

Inverurie Traffic Capacity Study Phase 2

Aberdeenshire Council

2016 S-Paramics Testing



INVERURIE TRAFFIC CAPACITY STUDY – PHASE 2

Description:	Inverurie Traffic Capacity Study – Phase 2	
Date:	21 December 2009	
Primary Author:	Julie Sey	
1 st Review:	Callum Guild	Project Manager
2 nd Review:	Peter Stewart	Project Director
Distribution:	Peter MacCallum	Aberdeenshire Council
	Mark Peters	Aberdeenshire Council
	Bob Nicol	SIAS

SIAS Limited
13 Rose Terrace
Perth PH1 5HA
UK

tel: 01738 621377
fax: 01738 632887
perth@sias.com
www.sias.com



INVERURIE TRAFFIC CAPACITY STUDY – PHASE 2

CONTENTS :

	Page
1 INTRODUCTION	1
1.1 Introduction	1
1.2 Objectives	1
1.3 Inverurie Model Background	1
1.4 Test Scenarios	2
2 2016 REFERENCE CASE	5
2.1 Introduction	5
2.2 2012 Reference Case Review	5
2.3 Network Infrastructure	5
2.4 Development Content	5
2.5 Traffic Growth	6
2.6 Matrix Totals	7
2.7 Model Observations – 2016 Reference Case	7
3 2016 OPTION TEST SCENARIOS	9
3.1 Introduction	9
3.2 2016 Test Development Summary	9
3.3 2016 Traffic Model Trip Matrix Development	11
3.4 2016 Development Trip Totals	13
3.5 2016 Infrastructure Improvements	14
4 INITIAL SCHEME ASSESSMENT	15
4.1 Introduction	15
5 TESTS 1-3 – INITIAL CRICHIE AND THAINSTONE DEVELOPMENT TESTING	19
5.1 Introduction	19
5.2 Test 1: Introduction and Model Observations	19
5.3 Test 2: Introduction and Model Observations	19
5.4 Test 3: Introduction and Model Observations	19
5.5 Test 1-3 Journey Time Comparisons	20
5.6 Test 1-3 Queue Summary	22
5.7 Test 1 – 3 Summary	25
6 TESTS 4 – 6: GOLF COURSE HOUSING DEVELOPMENT TESTING	27
6.1 Introduction	27
6.2 Test 4: Introduction and Model Observations	27
6.3 Test 5: Introduction and Model Observations	27
6.4 Test 6: Introduction and Model Observations	27
6.5 Test 4-6 Mean Travel Time	28



6.6	Test 4 – 6 Summary	28
7	TESTS 7 AND 8 – INNER RELIEF ROAD TESTING	31
7.1	Introduction	31
7.2	Test 7: Introduction and Model Observations	31
7.3	Test 8: Introduction and Model Observations	31
7.4	Test 7 and 8 Journey Time Comparisons	31
7.5	Test 7 and 8 Queue Summary	33
7.6	Test 7 and 8 Summary	35
8	TESTS 9 -11 – URYSIDE & PORTSTOWN DEVELOPMENT TESTING	37
8.1	Introduction	37
8.2	Test 9: Introduction and Model Observations	37
8.3	Test 10: Introduction and Model Observations	37
8.4	Test 11: Introduction and Model Observations	38
8.5	Test 11b: Introduction and Model Observations	38
8.6	Test 9-11 Journey Time Comparisons	39
8.7	Test 9 – 11 Summary	42
9	TESTS 12 AND 13: COMBINATION TESTING AND MITIGATION	43
9.1	Introduction	43
9.2	Test 12: Introduction and Model Observations	43
9.3	Test 12b: Introduction and Model Observations	43
9.4	Test 13: Introduction and Model Observations	44
9.5	Test 13b: Introduction and Model Observations	44
9.6	Test 12 and 13 Journey Time Comparisons	45
9.7	Test 12 and 13 Summary	48
10	SUMMARY	49
10.1	Introduction	49
10.2	Tests 1 – 3: Initial Crichtie and Thainstone Development Testing	49
10.3	Tests 4 – 6: Golf Course Housing Development Testing	49
10.4	Tests 7 and 8: Inner Relief Road Testing	50
10.5	Tests 9 – 11: Uryside and Portstown Development Testing	50
10.6	Tests 12 and 13: Combination Testing and Mitigation	50
10.7	Conclusions	51
A	BLACKHALL ROAD ROUNDABOUT FLOWS	53
B	THAINSTONE ROUNDABOUT DEMAND FLOWS	54
C	ELPHINSTONE ROUNDABOUT DEMANDS FLOWS	55
D	MEAN TRAVEL TIME	56



INVERURIE TRAFFIC CAPACITY STUDY – PHASE 2

FIGURES :

	Page
Figure 1.1 : Network Description	2
Figure 2.1 : 2016 Reference Case Development Locations	6
Figure 3.1 : Proposed 2016 Development Locations	11
Figure 3.2 : 2016 Infrastructure Improvements	14
Figure 4.1 : Initial Testing – Journey Time Routes	16
Figure 4.2 : Tests 9 and 9a AM Peak Hour Journey Times	17
Figure 4.3 : Tests 9 and 9a PM Peak Hour Journey Times	17
Figure 5.1 : Journey Time Routes	20
Figure 5.2 : Tests 1-3 AM Peak Hour Journey Times	21
Figure 5.3 : Tests 1-3 PM Peak Hour Journey Times	21
Figure 5.4 : Queue Cordons	22
Figure 5.5 : AM Peak – Queue Summary – A96	23
Figure 5.6 : PM Peak – Queue Summary – A96	23
Figure 5.7 : AM Peak – Queue Summary – High Street Close	24
Figure 5.8 : PM Peak – Queue Summary – High Street Close	24
Figure 6.1 : Mean Travel Time Summary	28
Figure 7.1 : Test 7 and 8 AM Peak Hour Average Journey Times	32
Figure 7.2 : Test 7 and 8 PM Peak Hour Average Journey Times	32
Figure 7.3 : Town Centre Cordon	33
Figure 7.4 : AM Peak - Average Number of Vehicles in a Queue	34
Figure 7.5 : AM Peak - Average Number of Vehicles in a Queue	34
Figure 8.1 : Thainstone Roundabout Improvements	38
Figure 8.2 : Thainstone Signal Timings – Test 11b	39
Figure 8.3 : Tests 9-11 AM Peak Hour Average Journey Times	40
Figure 8.4 : Tests 9-11 PM Peak Hour Average Journey Times	41
Figure 9.1 : Thainstone Signal Timings – Test 12	43
Figure 9.2 : Port Elphinstone Roundabout Improvements	44
Figure 9.3 : Port Elphinstone Signal Timings – Test 13b	45
Figure 9.4 : Tests 12 and 13 AM Peak Hour Average Journey Times	46
Figure 9.5 : Tests 12 and 13 PM Peak Hour Average Journey Times	47
Figure A.1 : Blackhall Road Roundabout Flows	53



Figure B.1 : Thainstone Roundabout Demand Flows	54
Figure C.1 : Port Elphinstone Roundabout Demand Flows	55
Figure D.1 : Mean travel Time Summary	56



INVERURIE TRAFFIC CAPACITY STUDY – PHASE 2

TABLES :

	Page
Table 1.1 : Test Scenarios	3
Table 2.1 : Background Growth	6
Table 2.2 : NRTF Traffic Growth 2007 to 2016	7
Table 2.3 : 2016 Reference Case Trip Totals	7
Table 3.1 : Test Summary	9
Table 3.2 : Development Summary	10
Table 3.3 : Trip Rates	11
Table 3.4 : Development Trip Totals	13
Table 4.1 : Peak Hour Link Flow	15
Table 8.1 : Test 9 to 11 Summary	37
Table 9.1 : Test 12 and 13 Summary	43





1 INTRODUCTION

1.1 Introduction

1.1.1 Following the recently completed Inverurie Traffic Capacity Study – Phase 1, Aberdeenshire Council subsequently requested a series of refined tests based on an updated 2016 Reference Case S-Paramics model.

1.1.2 The Inverurie Traffic Capacity Study – Phase 1 involved an assessment of various infrastructure and development impacts on the town. A Report (*Inverurie Traffic Capacity Study, SIAS Ref. 71441*) detailing the testing and findings was issued in June 2009.

1.2 Objectives

1.2.1 The overall aim of this second phase is to assess the traffic impact of each test scenario on the local and trunk road network and also, under advice from Aberdeenshire Council, identify any conceptual network improvements to aid the performance of the road network.

1.2.2 The principal objectives of this study are to:

- Evaluate the network impact of potential development areas, as advised by Aberdeenshire Council
- Evaluate the conceptual supporting infrastructure options proposed by Aberdeenshire Council

1.3 Inverurie Model Background

1.3.1 The Base Inverurie S-Paramics model was upgraded in 2008 using observed data from 2007, and is representative of 2007 conditions. As part of the Inverurie Traffic Capacity Study – Phase 1, a 2012 Reference Case model was developed. The updated 2016 Reference Case model has been developed from the 2012 Reference Case model.

1.3.2 The Inverurie model represents the following peak periods:

- AM Peak Period 07:00 – 10:00
- PM Peak Period 16:00 – 19:00

1.3.3 The peak hours for the Inverurie model have been defined as:

- AM Peak Hour 08:00 – 09:00
- PM Peak Hour 17:00 – 18:00

Figure 1.1 shows the Inverurie model network description.



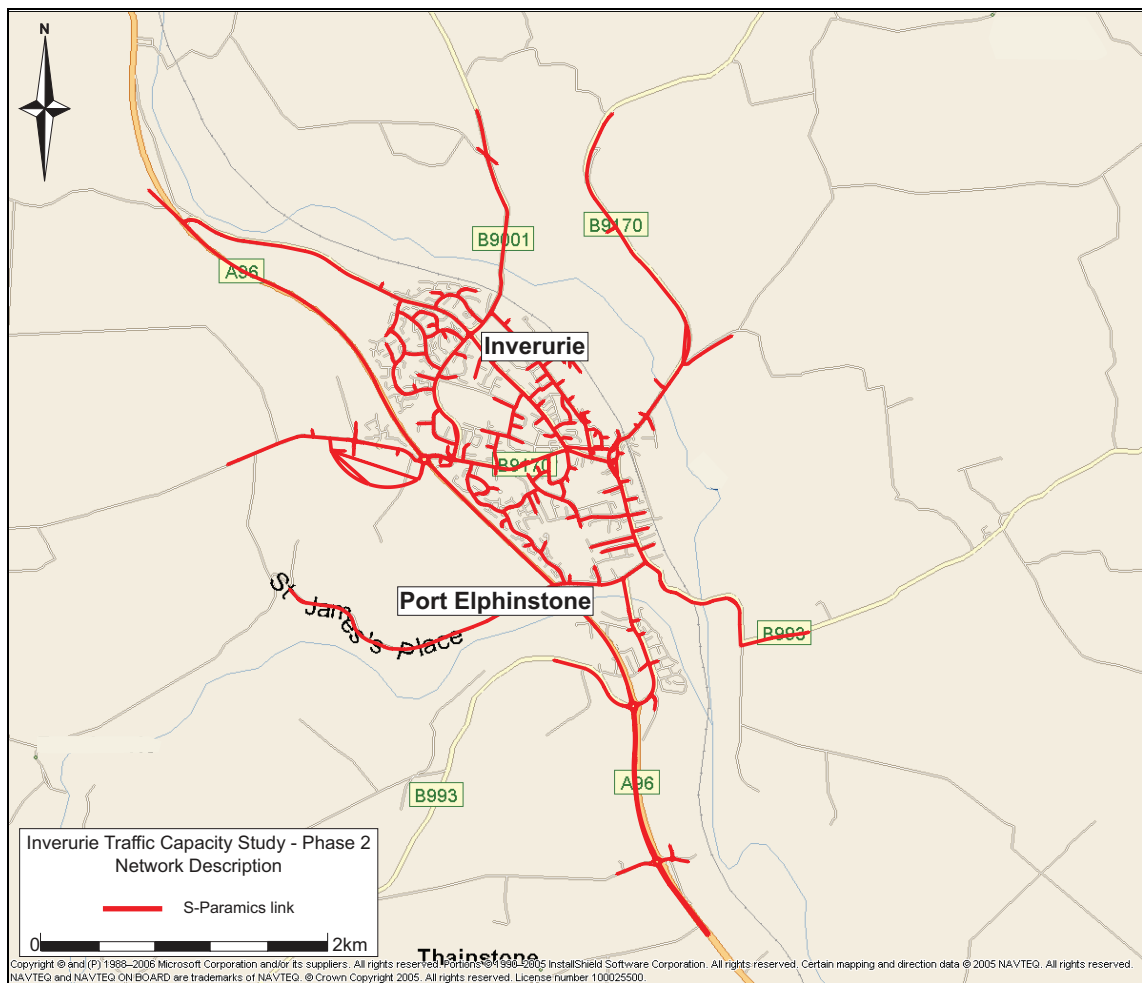


Figure 1.1 : Network Description

1.4 Test Scenarios

1.4.1 The test scenarios requested by Aberdeenshire Council are shown in Table 1.1.



Table 1.1 : Test Scenarios

Test	Development					Infrastructure			
	Uryside & Portstown	Harlaw Road North	Crichie	Thainstone	Golf Course	Northern Link Road	Inverurie Inner Relief Road	Alt Inner Relief Road	Keithhall Link Road
1			✓	✓					
2			✓	✓			✓		
3			✓	✓					✓
4			✓	✓	✓				
5			✓	✓	✓		✓		
6			✓	✓	✓				✓
7		✓						✓	
8		✓					✓		
9	✓	✓				✓	✓		
10	✓	✓				✓			✓
11	✓	✓				✓	✓		✓
12	✓	✓		✓		✓			✓
13	✓	✓	✓	✓		✓			✓
14	✓	✓	✓	✓	✓	✓			✓

- 1.4.2 Prior to undertaking the model test programme, the development of an updated 2016 Reference Case model, containing committed development to 2016 was required. This is detailed in Section 2.
- 1.4.3 Following the 2016 Reference Case development, a total of 14 tests identified by Aberdeenshire Council were considered. The detail of each test scenario is provided in the following sections. During the programme of testing, additional sensitivity tests and mitigation measures were identified and tested. Test 14 has been omitted from testing at this stage due to capacity issues in the network in Test 13.
- 1.4.4 The scenarios tested have been evaluated using model observations and average journey times. Where appropriate, additional queue and delay statistics have been provided and further statistics are also given in the appendices.





2 2016 REFERENCE CASE

2.1 Introduction

2.1.1 The Inverurie 2016 Reference Case model has been based on the 2012 Reference Case model, developed for the original Inverurie Traffic Capacity Study – Phase 1.

2.2 2012 Reference Case Review

2.2.1 Following a site visit by SIAS in August, the existing 2012 Reference Case model was reviewed. With agreement from Aberdeenshire Council, some aspects of the model were amended in order to better reflect current on-site conditions.

2.2.2 The right turn from High Street Close (northbound) to the minor road forming the eastern side of the town centre triangle was observed to cause significant delays due to right turning traffic blocking the ahead movement, particularly in the PM peak. The operation of this junction has been revised to allow the model to better reflect current town centre behavior.

2.2.3 From the site visit, it was noted that there was a mini roundabout at the junction of Elphinstone Road with St. James Place which was not explicitly modelled in the 2012 Reference Case model. The roundabout has been included in the 2016 Reference Case.

2.2.4 With agreement from Aberdeenshire Council, the assignment of traffic release profiles for the Reference Case developments has been amended so that each development has been assigned a profile from a similar type of development.

2.3 Network Infrastructure

2.3.1 Following advice from Aberdeenshire Council it was agreed that the road infrastructure for the 2016 Reference Case should include the following:

- Two-way traffic over Souterford Bridge and removal of traffic signals
- Signalised access to Souterford Retail Park
- New signalised junction of Keithhall Street/ St James Place
- Five arm roundabout at Blackhall Road junction
- Access roads to Blackhall Road development
- Port Elphinstone Roundabout improvement (section of two lanes on the A96 northbound exit to allow northbound A96 traffic to exit in two lanes)

2.4 Development Content

2.4.1 The updated 2016 Reference Case includes the following developments, as agreed with Aberdeenshire Council:

- Thainstone Business Park
- Blackhall Housing (28 units)
- Blackhall Road mixed use development
- Souterford Retail Park
- Harlaw Road Development



- Uryside Housing Development (250 units)

2.4.2 The 2016 Reference Case development locations are shown in Figure 2.1.

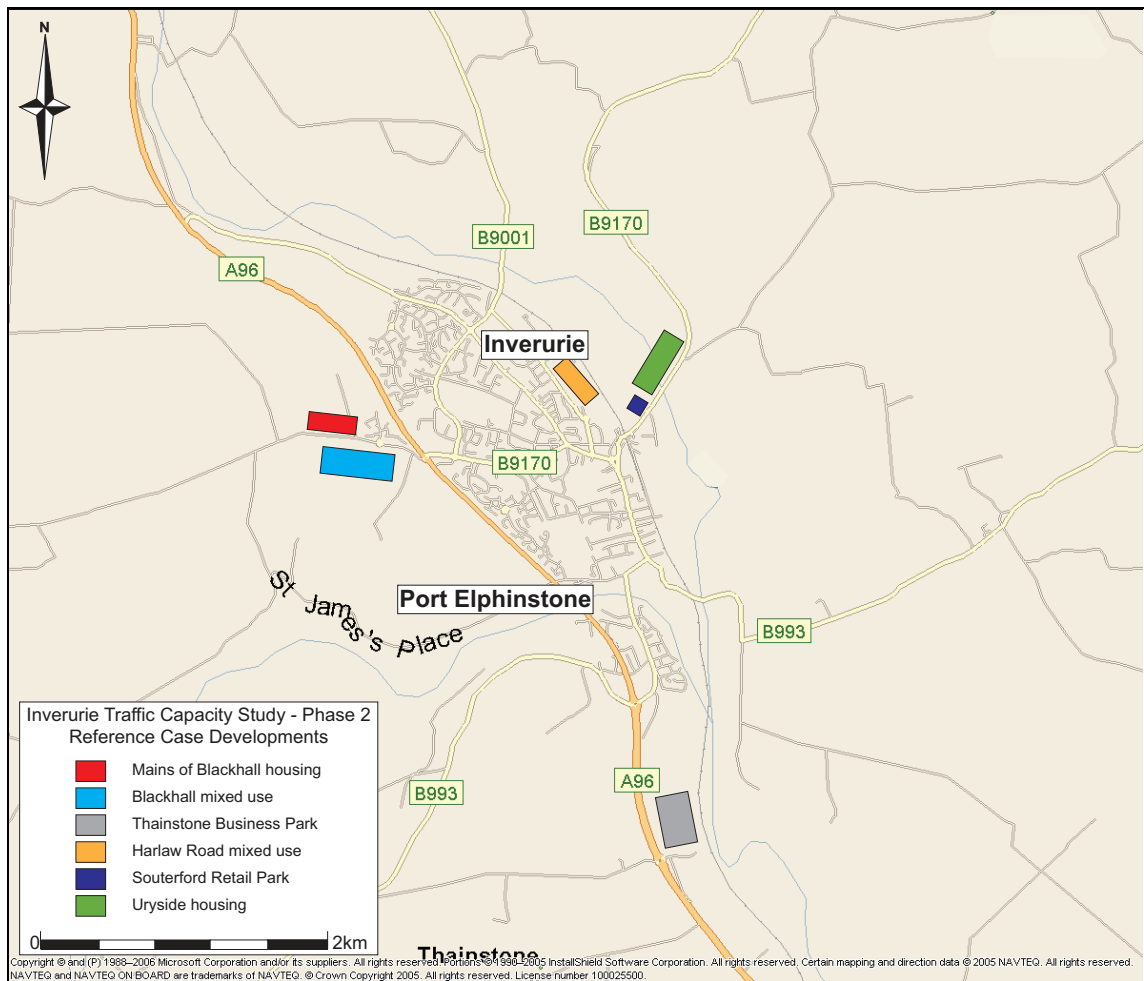


Figure 2.1 : 2016 Reference Case Development Locations

2.4.3 Trip rates and distributions for these developments were taken from the traffic assessment report extracts for each development, provided by Aberdeenshire Council.

2.5 Traffic Growth

2.5.1 NRTF growth rates from 2007 to 2016 were agreed with Aberdeenshire Council and have been applied to the 2007 Base traffic demand matrices as detailed in Table 2.1.

Table 2.1 : Background Growth

	Lights		Heavies	
	Internal	External	Internal	External
Internal	No growth	Half Low	No growth	Low
External	Half Low	Low	Low	Central

2.5.2 The NRTF growth rates from 2007 to 2016 are shown in Table 2.2.



Table 2.2 : NRTF Traffic Growth 2007 to 2016

Year	Growth Rate	Lights	Heavies
2016	Half Low	5.3%	6.7%
	Low	10.6%	13.3%
	Central	14.3%	16.8%
	High	18.0%	20.3%

2.6 Matrix Totals

- 2.6.1 The 2016 Reference Case traffic demand matrices have been developed from the previous 2007 Base matrices. Growth was applied as described in Section 2.5, and development trips for each of the committed developments were added. The traffic demand matrices were then adjusted to minimise double counting and allow internal trips to occur between new housing and existing employment and vice versa. This reduced the number of new trips which were added to the network.
- 2.6.2 Table 2.3 shows the number of trips added to the network from growth, and from each of the developments, and also shows the 2016 Reference Case totals after adjustment to remove any double counting.

Table 2.3 : 2016 Reference Case Trip Totals

	AM	PM
2007 Base	18453	20890
NRTF Growth (2007 - 2016)	897	1016
Thainstone Business Park	443	465
Mains of Blackhall Housing	118	172
Blackhall Road Mixed Use	945	1093
Southerford Retail Park	265	672
Harlaw Rd Development	289	687
Uryside Housing	420	615
Reference Case total after adjustment	21234	24488
Increase from 2007 Base	15.1%	17.2%

2.7 Model Observations – 2016 Reference Case

- 2.7.1 In the AM peak, queueing was observed southbound on the A96 from Elphinstone Roundabout, reaching approximately 1,700m at 09:00. Queueing on Elphinstone Road southbound from Port Elphinstone Roundabout extends almost to the mini roundabout at the junction with St James Place. A westbound queue was observed on Blackhall Road from Blackhall Road Roundabout reaching a maximum of approximately 600m at 09:00.
- 2.7.2 In the PM peak, queueing was observed on the A96 northbound from Blackhall Road Roundabout and northbound and southbound from Port Elphinstone Roundabout. By 18:00 the northbound queue from Blackhall extends almost to Elphinstone, and the queue from Elphinstone reaches Thainstone. Queueing was also observed northbound on Elphinstone Road



and High Street Close, with right turning traffic from High Street Close to the minor east arm of the town centre triangle causing blocking back and significant congestion as discussed in Section 2.2.2. By 18:55 there are approximately 60 vehicles unable to join the model network from Thainstone due to congestion.



3 2016 OPTION TEST SCENARIOS

3.1 Introduction

3.1.1 A total of 14 option tests have been proposed by Aberdeenshire Council. Table 3.1 summarises the content of the tests.

Table 3.1 : Test Summary

Test	Development					Infrastructure			
	Uryside & Portstown	Harlaw Road North	Crichie	Thainstone	Golf Course	Northern Link Road	Inverurie Inner Relief Road	Alt Inner Relief Road	Keithhall Link Road
1			✓	✓					
2			✓	✓			✓		
3			✓	✓					✓
4			✓	✓	✓				
5			✓	✓	✓		✓		
6			✓	✓	✓				✓
7		✓						✓	
8		✓					✓		
9	✓	✓				✓	✓		
10	✓	✓				✓			✓
11	✓	✓				✓	✓		✓
12	✓	✓		✓		✓			✓
13	✓	✓	✓	✓		✓			✓
14	✓	✓	✓	✓	✓	✓			✓

3.2 2016 Test Development Summary

3.2.1 A total of five proposed developments are included in this programme of testing. Table 3.2 summarises the developments.



Table 3.2 : Development Summary

Development	Content
Uryside & Portstown Development	300 Houses Souterford 750 Houses Boynds 400 Houses Portstown 15 Ha Employment Primary School (revised location)
Crichie Development	800 Houses 15 Ha Employment
Golf Course Development	1,000 Houses
Thainstone Development	15Ha of Employment West of Thainstone Roundabout
Harlaw Road North Development	140 Houses 920m ² Office 1,200m ² Non food retail 6000m ² Retail

3.2.2 Figure 3.1 shows the proposed 2016 development locations.



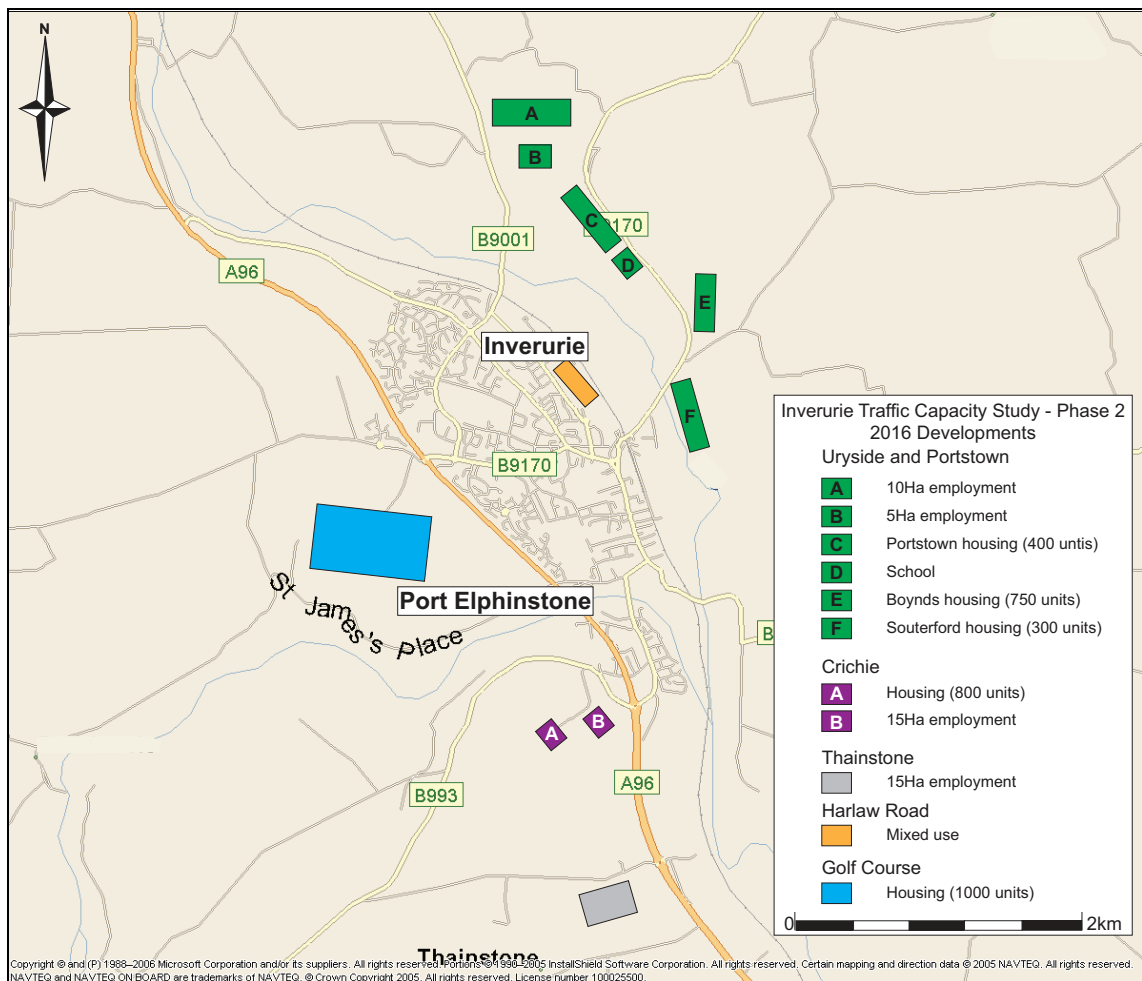


Figure 3.1 : Proposed 2016 Development Locations

3.2.3 Where necessary, the trip rates shown in Table 3.3 have been applied:

Table 3.3 : Trip Rates

	07:00-10:00		16:00 - 19:00	
	Arrivals	Departures	Arrivals	Departures
Housing	0.41	0.976	1.087	0.728
Light Industry	1.131	0.608	0.415	0.948
Office	2.801	0.499	0.404	2.333
Warehouse	0.619	0.379	0.315	0.538
Primary School	0.321	0.252	not required	

3.3 2016 Traffic Model Trip Matrix Development

3.3.1 Uryside & Portstown

3.3.2 The Uryside & Portstown development was tested as part of the original Inverurie Traffic Capacity Study. For consistency with other Aberdeenshire Traffic Capacity Studies, Aberdeenshire Council agreed that two elements of the matrix development process be altered:



- Trip rates for the housing elements of these developments changed to those in Table 3.3
- Build density of the Uryside Employment area changed to 25% class 4 at 3000m², 25% class 5 at 3000m², and 50% class 6 at 6,500m²

3.3.3 The trip distribution applied to this group of developments was taken from the previous study:

- 10% A96 North of Inverurie
- 35% Inverurie
- 35% A96 South of Thainstone
- 10% east beyond Inverurie
- 10% West via B993

3.3.4 Crichtie

3.3.5 The Crichtie development was also tested as part of the Inverurie Traffic Capacity Study – Phase 1. For consistency with other Aberdeenshire Traffic Capacity Studies, trip rates for the housing element of this development were changed to those in Table 3.3.

3.3.6 The trip distribution applied to the employment part of this development was taken from the previous study:

- 22% A96 North of Inverurie
- 33% Inverurie
- 13% A96 South of Thainstone
- 20% east beyond Inverurie
- 12% West via B993

3.3.7 The trip distribution applied to the housing element of the development was:

- 29% Inverurie Town Centre
- 64% A96 South
- 1% A96 North
- 2% B993 Westbound
- 4% B993 Eastbound

3.3.8 Golf Course Housing

3.3.9 Trip totals for the Golf Course housing development have been derived from the trip rates in Table 3.3. The trip distribution from the Crichtie housing development has been applied to the Golf Course development.

3.3.10 Thainstone

3.3.11 Trip totals for the Thainstone development were calculated using the trip rates in Table 3.3 and the following density assumption:



- 25% class 4 (business) at 3,000m²
- 25% class 5 (light Industry) at 3,000m²
- 50% class 6 (warehouse) at 6,500m²

3.3.12 With agreement from Aberdeenshire Council, the trip distribution from Thainstone Business Park was applied to the 2016 Thainstone development.

3.3.13 Harlaw Road North Development

3.3.14 This development was tested for Atkins in April 2009 (*Inverurie Town Centre North - Future Year S-Paramics Modelling, SIAS Ref: TPINVCTN/70841*).

3.3.15 Atkins assumed that 50% of the food retail element would be new trips and 50% would be 'Transferred' trips, i.e. trips that were in the network previously but now travel to the development.

3.3.16 The trip distribution applied to new development trips was:

- 10% A96 North
- 10% B9001 and B9170 North
- 30% Inverurie and Port Elphinstone
- 30% A96 South
- 10% B993 East
- 10% B993 West

3.3.17 Transferred trips were assigned to the model using the following distribution:

- 10% pass by trips from B9001 Harlaw Rd
- 40% transferred from: Tesco (30%) and Morrisons (10%)
- 50% from the outskirts of Inverurie

3.4 2016 Development Trip Totals

3.4.1 Table 3.4 shows the calculated trip totals for each of the developments.

Table 3.4 : Development Trip Totals

Development	AM	PM
	07:00-10:00	16:00-19:00
Crichie	1581	1904
Golf Course Housing	1386	1815
Thainstone	1052	877
Uryside & Portstown	3178	3510
Harlaw Rd North - New Trips (not including diverted trips)	611	1348



3.4.2 The traffic demand matrices were adjusted to minimise double counting and allow internal trips to occur between new housing and existing employment and vice versa. This reduced the number of new trips which were added to the network.

3.5 2016 Infrastructure Improvements

3.5.1 A total of four infrastructure improvements are included in the 2016 testing, and are illustrated in Figure 3.2.

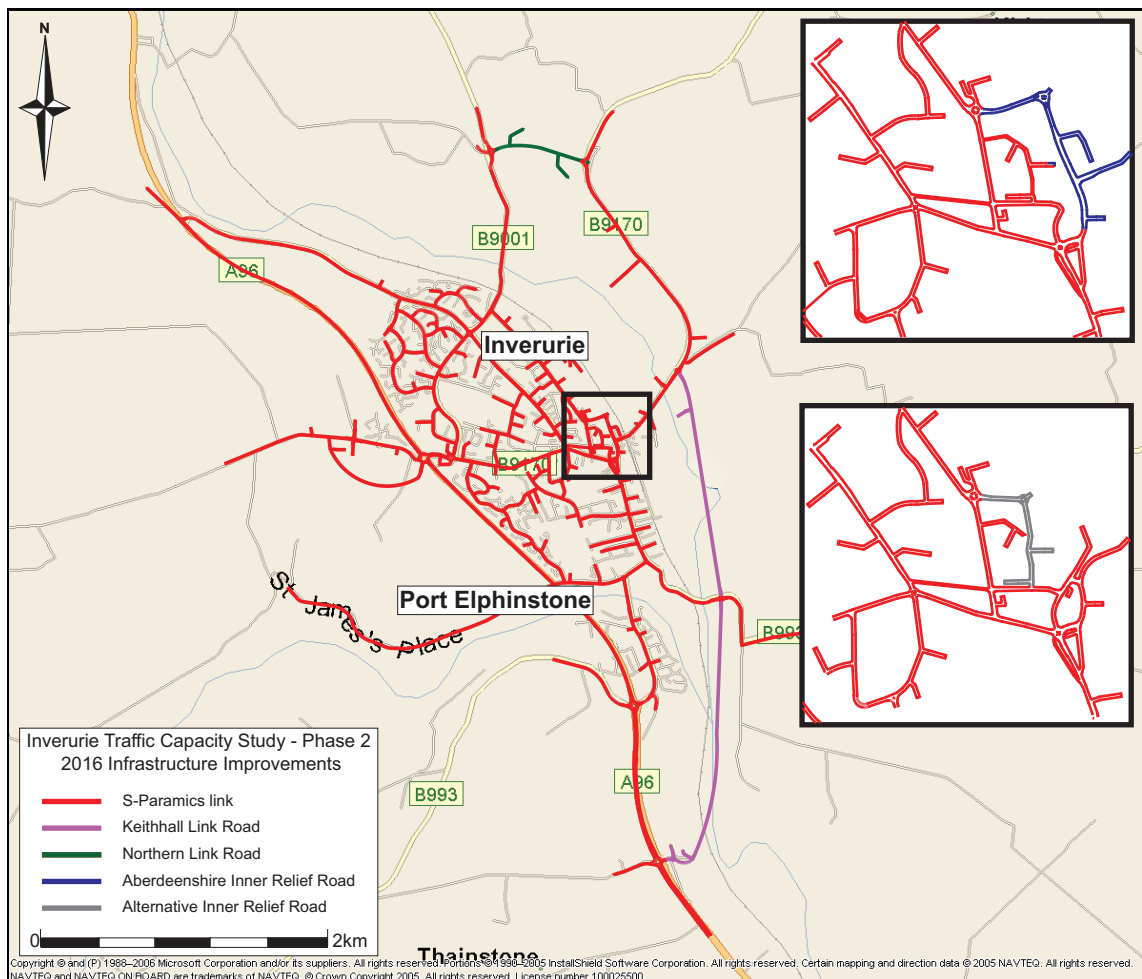


Figure 3.2 : 2016 Infrastructure Improvements

3.5.2 The Northern Link Road connects the B9001 with the B9170 at the North of Inverurie, with roundabout connections at each end. The Keithhall Link Road provides a by-pass to the East of the town, from Thainstone Roundabout at the south to a new roundabout on the B9170 at Uryside at the north. Approximately half way along the link road there is also a roundabout connection with the B993.

3.5.3 The Inverurie Inner Relief Road comprises a new T-junction arrangement with the B9170 and the new link connecting with the roundabout at Tesco. The Alternative Inner Relief Road is a smaller scheme incorporating an existing section of Burn Lane and also connecting to the roundabout at Tesco.



4 INITIAL SCHEME ASSESSMENT

4.1 Introduction

- 4.1.1 Prior to undertaking the full testing programme, an initial assessment was requested by Aberdeenshire Council of the Inverurie Inner Relief Road scheme. Right turning traffic from High Street Close to the minor east arm of the town centre triangle was observed on site to cause queueing on High Street Close northbound. The proposed increase in development traffic for the test scenarios would put additional pressure on this corridor.
- 4.1.2 An initial assessment was also carried out on Tests 8 and 9. Test 8 is the 2016 Reference Case plus the Harlaw Road North development and the Inverurie Inner Relief Road, Test 9 is Test 8 plus the Uryside developments and the Northern Link Road.
- 4.1.3 Two additional tests were carried out (Tests 8b and 9b) with the minor east arm of the triangle one way southbound. This removed the right turn from High Street Close, removing delay at this location. Table 4.1 demonstrates this alteration significantly reduced the volume of traffic using the minor arm of the triangle.
- 4.1.4 Peak hour traffic flows were extracted for the town centre area for both tests, and flows for the minor east arm of the town centre triangle are shown in Table 4.1.

Table 4.1 : Peak Hour Link Flow

Scenario	AM (08:00 - 09:00)			PM (17:00 - 18:00)		
	Northbound	Southbound	Total	Northbound	Southbound	Total
Ref Case	269	199	468	330	197	527
8	278	258	536	340	270	610
8b	-	226	226	-	225	225
9	324	309	633	306	310	616
9b	-	326	326	-	316	316

- 4.1.5 The traffic flows show an increase in the two way flow on the minor east arm of the triangle in Tests 8 and 9 compared to the Reference Case.
- 4.1.6 Average journey times were compared on two routes, in both directions, in the AM and PM peak hours. The routes compared are shown in Figure 4.1.



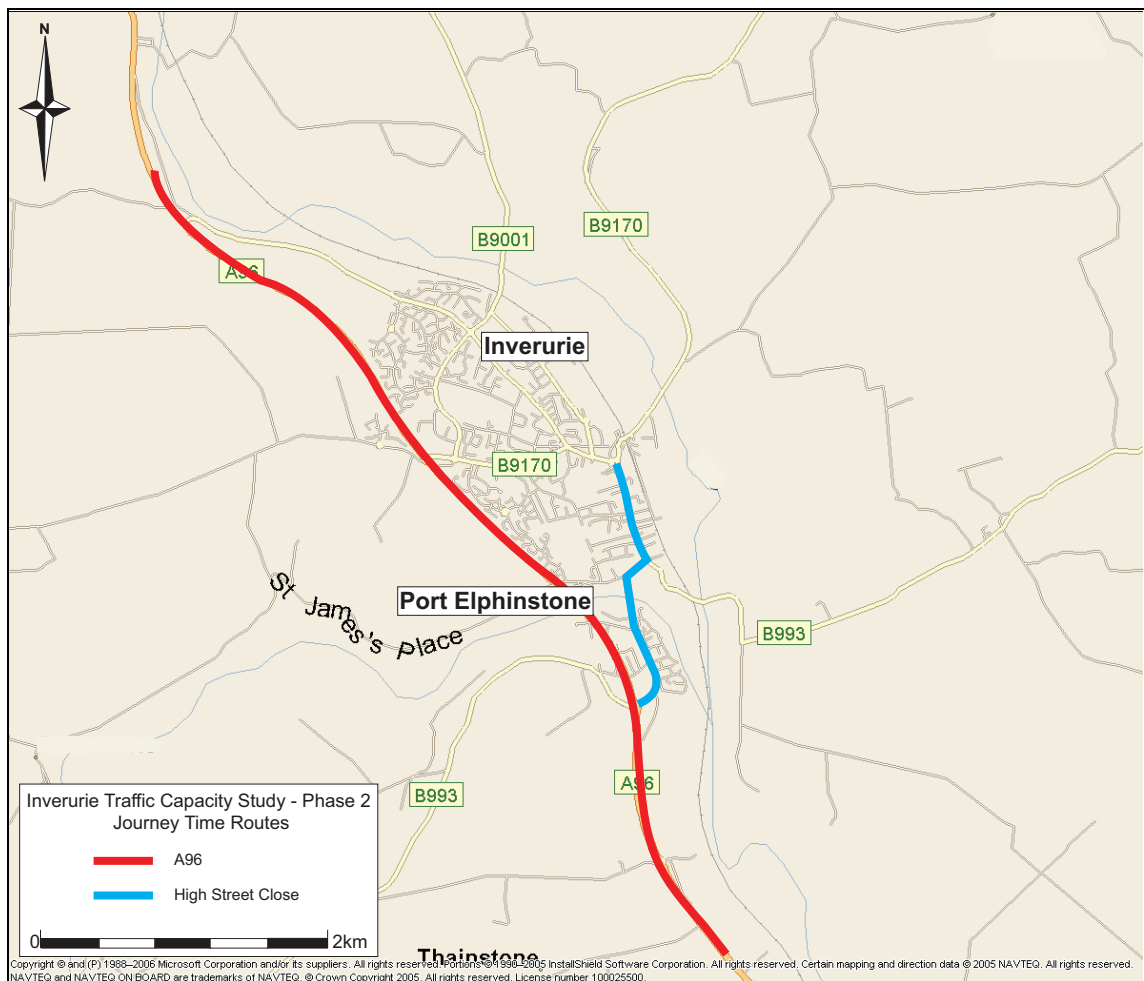


Figure 4.1 : Initial Testing – Journey Time Routes

4.1.7 All journey time statistics are calculated from an average of five S-Paramics model runs. Figures 4.2 and 4.3 show the AM and PM peak hour average journey times for Tests 9 and 9b. Results for Tests 9 and 9b have been shown and not 8 and 8b, as the Test 9 scenarios contain more development traffic and illustrate the differences more clearly.



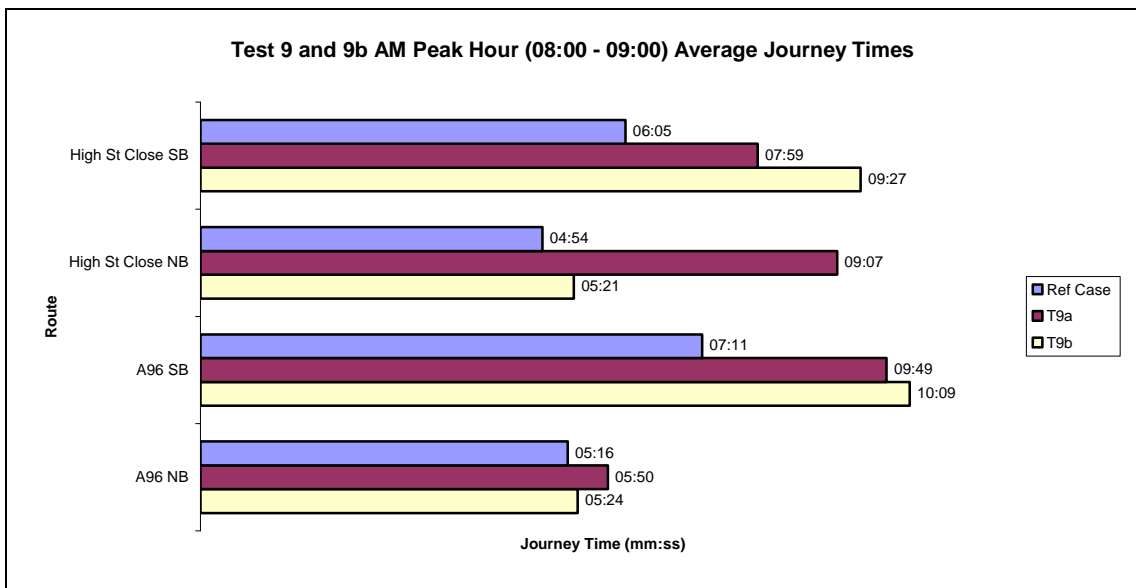


Figure 4.2 : Tests 9 and 9a AM Peak Hour Journey Times

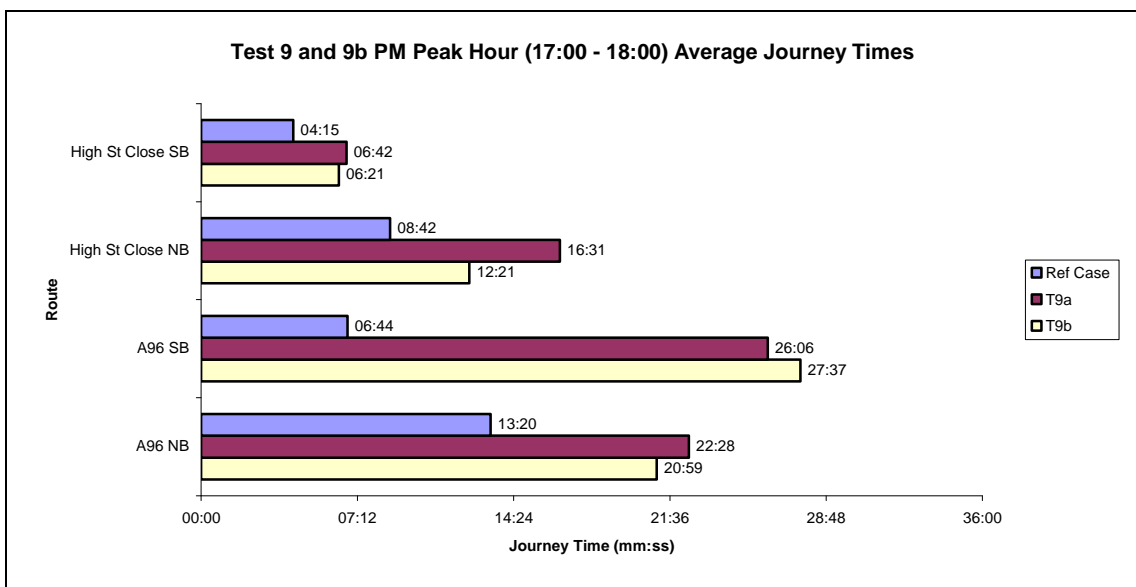


Figure 4.3 : Tests 9 and 9a PM Peak Hour Journey Times

4.1.8 Figure 4.2 shows that in the AM peak, journey times on High Street Close northbound are significantly lower in Test 9b compared to Test 9a. Journey times are also lower on the A96 northbound. Southbound journey times are higher in Test 9b, as southbound queuing on the new one way link results in traffic choosing to route via the mini roundabout and then south onto High Street Close. Overall the reduction in northbound delay seems to outweigh the increase in southbound delay.

4.1.9 Figure 4.3 shows a similar pattern in the PM peak. Northbound journey times are lower in Test 9b, as are southbound journey times on High Street Close. The southbound journey time on the A96 is slightly higher but the overall reduction in delay may outweigh the southbound increase on the A96.



- 4.1.10 With agreement from Aberdeenshire Council, the one way southbound amendment has been applied to all tests which include the Inverurie Inner Relief Road.



5 TESTS 1-3 – INITIAL CRICHIE AND THAINSTONE DEVELOPMENT TESTING

5.1 Introduction

5.1.1 Tests 1 to 3 have been grouped together for comparison as all are based on the 2016 Reference Case with the addition of the Crichtie and Thainstone Developments. Test 2 includes the Inverurie Inner Relief Road and Test 3 includes the Keithhall Link Road.

5.2 Test 1: Introduction and Model Observations

5.2.1 Test 1 – 2016 Reference Case with the addition of the Crichtie and Thainstone Developments.

5.2.2 In the AM peak, southbound queueing on the A96 from Port Elphinstone Roundabout was observed to reach approximately 1,800m by 08:25, due to the cutting movement caused by traffic from the Crichtie development. This delay results in re-routing through the town, and a southbound queue was observed from Port Elphinstone Roundabout extending back to the town centre. Traffic then re-routes back onto the A96 and the southbound queue from Port Elphinstone Roundabout extends past Blackhall Road Roundabout.

5.2.3 In the PM peak, queueing was observed northbound on the A96 from Port Elphinstone Roundabout due to the cutting movement of traffic turning into Crichtie. The queue reaches the extents of the model by 16:50 with approximately 1,300 vehicles queued into Thainstone development and off the south of the network on the A96 by 18:55. This compares to approximately 60 vehicles in the Reference Case.

5.3 Test 2: Introduction and Model Observations

5.3.1 Test 2 – Test 1 with the addition of the Inverurie Inner Relief Road. As discussed in Section 4, the inner relief road scheme also includes a one way southbound link on the east arm of the town centre triangle.

5.3.2 Queueing in Test 2 was observed to be similar to Test 1, in both the AM and PM peaks. In the AM peak, the addition of the Inverurie Inner Relief Road was observed to reduce congestion in the town centre, releasing traffic through the town quicker and slightly increasing congestion southbound at Port Elphinstone Roundabout.

5.3.3 In the PM peak, no significant benefits were observed compared to Test 1, due to the volume of traffic unable to join the model as a result of the northbound queue from Thainstone Roundabout.

5.4 Test 3: Introduction and Model Observations

5.4.1 Test 3 – Test 1 with the addition of the Keithhall Link Road.

5.4.2 In both the AM and PM peaks, the Keithhall Link Road improved the operation of the network by diverting traffic away from the town centre and the A96 roundabouts.

5.4.3 In the AM peak, southbound queueing on the A96 was lower than Test 1 for most of the model peak, although the queue still extended approximately 1,800m from Port Elphinstone Roundabout briefly after 09:00. The southbound queue on Elphinstone Road from Port Elphinstone Roundabout reached a maximum of approximately 700m (not as far as the mini roundabout at St James Place), compared to Test 1 which extended north on High St Close to the town centre.



- 5.4.4 In the PM peak, northbound delay from Port Elphinstone Roundabout was reduced. Approximately 250 vehicles were unable to join the model network from the Thainstone development at 18:55, due to the cutting movement of northbound traffic on the A96. This compares to a total of approximately 1,300 vehicles queued off the model network at the Thainstone Development and the A96 in Tests 1 and 2.

5.5 Test 1-3 Journey Time Comparisons

- 5.5.1 Average journey times were compared on four routes, in both directions, in the AM and PM peak hours. The routes compared are shown in Figure 5.1.

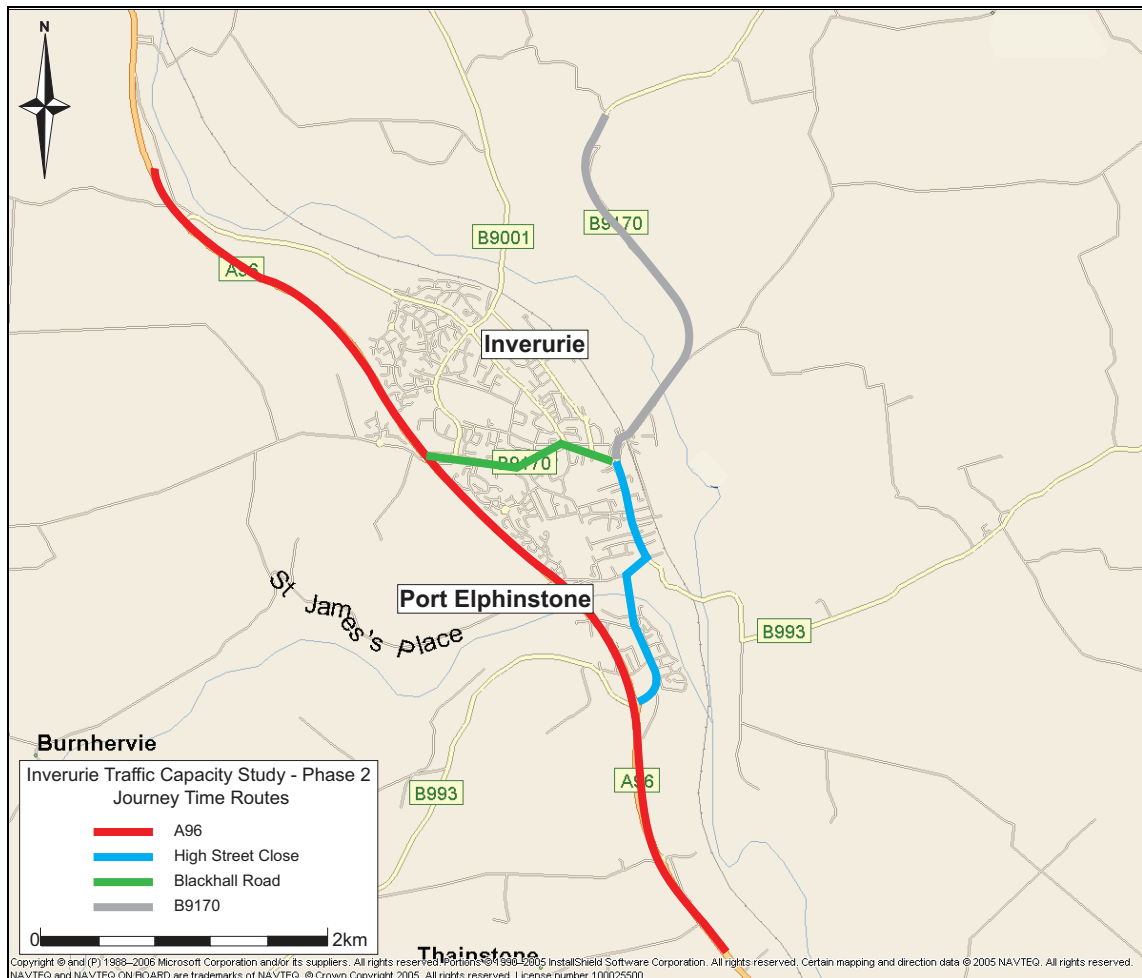


Figure 5.1 : Journey Time Routes

- 5.5.2 All journey time statistics are calculated from an average of five S-Paramics model runs. Figures 5.2 and 5.3 show the AM and PM peak hour average journey times.



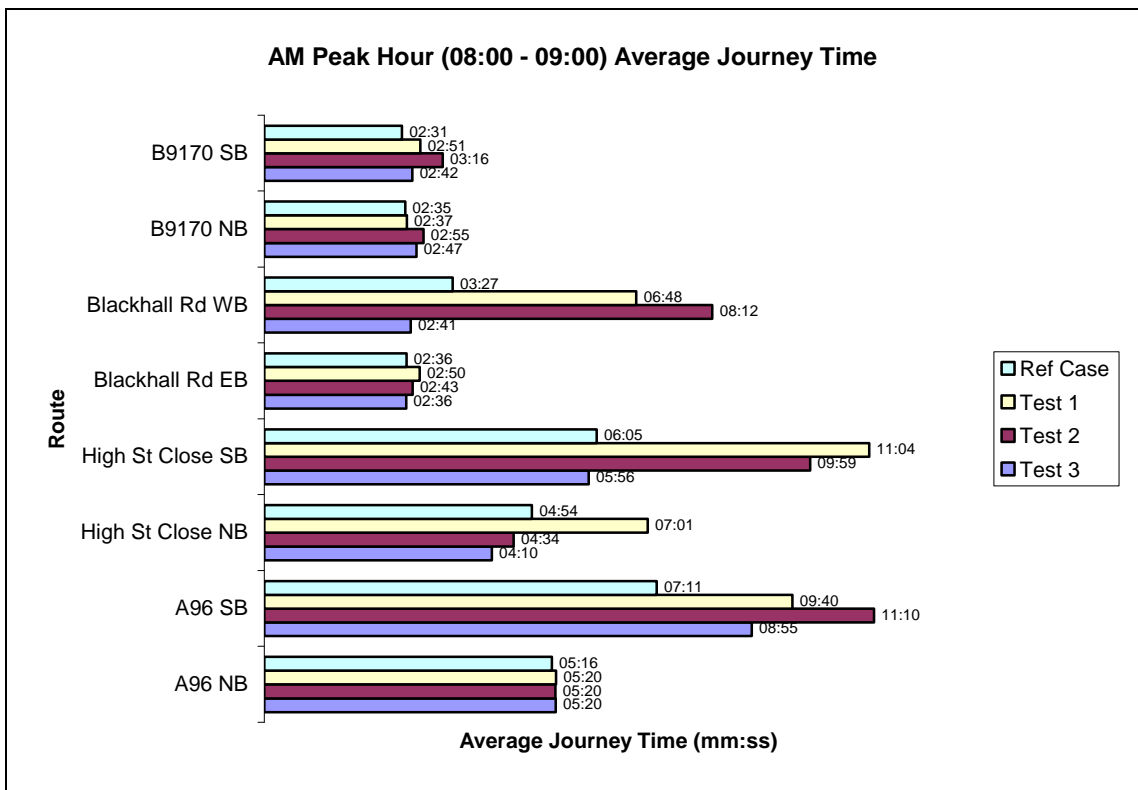


Figure 5.2 : Tests 1-3 AM Peak Hour Journey Times

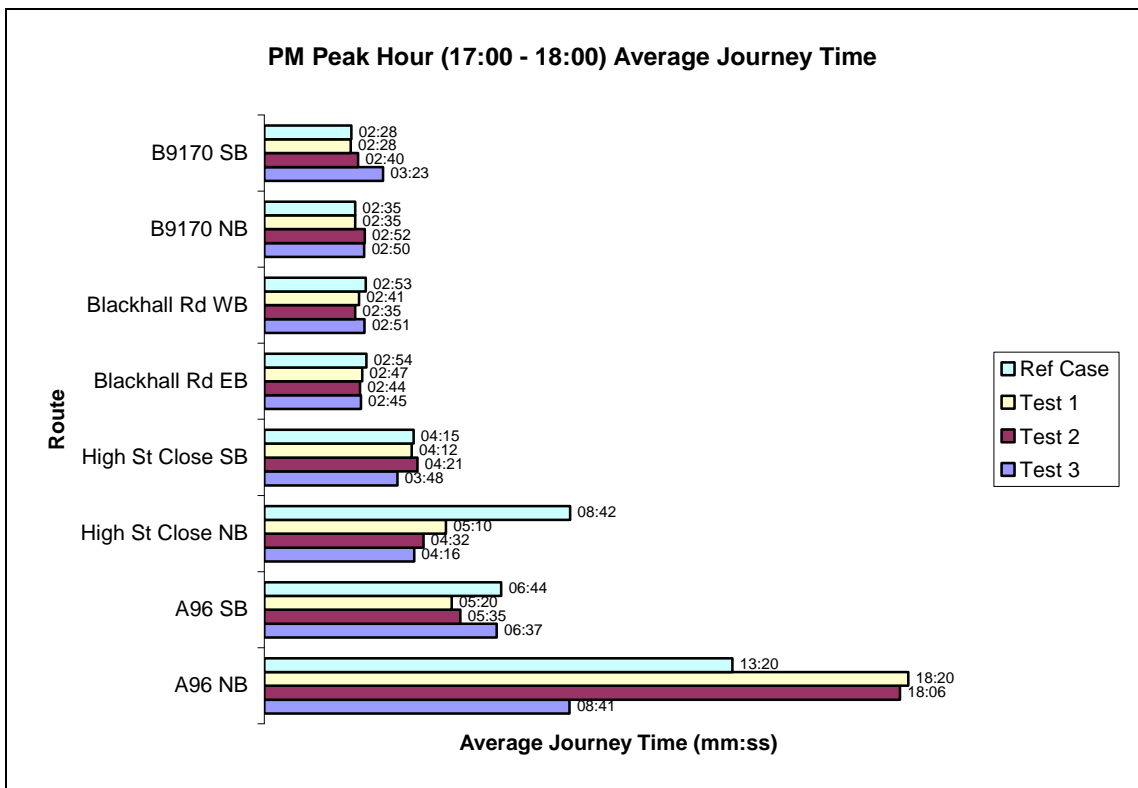


Figure 5.3 : Tests 1-3 PM Peak Hour Journey Times



- 5.5.3 Figure 5.2 shows that in the AM peak, journey times on High Street Close are longest in Test 1 with no network improvements and shortest in Test 3 with the Keithhall Link Road which diverts traffic away from the town centre and A96.
- 5.5.4 In the PM peak, journey times on High Street Close northbound appear lower compared to the Reference Case. This can mainly be attributed to the volume of traffic queued off the network as a result of junction capacity delay at Thainstone Roundabout.

5.6 Test 1-3 Queue Summary

- 5.6.1 As an additional delay comparison, the average number of queued vehicles inside the cordons shown in Figure 5.4, were compared for Tests 1 to 3. The results are calculated as an average of five S-Paramics model runs.

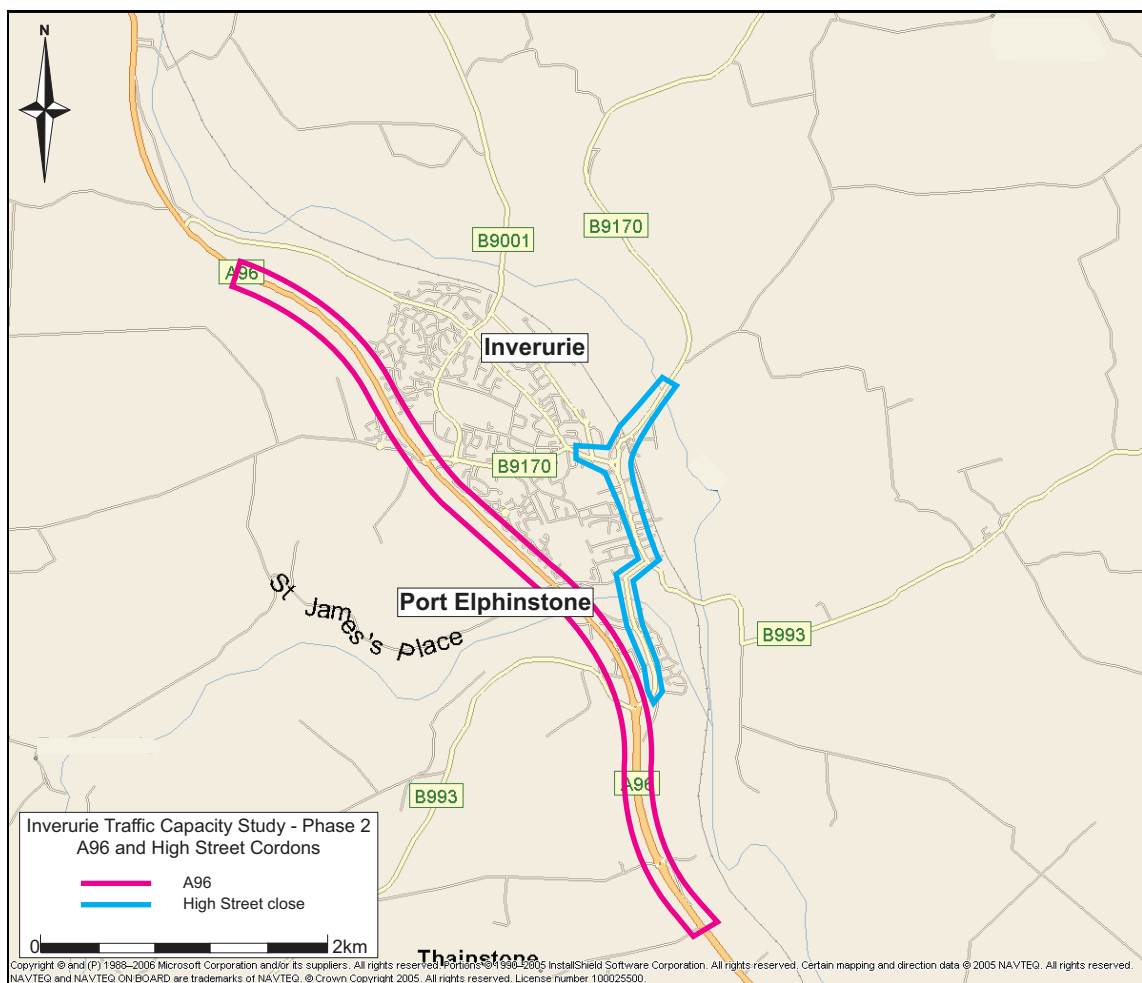


Figure 5.4 : Queue Cordons

- 5.6.2 The AM and PM A96 queue results are shown in Figures 5.5 and 5.6.



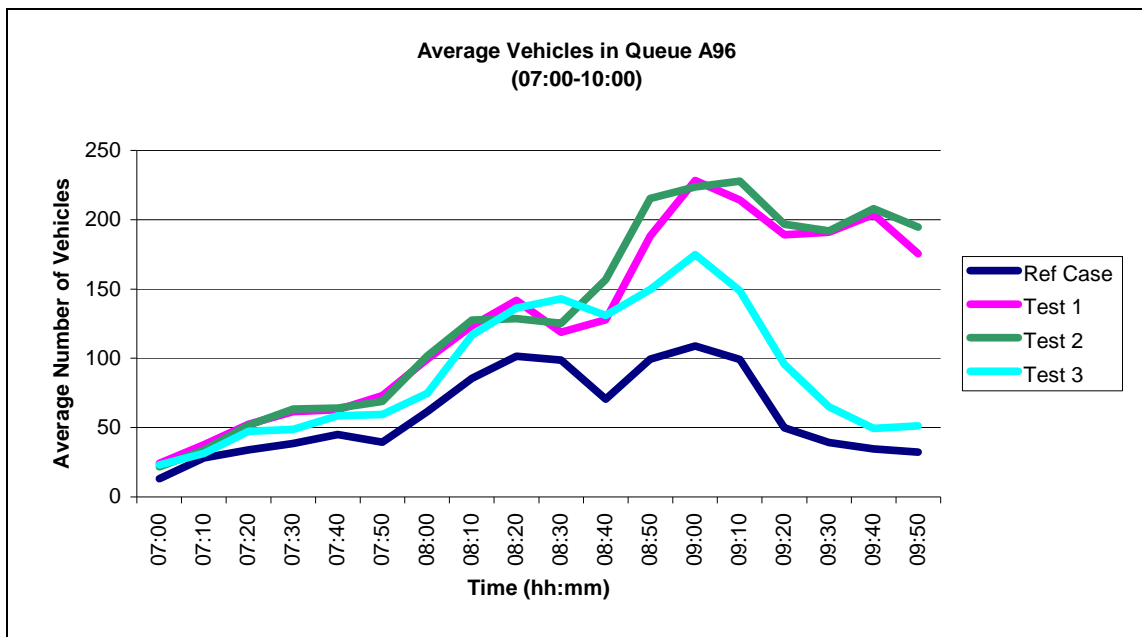


Figure 5.5 : AM Peak – Queue Summary – A96

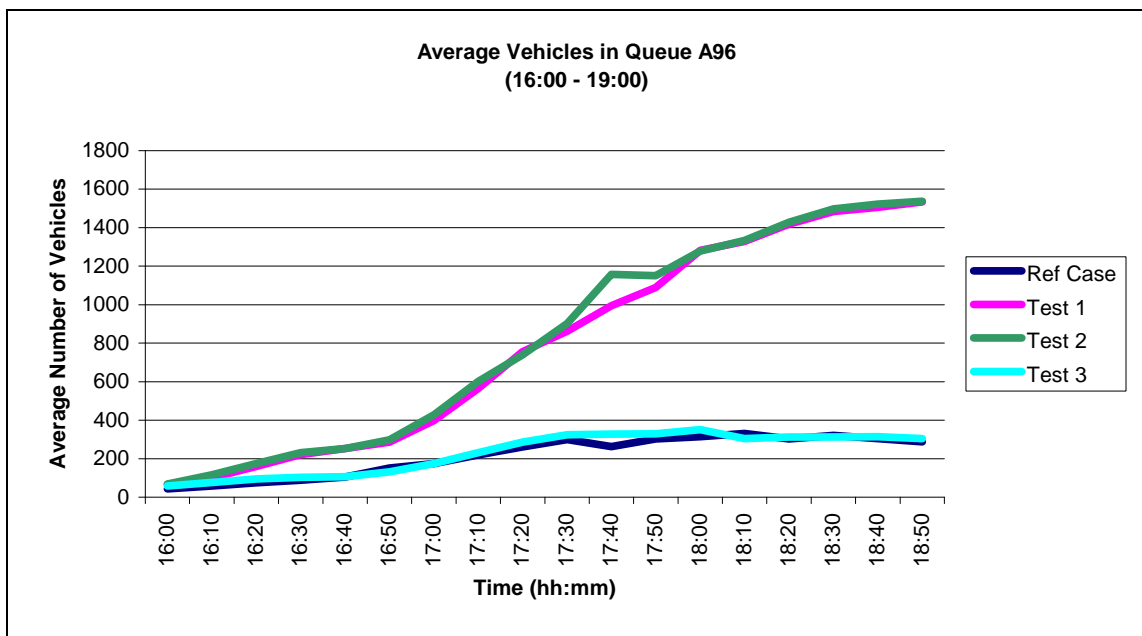


Figure 5.6 : PM Peak – Queue Summary – A96

5.6.3 Figures 5.5 and 5.6 show the significant difference in the levels of congestion between the AM and PM peaks, with Tests 1 and 2 reaching approximately 230 queued vehicles in the AM peak and approximately 1,500 vehicles in the PM peak. The introduction of the Keithhall Link Road in Test 3 reduces the number of queueing vehicles in the PM peak on the A96 to levels similar to the Reference Case.

5.6.4 The AM and PM High Street Close queue results are shown in Figures 5.7 and 5.8.



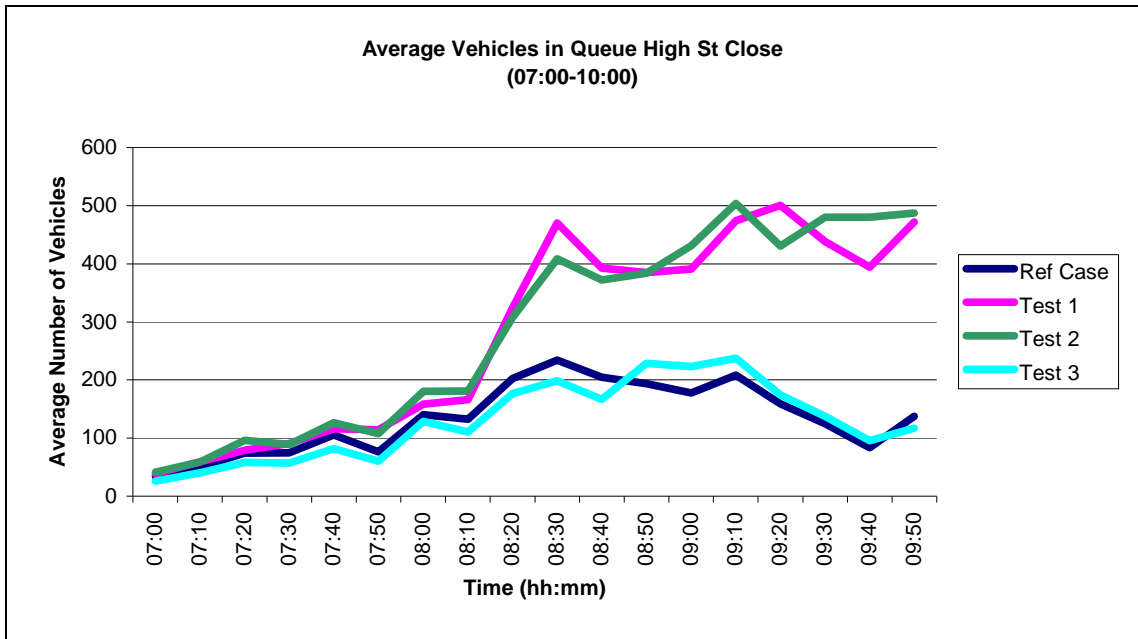


Figure 5.7 : AM Peak – Queue Summary – High Street Close

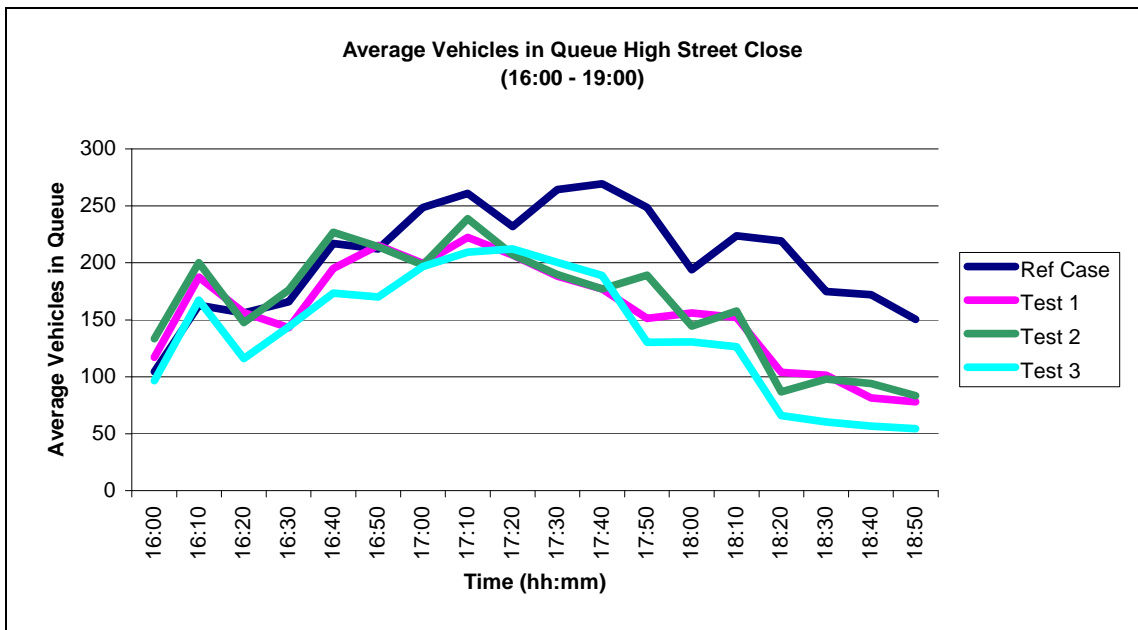


Figure 5.8 : PM Peak – Queue Summary – High Street Close

- 5.6.5 Figure 5.7 shows that in the AM peak, queuing in Test 3 was similar to the Reference Case, while Tests 1 and 2 were observed to have approximately 300 more queuing vehicles.
- 5.6.6 Figure 5.8 shows that in the PM peak there was no significant difference in queuing between the three tests. This is due to the high number of vehicles being held off the network to the south, as a result of northbound queuing from Port Elphinstone Roundabout.



5.7 Test 1 – 3 Summary

- 5.7.1 Tests 1 to 3 are based on the 2016 Reference Case with the addition of the Crichtie and Thainstone Developments. Test 2 includes the Inverurie Inner Relief Road and Test 3 includes the Keithhall Link Road.
- 5.7.2 The addition of the Crichtie and Thainstone developments in Test 1 results in a significant increase in queueing on the A96 at Port Elphinstone Roundabout, southbound in the AM peak and northbound in the PM peak. The addition of the inner relief road in Test 2 does not provide any significant benefit due to traffic being held in congestion at the south of the town.
- 5.7.3 The introduction of the Keithhall Link Road in Test 3 significantly reduces northbound congestion in the PM peak by providing an alternative route north, avoiding Port Elphinstone Roundabout and High Street Close, however, egress from the Thainstone Development remains a problem due to the cutting movement of northbound traffic on the A96, with approximately 250 vehicles queued into the development at 18:55.





6 TESTS 4 – 6: GOLF COURSE HOUSING DEVELOPMENT TESTING

6.1 Introduction

- 6.1.1 Tests 4 – 6 have been grouped together for comparison. Tests 4 – 6 have been developed from Tests 1 – 3, with the addition of the Golf Course Housing development.
- 6.1.2 Peak hour traffic flows at Blackhall Road Roundabout, for Tests 4 – 6, have been included in Appendix A, and illustrate the forecast increased traffic demand at the roundabout as a result of the Golf Course Development.

6.2 Test 4: Introduction and Model Observations

- 6.2.1 Test 4: Test 1 plus the Golf Course Housing development.
- 6.2.2 In the AM peak, the additional Golf Course traffic gains egress from the development via Blackhall Road Roundabout but quickly exacerbates the southbound queue on the A96 from Port Elphinstone Roundabout. Traffic then re-routes through the town causing significant congestion and the model gridlocks by 09:30.
- 6.2.3 In the PM peak, the A96 northbound queue from Port Elphinstone Roundabout, which was present in Test 1, was significantly increased. There are approximately 2,030 vehicles queued off the model network on the A96 south and Thainstone development, due to congestion at Thainstone Roundabout.

6.3 Test 5: Introduction and Model Observations

- 6.3.1 Test 5 – Test 2 plus the Golf Course Housing development.
- 6.3.2 In both the AM and PM peaks, Test 5 was observed to operate very similarly to Test 4. Test 5 includes the addition of the Inverurie Inner Relief Road. This was observed to make no significant difference due to the high level of congestion observed in both peaks, throughout the model network.

6.4 Test 6: Introduction and Model Observations

- 6.4.1 Test 6 – Test 3 plus the Golf Course Housing development.
- 6.4.2 In the AM peak, increased queueing was observed on all southbound routes compared to Test 3. At 09:00 the southbound queue on the A96 from Port Elphinstone Roundabout extends back to Blackhall Road Roundabout (approx 2400m), compared to approximately 1,600m in Test 3. Southbound queues on Elphinstone Road and the Keithhall Link Road are approximately 200m longer. A queue of approximately 500m was observed southbound on the A96 at Thainstone Roundabout, compared to 100m in Test 3. The model was able to run without gridlocking and there was significantly less congestion than Tests 4 or 5 due to the additional network capacity as a result of the Keithhall Link Road.
- 6.4.3 In the PM peak, northbound queueing was observed to increase throughout the network compared to Test 3, particularly on the A96. The northbound queue from Blackhall Road Roundabout was observed to reach approximately 1,700m compared to 200m in Test 3. The northbound queue on the B993 from the traffic signals at the junction with High Street Close extends back onto the Keithhall Link Road to a maximum total length of approximately 2,000m, compared to approximately 500m in Test 3. The northbound A96 queue from Thainstone



Roundabout was lower than Tests 4 and 5 with approximately 950 vehicles unable to join the model from the A96 south and the Thainstone development, compared to over 2,000 in Tests 4 and 5.

6.5 Test 4-6 Mean Travel Time

6.5.1 As an overall comparison of network performance, the mean travel time was calculated as an average of five S-Paramics model runs. The mean travel time is the total time taken for all vehicles to route in the model network. It is a good comparator statistic between varying model networks when assessing queueing and delay. Mean travel time is given as a time in days. Mean travel time statistics for all tests are provided in Appendix D.

6.5.2 Figure 6.1 shows the AM and PM mean travel times. Results for Tests 1 to 3 have been included for comparison.

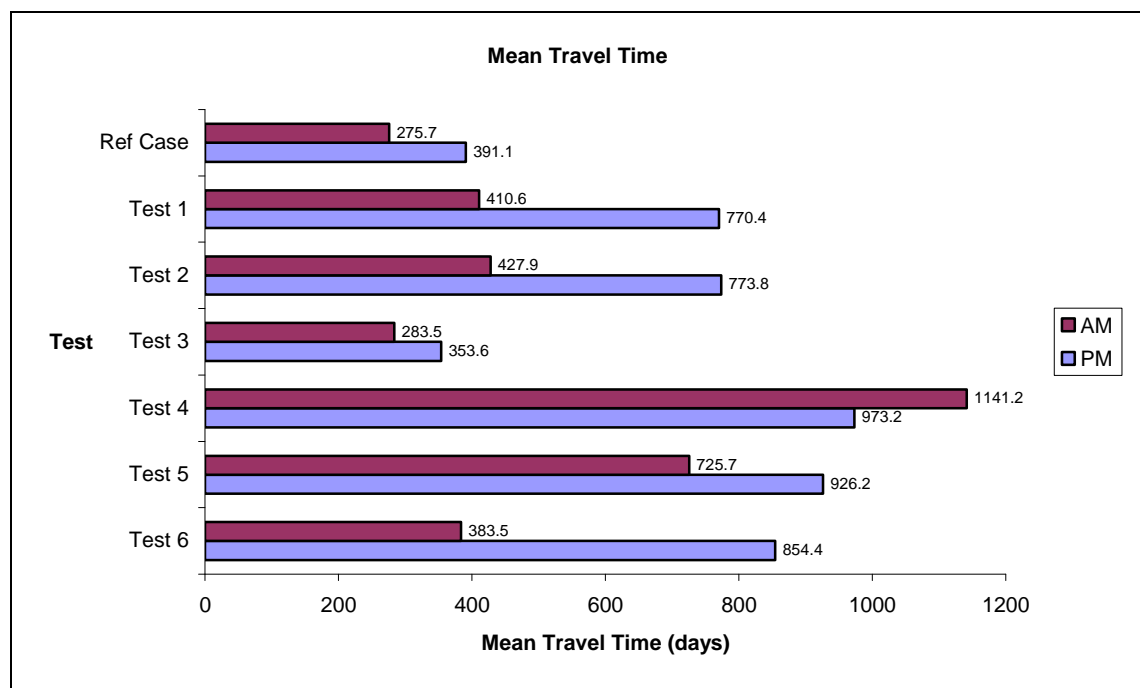


Figure 6.1 : Mean Travel Time Summary

6.5.3 Figure 6.1 shows that the mean travel time in the AM peak is significantly higher in Tests 4 and 5 than in Tests 1 and 2 due to the addition of the Golf Course housing development. Test 6, with the Keithhall Link Road copes well with the additional traffic in the AM peak.

6.5.4 In the PM peak Tests 4 – 6 show similar mean travel times, as the addition of the Golf Course housing development causes significant congestion throughout the model network, in particular the A96 northbound at Port Elphinstone and Thainstone Roundabouts.

6.6 Test 4 – 6 Summary

6.6.1 Tests 4 – 6 have been developed from Tests 1 to 3, with the addition of the Golf Course housing development. Peak hour traffic flows at Blackhall Road Roundabout have been included in Appendix A.

6.6.2 Test 4 contains the three developments (Crichie, Thainstone and Golf Course), but no infrastructure improvements. Test 4 gridlocks in the AM peak and in the PM peak over 2,000



vehicles are unable to join the model network due to congestion, extending back from a queue at Port Elphinstone Roundabout.

- 6.6.3 Test 5 contains the same development content as Test 4, but also includes the Inverurie Inner Relief Road. The relief road provides little benefit due to the high levels of congestion and the model gridlocks in the AM peak and has a similar number of vehicles unable to join the network in the PM peak.
- 6.6.4 Test 6 contains the same development content as Test 4, but also includes the Keithhall Link Road. The link road significantly reduces congestion in the AM peak, as shown in the mean travel time statistic, however, in the PM peak, queueing still extends from Port Elphinstone Roundabout, through Thainstone Roundabout and off the model with approx 950 vehicles unable to join the model network due to congestion.





7 TESTS 7 AND 8 – INNER RELIEF ROAD TESTING

7.1 Introduction

7.1.1 Tests 7 and 8 have not been based on any previous tests but have been developed from the 2016 Reference Case, with the addition of the Harlaw Road development, just north of Tesco. Test 7 contains the Alternative Inner Relief Road and Test 8 contains the Inverurie Inner Relief Road.

7.2 Test 7: Introduction and Model Observations

7.2.1 Test 7: 2016 Reference Case plus Harlaw Road North Development plus Alternative Inner Relief Road

7.2.2 In the AM peak, no significant difference in queueing was observed from the Reference Case.

7.2.3 In the PM peak, increased queueing was observed on the A96 northbound from Port Elphinstone Roundabout, extending off the model network on the A96 and Thainstone by approximately 270 vehicles, compared to 50 in the Reference Case. Congestion was also higher in the town centre due to the increase in development traffic, with the northbound queue on High Street Close extending back onto Elphinstone Road and the B993.

7.3 Test 8: Introduction and Model Observations

7.3.1 Test 8: 2016 Reference Case plus Harlaw Road North Development plus Inverurie Inner Relief Road

7.3.2 In the AM peak, Test 8 was observed to be very similar to Test 7 with no significant problems, only a slight increase in southbound queueing on the A96.

7.3.3 In the PM peak, Test 8 was observed to have similar levels of queueing on the A96 as Test 7 but less congestion was observed on High Street Close and in the town centre.

7.4 Test 7 and 8 Journey Time Comparisons

7.4.1 Average journey times were compared on four routes, in both directions, in the AM and PM peak hours. The AM and PM journey times are shown in Figures 7.1 and 7.2.



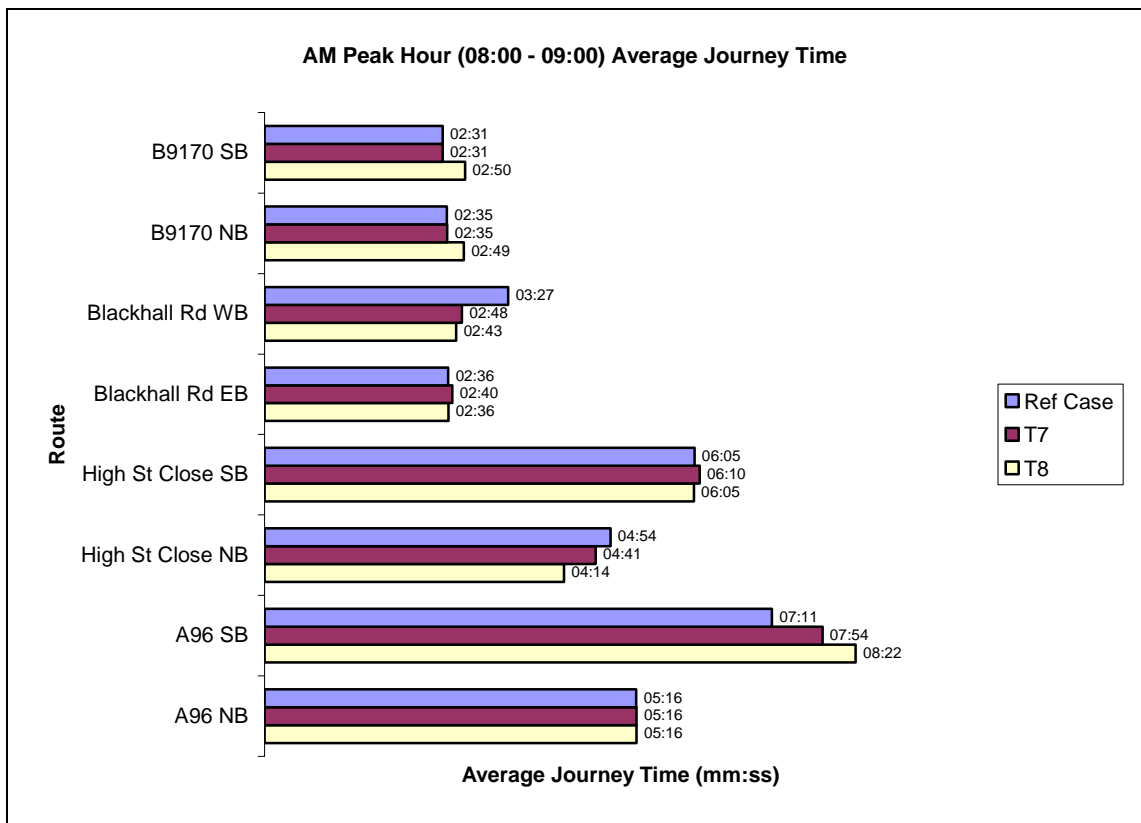


Figure 7.1 : Test 7 and 8 AM Peak Hour Average Journey Times

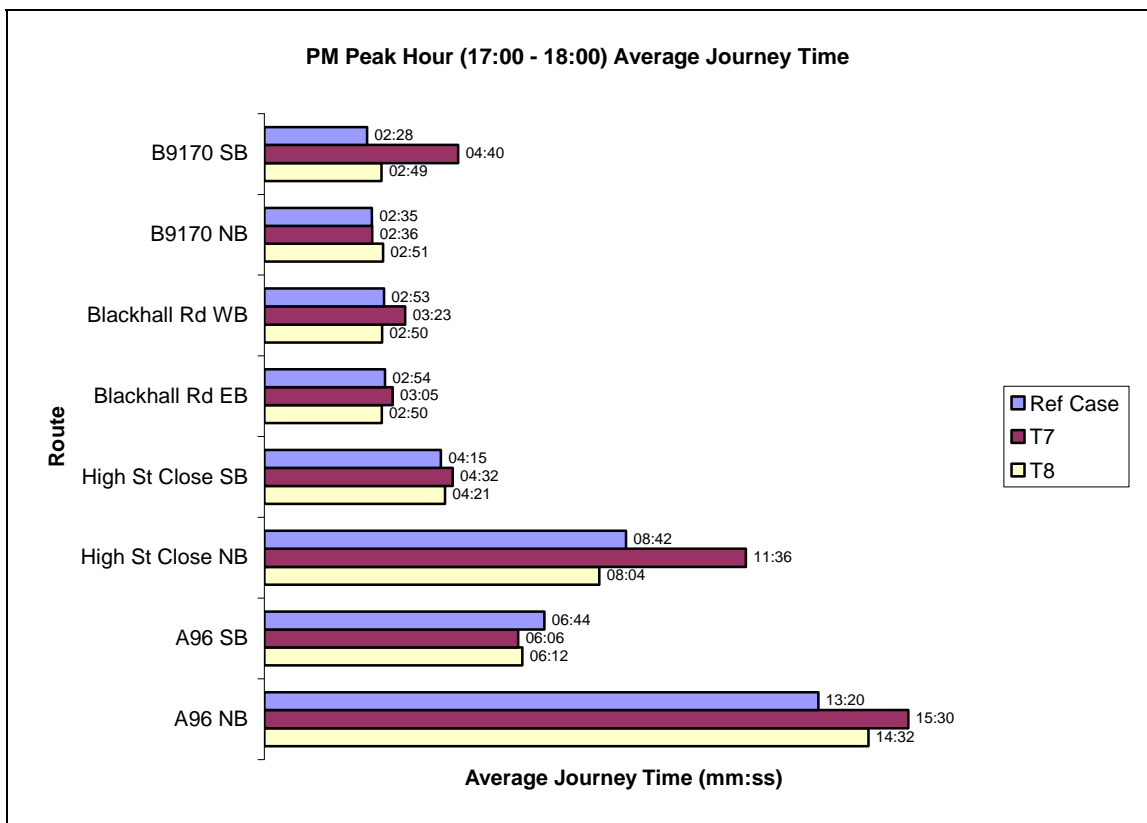


Figure 7.2 : Test 7 and 8 PM Peak Hour Average Journey Times



- 7.4.2 The journey time results show that in the AM peak there are no significant differences between the two tests on most routes. On High Street Close northbound, the journey time was slightly lower in Test 8 compared to Test 7, however, journey times were slightly higher on the A96 southbound, as traffic was able to progress through the town quicker.
- 7.4.3 In the PM peak, northbound journey times are lower in Test 8 compared to Test 7 on High Street Close and the A96, indicating that the Inverurie Inner Relief Road is more effective than the Alternative Inner Relief Road.

7.5 Test 7 and 8 Queue Summary

- 7.5.1 As an additional comparison of delay in the town centre, the average number of queued vehicles inside the cordon shown in Figure 7.3 was compared for Tests 7 and 8. The results are calculated as an average of five S-Paramics model runs.

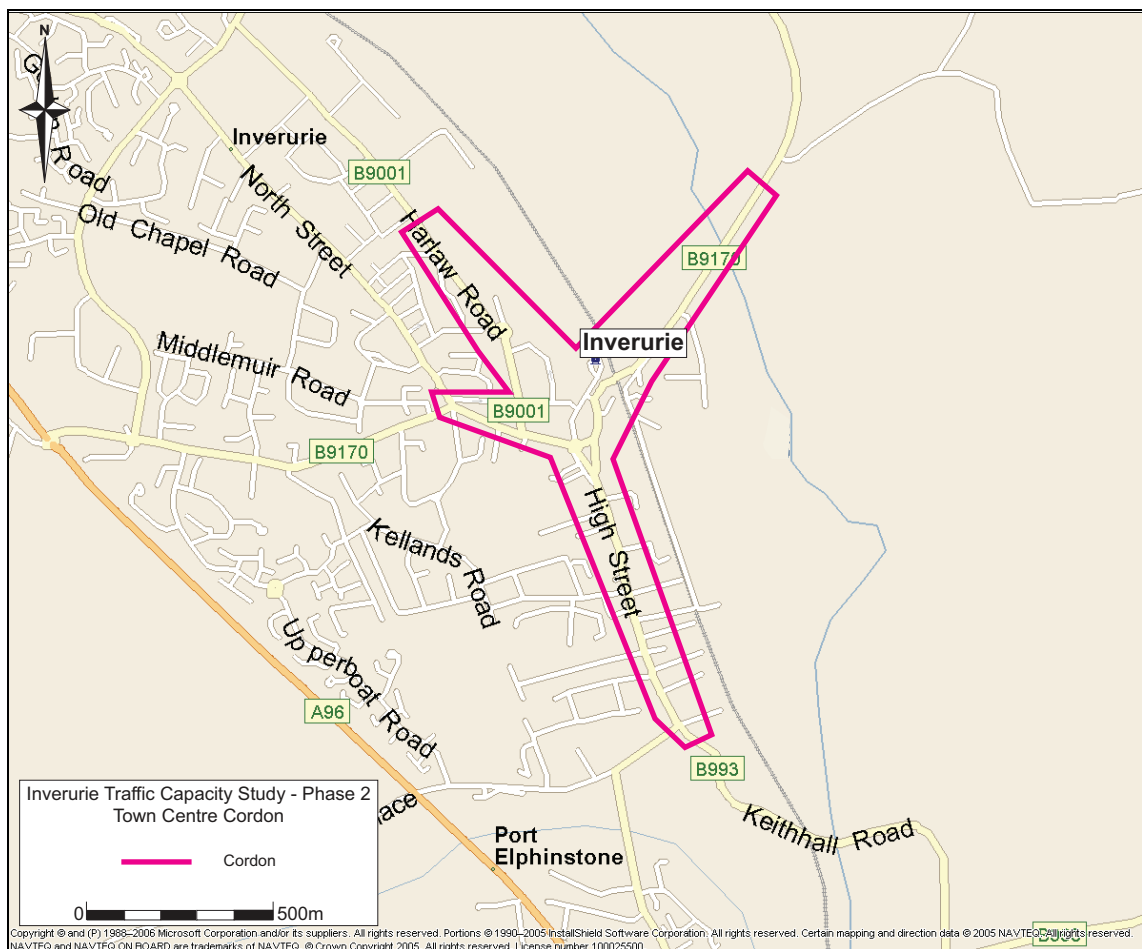


Figure 7.3 : Town Centre Cordon

- 7.5.2 The AM and PM results are shown in Figures 7.4 and 7.5.



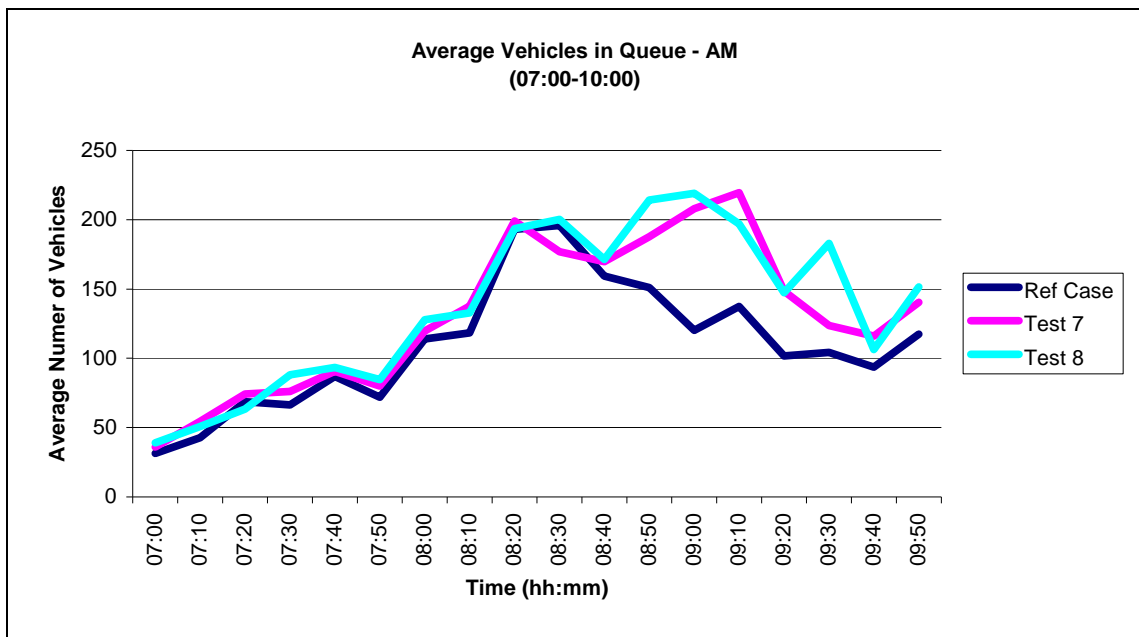


Figure 7.4 : AM Peak - Average Number of Vehicles in a Queue

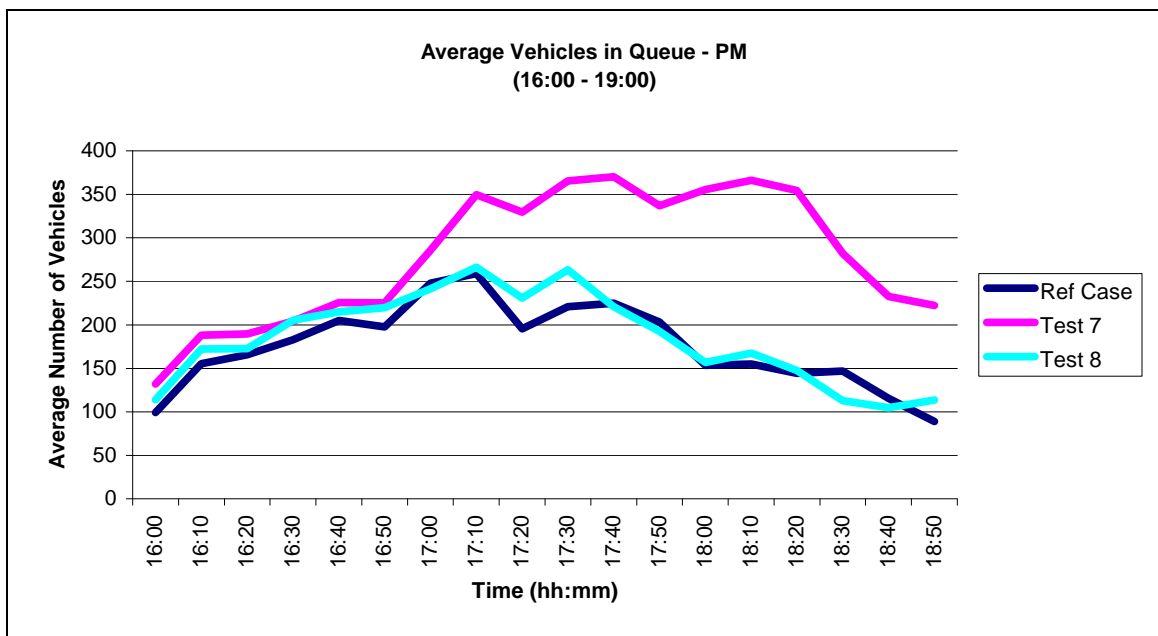


Figure 7.5 : AM Peak - Average Number of Vehicles in a Queue

- 7.5.3 Figure 7.4 shows that in the AM peak there is no significant difference in number of queuing vehicles in the town centre area, between Test 7 and 8.
- 7.5.4 In the PM peak Test 8 shows a significantly lower number of queued vehicles than Test 7, indicating that the Inverurie Inner Relief Road, with the one way southbound section on the east arm of the town centre triangle is more effective than the Alternative Inner Relief Road (Test 7).



7.6 Test 7 and 8 Summary

- 7.6.1 Tests 7 and 8 are developed from the 2016 Reference Case plus the Harlaw Road North development. Test 7 contains the Alternative Inner Relief Road and Test 8 the Inverurie Inner Relief Road.
- 7.6.2 The model observations and statistics show there is no significant difference in the operation of the two tests in the AM peak.
- 7.6.3 In the PM peak, model observations showed less congestion in the town centre area in Test 8. This was confirmed by lower journey times on the A96 and High Street Close northbound, and a reduction in the average number of queueing vehicles in the town centre area.





8 TESTS 9 -11 – URYSIDE & PORTSTOWN DEVELOPMENT TESTING

8.1 Introduction

8.1.1 Test 9 has been based on Test 8 (2016 Ref Case & Harlaw Rd & Inverurie Inner Relief Road) and also includes the Uryside and Portstown developments and the Northern Link Road. Test 10 has been developed from Test 9 with the Inverurie Inner Relief Road removed, but Keithhall Link Road added. Test 11 contains the same development content, but with both the Inverurie Inner Relief Road and the Keithhall Link Road. Tests 9 to 11 are summarised in Table 8.1.

Table 8.1 : Test 9 to 11 Summary

Test	Development					Infrastructure			
	Uryside & Portstown	Harlaw Rd North	Crichie	Thainstone	Golf Course	Northern Link Road	Inverurie Inner Relief Road	Alt Inner Relief Road	Keithhall Link Road
9	✓	✓				✓	✓		
10	✓	✓				✓			✓
11	✓	✓				✓	✓		✓

8.2 Test 9: Introduction and Model Observations

8.2.1 Test 9 – Test 8 plus Uryside & Portstown, plus the Northern Link Road.

8.2.2 In the AM peak, an increase in southbound queueing was observed from Port Elphinstone Roundabout on the A96, extending to Blackhall Road Roundabout by 09:00, an increase of approximately 500m from Test 8. The westbound queue on Blackhall Road, from Blackhall Road Roundabout was also approximately 500m longer. Southbound queueing was also observed approaching the town centre from the north, from the junction of High Street Close and the one way southbound section of the town centre triangle, for a total of approximately 600m. This queue was not present in Test 8. Further congestion throughout the northern area of the town was also observed, which was not present in Test 8.

8.2.3 In the PM peak, significant increases in congestion were observed throughout the model, in particular around Port Elphinstone Roundabout, the town centre and the whole northern area of the town. At 18:55 there were approximately 2,230 vehicles unable to join the model network due to congestion, compared to 70 in Test 8. Of the 2,230 unreleased vehicles, approximately 1,900 were on the A96 and 330 in Thainstone.

8.3 Test 10: Introduction and Model Observations

8.3.1 Test 10: Test 9 with Inner Relief Road removed and Keithhall Link Road included.

8.3.2 In the AM peak a southbound queue was observed on the A96 from Thainstone Roundabout due to the cutting movement caused by northbound traffic turning right onto the Keithhall Link Road. Southbound queueing was also observed on the Keithhall Link Road at Thainstone Roundabout.

8.3.3 In the PM peak queueing was observed on all arms of Thainstone Roundabout but in general the model was significantly less congested than Test 9, particularly in the town centre. There were no vehicles queueing off the model network but queue lengths on both the A96 southbound and



Keithhall Link Road southbound from Thainstone Roundabout reached a maximum of approximately 800m.

8.4 Test 11: Introduction and Model Observations

8.4.1 Test 11: Test 10 plus the Inverurie Inner Relief Road.

8.4.2 In both peak periods queuing was observed to be very similar to Test 10, but with slightly less congestion in the town centre due to the Inner Relief Road, and slightly more at Thainstone Roundabout due to a quicker release of traffic through the town centre.

8.5 Test 11b: Introduction and Model Observations

8.5.1 Traffic flow analysis suggested that the additional cutting movements at Thainstone Roundabout, as a result of the increase in traffic demand through the Keithhall Link Road, limited the capacity of a standard roundabout at this location.

8.5.2 With agreement from Aberdeenshire Council, an additional test was carried out with improvements at Thainstone Roundabout. As a mitigating measure, a revised three-lane roundabout with signal controls on the A96 north and south approaches was developed, to allow a more controlled egress of traffic through this junction. The layout of the larger roundabout is shown in Figure 8.1. The link between the small roundabout to the east and Thainstone Roundabout was increased to two lane in both directions.

8.5.3 An additional benefit of a signalised roundabout is that the signal control can be limited to peak periods and switched off during off-peak periods.

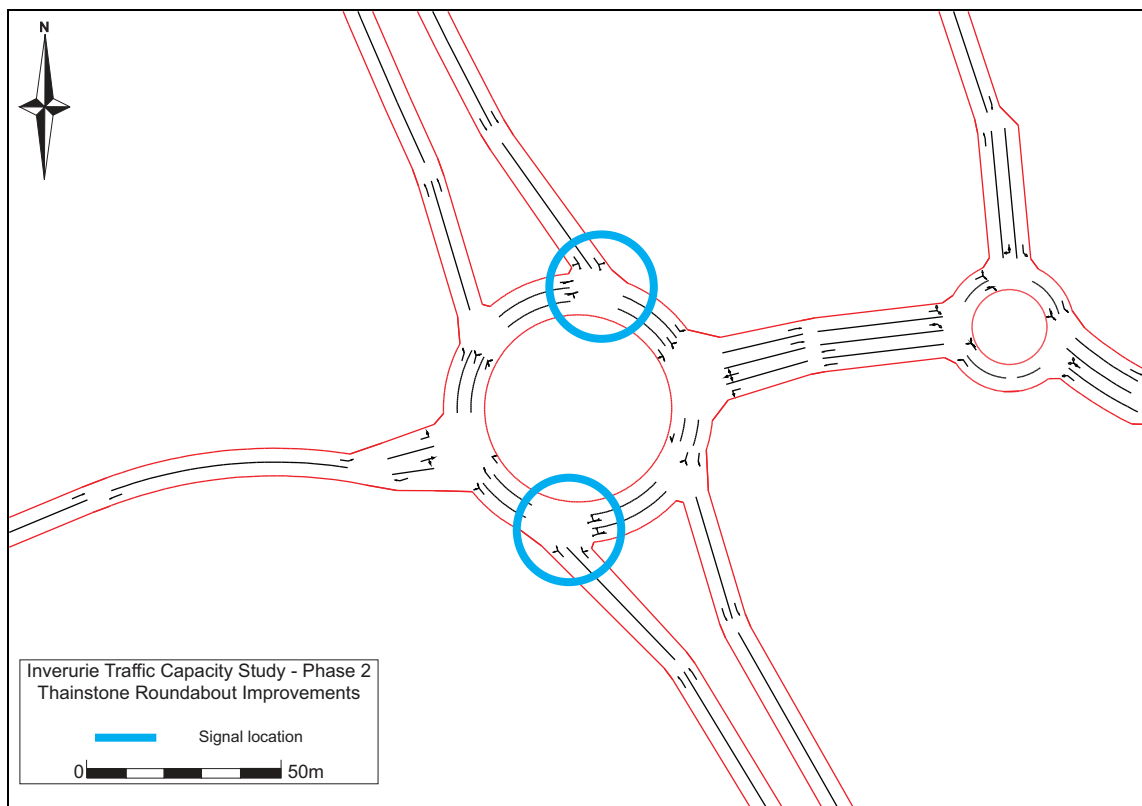


Figure 8.1 : Thainstone Roundabout Improvements



8.5.4 The model was run at a lower demand level and the flows factored up to 100% in order to establish the traffic demand flows (as opposed to stopline flows) through the roundabout. The demand flows can be found in Appendix B. The signal timings applied are shown in Figure 8.2.

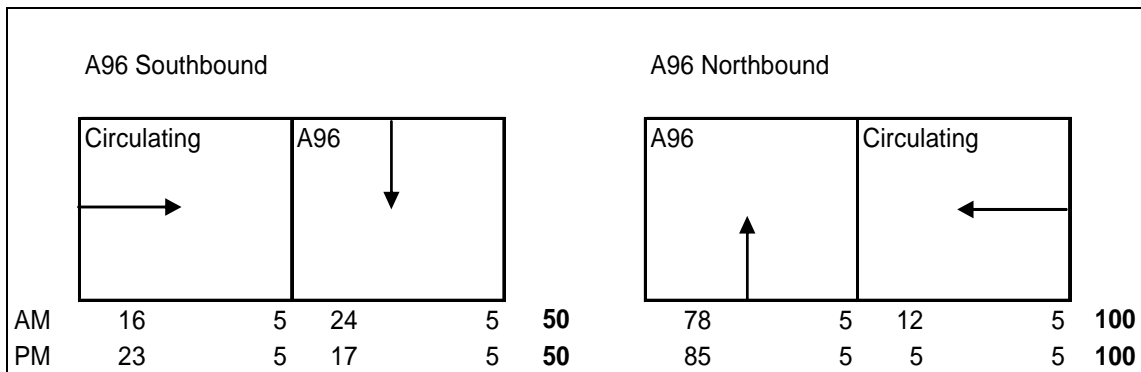


Figure 8.2 : Thainstone Signal Timings – Test 11b

8.5.5 In the AM peak the model runs well with no significant congestion observed. In the PM peak the model runs well. Some northbound queueing was observed throughout the model, particularly on the A96 from Blackhall Road Roundabout, High Street Close and from the middle roundabout on the Keithhall Link Road. Traffic which was previously unable to join the model network due to congestion at Thainstone is now released through the Roundabout. No traffic was prevented from joining the model network due to congestion.

8.6 Test 9-11 Journey Time Comparisons

8.6.1 Average journey times were compared on four routes, in both directions, in the AM and PM peak hours. The AM and PM journey times are shown in Figures 8.3 and 8.4.



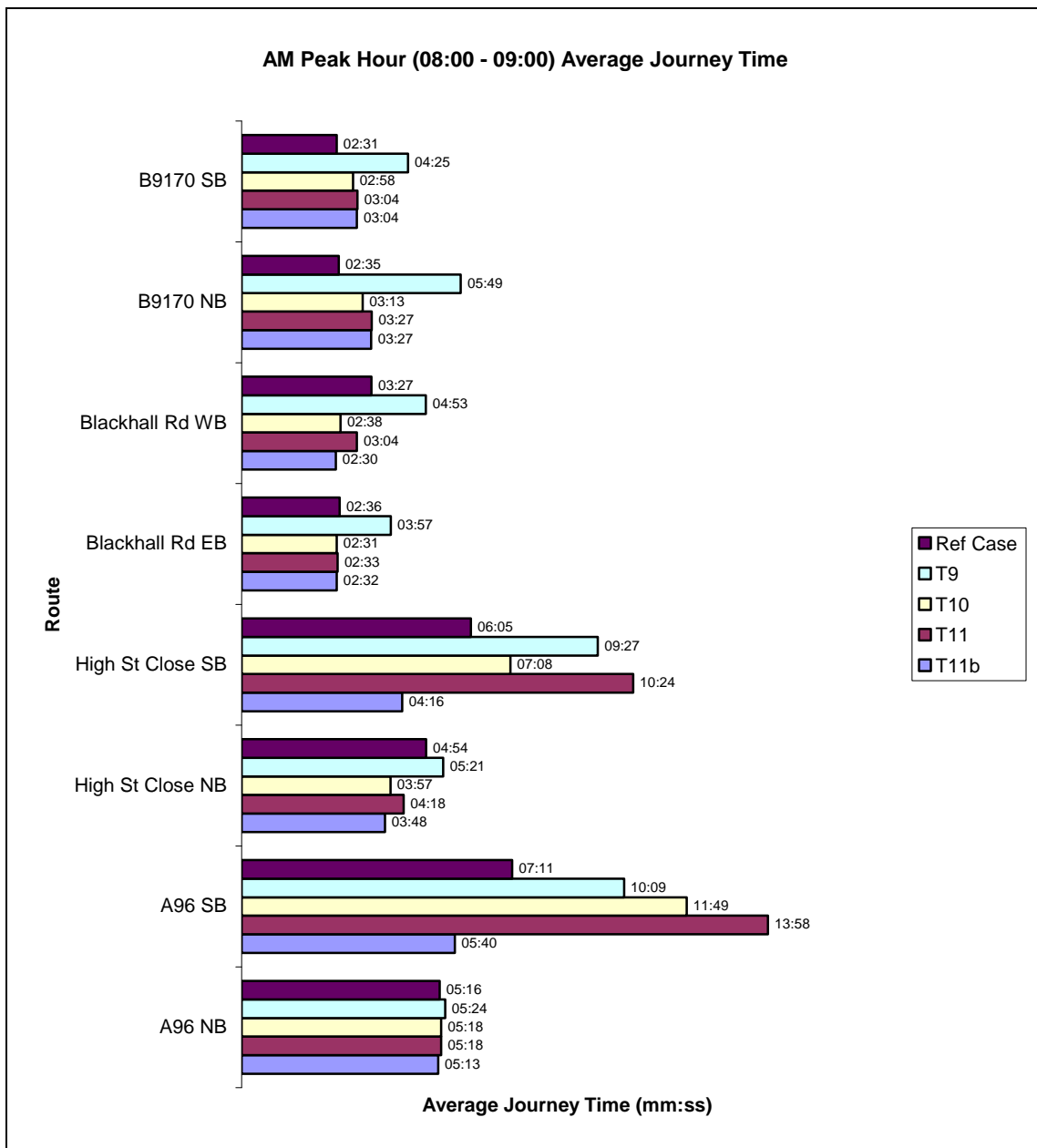


Figure 8.3 : Tests 9-11 AM Peak Hour Average Journey Times

- 8.6.2 Figure 8.3 shows an increase in journey time through all routes assessed in Test 9 compared to the Reference Case, as would be expected with the addition of the Uryside and Portstown, and Harlaw Rd North developments. The addition of the Keithhall Link Road in Test 10 reduces most journey times, with the exception of the A96 southbound. This increase can be attributed to the increased cutting movement from northbound traffic turning right from the A96 to the Keithhall Link Road.
- 8.6.3 Journey times are observed to increase in Test 11, which includes the Inverurie Inner Relief Road. This increase can be explained by traffic getting through the northern part of the town quicker, resulting in more delay at the south.
- 8.6.4 The improvements to Thainstone Roundabout in Test 11b (mitigation at Thainstone Roundabout) have reduced journey times to similar or lower than the Reference Case.



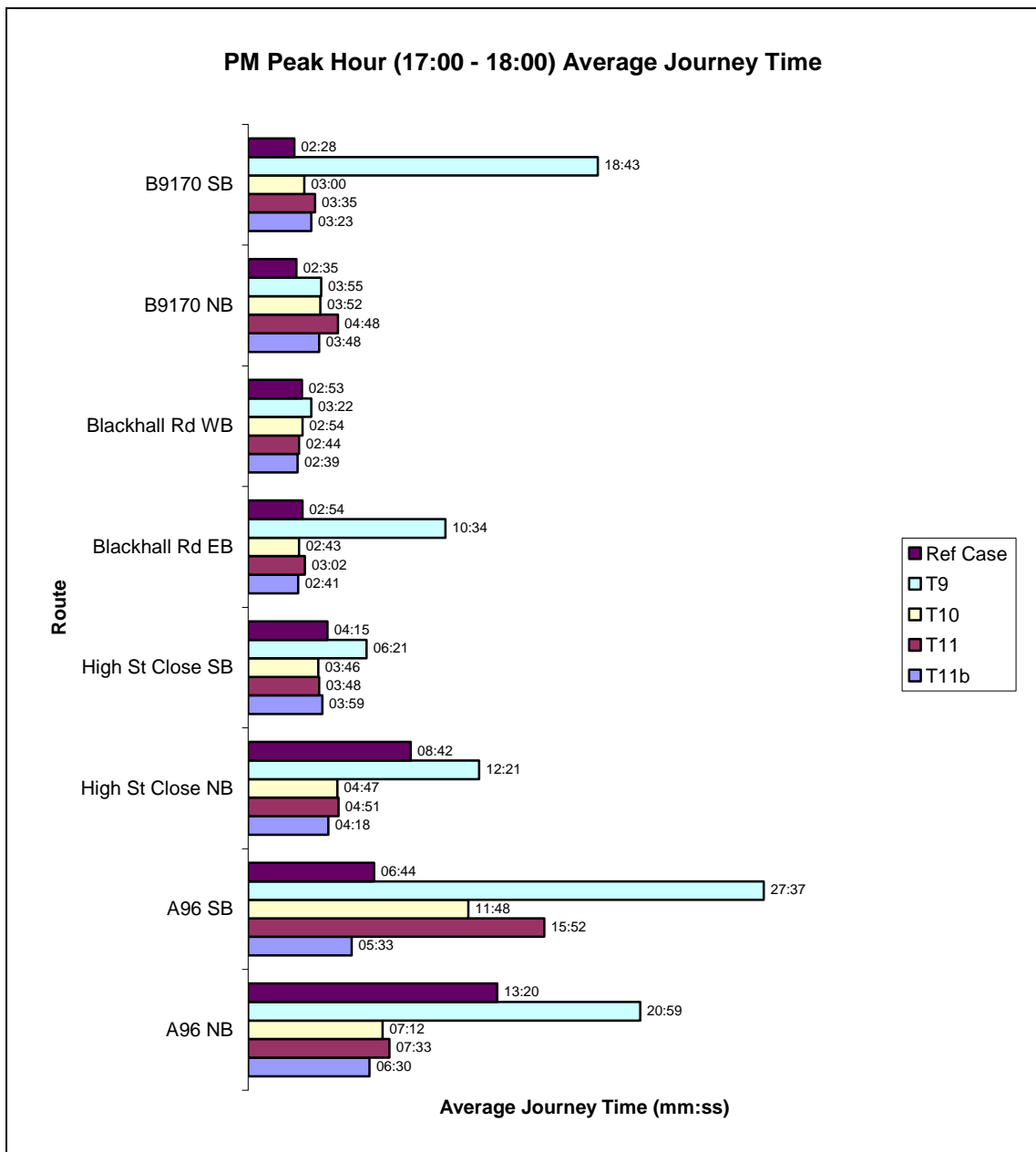


Figure 8.4 : Tests 9-11 PM Peak Hour Average Journey Times

- 8.6.5 Figure 8.4 shows an increase in all journey times in Test 9 compared to the Reference Case due to the additional development content. The addition of the Keithhall Link Road in Test 10 significantly reduces journey times by diverting traffic away from the town centre and the A96. Journey times in Test 11 are similar to Test 10, with the exception of the A96 southbound which has increased slightly due to the inner relief road allowing traffic to reach the south of the model quicker.
- 8.6.6 Journey times in Test 11b are significantly lower on the A96 southbound compared to Test 11 and are also slightly lower on most other routes.



8.7 Test 9 – 11 Summary

- 8.7.1 Test 9 has been based on Test 8 and also includes the Uryside and Portstown developments and the Northern Link Road. Test 10 is Test 9 with the Inverurie Inner Relief Road removed, but Keithhall Link Road added. Test 11 contains the same development content, but with both the Inverurie Inner Relief Road and the Keithhall Link Road.
- 8.7.2 Test 9 includes a significant increase in development traffic from Uryside and Portstown. The model observations and results have shown the network is heavily congested. In the PM peak over 2,000 vehicles are unable to join the model network from the A96 and Thainstone, due to northbound queueing from Port Elphinstone Roundabout, which extends past Thainstone Roundabout and off the model network.
- 8.7.3 Test 10 includes the Keithhall Link Road, this was observed to significantly reduce congestion and journey times by diverting traffic away from the town centre and A96. No overall benefits were observed in Test 11. With the inclusion of the inner relief road, the reduction in delay in the town centre resulted in increased delay at the south.
- 8.7.4 Improvements at Thainstone Roundabout in Test 11b, (a revised three lane roundabout with signal controls on the A96 north and south approaches) were observed to significantly reduce queueing and improve journey times, particularly on the A96 southbound in both the AM and PM peaks.



9 TESTS 12 AND 13: COMBINATION TESTING AND MITIGATION

9.1 Introduction

9.1.1 Test 12 and 13 are based on Test 11b, but include further developments. Test 12 includes the Thainstone development and Test 13 includes both the Thainstone and Crichtie developments. The contents of Test 12 and 13 are summarised in Table 9.1.

Table 9.1 : Test 12 and 13 Summary

Test	Development					Infrastructure				
	Uryside & Portstown	Harlaw Rd North	Crichtie	Thainstone	Golf Course	Northern Link Road	Inverurie Inner Relief Road	Alt Inner Relief Road	Keith-hall Link Road	Thainstone Rdbt Mitigation
12	✓	✓		✓		✓			✓	✓
13	✓	✓	✓	✓		✓			✓	✓

9.2 Test 12: Introduction and Model Observations

9.2.1 Test 12: Test 11b plus Thainstone development. The model was run at a lower demand level and the flows factored up to 100% in order to establish the demand flows (as opposed to stopline flows) through the roundabout. The demand flows can be found in Appendix B. Signal timings at Thainstone Roundabout were then adjusted to accommodate the Thainstone development traffic. The adjusted signal timings are shown in Figure 9.1.

	A96 Southbound					A96 Northbound				
	Circulating	A96				A96			Circulating	
AM	15	5	25	5	50	27	5	13	5	50
PM	25	5	15	5	50	80	5	10	5	100

Figure 9.1 : Thainstone Signal Timings – Test 12

9.2.2 In the AM peak the model runs well, queues of approximately 200m were observed southbound on the A96 at Port Elphinstone Roundabout but no other significant queueing was observed.

9.2.3 In the PM peak, queueing observed was similar to Test 11b, but with a slight increase in queueing northbound on the A96 from Port Elphinstone Roundabout.

9.3 Test 12b: Introduction and Model Observations

9.3.1 A sensitivity test was carried out, based on Test 12, but with the Inverurie Inner Relief Road included, in order to assess the benefits of the Inner Relief Road.

9.3.2 In both the AM and PM peaks, no significant difference was observed between Test 12 and Test 12b. Due to the volume of traffic using the Keithhall Link Road, less congestion was observed in the town centre, reducing the need for significant mitigation in this area, however with the Inner Relief Road included further benefit will be gained by pedestrians.



9.4 Test 13: Introduction and Model Observations

9.4.1 Test 13: Test 12 plus Crichtie development.

9.4.2 The addition of the development at Crichtie puts additional pressure on Port Elphinstone Roundabout. In the AM peak, a southbound queue was observed on the A96 from Port Elphinstone Roundabout due to the cutting movement of traffic from Crichtie. Peak hour demand flows for Port Elphinstone Roundabout are provided in Appendix C, and show the increase in traffic on the Crichtie arm of the roundabout. The flows also show a reduction in traffic both northbound and southbound on Elphinstone Road due to the Keithhall Link Road.

9.4.3 In the PM peak, significant queueing was observed northbound on the A96 from Port Elphinstone Roundabout. This queue extends past Thainstone Roundabout and off the model network by 17:15. The maximum number of vehicles unable to join the model network due to congestion reaches approximately 400. Queueing was also observed northbound on the Keithhall Link Road from the roundabout at the junction with the B993, extending to a maximum of approximately 2km (almost to Thainstone Roundabout), due to traffic re-routeing away from the A96.

9.5 Test 13b: Introduction and Model Observations

9.5.1 An additional Test was undertaken to provide mitigation at Port Elphinstone Roundabout. To accommodate the additional traffic demand and movements at Port Elphinstone as a result of the Crichtie development, a larger three lane roundabout was modelled, with signal control on the A96 north and south approaches. The layout of the roundabout is shown in Figure 9.2. The east and west exits from the roundabout have been increased to two lanes in order to increase capacity.

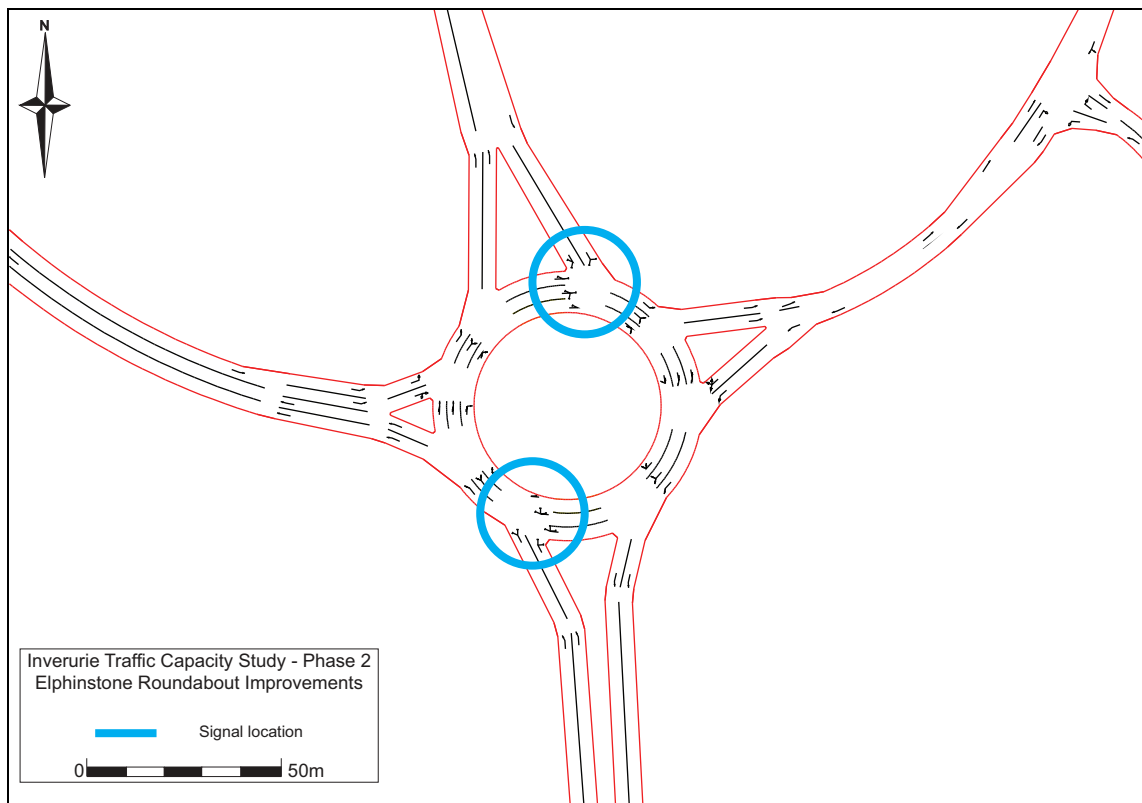


Figure 9.2 : Port Elphinstone Roundabout Improvements



9.5.2 The model was run at a lower demand level and the flows factored up to 100% in order to establish the demand flows through the roundabout. The demand flows can be found in Appendix C. The signal timings applied are shown in Figure 9.3.

	A96 Southbound				A96 Northbound				
	Circulating	A96			A96	Circulating			
AM	31	5	19	5	31	5	19	5	60
PM	29	5	21	5	33	5	17	5	60

Figure 9.3 : Port Elphinstone Signal Timings – Test 13b

9.5.3 In the AM peak, the queueing observed was similar to Test 13 with southbound queueing on the A96.

9.5.4 In the PM peak, northbound queueing on the A96 from Port Elphinstone Roundabout extended to Thainstone Roundabout, and the queue from Thainstone Roundabout extended to the extents of the model. Although this queueing was lower than Test 13, both the roundabouts appear to be operating over capacity. A higher queue was observed at Blackhall Road Roundabout as traffic was able to route north from Port Elphinstone Roundabout quicker.

9.6 Test 12 and 13 Journey Time Comparisons

9.6.1 Average journey times were compared on four routes, in both directions, in the AM and PM peak hours. The AM and PM journey times are shown in Figures 9.4 and 9.5.



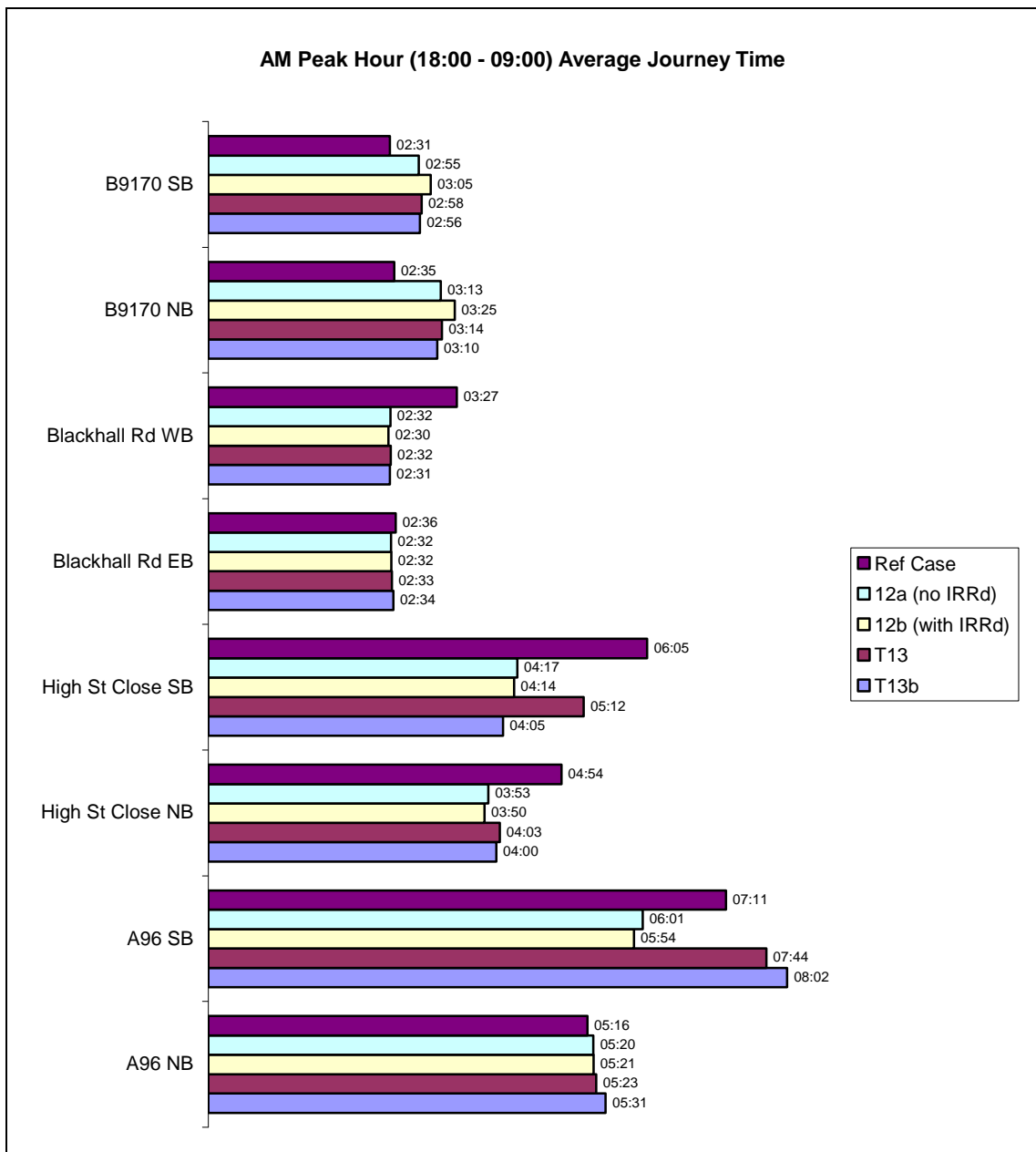


Figure 9.4 : Tests 12 and 13 AM Peak Hour Average Journey Times

- 9.6.2 Figure 9.4 shows that in the AM peak there were no significant differences in journey times between Tests 12a and 12b.
- 9.6.3 The improvements in Test 13b have resulted in lower journey times on High Street Close southbound, but higher times on the A96 southbound as the traffic signals balance queue lengths on all arms.



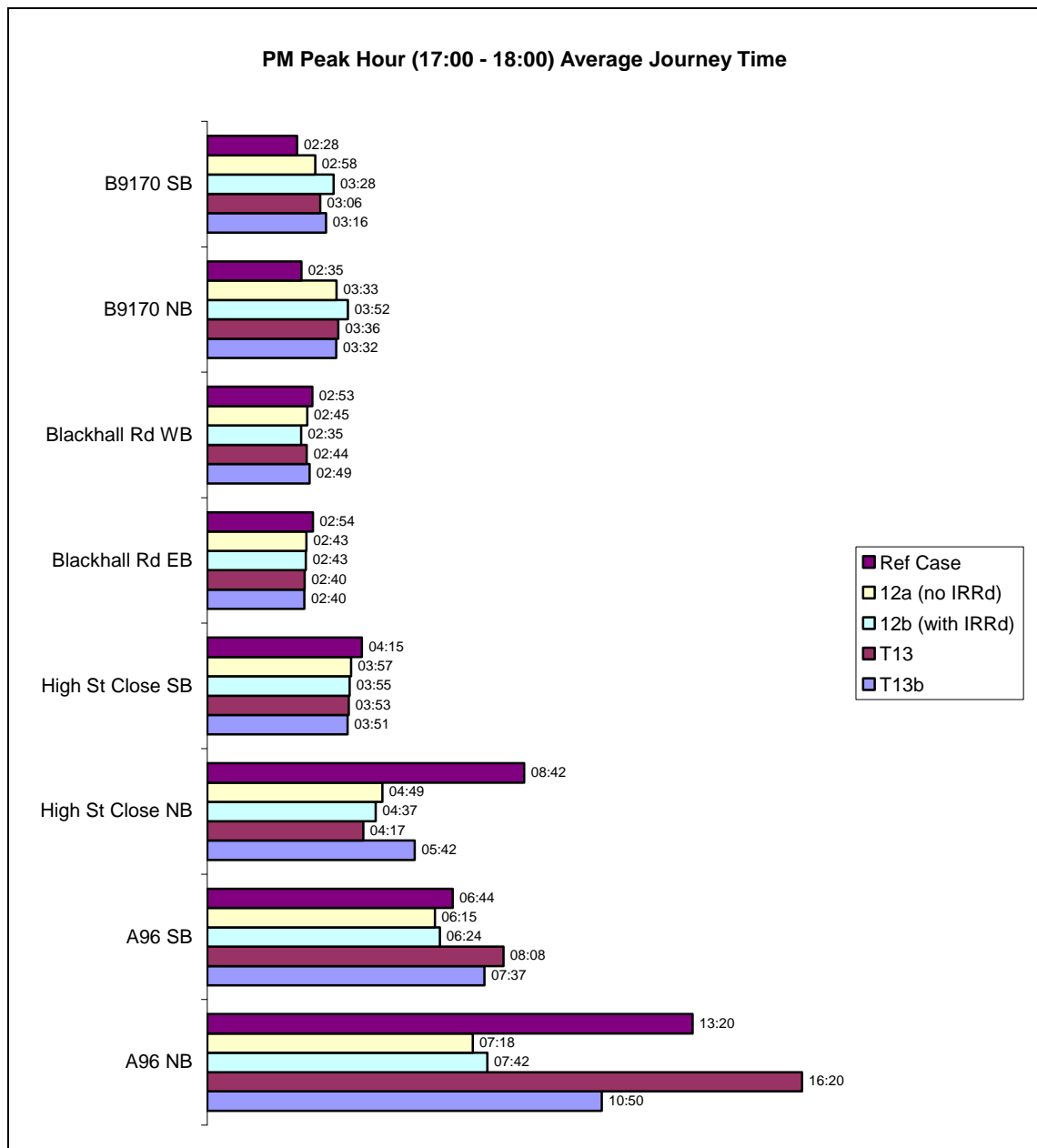


Figure 9.5 : Tests 12 and 13 PM Peak Hour Average Journey Times

9.6.4 Figure 9.5 shows that in the PM peak there are no significant differences in journey times between Tests 12a and 12b.

9.6.5 The introduction of the Crichton development in Test 13 results in an increase in journey times on the A96 northbound, due to the additional development traffic and the additional cutting movement at Port Elphinstone Roundabout from traffic turning into Crichton. A signal roundabout flow assessment showed the junction was over capacity due to the volume of traffic associated with the Crichton Development. The improvements at Port Elphinstone Roundabout in Test 13b were observed to reduce journey times on the A96 northbound, however both the Port Elphinstone and Thainstone Roundabouts remain over capacity and significant northbound queuing is still observed.



9.7 Test 12 and 13 Summary

- 9.7.1 Test 12 and 13 are based on Test 11b, but include further developments. Test 12 includes Thainstone and Test 13 includes both Thainstone and Crichtie.
- 9.7.2 Test 12 was tested with and without the Inverurie Inner Relief Road and no significant difference was found between the two tests. Both the AM and PM peaks operate well with only slightly more queueing at Thainstone Roundabout than Test 11b.
- 9.7.3 In Test 13 the addition of the Crichtie Development puts pressure on Port Elphinstone Roundabout and increased queueing was observed, southbound on the A96 in the AM peak and northbound in the PM peak.
- 9.7.4 The Port Elphinstone Roundabout improvements introduced in Test 13b significantly reduce the northbound queue on the A96 in the PM peak, but do not resolve the issue, as queue lengths of over 1km are still observed on the A96 northbound from Port Elphinstone and queue lengths of approximately 600m are observed on the A96 northbound from Thainstone.



10 SUMMARY

10.1 Introduction

10.1.1 Following the recently completed Inverurie Traffic Capacity Study – Phase 1, Aberdeenshire Council subsequently requested a series of refined tests based on a 2016 Reference Case S-Paramics model. The 2016 Reference Case model has been developed as part of this study from the 2012 Reference Case model from the previous study.

10.1.2 Five proposed developments and four proposed infrastructure improvements form the basis of the 2016 testing, in different combinations.

10.2 Tests 1 – 3: Initial Crichtie and Thainstone Development Testing

10.2.1 Tests 1 – 3 all include the Crichtie and Thainstone developments. Test 2 includes the Inverurie Inner Relief Road and Test 3 includes the Keithhall Link Road. The addition of the Crichtie and Thainstone developments in Test 1 result in an increase in queueing on the A96 from Port Elphinstone Roundabout, southbound in the AM peak and northbound in the PM peak. In the AM peak, the southbound queue extends to approximately the same length as the Reference Case, but reaches a maximum length half an hour earlier. In the PM peak, the queue from Port Elphinstone Roundabout extends off the model network on the A96 and Thainstone development by a total of approximately 1,300 vehicles, an increase of approximately 1,240 from the Reference Case.

10.2.2 The addition of the Inverurie Inner Relief Road in Test 2 does not provide any significant benefit due to traffic being held in congestion at the south of the town.

10.2.3 The introduction of the Keithhall Link Road (without improvements at Thainstone Roundabout) in Test 3 significantly reduces northbound congestion in the PM peak by providing an alternative route north, avoiding Port Elphinstone Roundabout and High Street Close. Northbound queueing of approximately 500m remains on the A96 from Port Elphinstone Roundabout (with no improvements) and approximately 250 vehicles are queued off the network into the Thainstone development at 18:55.

10.3 Tests 4 – 6: Golf Course Housing Development Testing

10.3.1 Tests 4 – 6 have been developed from Tests 1 – 3, with the addition of the Golf Course housing development.

10.3.2 Test 4 (Test 1 plus Golf Course Housing) gridlocks in the AM peak. In the PM peak, over 2,000 vehicles are unable to join the model network due to congestion, extending back from a northbound A96 queue at Port Elphinstone Roundabout.

10.3.3 Test 5 (Test 2 plus Golf Course Housing). The Inverurie Inner Relief Road was observed to provide no significant benefit due to the increase in development traffic and resultant high level of congestion in the town centre area. In the AM peak, the model gridlocks and the PM peak has a similar number of vehicles unable to join the network due to congestion as found in Test 1.

10.3.4 Test 6 (Test 3 plus Golf Course Housing). The Keithhall Link Road significantly reduces congestion in both peaks, however, in the PM peak a queue still extends from Port Elphinstone Roundabout on the A96, through Thainstone Roundabout, and off the model network with approx 950 vehicles unable to join the model due to congestion.



10.4 Tests 7 and 8: Inner Relief Road Testing

- 10.4.1 Tests 7 and 8 are developed from the 2016 Reference Case plus the Harlaw Road North development. Test 7 contains the Alternative Inner Relief Road and Test 8 the Inverurie Inner Relief Road.
- 10.4.2 The model observations and statistics show there is no significant difference in the operation of the two tests in the AM peak.
- 10.4.3 In the PM peak, model observations showed less congestion in the town centre area in Test 8. This was confirmed by a reduction in journey times on the A96 and High Street Close northbound, and a reduction in the average number of queueing vehicles in the town centre area.

10.5 Tests 9 – 11: Uryside and Portstown Development Testing

- 10.5.1 Test 9 is based on Test 8 and also includes the Uryside and Portstown developments and the Northern Link Road. Test 10 is based on Test 9 with the Inverurie Inner Relief Road removed and the Keithhall Link Road added. Test 11 contains the same development content, but with both the Inverurie Inner Relief Road and the Keithhall Link Road.
- 10.5.2 Test 9 includes a significant increase in development traffic from Uryside and Portstown. The model observations and results have shown the network is heavily congested, particularly in the PM peak. Journey times on key routes were significantly increased and over 2,000 vehicles were unable to join the model network from Thainstone Development and the A96, due to queueing from Port Elphinstone Roundabout.
- 10.5.3 The inclusion of the Keithhall Link Road in Test 10 resulted in a reduction in congestion and journey times throughout the model, by diverting traffic away from the town centre and the A96. Test 11 was not observed to have any overall benefit compared to Test 10 as the reduction in delay in the town centre resulted in increased delay at the south of the network on the A96.
- 10.5.4 Mitigation improvements at Thainstone Roundabout in Test 11b (signalised three lane roundabout) were observed to significantly reduce queueing and improve journey times, particularly on the A96 southbound in both the AM and PM peaks.

10.6 Tests 12 and 13: Combination Testing and Mitigation

- 10.6.1 Test 12 and 13 are based on Test 11b, but include further developments. Test 12 includes Thainstone and Test 13 includes both Thainstone and Crichtie.
- 10.6.2 Test 12 was tested with and without the Inverurie Inner Relief Road and no significant difference was found between the two tests. Both the AM and PM peaks operate well with only slightly more queueing at Thainstone Roundabout than Test 11b, showing that the mitigation measures appear to be able to accommodate the Thainstone Development traffic.
- 10.6.3 In Test 13 the addition of the Crichtie Development puts pressure on Port Elphinstone Roundabout and increased queueing was observed southbound on the A96 in the AM peak and northbound in the PM peak. Increased congestion was also observed at Thainstone Roundabout.
- 10.6.4 The Port Elphinstone Roundabout improvements introduced in Test 13b were observed to significantly reduce the northbound queue on the A96 in the PM peak, however queueing still remains at this location. The queue from Port Elphinstone Roundabout extends back to



Thainstone Roundabout and the queue from Thainstone Roundabout extends to the extents of the model.

- 10.6.5 Previous testing of development proposals at Crichton identified that by widening the A96(T) southern approach to Port Elphinstone Roundabout and widening the Kemnay approach, further reductions in the northbound queue on the A96 are experienced in the PM peak.
- 10.6.6 As discussed with Aberdeenshire Council, Test 14 has been omitted from testing at this stage as the A96 roundabouts remain congested in Test 13, and previous tests have shown that the addition of the Golf Course housing development adds significant pressure in this area.
- 10.6.7 The improvements modelled at Thainstone and Port Elphinstone Roundabouts are based on preliminary conceptual designs which would require further detailed design.

10.7 Conclusions

- The Keithhall Link Road appears to be essential when considering the additional development in various combinations.
- Testing has shown that Thainstone mitigation and the Keithhall Link Road can cater for the Uryside and Portstown developments, the Harlaw Road development and the Thainstone development.
- With the addition of the Crichton developments, further mitigation would be required at Port Elphinstone Roundabout.
- Previous testing of development proposals at Crichton has identified that additional mitigation at the Port Elphinstone Roundabout results in further reductions in the northbound queue on the A96 in the PM peak.
- The addition of the Golf Course housing development adds significant pressure on both the local and trunk road network even with the addition of the Keithhall Link Road. Without the Keithhall Link Road the model gridlocks in the AM peak.
- Further testing could consider grade separation at Port Elphinstone/Thainstone Roundabouts to provide additional capacity for combinations of developments. Alternatively, development concentrated to the north of the town could be considered with the Keithhall Link Road, Thainstone and Port Elphinstone Roundabout mitigation in place. This would reduce the traffic demand at Port Elphinstone Roundabout and utilise the additional network capacity at the north.





A BLACKHALL ROAD ROUNDABOUT FLOWS

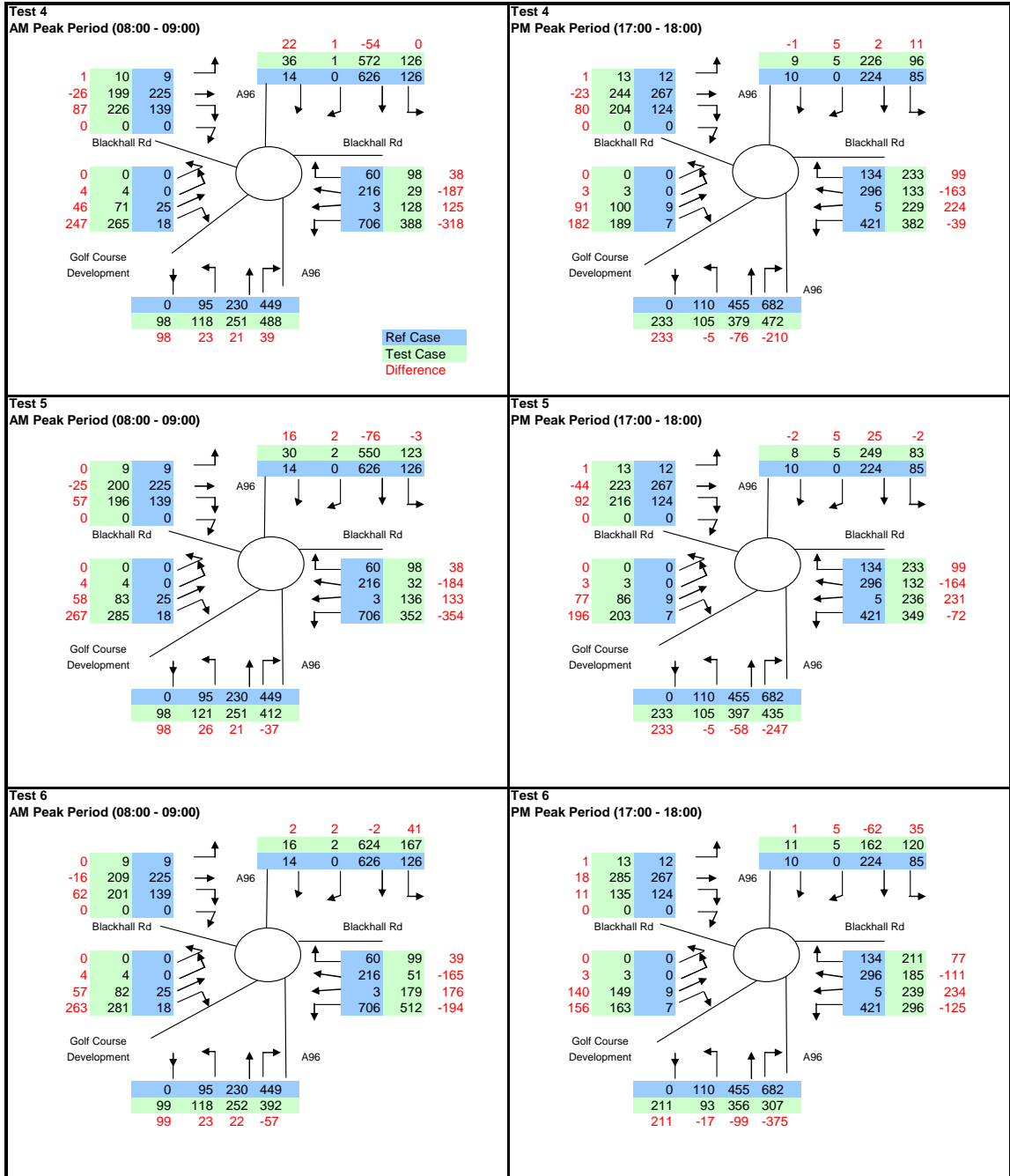


Figure A.1 : Blackhall Road Roundabout Flows



B THAINSTONE ROUNDABOUT DEMAND FLOWS

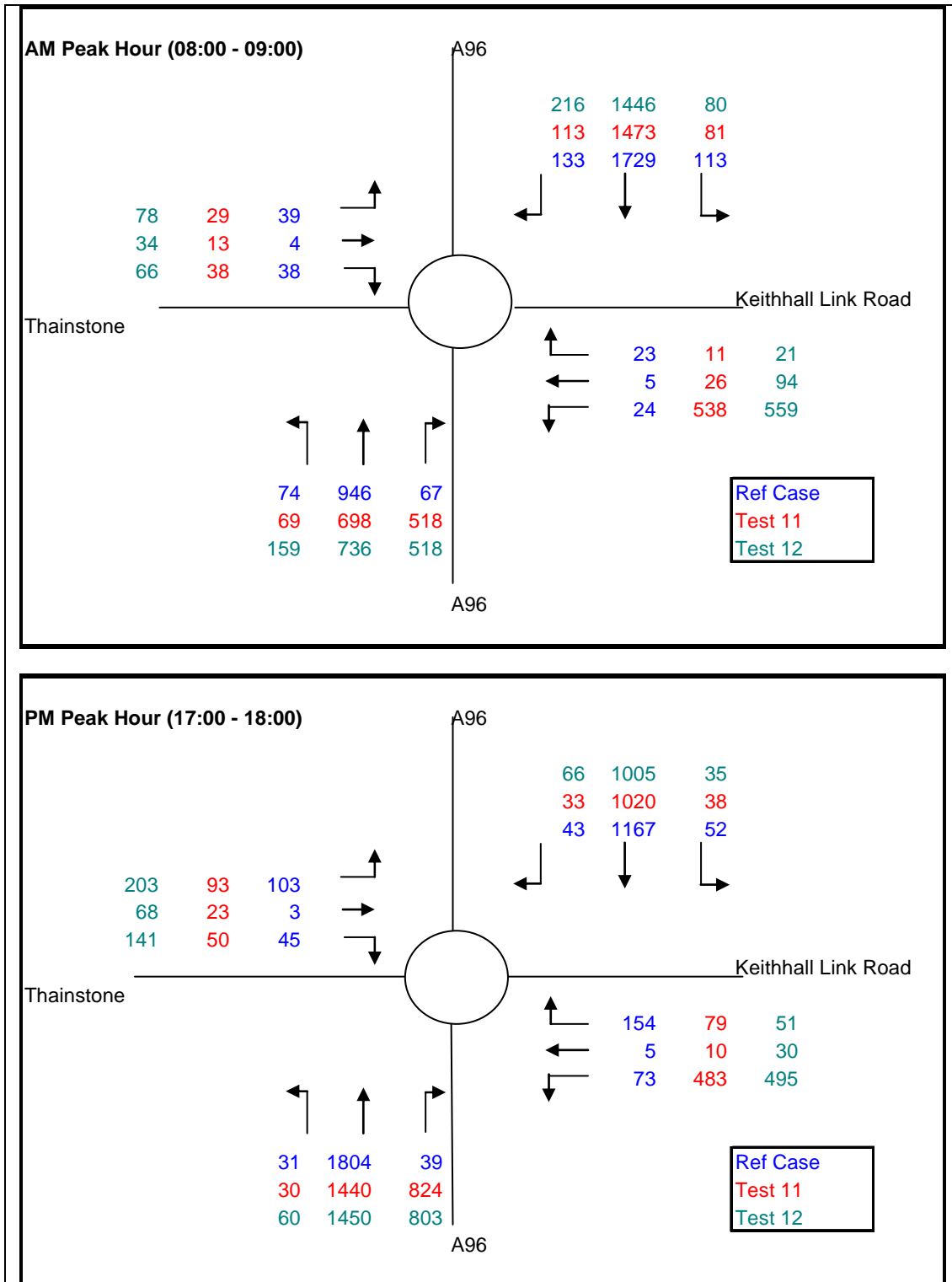


Figure B.1 : Thainstone Roundabout Demand Flows



C PORT ELPHINSTONE ROUNDABOUT DEMANDS FLOWS

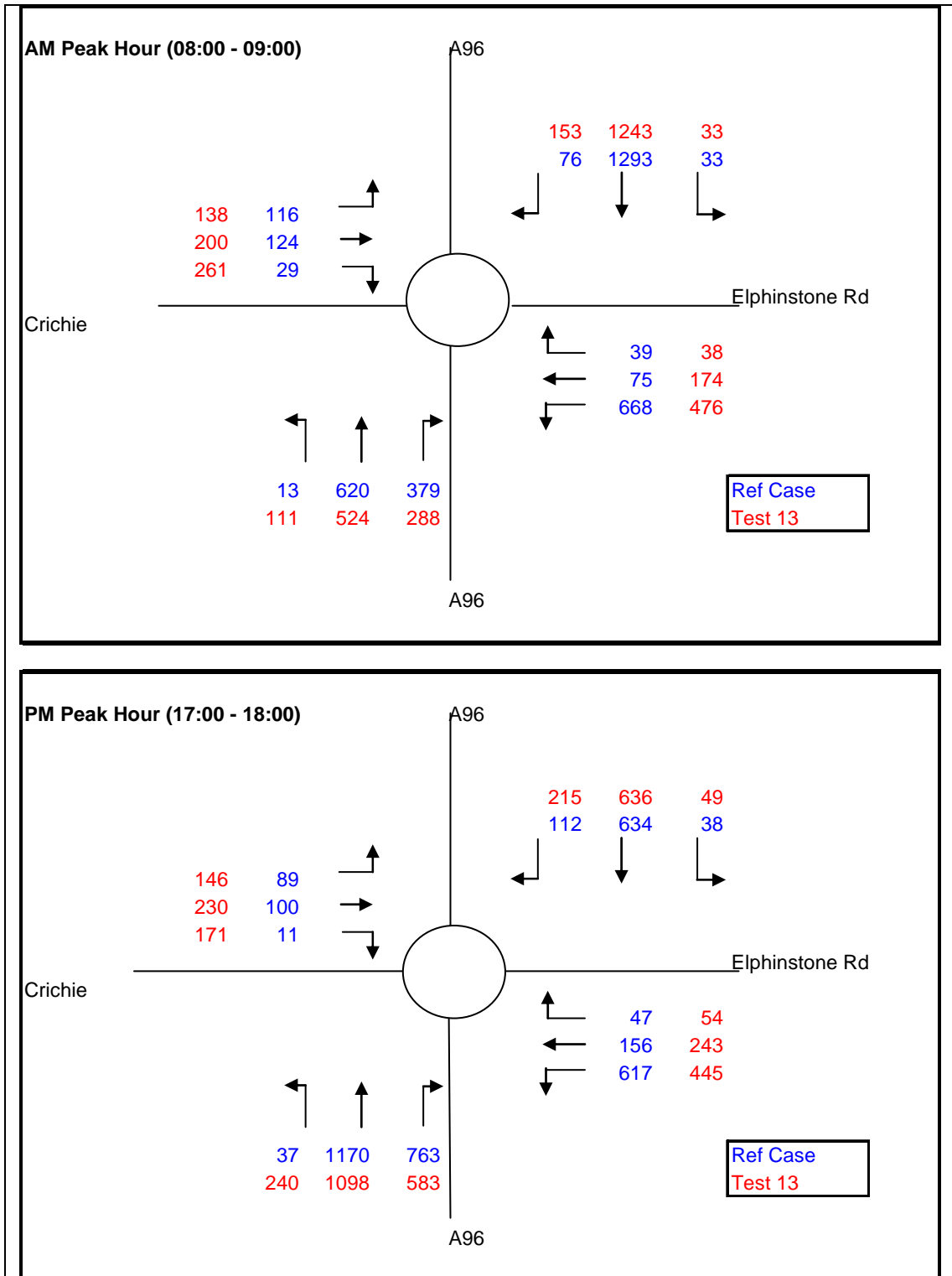


Figure C.1 : Port Elphinstone Roundabout Demand Flows



D MEAN TRAVEL TIME

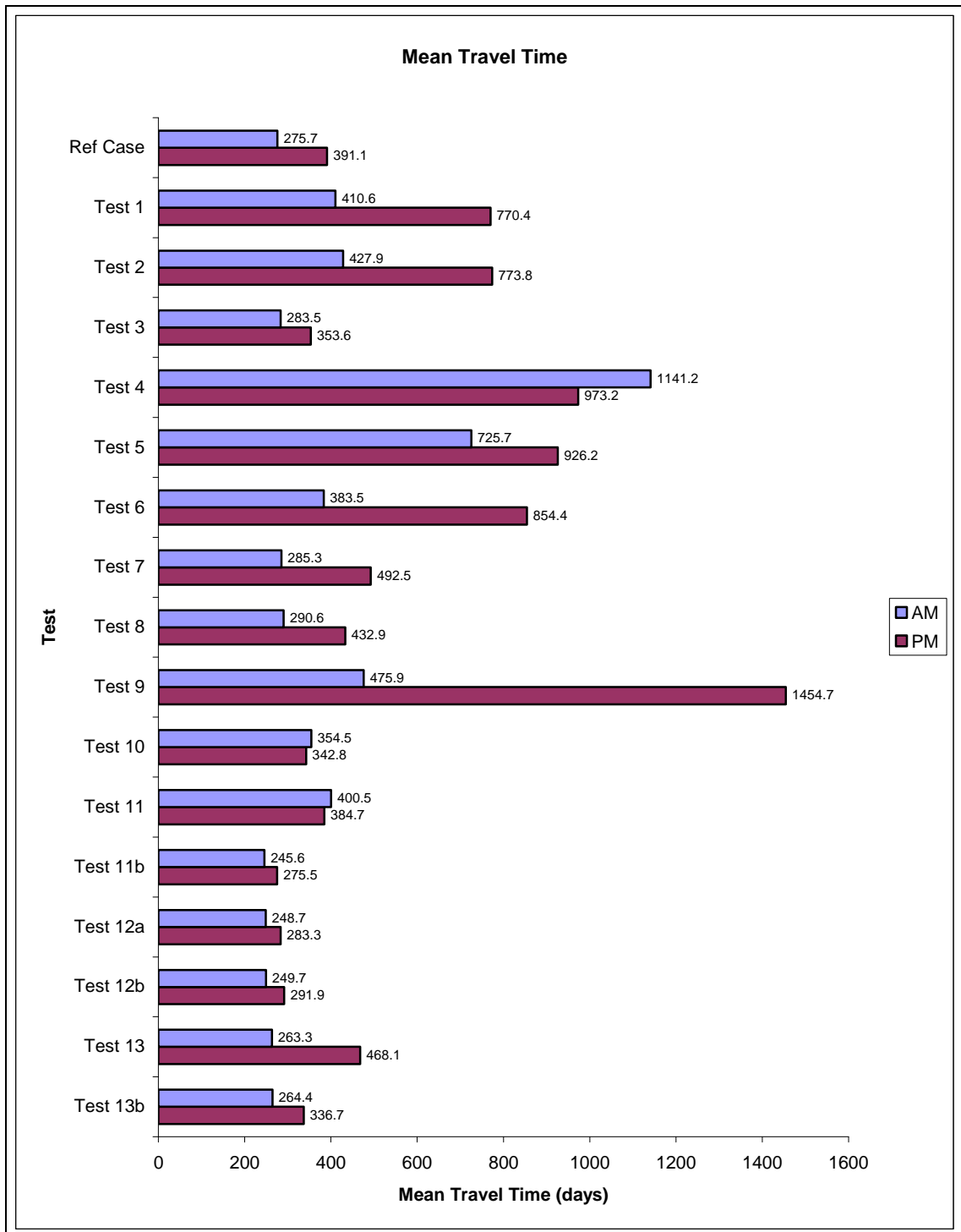


Figure D.1 : Mean travel Time Summary

