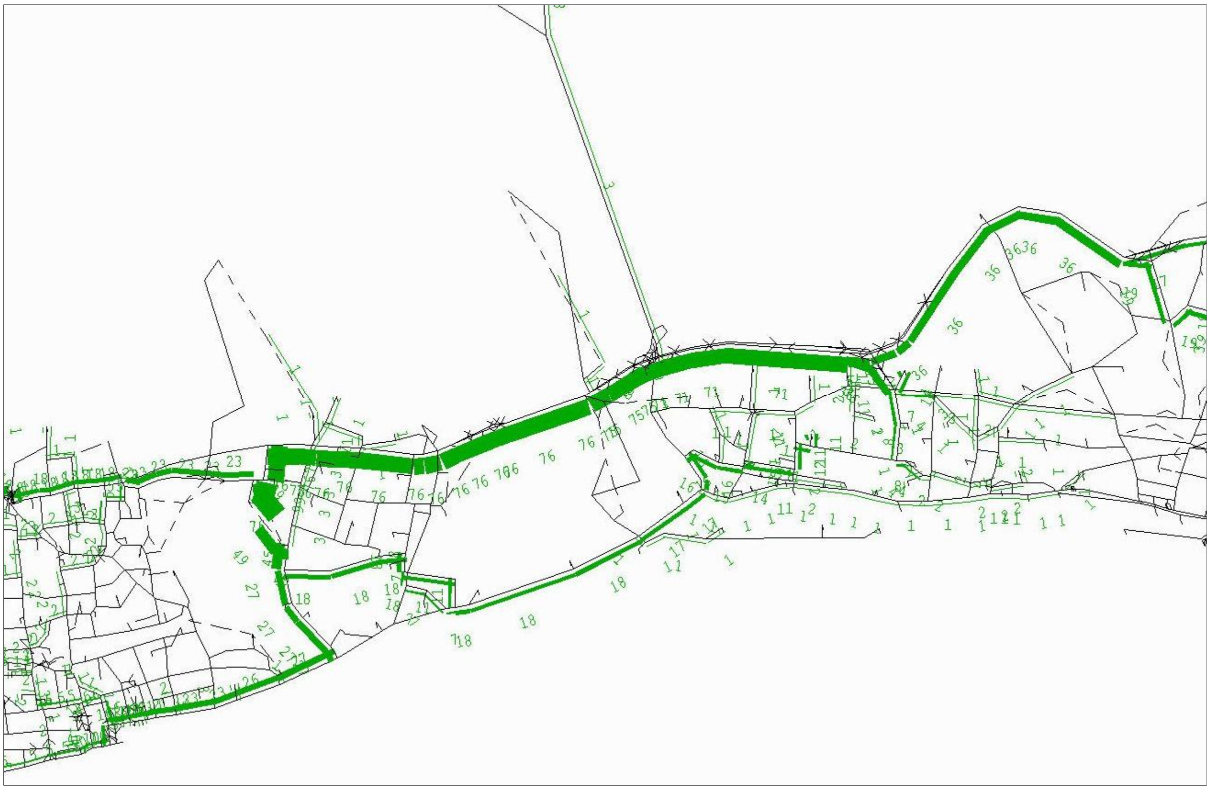
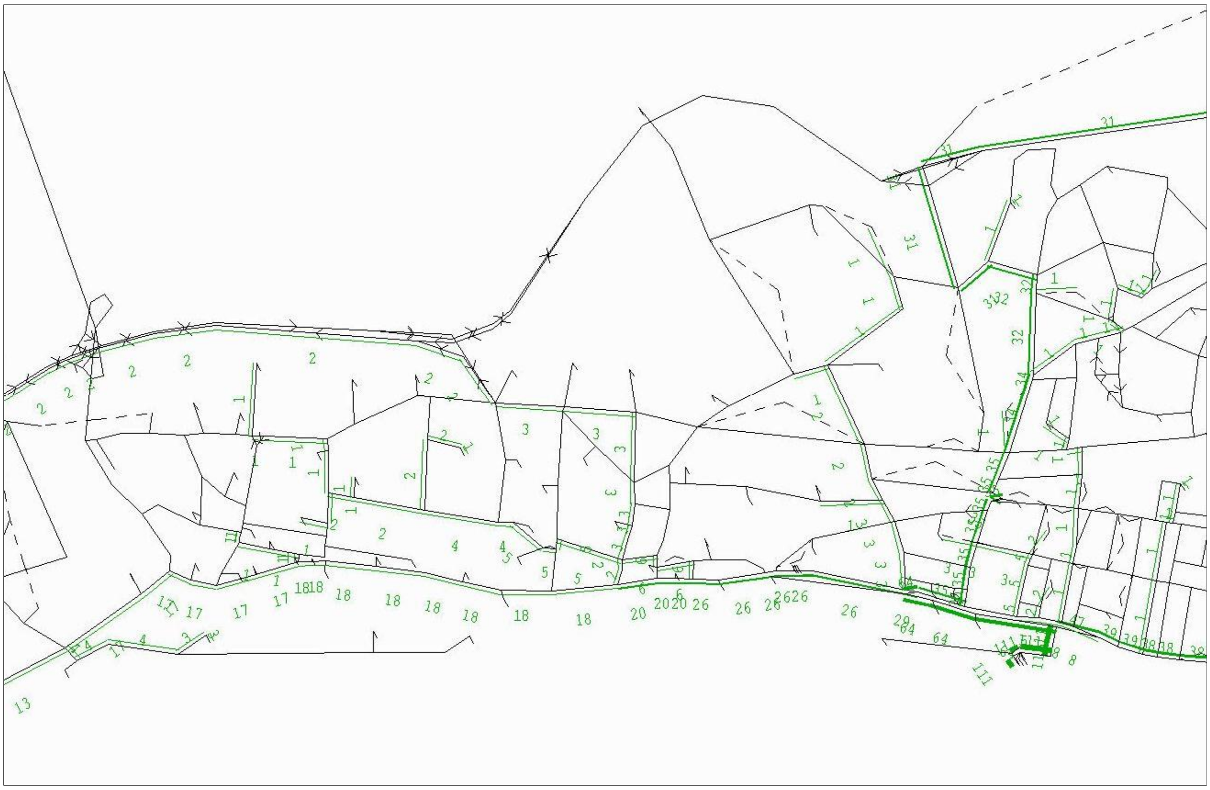


Trips to Sompting Fringe, Scenario B PM

Trips from Shoreham Harbour - Aldrington Basin, Scenario B AM



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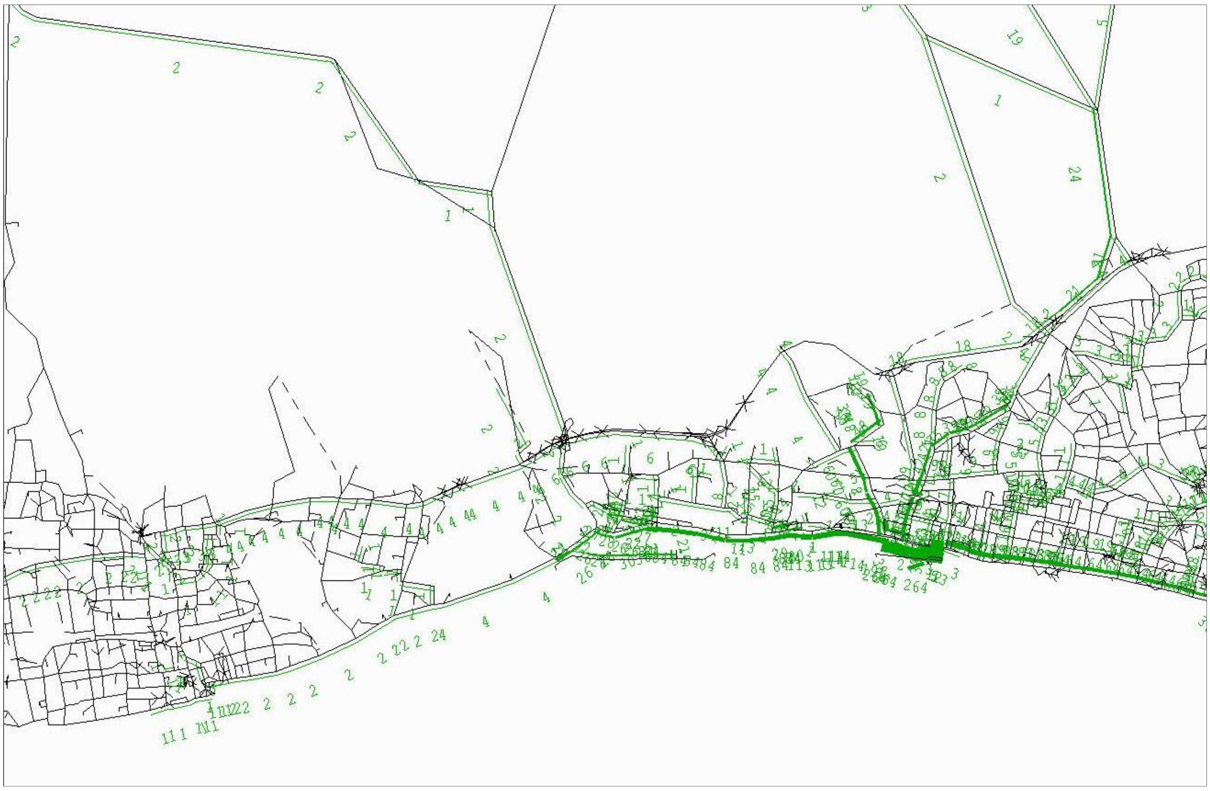
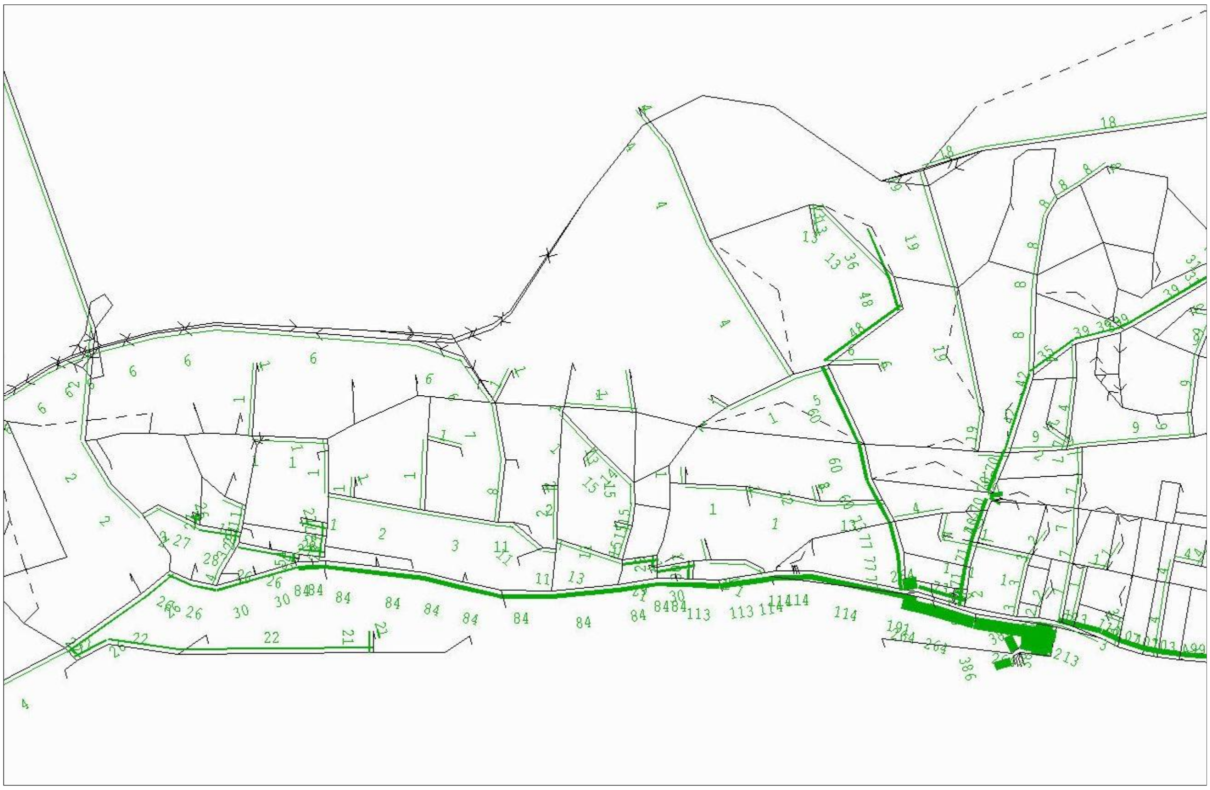
Trips to Shoreham Harbour - Aldrington Basin, Scenario B AM

Trips to Shoreham Harbour - Aldrington Basin, Scenario B AM



Trips from Shoreham Harbour - Aldrington Basin, Scenario B PM



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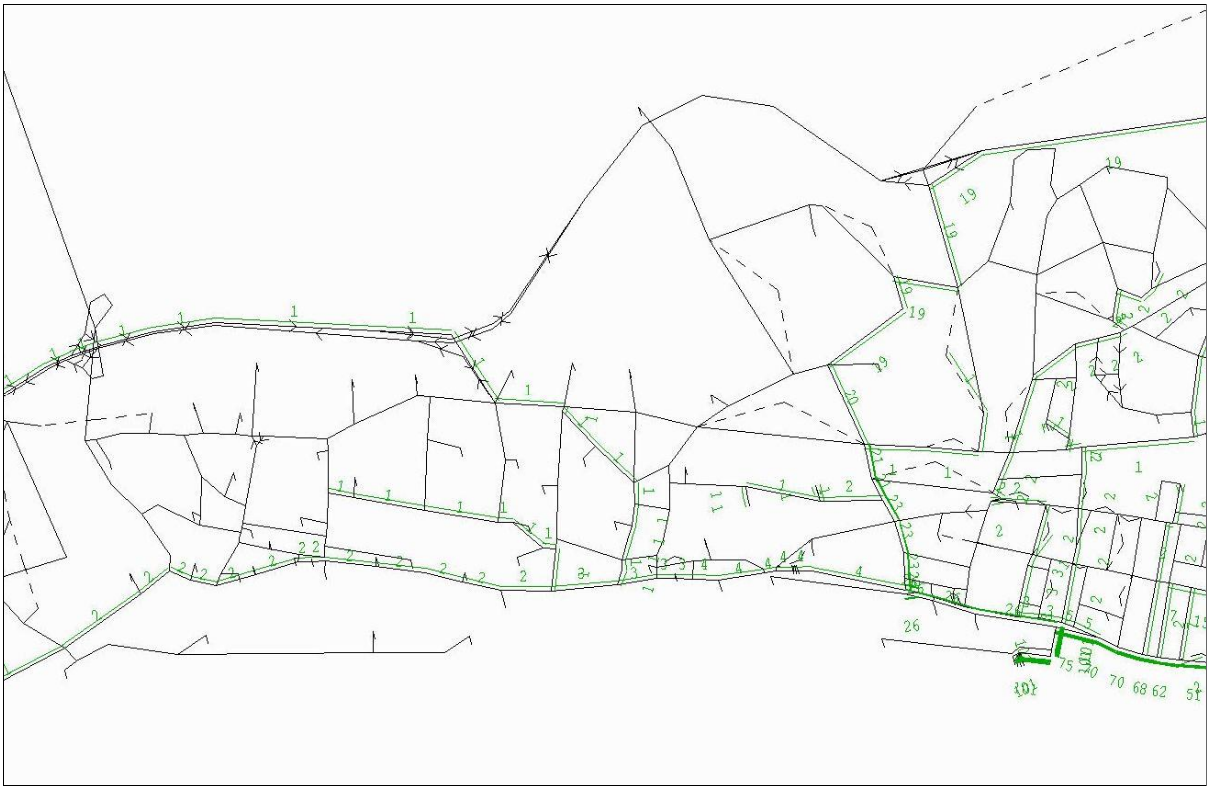
Trips to Shoreham Harbour - Aldrington Basin, Scenario B PM

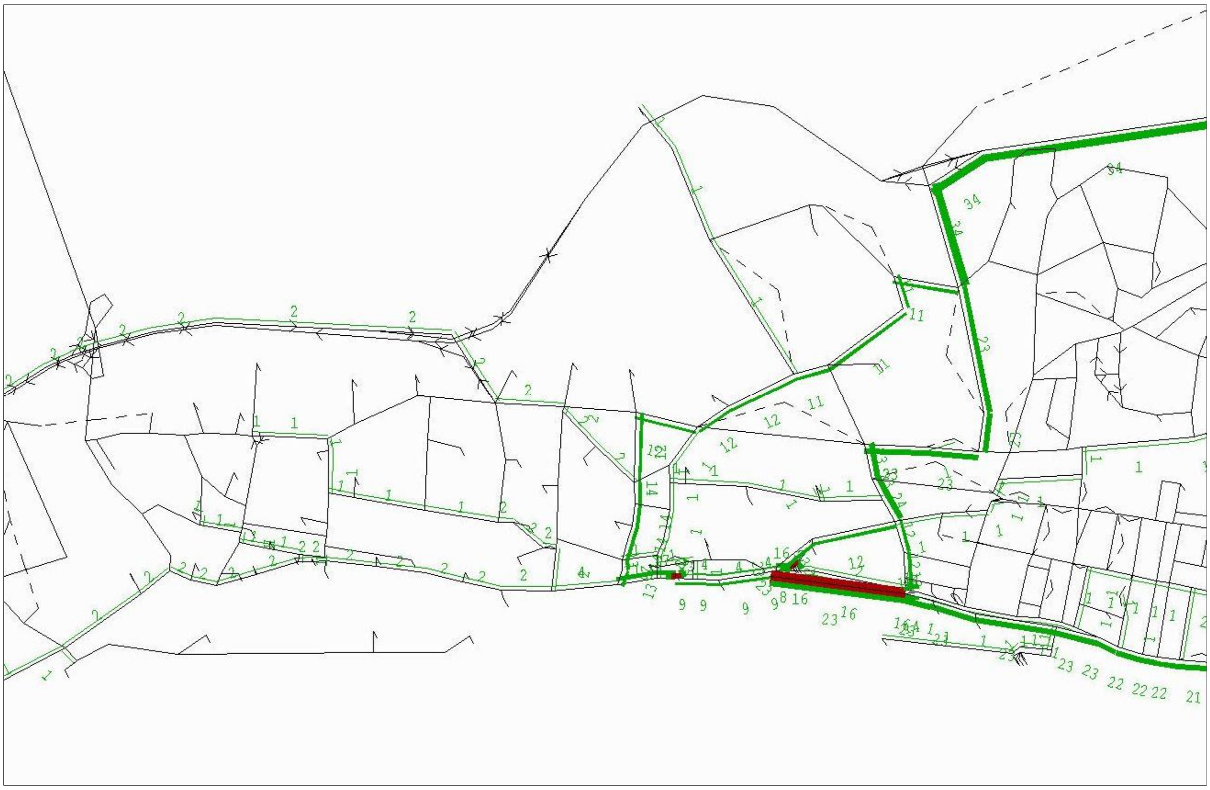


Trips to Shoreham Harbour - Aldrington Basin, Scenario B PM

Trips from Shoreham Harbour - Port Operational North, Scenario B AM

Trips from Shoreham Harbour - Port Operational North, Scenario B AM

Trips to Shoreham Harbour - Port Operational North, Scenario B AM



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Trips from Shoreham Harbour - Port Operational North, Scenario B PM

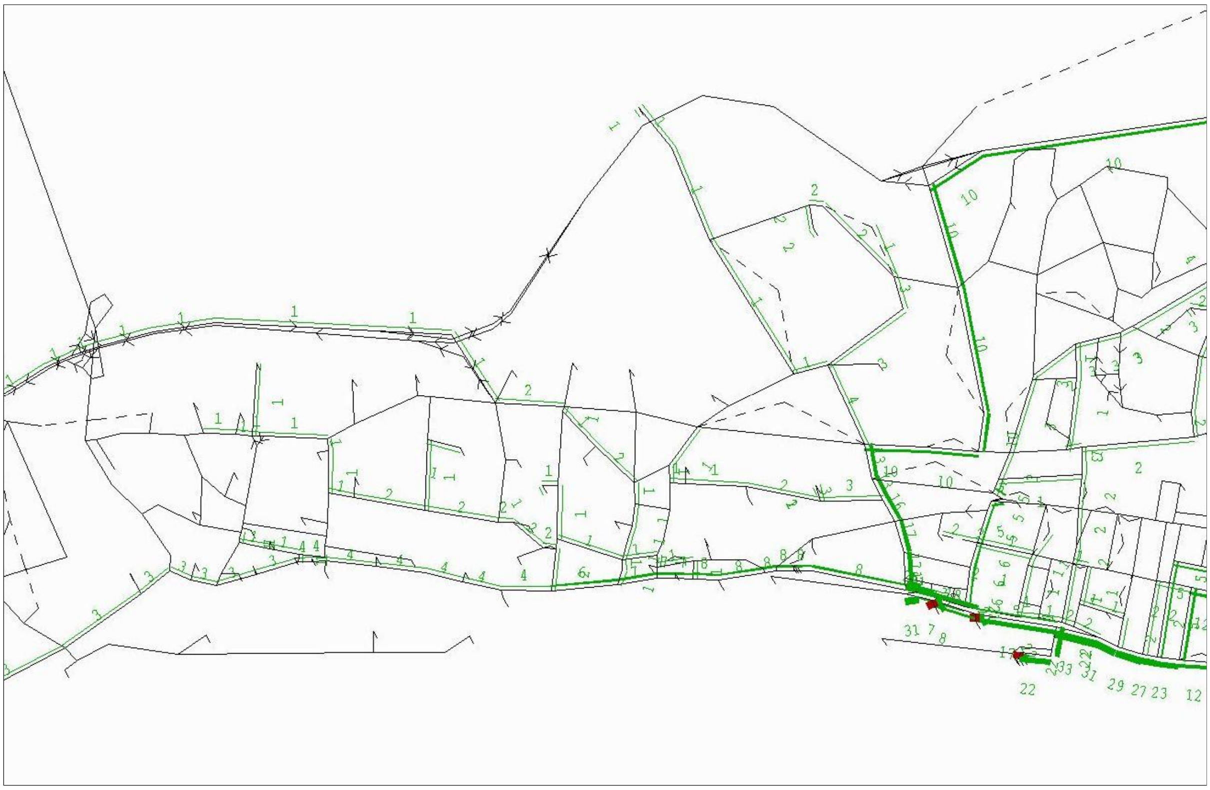
Trips to Shoreham Harbour - Port Operational North, Scenario B PM

Trips to Shoreham Harbour - Port Operational North, Scenario B PM

Trips from Shoreham Harbour - Port Operational East, Scenario B AM

Trips from Shoreham Harbour - Port Operational East, Scenario B AM

Trips to Shoreham Harbour - Port Operational East, Scenario B AM



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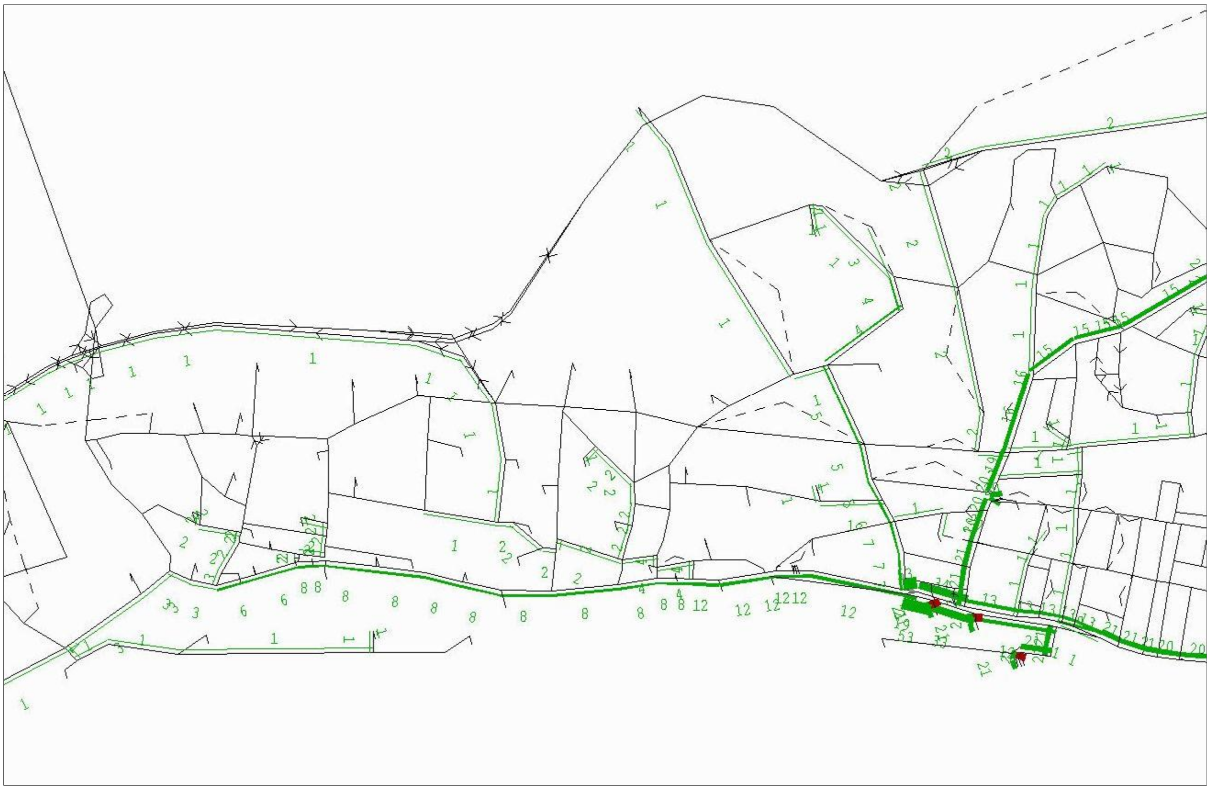

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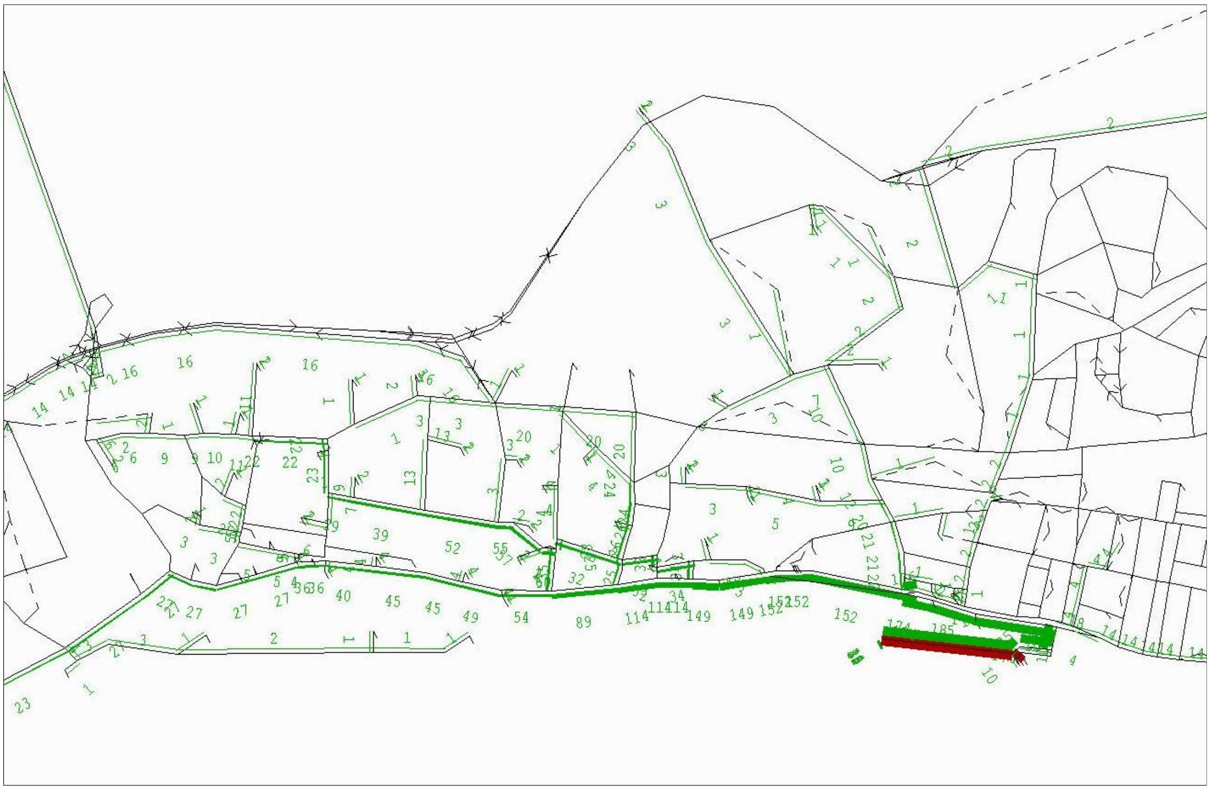
Trips to Shoreham Harbour - Port Operational East, Scenario B PM

Trips to Shoreham Harbour - Port Operational East, Scenario B PM

Trips from Shoreham Harbour - Port Operational South, Scenario B AM



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Trips to Shoreham Harbour - Port Operational South, Scenario B AM

Trips from Shoreham Harbour - Port Operational South, Scenario B PM

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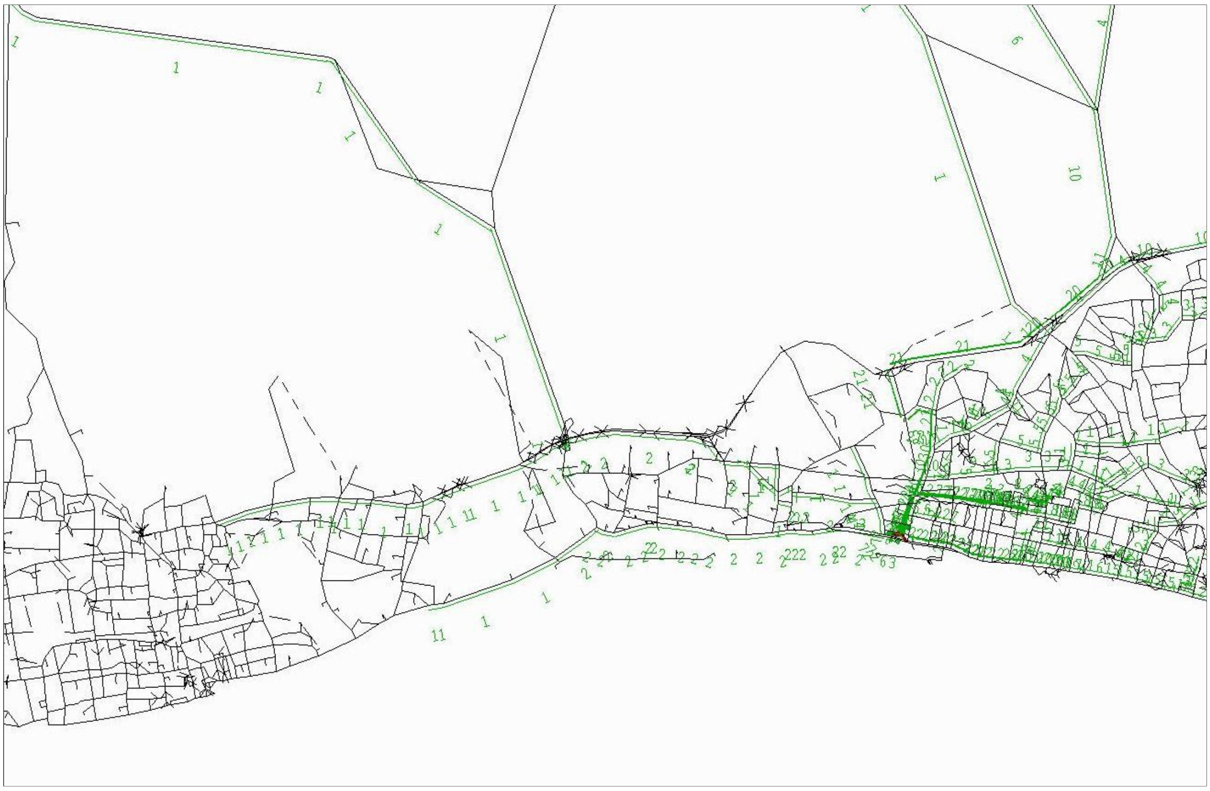
Trips to Shoreham Harbour - Port Operational South, Scenario B PM



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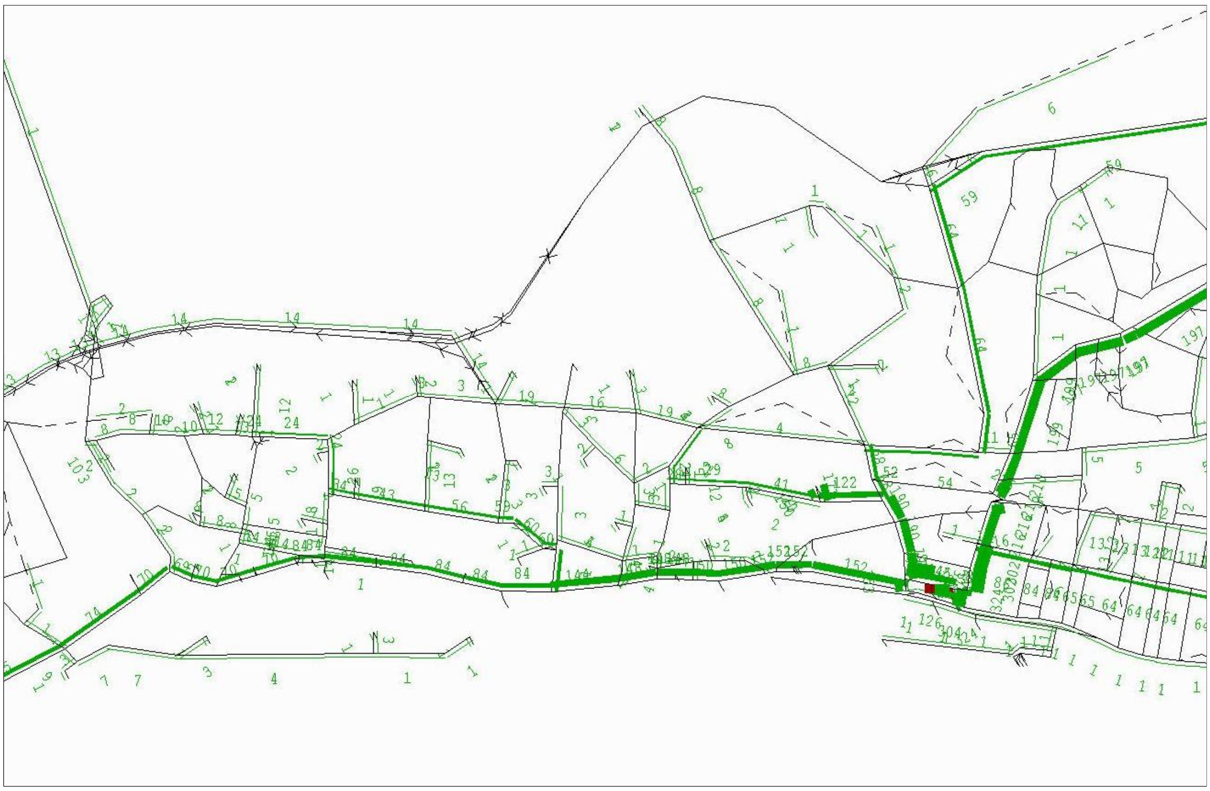


Trips to Shoreham Harbour - South Portslade, Scenario B AM

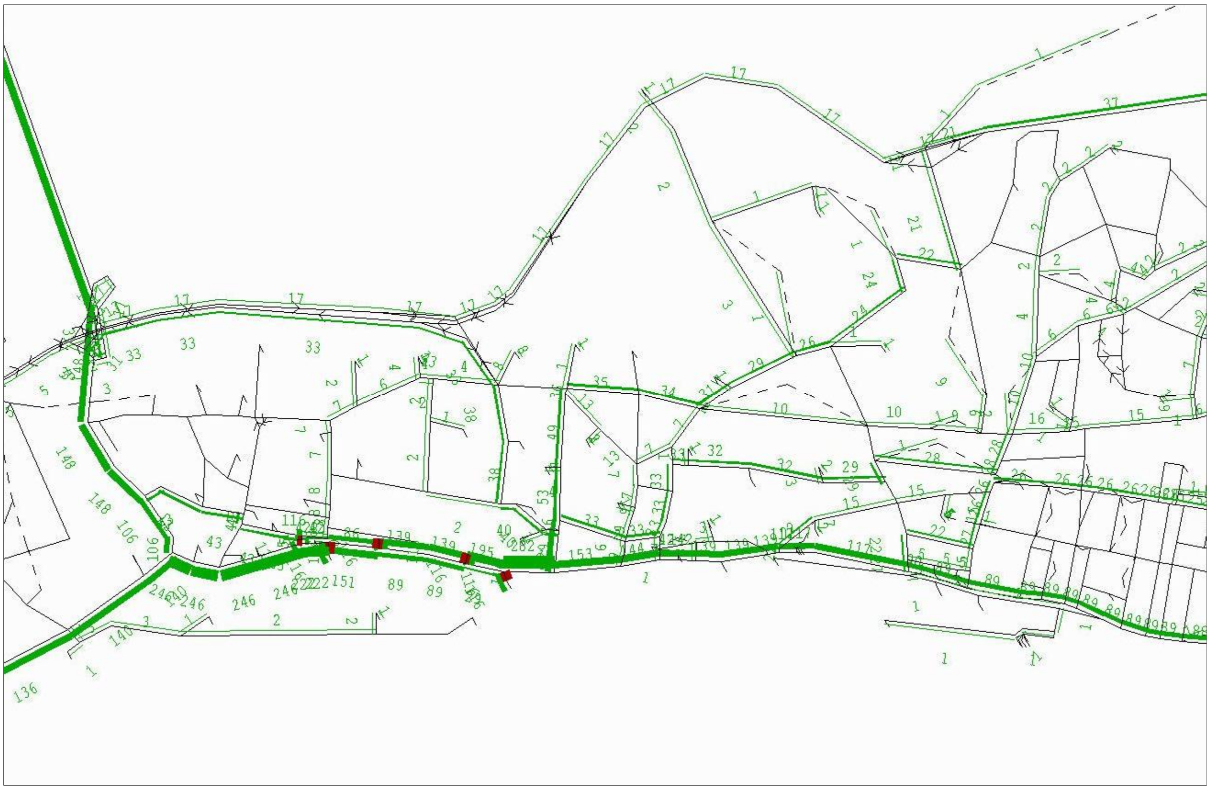
Trips from Shoreham Harbour - South Portslade, Scenario B PM

Trips from Shoreham Harbour - South Portslade, Scenario B PM

Trips to Shoreham Harbour - South Portslade, Scenario B PM

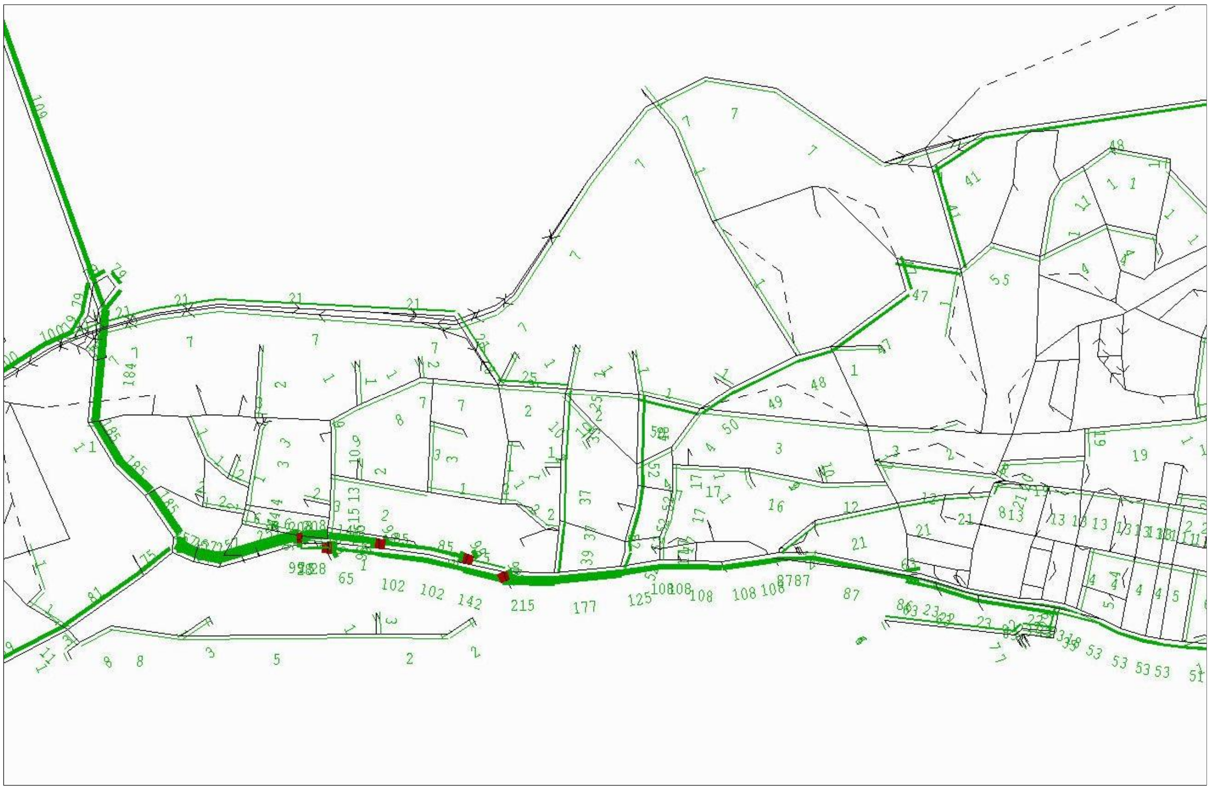
Trips to Shoreham Harbour - South Portslade, Scenario B PM

Trips from Shoreham Harbour - Western Arm, Scenario B AM



Trips from Shoreham Harbour - Western Arm, Scenario B AM

Trips to Shoreham Harbour - Western Arm, Scenario B AM



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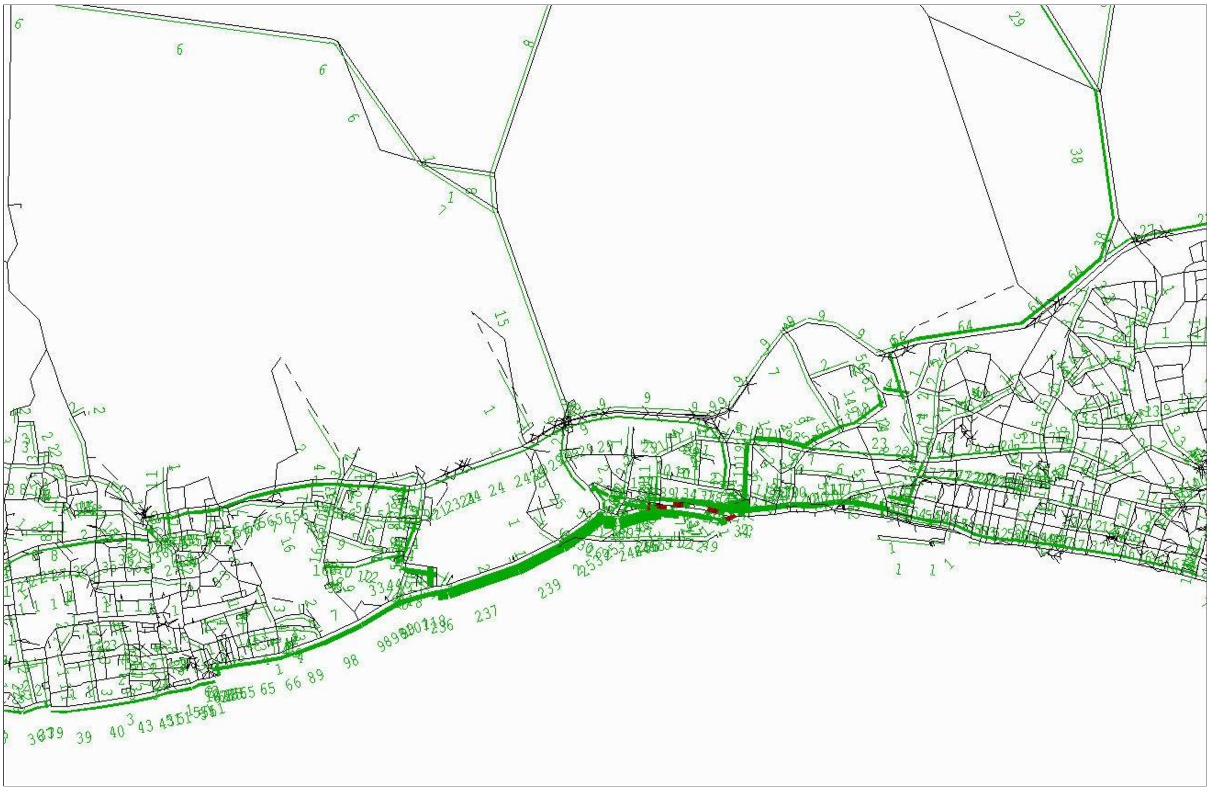

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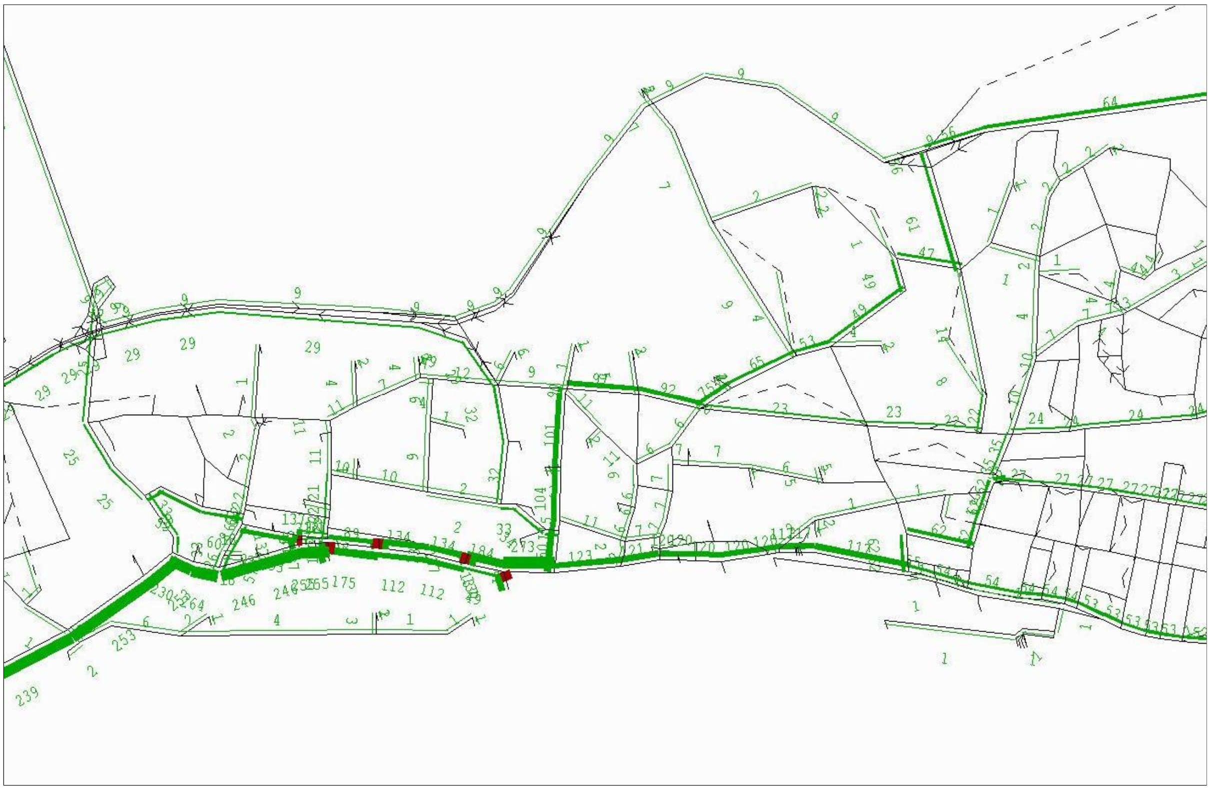

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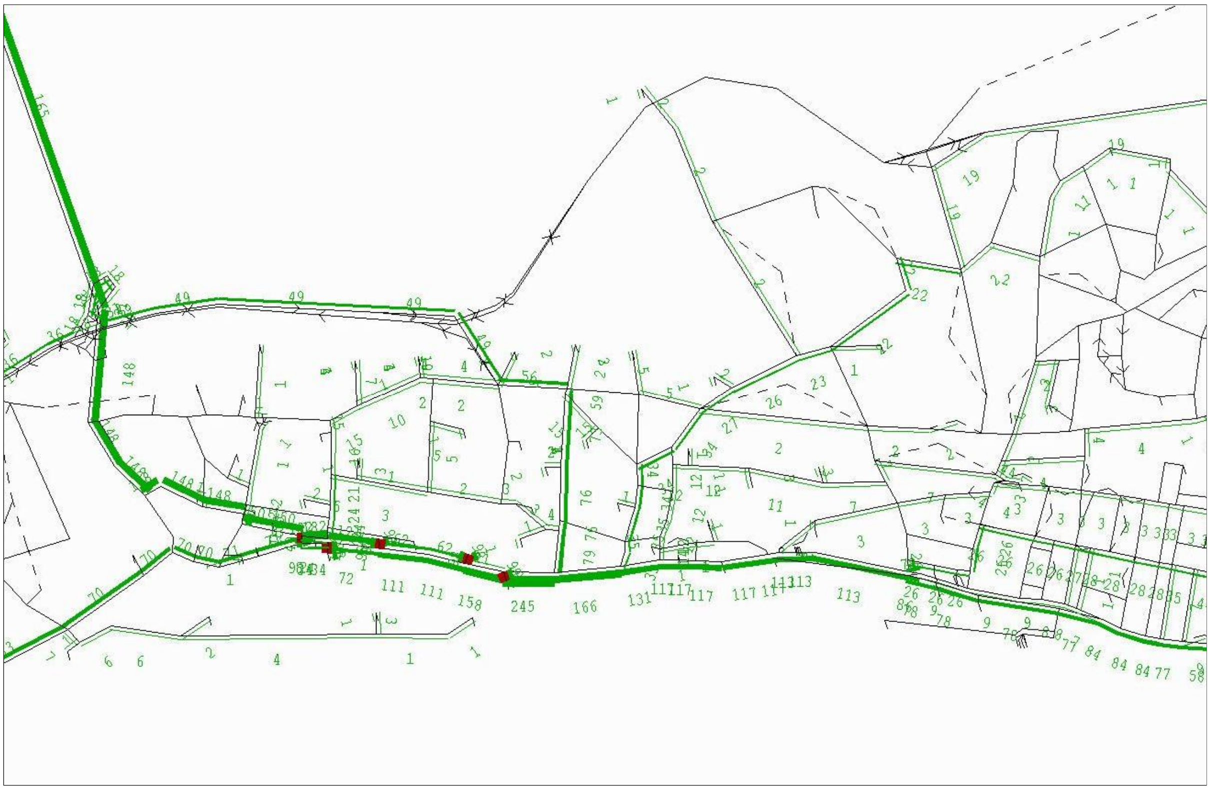
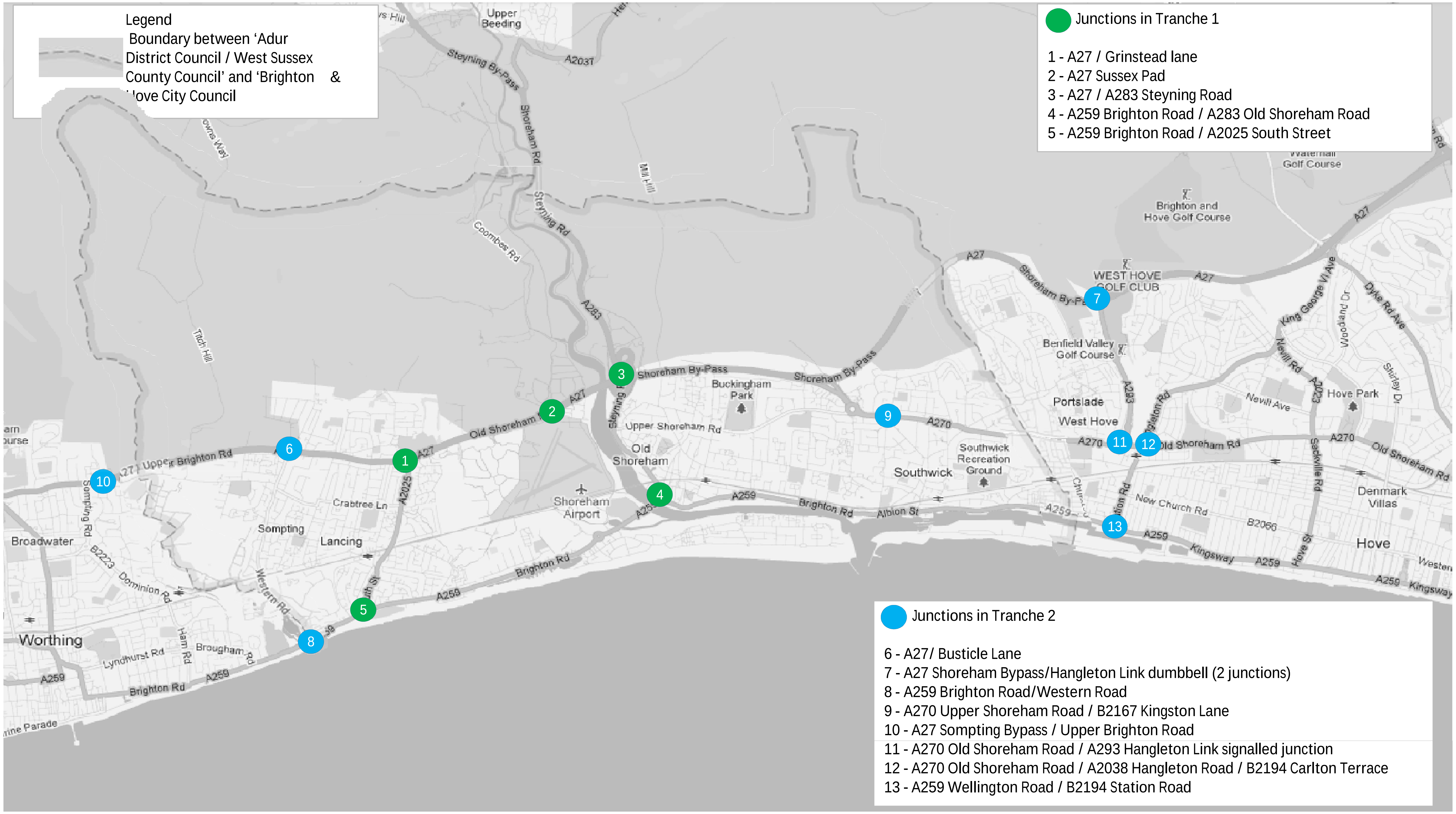


Trips to Shoreham Harbour - Western Arm, Scenario B PM

APPENDIX K

LOCATION OF KEY JUNCTIONS ASSESSED



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CLIENT/PROJECT
Adur Distric Council
Adur Local Plan and Shoreham Harbour Transport Study

TITLE
Location of Key Junctions Assessed

DATE
27/08/13

SCALE
Not to scale

PRODUCED
SP

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NW

Appendix K