South East of Scotland Transport Partnership (SEStran)

Edinburgh Orbital Bus Rapid Transit (EOBRT) Project

Capacity Analysis Study

Scott Wilson Ltd
July 2010

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Revision Schedule

Edinburgh Orbital Bus Rapid Transit Project (EOBRT)
Capacity Analysis Study – Interim Report

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Rev	Date	Details	Prepared by	Reviewed by	Approved by
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1.0 INTRODUCTION

1.1 Background

1.1.1 SEStran (South East Scotland Transport Partnership) appointed Scott Wilson to prepare a Pre-Feasibility and STAG Part 2 Report on potential options for an orbital bus system in Edinburgh. This would link a number of key employment, retail and Park-and-Ride (P&R) sites located within the vicinity of the A720 Edinburgh City Bypass.

1.1.2 Known as the Edinburgh Orbital Bus Rapid Transit Project (EOBRT), a preferred alignment was produced following the STAG Part 2 Appraisal which links Edinburgh Airport with Millerhill P&R and has different segments running on and off the Bypass.

1.1.3 Following on from this, Scott Wilson developed an outline programme for the implementation of the scheme, which sub-divided the proposed route into 6 segments. The outline programme suggested that the full EOBRT route could be implemented as a phased approach made up of two parts (Phase 1 from Edinburgh Airport to Lothianburn/Straiton P&R or further east depending on traffic congestion, and Phase 2 would complete the route to Millerhill Park-and-Ride).

1.1.4 It was therefore recommended that further analysis should be carried out to look at implementing Phase 1, including an assessment of current levels of congestion along the various segments of the proposed route. For this purpose, a programme of traffic surveys at key locations in the study corridor was undertaken, which was detailed in the previous Traffic Survey and Data Report.

1.1.5 This document presents the analysis of the data collected from the traffic surveys and the findings from the congestion analysis.

1.2 Structure of this Report

1.2.1 The overall structure of this report is as follows:

Chapter 2 – describes the traffic growth scenarios used in this study;

Chapter 3 – explains the process used for the link capacity analysis and presents the results;

Chapter 4 – details the methodology used for the junction capacity analysis and displays the results;

Chapter 5 – describes the process used for the delay analysis of the grade separated merge slips and presents the results;

Chapter 6 – outlines the methodology used for the A720 speed analysis and presents the results; and

Chapter 7 – sets out the conclusions and recommendations for taking the project forward.

2.0 TRAFFIC GROWTH SCENARIOS

2.1 Assumed Opening Year

2.1.1 In order to analyse the impact of traffic growth on congestion in the EOBRT corridor, it is necessary to examine traffic movements in the current year and also sometime in the future. This therefore requires an estimation of how traffic will grow over time.

2.1.2 The EOBRT implementation programme[1] reported that a number of sections of the scheme could be constructed by 2013. Consequently, we have assumed an opening year of 2013 and estimated annual growth rates of traffic. These have been applied to the 2009/2010 base flows to derive the 2013 flows as described below.

2.2 Estimated Traffic Growth Rate

Overview

2.2.1 Two sources of data were used to identify suitable annual growth rates for traffic along the A720 Bypass.

2.2.2 The first source was a series of Automatic Traffic Counters (ATC) along the A720. These provided observed growth rates over recent years at individual sections of the A720. Details of the ATC data used in this study are set out in the Traffic Surveys Report[2], which is the companion to this document.

2.2.3 The second source of annual growth rates was the Transport Model for Scotland version 05a (TMfS:05a). This model contains a number of landuse and planning assumptions, the details of which are outlined in the 'TMfS Demand Model Development – 2005 Rebase Final Report'[3], which also explains the working of the model itself.

Observed Growth Rates

2.2.4 Transport Scotland maintains a system of permanent ATCs across the road network, five of which are located along the studied section of the A720 Bypass. The five permanent ATCs are as follows:

- Site 1a & 1b (Ref. JTC08232 & JTC08233): A720 Dreghorn (Eastbound and Westbound respectively);
- Site 2 (Ref. JTC00035): A720 West of Junction with A701;
- Site 3 (Ref. JTC00300): City Bypass, East of Gilmerton Junction; and
- Site 4 (Ref. JTC00251): City Bypass at Millerhill (West of A68 Dalkeith Bypass).

2.2.5 Traffic data from the permanent ATC sites was used to determine the annual growth of traffic. The 5-day average data from November 2006 and 2009 (plus 2007 and 2008 for Sites 3 and 4) was obtained from the ATC sites at different sections of the A720 Bypass. This is broken down for all peak periods (07:00 to 10:00hrs, 12:00 to 14:00hrs and 16:00 to 19:00hrs) and for daily flows.

[1] EOBRT Project – Outline Implementation Programme and Updated Business Case Analysis, Scott Wilson, September 2009
[2] EOBRT Phase 1 Implementation - Traffic Surveys and Data Report, Scott Wilson, January 2010
[3] TMfS Demand Model Development – 2005 Rebase Final Report, MVA, May 2007

2.2.6 Traffic data from 2009 was not used as the opening of the A68 Dalkeith Bypass at the beginning of this year would have led to abnormally high growth rates.

2.2.7 For each section, flows were obtained for both the AM and PM Peak periods and each direction. It was found that growth rates varied depending on the section of the A720, the direction and the time period. As a result, average values across the corridor were used for both the AM and PM Peaks. Table 2.1 shows the traffic flows and observed growth rates.

Table 2.1 – Two-Way ATC Annual Growth (November 2006-2009 5-day average)

		2006	2007		2008		2009	
		2-Way Flows (PCU)	2-Way Flows (PCU)	Observed Annual Growth	2-Way Flows (PCU)	Observed Annual Growth	2-Way Flows (PCU)	Observed Annual Growth
Sites 1a & 1b	AM Peak	20,319	-	-	-	-	20,059	-0.4%
	Off Peak	10,359	-	-	-	-	10,467	0.3%
	PM Peak	18,709	-	-	-	-	19,004	0.5%
	Daily	85,723	-	-	-	-	86,338	0.2%
Site 2	AM Peak	14,551	14,534	-0.1%	14,316	-1.5%	14,720	2.8%
	Off Peak	8,432	8,290	-1.7%	8,262	-0.3%	8,628	4.4%
	PM Peak	15,093	15,150	0.4%	15,275	0.8%	15,719	2.9%
	Daily	67,742	67,713	0.0%	67,450	-0.4%	69,860	3.6%
Site 3	AM Peak	9,025	8,996	-0.3%	9,294	3.3%	9,550	2.8%
	Off Peak	5,835	5,587	-4.2%	5,724	2.4%	5,962	4.1%
	PM Peak	9,355	9,135	-2.4%	9,841	7.7%	10,114	2.8%
	Daily	44,539	43,678	-1.9%	45,010	3.0%	46,337	2.9%
Site 4	AM Peak	8,423	-	-	-	-	9,073	2.6%
	Off Peak	5,093	-	-	-	-	5,534	2.9%
	PM Peak	8,218	-	-	-	-	9,446	5.0%
	Daily	39,792	-	-	-	-	43,157	2.8%

2.2.8 The obtained annual growth rates were then applied to the 2009/2010 traffic counts to estimate the future level of traffic at the relevant junctions and roads at the opening year of 2013.

TMfS Growth Rates

2.2.9 To derive growth rates from TMfS:05a, traffic flows at the same sections of the A720 as used in the ATC analysis were obtained from the model.

2.2.10 As with the ATC information, these flows were used to calculate the annual growth rates for each individual section, by direction and time period. This data also showed variations along the corridor and therefore the average was adopted.

2.2.11 Using TMfS:05a in this way helps to provide some consistency with the forecasted growth in traffic at a strategic planning level.

Projected Traffic Growth Rates

2.2.12 Estimates of annual and future increases in traffic, using results from both ATC and TMfS traffic growth assumptions, are shown in Table 2.2 overleaf.

Table 2.2 – Projected Traffic Growth Rates

	ATC Growth Rates		TMfS Growth Rates	
	Annual Growth	2009-2013 Increase	Annual Growth	2009-2013 Increase
AM Peak	1.8%	1.07	0.4%	1.02
PM Peak	1.0%	1.04	1.6%	1.07

2.2.13 Using these growth rates allows projected traffic conditions to be analysed and the impact of congestion on the operation of the EOBRT to be determined.

2.2.14 However it should be noted, these growth rates reflect the increase in traffic flows and may not necessarily reflect the growth in overall demand, which would be revealed by a growth in queue lengths on the A720 and its approach roads. Furthermore, the above growth rates do not take into account the potential further increases in demand due to new land-use developments for the bus services. This may lead to the benefits of the bus services being underestimated and also the difficulties facing the buses accessing the facilities.

Comparison to National Road Traffic Forecasts (NRTF) Growth Rates

2.2.15 The observed growth rates shown above can also be compared to national growth rates using the National Road Traffic Forecasts (NRTF). As traffic growth is subject to uncertainty three growth scenarios are taken into account: Low Growth, Central Growth and High Growth. Central growth is considered to be the most likely scenario and is also recommended for use when considering Scottish Trunk Road schemes. Table 2.3 shows the central growth forecasts for the years 2007 to 2016 by vehicle type.

Table 2.3 – NRTF Central Growth Forecasts (% per year)

Range of Years	Central Growth Forecasts (% per year)				
	Car	LGV	OGV1	OGV2	PSV
2007 to 2011	1.5%	2.2%	0.8%	2.4%	0.7%
2012 to 2016	1.4%	2.3%	0.9%	2.5%	0.8%

2.2.16 Taking these growth rates into account and the observed traffic split on the Edinburgh City Bypass, an overall increase of 1.1% per annum was calculated between 2009 and 2013, which is comparable to the results from the ATC and TMfS Growth rates.

3.0 LINK CAPACITY ANALYSIS

3.1 Methodology

3.1.1 In order to analyse the impacts of congestion on the operation of the EOBRT, the Ratio of Flow-to-Capacity (RFC) for individual links along the proposed route was calculated. RFCs are an indication of the utilisation of a link, and a value of up to 85% is generally considered suitable. Higher values lead to a decrease in speed and congestion developing, with values higher than 100% considered critical.

3.1.2 The link flows used in the analysis were obtained from the traffic counts collected and described previously in the survey report[4]. Maximum hourly flows were used for both the AM Peak and PM Peak.

3.1.3 Link capacities were based on the link characteristics, (e.g. road category/link class, number of lanes, speed limit, rural/urban location, etc), with the capacity for each type of link sourced from the NESA Manual[5].

3.2 Link Capacity Analysis Results

3.2.1 The resulting RFCs for 2009/2010 and the assumed Opening Year of 2013 are shown in Table 3.1 overleaf. The analysis has been carried out for both the observed (ATC) and TMfS traffic growth rates.

3.2.2 The results show that a number of links are already above capacity in 2009/2010 during the AM and PM peaks. These include the A8 and South Gyle Broadway, as well as the A720 between Dreghorn and the east of Straiton. To the far east, traffic levels decrease leading to lower RFCs.

3.2.3 For both Opening Year growth scenarios, the general rise in traffic leads to a further increase in congestion, with an increasing number of links having a RFC of more than 85%. In addition, some sections which previously had an RFC of less than 100% have now exceeded their capacity. These are South Gyle Broadway during the PM Peak, the A720 to the west of Dreghorn (eastbound during the AM peak) and to the west of Straiton (westbound during the PM peak). The congestion is particularly critical on the A8 during the AM Peak and on the A720 at Dreghorn and Straiton.

3.2.4 Clearly, these results would worsen in future years beyond 2013.

[4] EOBRT Phase 1 Implementation - Traffic Surveys and Data Report, Scott Wilson, January 2010
[5] Economic Assessment of Road Schemes in Scotland, Section 1 – The NESA Manual, July 2005

Table 3.1 – Link Capacity Analysis

Link / Section	Direction	Peak Period	Capacity (veh)	2009/2010 Flow (veh)	2009/2010 RFC	2013 (ATC Growth) Flow (veh)	2013 (ATC Growth) RFC	2013 (TMfS Growth) Flow (veh)	2013 (TMfS Growth) RFC
A8 (West of RBS)	E/b	AM	2,400	2,651	**110%**	2,837	**118%**	2,704	**113%**
		PM		1,928	80%	2,005	84%	2,063	86%
	W/b	AM	2,400	1,473	61%	1,576	66%	1,502	63%
		PM		1,774	74%	1,845	77%	1,898	79%
South Gyle Broadway (between Gogar and Shopping Centre access)	E/b	AM	2,400	2,541	**106%**	2,719	**113%**	2,592	**108%**
		PM		649	27%	675	28%	694	29%
	W/b	AM	2,400	524	22%	561	23%	534	22%
		PM		2,370	99%	2,465	**103%**	2,536	**106%**
South Gyle Broadway (East of Shopping Centre access)	E/b	AM	1,200	666	56%	713	59%	679	57%
		PM		1,179	98%	1,226	**102%**	1,262	**105%**
	W/b	AM	2,400	1,393	58%	1,491	62%	1,421	59%
		PM		713	30%	742	31%	763	32%
A720 (West of Dreghorn)	E/b	AM	3,175*	3,318	**105%**	3,550	**112%**	3,384	**107%**
		PM		3,629	**114%**	3,774	**119%**	3,883	**122%**
	W/b	AM	3,400	3,892	**114%**	4,164	**122%**	3,970	**117%**
		PM		3,502	**103%**	3,642	**107%**	3,747	**110%**
A720 (Between Dreghorn & Lothianburn)	E/b	AM	3,000	3,188	**106%**	3,411	**114%**	3,252	**108%**
		PM		3,582	**119%**	3,725	**124%**	3,833	**128%**
	W/b	AM	3,000	3,160	**105%**	3,381	**113%**	3,223	**107%**
		PM		3,313	**110%**	3,446	**115%**	3,545	**118%**
A720 (West of Straiton)	E/b	AM	3,000	2,436	81%	2,607	87%	2,485	83%
		PM		3,157	**105%**	3,283	**109%**	3,378	**113%**
	W/b	AM	3,000	3,104	**103%**	3,321	**111%**	3,166	**106%**
		PM		2,882	96%	2,997	**100%**	3,084	**103%**
A720 (East of Straiton)	E/b	AM	3,000	2,591	86%	2,772	92%	2,643	88%
		PM		3,151	**105%**	3,277	**109%**	3,372	**112%**
	W/b	AM	3,000	3,091	**103%**	3,307	**110%**	3,153	**105%**
		PM		2,676	89%	2,783	93%	2,863	95%
A720 (Between Lasswade and Gilmerton)	E/b	AM	3,000	2,240	75%	2,397	80%	2,285	76%
		PM		2,655	89%	2,761	92%	2,841	95%
	W/b	AM	3,000	2,675	89%	2,862	95%	2,729	91%
		PM		2,214	74%	2,303	77%	2,369	79%
A720 (East of Gilmerton)	E/b	AM	3,000	1,571	52%	1,681	56%	1,602	53%
		PM		2,040	68%	2,122	71%	2,183	73%
	W/b	AM	3,000	1,950	65%	2,087	70%	1,989	66%
		PM		1,822	61%	1,895	63%	1,950	65%
A720 (West of A68 Bypass)	E/b	AM	3,000	1,507	50%	1,612	54%	1,537	51%
		PM		1,604	53%	1,668	56%	1,716	57%
	W/b	AM	3,000	1,700	57%	1,819	61%	1,734	58%
		PM		1,855	62%	1,929	64%	1,985	66%

RFC numbers in red show links that are over 85%.

RFC numbers in **bold red** show links that are over 100%.

* Due to rising gradient the default capacity of 3400 vehicles per hour has been reduced by 225 vehicles per hour as per Table 4 of TA79/99 Part 3.

3.3 Impacts due to the EOBRT

3.3.1 Scott Wilson have been commissioned to carry out a separate study to develop the traffic engineering and preliminary designs for the introduction of the Edinburgh Orbital Bus Rapid Transit (EOBRT) Project[6]. This study is only looking at two sections of the whole route, namely the link between Lothianburn and Straiton Park-and-Ride sites and the on-street section from Baberton Junction to the South Gyle Shopping Centre.

3.3.2 However, the traffic engineering has taken into account the capacity impacts on the highway network when the new BRT infrastructure is added onto the road network.

3.3.3 In terms of link capacity issues the proposed designs for introducing the EOBRT on the two sections designed to date has suggested there are no changes to the results shown in Table 3.1 above. This is because the designs are providing additional separate lanes for the EOBRT and therefore do not reduce the current provision of road space for other road users.

3.3.4 Clearly, however, this is based on only the two sections of the whole proposed EOBRT route which have been designed to date. This result may change as further sections are developed.

[6] EOBRT Traffic Engineering and Preliminary Design, Scott Wilson Ltd, April 2010

4.0 JUNCTION CAPACITY ANALYSIS

4.1 Methodology

4.1.1 Based on the Traffic Surveys and Data Report, the following junctions were included in the analysis:

- Site 1 – Eastfield Road / A8 slip road (North): 6-arm roundabout;
- Site 2 – Eastfield Road / A8 slip road (South): 4-arm roundabout;
- Site 3 – Gogar Roundabout: segregated roundabout;
- Site 4 – South Gyle Broadway / Edinburgh Park: 4-arm roundabout;
- Site 5 – South Gyle Access / Bankhead Drive / Bankhead Avenue: 4-arm staggered signalised junction;
- Site 6 – Bankhead Avenue: 3-arm priority junction;
- Site 7 – A71 / Wester Hailes Road (Sighthill): 4-arm roundabout;
- Site 8 – Clovenstone Road / Wester Hailes Road: 5-arm roundabout;
- Site 9 – Baberton Mains View / A720 Westbound Off Slip: 3-arm priority junction;
- Site 10 – Dreghorn Link / A720 Eastbound Slips: 4-arm priority junction;
- Site 11 – Dreghorn Link / A720 Westbound Slips: 3-arm priority junction;
- Site 12 – Biggar Road / A720 slip road (North): 3-arm roundabout;
- Site 13 – Biggar Road / A720 slip road (South): 3-arm roundabout;
- Site 14 – A701 / A720 slip road (North): 5-arm roundabout;
- Site 15 – A701 / B702: 3-arm roundabout;
- Site 16 – Lasswade Road / A720 Eastbound Off Slip: 3-arm priority junction;
- Site 17 – Lasswade Road / A720 Westbound On Slip: 3-arm priority junction;
- Site 18 – Gilmerton Road / A720 Eastbound Off Slip: 4-arm roundabout; and
- Site 19 – Gilmerton Road / A720 Westbound On Slip: 3-arm roundabout.

4.1.2 To analyse the junctions' operation the following programs, developed by the Transport Research Laboratory (TRL), were used:

- ARCADY version 6.2 for roundabouts;
- OSCADY version 5.1 for signalised junctions; and
- TRANSYT version 12.1 for more complex signalised junctions (e.g. signalised roundabout).

4.1.3 These programs require traffic data to be input (including flows and percentage of HGVs) as well as junction geometry details such as lane widths, size of roundabouts, flare lengths etc to be specified.

4.1.4 The geometry of the junctions was measured from Ordnance Survey mapping and aerial photos at each location.

4.1.5 Regarding traffic signals, phasing and staging were determined based on the junction configuration and traffic flows. In all cases, default intergreen times and minimum green

settings were selected in the software packages. In addition, the software was run so that it calculated the optimal signal timings and cycle times based on the traffic flows through the relevant junction.

4.2 Junction Capacity Analysis Results

4.2.1 The junctions were analysed for both the AM and PM Peak hours.

4.2.2 For each arm, maximum Ratios of Flow to Capacity (RFC) and queue lengths were calculated during the peak period. RFCs are a measure of the level of saturation of a junction and values of up to 85% for a roundabout/priority junction and 90% for traffic signals are generally regarded as acceptable. Values greater than these thresholds lead to a deterioration in the junction's operation and a build-up in queue length.

4.2.3 The analysis was carried out for the current conditions in 2009/2010 and for the 2013 assumed opening year. For 2013, the results are shown using both the observed (ATC) growth rates and the TMfS growth rates.

4.2.4 The results from the analysis are shown in Table 4.1 overleaf.

4.2.5 The results suggest that a number of junctions along the EOBRT corridor are already operating close to or exceeding capacity in 2009/2010. These include Gogar roundabout, South Gyle, the signalised junction at Bankhead Drive, Baberton Westbound off slip, the roundabouts at Lothianburn (north), Straiton (north) and Gilmerton south interchanges and Lasswade north and south slip roads.

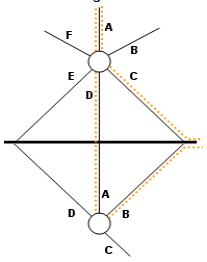
4.2.6 As expected, this congestion issue increases in 2013. In addition, the RFCs for some of the movements at Sighthill roundabout, Baberton roundabout, and Straiton north and south interchange roundabouts exceed the target threshold. It should be noted, however, the junction analysis programs used in this study examine operating conditions in isolation from the surrounding network. This is evident from the results of the Straiton South roundabout (junction 15) which shows a maximum queue length of 2 vehicles on the northbound approach, whereas site observations suggest this is a particularly problematic approach. Hence, the results could be significantly worse than indicated in this report.

4.2.7 Clearly, these results would worsen and operating conditions deteriorate in future years beyond 2013.

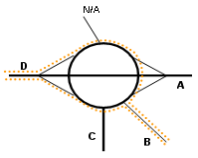
Table 4.1 - Junction Capacity Analysis 2009/2010 and 2013 (ATC & TMfS Growth Rates)

			Junction 1		Junction 2		Junction 3		Junction 4		Junction 5				Junction 6				Junction 7		Junction 8		Junction 9			
	Year	Arm	Max RFC	Max Queue	Max RFC	Max Queue	Max RFC	Max Queue	Max RFC	Max Queue	Max RFC		Max Queue		Max RFC		Max Queue		Max RFC	Max Queue	Max RFC	Max Queue	Max RFC		Max Queue	
2009 / 2010	AM	A	48%	0	-	-	70%	3	25%	0	L: 64%	S: 76%	L: 6	S: 6	-		-		41%	1	41%	1	-		-	
		B	2%	0	30%	0	45%	3	41%	0	L: 90%	R: 36%	L: 11	R: 2	L: 44%	R: 82%	L: 1	R: 4	82%	1	21%	0	L: 2%	R: 64%	L: 0	R: 2
		C	-	-	0%	0	L: 48%	SR: 86%	L: 3	SR: 6	9%	0	S: 55%	R: 87%	S: 6	R: 5	13%		-		60%	1	62%	2	-	
		D	-	-	0%	0	93%	8	**104%**	33	L: 61%	S: 23%	L: 3	S: 1					83%	2	-	-				
		E	26%	0							L: 2%	R: 58%	L: 0	R: 4							40%	1				
		F	2%	0							S: 51%	R: 3%	S: 4	R: 0												
	PM	A	76%	2	-	-	43%	2	34%	0	L: 26%	**S: 104%**	L: 2	S: 32	-		-		81%	4	82%	4	-		-	
		B	24%	0	29%	0	76%	8	57%	0	**L: 110%**	R: 46%	L: 63	R: 4	L: 19.3%	R: 65.3%	L: 1	R: 2	63%	1	46%	1	L: 10%	R: 95%	L: 1	R: 11
		C	-	-	0%	0	L: 48%	SR: 55%	L: 9	SR: 5	18%	0	S: 63%	R: 97%	S: 10	R: 6	24%		-		41%	0	56%	1	-	
		D	-	-	0%	0	61%	4	19%	0	L: 59%	S: 50%	L: 3	S: 3					77%	1	-	-				
		E	18%	0							L: 3%	R: 65%	L: 0	R: 5							38%	1				
		F	5%	0							S: 42%	R: 7%	S: 3	R: 0												
2013 (ATC Growth Rates)	AM	A	52%	1	-	-	75%	4	26%	0	L: 68%	S: 82%	L: 7	S: 7	-		-		47%	1	45%	1	-		-	
		B	2%	0	32%	0	48%	3	44%	0	L: 96%	R: 39%	L: 16	R: 2	L: 76%	R: 91%	L: 3	R: 7	89%	2	23%	0	L: 2%	R: 69%	L: 0	R: 3
		C	-	-	0%	0	L: 51%	SR: 92%	L: 3	SR: 8	9%	0	S: 58%	R: 93%	S: 7	R: 6	14%		-		68%	1	67%	2	-	
		D	-	-	0%	0	99%	12	**111%**	77	L: 64%	S: 24%	L: 4	S: 1					90%	3	0%	-				
		E	29%	0							L: 2%	R: 62%	L: 0	R: 4							43%	1				
		F	3%	0							S: 55%	R: 3%	S: 4	R: 0												
	PM	A	79%	2	-	-	45%	3	36%	0	L: 26%	**S: 109%**	L: 2	S: 41	-		-		89%	7	87%	6	-		-	
		B	26%	0	31%	0	79%	9	60%	1	**L: 115%**	R: 48%	L: 81	R: 4	L: 22%	R: 69%	L: 1	R: 3	67%	1	49%	1	L: 10%	R: 100%	L: 1	R: 15
		C	-	-	1%	0	L: 50%	SR: 57%	L: 4	SR: 3	20%	0	S: 65%	**R: 101%**	S: 11	R: 7	25%		-		44%	0	59%	1	-	
		D	-	-	0%	0	64%	4	20%	0	L: 60%	S: 51%	L: 4	S: 4					81%	1	%	-				
		E	19%	0							L: 3%	R: 67%	L: 1	R: 6							40%	1				
		F	5%	0							S: 44%	R: 7%	S: 4	R: 1												
2013 (TMfS Growth Rates)	AM	A	49%	1	-	-	71%	4	25%	0	L: 65%	S: 78%	L: 6	S: 7	-		-		42%	1	42%	1	-		-	
		B	2%	0	30%	0	46%	3	42%	0	L: 92%	R: 37%	L: 12	R: 2	L: 49%	R: 85%	L: 1	R: 5	84%	2	22%	0	L: 2%	R: 65%	L: 0	R: 2
		C	-	-	0%	0	L: 49%	SR: 87%	L: 3	SR: 6	9%	0	S: 56%	R: 88%	S: 7	R: 5	13%		-		63%	1	63%	2	-	
		D	-	-	0%	0	95%	9	**106%**	45	L: 63%	S: 24%	L: 4	S: 2					85%	2	0%	-				
		E	27%	0							L: 2%	R: 60%	L: 1	R: 5							41%	1				
		F	2%	0							S: 53%	R: 3%	S: 5	R: 1												
	PM	A	81%	2	-	-	46%	3	37%	0	L: 27%	**S: 112%**	L: 3	S: 49	-		-		95%	12	89%	7	-		-	
		B	28%	0	32%	0	82%	10	62%	1	**L: 119%**	R: 49%	L: 96	R: 4	L: 24%	R: 71%	L: 1	R: 3	70%	1	51%	1	L: 10%	**R: 102%**	L: 1	R: 18
		C	-	-	1%	0	L: 52%	SR: 59%	L: 4	SR: 3	21%	0	S: 68%	**R: 104%**	S: 11	R: 8	26%		-		46%	0	61%	2	-	
		D	-	-	0%	0	66%	4	20%	0	L: 62%	S: 53%	L: 4	S: 4					83%	2	0%	-				
		E	20%	0							L: 3%	R: 68%	L: 1	R: 6							40%	1				
		F	6%	0							S: 45%	R: 8%	S: 4	R: 1												

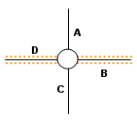
Junction 1 - Ingliston North



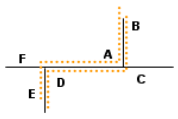
Junction 2 - Ingliston South



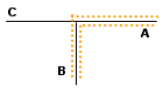
Junction 3 - Gogar Roundabout



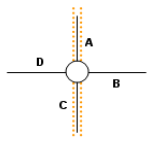
Junction 4 - South Gyle



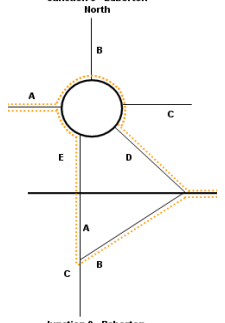
Junction 5 - Bankhead



Junction 6 - Bankhead Avenue



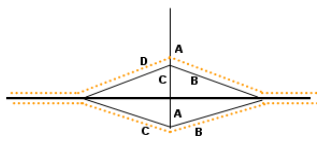
Junction 7 - Sighthill



Junction 9 - Baberton South

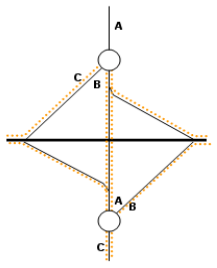
			Junction 10		Junction 11		Junction 12		Junction 13		Junction 14		Junction 15		Junction 16				Junction 17		Junction 18		Junction 19	
	Year	Arm	Max RFC	Max Queue	Max RFC	Max Queue	Max RFC	Max Queue	Max RFC	Max Queue	Max RFC	Max Queue	Max RFC	Max Queue	Max RFC		Max Queue		Max RFC	Max Queue	Max RFC	Max Queue	Max RFC	Max Queue
2009 / 2010	AM	A	-	-	-	-	89%	4	62%	1	42%	0	56%	1	-		-		0%	0	28%	0	64%	2
		B	-	-	L: 6%	R: 40%	L: 1	R: 1	51%	0	28%	0	55%	0	55%	1	L: 48%	R: 58%	L: 1	R: 2	-	-	0%	0	80%	4
		C	1%	0	-		-		73%	1	69%	1	-	-	73%	7	-		-		50%	2	46%	1	-	-
		D	L: 70%	R: 3%	L: 3	R: 0							48%	0	70%	4							40%	1		
		E											46%	0	52%	1										
		F																								
	PM	A	-	-	-	-	111%	37	73%	2	87%	3	68%	2	-		-		0%	0	61%	2	99%	21
		B	-	-	L: 1%	R: 64%	L: 0	R: 2	34%	0	35%	1	18%	0	65%	1	L: 102%	R: 103%	L: 13	R: 15	-	-	0%	0	69%	2
		C	1%	0	-		-		56%	1	48%	1	-	-	84%	9	-		-		99%	28	21%	0	-	-
		D	L: 60%	R: 5%	L: 2	R: 1							50%	0	82%	5							44%	1		
		E											42%	0	67%	1										
		F																								
2013 (ATC Growth Rates)	AM	A	-	-	-	-	98%	9	66%	1	47%	1	60%	1	-		-		0%	0	30%	0	69%	2
		B	-	-	L: 6%	R: 45%	L: 1	R: 1	54%	0	31%	0	62%	1	60%	1	L: 54%	R: 65%	L: 2	R: 2	-	-	0%	0	85%	5
		C	1%	0	-		-		81%	2	75%	2	-	-	78%	8	-		-		56%	2	50%	1	-	-
		D	L: 75%	R: 3%	L: 3	R: 0							51%	1	75%	5							44%	1		
		E											51%	0	57%	1										
		F																								
	PM	A	-	-	-	-	117%	53	76%	2	92%	5	70%	2	-		-		0%	0	65%	2	103%	35
		B	-	-	L: 1%	R: 67%	L: 0	R: 2	35%	0	38%	1	19%	0	68%	1	L: 108%	R: 109%	L: 17	R: 21	-	-	0%	0	72%	3
		C	1%	0	-		-		59%	1	51%	1	-	-	89%	11	-		-		104%	44	22%	0	-	-
		D	L: 63%	R: 6%	L: 2	R: 1							52%	1	86%	5							46%	1		
		E											45%	0	72%	3										
		F																								
2013 (TMfS Growth Rates)	AM	A	-	-	-	-	92%	5	63%	1	44%	1	57%	1	-		-		0%	0	28%	0	65%	2
		B	-	-	L: 6%	R: 41%	L: 1	R: 1	52%	0	29%	0	57%	1	57%	1	L: 50%	R: 60%	L: 1	R: 2	-	-	0%	0	81%	4
		C	1%	0	-		-		75%	1	71%	2	-	-	75%	7	-		-		52%	2	47%	1	-	-
		D	L: 71%	R: 3%	L: 3	R: 0							49%	1	72%	4							41%	1		
		E											48%	0	54%	1										
		F																								
	PM	A	-	-	-	-	122%	67	78%	2	96%	7	71%	2	-		-		0%	0	66%	2	105%	43
		B	-	-	L: 1%	R: 69%	L: 0	R: 3	36%	0	40%	1	21%	0	69%	1	L: 111%	R: 113%	L: 20	R: 25	-	-	0%	0	73%	3
		C	1%	0	-		-		61%	1	53%	1	-	-	91%	13	-		=		106%	53	22%	0	-	-
		D	L: 67%	R: 6%	L: 2	R: 1							53%	1	89%	6							47%	1		
		E											47%	0	75%	4										
		F																								

Junction 10 - Dreghorn North



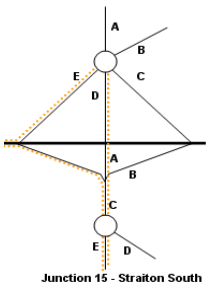
Junction 11 - Dreghorn South

Junction 12 - Lothianburn North



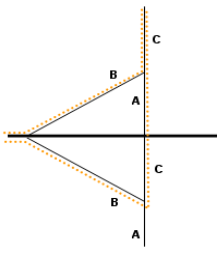
Junction 13- Lothianburn South

Junction 14 - Straiton North



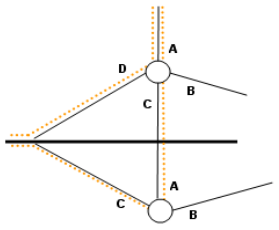
Junction 15 - Straiton South

Junction 16- Lasswade North



Junction 17 - Lasswade South

Junction 18- Gilmerton North



Junction 19- Gilmerton South

Maximum Queue Lengths are shown in vehicle per lane.

For Signalised Junctions, lane movements are indicated as follows:

- L: Left turn - S: Straight - R: Right turn

RFC numbers in red show arms that are over 85% (90% for traffic signal).

RFC numbers in **bold red** show arms that are over 100%

4.3 Impacts due to the EOBRT

4.3.1 Scott Wilson have been commissioned to carry out a separate study to develop the traffic engineering and preliminary designs for the introduction of the Edinburgh Orbital Bus Rapid Transit (EOBRT) Project[7]. This study is only looking at two sections of the whole route, namely the link between Lothianburn and Straiton Park-and-Ride sites and the on-street section from Baberton Junction to South Gyle Shopping Centre.

4.3.2 However, the traffic engineering has taken into account the capacity impacts on the highway network when the new BRT infrastructure is added onto the road network.

4.3.3 The junctions affected by the traffic engineering works include those at South Gyle, Bankhead, Sighthill, Lothianburn and Straiton. The measures introduced retain the existing capacity of the network for general traffic and accommodate buses by introducing additional flares/lanes or re-programming the settings of signal controlled junctions. The proposed alterations to the junctions examined to date to accommodate the EOBRT scheme have been tested with the new traffic engineering measures using TRANSYT.

4.3.4 Table 4.2 overleaf displays the results of the junction analysis taking into account the proposed traffic engineering measures.

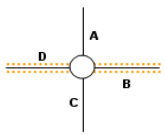
4.3.5 The results of the assessment have shown the proposals to accommodate the EOBRT do not impact significantly upon other road users at the opening year (2013) of the project. Clearly, however, this result is based on only the two sections of the whole proposed EOBRT route which have been designed to date. This result may change as further sections are developed.

[7] EOBRT Traffic Engineering and Preliminary Design, Scott Wilson Ltd, April 2010

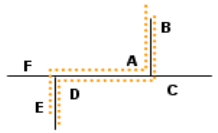
Table 4.2 Junction Capacity Analysis

2013 EOBRT (ATC and TMfS Growth Rates)

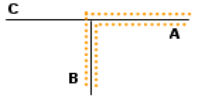
			Junction 4		Junction 5				Junction 6		Junction 7		Junction 12		Junction 13		Junction 14		Junction 15	
Year	Time	Arm	Max RFC	Max Queue	Max RFC		Max Queue		Max RFC	Max Queue	Max RFC	Max Queue	Max RFC	Max Queue	Max RFC	Max Queue	Max RFC	Max Queue	Max RFC	Max Queue
2013 (ATC Growth Rates) with EOBRT	AM	A	26%	0	L: 68%	S: 92%	L: 18	S: 12	26%	0	47%	1	95%	19	73%	5	41%	0	50%	18
		B	44%	0	L: 79%	R: 35%	L: 10	R: 6	27%	0	89%	7	46%	0	35%	2	43%	0	49%	2
		C	9%	0	S: 68%	R: 92%	S: 12	R: 13	13%	0	68%	2	67%	6	87%	7	-	-	65%	19
		D	**111%**	77	L: 43%	S: 13%	L: 2	S: 2			90%	9					72%	13	59%	7
		E			L: 1%	R: 45%	L: 0	R: 7									40%	4	52%	11
		F			S: 45%	R: 5%	S: 9	R: 0												
	PM	A	36%	0	L: 32%	**S: 135%**	L: 6	S: 84	40%	0	89%	7	**105%**	55	81%	9	84%	11	64%	15
		B	60%	1	**L: 140%**	R: 58%	L: 85	R: 11	21%	0	67%	2	31%	0	36%	1	13%	0	63%	8
		C	20%	0	S: 59%	R: 48%	S: 9	R: 5	14%	0	44%	1	63%	5	59%	2	-	-	77%	21
		D	20%	0	L: 42%	S: 36%	L: 2	S: 6			81%	4					71%	13	62%	6
		E			L: 1%	R: 43%	L: 0	R: 6									45%	5	58%	13
		F			S: 43%	R: 8%	S: 8	R: 1												
2013 (TMfS Growth Rates) with EOBRT	AM	A	25%	0	L: 53%	S: 88%	L: 10	S: 10	25%	0	42%	1	89%	13	69%	4	39%	0	47%	17
		B	42%	0	L: 76%	R: 25%	L: 8	R: 5	25%	0	84%	5	43%	0	32%	1	40%	0	47%	2
		C	9%	0	S: 52%	R: 87%	S: 11	R: 20	13%	0	63%	2	64%	6	82%	10	-	-	62%	18
		D	**106%**	45	L: 41%	S: 13%	L: 2	S: 2			85%	6					68%	13	56%	6
		E			L: 1%	R: 43%	L: 0	R: 6									37%	3	50%	10
		F			S: 43%	R: 5%	S: 9	R: 0												
	PM	A	37%	0	L: 28%	**S: 139%**	L: 4	S: 84	41%	0	95%	12	**119%**	93	77%	7	89%	13	66%	15
		B	62%	1	**L: 144%**	R: 48%	L: 90	R: 10	21%	0	70%	2	31%	0	37%	1	14%	0	65%	8
		C	21%	0	S: 47%	R: 49%	S: 10	R: 6	14%	0	46%	1	65%	5	60%	2	-	-	79%	24
		D	20%	0	L: 44%	S: 37%	L: 2	S: 6			83%	5					73%	14	64%	6
		E			L: 1%	R: 44%	L: 0	R: 6									47%	5	59%	13
		F			S: 44%	R: 8%	S: 8	R: 1												



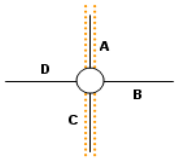
Junction 4 - South Gyle



Junction 5 - Bankhead

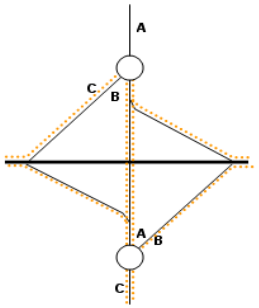


Junction 6 - Bankhead Avenue



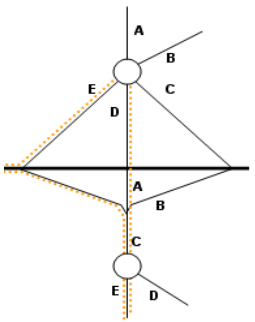
Junction 7 - Sighthill

Junction 12 - Lothianburn North



Junction 13- Lothianburn South

Junction 14 - Straiton North



Junction 15 - Straiton South

Maximum Queue Lengths are shown in vehicle per lane.

For Signalised Junctions, lane movements are indicated as follows:

- L: Left turn - S: Straight - R: Right turn

RFC numbers in red show arms that are over 85% (90% for traffic signal).

RFC numbers in **bold red** show arms that are over 100%

5.0 MERGE CAPACITY ANALYSIS

5.1 Methodology

5.1.1 Congestion analysis for on-slip merge ramps onto the A720 was undertaken using the process adopted in the SATURN (Simulation and Assignment of Traffic to Urban Road Networks) model[8]. SATURN is a suite of network analysis programs developed at the Institute for Transport Studies, University of Leeds since 1981.

5.1.2 SATURN estimates the merge delay for traffic entering a downstream link from a slip road using formula from COBA:

$$d1 = 227 (V/C - 0.75) \qquad \text{(Equation 1)}$$

where d1 = merge delay (seconds per vehicle);
V = volume of traffic on the downstream link; and
C = link capacity downstream.

5.1.3 The formula holds for all values of V, including V > C. Note the formula works for ranges of V/C greater than 0.75. Ranges of V/C less than 0.75 are assumed to have zero delay.

5.1.4 The affects of additional queuing delay (i.e. delay caused by oversaturated conditions) is added to the initial estimate obtained from Equation 1 above. Hence, if the total traffic on the downstream link (V) exceeds the capacity of the downstream link (C) the oversaturated queuing delay is calculated as follows:

$$d2 = T/2 (V/C - 1) \qquad \text{(Equation 2)}$$

where d2 = oversaturated delay (seconds per vehicle); and
T = unit time period.

5.1.5 In situations where V > C the total delay is d1 plus d2.

5.2 Merges/Diverges Capacity Analysis Results

5.2.1 The results of the analysis for 2009/2010 and the assumed Opening Year of 2013 are shown in Table 5.1 overleaf. The analysis has been carried out for both the observed (ATC) and TMfS traffic growth rates. The results suggest that a number of merge junctions along the A720 are already experiencing significant delays in 2009/2010. These include:

- Baberton – eastbound (AM and PM periods);
- Dreghorn – eastbound (PM only) and westbound (AM and PM periods); and
- Lothianburn – westbound (AM period and to a lesser extent PM period).

5.2.2 As expected, levels of congestion worsen in 2013. The delays for some of the junctions increase significantly and clearly these results would worsen in future years beyond 2013.

5.2.3 In addition to the above analysis, SEStran has undertaken its own speed surveys along parts of the route. They have prepared a brief report with commentary on the operating conditions and driver behaviour observed in the course of their surveys[9]. One of the key conclusions in the SEStran report is that the traffic demand on the A720 exceeds the capacity of route and that capacity, at least in the peak periods, is dictated by the capacity of the merge points[10].

[8] SATURN User Manual – Version 10.9, Institute for Transport Studies, University of Leeds, November 2009
[9] Edinburgh Orbital Bus – A720 Speed Surveys, Internal Report, SEStran, May 2010
[10] Paragraph 3.4 of the SEStran Report (Edinburgh Orbital Bus – A720 Speed Surveys)

Figure 5.1 Merge Analysis

				2009/2010					2013 (ATC Growth)						2013 (TMfS Growth)					
			Ramp	Mainline Flows	Slip Flows	Merge Delay (s)	Over Sat Delay (s)	Total Delay (s)	Mainline Flows	Slip Flows	Merge Delay	Over Sat Delay	Total Delay	Ratio of Delay	Mainline Flows	Slip Flows	Merge Delay	Over Sat Delay	Total Delay	Ratio of Delay
AM Peak	**Baberton**	E/b	On	2903	415	60	25	85	3106	444	76	153	229	2.70	2961	423	64	61	126	1.48
	Dreghorn	E/b	On	2929	259	51	0	51	3134	277	66	76	142	2.80	2988	264	55	0	55	1.09
		W/b	On	3022	870	100	341	440	3234	931	119	490	609	1.38	3082	887	105	383	489	1.11
	Lothianburn	E/b	On	2050	386	0	0	0	2194	413	11	0	11	-	2091	394	2	0	2	-
		W/b	On	2828	720	76	151	227	3026	770	93	288	381	1.68	2885	734	81	190	271	1.19
	Straiton	E/b	On	2267	324	9	0	9	2426	347	22	0	22	2.33	2312	330	13	0	13	1.38
		W/b	On	2539	565	45	0	45	2717	605	60	27	87	1.93	2590	576	49	0	49	1.10
	Lasswade	W/b	On	2675	416	44	0	44	2862	445	59	19	78	1.77	2729	424	48	0	48	1.10
	Gilmerton	W/b	On	1950	329	0	0	0	2087	352	0	0	0	-	1989	336	0	0	0	-
PM Peak	**Baberton**	E/b	On	2941	688	81	196	277	3059	716	92	276	367	1.32	3147	736	99	336	435	1.57
	Dreghorn	E/b	On	3,305	287	79	176	254	3437	298	89	255	343	1.35	3536	307	96	314	410	1.61
		W/b	On	3,046	456	73	126	199	3168	474	82	203	286	1.44	3259	488	90	261	351	1.76
	Lothianburn	E/b	On	2700	457	49	0	49	2808	475	57	6	63	1.30	2889	489	64	58	122	2.50
		W/b	On	2576	725	59	16	74	2679	754	68	88	156	2.10	2756	776	75	143	217	2.93
	Straiton	E/b	On	2665	486	48	0	48	2772	505	57	2	59	1.23	2852	520	64	54	118	2.44
		W/b	On	2104	778	30	0	30	2188	809	38	0	38	1.27	2251	832	44	0	44	1.47
	Lasswade	W/b	On	2214	462	15	0	15	2303	480	23	0	23	1.48	2369	494	28	0	28	1.85
	Gilmerton	W/b	On	1822	521	0	0	0	1895	542	0	0	0	-	1950	557	4	0	4	-

5.3 Impacts due to the EOBRT

5.3.1 Scott Wilson have been commissioned to carry out a separate study to develop the traffic engineering and preliminary designs for the introduction of the Edinburgh Orbital Bus Rapid Transit (EOBRT) Project[11]. This study is only looking at two sections of the whole route, namely the link between Lothianburn and Straiton Park-and-Ride sites and the on-street section from Baberton Junction to South Gyle Shopping Centre.

5.3.2 However, the traffic engineering has taken into account the capacity impacts on the highway network when the new EOBRT infrastructure is added onto the road network. In terms of merge capacity issues the proposed designs for introducing the EOBRT on the two sections designed to date has suggested there are no changes to the results shown in Table 5.1 above. This is because the designs examined to date are providing additional separate lanes for the EOBRT at key junctions affected by the new scheme. Since there is not a reduction in the current provision of road space for other road users there is no impact to them.

5.3.3 Clearly, however, this is based on only the two sections of the whole proposed EOBRT route which have been designed to date. This result may change as further sections are developed.

[11] EOBRT Traffic Engineering and Preliminary Design, Scott Wilson Ltd, April 2010

6.0 OBSERVED SPEED

6.1 Journey Time Surveys

6.1.1 A number of journey time surveys were undertaken between the 25th and 26th of January 2010, during the AM and PM Peak periods. These were carried out along the A720 Bypass, generally between Sheriffhall roundabout and the junction between Calder Road and the A720. This involved observation vehicles driving back and forth along the A720, moving with the general speed of the traffic flows.

6.1.2 The resulting speed measurements from these journey time surveys are shown in Figure 6.1 to 6.4, for AM and PM Peaks and per direction.

6.1.3 The journey time surveys show that congestion on the A720 Bypass has a direct impact on vehicle speed, with traffic moving generally between 40 and 60mph instead of the 70mph limitation.

6.1.4 However, some sections of the Bypass are more seriously impacted and show lesser speeds, particularly the section between Gilmerton and Dreghorn during the AM Peak in the westbound direction.

Figure 6.1 – A720 Speed Survey (AM Peak, Westbound)

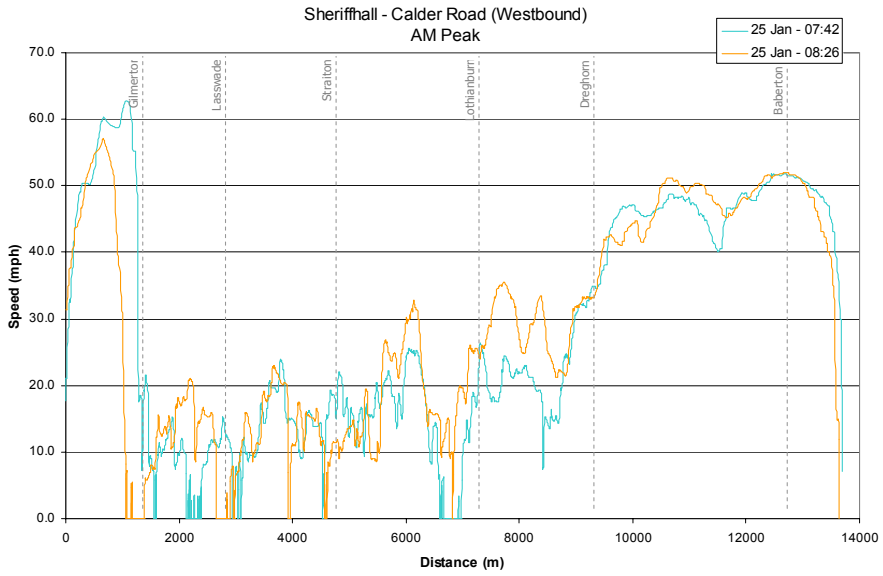


Figure 6.2 – A720 Speed Survey (AM Peak, Eastbound)

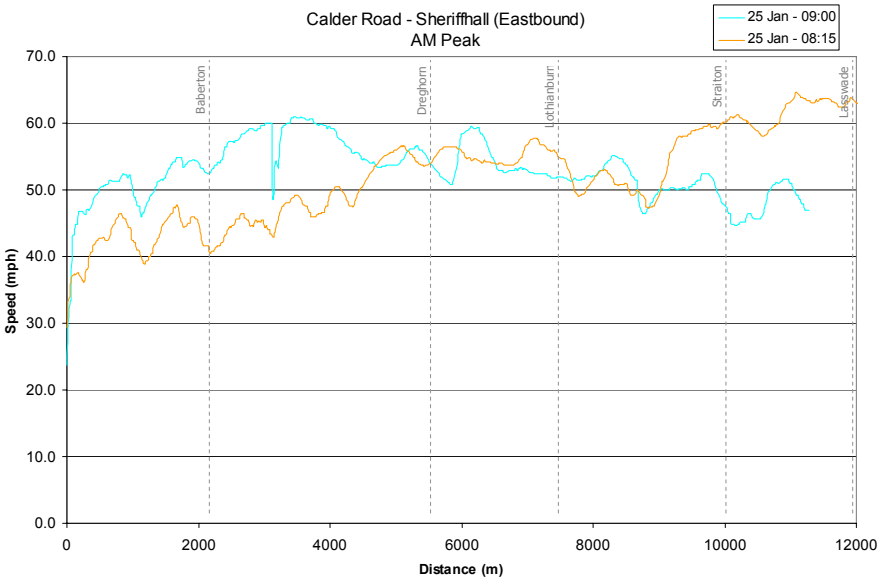


Figure 6.3 – A720 Speed Survey (PM Peak, Westbound)

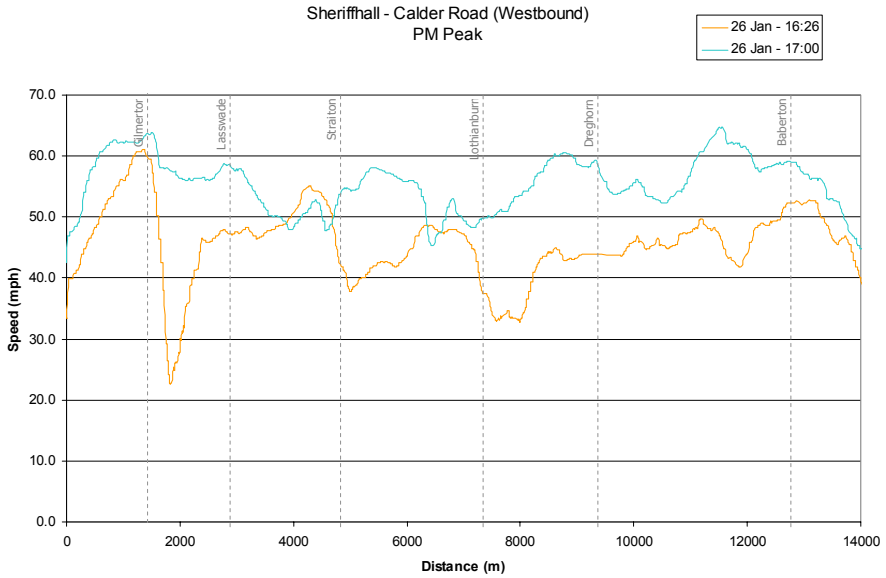
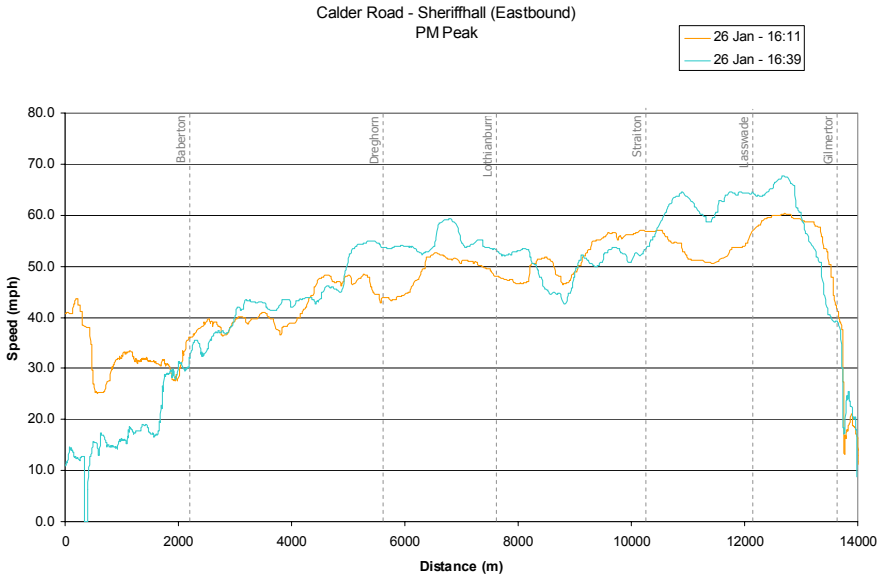


Figure 6.4 – A720 Speed Survey (PM Peak, Eastbound)



6.2 Historic Speed Observations

6.2.1 In addition to the new journey time surveys, we have also analysed observed speed data from the ATC sites along the A720, which provided information over longer periods of time. The 5-day average values were used, in order to smooth out the effect of any abnormal incidents on the bypass.

6.2.2 Values recorded from the ATCs during January 2010 were first used to compare against the journey time surveys undertaken on the Bypass, as detailed in the previous section. These are shown on Figure 6.5 and 6.6 below, respectively for Eastbound and Westbound Flows.

Figure 6.5 – A720 ATC Speed (January 2010, Eastbound)

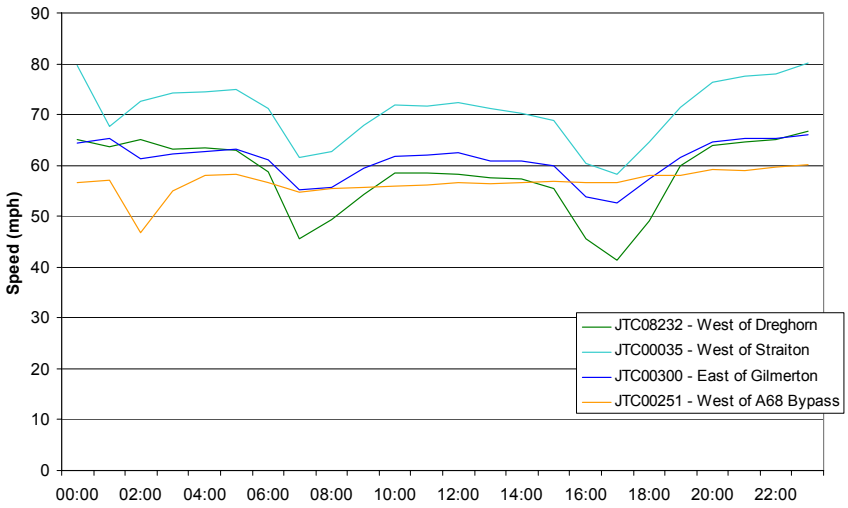
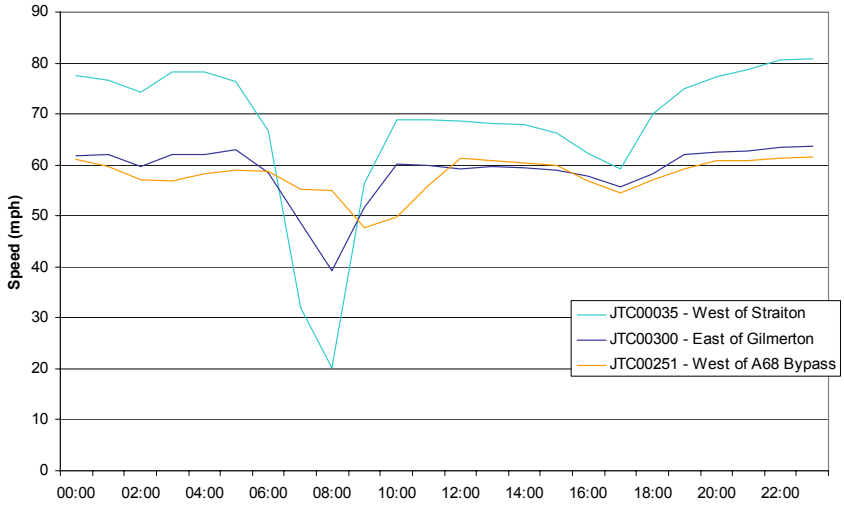


Figure 6.6 – A720 ATC Speed (January 2010, Westbound)



6.2.3 The above figures corroborate the journey time surveys results, with speeds considerably lower during the AM and PM Peaks than during the rest of the day. As observed in Section 6.1, traffic speed is mostly impacted during the AM Peak in the westbound direction, with average speeds down to 40mph to the east of Gilmerton and 20mph to the west of Straiton.

6.2.4 The 5-day average values over November 2009 were then analysed to correspond with the traffic surveys used in this study report. These are shown in Figures 6.7 and 6.8 overleaf.

Figure 6.7 – A720 ATC Speed (November 2009, Eastbound)

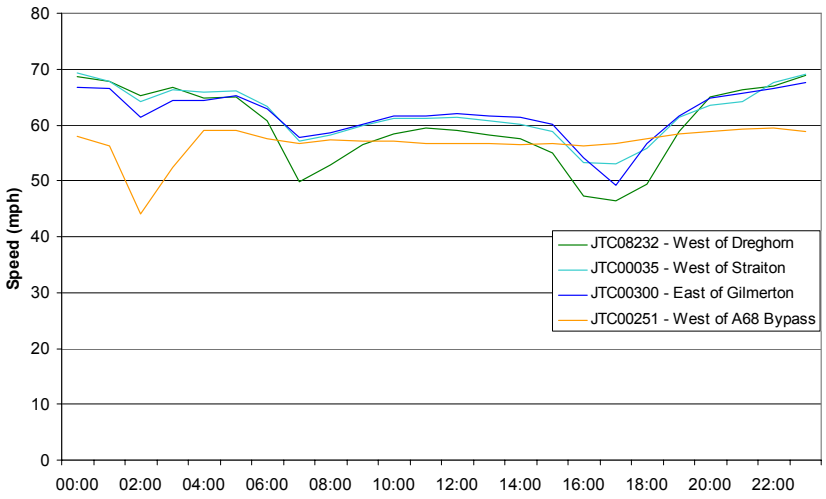
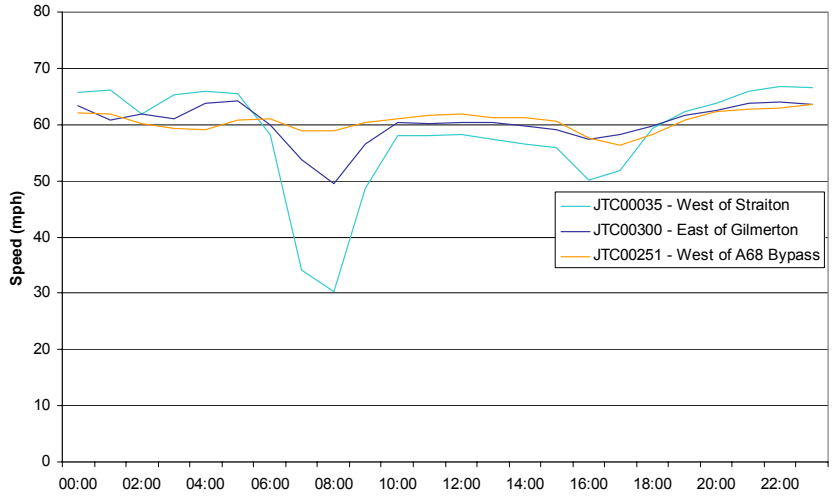


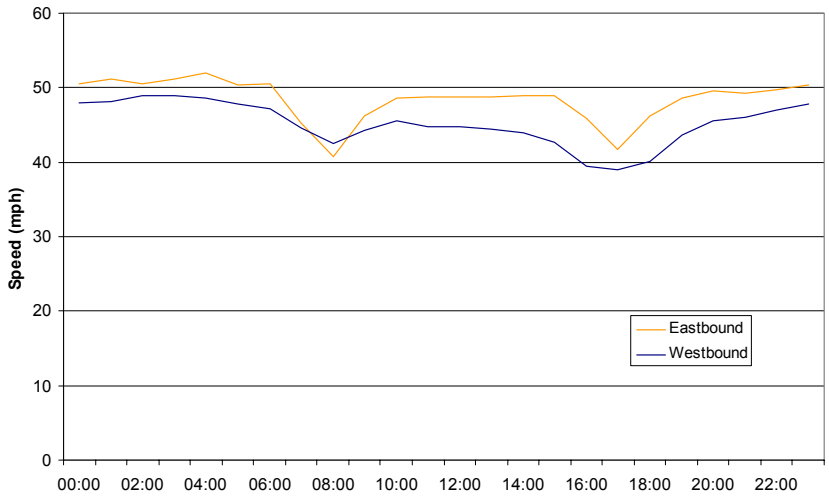
Figure 6.8 – A720 ATC Speed (November 2009, Westbound)



6.2.5 The results for November 2009 are similar to those for January 2010 and further confirm the findings from the journey time surveys along the route of the EOBRT, with traffic slower during the peak hours and particularly during the AM peak in the westbound direction.

6.2.6 In addition, speed measurements from temporary ATC Site 2 on the A8 were also analysed, and the results are illustrated on Figure 6.9.

Figure 6.9 – A8 West of RBS – ATC Speed (November 2009)



6.2.7 The results show a similar pattern as on the A720 with speed reduced during peak hours. However, the decrease in speed stays at a reasonable level, with a minimum of circa 40mph during the PM Peak.

7.0 CONCLUSIONS AND RECOMMENDATIONS

7.1 Concluding Remarks

7.1.1 The previous chapters of this report have detailed the effect of traffic congestion along key areas of the A720 on the operation of the proposed EOBRT. This chapter summarises the main conclusions and issues for each segment of the scheme (the segments forming parts of the EOBRT route were defined in the Outline Implementation Programme[12]).

Segment 1 – Edinburgh Airport to Gogar Roundabout

7.1.2 This section of the EOBRT route experiences high levels of traffic in the current situation. Some congestion occurs, mostly on the A8 in the eastbound direction during the AM peak, with the situation deteriorating in the future. However, ATC data shows that traffic speed stays at a reasonable level even during peak hours.

7.1.3 In terms of junction capacity, the two roundabouts at the Ingliston interchange operate satisfactorily.

Segment 2 – Gogar Roundabout to Baberton Junction

7.1.4 The first part of segment 2 (e.g. from Gogar roundabout to the Gyle Shopping Centre / Edinburgh Park roundabout) experiences very tidal flows of traffic, with link congestion occurring in the westbound direction in the AM peak and in the eastbound direction in the PM peak.

7.1.5 As a result, both roundabouts suffer from delays on their eastern approaches in the morning. Conditions are however acceptable during the evening peak hour.

7.1.6 Further east, link congestion also occurs eastbound from the Gyle Shopping Centre / Edinburgh Park roundabout during the evening peak.

7.1.7 Regarding subsequent intersections in this segment, the signalised junction at Bankhead is already significantly congested, especially during the PM peak and this is expected to worsen in the future with significant queuing occurring. Similarly, the roundabout at Sighthill is currently close to capacity, and is then over capacity in both 2013 scenarios. The eastbound on ramp at Baberton also experiences some delays in the 2013 scenarios.

Segment 3 – Baberton Junction to Lothianburn

7.1.8 This section of the EOBRT route runs along a portion of the A720 which currently experiences significant levels of congestion during the peak periods. Links are above capacity during the AM and PM peaks in both direction, and the situation is forecasted to worsen by 2013.

7.1.9 This translates to reduced speeds, particularly between Dreghorn and Lothianburn, during the AM peak where traffic is considerably slowed down in the westbound direction.

7.1.10 These high levels of traffic also impact on the operation of the on-ramps at the Lothianburn interchange in the westbound direction, which experiences delays during both AM and PM peak hours.

[12] EOBRT Project – Outline Implementation Programme and Updated Business Case Analysis, Scott Wilson, September 2009

7.1.11 The access roundabouts at the Lothianburn interchange do not show any significant congestion from the A720 off-ramp. However, some queuing occurs on the A702 northern approach to the interchange, which becomes substantial in the afternoon peak.

7.1.12 The A702 southern approach capacity analysis does not show any noticeable delay on this arm. However, on-site observations at this junction showed that some queuing occurs during the AM peak. It can therefore be assumed that the Arcady software used in this analysis is not precise enough to pick up some nuances that might impact on the operation of this junction. It is recommended that this should be inspected later by more on-site visits.

Segment 4 – Lothianburn to Straiton

7.1.13 Segment 4 of the EOBRT route is also heavily congested, with the A720 Bypass being over-capacity and speed greatly reduced during peak hours, particularly in the westbound direction. Similarly, this impacts on the operation of the Straiton Interchange.

7.1.14 Regarding junction capacity, no significant delay occurs in current conditions although the westbound exit from the Bypass is slightly over capacity. This gets worse in the future but queue lengths remain within reasonable levels.

Segment 5 – Straiton to Gilmerton

7.1.15 Segment 5 has congestion issues between Straiton and Lasswade in the westbound direction during the AM peak and eastbound in the PM peak. Travelling further east the flows and capacity decrease leading to less congestion impacts.

7.1.16 With regards to the junctions in this section Lasswade North, South and Gilmerton South show capacity issues in the 2009/2010 PM peak with Lasswade North exceeding 100%. In the 2013 scenarios these problems increase with Lasswade and Gilmerton South also exceeding 100% on some arms.

7.2 Recommendations

7.2.1 The following recommendations are suggested:

- further consideration should be given to including sections up to Gilmerton in Phase 1 of the EOBRT Project, due to the results of the above capacity analysis;
- the section between Lothianburn and Straiton should be included in the design works for Phase 1;
- the section between Gogar roundabout and Baberton junction should be progressed to design stage; and
- the results of this study should be discussed with Transport Scotland and the relevant Local Authorities.

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