Aberdeen City Centre Masterplan Testing – Phase 1

Aberdeen City Council

Traffic Model Testing Report

TPXACCM1 \ 77681
December 2015

CITY CENTRE MASTERPLAN TESTING – PHASE 1

Description:	**City Centre Masterplan Testing – Phase 1**
Date:	**9 December 2015**
Project Manager:	**Callum Guild**
Project Director:	**Bob Nicol**

SIAS Limited
13 Rose Terrace
Perth PH1 5HA
UK

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

CITY CENTRE MASTERPLAN TESTING – PHASE 1

CONTENTS :

CITY CENTRE MASTERPLAN TESTING – PHASE 1

FIGURES :

CITY CENTRE MASTERPLAN TESTING – PHASE 1

TABLES :

1 INTRODUCTION

1.1 Study Brief

Under the Scotland Excel Framework, Aberdeen City Council (ACC) commissioned SIAS Limited (SIAS) in September 2015 to undertake transport model testing of key transport related elements of the proposed Aberdeen City Centre Masterplan.

There are several core schemes which are to form the basis of the model testing, these are:

- Update of the Aberdeen City Centre 2023 Future Year Model
- Phase 1 Testing: Broad St and Schoolhill schemes
- Phase 2 Testing: Union Street and Guild Street schemes

This Technical Report will detail the development of an updated 2023 City Centre Reference Case Model and the Phase 1 model testing relating to assessment of various transport options for Broad Street and Schoolhill.

The Phase 2 testing is to be undertaken following the completion of Phase 1 and will be reported separately.

1.2 Background

The Aberdeen City Centre Masterplan proposals were proposed by independent consultants BDP and accepted by Aberdeen City Councillors at their full council meeting of 24 June 2015. The City Centre Masterplan strategy is focused on reviving the historical core and incorporating areas of growth between the rivers Don and Dee. As part of the Masterplan strategy, limited traffic movement within the city core to private vehicles is required to facilitate the vision to improve the attractiveness of the city centre to pedestrians and cyclists and other sustainable modes of transport.

The full Masterplan proposals include the restriction to general traffic through most of the core area of the city centre area. The implementation of the Masterplan will develop incrementally over the next 20 years. ACC is, therefore, required to consider the development and infrastructure measures as packages or phases of implementation in the coming years.

ACC currently has a traffic model covering Aberdeen City Centre area. This traffic forecasting tool is to be utilised to assist in the development of these phases of Masterplan implementation. The development of the Aberdeen City Centre Paramics Model (ACCPM12) is detailed in a separate Report, *Aberdeen City Centre: 2012 Base Model Development Report (SIAS Ref. 75883, November 2013)*. The model network description is provided in Figure 1.1.

SIAS was required to develop a 2017 and 2023 Reference Case Network, which includes the Berryden dualling proposals as previously detailed in the report *Berryden Corridor Study – Traffic Modelling (SIAS Ref. 71550, July 2009)* and also includes the South College Street junction (with QEII Bridge) proposals as previously detailed in *South College Street Junction – Phase 4 Testing (SIAS Ref. 67586, April 2007)*.

The development of the initial version of 2023 Reference Case Model is detailed in a separate Report, *Aberdeen City Centre: 2017 and 2023 Model Development Report (SIAS Ref. 76041, February 2014)*.

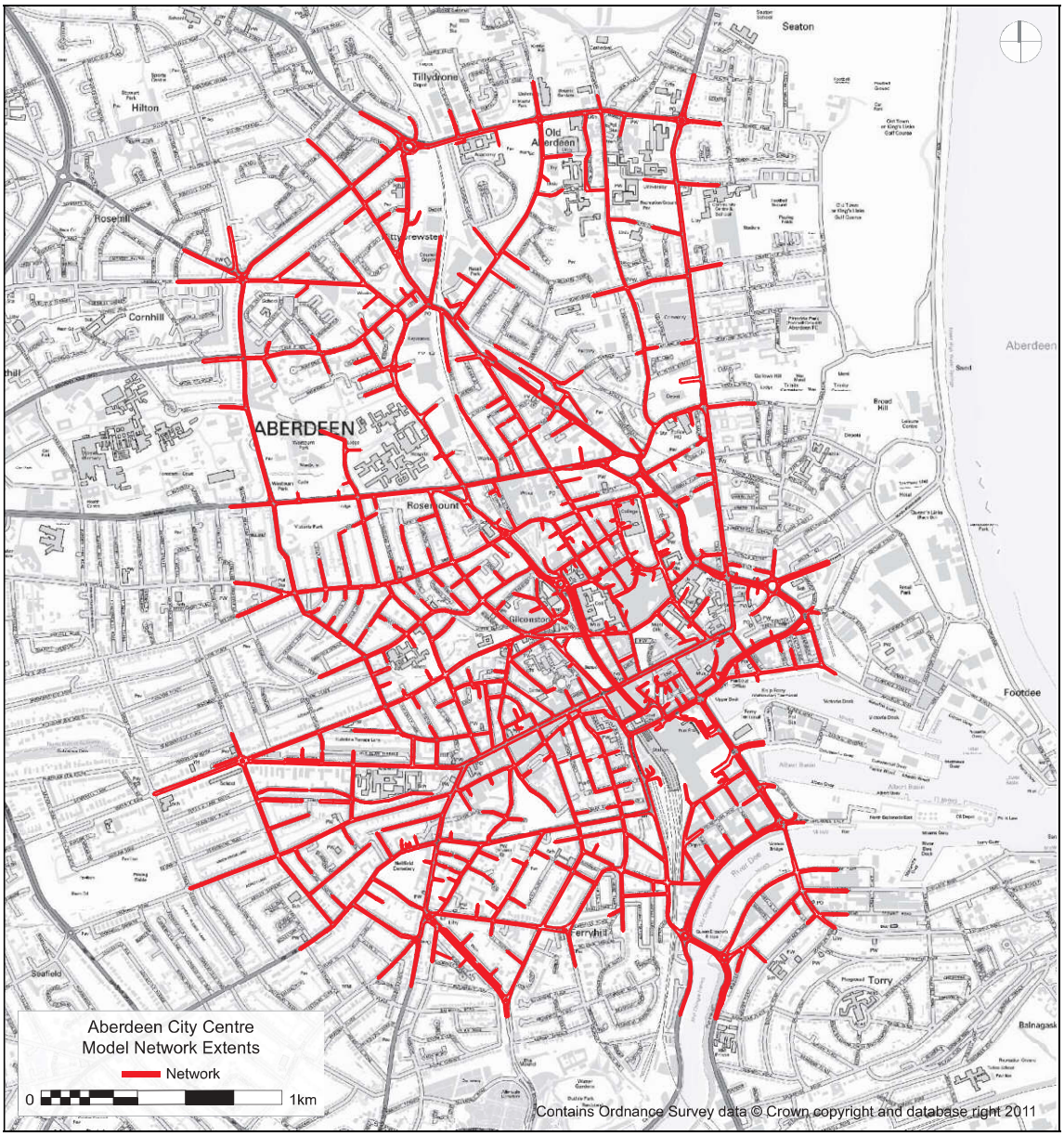

Figure 1.1 : Aberdeen City Centre Paramics Model Network Extent

2 DEVELOPMENT OF 2023 REFERENCE CASE NETWORK

2.1 Introduction

ACC advised SIAS that the initial Phase 1 model testing of the City Centre Masterplan should be undertaken on the 2023 Reference Case Model network. Previous model testing of the, now superseded, Union Street pedestrianisation was also undertaken on the 2023 network scenario. It was proposed that, by 2023, all of the currently committed infrastructure proposals within the city centre area would be in place.

SIAS has previously developed a 2023 model network scenario as detailed in the Report *Aberdeen City Centre: Future Year Model Development Report – Transport Model Input Report (SIAS Ref. 76042, March 2014)*. As part of this study, the Reference Case Model was refined to reflect the most recent infrastructure and development proposals as is detailed in this section.

2.2 2023 Infrastructure

Within the 2023 Reference Case, there are network wide infrastructure changes proposed to be in place within the city centre area and also in the wider Aberdeen Network as advised by ACC.

The major infrastructure measures have been modelled in the wide area strategic Aberdeen Sub Area Model '4a' (ASAM4a). The influence of these measures on the city centre have been extracted from the ASAM models and then applied in the City Centre Model. The major infrastructure which is within the city centre area has been coded within the Paramics model.

Table 2.1 summarises the primary road infrastructure measures included either within the 2023 Reference Case model, or the influence of the measures included within the model.

Table 2.1 : 2023 Network Infrastructure Proposals

Major Infrastructure	Applied in City Centre Model	Strategic Influence from ASAM
AWPR	×	✓
Berryden Dualling	✓	✓
South College St Improvements	✓	✓
Third Don Crossing	Partial	✓
Haudagain Junction improvements	×	✓
Masterplan	×	×

The detail of these infrastructure measures is provided within the SIAS Report *Aberdeen City Centre: Future Year Model Development Report – Transport Model Input Report (SIAS Ref. 76042, March 2014)*.

Figure 2.1 provides a schematic of the proposed infrastructure changes in the Aberdeen City Centre area within the 2023 Reference Case Network.

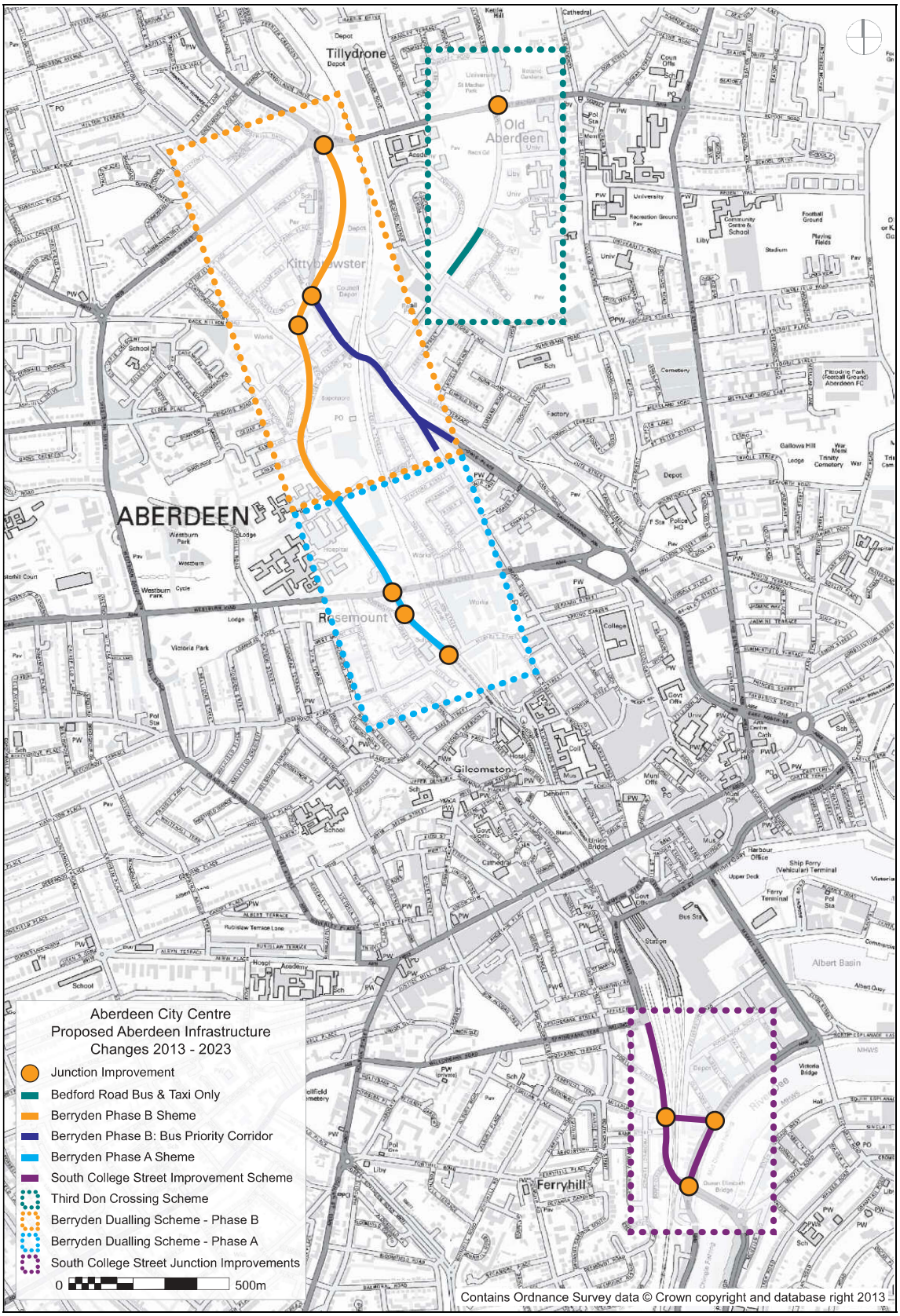

Figure 2.1 : Proposed Aberdeen infrastructure Changes 2012 to 2023

2.2.1 South College Street Improvement Scheme

The South College Street scheme has undergone further testing since the Reference Case development report was produced in March 2014. This further testing has not been concluded therefore ACC advised that the approved scheme as at March 2014 (with existing roundabout at Queen Elizabeth II Bridge and Palmerston Link Road included) would be utilised for the purposes of the Phase 1 element of the Masterplan Testing. ACC has accepted that this design does not fully cater for the modelled network demand by 2023 and that some traffic queueing occurs off the model network on Wellington Road during the peaks.

The detailed design of the South College Street improvements are to be considered in a future phase of the Masterplan testing.

2.2.2 Berryden Dualling Scheme

The Berryden dualling scheme was developed in 2009. With the first stages of the improvements to be implemented in 2016 – 2017, the scheme is currently undergoing a detailed design review by appointed consultants. SIAS has been advised to use the currently approved scheme for the Masterplan –Phase 1 Testing with the following Public Transport exceptions:

- Removal of bus stop on west side of Caroline Place
- Removal of bus stop on east side of Berryden Road, approximately 30m north of the junction with Hutcheon Street
- Addition of two bus stops on the west and east side of the proposed dual link road between Powis Terrace and St. Machar Roundabout (on-street)

2.3 2023 Development Content

By 2023, there are proposed to be a number of committed developments within Aberdeen City Centre, and these have been included in the 2023 Reference Case Model as advised by ACC. Table 2.2 details the additional traffic volumes within the city centre network associated with each development.

Table 2.2 : 2023 Committed Development Content (vehs)

Major Infrastructure				06:00-10:00		15:00-19:00		12:00-16:00	
Test Detail	Paramics Model Changes	ASAM Influence	2023 Reference Case	From	To	From	To	From	To
Old Capitol site, Union Street	✓	✗	✓	12	80	77	13	9	9
Frederick Street	✓	✗	✓	15	103	116	14	66	66
Broadford Works.	✓	✗	✓	308	179	424	378	352	371
St Nicholas House/Marishcal Sq	✓	✗	✓	84	401	299	76	285	223
Ardent House	✓	✗	✓	106	566	466	100	57	67
The Grande	✓	✗	✓	50	267	220	47	27	31
Riverside Development	✓	✗	✓	18	94	78	17	10	11
Royal Cornhill Development	✓	✗	✓	328	148	279	407	246	360
Total				921	1,838	1,959	1,052	1,051	1,138
					2,759		**3,010**		**2,190**

There are changes in the development trip totals for the Broadford Works and Cornhill Hospital development compared to previous studies. The trip totals for these two developments that previously came from the ASAM 2023 traffic matrices were been found to be significantly lower than was considered within their respective Transport Assessment Reports. ACC provided SIAS with revised trip totals to apply in the 2023 Reference Case Model.

In addition, the trip totals for traffic associated with the Frederick Street Development was initially applied according to the Transport Assessment. As this development has now been constructed, ACC provided SIAS with actual traffic flow survey data for the development and this was found to be lower than what had been previously applied in the model. The figures shown in Table 2.2 reflect the most up to date figures available.

It is understood that there are development proposals submitted to expand the Union Square development car parking and retail elements. As these development proposals are not considered committed by ACC, SIAS was advised not to include any changes to the trip attraction to the Union Square development as part of this phase of the Masterplan testing.

Table 2.2 shows the total volume of traffic growth associated with the committed developments in each of the modelled periods. Table 2.3 shows how these additional trips affect the overall traffic growth within the city centre model between 2012 and 2023.

Table 2.3 : 2023 Reference Case, Final Matrix Totals

Data	Matrix	Type	AM	PM	SAT
2012	Matrix 1	Lights	60,447	74,927	80,749
Model Matrices	Matrix 2	Heavies	3,339	3,547	864
		Total	63,786	78,474	81,613
2023	Matrix 1	Lights	61,590	77,581	82,880
Final Matrices	Matrix 2	Heavies	3,824	4,101	1,021
	Matrix 3	Development	2,759	3,010	2,190
		Total	**68,173**	**84,692**	**86,091**
Growth (v)			**4,387**	**6,218**	**4,478**
% Growth			**7%**	**8%**	**5%**

Table 2.3 shows that the final 2023 Reference Case model matrices are 7%, 8%, and 5% higher than the 2012 Baseline in the AM, PM, and Saturday Peak periods respectively. The background growth in the 2023 model comes from the traffic growth within the ASAM model. All the developments within the city centre are included separately to this.

It is important to consider that in the historical testing of the Union Street Pedestrianisation scheme, the influence of the AWPR on the city centre area (from the ASAM modelling) resulted in a net reduction of traffic within the city centre area of approximately 5%. This facilitated the road restrictions within the city centre as part of that scheme. The current ASAM predictions show a slight increase in the traffic demand within the city centre area (Matrix 1 and 2), this is with the inclusion of the AWPR. The increase in background growth is assumed to be due to the high level of LDP housing and development growth within the wider Aberdeen network proposed by 2023.

When the committed development trips are applied within the city centre model (Matrix 3), then the net effect is a 5-8% growth in traffic demand within the city centre area.

These traffic demand issues are acknowledged by ACC and there are plans to restrict the volume of traffic routeing in the city centre area by means of:

- Modal shift to more sustainable transport
- Relocation of strategic traffic (routeing right through the city centre area)

There are currently other ongoing studies to assess and develop these measures. For the purposes of the City Centre Masterplan Study, SIAS is required to test the various phases of implementation of the Masterplan and report on when a traffic reduction is required to enable the city centre network to operate.

The network test scenarios which require a reduction in the model traffic demand are detailed in subsequent chapters.

2.4 Public Transport Update

ACC undertook bus dwell surveys at the key bus stops around the Broad Street area (namely H1, H2, R1, G2-G5) on Tuesday 6 October and Saturday 10 October 2015. These surveys were undertaken through the modelled periods of each peak. The Survey data was collated and the average bus dwell time per service per stop was updated within the 2023 Reference Case Model.

In order to further update the modelled public transport network, the First bus Route No. 4 was added to the model, and the No. 20 was amended to the latest route plan. These changes were identified by the ACC Public Transport Unit.

2.5 Traffic Signal Review

Within the 2023 Reference Case Model, and also within the subsequent option test models, it was necessary to review the signal timings of the signalised junctions to try to replicate the optimisation of the timings which would occur within the real-time SCOOT system (Split Offset Optimisation Technique). This was necessary to try to accommodate the increase in traffic demand, as well as the changes in travel patterns across the city centre network associated with the test options.

The model traffic signals were either amended manually, from observing the modelled runs and queue levels and adjusting the greentime applied to each signal phase, or model flow analysis was undertaken to calculate the traffic demand at the junction and thus the optimal greentime required (based on first principles of a 2s headway per vehicle).

The pedestrian timings and junction staging was kept the same as the 2013 Base Model in the 2023 Reference Case Model and all option tests.

3 TRAFFIC MODEL TEST PROGRAMME

3.1 Introduction

A range of transportation measures will be required to support the City Centre Masterplan, this will include measures to support modal shift. The programme of testing considers the prioritisation of schemes in the coming years that will ultimately support the full Masterplan proposals.

The first area identified for review and assessment is the operation of the network through the Broad Street and Schoolhill area. The Masterplan includes proposals to restrict general traffic on Broad Street, between Upperkirkgate and Queen Street to create a more pedestrian friendly environment outside Marischal College and the new Marischal Square. This could be considered for either bus only, bus and taxi only or a complete road closure.

Similarly, Schoolhill is proposed to be completely closed to all traffic between Harriet Street and Flourmill Lane. This is proposed in order to improve the pedestrian linkage between the shopping centres.

3.2 Model Test Programme Development

Through discussions between SIAS and ACC, the model test scenarios were identified as follows:

Table 3.1 : Model Testing, Initial Programme

Scenario	Broad Street		Schoolhill		Mitigation / Further Measures	Bus Route Impact
	Bus & Taxi Only	Closed	Closed	Open		
Test 1	✓			✓	-	No Change
Test 2	✓		✓		-	A .Broad St open, Schoolhill closed
Test 3		✓		✓	-	B .Broad St closed, Schoolhill open
Test 4		✓	✓		-	C .Broad St closed, Schoolhill closed

ACC sought to primarily assess Broad Street as closed to all traffic or as bus and taxi only, but with the variation of Schoolhill as either open or closed in each of these Broad Street scenarios.

ACC also initially considered further model test scenarios for bus only restrictions on Broad Street as well as the Bus and taxi only restriction tests detailed, however, the traffic model does not include a specific taxi route matrix. Taxis are included within the traffic model, but only as a proportion of general traffic. SIAS advised that there would not be any significant benefit to test this difference within the traffic model. ACC therefore carried out taxi flow surveys in the area and the detail of these and the implication of the taxi flows are discussed in Section 4.

Table 3.1 also highlights the bus route impact of the test scenarios. The bus route networks can be divided into three configurations: A, B, and C. This is detailed in Section 3.5

3.3 High Level Testing

Through the development of the model testing programme, SIAS undertook a series of initial high level testing on the 2023 Reference Case model to gain an understanding of the impact of closing Broad Street and Schoolhill to general traffic.

This high level testing did not consider changes to the PT network (road closures were applied to general traffic but not buses or taxis), nor did it consider any changes to traffic signal timings within the modelled network. It did allow an initial understanding of where the traffic displacement would likely occur within certain scenarios.

The scenarios assessed at high level were as follows:

- Broad Street closed to general traffic
- Schoolhill closed to general traffic
- Broad Street and Schoolhill closed to general traffic

This assessment highlighted areas of the network where further mitigation may be required to either facilitate the movement of traffic through the network, or restrict the displaced traffic from rat-run routes.

Section 4 provides detail on the reasons for the further mitigation but, essentially, where restrictions on Broad Street are proposed, traffic flow increases are observed on Union Terrace. A bus and taxi only proposal for Union Terrace was, therefore, proposed as a further infrastructure measure consideration.

Where restrictions on Schoolhill are proposed, traffic flow increases are observed east-west through the George Street shopping area, particularly on John Street and St. Andrews Street. A mitigation measure was therefore proposed to include traffic restrictions through the George Street/John Street area to limit the volume of traffic through this area.

George Street traffic routeing restrictions are proposed within the City Centre Masterplan, therefore these measures were taken forward as a mitigation test associated with the closure of Schoolhill. The detail of the George Street traffic routeing restrictions applied is detailed in the following section.

3.4 Detailed Test Programme

From the high level testing, the detailed traffic model testing programme was identified as follows:

Table 3.2 : Model Testing, Detailed Testing Programme

Scenario	Broad Street		Schoolhill		Mitigation / Further Measures	Bus Route Impact
	Bus & Taxi Only	Closed	Closed	Open		
Test 1	✓			✓	-	No Change
Test 2	✓		✓		-	A .Broad St open, Schoolhill closed
Test 3		✓		✓	-	B .Broad St closed, Schoolhill open
Test 4		✓	✓		-	C .Broad St closed, Schoolhill closed
Test 5	✓			✓	Test 1 with Union Terrace B&T	No Change
Test 6	✓		✓		Test 2 with Union Terrace B&T & George St TM	A .Broad St open, Schoolhill closed
Test 7		✓		✓	Test 3 with Union Terrace B&T	B .Broad St closed, Schoolhill open
Test 8		✓	✓		Test 4 with Union Terrace B&T & George St TM	C .Broad St closed, Schoolhill closed

Figures 3.1 and 3.2 show a schematic of the Test Scenarios 1-4 and 5-8 respectively

Figure 3.1 : Test Scenarios 1-4

For all scenarios where Broad Street is restricted to bus and taxi only between Upperkirkgate and Queen Street, ACC requested that the existing bus stops on Broad Street (Stops H1 and H2) be moved to the south end of Broad Street.

The bus stop H1 on the west of Broad Street was to be modelled within a new lay-by approximately where the Netherkirkgate lane accesses Broad Street. The bus stop H2 was to be modelled on-street mid-way between Queen Street and Union Street.

By moving the bus stop locations on Broad Street to the south of Queen Street, this would potentially allow footway widening outside Marischal College, as only a two-way link road for buses and taxis would be require. This would assist in creating a more civic square environment for pedestrians at this location.

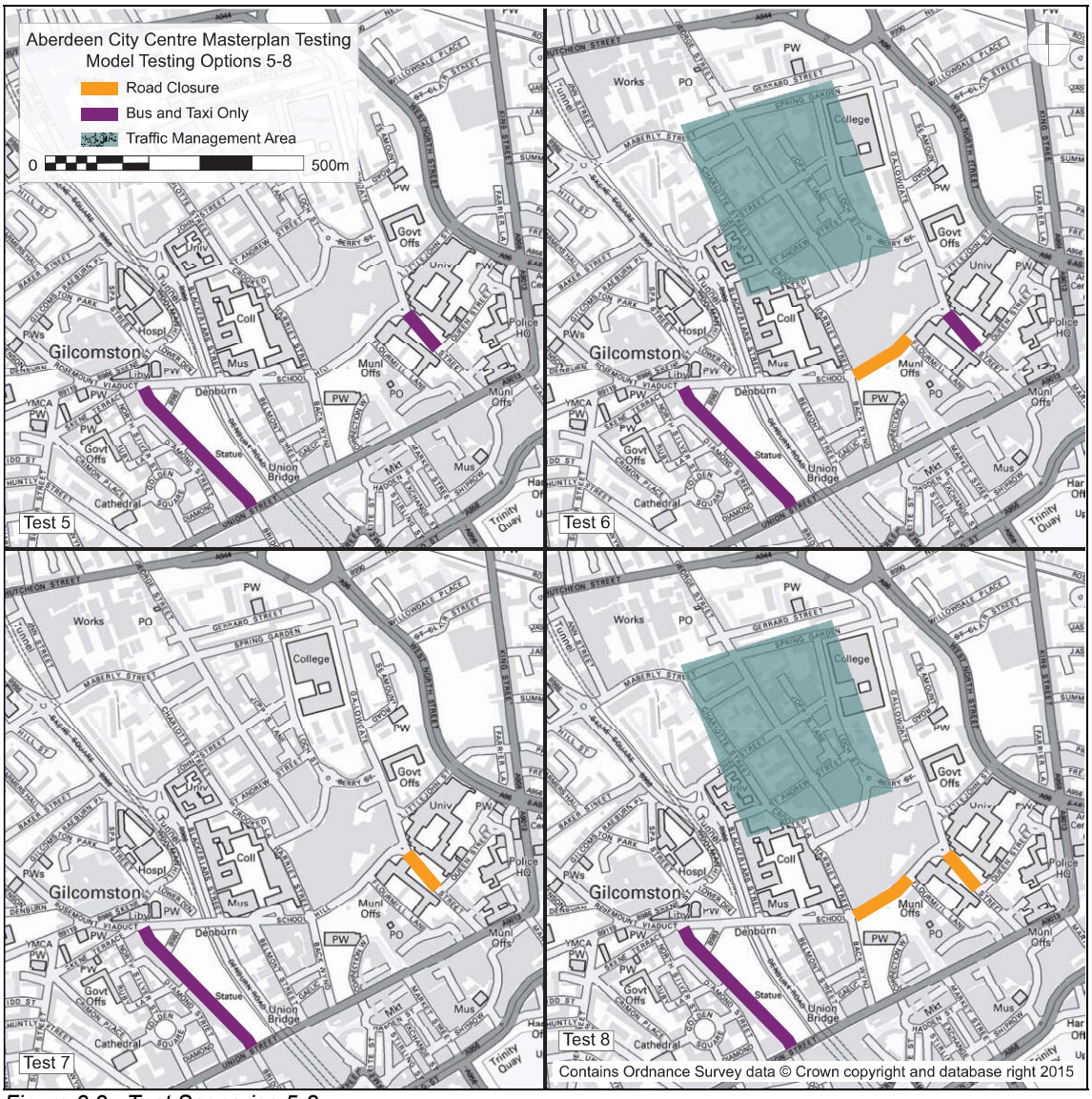

Figure 3.2 : Test Scenarios 5-8

The mitigation measure associated with Union Terrace was considered as restriction to general traffic between Union Street and Diamond Place. Only buses and taxis were permitted to route through Union Terrace.

The mitigation measures associated with the George Street traffic management proposals include:

- John Street - bus and taxi only between Charlotte St and Jopps Lane (from Masterplan)
- George Street – bus and taxi only between St. Andrews Street and Craigie Street (from Masterplan)
- St. Andrews Street - bus and taxi only between Loch Street and Charlotte Street (from Masterplan)
- Gallowgate – bus and taxi only NB, general traffic southbound, between Spring Garden and Gallowgate Car Park (from Masterplan)
- Blackfriars Street – Bus and taxi only NB, general traffic southbound, between St. Andrews Street and Schoolhill

The Blackfriars Street measures are a slight variation to the Masterplan proposals as the Masterplan includes SB only restrictions on Blackfriars St. Given that this route is a key bus route in both directions, ACC confirmed that the model testing should include a bus and taxi lane northbound.

Figure 3.3 shows the general layout of the George Street traffic management proposals associated with test scenarios 6 and 8.

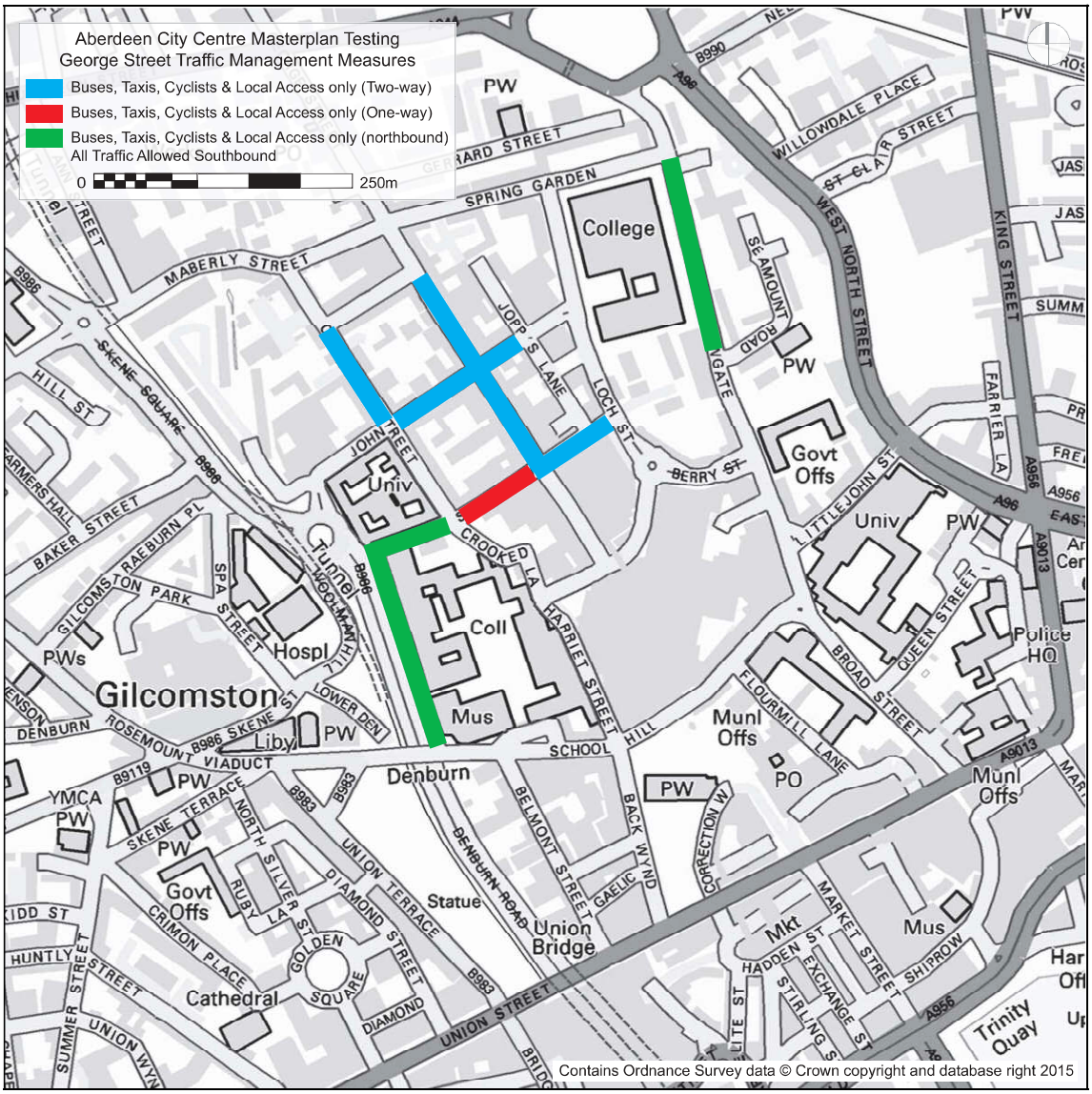

Figure 3.3 : George Street Traffic Management Proposals

The proposed measures through the George Street area will require further review, especially as part of any potential car park access strategy within the City Centre. The measures modelled as part of this stage of testing replicate the purpose of restricting through (strategic) traffic through this area of the network.

3.5 Public Transport Network

3.5.1 Bus Routes

The ACC Public Transport Unit provided SIAS with the likely revised bus routes associated with each of the test scenarios. Figures 3.4 to 3.7 show the PT routes for the buses directly affected by each of the closure scenarios (A, B, C).

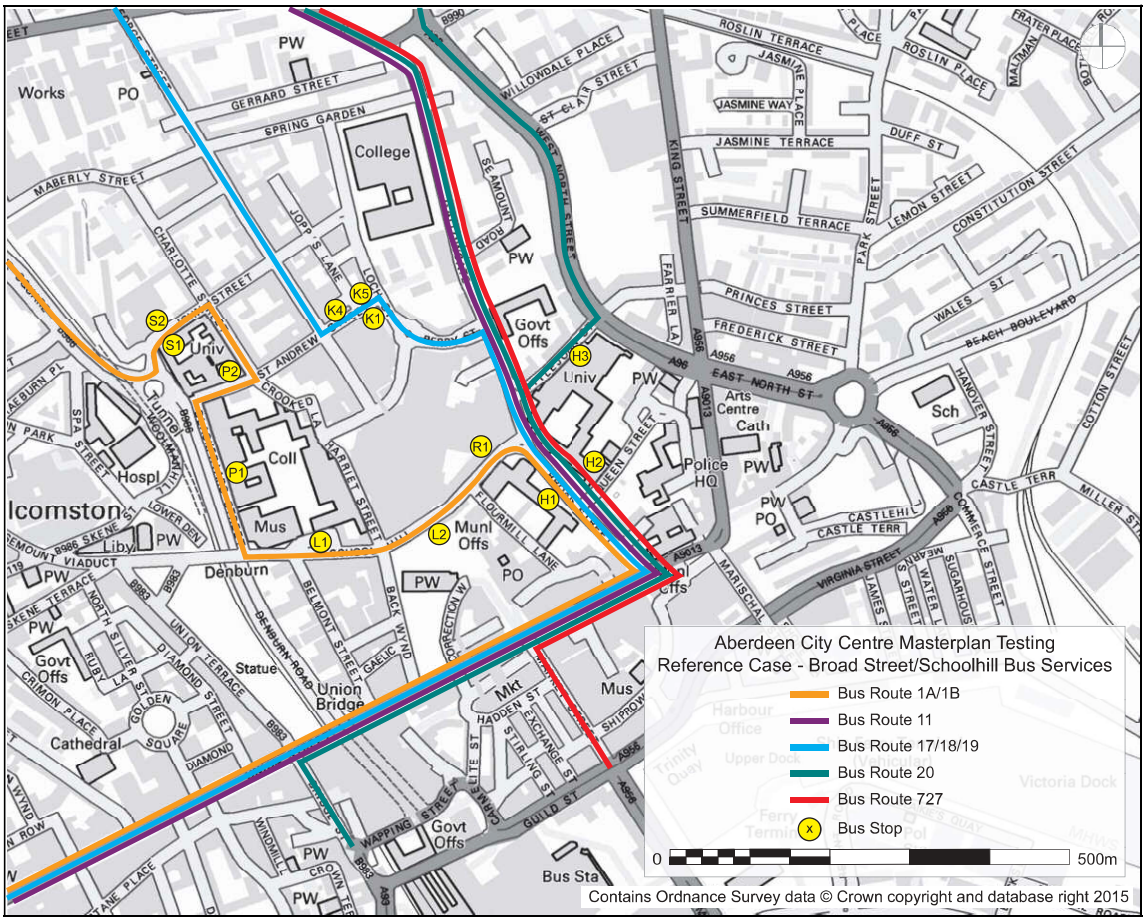

Figure 3.4 : PT Network - Reference Case

Figure 3.4 shows that in the Reference Case scenario, only one of the affected routes currently uses Schoolhill, while all the others route through Union Street and Broad Street.

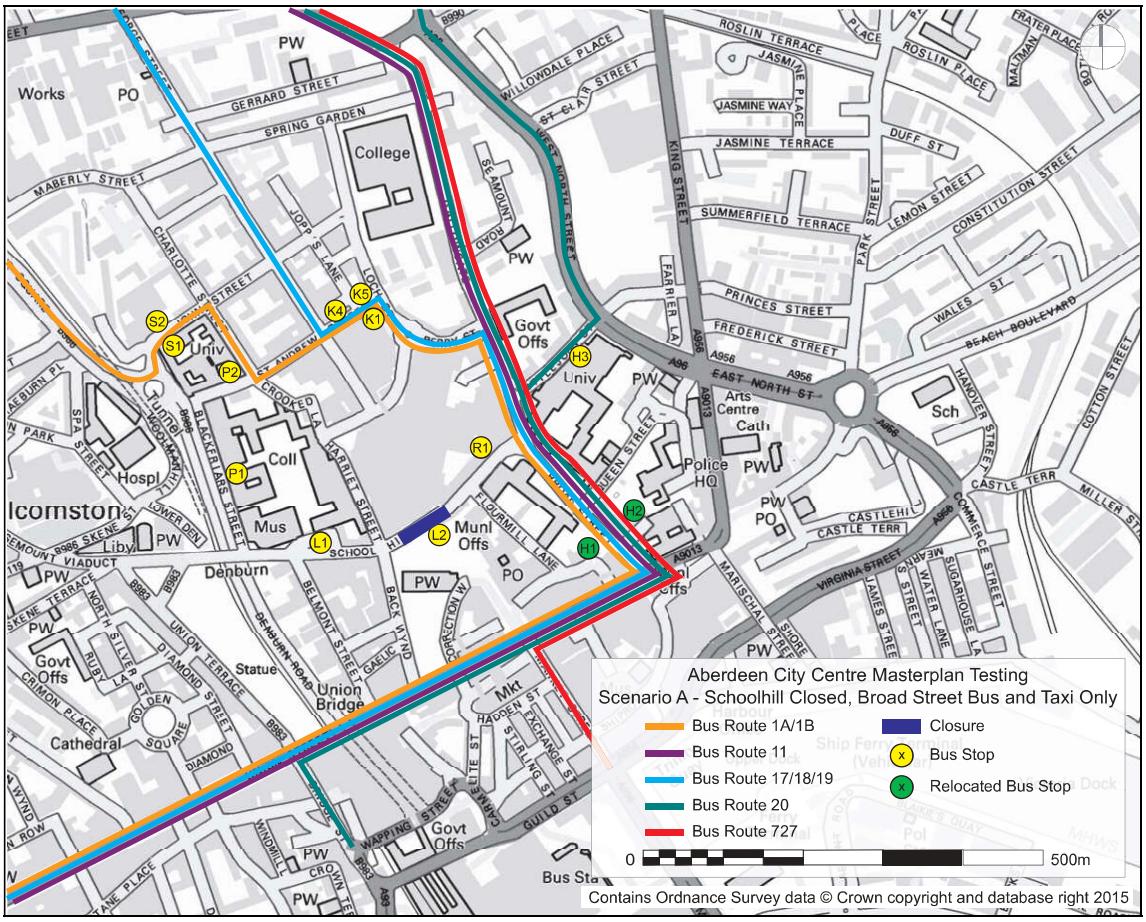

Figure 3.5 : PT Network – Scenario A

In the scenarios where Schoolhill is closed to all traffic (Figure 3.5), only the 1A/1B service is required to re-route.

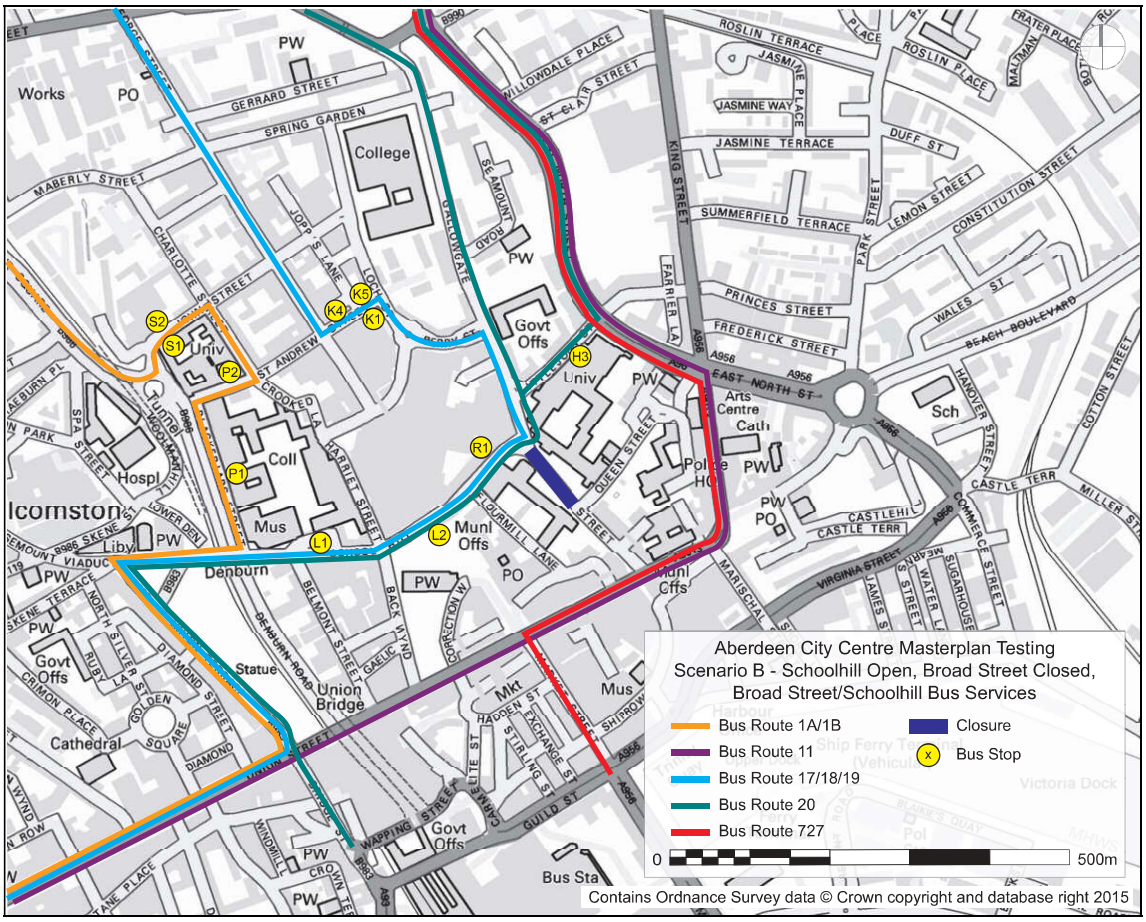

Figure 3.6 : PT Network – Scenario B

In the scenarios where Broad Street is closed to all traffic, a number of the bus services in the area are affected. These services are re-routed via either Schoolhill or King St/West North Street. It is important to note that there are fewer buses routeing fully along Union Street in this scenario.

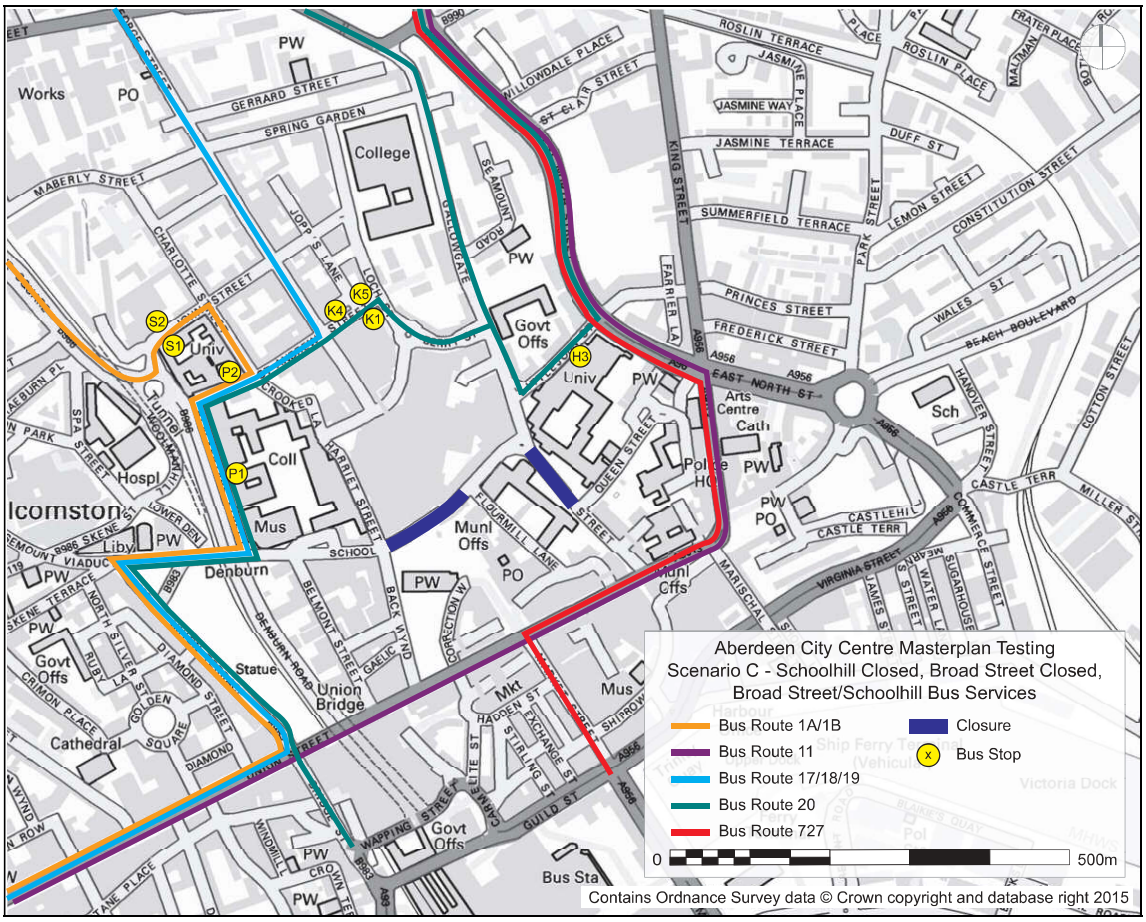

Figure 3.7 : PT Network – Scenario C

In the scenarios where Broad Street and Schoolhill is closed to all traffic, all of the noted bus services in the area are affected. These services are re-routed via either Union Terrace or King St/West North Street. It is important to note that there are fewer buses routeing fully along Union Street in this scenario.

3.5.2 Bus Stops/Bus Dwell

In each test scenario, where bus stops are removed, the dwell time of the buses at these stops is re-allocated to another nearly stop. This is undertaken based on the assumption that the number of passengers does not change between options and therefore the total bus dwell time for each service remains the same through the city centre no matter which route that they take. This also allows a clear comparison of the journey time and reliability statistics of the bus services between scenarios.

The PTU team within ACC advised SIAS of where the likely bus dwell times should be re-allocated. Appendix A details the modelled changes for the PT scenarios A to C.

3.6 Additional Network Detail

In all option test scenarios, ACC advised that the following measures should also be applied in the network to take cognisance of the revised bus route network associated with each test scenario.

3.6.1 Blackfriars St/St. Andrews Street

Where Blackfriars St joins St. Andrews Street, there is a very tight turning radius. ACC has advised that buses have difficulty in making this manoeuvre when other buses or HGVs are turning in the opposite direction. ACC advised SIAS to apply a set of traffic signals at this location in the model to replicate the delay which would be encountered by vehicles waiting to turn against traffic routeing in the opposite direction.

3.6.2 Upperkirkgate/Gallowgate

In the test scenarios where Broad Street is closed and Schoolhill is open to all traffic, the signalised junction at Upperkirkgate/Gallowgate was modelled so that the Upperkirgate arm of the junction ran separately to the Gallowgate arm. This was due to similar reasons to the Blackfriars Street/St. Andrews Street junction in that there is known difficulty in larger vehicles routeing between Gallowgate and Upperkirgate in opposing direction at the same time. This model configuration was confirmed by ACC.

4 MODEL TEST RESULTS

4.1 Introduction

This section details the test results of the eight test scenarios identified when compared against the 2023 Reference Case scenario.

It should be noted that the traffic model statistics are based upon future year traffic modelling. Traffic modelling can never be precise and it is not presented as such, because it involves assumptions about the future and driver behaviour. The model statistics shown in this report should be seen as indicative of potential changes to the network area when considering the impact of the proposals outlined in this Report.

The model test scenarios are shown in Table 4.1

Table 4.1 : Option Test Scenarios

Scenario	Broad Street		Schoolhill		Mitigation / Further Measures	Bus Route Impact
	Bus & Taxi Only	Closed	Closed	Open		
Test 1	✓			✓	-	No Change
Test 2	✓		✓		-	A .Broad St open, Schoolhill closed
Test 3		✓		✓	-	B .Broad St closed, Schoolhill open
Test 4		✓	✓		-	C .Broad St closed, Schoolhill closed
Test 5	✓			✓	Test 1 with Union Terrace B&T	No Change
Test 6	✓		✓		Test 2 with Union Terrace B&T & George St TM	A .Broad St open, Schoolhill closed
Test 7		✓		✓	Test 3 with Union Terrace B&T	B .Broad St closed, Schoolhill open
Test 8		✓	✓		Test 4 with Union Terrace B&T & George St TM	C .Broad St closed, Schoolhill closed

The statistics extracted from the models and detailed in the flowing sections are:

- Model run success
- Traffic flow difference plots
- Traffic flow volumes
- Queue Analysis
- Bus Journey Times
- Bus Reliability

4.2 Model Run Success

When running the option test traffic models, the proposed traffic restrictions within the city centre area resulted in network failure (model grid locking) in model runs for certain scenarios.

Traffic models which gridlock suggest an unstable network and give an indication that there may be major junction and corridor capacity issues throughout the area of study.

The proportion of model runs which fail through gridlock is one statistic used when comparing model scenarios. For example, if a high number of model runs fail, this suggests that there could be traffic capacity issues predicted throughout the study area.

Table 4.2 shows the model run success rate for all network scenarios.

Three model runs were undertaken for each model scenario and the table details the number of model runs that were able to be completed without grid locking.

Where models failed at the full anticipated traffic demand for 2023, the demand level was reduced by 5% and also 10% to assess whether the models could run at a lower demand level.

Table 4.2 : Model Scenario Run Success

Scenario	Broad Street		Schoolhill		Mitigation / Further Measures	Model Run Success								
	Bus & Taxi Only	Closed	Closed	Open		00% Deman			95% Demand			90% Demand		
						AM	PM	SAT	AM	PM	SAT	AM	PM	SAT
Test 1	✓			✓	-	3/3	3/3	3/3	N/A	N/A	N/A	N/A	N/A	N/A
Test 2	✓		✓		-	3/3	3/3	3/3	N/A	N/A	N/A	N/A	N/A	N/A
Test 3		✓		✓	-	3/3	3/3	3/3	N/A	N/A	N/A	N/A	N/A	N/A
Test 4		✓	✓		-	3/3	3/3	3/3	N/A	N/A	N/A	N/A	N/A	N/A
Test 5	✓			✓	Test 1 with Union Terrace B&T	3/3	3/3	3/3	N/A	N/A	N/A	N/A	N/A	N/A
Test 6	✓		✓		Union Terrace B&T & George St TM	3/3	0/3	0/3	3/3	0/3	0/3	3/3	1/3	0/3
Test 7		✓		✓	Test 3 with Union Terrace B&T	3/3	3/3	3/3	N/A	N/A	N/A	N/A	N/A	N/A
Test 8		✓	✓		Test 4 with Union Terrace B&T & George St TM	3/3	0/3	0/3	3/3	0/3	0/3	3/3	1/3	0/3

Table 4.2 shows that all model scenarios are able to run at the full anticipated 2023 network demand with the exception of Tests 6 and 8.

Test 6 and 8 include the George Street traffic management measures as detailed in Figure 3.3. These models fail through gridlock at 100% and 95% in the PM and Saturday Peaks. At 90% demand selected PM peak models run but none of the Saturday Peak models run.

4.2.1 Reason for Network Failure, Test 6 & 8

As noted in Section 3.3: *Where restrictions on Schoolhill are proposed, traffic flow increases are observed east-west through the George Street shopping area, particularly on John Street and St. Andrews Street. A mitigation measure was therefore proposed to include traffic restriction measures through the George Street/John Street area to limit the volume of traffic through this area.*

In Tests 6 and 8, the east-west routeing traffic displaced from the George Street area is generally forced up through Skene Square and Caroline Place to Hutcheon Street. This creates a very heavy right turning demand from Caroline Place to Hutcheon Street. The traffic demand at this junction was observed to be at capacity prior to the closure of the east –west routeing through the George Street area, therefore, with these additional restrictions, the capacity of the junction is exceeded.

The modelling shows that when the Berryden Road/Hutcheon Street junction cannot cater for the increase in northbound traffic demand, the traffic migrates to routes through the Rosemount area where gridlock occurs. Figures 4.1 and 4.2 show the congestion and grid locking occurring in Test 6 in the 2023 Network - PM Peak. The same is shown for Test 8 in Figures 4.3 and 4.4.

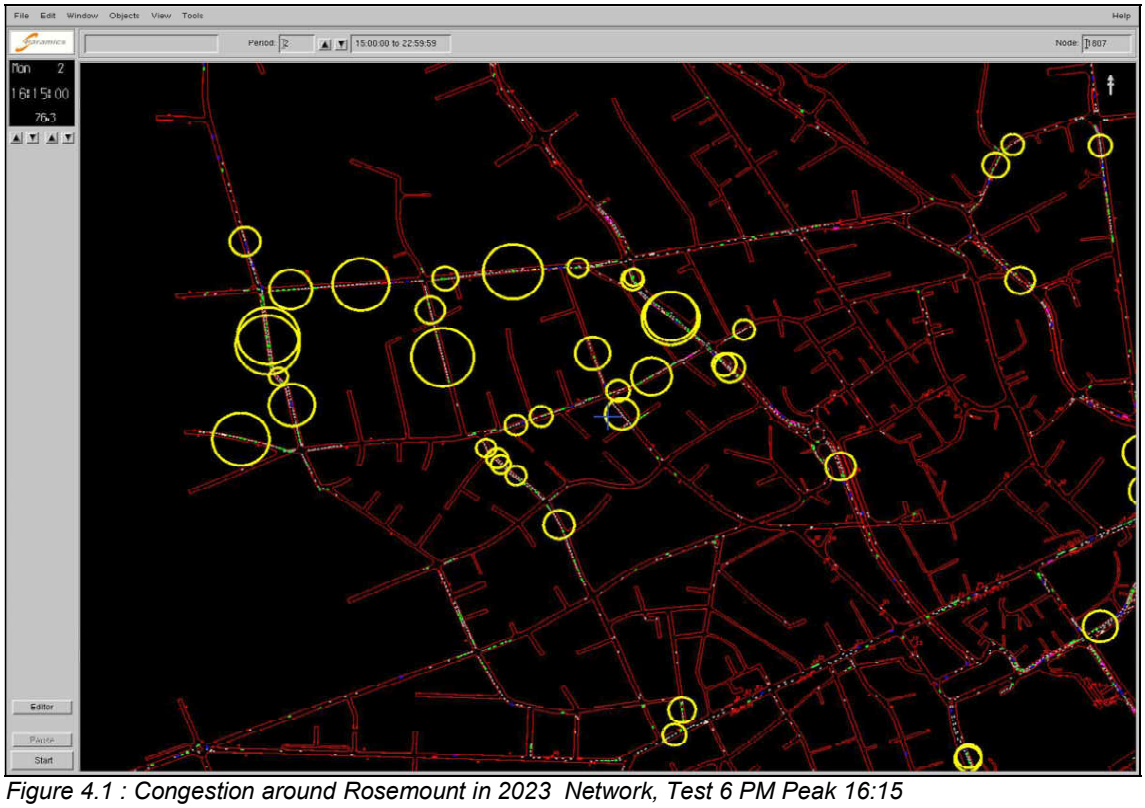

Figure 4.1 : Congestion around Rosemount in 2023 Network, Test 6 PM Peak 16:15

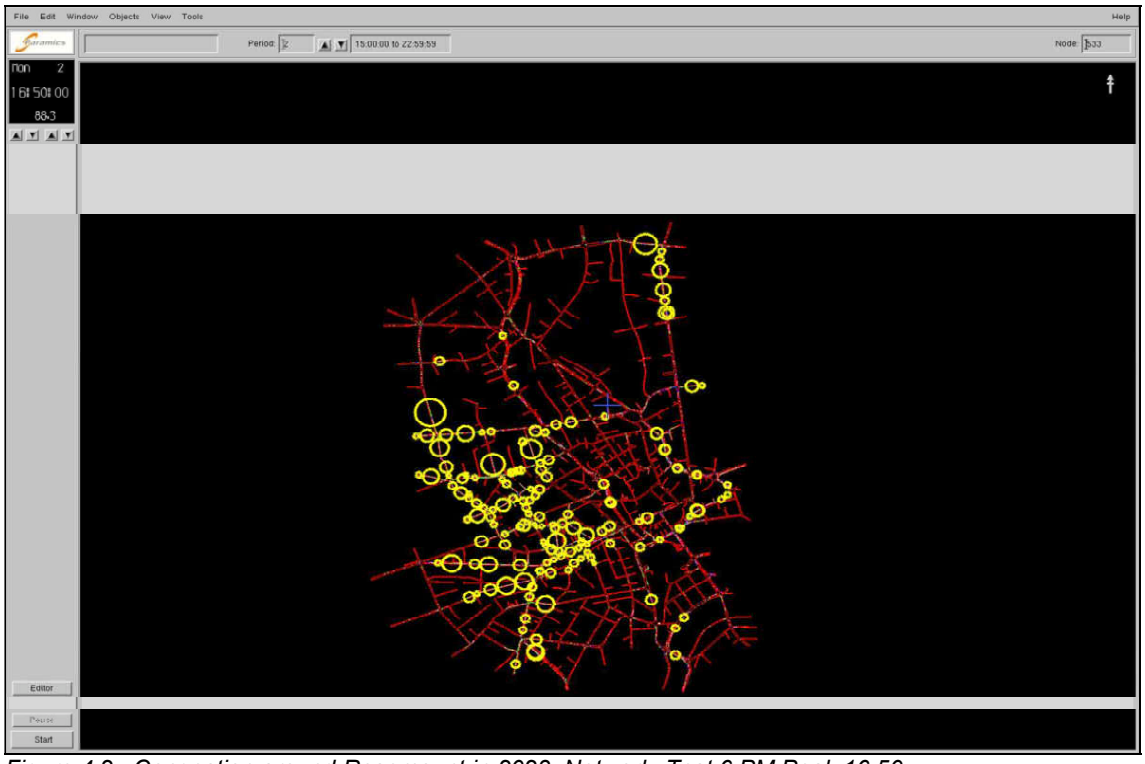

Figure 4.2 : Congestion around Rosemount in 2023 Network, Test 6 PM Peak 16:50

Figure 4.3 : Congestion around Rosemount in 2023 Network, Test 8 PM Peak 16:20

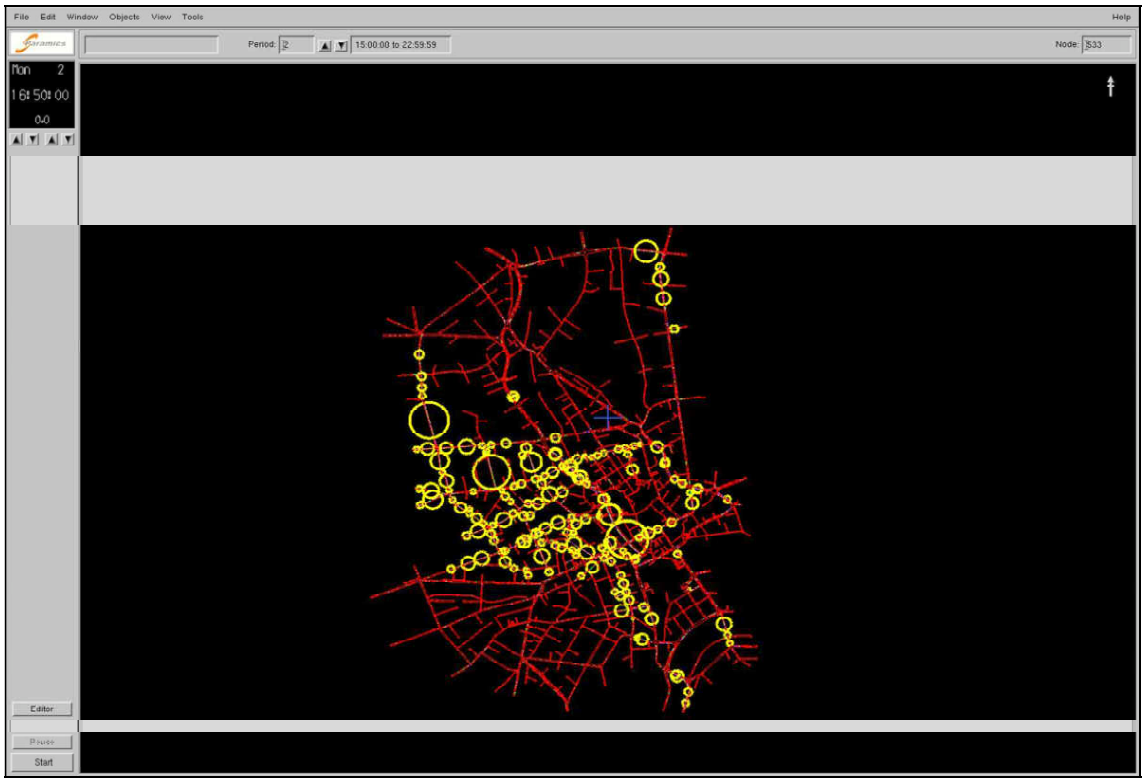

Figure 4.4 : Congestion around Rosemount in 2023 Network, Test 8 PM Peak 16:50

4.3 Traffic Flow Comparisons for Test Options 1 – 5 and 7

The impact of traffic displacement from the routes restricted by bus and taxi only measures or complete road closure was undertaken for each test scenario in the AM, PM, and Saturday peak periods.

The following figures show network plots of the difference in traffic flow between the Reference Case model and each of the test model scenarios (PM Peak figures are presented as AM and Saturday Peak figures show similar trends). Where there are red bands, this represents an increase in traffic flow and conversely, where there are blue bands, this represents a decrease in traffic flow. The width of the band is proportional to the volume of traffic flow change. For example, when Broad Street is closed to general traffic, the figure will show a wide blue band through Broad Street as the volume of traffic on this corridor is significantly reduced.

In addition to the PM Peak flow difference plots, a table summarising the key traffic flow differences are also provided for each test scenario. Appendix B provides further information on the impact of the restrictions for each test scenario.

4.3.1 Test 1: Broad Street Bus & Taxi Only

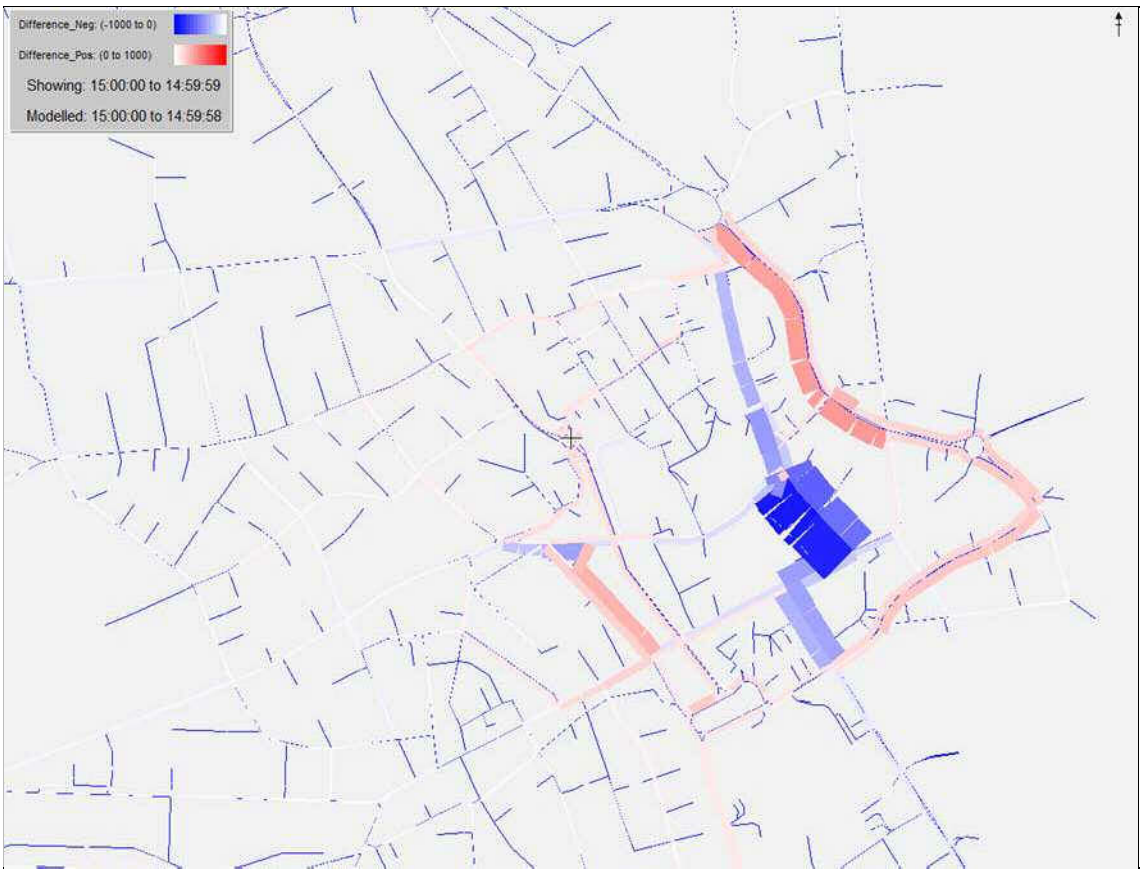

Figure 4.5 : Test 1 Flow Difference Plot – PM Peak Period – 2023 Network

Table 4.3 : Test 1, Key Flow Changes to 2023 Reference Case (vehs)

Location	Dir	AM Peak Period 06:00-10:00 2023 Ref Case (v)	AM Peak Period 06:00-10:00 Test 1 Diff to Ref Case (v)	PM Peak Period 15:00-19:00 2023 Ref Case (v)	PM Peak Period 15:00-19:00 Test 1 Diff to Ref Case (v)	Sat Peak Period 12:00 - 16:00 2023 Ref Case (v)	Sat Peak Period 12:00 - 16:00 Test 1 Diff to Ref Case (v)
Key Routes Affected by Broad Street Restrictions							
West North Street	NB	1,118	165	1,979	385	2,251	223
	SB	2,148	300	2,004	138	1,886	214
Virginia St	EB	3,028	74	4,856	148	4,000	171
	WB	3,445	137	3,047	219	3,022	329
Broad Street	NB	481	-383	1,040	-917	1,295	-1,121
	SB	785	-695	697	-620	823	-738
Union Terrace	NB	622	156	1,173	176	1,089	249
	SB	1,452	309	1,364	294	1,452	337
Denburn Rd	NB	1,708	50	4,104	120	2,613	357
	SB	3,017	24	2,354	65	2,538	6
Union Street	EB	1,678	206	1,717	-112	1,656	40
	WB	1,318	-10	1,638	104	1,587	253
Gallowgate	NB	483	-57	1,472	-273	1,666	-156
	SB	1,691	-191	1,180	-35	1,568	152

Figure 4.1 and Table 4.3 show that when Broad Street is closed to routeing traffic, there is a migration of north-south routeing traffic to the East & West North Street/Virginia Street corridor and to a smaller extend to Denburn Road. In addition, the traffic flow on Union Terrace also increases.

The Broad Street restrictions also impact on traffic flow through Gallowgate, which is significantly reduced.

4.3.2 Test 2: Broad Street Bus & Taxi Only, Schoolhill Closed

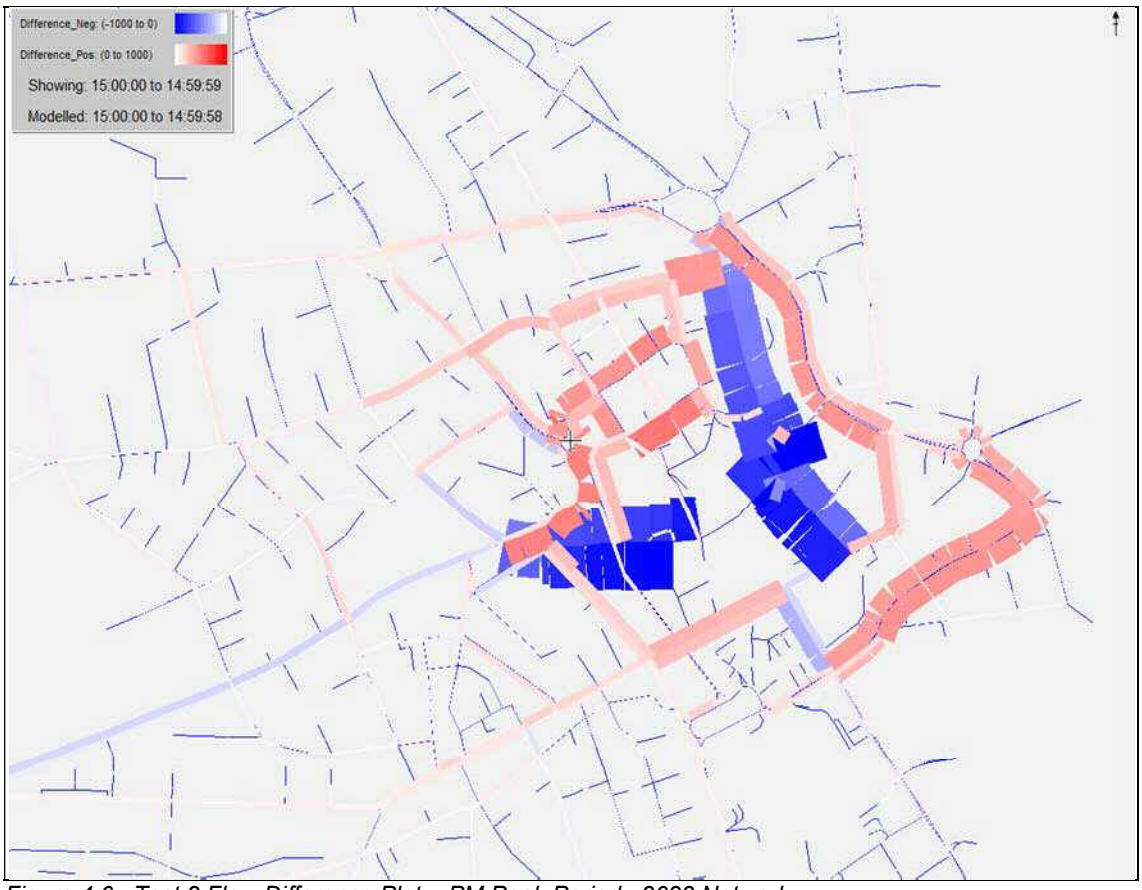

Figure 4.6 : Test 2 Flow Difference Plot – PM Peak Period– 2023 Network

Table 4.4 : Test 2, Key Flow Changes to 2023 Reference Case (vehs)

Location	Dir	AM Peak Period 06:00-10:00 2023 Ref Case (v)	AM Peak Period 06:00-10:00 Test 2 Diff to Ref Case (v)	PM Peak Period 15:00-19:00 2023 Ref Case (v)	PM Peak Period 15:00-19:00 Test 2 Diff to Ref Case (v)	Sat Peak Period 12:00 - 16:00 2023 Ref Case (v)	Sat Peak Period 12:00 - 16:00 Test 2 Diff to Ref Case (v)
Key Routes Affected by Broad Street Restrictions							
West North Street	NB	1,118	213	1,979	392	2,251	403
	SB	2,148	411	2,004	203	1,886	215
Virginia St	EB	3,028	258	4,856	383	4,000	393
	WB	3,445	263	3,047	420	3,022	447
Broad Street	NB	481	-383	1,040	-928	1,295	-1,132
	SB	785	-682	697	-617	823	-739
Union Terrace	NB	622	19	1,173	141	1,089	81
	SB	1,452	44	1,364	177	1,452	276
Denburn Rd	NB	1,708	154	4,104	82	2,613	262
	SB	3,017	-30	2,354	-39	2,538	-178
Union Street	EB	1,678	257	1,717	293	1,656	158
	WB	1,318	211	1,638	249	1,587	342
Gallowgate	NB	483	-82	1,472	-563	1,666	-424
	SB	1,691	-598	1,180	-508	1,568	-236
Key Routes Affected by Schoolhill Restrictions							
Hutcheon Street	EB	1,819	80	2,471	96	2,423	219
	WB	1,570	177	2,688	117	2,828	132
Spring Garden	EB	587	185	889	402	823	493
	WB	589	208	1,010	403	862	365
John Street	EB	1,427	486	1,813	411	1,747	508
	WB	451	221	740	262	894	191
St. Andrews Stre	EB	104	7	175	119	143	143
	WB	187	197	407	256	659	261
Schoolhill	EB	1,363	-643	1,721	-756	2,004	-979
	WB	1,034	-916	1,438	-1,114	1,387	-1,205

Figure 4.2 and Table 4.4 show that when Broad Street and Schoolhill are closed to routeing traffic, in addition to the flow changes noted in Test 1, there is a migration of east-west routeing traffic from Schoolhill to the George Street area, particularly through John St, St. Andrews St., and Spring Garden.

There is also a wider migration of east-west routeing traffic to Hutcheon Street in the north, and Union Street in the South.

4.3.3 Test 3: Broad Street Closed

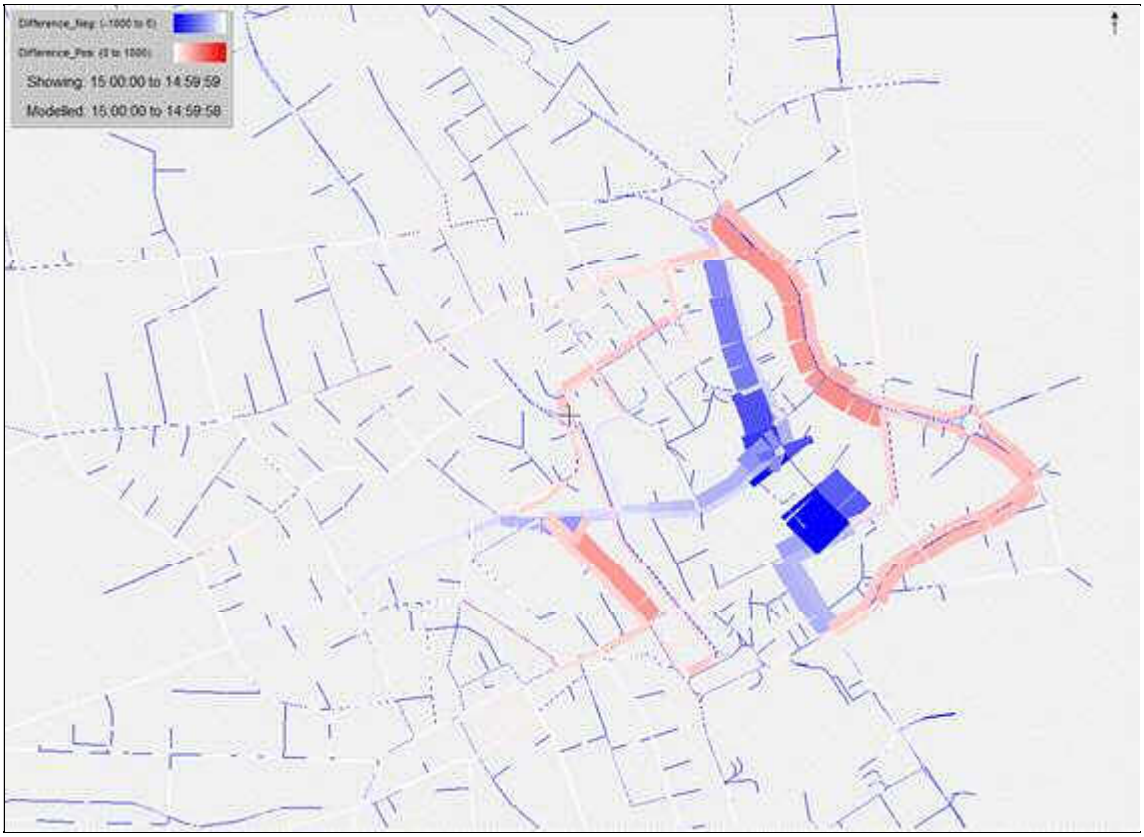

Figure 4.7 : Test 3 Flow Difference Plot – PM Peak Period– 2023 Network

Table 4.5 : Test 3, Key Flow Changes to 2023 Reference Case (vehs)

		AM Peak Period 06:00-10:00		PM Peak Period 15:00-19:00		Sat Peak Period 12:00 - 16:00	
Location	Dir	2023 Ref Case (v)	Test 3 Diff to Ref Case (v)	2023 Ref Case (v)	Test 3 Diff to Ref Case (v)	2023 Ref Case (v)	Test 3 Diff to Ref Case (v)
Key Routes Affected by Broad Street Restrictions							
West North Stree	NB	1,118	212	1,979	391	2,251	298
	SB	2,148	353	2,004	242	1,886	316
Virginia St	EB	3,028	76	4,856	204	4,000	248
	WB	3,445	169	3,047	273	3,022	350
Broad Street	NB	481	-481	1,040	-1,040	1,295	-1,295
	SB	785	-785	697	-697	823	-823
Union Terrace	NB	622	152	1,173	155	1,089	170
	SB	1,452	370	1,364	392	1,452	355
Denburn Rd	NB	1,708	74	4,104	127	2,613	414
	SB	3,017	53	2,354	-77	2,538	-73
Union Street	EB	1,678	174	1,717	12	1,656	87
	WB	1,318	-9	1,638	86	1,587	259
Gallowgate	NB	483	-127	1,472	-449	1,666	-424
	SB	1,691	-311	1,180	-124	1,568	-72

Figure 4.3 and Table 4.5 show very similar traffic flow changes to Test 1 as in both scenarios, Broad Street is closed to routeing traffic. The difference between the two options relates to the PT network operation only.

4.3.4 Test 4: Broad Street and Schoolhill Closed

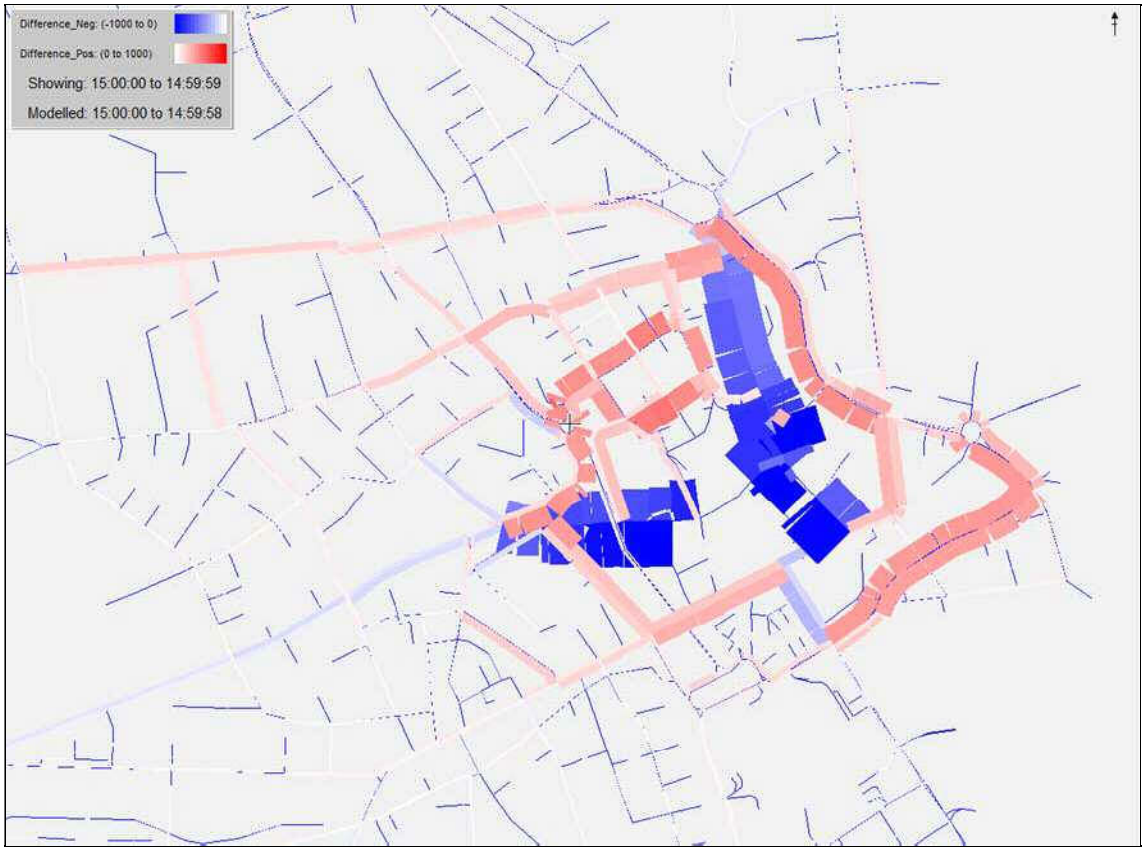

Figure 4.8 : Test 4 Flow Difference Plot – PM Peak Period– 2023 Network

Table 4.6 : Test 4, Key Flow Changes to 2023 Reference Case (vehs)

Location	Dir	AM Peak Period 06:00-10:00 2023 Ref Case (v)	AM Peak Period 06:00-10:00 Test 4 Diff to Ref Case (v)	PM Peak Period 15:00-19:00 2023 Ref Case (v)	PM Peak Period 15:00-19:00 Test 4 Diff to Ref Case (v)	Sat Peak Period 12:00 - 16:00 2023 Ref Case (v)	Sat Peak Period 12:00 - 16:00 Test 4 Diff to Ref Case (v)
Key Routes Affected by Broad Street Restrictions							
West North Street	NB	1,118	246	1,979	431	2,251	448
	SB	2,148	402	2,004	169	1,886	267
Virginia St	EB	3,028	219	4,856	397	4,000	477
	WB	3,445	220	3,047	369	3,022	448
Broad Street	NB	481	-481	1,040	-1,040	1,295	-1,295
	SB	785	-785	697	-697	823	-823
Union Terrace	NB	622	74	1,173	177	1,089	86
	SB	1,452	107	1,364	233	1,452	330
Denburn Rd	NB	1,708	127	4,104	70	2,613	356
	SB	3,017	21	2,354	22	2,538	-252
Union Street	EB	1,678	239	1,717	219	1,656	152
	WB	1,318	162	1,638	304	1,587	374
Gallowgate	NB	483	-89	1,472	-558	1,666	-434
	SB	1,691	-676	1,180	-540	1,568	-260
Key Routes Affected by Schoolhill Restrictions							
Hutcheon Street	EB	1,819	134	2,471	152	2,423	217
	WB	1,570	169	2,688	129	2,828	115
Spring Garden	EB	587	146	889	368	823	398
	WB	589	245	1,010	328	862	349
John Street	EB	1,427	487	1,813	437	1,747	514
	WB	451	238	740	256	894	259
St. Andrews Stre	EB	104	59	175	87	143	126
	WB	187	216	407	234	659	218
Schoolhill	EB	1,363	-633	1,721	-711	2,004	-932
	WB	1,034	-917	1,438	-1,120	1,387	-1,204

Figure 4.4 and Table 4.6 show very similar traffic flow changes to Test 2 as in both scenarios, Broad Street and Schoolhill are closed to routeing traffic. The difference between the two options relates to the PT network operation only.

4.3.5 Test 5: Broad Street & Union Terrace Bus & Taxi Only

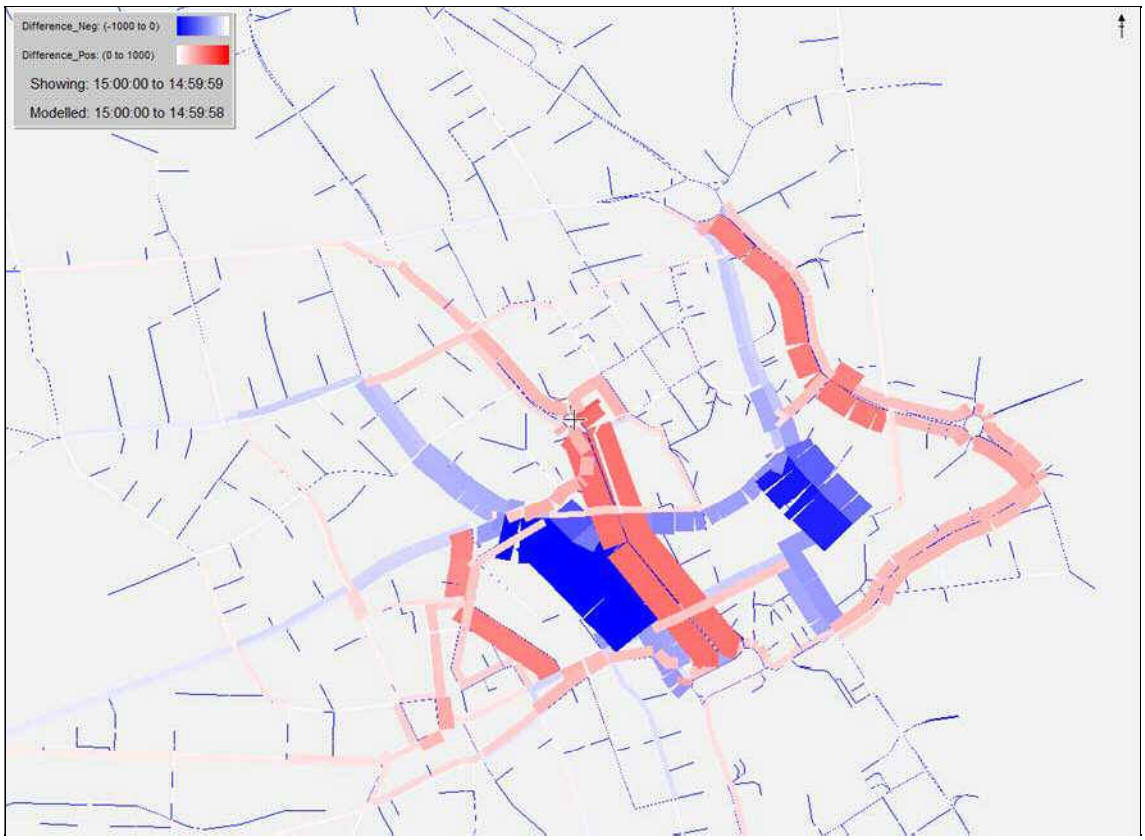

Figure 4.9 : Test 5 Flow Difference Plot – PM Peak Period– 2023 Network

Table 4.7 : Test 5, Key Flow Changes to 2023 Reference Case (vehs)

Location	Dir	AM Peak Period 2023 Ref Case (v)	AM Peak Period Test 5 Diff to Ref Case (v)	PM Peak Period 2023 Ref Case (v)	PM Peak Period Test 5 Diff to Ref Case (v)	Sat Peak Period 2023 Ref Case (v)	Sat Peak Period Test 5 Diff to Ref Case (v)
Key Routes Affected by Broad Street Restrictions							
West North Street	NB	1,118	247	1,979	502	2,251	364
	SB	2,148	314	2,004	208	1,886	301
Virginia St	EB	3,028	133	4,856	266	4,000	270
	WB	3,445	162	3,047	279	3,022	309
Broad Street	NB	481	-382	1,040	-923	1,295	-1,138
	SB	785	-687	697	-622	823	-738
Union Terrace	NB	622	-541	1,173	-1,074	1,089	-1,000
	SB	1,452	-1,321	1,364	-1,227	1,452	-1,331
Denburn Rd	NB	1,708	199	4,104	555	2,613	805
	SB	3,017	628	2,354	549	2,538	486
Union Street	EB	1,678	-138	1,717	-181	1,656	-206
	WB	1,318	102	1,638	223	1,587	379
Gallowgate	NB	483	1	1,472	-208	1,666	-40
	SB	1,691	-328	1,180	-153	1,568	40
Key Route Affected by Union Terrace Restriction							
Huntly St	NB	745	324	797	495	688	531
Summer St	NB	701	81	586	451	583	398
	SB	527	152	593	223	567	359

Figure 4.5 and Table 4.7 show similar traffic flow changes to Test 1, associated with the restrictions through Broad Street. The additional restriction to traffic through Union Terrace addresses the increased traffic volumes observed through this route in Test 1, and primarily pushes traffic out to the East/West North Street corridor.

There is an increase in local routeing through the Huntly Street and Summer Street corridors as traffic seeks to route between Union Street and Skene Street/Rosemount Viaduct. Traffic management measures should be considered through these routes in the scenarios where bus and taxi only measures are proposed for Union Terrace.

4.3.6 Test 6: Broad Street & Union Terrace Bus & Taxi Only, Schoolhill Closed, George Street Traffic Management

As noted in Section 4.2, the Test 6 scenario does not run at the full traffic demand without network grid locking. Traffic flow differences between the test scenario and the Reference Case cannot therefore be assessed. The primary statistic in this case is that the models do not run at the full anticipated demand.

4.3.7 Test 7: Broad Street Closed, Union Terrace Bus & Taxi Only

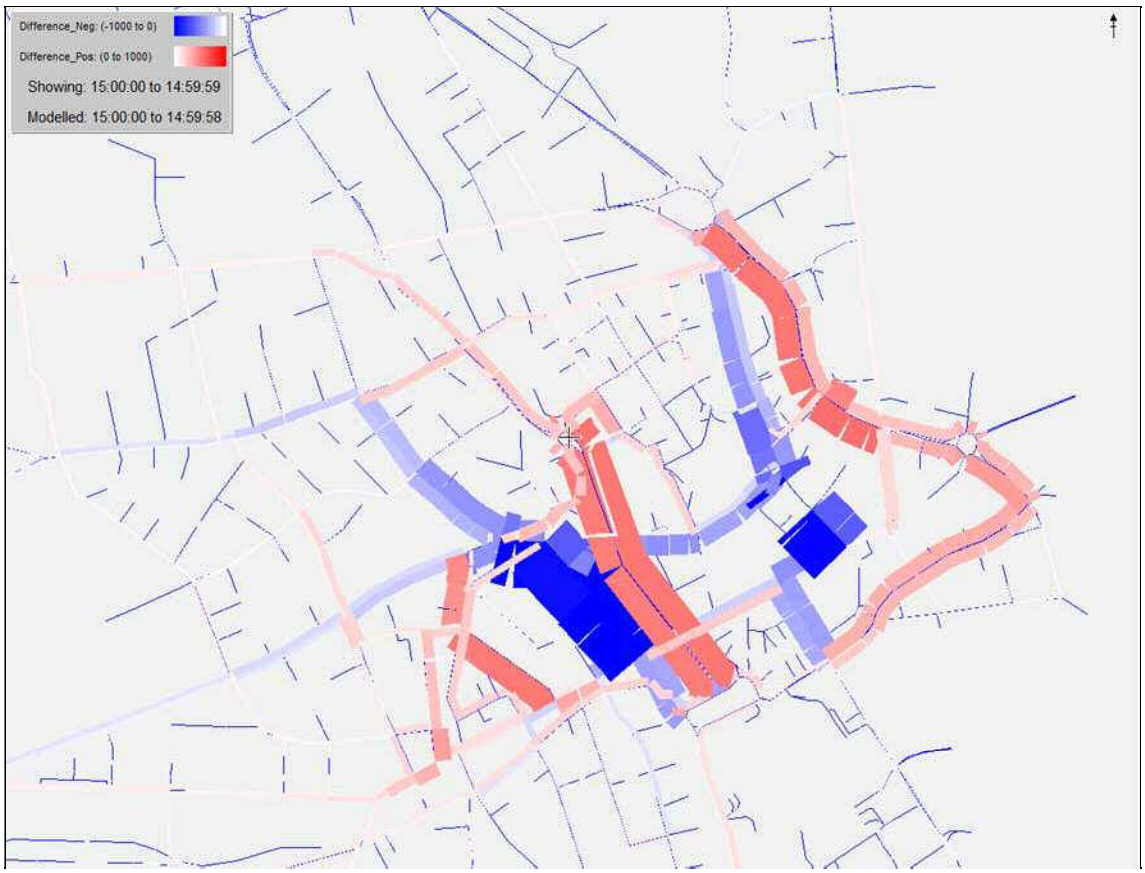

Figure 4.10 : Test 7 Flow Difference Plot – PM Peak Period– 2023 Network

Table 4.8 : Test 7, Key Flow Changes to 2023 Reference Case (vehs)

Location	Dir	AM Peak Period 2023 Ref Case (v)	AM Peak Period Test 7 Diff to Ref Case (v)	PM Peak Period 2023 Ref Case v	PM Peak Period Test 7 Diff to Ref Case v	Sat Peak Period 2023 Ref Case v	Sat Peak Period Test 7 Diff to Ref Case v
Key Routes Affected by Broad Street Restrictions							
West North Street	NB	1,118	279	1,979	535	2,251	467
	SB	2,148	431	2,004	287	1,886	360
Virginia St	EB	3,028	152	4,856	312	4,000	310
	WB	3,445	222	3,047	277	3,022	323
Broad Street	NB	481	-481	1,040	-1,040	1,295	-1,295
	SB	785	-785	697	-697	823	-823
Union Terrace	NB	622	-462	1,173	-1,012	1,089	-925
	SB	1,452	-1,249	1,364	-1,175	1,452	-1,247
Denburn Rd	NB	1,708	173	4,104	512	2,613	757
	SB	3,017	616	2,354	534	2,538	460
Union Street	EB	1,678	-143	1,717	-176	1,656	-163
	WB	1,318	58	1,638	206	1,587	343
Gallowgate	NB	483	-109	1,472	-360	1,666	-301
	SB	1,691	-437	1,180	-217	1,568	-67
Key Route Affected by Union Terrace Restriction							
Huntly St	NB	745	332	797	524	688	541
Summer St	NB	701	60	586	426	583	368
	SB	527	146	593	217	567	305

Figure 4.6 and Table 4.8 show similar traffic flow changes to Test 5, associated with the restrictions through Broad Street and Union Terrace. The key difference between these scenarios relates to the operation of the bus network as Test 7 required buses to re-route away from Broad Street. This is covered in Section 5.

4.3.8 Test 8: Broad Street & Schoolhill Closed, Union Terrace Bus & Taxi Only, George Street Traffic Management

As noted in Section 4.2, the Test 8 scenario does not run at the full traffic demand without network grid locking. Traffic flow differences between the test scenario and the Reference Case cannot therefore be assessed. The primary statistic in this case is that the models do not run at the full anticipated demand.

4.4 Queue Analysis

In order to simply quantify and compare the extent of traffic queueing in the model scenarios, network queueing can be assessed over a specified area rather than link by link. This allows for a general review of traffic queueing differences for schemes covering wide areas.

Traffic queueing was assessed over the full model network and also the city centre core area. Figures 4.7 to 4.12 show the queue graphs for all test scenarios which could run at full demand (not Test 6 and 8) in the AM, PM, and Saturday Peak periods.

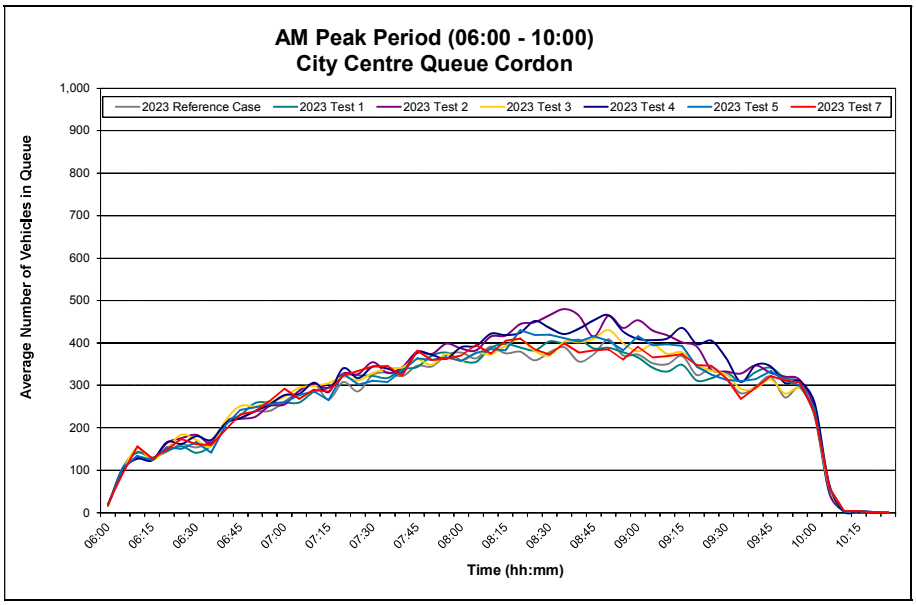

Figure 4.11 : AM Peak Period – City Centre Queue Cordon – 2023 Network

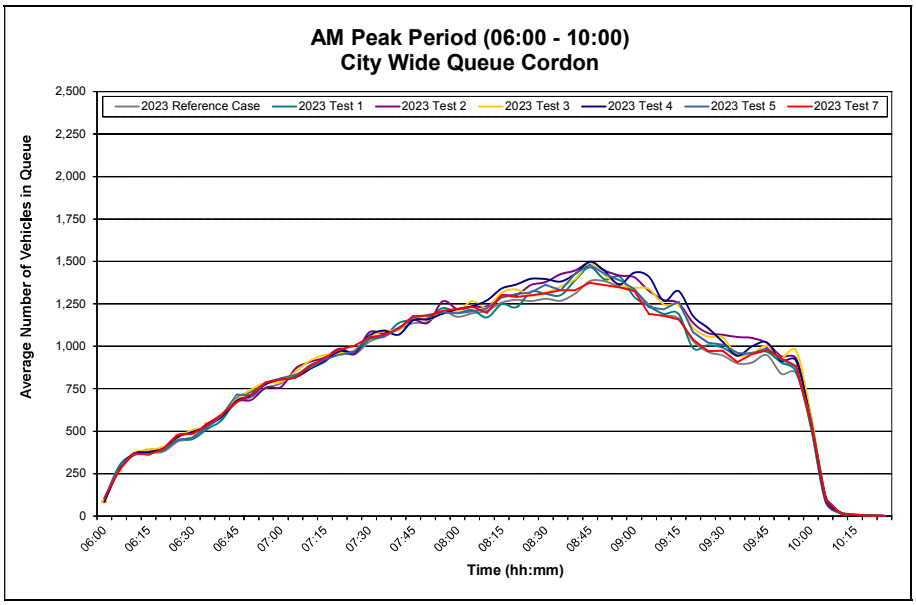

Figure 4.12 : AM Peak Period – City Wide Queue Cordon – 2023 Network

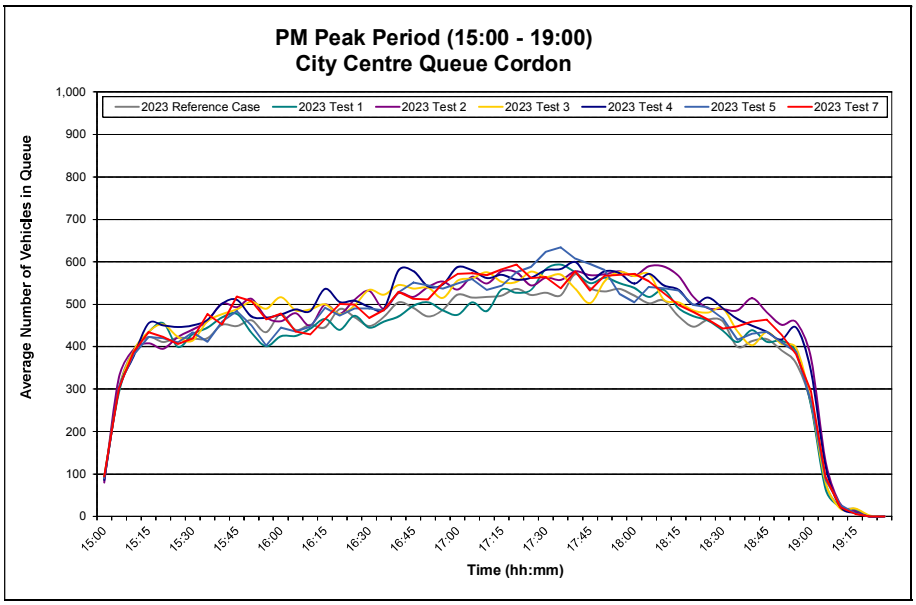

Figure 4.13 : PM Peak Period – City Centre Queue Cordon – 2023 Network

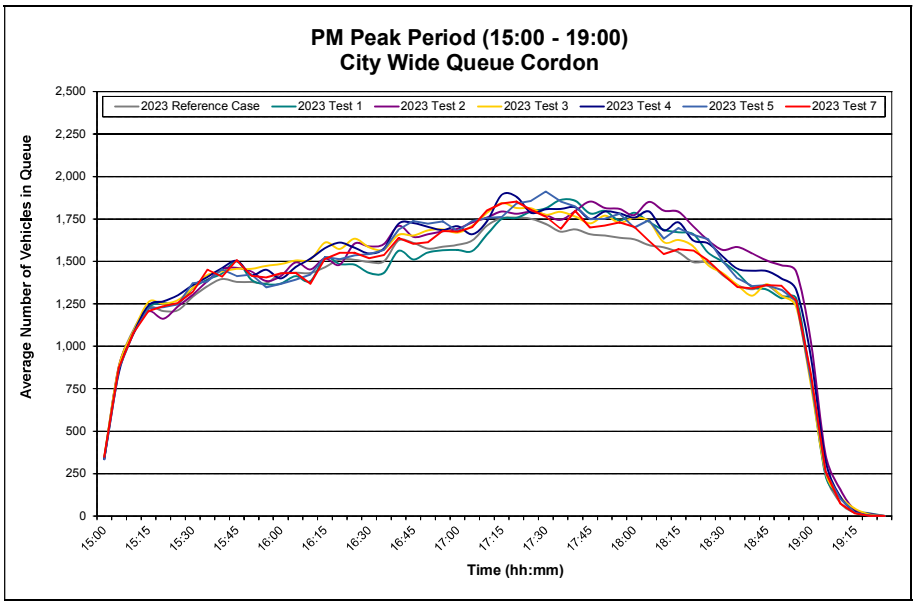

Figure 4.14 : PM Peak Period – City Wide Queue Cordon – 2023 Network

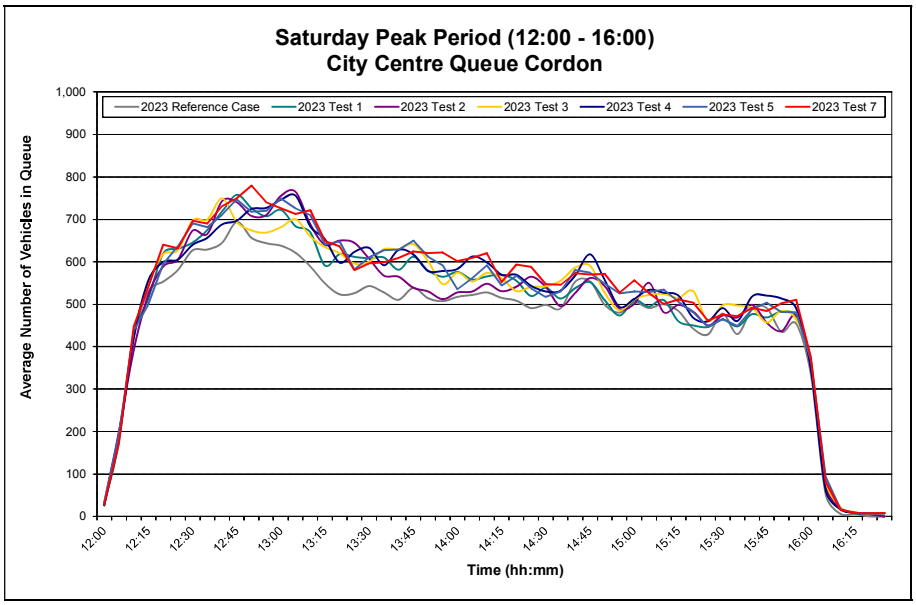

Figure 4.15 : Saturday Peak Period – City Centre Queue Cordon – 2023 Network

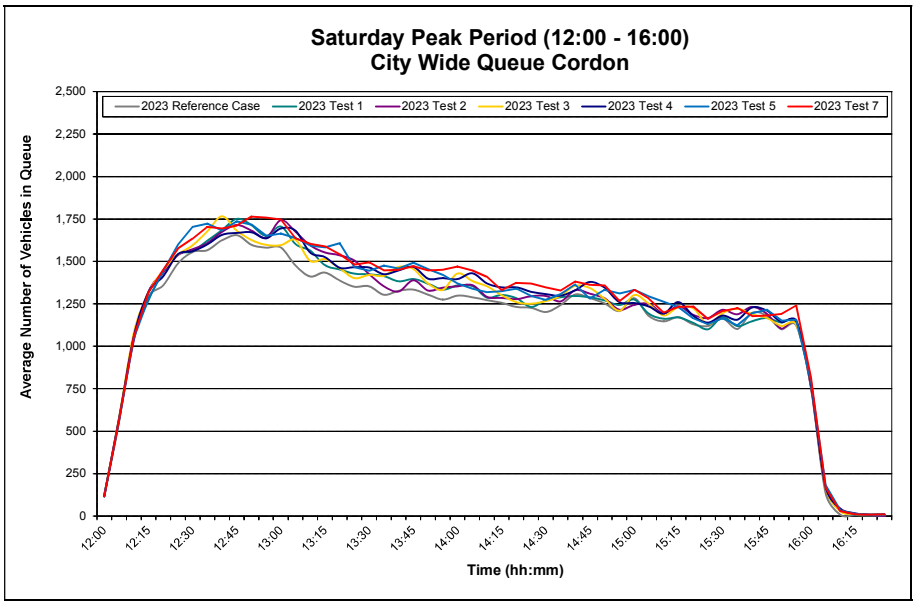

Figure 4.16 : Saturday Peak Period – City Wide Queue Cordon – 2023 Network

Figures 4.7 to 4.12 show that, in all peak periods, there is little difference in traffic queue levels between the test scenarios (excluding tests 6 and 8) within the core city centre area or through the wider model extent.

This outcome suggests that the traffic queueing which occurs within the Broad Street, Schoolhill, and Union Terrace area in the 2023 Reference Case, transfers to the routes identified in the traffic flow difference plots. There is, therefore, no net detriment to queue levels within the city centre as a whole when restrictions to routeing traffic are included within the core areas of Schoolhill, Broad Street, and Union Terrace.

5 MODEL TEST RESULTS: PUBLIC TRANSPORT ASSESSMENT

5.1 Bus Journey Time Assessment

In order to assess the impact of the various traffic restriction proposals on the public transport network, bus journey times were extracted from the models throughout the period for the services which used Broad Street and Schoolhill

5.1.1 Full Modelled Route Assessment

Appendix C provides the average journey time statistics for individual routes directly affected by the Broad Street and Schoolhill traffic restriction proposals. Appendix C also provides the average journey time for selected bus services indirectly affected by the proposed traffic restrictions.

Table 5.1 provides a summary of the average bus journey time within the study area for the services directly affected by the proposed restrictions.

Table 5.1 : Average Bus Journey Times (mm:ss)

Average Bus Journey Times Compared to the 2023 Reference Case		AM Peak Period (06:00 - 10:00) Bus Route Buses diverted due to closure	PM Peak Period (15:00 - 19:00) Bus Route Buses diverted due to closure	Saturday Peak Period (12:00 - 16:00) Bus Route Buses diverted due to closure
	2023 Reference Case Journey Time ([h]:mm:ss)	0:21:32	0:20:57	0:21:41
2023 Test 1	Journey Time ([h]:mm:ss)	0:21:14	0:20:54	0:21:34
	Absolute Difference ([h]:mm:ss)	-0:00:18	-0:00:03	-0:00:07
	Percentage Difference	-1.39%	-0.27%	-0.52%
2023 Test 2	Journey Time ([h]:mm:ss)	0:20:56	0:20:45	0:20:54
	Absolute Difference ([h]:mm:ss)	-0:00:36	-0:00:12	-0:00:47
	Percentage Difference	-2.75%	-0.97%	-3.59%
2023 Test 3	Journey Time ([h]:mm:ss)	0:21:01	0:20:58	0:21:20
	Absolute Difference ([h]:mm:ss)	-0:00:31	0:00:00	-0:00:21
	Percentage Difference	-2.37%	0.02%	-1.62%
2023 Test 4	Journey Time ([h]:mm:ss)	0:21:24	0:21:21	0:21:42
	Absolute Difference ([h]:mm:ss)	-0:00:07	0:00:24	0:00:01
	Percentage Difference	-0.56%	1.90%	0.06%
2023 Test 5	Journey Time ([h]:mm:ss)	0:21:17	0:20:56	0:21:22
	Absolute Difference ([h]:mm:ss)	-0:00:15	-0:00:01	-0:00:19
	Percentage Difference	-1.17%	-0.08%	-1.43%
2023 Test 7	Journey Time ([h]:mm:ss)	0:20:47	0:20:41	0:21:25
	Absolute Difference ([h]:mm:ss)	-0:00:44	-0:00:16	-0:00:16
	Percentage Difference	-3.42%	-1.27%	-1.26%

Table 5.1 shows that, in general, there is a slight improvement to the average journey time of the buses directly affected by the proposed restrictions in each test option. The results do not show any significant improvement or detriment to the overall bus journey time through the model network.

Appendix C shows that, for the indirectly affected services assessed, there is a generally a slight detriment to the journey time of services routeing along Union Street. This could be attributed to the slight increase in traffic observed on Union Street in the traffic flow assessment for each test scenario.

5.1.2 City Centre Assessment

The journey time results detailed in Table 5.1 are based on the time it takes for the buses to complete their full route through the modelled network. It should be recognised that these bus services are routeing through areas of the network where traffic may have increased as a result of displacement from the proposed restrictions. From this, it was deemed pertinent to assess the bus journey times through the core area of the city centre to ascertain whether the proposed bus and taxi only restrictions were improving the journey time of buses traversing the city centre network.

The key services routeing through the Broad Street (First Bus 19, Bluebird 727) and Union Terrace (Bluebird 35) were selected to assess the impact of the proposed city centre restrictions on bus journey times through the city centre area only.

Table 5.2 provides a summary of the average bus journey time for these services through the city centre area.

Appendix D provides the average journey time through the city centre area for each individual bus service.

Table 5.2 : Average Bus Journey Times through City Centre, Selected Routes (mm:ss)

Average Bus Journey Times Compared to the 2023 Reference Case		AM Peak Period (06:00 - 10:00) Bus Route Buses diverted due to closure	PM Peak Period (15:00 - 19:00) Bus Route Buses diverted due to closure	Saturday Peak Period (12:00 - 16:00) Bus Route Buses diverted due to closure
	2023 Reference Case Journey Time ([h]:mm:ss)	0:09:19	0:09:41	0:09:14
2023 Test 1	Journey Time ([h]:mm:ss)	0:09:16	0:09:05	0:10:15
	Absolute Difference ([h]:mm:ss)	-0:00:02	-0:00:36	0:01:01
	Percentage Difference	▲ -0.44%	▲ -6.20%	▼ 10.95%
2023 Test 2	Journey Time ([h]:mm:ss)	0:07:23	0:09:21	0:09:30
	Absolute Difference ([h]:mm:ss)	-0:01:55	-0:00:20	0:00:16
	Percentage Difference	▲ -20.66%	▲ -3.43%	▼ 2.89%
2023 Test 3	Journey Time ([h]:mm:ss)	0:07:43	0:10:04	0:10:07
	Absolute Difference ([h]:mm:ss)	-0:00:02	-0:00:36	0:01:01
	Percentage Difference	▲ -0.44%	▲ -6.20%	▼ 10.95%
2023 Test 4	Journey Time ([h]:mm:ss)	0:07:45	0:10:02	0:10:20
	Absolute Difference ([h]:mm:ss)	-0:01:34	0:00:21	0:01:06
	Percentage Difference	▲ -16.86%	▼ 3.68%	▼ 11.88%
2023 Test 5	Journey Time ([h]:mm:ss)	0:07:13	0:09:12	0:09:15
	Absolute Difference ([h]:mm:ss)	-0:02:05	-0:00:29	0:00:01
	Percentage Difference	▲ -22.42%	▲ -4.93%	▼ 0.11%
2023 Test 7	Journey Time ([h]:mm:ss)	0:10:24	0:09:41	0:10:01
	Absolute Difference ([h]:mm:ss)	0:01:05	0:00:01	0:00:47
	Percentage Difference	▼ 11.65%	▬ 0.09%	▼ 8.43%

Table 5.2 and Appendix D show that the journey times through the core area of the city centre also vary between services across all the option test scenarios. These mixed journey time results can be attributed to a combination of factors occurring in each of the test scenarios including:

- Differences in route length when re-routeing is required
- Traffic displacement
- Signal timing changes

5.2 Bus Reliability

5.2.1 Introduction

In addition to the consideration of bus journey time changes, it is important to consider any changes to the reliability of the public transport network. To quantify bus reliability in a traffic model, the spread of journey times for each service across the modelled period can be extracted from the model. The difference between the quickest and slowest journey time for that service to complete its route on the various number of trips through the network can be deemed the spread of journey times. The higher the spread of journey times, the less reliable the service is and visa versa.

Figure 5.1 shows a graphical example of the concept of journey time spread. The figure shows that one bus route is quicker than the other but the spread of journey times is greater, so less reliable.

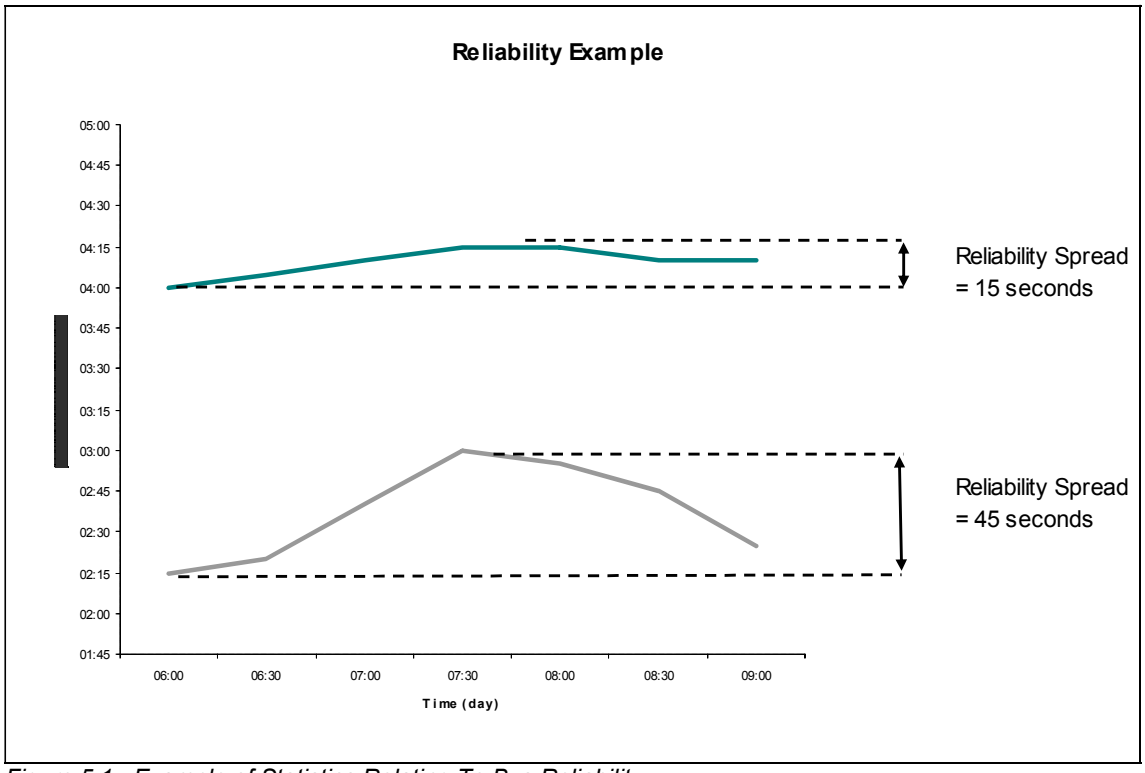

Figure 5.1 : Example of Statistics Relating To Bus Reliability

5.2.2 Full Modelled Route Assessment

Table 5.3 provides a summary of the bus journey time variance for the services directly affected by the proposed restrictions. Appendix E provides the reliability statistics for each individual route for those directly affected by the proposed restrictions and selected bus services indirectly affected by the proposed traffic restrictions.

Table 5.3 : Journey Time Variance for Directly Affected Services (mm:ss)

Variance in Bus Journey Times Compared to the 2023 Reference Case		AM Peak Period (06:00 - 10:00) Bus Route Buses diverted due to closure	PM Peak Period (15:00 - 19:00) Bus Route Buses diverted due to closure	Saturday Peak Period (12:00 - 16:00) Bus Route Buses diverted due to closure
	2023 Reference Case Journey Time ([h]:mm:ss)	0:06:39	0:07:02	0:07:05
2023 Test 1	Average Variance ([h]:mm:ss)	0:04:39	0:07:33	0:06:47
	Absolute Difference ([h]:mm:ss)	-0:02:00	0:00:30	-0:00:18
	Percentage Difference	-30.15%	7.13%	-4.25%
2023 Test 2	Average Variance ([h]:mm:ss)	0:05:40	0:06:58	0:07:15
	Absolute Difference ([h]:mm:ss)	-0:01:00	-0:00:05	0:00:10
	Percentage Difference	-14.97%	-1.12%	2.35%
2023 Test 3	Average Variance ([h]:mm:ss)	0:04:56	0:06:17	0:06:52
	Absolute Difference ([h]:mm:ss)	-0:01:43	-0:00:45	-0:00:14
	Percentage Difference	-25.84%	-10.73%	-3.18%
2023 Test 4	Average Variance ([h]:mm:ss)	0:05:21	0:06:42	0:06:55
	Absolute Difference ([h]:mm:ss)	-0:01:18	-0:00:21	-0:00:11
	Percentage Difference	-19.65%	-4.94%	-2.49%
2023 Test 5	Average Variance ([h]:mm:ss)	0:04:45	0:06:06	0:06:46
	Absolute Difference ([h]:mm:ss)	-0:01:55	-0:00:56	-0:00:19
	Percentage Difference	-28.73%	-13.37%	-4.47%
2023 Test 7	Average Variance ([h]:mm:ss)	0:04:46	0:05:55	0:06:36
	Absolute Difference ([h]:mm:ss)	-0:01:53	-0:01:08	-0:00:30
	Percentage Difference	-28.36%	-16.07%	-6.96%

Table 5.3 shows that there is generally an improvement to bus reliability for the key affected services in each of the test options considered. This suggests that the proposed restrictions to general traffic have a positive impact on bus reliability within the city centre area. This occurs when Broad Street is either closed to general traffic or all traffic and whether Schoolhill is closed to all traffic or open.

5.2.3 City Centre Assessment

As per the bus journey time assessment, the bus reliability through the core area of the city centre was considered to ascertain whether the proposed bus and taxi only restrictions were improving the reliability of buses traversing the city centre network.

The key services routeing through the Broad Street (First Bus 19, Bluebird 727) and Union Terrace (Bluebird 35) were selected to assess the impact of the proposed city centre restrictions on bus reliability through the city centre area only.

Table 5.4 provides a summary of the journey time variance for these services through the city centre area.

Appendix F provides the average journey time through the city centre area for each individual bus service.

Table 5.4 : Journey Time Variance (Cumulative) for Selected Services through City Centre (mm:ss)

Variance in Bus Journey Times Compared to the 2023 Reference Case		AM Peak Period (06:00 - 10:00) Bus Route Buses diverted due to closure	PM Peak Period (15:00 - 19:00) Bus Route Buses diverted due to closure	Saturday Peak Period (12:00 - 16:00) Bus Route Buses diverted due to closure
	2023 Reference Case Journey Time ([h]:mm:ss)	0:04:57	0:06:13	0:06:08
2023 Test 1	Average Variance ([h]:mm:ss)	0:04:34	0:04:58	0:04:50
	Absolute Difference ([h]:mm:ss)	-0:00:23	-0:01:15	-0:01:18
	Percentage Difference	-7.58%	-20.15%	-21.18%
2023 Test 2	Average Variance ([h]:mm:ss)	0:04:25	0:05:40	0:05:34
	Absolute Difference ([h]:mm:ss)	-0:00:31	-0:00:33	-0:00:34
	Percentage Difference	-10.62%	-8.94%	-9.28%
2023 Test 3	Average Variance ([h]:mm:ss)	0:03:34	0:06:03	0:05:18
	Absolute Difference ([h]:mm:ss)	-0:01:23	-0:00:10	-0:00:51
	Percentage Difference	-27.98%	-2.59%	-13.80%
2023 Test 4	Average Variance ([h]:mm:ss)	0:03:41	0:05:47	0:05:53
	Absolute Difference ([h]:mm:ss)	-0:01:15	-0:00:26	-0:00:15
	Percentage Difference	-25.45%	-6.93%	-4.07%
2023 Test 5	Average Variance ([h]:mm:ss)	0:03:14	0:04:37	0:04:46
	Absolute Difference ([h]:mm:ss)	-0:01:43	-0:01:36	-0:01:23
	Percentage Difference	-34.78%	-25.87%	-22.49%
2023 Test 7	Average Variance ([h]:mm:ss)	0:04:53	0:05:28	0:05:42
	Absolute Difference ([h]:mm:ss)	-0:00:03	-0:00:45	-0:00:26
	Percentage Difference	-1.15%	-11.97%	-7.01%

Table 5.4 and Appendix F show that there is almost universally an improvement to bus reliability for the key affected services in each of the test options considered. This suggests that the proposed restrictions to general traffic have a positive impact on bus reliability within the city centre area. This occurs when Broad Street is either closed to general traffic or all traffic and whether Schoolhill is closed to all traffic or open.

5.3 Summary of Impact of Test Options on Bus Network

When considering the overall impact to the bus network for each test option, it is important to consider, not just the changes to bus journey time and reliability associated with the options considered, but also the actual bus route implications for the catchment area within the city centre. This is important for both the operators, to be able to route to where people will utilise the service, but also to the passengers who require to be able to get on and off the bus as close to the key city centre amenities as possible.

The following therefore summarises the impact to the public transport network for each test scenario assessed.

5.3.1 Test 1: Broad Street Bus & Taxi Only

- No bus re-routeing required
- Mixed results for bus journey times and reliability through full route analysis
- Slightly higher journey times for buses routeing along Union Street (Services 1/2)
- Improvement to bus journey time and reliability through Broad Street corridor
- Detriment to bus journey time and reliability through Union Terrace corridor

5.3.2 Test 2: Broad Street Bus & Taxi Only, Schoolhill Closed

- Only service 1A/1B requires re-routeing
- Mixed results for bus journey times and reliability through full route analysis
- Buses routeing along Union Street show longer journey times compared to Test 1 due to higher traffic demand on Union Street in Test 2

5.3.3 Test 3: Broad Street Closed

- Buses re-routed from Broad Street and Union Street, therefore reduced coverage of PT network in the city centre area
- Mixed results for bus journey times and reliability through full route analysis
- Journey time analysis through the city centre area shows worst results compared to the other scenarios
- No real benefit found to closing Broad Street for public transport

5.3.4 Test 4: Broad Street and Schoolhill Closed

- Buses re-routed away from city centre core area (no buses on Broad St & Schoolhill, reduced volume of buses through Union Street
- Primary bus route through Union Terrace and Blackfriars Street.
- Added issue of bus manoeuvre issues between Blackfriars Street and St. Andrews Street
- Mixed results for bus journey times and reliability through full route analysis
- Generally detrimental impact to bus journey times through city centre area but improvements observed to bus reliability

5.3.5 Test 5: Broad Street & Union Terrace Bus & Taxi Only

- No bus re-routeing required
- Mixed results for bus journey times and reliability through full route analysis
- Similar overall results to Test 1 except:
- Improvement to reliability for bus services which route through Union Terrace
- Best bus reliability results compared to all other scenarios

Note: Test 6 and 8 included traffic management proposals through George Street. In these scenarios the network did not run at 100% demand, therefore, no bus statistics could be extracted from the model.

5.3.6 Test 7: Broad Street Closed, Union Terrace Bus & Taxi Only

- Buses are re-routed from Broad Street and Union Street, therefore reduced coverage of PT network in the city centre area.
- Mixed results for bus journey times and reliability through full route analysis.
- Journey time analysis through the city centre area shows no additional benefit to applying bus and taxi measures on Union Terrace compared to Test 3. With Schoolhill remaining open to all traffic, buses are potentially delayed through Rosemount Viaduct.
- No real benefit found to closing Broad Street for public transport.

From the analysis, the Test 5 network scenario suggests the most benefit to the PT network within the city centre area. In the longer term, further bus improvement measures may be considered outwith the city centre core area to compliment these PT improvement measures to allow reliability improvements through the full bus network.

6 ANALYSIS OF TAXI OPERATION

6.1 General

ACC requested that SIAS reviewed the volume of taxis which route through Schoolhill, Broad Street, and Union Terrace to gain an understanding of the traffic flows which would likely occur through the proposed bus and taxi corridors.

Taxis are included within the Aberdeen City Centre Paramics model but the traffic model was not developed with a unique trip matrix. Taxis were applied in the model as a proportion of the general traffic matrix, therefore, the model could not accurately provide information on the volume of taxis which route through the proposed bus and taxi corridors.

ACC therefore undertook a traffic survey of taxi volumes through Broad Street, Union Terrace, and Schoolhill through the AM and PM Peak hour on 4 November 2015. Table 6.1 summarises the taxi traffic volumes observed.

Table 6.1 : Observed Bus Flows

Location	Direction	AM Peak 08:00-09:00	Proportion	PM Peak 16:30-17:30	Proportion
Broad St	NB	2		3	
	SB	4		3	
	Total	6	12%	6	20%
Union Terrace	NB	16		18	
	SB	9		12	
	Total	25	49%	30	27%
Schoolhill	EB	6		29	
	WB	14		10	
	Total	20	39%	39	53%
Total		51		75	

Table 6.1 also shows the proportion of taxis between these three routes. Note that this is not a proportion of all taxis in the city centre area. The taxi surveys were only carried out for the three routes identified.

It can be seen from Table 6.1 that there is a significantly higher volume of taxis which use Union Terrace and Schoolhill. Only six taxis were observed to route through Broad Street in both the AM and PM peak periods. Taxis also route through Back Wynd with this corridor used as a taxi rank.

In the scenarios which have considered Broad Street as bus and taxi only, given the low volume of taxis which use Broad Street, there could be consideration to apply a bus only corridor on Broad Street to allow the area between the Marischal Square Development and Marischal College to operate more as a civic square (pedestrian priority) with a narrow road carriageway for buses only. Union Terrace would be retained as a strong public Transport corridor for both buses and taxis to operate. The aesthetics of the road space for these two corridors could look quite different to reflect the different traffic priorities.

7 REPORT SUMMARY

7.1 Summary

Under the Scotland Excel Framework, Aberdeen City Council (ACC) commissioned SIAS Limited (SIAS) in September 2014 to undertake transport model testing of key transport related elements of the proposed Aberdeen City Centre Masterplan.

This Technical Report details the development of an updated 2023 City Centre Reference Case Model and the City Centre Masterplan Phase 1 model testing relating to assessment of various transport options for Broad Street and Schoolhill.

Through discussions with ACC and initial high level model testing, a series of eight network scenarios were developed for model testing.

The results of the model testing is summarised as follows:

7.1.1 Test 1: Broad Street bus & taxi only

- Traffic network is able to operate at full anticipated traffic demand in 2023
- Traffic migrates to the strategic routes of West North Street and Denburn Road, but also to Union Terrace
- Overall traffic queue levels as per Reference Case
- No bus re-routeing required
- Improvement to bus journey times and reliability through Broad St corridor
- Slight detriment to bus journey times and reliability through Union Terrace and Union Street

7.1.2 Test 2: Broad Street bus & taxi only & Schoolhill closed to all traffic

- Traffic network is able to operate at full anticipated traffic demand in 2023
- Closure of Schoolhill pushes east-west routeing traffic to John Street/St. Andrews Street, and to Union Street
- Overall traffic queue levels as per Reference Case
- Only service 1A/1B requires re-routeing
- Longer journey times for buses routeing along Union Street than in Test 1

7.1.3 Test 3: Broad Street closed to all traffic

- Traffic network is able to operate at full anticipated traffic demand in 2023
- Traffic displacement to West North Street and Denburn Road, but also to Union Terrace, as per Test 1
- Overall traffic queue levels as per Reference Case
- Buses re-routed from Broad Street and Union Street – reduced PT coverage in core of city centre
- Bus journey times worse than all other scenarios
- No real benefit to vehicles or buses in closing Broad Street

7.1.4 Test 4: Broad Street and Schoolhill closed to all traffic

- Traffic network is able to operate at full anticipated traffic demand in 2023.
- Closure of Schoolhill pushes east-west routeing traffic to John St/St. Andrews Street and to Union Street. Similar traffic displacement to Test 2.
- Overall traffic queue levels as per Reference Case.
- Buses re-routed away from city centre core area (no buses on Broad St & Schoolhill) reduced volume of buses through Union Street.
- Increased volume of buses requiring to make difficult manoeuvre through Blackfriars Street.
- Generally detrimental impact to bus journey times through city centre area, but improvements observed to bus reliability.

7.1.5 Test 5: Broad Street & Union Terrace bus & taxi only

- Traffic network is able to operate at full anticipated traffic demand in 2023.
- Traffic migrates to the strategic routes of West North Street and Denburn Road.
- Union Terrace restrictions push some north-south routeing traffic to Huntly Street/Summer Street area. This would require traffic management measures to reduce the traffic flow through these rat runs.
- Overall traffic queue levels as per Reference Case.
- Best bus reliability results compared to all other scenarios.

7.1.6 Test 6: Broad Street & Union Terrace bus & taxi only, Schoolhill closed to all traffic, George Street traffic management area

- George Street Traffic management measures introduced to address increase in traffic flow through John Street and St. Andrews Street. when Schoolhill is closed
- Traffic network gridlocks at 100%, 95%, and 90% of the anticipated 2023 demand level
- Grid locking occurs through Rosemount area due to the removal of east-west routes through John Street, St. Andrews Street, and Schoolhill
- No further model statistics can be assessed at the anticipated demand level due to network grid locking

7.1.7 Test 7: Broad Street Closed, Union Terrace Bus & Taxi Only

- Traffic network is able to operate at full anticipated traffic demand in 2023
- Traffic displacement similar to Test 5
- Overall traffic queue levels as per Reference Case
- No real benefit found to closing Broad Street for public transport

7.1.8 Test 8: Broad Street & Schoolhill closed, Union Terrace Bus & Taxi Only, George Street traffic management

- George Street Traffic management measures introduced to address increase in traffic flow through John Street and St. Andrews Street. when Schoolhill is closed
- Traffic network gridlocks at 100%, 95% and 90% of the anticipated 2023 demand level
- Grid locking occurs through Rosemount area due to the removal of east-west routes through John Street, St. Andrews Street, and Schoolhill
- No further model statistics can be assessed at the anticipated demand level due to network grid locking

7.1.9 Summary Table

These findings have been summarised into a high level summary detailed in Table 7.1.

Table 7.1 : Model Testing – High Level Summary

Scenario	Models run at full demand prediction	Increase in traffic flow to Non-strategic routes	Bus Route / Bus Coverage Affected	Bus Reliability / Journey time Improvements	Bus Reliability / Journey time Detriment
Test 1	✓	Union Terrace	None	Broad Street	Union Terrace
Test 2	✓	Union Terrace, Union Street, John Street, St. Andrews St	Minimal	Broad Street	Union Street
Test 3	✓	Union Terrace	Routes on Broad St affected	Some	Worst of all Tests
Test 4	✓	Union Terrace, Union Street, John Street, St. Andrews St	Routes on Broad St affected	Some	Union Street
Test 5	✓	Huntly St / Summer St	None	Best of all tests	Limited
Test 6	×	-		-	
Test 7	✓	Huntly St / Summer St	Routes on Broad St affected	Some	Some
Test 8	×	-		-	

Traffic Network Improvement
Slight Traffic Detriment
Traffic Detriment

7.1.10 Overview

The traffic modelling suggests that the proposed closure of Schoolhill, between the Bon Accord and St. Nicholas shopping centres has an implication of significantly increased traffic flows through the shopping areas north of the Bon Accord Centre. If measures were introduced to restrict routeing traffic through these routes, there would need to be a significant reduction in traffic demand through the city centre area to accommodate such measures. This would require the consideration of wider area traffic management measures which could not be implemented in the short term.

If restrictions to general traffic were implemented on Broad Street, there would be low impact to traffic in the city centre area and potential improvements to bus services directly affected through the core area of the city centre. A complimentary measure would be to also restrict general traffic through Union Terrace to reduce the impact of displaced traffic within the city centre and also to further improve the operation of the bus network through the core area of the city centre. These measures could be implemented in the short term and have already been in operation to some extent through seasonal restrictions on Union Terrace and traffic management measures on Broad Street

Within the Broad Street traffic considerations; there are further options as to whether restrictions on Broad Street would be for a full closure, bus and taxi only, or bus only (all north of Queen Street). The model testing outcome could assist in the consideration of these options.

A OPTION TESTING, BUS DWELL TIME RELOCATION

Table A.1 : Bus Dwell Relocation: Scenario A –Schoolhill closed to PT – 2023 Network

Service Number		Old Route & Dwell Time				New Route & Dwell Time			
		Stop	AM Dwell (sec)	PM Dwell (sec)	SAT Dwell (sec)	Stop	AM Dwell (sec)	PM Dwell (sec)	SAT Dwell (sec)
FAB	1B-SB	L1	29	60	34	K5	29	60	34
FAB	1B-SB	R1	15	15	15	-	-	-	-
FAB	1B-SB	H2	12	20	34	H2	27	35	49
FAB	1A-SB	P1	21	21	28	K5	42	42	56
FAB	1A-SB	L1	21	21	28	-	-	-	-
FAB	1A-SB	R1	15	15	15	-	-	-	-
FAB	1A-SB	H2	16	27	34	H2	31	42	49
FAB	1A-NB	N3	26	48	63	N3	46	96	91
FAB	1A-NB	L1	20	48	28	-	-	-	-
Total Dwell			**175**	**275**	**279**		**175**	**275**	**279**

Table A.2 : Bus Dwell Relocation: Scenario B – Broad St closed to PT – 2023 Network

Service Number		Old Route & Dwell Time				New Route & Dwell Time			
		Stop	AM Dwell (sec)	PM Dwell (sec)	SAT Dwell (sec)	Stop	AM Dwell (sec)	PM Dwell (sec)	SAT Dwell (sec)
FAB	1B-SB	L1	29	60	34	N4	43	78	59
FAB	1B-SB	R1	15	15	15	-	-	-	-
FAB	1B-SB	H2	12	20	34	-	-	-	-
FAB	1B-SB	F9	29	60	34	-	-	-	-
FAB	1B-SB	C7	42	44	36	C7	84	121	94
FAB	1A-SB	L1	21	21	28	N4	51	72	68
FAB	1A-SB	R1	15	15	15	-	-	-	-
FAB	1A-SB	H2	16	27	34	-	-	-	-
FAB	1A-SB	F9	29	60	34	-	-	-	-
FAB	1A-SB	C7	42	35	16	C7	72	86	57
BLB	727-BS-OB	H1	15	39	36	WNS-N/B	15	39	36
BLB	727-BS-IB	H2	21	16	11	WNS-S/B	21	16	11
FAB	20_LOOP	H2	76	0	103	N4	80	30	131
FAB	20_LOOP	G5	4	30	28	E2	77	91	92
FAB	20_LOOP	F9	27	41	42	N1	20.5	29	45
FAB	20_LOOP	E2	50	50	50	L1	20.5	29	45
FAB	20_LOOP	F1	41	58	90	R1	53	63	110
FAB	20_LOOP	G2	53	63	110	-	-	-	-
FAB	17-NB	F4	38	68	93	N1	38	68	93
FAB	17-NB	H1	62	63	40	R1	62	63	40
FAB	17-SB	K5	21	16	15	K5	60	66	89
FAB	17-SB	H2	39	50	74	-	-	-	-
FAB	17-SB	G5	50	40	34	-	-	-	-
FAB	17-SB	F6	16	56	75	N4	66	96	109
FAB	18-NB	F4	72	126	104	N1	72	126	104
FAB	18-NB	H1	52	75	63	R1	52	75	63
FAB	18-SB	K4	21	21	28	K4	66	66	53
FAB	18-SB	H2	45	45	25	-	-	-	-
FAB	18-SB	G5	36	29	42	-	-	-	-
FAB	18-SB	F6	20	35	42	N4	56	64	84
FAB	19-SB	K4	16	20	20	K4	86	154	171
FAB	19-SB	H2	70	134	151	-	-	-	-
FAB	19-SB	F5	19	81	86	N4	19	81	86
FAB	11-EB	F3	38	82	80	N1	38	82	80
FAB	11-EB	H1	47	44	55	R1	47	44	55
FAB	11-SB	GALLOW	15	15	15	GALLOW	96	96	129
FAB	11-SB	H2	81	81	114	-	-	-	-
FAB	11-SB	G6	48	70	68	N4	75	125	136
FAB	11-SB	F8	27	55	66	-	-	-	-
Total Dwell			**1370**	**1860**	**2040**		**1370**	**1860**	**2040**

Table A.3 : Bus Dwell Relocation: Scenario C – Broad ST and Schoolhill closed to PT – 2023 Network

Service Number		Old Route & Dwell Time				New Route & Dwell Time			
		Stop	AM Dwell (sec)	PM Dwell (sec)	SAT Dwell (sec)	Stop	AM Dwell (sec)	PM Dwell (sec)	SAT Dwell (sec)
FAB	1B-SB	L1	29	60	34	J4	56	95	83
FAB	1B-SB	R1	15	15	15	-	-	-	-
FAB	1B-SB	H2	12	20	34	-	-	-	-
FAB	1B-SB	F9	29	60	34	F9	71	104	70
FAB	1B-SB	C7	42	44	36	-	-	-	-
FAB	1A-SB	P1	21	21	28	K4	21	21	28
FAB	1A-SB	L1	21	21	28	H3	36	36	43
FAB	1A-SB	R1	15	15	15	-	-	-	-
FAB	1A-SB	H2	16	27	34	J4	16	27	34
BLB	727-BS-OB	H1	15	39	36	WNS-N/B	15	39	36
BLB	727-BS-IB	H2	21	16	11	WNS-S/B	21	16	11
FAB	20_LOOP	H2	76	0	103	K1	76	0	103
FAB	20_LOOP	G5	4	30	28	P1	4	30	28
FAB	20_LOOP	F9	27	41	42	N4	27	41	42
FAB	20_LOOP	E2	50	50	50	E2	50	50	50
FAB	20_LOOP	F1	41	58	90	N1	41	58	90
FAB	20_LOOP	G2	53	63	110	P2	26.5	31.5	55
FAB	20_LOOP	-	-	-	-	K5	26.5	31.5	55
FAB	17-NB	F4	38	68	93	N1	38	68	93
FAB	17-NB	H1	62	63	40	P2	62	63	40
FAB	17-SB	K5	21	16	15	P1	60	66	89
FAB	17-SB	H2	39	50	74	-	-	-	-
FAB	17-SB	G5	50	40	34	-	-	-	-
FAB	17-SB	F6	16	56	75	N4	66	96	109
FAB	18-NB	F4	72	126	104	N1	72	126	104
FAB	18-NB	H1	52	75	63	P2	52	75	63
FAB	18-SB	K4	21	21	28	P1	21	21	28
FAB	18-SB	H2	45	45	25	-	-	-	-
FAB	18-SB	G5	36	29	42	-	-	-	-
FAB	18-SB	F6	20	35	42	N4	101	109	109
FAB	19-SB	K4	16	20	20	P1	16	20	20
FAB	19-SB	H2	70	134	151	-	-	-	-
FAB	19-SB	F5	19	81	86	N4	89	215	237
FAB	11-EB	F3	38	82	80	N1	38	82	80
FAB	11-EB	H1	47	44	55	K5	47	44	55
FAB	11-SB	H2	81	81	114	H3	81	81	114
Total Dwell			**1230**	**1646**	**1869**		**1230**	**1646**	**1869**

B TRAFFIC FLOW DIFFERENCE ANALYSIS

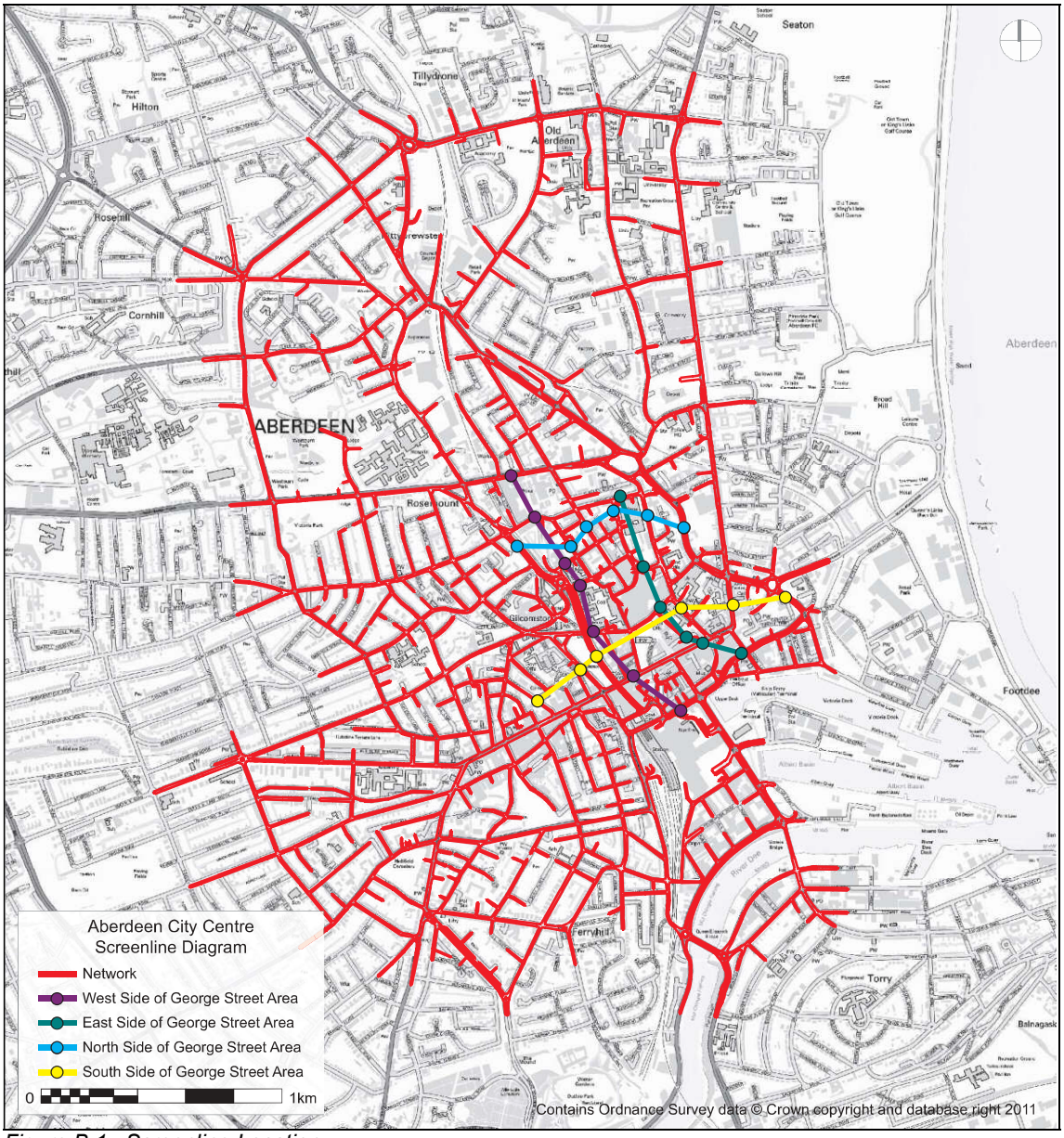

Figure B.1 : Screenline Location

Table B.1 : Screenline 1 AM Peak 06:00 – 10:00 (vehs)

AM Peak Period West Side of George Street Area	Direction	2023 Ref Case Flow	2023 Test 1 Change	2023 Test 2 Change	2023 Test 3 Change	2023 Test 4 Change	2023 Test 5 Change	2023 Test 7 Change
Hutcheon Street	East	1,819	13	80	17	134	-38	-8
Maberly Street	East	91	2	20	5	13	5	2
St John Street	East	1,427	44	486	125	487	8	93
St Andrew St	East	104	-14	7	-12	59	0	14
Schoolhill	East	1,363	-37	-643	-125	-633	70	-53
Union Street	East	1,678	206	257	174	239	-138	-143
Guild Street	East	1,553	49	7	37	20	159	148
Screenline Total		**8,035**	**263**	**215**	**221**	**319**	**65**	**54**
Hutcheson Street	West	1,570	26	177	25	169	72	55
Maberly Street	West	497	55	134	93	201	86	90
St John Street	West	451	44	221	71	238	122	116
St Andrew St	West	187	-4	197	-3	216	-30	-20
Schoolhill	West	1,034	38	-916	-20	-917	-303	-300
Union Street	West	1,318	-10	211	-9	162	102	58
Guild Street	West	640	7	30	-2	16	28	5
Screenline Total		**5,696**	**157**	**54**	**155**	**84**	**78**	**4**

Table B.2 : Screenline 2 AM Peak 06:00 – 10:00 (vehs)

AM Peak Period East Side of George Street Area	Direction	2023 Ref Case Flow	2023 Test 1 Change	2023 Test 2 Change	2023 Test 3 Change	2023 Test 4 Change	2023 Test 5 Change	2023 Test 7 Change
Virginia St	East	3,028	74	258	76	219	133	152
Union Street	East	1,358	-75	6	-110	-28	-152	-210
Flourmill Lane	South	0	0	0	0	0	0	0
Schoolhill	East	862	-225	-390	-327	-388	41	-125
Berry Street	East	192	1	230	-9	253	15	9
Spring Gardens	East	587	1	185	29	146	-31	4
Virginia St	West	3,445	137	263	169	220	162	222
Union Street	West	2,103	-272	-14	-291	-96	-96	-159
Schoolhill	West	1,349	-142	-651	-202	-657	-300	-312
Berry Street	West	296	-15	184	-62	132	16	-63
Spring Gardens	West	589	37	208	82	245	66	78
Screenline Total		**7,781**	**-255**	**-10**	**-303**	**-155**	**-152**	**-234**

Table B.3 : Screenline 3 AM Peak 06:00 – 10:00 (vehs)

AM Peak Period North Side of George Street Area	Direction	2023 Ref Case Flow	2023 Test 1 Change	2023 Test 2 Change	2023 Test 3 Change	2023 Test 4 Change	2023 Test 5 Change	2023 Test 7 Change
Skene Square	North	1,805	6	43	28	58	76	78
George Street	North	128	31	52	8	39	5	4
George Street	North	221	-4	15	11	5	8	5
Loch Street	North	506	-24	125	19	107	-39	6
Gallowgate	North	483	-57	-82	-127	-89	1	-109
West North Street	North	1,118	165	213	212	246	247	279
Screenline Total		**4,261**	**117**	**367**	**151**	**366**	**299**	**263**
Skene Square	South	3,307	27	37	40	151	80	76
George Street	South	249	21	22	18	31	20	13
George Street	South	311	5	66	21	50	9	8
Loch Street	South	187	-2	75	7	87	-3	7
Gallowgate	South	1,691	-191	-598	-311	-676	-328	-437
West North Street	South	2,148	300	411	353	402	314	431
Screenline Total		**7,892**	**159**	**13**	**128**	**45**	**93**	**98**

Table B.4 : Screenline 4 AM Peak 06:00 – 10:00 (vehs)

AM Peak Period South Side of George Street Area	Direction	2023 Ref Case Flow	2023 Test 1 Change	2023 Test 2 Change	2023 Test 3 Change	2023 Test 4 Change	2023 Test 5 Change	2023 Test 7 Change
Union Terrace	North	622	156	19	152	74	-541	-462
Huntly Street	North	745	50	2	62	60	324	332
Denburn Road	North	1,708	50	154	74	127	199	173
Broad Street at Closure	North	481	-383	-383			-382	
King Street	North	891	10	63	37	94	8	28
Commerce St	North	2,256	81	231	104	218	145	161
Screenline Total		**6,703**	**-37**	**87**	**-51**	**93**	**-247**	**-248**
Union Terrace	South	1,452	309	44	370	107	-1,321	-1,249
Huntly Street	South							
Denburn Road	South	3,017	24	-30	53	21	628	616
Broad Street at Closure	South	785	-695	-682			-687	
King Street	South	1,683	83	358	102	365	259	267
Commerce St	South	3,557	139	215	179	176	212	258
Screenline Total		**10,495**	**-139**	**-95**	**-81**	**-116**	**-909**	**-893**

Table B.5 : Screenline 1 PM Peak 15:00 – 19:00 (vehs)

PM Peak Period West Side of George Street Area	Direction	2023 Ref Case Flow	2023 Test 1 Change	2023 Test 2 Change	2023 Test 3 Change	2023 Test 4 Change	2023 Test 5 Change	2023 Test 7 Change
Hutcheon Street	East	2,471	-48	96	77	152	-77	43
Maberly Street	East	204	-22	52	19	69	-1	-8
St John Street	East	1,813	107	411	198	437	51	103
St Andrew St	East	175	-26	119	23	87	50	60
Schoolhill	East	1,721	101	-756	-168	-711	139	1
Union Street	East	1,717	-112	293	12	219	-181	-176
Guild Street	East	1,421	97	116	38	133	157	86
Screenline Total		**9,523**	**98**	**330**	**200**	**386**	**138**	**109**
Hutcheson Street	West	2,688	-80	117	-7	129	26	52
Maberly Street	West	1,308	87	243	70	256	114	106
St John Street	West	740	86	262	124	256	259	251
St Andrew St	West	407	-81	256	-99	234	-125	-128
Schoolhill	West	1,438	-67	-1,114	-86	-1,120	-439	-392
Union Street	West	1,638	104	249	86	304	223	206
Guild Street	West	1,609	49	111	78	82	21	5
Screenline Total		**9,829**	**98**	**123**	**166**	**142**	**78**	**100**

Table B.6 : Screenline 2 PM Peak 15:00 – 19:00 (vehs)

PM Peak Period East Side of George Street Area	Direction	2023 Ref Case Flow	2023 Test 1 Change	2023 Test 2 Change	2023 Test 3 Change	2023 Test 4 Change	2023 Test 5 Change	2023 Test 7 Change
Virginia St	East	4,856	148	383	204	397	266	312
Union Street	East	1,663	-379	-138	-355	-233	-394	-435
Flourmill Lane	South	0	0	0	0	0	0	0
Schoolhill	East	1,494	-100	-815	-425	-817	44	-174
Berry Street	East	767	-43	4	5	80	35	7
Spring Gardens	East	889	103	402	192	368	-15	133
Virginia St	West	3,047	219	420	273	369	279	277
Union Street	West	2,021	-218	-41	-249	-19	-46	-88
Schoolhill	West	1,204	-249	-1,077	-288	-1,075	-402	-398
Berry Street	West	998	-65	149	-110	122	-30	-95
Spring Gardens	West	1,010	108	403	143	328	69	100
Screenline Total		**8,281**	**-205**	**-146**	**-230**	**-275**	**-129**	**-203**

Table B.7 : Screenline 3 PM Peak 15:00 – 19:00 (vehs)

PM Peak Period North Side of George Street Area	Direction	2023 Ref Case Flow	2023 Test 1 Change	2023 Test 2 Change	2023 Test 3 Change	2023 Test 4 Change	2023 Test 5 Change	2023 Test 7 Change
Skene Square	North	3,611	23	-55	-49	-64	174	112
George Street	North	530	-4	149	40	119	20	53
George Street	North	434	0	40	11	33	42	25
Loch Street	North	930	66	212	133	174	-5	54
Gallowgate	North	1,472	-273	-563	-449	-558	-208	-360
West North Street	North	1,979	385	392	391	431	502	535
Screenline Total		**8,956**	**197**	**176**	**77**	**136**	**526**	**418**
Skene Square	South	2,747	93	187	-86	211	277	213
George Street	South	319	-12	-8	13	-22	-42	-39
George Street	South	238	31	43	-3	39	13	6
Loch Street	South	274	-30	147	69	132	3	48
Gallowgate	South	1,180	-35	-508	-124	-540	-153	-217
West North Street	South	2,004	138	203	242	169	208	287
Screenline Total		**6,762**	**185**	**63**	**112**	**-11**	**306**	**298**

Table B.8 : Screenline 4 PM Peak 15:00 – 19:00 (vehs)

PM Peak Period South Side of George Street Area	Direction	2023 Ref Case Flow	2023 Test 1 Change	2023 Test 2 Change	2023 Test 3 Change	2023 Test 4 Change	2023 Test 5 Change	2023 Test 7 Change
Union Terrace	North	1,173	176	141	155	177	-1,074	-1,012
Huntly Street	North	797	101	125	101	190	495	524
Denburn Road	North	4,104	120	82	127	70	555	512
Broad Street at Closure	North	1,040	-917	-928			-923	
King Street	North	1,093	82	291	160	295	87	148
Commerce St	North	3,664	203	375	260	400	345	383
Screenline Total		**11,871**	**-236**	**86**	**-237**	**93**	**-515**	**-484**
Union Terrace	South	1,364	294	177	392	233	-1,227	-1,175
Huntly Street	South							
Denburn Road	South	2,354	65	-39	-77	22	549	534
Broad Street at Closure	South	697	-620	-617			-622	
King Street	South	1,813	-38	142	6	208	108	144
Commerce St	South	2,924	197	317	232	276	295	287
Screenline Total		**9,152**	**-103**	**-20**	**-145**	**41**	**-897**	**-906**

Table B.9 : Screenline 1 Saturday Peak 12:00 – 16:00 (vehs)

SAT Peak Period West Side of George Street Area	Direction	2023 Ref Case Flow	2023 Test 1 Change	2023 Test 2 Change	2023 Test 3 Change	2023 Test 4 Change	2023 Test 5 Change	2023 Test 7 Change
Hutcheon Street	East	2,423	83	219	228	217	-16	38
Maberly Street	East	438	56	180	77	185	63	139
St John Street	East	1,747	125	508	327	514	103	192
St Andrew St	East	143	-22	143	57	126	32	118
Schoolhill	East	2,004	92	-979	-382	-932	201	-145
Union Street	East	1,656	40	158	87	152	-206	-163
Guild Street	East	1,574	-100	53	-82	5	30	-26
Screenline Total		**9,984**	**274**	**283**	**311**	**267**	**206**	**152**
Hutcheson Street	West	2,828	-47	132	-14	115	-3	29
Maberly Street	West	1,326	-37	225	-19	226	68	58
St John Street	West	894	55	191	100	259	166	177
St Andrew St	West	659	-96	261	-127	218	-114	-152
Schoolhill	West	1,387	-13	-1,205	-108	-1,204	-302	-299
Union Street	West	1,587	253	342	259	374	379	343
Guild Street	West	1,606	26	49	19	23	49	24
Screenline Total		**10,288**	**140**	**-4**	**110**	**12**	**243**	**180**

Table B.10 : Screenline 2 Saturday Peak 12:00 – 16:00 (vehs)

SAT Peak Period East Side of George Street Area	Direction	2023 Ref Case Flow	2023 Test 1 Change	2023 Test 2 Change	2023 Test 3 Change	2023 Test 4 Change	2023 Test 5 Change	2023 Test 7 Change
Virginia St	East	4,000	171	393	248	477	270	310
Union Street	East	1,698	-456	-311	-502	-439	-594	-625
Flourmill Lane	South	0	0	0	0	0	0	0
Schoolhill	East	1,367	-60	-946	-575	-946	122	-276
Berry Street	East	1,308	15	69	87	108	74	142
Spring Gardens	East	823	59	493	326	398	6	186
Virginia St	West	3,022	329	447	350	448	309	323
Union Street	West	2,122	-83	43	-77	65	85	51
Schoolhill	West	1,447	-155	-1,162	-276	-1,163	-345	-365
Berry Street	West	2,099	-90	-39	-309	-66	-19	-207
Spring Gardens	West	862	-41	365	151	349	6	76
Screenline Total		**9,552**	**-40**	**-347**	**-161**	**-367**	**36**	**-122**

Table B.11 : Screenline 3 Saturday Peak 12:00 – 16:00 (vehs)

SAT Peak Period North Side of George Street Area	Direction	2023 Ref Case Flow	2023 Test 1 Change	2023 Test 2 Change	2023 Test 3 Change	2023 Test 4 Change	2023 Test 5 Change	2023 Test 7 Change
Skene Square	North	3,099	158	-6	126	-10	227	172
George Street	North	294	12	70	55	41	37	51
George Street	North	522	28	18	8	39	66	18
Loch Street	North	999	11	201	124	178	-48	73
Gallowgate	North	1,666	-156	-424	-424	-434	-40	-301
West North Street	North	2,251	223	403	298	448	364	467
Screenline Total		**8,832**	**275**	**262**	**188**	**262**	**606**	**480**
Skene Square	South	3,027	-63	-44	-143	-183	58	34
George Street	South	377	-20	-45	-41	-43	-56	-58
George Street	South	563	13	36	17	69	37	50
Loch Street	South	299	29	176	174	166	26	144
Gallowgate	South	1,568	152	-236	-72	-260	40	-67
West North Street	South	1,886	214	215	316	267	301	360
Screenline Total		**7,720**	**325**	**103**	**250**	**16**	**406**	**464**

Table B.12 : Screenline 4 Saturday Peak 12:00 – 16:00 (vehs)

SAT Peak Period South Side of George Street Area	Direction	2023 Test 1 Flow	2023 Test 1 Change	2023 Test 2 Change	2023 Test 3 Change	2023 Test 4 Change	2023 Test 5 Change	2023 Test 7 Change
Union Terrace	North	1,089	249	81	170	86	-1,000	-925
Huntly Street	North	688	97	172	172	205	531	541
Denburn Road	North	2,613	357	262	414	356	805	757
Broad Street at Closure	North	1,295	-1,121	-1,132			-1,138	
King Street	North	973	24	86	34	83	6	63
Commerce St	North	2,808	211	419	308	520	331	381
Screenline Total		**9,466**	**-185**	**-112**	**-197**	**-44**	**-465**	**-478**
Union Terrace	South	1,452	337	276	355	330	-1,331	-1,247
Huntly Street	South							
Denburn Road	South	2,538	6	-178	-73	-252	486	460
Broad Street at Closure	South	823	-738	-739			-738	
King Street	South	1,775	-30	69	9	145	117	115
Commerce St	South	2,860	316	397	348	411	341	337
Screenline Total		**9,448**	**-108**	**-176**	**-183**	**-189**	**-1,124**	**-1,158**

C BUS JOURNEY TIME ANALYSIS, FULL MODELLED ROUTE

C.1 Key Routes

Table C.1 : AM Peak – Individual Bus Journey Times (mm:ss) – Full Modelled Route

		2023 Test 1	2023 Test 2	2023 Test 3	2023 Test 4	2023 Test 5	2023 Test 7
AM Peak Period (06:00 - 10:00) Bus Route	2023 Reference Case	Absolute Difference (mm:ss)	Absolute Difference (mm:ss)	Absolute Difference (mm:ss)	Absolute Difference (mm:ss)	Absolute Difference (mm:ss)	Absolute Difference (mm:ss)
BLB_727_BS_IB	12:59	-00:35 ▲	-00:47 ▲	00:25 ▼	00:55 ▼	-00:30 ▲	00:24 ▼
BLB_727_BS_OB							
FAB_11_EB	23:23	00:18 ▼	00:39 ▼	02:08 ▼	02:57 ▼	-00:19 ▲	01:42 ▼
FAB_11_SB	26:03	00:02 ▼	-01:03 ▲	-00:45 ▲	01:40 ▼	00:09 ▼	-00:39 ▲
FAB_17_NB	24:22	-00:45 ▲	-00:26 ▲	01:03 ▼	-01:20 ▲	-00:34 ▲	00:59 ▼
FAB_17_SB	25:49	-01:28 ▲	-01:48 ▲	-01:56 ▲	-03:08 ▲	-01:09 ▲	-02:51 ▲
FAB_18_NB	26:20	-00:11 ▲	-00:04 ▲	00:32 ▼	-01:08 ▲	00:02 ▼	00:23 ▼
FAB_18_SB	27:05	-00:26 ▲	-00:30 ▲	00:04 ▼	00:10 ▼	-00:24 ▲	-00:47 ▲
FAB_19_NB	25:20	-00:08 ▲	-00:23 ▲	00:08 ▼	-00:28 ▲	00:06 ▼	00:20 ▼
FAB_19_SB	25:39	-00:26 ▲	-01:04 ▲	-01:12 ▲	-02:04 ▲	-00:09 ▲	-01:11 ▲
FAB_1A_NB	11:48	-00:01 ▲	-00:22 ▲	-00:09 ▲	-00:49 ▲	-00:08 ▲	00:16 ▼
FAB_1A_SB	17:30	-00:14 ▲	-00:59 ▲	-03:41 ▲	01:10 ▼	-00:11 ▲	-03:46 ▲
FAB_1B_SB	13:50	-01:13 ▲	-00:56 ▲	-04:14 ▲	-02:51 ▲	-00:58 ▲	-04:19 ▲
FAB_20_LOOP	34:49	00:16 ▼	-00:04 ▲	00:39 ▼	04:18 ▼	00:08 ▼	-00:03 ▲
FAB_4_LOOP	27:56	00:23 ▼	-01:06 ▲	-00:41 ▲	-01:11 ▲	00:11 ▼	-01:32 ▲

Table C.2 : PM Peak – Individual Bus Journey Times (mm:ss) – Full Modelled Route

		2023 Test 1	2023 Test 2	2023 Test 3	2023 Test 4	2023 Test 5	2023 Test 7
PM Peak Period (15:00 - 19:00) Bus Route	2023 Reference Case	Absolute Difference (mm:ss)	Absolute Difference (mm:ss)	Absolute Difference (mm:ss)	Absolute Difference (mm:ss)	Absolute Difference (mm:ss)	Absolute Difference (mm:ss)
BLB_727_BS_IB	13:51	-00:26 ▲	-00:20 ▲	00:22 ▼	00:01 ▼	-00:13 ▲	-00:19 ▲
BLB_727_BS_OB	13:59	-00:36 ▲	00:09 ▼	01:54 ▼	01:25 ▼	-00:29 ▲	00:49 ▼
FAB_11_EB	26:02	00:02 ▼	00:03 ▼	00:14 ▼	02:07 ▼	00:00 ▬	00:13 ▼
FAB_11_SB	30:29	-00:21 ▲	-02:03 ▲	-01:30 ▲	00:34 ▼	-00:01 ▬	-01:47 ▲
FAB_17_NB	27:00	-00:25 ▲	-00:31 ▲	01:15 ▼	-01:18 ▲	-00:09 ▲	01:08 ▼
FAB_17_SB							
FAB_18_NB	29:17	-00:15 ▲	00:10 ▼	00:50 ▼	-00:32 ▲	-00:25 ▲	00:49 ▼
FAB_18_SB							
FAB_19_NB	28:49	-00:26 ▲	-00:18 ▲	-01:16 ▲	-00:41 ▲	-00:28 ▲	-01:22 ▲
FAB_19_SB	28:44	-00:04 ▲	-01:24 ▲	-00:10 ▲	-00:49 ▲	-00:03 ▲	-00:27 ▲
FAB_1A_NB	13:44	00:26 ▼	00:03 ▼	02:25 ▼	01:02 ▼	01:28 ▼	03:56 ▼
FAB_1A_SB	18:18	-00:14 ▲	-01:49 ▲	-03:05 ▲	00:21 ▼	-00:03 ▲	-03:29 ▲
FAB_1B_SB	14:48	-00:16 ▲	00:46 ▼	-03:22 ▲	-02:47 ▲	-00:33 ▲	-03:30 ▲
FAB_20_LOOP	38:46	00:37 ▼	-00:02 ▬	01:02 ▼	03:50 ▼	00:37 ▼	00:07 ▼
FAB_4_LOOP	30:35	01:07 ▼	02:14 ▼	01:24 ▼	02:45 ▼	00:03 ▼	-00:09 ▲

Table C.3 : Saturday Peak – Individual Bus Journey Times (mm:ss) – Full Modelled Route

Saturday Peak Period (12:00 - 16:00) Bus Route	2023 Reference Case	2023 Test 1 Absolute Difference (mm:ss)	2023 Test 2 Absolute Difference (mm:ss)	2023 Test 3 Absolute Difference (mm:ss)	2023 Test 4 Absolute Difference (mm:ss)	2023 Test 5 Absolute Difference (mm:ss)	2023 Test 7 Absolute Difference (mm:ss)
BLB_727_BS_IB	14:21	-00:28 ▲	-00:09 ▲	-00:22 ▲	00:14 ▼	00:07 ▼	00:11 ▼
BLB_727_BS_OB	16:18	00:26 ▼	-00:19 ▲	03:48 ▼	02:09 ▼	-00:07 ▲	02:06 ▼
FAB_11_EB	26:50	-00:43 ▲	-00:46 ▲	00:38 ▼	01:38 ▼	-00:32 ▲	00:56 ▼
FAB_11_SB	30:39	-00:23 ▲	-01:33 ▲	-00:48 ▲	00:36 ▼	00:32 ▼	-00:29 ▲
FAB_17_NB	27:23	-00:20 ▲	00:18 ▼	00:05 ▼	-02:14 ▲	-00:02 ▲	00:49 ▼
FAB_17_SB							
FAB_18_NB	29:27	-00:36 ▲	-00:22 ▲	01:13 ▼	-01:53 ▲	-00:08 ▲	01:46 ▼
FAB_18_SB							
FAB_19_NB	30:31	-00:33 ▲	-00:09 ▲	-02:03 ▲	-01:21 ▲	-00:33 ▲	-01:48 ▲
FAB_19_SB	30:43	-00:43 ▲	-03:33 ▲	-00:35 ▲	-01:48 ▲	-01:13 ▲	-00:38 ▲
FAB_1A_NB	13:51	-00:48 ▲	-01:31 ▲	-00:29 ▲	-00:45 ▲	-01:20 ▲	01:19 ▼
FAB_1A_SB	19:05	-00:02 ▲	-01:40 ▲	-04:39 ▲	02:02 ▼	-02:13 ▲	-04:34 ▲
FAB_1B_SB	15:16	00:18 ▼	-00:59 ▲	-05:30 ▲	-03:38 ▲	-00:33 ▲	-05:41 ▲
FAB_20_LOOP	39:59	01:19 ▼	-01:44 ▲	02:02 ▼	04:02 ▼	00:48 ▼	01:56 ▼
FAB_4_LOOP	30:51	00:53 ▼	00:48 ▼	01:26 ▼	01:10 ▼	00:34 ▼	00:02 ▼

C.2 Indirectly Affected Routes

Table C.4 : AM Peak – Individual Bus Journey Times -Indirectly Affected (mm:ss) – Full Modelled Route

AM Peak Period (06:00 - 10:00) Bus Route	2023 Reference Case	2023 Test 1 Absolute Difference (mm:ss)	2023 Test 2 Absolute Difference (mm:ss)	2023 Test 3 Absolute Difference (mm:ss)	2023 Test 4 Absolute Difference (mm:ss)	2023 Test 5 Absolute Difference (mm:ss)	2023 Test 7 Absolute Difference (mm:ss)
FAB_1_NB	21:23	-00:01 ▬	00:17 ▼	00:24 ▼	00:35 ▼	00:28 ▼	00:09 ▼
FAB_1_SB	21:28	-00:02 ▲	00:02 ▼	00:12 ▼	00:33 ▼	00:16 ▼	00:02 ▼
FAB_2_NB	21:57	00:05 ▼	00:24 ▼	00:43 ▼	00:11 ▼	00:46 ▼	00:07 ▼
FAB_2_SB	20:18	00:07 ▼	00:34 ▼	-00:13 ▲	00:21 ▼	00:30 ▼	00:08 ▼
FAB_12_NB	23:22	-00:10 ▲	-00:01 ▬	00:22 ▼	-00:04 ▲	-00:10 ▲	00:02 ▼
FAB_12_SB	23:59	-00:06 ▲	00:48 ▼	00:25 ▼	01:13 ▼	00:11 ▼	00:27 ▼
BLB_35_BS_IB	14:19	-00:03 ▲	00:31 ▼	-00:03 ▲	00:35 ▼	00:01 ▼	-00:14 ▲
BLB_35_BS_OB	12:50	00:15 ▼	00:26 ▼	00:22 ▼	00:50 ▼	00:02 ▼	00:18 ▼

Table C.5 : PM Peak – Individual Bus Journey Times - Indirectly Affected (mm:ss) – Full Modelled Route

PM Peak Period (15:00 - 19:00) Bus Route	2023 Reference Case	2023 Test 1 Absolute Difference (mm:ss)	2023 Test 2 Absolute Difference (mm:ss)	2023 Test 3 Absolute Difference (mm:ss)	2023 Test 4 Absolute Difference (mm:ss)	2023 Test 5 Absolute Difference (mm:ss)	2023 Test 7 Absolute Difference (mm:ss)
FAB_1_NB	26:38	-00:03 ▲	00:20 ▼	-00:02 ▲	00:13 ▼	00:02 ▬	00:02 ▼
FAB_1_SB	22:58	00:03 ▼	00:10 ▼	-00:06 ▲	-00:05 ▲	00:00 ▬	-00:02 ▲
FAB_2_NB	25:52	-00:11 ▲	00:09 ▼	00:15 ▼	00:18 ▼	00:22 ▼	-00:02 ▲
FAB_2_SB	22:58	00:06 ▼	00:29 ▼	-00:01 ▬	00:05 ▼	-00:07 ▲	00:16 ▼
FAB_12_NB	28:07	00:20 ▼	00:30 ▼	01:02 ▼	00:59 ▼	00:37 ▼	01:01 ▼
FAB_12_SB	24:30	00:16 ▼	00:37 ▼	00:39 ▼	01:13 ▼	00:15 ▼	00:17 ▼
BLB_35_BS_IB	15:07	00:12 ▼	00:27 ▼	01:09 ▼	01:13 ▼	00:16 ▼	00:52 ▼
BLB_35_BS_OB	16:50	00:28 ▼	00:48 ▼	01:09 ▼	01:07 ▼	00:37 ▼	01:26 ▼

Table C.6 : Saturday Peak – Individual Bus Journey Times - Indirectly Affected (mm:ss) – Full Modelled Route

Saturday Peak Period (12:00 - 16:00) Bus Route	2023 Reference Case	2023 Test 1 Absolute Difference (mm:ss)	2023 Test 2 Absolute Difference (mm:ss)	2023 Test 3 Absolute Difference (mm:ss)	2023 Test 4 Absolute Difference (mm:ss)	2023 Test 5 Absolute Difference (mm:ss)	2023 Test 7 Absolute Difference (mm:ss)
FAB_1_NB	25:36	01:11 ▼	01:13 ▼	01:45 ▼	01:05 ▼	01:45 ▼	01:51 ▼
FAB_1_SB	22:22	00:04 ▼	-00:03 ▲	00:12 ▼	00:30 ▼	-00:12 ▲	-00:00 ▬
FAB_2_NB	25:02	01:16 ▼	01:34 ▼	01:46 ▼	01:44 ▼	01:43 ▼	01:56 ▼
FAB_2_SB	22:28	00:26 ▼	00:34 ▼	00:03 ▼	00:28 ▼	00:30 ▼	00:19 ▼
FAB_12_NB	25:21	00:59 ▼	00:33 ▼	01:02 ▼	00:42 ▼	00:31 ▼	01:19 ▼
FAB_12_SB	26:08	-00:42 ▲	-00:24 ▲	00:33 ▼	01:36 ▼	-00:36 ▲	00:15 ▼
BLB_35_BS_IB	15:23	00:37 ▼	00:55 ▼	01:58 ▼	02:36 ▼	00:42 ▼	01:39 ▼
BLB_35_BS_OB	14:09	00:16 ▼	00:00 ▬	00:18 ▼	00:29 ▼	00:11 ▼	00:39 ▼

D BUS JOURNEY TIME ANALYSIS, CITY CENTRE AREA

Table D.1 : AM Peak – Individual Bus Journey Times (mm:ss) – City Centre Area

		2023 Test 1	2023 Test 2	2023 Test 3	2023 Test 4	2023 Test 5	2023 Test 7
AM Peak Period (06:00 - 10:00) Bus Route	2023 Reference Case	Absolute Difference (mm:ss)	Absolute Difference (mm:ss)	Absolute Difference (mm:ss)	Absolute Difference (mm:ss)	Absolute Difference (mm:ss)	Absolute Difference (mm:ss)
BLB_727_BS_IB	08:47	-00:12 ▲	00:28 ▼	00:31 ▼	01:09 ▼	-00:20 ▲	00:45 ▼
FAB_19_NB	07:27	-00:04 ▲	-00:02 ▲	01:34 ▼	01:14 ▼	00:03 ▼	01:30 ▼
FAB_19_SB	09:15	-00:17 ▲	-00:10 ▲	00:20 ▼	-00:31 ▲	-00:09 ▲	00:11 ▼
BLB_35_BS_OB	09:17	00:11 ▼	00:09 ▼	00:09 ▼	00:36 ▼	-00:05 ▲	00:08 ▼
BLB_35_BS_IB	09:01	00:01 ▼	00:09 ▼	-00:04 ▲	00:13 ▼	00:06 ▼	-00:10 ▲

Table D.2 : PM Peak – Individual Bus Journey Times (mm:ss) – City Centre Area

		2023 Test 1	2023 Test 2	2023 Test 3	2023 Test 4	2023 Test 5	2023 Test 7
PM Peak Period (15:00 - 19:00) Bus Route	2023 Reference Case	Absolute Difference (mm:ss)	Absolute Difference (mm:ss)	Absolute Difference (mm:ss)	Absolute Difference (mm:ss)	Absolute Difference (mm:ss)	Absolute Difference (mm:ss)
BLB_727_BS_IB	10:22	-00:58 ▲	00:02 ▼	-00:12 ▲	-00:20 ▲	-00:47 ▲	-00:51 ▲
BLB_727_BS_OB	14:15	-02:40 ▲	-01:58 ▲	00:02 ▼	-00:09 ▲	-02:36 ▲	-01:14 ▲
FAB_19_NB	09:36	-00:43 ▲	-00:41 ▲	00:24 ▼	00:42 ▼	-00:39 ▲	00:27 ▼
FAB_19_SB	02:31	00:01 ▼	-00:03 ▲	00:02 ▼	00:02 ▼	00:01 ▼	00:03 ▼
BLB_35_BS_OB	11:34	00:29 ▼	00:26 ▼	01:05 ▼	00:52 ▼	01:02 ▼	01:20 ▼
BLB_35_BS_IB	09:49	00:15 ▼	00:15 ▼	00:57 ▼	01:01 ▼	00:06 ▼	00:18 ▼

Table D.3 : Saturday Peak – Individual Bus Journey Times (mm:ss) – City Centre Area

		2023 Test 1	2023 Test 2	2023 Test 3	2023 Test 4	2023 Test 5	2023 Test 7
Saturday Peak Period (12:00 - 16:00) Bus Route	2023 Reference Case	Absolute Difference (mm:ss)	Absolute Difference (mm:ss)	Absolute Difference (mm:ss)	Absolute Difference (mm:ss)	Absolute Difference (mm:ss)	Absolute Difference (mm:ss)
BLB_727_BS_IB	10:11	-01:14 ▲	00:55 ▼	-00:42 ▲	-01:00 ▲	-00:51 ▲	-00:31 ▲
BLB_727_BS_OB	14:30	00:23 ▼	-00:18 ▲	02:36 ▼	03:44 ▼	-00:09 ▲	02:05 ▼
FAB_19_NB	09:10	00:06 ▼	00:27 ▼	00:58 ▼	01:34 ▼	00:00 ▬	00:48 ▼
FAB_19_SB	02:16	-00:03 ▲	-00:01 ▲	00:01 ▼	-00:00 ▬	-00:02 ▲	-00:03 ▲
BLB_35_BS_OB	09:43	00:33 ▼	00:11 ▼	00:42 ▼	00:44 ▼	00:31 ▼	00:58 ▼
BLB_35_BS_IB	09:35	06:19 ▼	00:22 ▼	01:45 ▼	01:33 ▼	00:34 ▼	01:23 ▼

E BUS RELIABILITY ANALYSIS- FULL MODELLED ROUTE

E.1 Key Routes

Table E.1 : AM Peak – Individual Bus Journey Time Variance (Cumulative), (mm:ss) – Full Modelled Route

		2023 Test 1	2023 Test 2	2023 Test 3	2023 Test 4	2023 Test 5	2023 Test 7
AM Peak Period (06:00 - 10:00) Bus Route	**2023 Reference Case**	**Absolute Difference (mm:ss)**	**Absolute Difference (mm:ss)**	**Absolute Difference (mm:ss)**	**Absolute Difference (mm:ss)**	**Absolute Difference (mm:ss)**	**Absolute Difference (mm:ss)**
BLB_727_BS_IB	05:19	-00:09 ▲	-00:02 ▲	-00:53 ▲	-00:11 ▲	-01:26 ▲	02:17 ▼
BLB_727_BS_OB							
FAB_11_EB	08:01	-00:48 ▲	03:15 ▼	-01:18 ▲	01:41 ▼	-01:32 ▲	-03:21 ▲
FAB_11_SB	07:29	-00:53 ▲	-01:24 ▲	-02:34 ▲	01:42 ▼	-03:12 ▲	-03:24 ▲
FAB_17_NB	17:15	-13:10 ▲	-13:06 ▲	-11:17 ▲	-09:01 ▲	-13:07 ▲	-11:17 ▲
FAB_17_SB	03:22	-01:30 ▲	-01:41 ▲	00:07 ▼	-01:32 ▲	-01:15 ▲	00:26 ▼
FAB_18_NB	06:07	-00:10 ▲	00:36 ▼	02:50 ▼	02:29 ▼	00:59 ▼	01:08 ▼
FAB_18_SB	04:49	00:52 ▼	-02:58 ▲	00:54 ▼	-00:37 ▲	-00:37 ▲	00:56 ▼
FAB_19_NB	10:01	-03:58 ▲	-03:58 ▲	-03:59 ▲	-03:58 ▲	-03:00 ▲	-03:02 ▲
FAB_19_SB	05:08	-00:14 ▲	02:14 ▼	-01:49 ▲	00:31 ▼	-00:41 ▲	-00:05 ▲
FAB_1A_NB	01:37	00:03 ▼	02:32 ▼	00:18 ▼	-00:50 ▲	00:00 ▬	-00:21 ▲
FAB_1A_SB	03:54	-02:54 ▲	-00:57 ▲	-01:51 ▲	-01:42 ▲	-01:02 ▲	-01:12 ▲
FAB_1B_SB	04:10	-00:29 ▲	-01:23 ▲	-02:31 ▲	-02:24 ▲	-00:44 ▲	-02:32 ▲
FAB_20_LOOP	17:38	-07:12 ▲	-01:53 ▲	-07:03 ▲	-08:59 ▲	-03:02 ▲	-10:50 ▲
FAB_4_LOOP	05:01	00:26 ▼	03:48 ▼	03:18 ▼	03:14 ▼	-00:02 ▲	02:58 ▼

Table E.2 : PM Peak – Individual Bus Journey Time Variance (Cumulative), (mm:ss) – Full Modelled Route

		2023 Test 1	2023 Test 2	2023 Test 3	2023 Test 4	2023 Test 5	2023 Test 7
PM Peak Period (15:00 - 19:00) Bus Route	**2023 Reference Case**	**Absolute Difference (mm:ss)**	**Absolute Difference (mm:ss)**	**Absolute Difference (mm:ss)**	**Absolute Difference (mm:ss)**	**Absolute Difference (mm:ss)**	**Absolute Difference (mm:ss)**
BLB_727_BS_IB	08:57	-04:29 ▲	-02:31 ▲	-04:50 ▲	-02:45 ▲	-03:22 ▲	-02:57 ▲
BLB_727_BS_OB	06:57	-04:08 ▲	-01:13 ▲	00:16 ▼	-03:06 ▲	-03:33 ▲	-04:01 ▲
FAB_11_EB	06:45	01:21 ▼	01:56 ▼	02:08 ▼	01:23 ▼	00:44 ▼	00:53 ▼
FAB_11_SB	08:36	01:15 ▼	00:49 ▼	-01:26 ▲	00:29 ▼	-00:12 ▲	-02:09 ▲
FAB_17_NB	09:49	03:21 ▼	-01:31 ▲	01:17 ▼	02:14 ▼	00:08 ▼	-01:43 ▲
FAB_17_SB							
FAB_18_NB	10:13	01:39 ▼	-02:59 ▲	-03:57 ▲	-02:16 ▲	-03:54 ▲	-04:19 ▲
FAB_18_SB							
FAB_19_NB	11:43	01:55 ▼	-02:56 ▲	-01:58 ▲	00:26 ▼	-04:13 ▲	-04:49 ▲
FAB_19_SB	08:13	03:23 ▼	02:41 ▼	-01:19 ▲	-00:34 ▲	02:49 ▼	02:22 ▼
FAB_1A_NB	04:15	00:10 ▼	-02:33 ▲	-03:40 ▲	-01:08 ▲	-03:00 ▲	00:39 ▼
FAB_1A_SB	01:30	-00:45 ▲	02:17 ▼	01:14 ▼	00:26 ▼	-00:26 ▲	-00:36 ▲
FAB_1B_SB	03:51	-01:20 ▲	01:21 ▼	-01:50 ▲	-01:47 ▲	01:37 ▼	-01:41 ▲
FAB_20_LOOP	14:20	03:17 ▼	02:55 ▼	00:32 ▼	-02:35 ▲	-00:21 ▲	-01:07 ▲
FAB_4_LOOP	10:27	01:53 ▼	00:33 ▼	02:13 ▼	04:00 ▼	-00:24 ▲	02:30 ▼

Table E.3 : Saturday Peak – Individual Bus Journey Time Variance (Cumulative), (mm:ss) – Full Modelled Route

Saturday Peak Period (12:00 - 16:00) Bus Route	2023 Reference Case	2023 Test 1 Absolute Difference (mm:ss)	2023 Test 2 Absolute Difference (mm:ss)	2023 Test 3 Absolute Difference (mm:ss)	2023 Test 4 Absolute Difference (mm:ss)	2023 Test 5 Absolute Difference (mm:ss)	2023 Test 7 Absolute Difference (mm:ss)
BLB_727_BS_IB	04:06	01:38 ▼	02:38 ▼	01:27 ▼	00:29 ▼	01:53 ▼	02:46 ▼
BLB_727_BS_OB	07:55	-04:03 ▲	-01:47 ▲	02:08 ▼	-02:09 ▲	-03:37 ▲	-05:53 ▲
FAB_11_EB	06:36	-01:12 ▲	-01:32 ▲	-00:10 ▲	-00:20 ▲	-00:27 ▲	00:23 ▼
FAB_11_SB	10:51	04:15 ▼	03:34 ▼	-02:47 ▲	-00:21 ▲	01:03 ▼	01:01 ▼
FAB_17_NB	10:03	-02:36 ▲	01:11 ▼	-00:34 ▲	01:51 ▼	00:59 ▼	04:02 ▼
FAB_17_SB							
FAB_18_NB	12:04	-00:03 ▲	00:58 ▼	02:18 ▼	-00:07 ▲	00:43 ▼	00:49 ▼
FAB_18_SB							
FAB_19_NB	08:59	02:01 ▼	03:01 ▼	03:05 ▼	01:03 ▼	-00:01 ▲	04:02 ▼
FAB_19_SB	07:03	02:43 ▼	00:55 ▼	02:02 ▼	01:16 ▼	01:58 ▼	02:17 ▼
FAB_1A_NB	02:03	01:09 ▼	-00:29 ▲	01:07 ▼	-00:10 ▲	00:58 ▼	00:29 ▼
FAB_1A_SB	06:54	-03:43 ▲	-04:32 ▲	-06:29 ▲	-01:12 ▲	-05:12 ▲	-06:37 ▲
FAB_1B_SB	09:26	-02:17 ▲	-03:15 ▲	-06:56 ▲	-03:40 ▲	-02:44 ▲	-07:29 ▲
FAB_20_LOOP	12:22	-01:22 ▲	01:37 ▼	-00:27 ▲	-01:24 ▲	02:17 ▼	00:33 ▼
FAB_4_LOOP	07:56	-01:01 ▲	00:11 ▼	01:53 ▼	02:05 ▼	-02:35 ▲	-03:47 ▲

E.2 Indirectly Affected Routes

Table E.4 : AM Peak – Individual Bus Journey Time Variance (Cumulative), (mm:ss) Indirectly Affected – Full Modelled Route

AM Peak Period (06:00 - 10:00) Bus Route	2023 Reference Case	2023 Test 1 Absolute Difference (mm:ss)	2023 Test 2 Absolute Difference (mm:ss)	2023 Test 3 Absolute Difference (mm:ss)	2023 Test 4 Absolute Difference (mm:ss)	2023 Test 5 Absolute Difference (mm:ss)	2023 Test 7 Absolute Difference (mm:ss)
FAB_1_NB	05:34	02:45 ▼	00:54 ▼	03:15 ▼	02:24 ▼	03:42 ▼	03:30 ▼
FAB_1_SB	04:11	00:56 ▼	02:08 ▼	02:29 ▼	03:49 ▼	03:49 ▼	01:21 ▼
FAB_2_NB	08:44	-02:42 ▲	-02:30 ▲	01:14 ▼	-00:47 ▲	05:20 ▼	-03:07 ▲
FAB_2_SB	06:24	00:58 ▼	01:47 ▼	-00:12 ▲	-00:42 ▲	00:20 ▼	00:19 ▼
FAB_12_NB	07:46	-03:01 ▲	-00:26 ▲	-01:20 ▲	01:55 ▼	-03:30 ▲	-00:32 ▲
FAB_12_SB	06:21	-01:19 ▲	02:14 ▼	-02:48 ▲	-01:18 ▲	-01:26 ▲	-01:48 ▲
BLB_35_BS_IB	08:49	-02:38 ▲	01:17 ▼	-03:11 ▲	-00:54 ▲	-03:13 ▲	-02:15 ▲
BLB_35_BS_OB	06:03	00:03 ▼	-00:06 ▲	-00:05 ▲	00:08 ▼	-00:02 ▲	00:00 ▬

Table E.5 : PM Peak – Individual Bus Journey Time Variance (Cumulative), (mm:ss) Indirectly Affected – Full Modelled Route

		2023 Test 1	2023 Test 2	2023 Test 3	2023 Test 4	2023 Test 5	2023 Test 7
PM Peak Period (15:00 - 19:00) Bus Route	**2023 Reference Case**	**Absolute Difference (mm:ss)**	**Absolute Difference (mm:ss)**	**Absolute Difference (mm:ss)**	**Absolute Difference (mm:ss)**	**Absolute Difference (mm:ss)**	**Absolute Difference (mm:ss)**
FAB_1_NB	11:04	-01:31 ▲	00:32 ▼	-00:12 ▲	-00:37 ▲	-01:10 ▲	02:01 ▼
FAB_1_SB	04:56	00:56 ▼	00:11 ▼	-00:58 ▲	-01:16 ▲	-00:59 ▲	-00:17 ▲
FAB_2_NB	13:23	-03:45 ▲	-02:20 ▲	-04:39 ▲	-02:23 ▲	-03:16 ▲	-04:38 ▲
FAB_2_SB	05:25	-01:01 ▲	-01:25 ▲	-00:15 ▲	-01:42 ▲	-01:38 ▲	-00:25 ▲
FAB_12_NB	15:44	-06:30 ▲	-02:23 ▲	-03:42 ▲	-02:45 ▲	-04:42 ▲	-04:09 ▲
FAB_12_SB	08:13	-01:59 ▲	-00:39 ▲	-01:33 ▲	-00:58 ▲	-00:59 ▲	-00:42 ▲
BLB_35_BS_IB	10:40	00:06 ▼	-02:22 ▲	-00:43 ▲	-02:05 ▲	-00:39 ▲	-01:39 ▲
BLB_35_BS_OB	12:31	01:57 ▼	-01:14 ▲	00:37 ▼	-02:05 ▲	-02:04 ▲	-00:08 ▲

Table E.6 : Saturday Peak – Individual Bus Journey Time Variance (Cumulative), (mm:ss) Indirectly Affected – Full Modelled Route

		2023 Test 1	2023 Test 2	2023 Test 3	2023 Test 4	2023 Test 5	2023 Test 7
Saturday Peak Period (12:00 - 16:00) Bus Route	**2023 Reference Case**	**Absolute Difference (mm:ss)**	**Absolute Difference (mm:ss)**	**Absolute Difference (mm:ss)**	**Absolute Difference (mm:ss)**	**Absolute Difference (mm:ss)**	**Absolute Difference (mm:ss)**
FAB_1_NB	13:10	00:44 ▼	01:14 ▼	00:50 ▼	-01:10 ▲	-01:01 ▲	01:46 ▼
FAB_1_SB	08:05	-01:40 ▲	-00:48 ▲	-01:01 ▲	-01:28 ▲	-02:40 ▲	-02:55 ▲
FAB_2_NB	08:51	02:50 ▼	03:08 ▼	04:38 ▼	03:41 ▼	00:44 ▼	04:18 ▼
FAB_2_SB	06:23	01:31 ▼	02:58 ▼	-01:37 ▲	-01:09 ▲	-00:34 ▲	-02:43 ▲
FAB_12_NB	06:16	02:45 ▼	02:19 ▼	03:59 ▼	01:57 ▼	02:14 ▼	03:54 ▼
FAB_12_SB	08:06	-01:24 ▲	05:16 ▼	01:50 ▼	05:45 ▼	01:46 ▼	01:49 ▼
BLB_35_BS_IB	07:29	-00:49 ▲	03:07 ▼	01:46 ▼	04:26 ▼	-00:43 ▲	-00:41 ▲
BLB_35_BS_OB	06:26	-00:04 ▲	00:02 ▼	-00:07 ▲	-00:08 ▲	01:28 ▼	04:04 ▼

F BUS RELIABILITY ANALYSIS- CITY CENTRE AREA

Table F.1 : AM Peak – Individual Bus Journey Time Variance (Cumulative), (mm:ss) – City Centre Area

		2023 Test 1	2023 Test 2	2023 Test 3	2023 Test 4	2023 Test 5	2023 Test 7
AM Peak Period (06:00 - 10:00) Bus Route	**2023 Reference Case**	**Absolute Difference (mm:ss)**	**Absolute Difference (mm:ss)**	**Absolute Difference (mm:ss)**	**Absolute Difference (mm:ss)**	**Absolute Difference (mm:ss)**	**Absolute Difference (mm:ss)**
BLB_727_BS_IB	05:01	-00:23 ▲	00:17 ▼	-00:23 ▲	-00:26 ▲	-01:42 ▲	03:08 ▼
FAB_19_NB	03:55	-00:25 ▲	-00:38 ▲	-00:20 ▲	00:03 ▼	-00:24 ▲	-01:03 ▲
FAB_19_SB	04:00	-00:32 ▲	01:18 ▼	-00:21 ▲	-01:08 ▲	-01:12 ▲	00:05 ▼
BLB_35_BS_OB	04:42	-00:01 ▲	00:11 ▼	-00:02 ▲	01:23 ▼	00:02 ▼	-00:02 ▲
BLB_35_BS_IB	07:41	-02:54 ▲	00:04 ▼	-02:51 ▲	-03:04 ▲	-02:42 ▲	-02:43 ▲

Table F.2 : PM Peak – Individual Bus Journey Time Variance (Cumulative), (mm:ss) – City Centre Area

		2023 Test 1	2023 Test 2	2023 Test 3	2023 Test 4	2023 Test 5	2023 Test 7
PM Peak Period (15:00 - 19:00) Bus Route	**2023 Reference Case**	**Absolute Difference (mm:ss)**	**Absolute Difference (mm:ss)**	**Absolute Difference (mm:ss)**	**Absolute Difference (mm:ss)**	**Absolute Difference (mm:ss)**	**Absolute Difference (mm:ss)**
BLB_727_BS_IB	06:28	-02:02 ▲	00:23 ▼	00:38 ▼	-02:32 ▲	-01:31 ▲	-01:25 ▲
BLB_727_BS_OB	08:17	-05:21 ▲	-02:54 ▲	-02:51 ▲	-01:11 ▲	-04:50 ▲	-05:19 ▲
FAB_19_NB	04:34	-00:45 ▲	00:40 ▼	-00:20 ▲	01:59 ▼	-01:03 ▲	00:09 ▼
FAB_19_SB	01:54	-00:22 ▲	-00:28 ▲	-00:36 ▲	-00:06 ▲	-00:10 ▲	00:07 ▼
BLB_35_BS_OB	09:06	00:38 ▼	-00:01 ▲	02:11 ▼	-01:20 ▲	-01:08 ▲	01:54 ▼
BLB_35_BS_IB	06:59	00:21 ▼	-01:00 ▲	00:00 ▬	00:35 ▼	-00:57 ▲	00:06 ▼

Table F.3 : Saturday Peak – Individual Bus Journey Time Variance (Cumulative), (mm:ss) – City Centre Area

		2023 Test 1	2023 Test 2	2023 Test 3	2023 Test 4	2023 Test 5	2023 Test 7
Saturday Peak Period (12:00 - 16:00) Bus Route	**2023 Reference Case**	**Absolute Difference (mm:ss)**	**Absolute Difference (mm:ss)**	**Absolute Difference (mm:ss)**	**Absolute Difference (mm:ss)**	**Absolute Difference (mm:ss)**	**Absolute Difference (mm:ss)**
BLB_727_BS_IB	06:45	-01:37 ▲	-00:42 ▲	-03:09 ▲	-01:48 ▲	-01:18 ▲	-00:41 ▲
BLB_727_BS_OB	10:07	-06:04 ▲	-04:07 ▲	-02:12 ▲	00:02 ▼	-05:54 ▲	-08:02 ▲
FAB_19_NB	06:09	-01:35 ▲	01:31 ▼	-00:57 ▲	-00:49 ▲	-01:51 ▲	02:32 ▼
FAB_19_SB	00:55	-00:04 ▲	00:05 ▼	00:06 ▼	-00:04 ▲	-00:04 ▲	00:01 ▼
BLB_35_BS_OB	06:35	01:11 ▼	00:49 ▼	-00:29 ▲	-00:22 ▲	00:54 ▼	03:21 ▼
BLB_35_BS_IB	06:19	00:21 ▼	-01:01 ▲	01:36 ▼	01:31 ▼	-00:04 ▲	00:14 ▼