South Bristol Link
Forecasting Report

April 2013

Plan Design Enable

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1. Introduction

1.1. Background

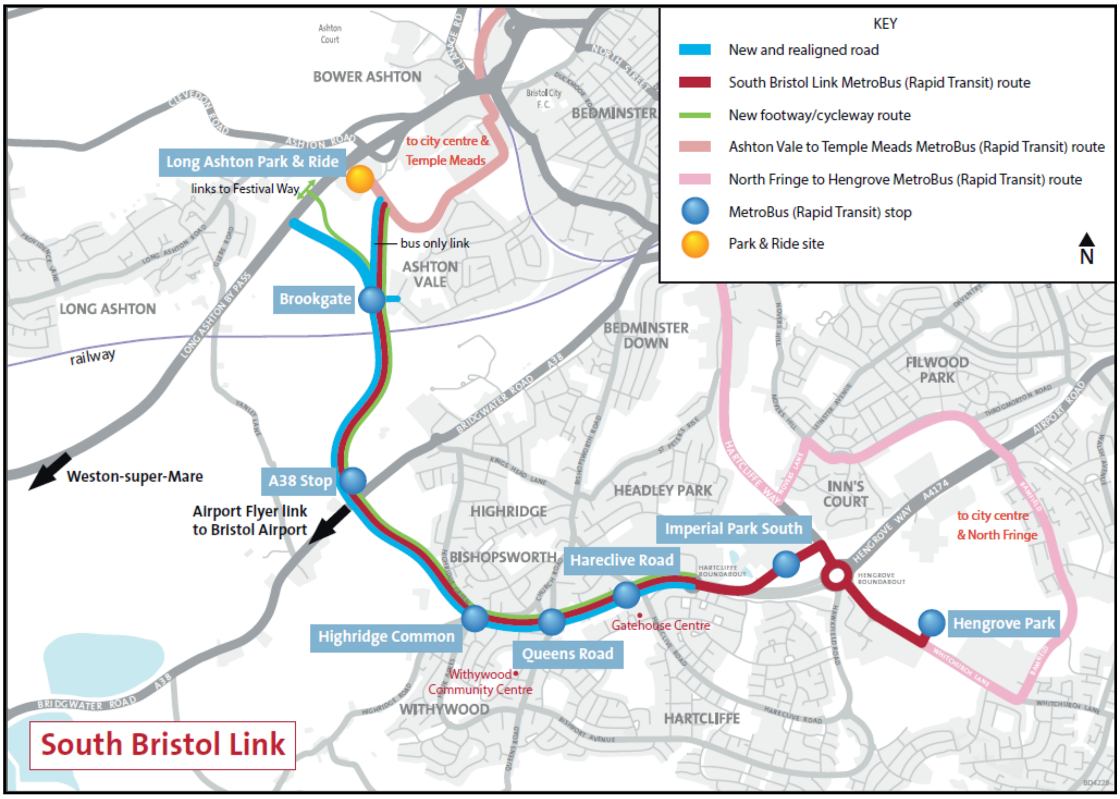
1.1.1. The West of England (WEPO) Partnership Organisation local authorities: Bath and North East Somerset (B&NES), Bristol City (BCC), North Somerset (NSC) and South Gloucestershire Council (SGC) are delivering the South Bristol Link (SBL), a major transport scheme to address current and future transport problems in the south Bristol area. Atkins was appointed in April 2010 to undertake Lot 1 – Environmental Impact, of the South Bristol Link package, promoted by North Somerset Council (NSC).

1.2. The Scheme

1.2.1. The proposed development comprises the construction of a section of highway 4.5 kilometres in length from the A370 Long Ashton bypass within North Somerset to the Hartcliffe (Cater Road) Roundabout within the Bishopsworth area of South Bristol. This incorporates the minor realignment of sections of existing highway at Highridge Green, King George's Road and Whitchurch Lane. The entire route is to be classed as an Urban All-Purpose Road (UAP) in accordance with TA 79/99.

1.2.2. The route includes the construction of new junctions with the A370, Brookgate Road, A38, Highridge Road, Queens Road and Hareclive Road. New bridges will be constructed to cross Ashton Brook, Colliter's Brook and to pass under the Bristol to Taunton Railway Line. The route corridor will incorporate a bus-only link to connect with the Ashton Vale to Temple Meads (AVTM) spur into the Long Ashton Park and Ride site, and dedicated bus lanes between the railway and the new A38 roundabout junction. New bus stops and shelters, and a continuous shared cycleway and footway will be provided along the route corridor. Associated proposals include drainage facilities, landscaping and planting.

Figure 1 – SBL Scheme



1.2.3. The route will form part of the West of England rapid transit network (Metro Bus) and will be used by buses and other motorised vehicles. The route will link with the AVTM at the Long Ashton Park and Ride site, and within the South Bristol section, once buses have reached the Hartcliffe

Roundabout, services will follow existing roads via Hengrove Way to Imperial Park and onwards to Whitchurch Lane and Hengrove Park.

1.3. SBL Modelling System

1.3.1. The SBL modelling system was developed to represent travel conditions in 2012 and consists of three key elements:

- a Highway Assignment Model (HAM) representing vehicle-based movements across the Greater Bristol Area for a 2012 March weekday morning peak hour (08:00 – 09:00), an average inter-peak hour (10:00 – 16:00) and an evening peak hour (17:00 – 18:00);
- a Public Transport Assignment Model (PTAM) representing bus and rail-based movements across the same area and for the same time periods, month and year; and
- a five-stage multi-modal incremental Demand Model that estimates frequency choice, main mode choice, time period choice, destination choice, and sub mode choice in response to changes in generalised costs of travel across the 24-hour period (07:00 – 07:00).

1.4. Forecasting Approach

Transport Appraisal Guidance

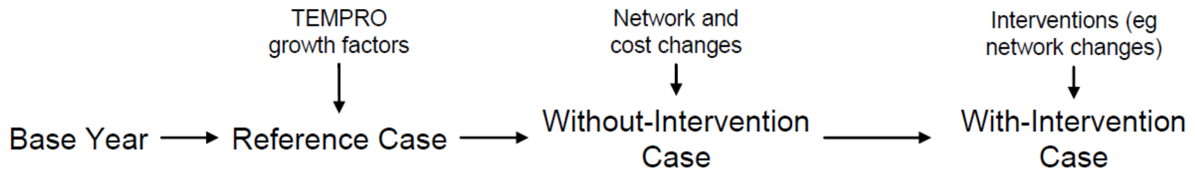
1.4.1. The SBL forecasting methodology closely follows the current DfT’s Transport Appraisal Guidance (TAG), in particular:

- TAG Unit 3.1.2 – Transport Models (June 2005);
- TAG Unit 3.5.6 – Values of Time and Vehicle Operating Costs (April 2011);
- TAG Unit 3.10.1 - Variable Demand Modelling (October 2009);
- TAG Unit 3.10.2 – Variable Demand Modelling - Scope of the Model (April 2011);
- TAG Unit 3.10.3 – Variable Demand Modelling - Key Processes (October 2009);
- TAG Unit 3.10.4 – Variable Demand Modelling – Convergence Realism and Sensitivity (April 2011);
- TAG Unit 3.15.1 – Forecasting Using Transport Models (April 2011);
- TAG Unit 3.15.2 - Use of TEMPRO Data (April 2011); and
- TAG Unit 3.15.5 – The Treatment of Uncertainty in Model Forecasting (April 2011).

Methodology

1.4.2. The general approach is summarised below in Figure 2 whereby the forecasting process commences with the development of the reference case by updating demand factors to each forecast year being appraised and producing a forecast on the basis of unchanged costs. The supply-side factors are then updated (i.e. network changes and difference cost assumptions) and the reference case forecast is modified iteratively until demands and costs are consistent. Once achieved there is a sound basis for the ‘with and without intervention’ scenarios to be tested.

Figure 2 - Forecasting Methodology



Source: TAG Unit 3.15.1 Figure 2

Forecast Years

1.4.3. Nationally concistent planning data forecasts are available for the period 2001 to 2031 from the Department for Transport's National Trip End Model and accessed via the TEMPRO software program.

1.4.4. Local planning data were available from the West of England Partnership for specific five-year periods from 2012 onwards (i.e. 2012 – 2016) which also matched the time horizons for various local transport plans. Therefore, the choice of forecast years was constrained to five yearly intervals (i.e. 2016, 2021, 2026 and 2031).

1.4.5. The SBL modelling system was developed to represent a 2012 base year with two forecast years – 2016 and 2031 - selected to support the appraisal of the SBL scheme. The 2016 forecast year was selected as an appropriate opening year forecast for the SBL scheme (due to commence operation in 2014/5) with the 2031 forecast year represents the design year.

1.5. Scope of Report

1.5.1. This structure of this Forecasting Report follows that outlined in Figure 2; following this introductory section:

- Section Two describes the development of the reference case;
- Section Three summarises the changes in the generalised cost assumptions over time;
- Section Four presents the Without Intervention case;
- Section Five describes the With Intervention case (i.e. the SBL scheme); whilst
- A summary of the SBL forecasts is presented in Section Six.

2. Developing the Reference Case

2.1. Introduction

2.1.1. The reference case was developed from the base year case by taking into account the growth in demand arising from changes in demographics and macro-economic factors between the 2012 base year and 2016/31 forecast years. The forecast growth in travel demand is described in more detail within this section.

2.2. Growth in Demand

2.2.1. TAG Unit 3.15.2, para 5.7.8 states that the forecast trip end growth should be consistent with TEMPRO at the study area level, in order to allow consistency between different parts of the country when justifying transport proposals, as well as reducing the risk of optimism bias.

2.2.2. Accordingly, the growth in demand between the base year and the forecast years were derived using two datasets:

- Central Government forecasts provided by TEMPRO v6.2 dataset; and
- Local planning data provided by the West of England Partnership including the indentified development sites within the sub-region.

2.2.3. The trip end growth was controlled to TEMPRO growth forecasts at the study area level within the West of England sub-region and distributed within each TEMPRO district on the basis of the more detailed local planning data. Outside the West of England sub-region, TEMPRO growth was applied directly.

2.2.4. The development of the reference case trip ends was undertaken in the following six steps:

1. determine the growth in forecast trip-ends projected by TEMPRO for the UK and the sub-region between the base and the forecast years;
2. apply the TEMPRO growth to the base year trip ends at the TEMPRO district level;
3. within the West-of-England sub-region, redistribute the forecast growth in trip ends using more detailed planning data provided by the local authorities;
4. produce forecast year demand matrices by furnessing the existing base demand matrices to match the forecast trip ends (including adjustments for the existing brownfield and greenfield development sites);
5. segment the forecast year demand matrices by mode and time period using base year proportions (including adjustments for the existing brownfield and greenfield development sites); and
6. finally, control the resulting demand matrices to the growth in TEMPRO trip ends to ensure consistency with the sub-regional and national forecasts.

2.2.5. Further details of each stage in the process are provided below.

Step 1 - TEMPRO Growth Forecasts

2.2.6. The growth forecasts were calculated using TEMPRO (version 6.2) to extract data from the National Trip End Model (NTEM) version 6.2 dataset published by the Department for Transport in April 2011.

2.2.7. Table 1 summarises the overall population and household projections for the West of England sub-region for the base year (2012) and the 2016 and 2031 forecast years. TEMPRO forecasts that the population will increase by approximately 3% between 2012 and 2016 with a 4% increase in the number of households (due to a reduction in the average household size over this period). The projected growth in the population between 2012 and 2031 is around 14% with the number of households increasing by 16%.

Table 1. Population and Household Growth Forecasts (2012 - 2016/31)

Authority	Population			Households		
	2012	**2016**	**2031**	**2012**	**2016**	**2031**
Bath & NE Somerset	174469	179,739	192,676	76896	80,458	88,166
Bristol City	424764	435,922	482,240	188356	194,306	212,851
North Somerset	203895	209,670	237,340	90372	93,678	105,845
South Gloucestershire	261222	270,723	300,758	110005	115,839	132,288
West of England Sub-Region	**1064350**	**1,096,054**	**1,213,014**	**465628**	**484,281**	**539,150**
%Change from 2012						
Bath & NE Somerset		3.0%	10.4%		4.6%	14.7%
Bristol City		2.6%	13.5%		3.2%	13.0%
North Somerset		2.8%	16.4%		3.7%	17.1%
South Gloucestershire		3.6%	15.1%		5.3%	20.3%
West of England Sub-Region		**3.0%**	**14.0%**		**4.0%**	**15.8%**

Source: TEMPRO / NTEM v6.2 Dataset

2.2.8. Table 2 summarises the overall growth in employment for the West of England sub-region for the base year (2012) and the 2016 and 2031 forecast years. TEMPRO forecasts that employment will increase by approximately 5% between 2012 and 2016 and by 17% by 2031.

Table 2. Employment Growth Forecasts (2012 – 2016/31)

Authority	2012	2016	2031
Bath & NE Somerset	89,341	93,137	102,748
Bristol City	209,789	221,587	256,970
North Somerset	90,315	95,339	106,127
South Gloucestershire	168,366	177,931	188,622
West of England Sub-Region	**557,812**	**587,994**	**654,467**
%Change from2012			
Bath & NE Somerset		4.2%	15.0%
Bristol City		5.6%	22.5%
North Somerset		5.6%	17.5%
South Gloucestershire		5.7%	12.0%
West of England Sub-Region		5.4%	17.3%

Source: TEMPRO / NTEM v6.2 Dataset

2.2.9. Table 3 summarises the overall growth in car ownership in the West of England sub-region between the base year (2012) and the 2016 and 2031 forecast years. TEMPRO forecasts that the total number of cars owned will increase by approximately 36,700 vehicles (+6%) between 2012 and 2016 and by nearly 130,000 vehicles (22%) by 2031. The projected growth in car ownership is higher than the growth of the number of households of 4% and16% for 2016 and 2031, respectively (Table 1).

Table 3. Change in Car Ownership in West of England Sub-Region (2012 – 2016/31)

Authority / Year		Cars Per Household				
		No Car	1 Car	2 Cars	3+ Cars	Total
2012	Bath & NE Somerset	13,288	36,724	21,095	5,789	97,440
	City of Bristol	43,126	94,088	40,917	10,227	208,647
	North Somerset	12,830	42,031	27,936	7,578	122,152
	South Gloucestershire	11,907	50,938	36,827	10,332	157,654
	Total	81,151	223,780	126,775	33,925	585,891
2016	Bath & NE Somerset	12,881	38,812	22,509	6,257	103,852
	City of Bristol	40,703	98,090	44,179	11,334	222,717
	North Somerset	12,335	43,946	29,346	8,054	128,411
	South Gloucestershire	11,825	53,814	39,040	11,162	167,612
	Total	77,744	234,662	135,074	36,807	622,592
2031	Bath & NE Somerset	12,888	42,797	25,209	7,272	116,485
	City of Bristol	39,493	106,324	52,279	14,755	258,098
	North Somerset	12,661	49,396	33,811	9,974	148,935
	South Gloucestershire	12,975	62,092	44,133	13,084	192,227
	Total	78,017	260,609	155,432	45,085	715,745
% Change from 2012 by 2016	Bath & NE Somerset	-3.1%	5.7%	6.7%	8.1%	6.6%
	City of Bristol	-5.6%	4.3%	8.0%	10.8%	6.7%
	North Somerset	-3.9%	4.6%	5.0%	6.3%	5.1%
	South Gloucestershire	-0.7%	5.6%	6.0%	8.0%	6.3%
	Total	-4.2%	4.9%	6.5%	8.5%	6.3%
% Change from 2012 by 2031	Bath & NE Somerset	-3.0%	16.5%	19.5%	25.6%	19.5%
	City of Bristol	-8.4%	13.0%	27.8%	44.3%	23.7%
	North Somerset	-1.3%	17.5%	21.0%	31.6%	21.9%
	South Gloucestershire	9.0%	21.9%	19.8%	26.6%	21.9%
	Total	-3.9%	16.5%	22.6%	32.9%	22.2%

Source: TEMPRO / NTEM v6.2 Dataset

2.2.10. Table 4 summarises the overall growth in trip ends for the West of England sub-region for the base year (2012) and the 2016 and 2031 forecast years. TEMPRO forecasts that the total trip ends will increase by approximately 4% between 2012 and 2016 and by 16/19% by 2031.

Table 4. Forecast Growth in Trip Ends (2012 – 2016/31)

Authority	2012		2016		2031	
	Production	Attraction	Production	Attraction	Production	Attraction
Bath & NE Somerset	233,493	252,252	242,324	261,313	263,323	293,280
Bristol City	538,004	509,715	561,385	530,048	632,464	612,030
North Somerset	266,334	257,990	275,874	272,006	311,459	314,306
South Gloucestershire	368,010	411,230	384,513	434,848	424,371	481,312
West of England Sub-Region	**1,405,841**	**1,431,188**	**1,464,096**	**1,498,215**	**1,631,618**	**1,700,929**
%Change from 2012						
Bath & NE Somerset			4%	4%	13%	16%
Bristol City			4%	4%	18%	20%
North Somerset			4%	5%	17%	22%
South Gloucestershire			4%	6%	15%	17%
West of England Sub-Region			**4%**	**5%**	**16%**	**19%**

Source: TEMPRO / NTEM v6.2 Dataset

2.2.11. The TEMPRO growth forecasts for the sub-region were calculated separately for each of the five purposes (i.e. home-based work, home-based other, home-based employers business, non-home based other and non-home based employers business) and also by car availability (i.e. car available and non car available groups).

Step 2 - Applying the TEMPRO Growth

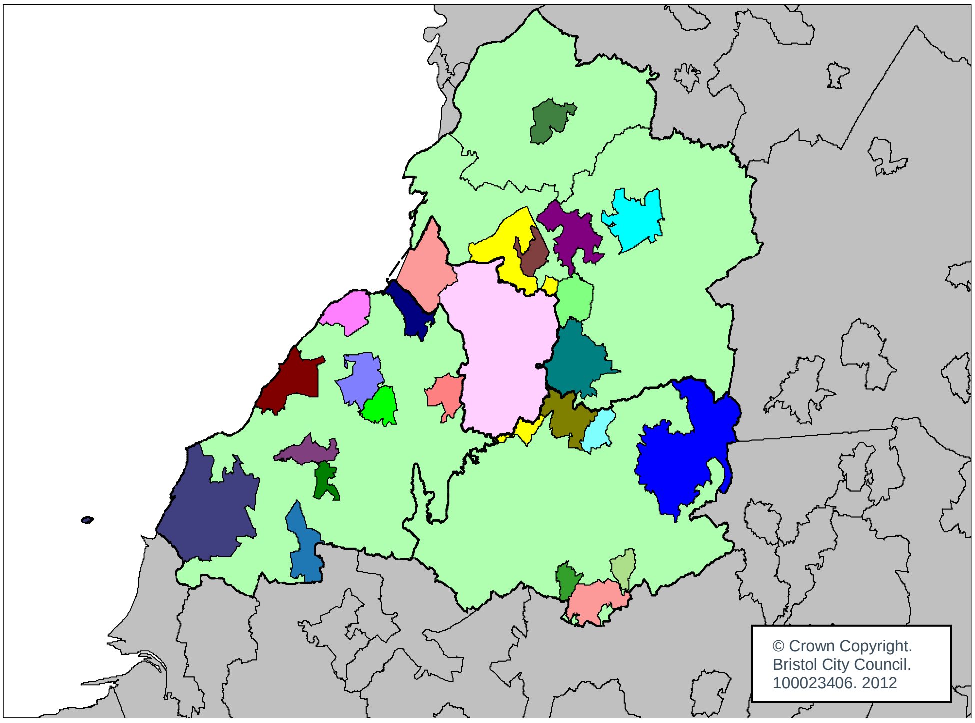
2.2.12. The TEMPRO growth was applied to the base year trip ends at the TEMPRO zone level using the following process:

- aggregate 2012 base year production / attraction (P/A) demand matrices over all modes and time periods to produce the 24-hour base production and attraction trip ends (PA_base);
- extract the equivalent all-day and all-modes trip ends from TEMPRO for the 2012 base year (TEMPRO_base) and the 2016 and 2031 forecast year trip ends (TEMPRO_future) at the TEMPRO district level; and
- calculate the growth in all-day and all-modes trip ends for the 2016 and 2031 forecast years by purpose and by car availability (PA_Future_background), by applying TEMPRO growth factors to base P/A trip ends at an TEMPRO zonal level:

*PA_Future_background = PA_base * (TEMPRO_future / TEMPRO_base)*

2.2.13. The 600 SBL model zones were aggregated to the TEMPRO zones as shown below in **Error! eference source not found.**3 to enable the projected growth to be applied to the base year trip ends.

Figure 3 - TEMPRO Zones in West of England Sub-Region



Step 3 – Using Local Planning Data

Development Sites

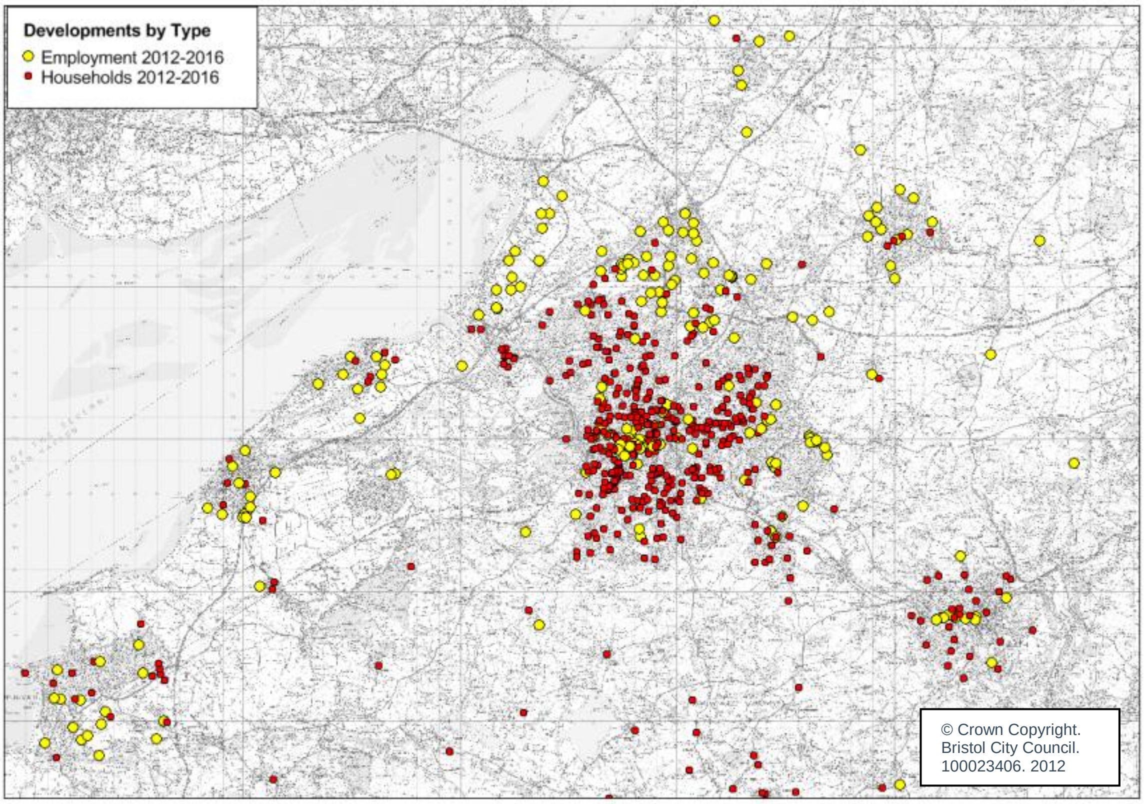
2.2.14. The West of England Partnership provided information regarding the identified land use developments planned for the Greater Bristol area up to 2016 and 2031 to enable the TEMPRO growth to be distributed across the sub-region.

2.2.15. Within the planning dataset, each new development was classified by land use type as follows:

- Residential developments, specified as number of new dwellings.
- Employment developments , specified in Gross Floor Area (GFA); further sub-divided into, for example,
  - Retail.
  - Office; and
  - Leisure.

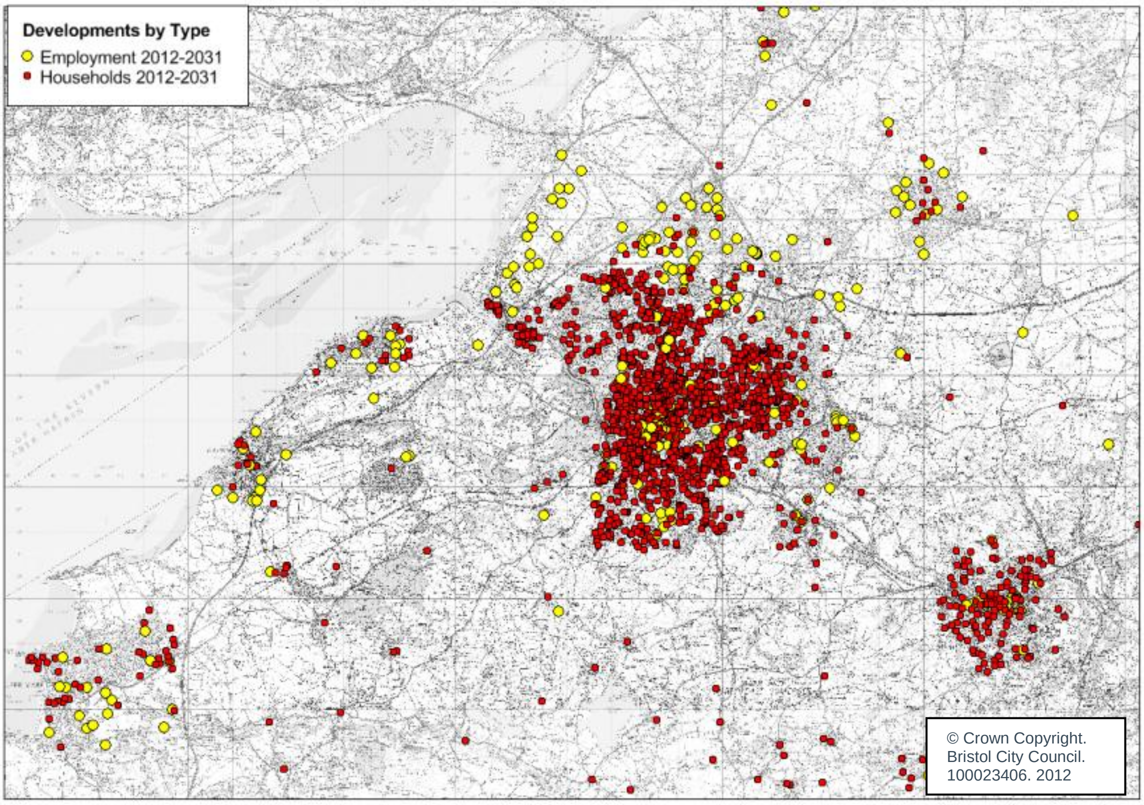
2.2.16. The locations of the identified developments in the West of England area are summarised below shown in Figure 4 and Figure 5 for 2012 to 2016 and 2012 to 2031, respectively.

Figure 4 - Developments in the West of England (2012 – 2016)



Source: West of England Partnership

Figure 5 - Developments in the West of England (2012 – 2031)



Source: West of England Partnership

Uncertainty Log

2.2.17. The location of the developments and their planning status is summarised in the Uncertainty Log located in Appendix B based on the data provided by the West of England Partnership Organisation.

Development Trip Ends

2.2.18. The local planning data specified the location of development sites, the land-use and number of households and employment but the SBL modelling system required the number of trips.

2.2.19. The trip rate database package TRICS (version 6.8.1) was used to calculate trip rates at all-day and all-modes level. The TRICS database stores an extensive set of data collection surveys recording travel demand (including, for example, by mode, by time of day etc), throughout UK for a wide range of the different land-uses (and sizes).

2.2.20. The total number of trips generated at (or attracted to) each development site was calculated using TRICS. The TRICS software requires the specification of an area type. In order to correctly model the study area, the study area was divided into city centre, suburban and rural areas. These were respectively associated with TRICS trip rates as defined in Table 2 below.

Table 1. Allocation to TRICS Area Types

West of England Area	TRICS Area Type	Comment
City Centre	Edge of Town Centre	TRICS ‘Edge of Town Centre’ selected over ‘Town Centre’ due to the very low survey sample available
Suburban	Suburban	
Rural areas	Edge of Town Sites	

2.2.21. Survey data were extracted from TRICS for the whole of England but excluding the Greater London Area to provide the largest possible dataset to determine the trip generation rates for each land use type. The trip generation rates for each of the land-use types are summarised in Appendix A.

2.2.22. The total trip ends by car and public transport modes for the local development sites within the sub-region were estimated and subsequently converted from O/D format to P/A format using the same procedures used in the development of the base year demand model.

Controlled to TEMPRO Forecast Trip Ends

2.2.23. The sub-regional trip ends derived from the local planning data and TRICS generation rates were controlled to the TEMPRO-derived growth in trip-ends to ensure consistency with the sub-regional forecasts.

Trip Distribution

Existing Sites

2.2.24. For the majority of the development zones, the distribution of the future year trip ends adopted the distribution from the base year model. However, for existing brownfield or new greenfield sites, the base year demand matrices would not provide a representative set of travel patterns.

Brownfield / Greenfield Seeding

2.2.25. In these specific cases, the base year trip matrices were 'seeded' with a synthetic distribution taking account of the cost of travel between zones and the relative attractiveness of each destination zone.

Step 4 – Applying Base Year Demand Segmentation

Existing Sites

2.2.26. The segmentation of the future year matrices by mode and time period were undertaken by re-applying the base year proportions as recommended TAG Unit 3.10.2c. Note that this segmentation process was applied within each purpose (i.e. home-based work, home-based other, home-based employers business, non-home based other and non-home based employers business) and person type (i.e. car-available and non car-available), as TEMPRO background trip ends are extracted at this level.

Brownfield / Greenfield Sites

2.2.27. For brownfield (or greenfield) development zones for which base trips are zero, or for which the base patterns of trip making cannot be assumed to apply to the future year demand, the segmentation cannot be applied at the matrix-cell level. Instead, the average base proportions calculated across the overall demand matrix were applied to the brownfield and greenfield development zones.

Step 5 – Controlling to TEMPRO Sub-regional Forecasts

2.2.28. The resulting forecast reference case demand matrices were controlled to the growth in TEMPRO forecast trip ends (through a Furness process) to produce the final Reference Case demand matrices and ensure consistency with the national forecasts.

Step 6 - Growth for Light and Heavy Goods Vehicles

2.2.29. The growth in light and heavy goods vehicle demand was derived from the Department for Transport's 2011 National Road Traffic Forecasts for England. Table 5 below shows the growth rates used to forecast Light Goods Vehicles (LGV) and Heavy Goods Vehicles (HGV) from the 2012 Base Year to 2016 and 2031 respectively. Growth factors were.

Table 5. Growth for Light and Heavy Goods Vehicles

Vehicle Type	2012 - 2016	2012 - 2031
Light Goods Vehicles	1.124	1.62
Heavy Goods Vehicles	1.104	1.216

Source: DfT 2011 National Road Traffic Forecasts (England)

3. Generalised Cost Assumptions

3.1. Introduction

3.1.1. The SBL model system uses generalised cost as a measure of disutility of a journey from origin to destination across the transport network. The change in generalised cost arising from changes in network costs causes the Demand Model to estimate changes in travel demand. The generalised cost is defined in units of time but the value of time increases with income which means that money, expressed in units of time has lower values. The model accounts for this.

3.1.2. The Demand Model was developed for a 2012 base year – as described in the SBL Demand Model Development Report (Atkins, November 2012) and there are a number of key forecasting assumptions, in addition to changes in supply and demand, that need to be updated for the model forecasting namely:

- Values of time;
- Vehicle occupancies;
- Vehicle operating costs;
- Public Transport Fares;
- Tolls and Road user charges; and
- Parking charges.

3.1.3. Note that the SBL model system considers the changes in real terms (i.e. excluding the effects of inflation) and only the changes in real costs and values are required within the forecasting process.

3.1.4. The changes to the generalised cost assumptions are described in the following paragraphs.

3.2. Cost Components

Values of Time

3.2.1. The growth in the values of time per person were specified in TAG Unit 3.5.6 Table 3b and provided the percentage growth per annum for work and non-work trips as reproduced below in Table 6.

Table 6. Forecast Growth in the Working and Non-Working Values of Time

Year	Work VOT Growth (% pa)	Non-Work VOT Growth (% pa)
2012	+1.78%	+1.42%
2013	+2.18%	+1.75%
2014	+2.19%	+1.76%
2015	+2.10%	+1.68%
2016	+2.05%	+1.64%
2017 - 2021	+1.67%	+1.34%
2022 - 2031	+1.67%	+1.34%

3.2.2. The resulting values of time per person by forecast year and purposes are summarised below in Table 7.

Table 7. Values of Time by Forecast Year and Purpose (£ / hour, 2002 prices and values)

Purpose	Income Band	2012	2016	2031
Commute	Low	8.97	9.60	11.72
	Medium	8.97	9.60	11.72
	High	8.97	9.60	11.72
Other	Low	7.94	8.50	10.38
	Medium	7.94	8.50	10.38
	High	7.94	8.50	10.38
Work	All	38.20	40.21	47.46

Vehicle Occupancy

3.2.3. The reductions in vehicle occupancy by purpose over time were provided by TAG Unit 3.5.6 Table 6 and summarised below in Table 8. The TAG Unit provided the annual percentage reductions in average number of car passengers up to 2036 after which the average number of car passengers are assumed to remain constant. Note that the occupancy of all vehicle types other than cars was assumed to remain unchanged over time.

Table 8. Annual Percentage Change in Car Passenger Occupancy (% pa)

Weekday Time Period	Purpose	
	Work	Non-Work
AM Peak Period	-0.48%	-0.67%
Inter Peak Period	-0.40%	-0.65%
PM Peak Period	-0.62%	-0.53%

SATURN Time-based Assignment Coefficients

3.2.4. The changes to the values of time per person and vehicle occupancies were converted into the equivalent time based coefficients per vehicle (i.e. SATURN **P**ence-**P**er-**M**inute values) for use in the forecast Highway Assignment Models. The resulting values by forecast year and time period are summarised below in Table 9.

Table 9. HAM Time -based Assignment Coefficients (PPM)

Purpose	2012			2016			2031		
	AM	IP	PM	AM	IP	PM	AM	IP	PM
Work Car	47.26	42.69	38.90	52.10	47.15	43.03	65.98	60.41	55.16
Non-Work Car - Low Income	11.00	12.14	11.78	11.71	12.88	12.53	14.00	15.26	14.96
Non-Work Car - Medium Income	11.00	12.14	11.78	11.71	12.88	12.53	14.00	15.26	14.96
Non-Work Car - High Income	11.00	12.14	11.78	11.71	12.88	12.53	14.00	15.26	14.96
Light Goods Vehicles	17.52	17.52	17.52	19.03	19.03	19.03	24.31	24.31	24.31
Heavy Goods Vehicles	30.56	29.53	30.67	33.24	32.13	33.37	42.62	41.19	42.78

Units: Per Vehicle

Vehicle Operating Costs

3.2.5. The change in vehicle operating costs with determined separately for the fuel and non-fuel components as described below.

Fuel Vehicle Operating Costs

3.2.6. The change of Fuel vehicle operating costs over time arise from: (i) improvements in vehicle efficiency; and changes in the cost of fuel. For cars, changes in fuel VOCs also reflect changes in the proportion of traffic using either petrol or diesel. Taking these in turn:

- the increase in vehicle efficiency was specified in TAG Unit 3.5.6 Table 13;
- the increase in the resource cost of fuel was specified in TAG Unit 3.5.16 Table 14; and
- the increase in the proportion of diesel-powered cars and LGVs are provided in TAG Unit 3.5.6 Table 12.

Non-Fuel Vehicle Operating Costs

3.2.7. The non-fuel vehicle operating costs were assumed to remain constant in real terms over the forecast period as specified in TAG Unit 3.5.6 paragraph 1.3.24.

SATURN Distance-based Assignment Coefficients

3.2.8. The changes to the fuel and non-fuel operating costs were converted into the equivalent distance based vehicle coefficients (i.e. SATURN **P**ence-**P**er-**K**ilometre values) for use in the forecast Highway Assignment Models. The resulting values by forecast year and time period are summarised below in Table 10.

Table 10. HAM Distance-based Assignment Coefficients (PPK)

Purpose	2012			2016			2031		
	AM	IP	PM	AM	IP	PM	AM	IP	PM
Work Car	11.75	11.45	12.07	11.58	11.27	11.89	10.28	10.01	10.57
Non-Work Car - Low Income	5.96	5.84	6.10	5.75	5.63	5.88	4.19	4.11	4.29
Non-Work Car - Medium Income	5.96	5.84	6.10	5.75	5.63	5.88	4.19	4.11	4.29
Non-Work Car - High Income	5.96	5.84	6.10	5.75	5.63	5.88	4.19	4.11	4.29
Light Goods Vehicles	12.26	12.10	12.45	12.12	11.96	12.30	11.82	11.67	12.00
Heavy Goods Vehicles	35.46	34.53	34.85	36.37	35.41	35.74	38.08	37.09	37.43

Units: Per Vehicle

Public Transport Fares

3.2.9. The changes in public transport fares over time are more difficult to determine. TAG Unit 3.15.3 identifies three main reasons for changes in fares:

- the costs of operating public transport services may change at a rate different to the rate of inflation;
- the demand for public transport may change and one of the responses available is to change fare levels so that constant subsidy or operating surpluses are maintained; and
- policy intervention, although, under current political structures, this may be rare outside London.

3.2.10. The changes in public transport fares over time were estimated by reviewing historical fare data for bus and rail separately as detailed below.

Bus Fares

3.2.11. The changes in bus fares over time were derived using historical fare data taken from the Bulletin of Public Transport Statistics (HM Government, October 2009) and summarised below in Table 11. The analysis showed that bus fares increased at annual rate of 1.012% per annum in real terms between 1998/99 and 2009/09 and this annual growth rate was assumed to continue through to the 2031 forecast year.

Table 11. Bus Fare Index (Constant Prices, Outside London)

Year	Fare Index, (constant prices)
1998/99	107.6
1999/00	110.4
2000/01	112.2
2001/02	115.9
2002/03	117.9
2003/04	119.3
2004/05	120.7
2005/06	125.2
2006/07	119.6
2007/08	117.4
2008/09	121.4

Park and Ride Fares

3.2.12. Park and Ride Fares were index linked to the changes in parking charges (as detailed below).

Rail Fares

3.2.13. The changes in rail fares over time were derived in the same way to the change in bus fares, using the Bulletin of Public Transport Statistics (Table 12). The analysis showed that rail fares increased at annual rate of 1.019% per annum in real terms between January 1998 and January 2009 and this annual growth rate was assumed to continue through to the 2031 forecast year.

Table 12. Rail Fare Index (Constant Prices, GB)

Year	Fare Index, (constant prices)
1998/99	102.1
1999/00	102.9
2000/01	103.4
2001/02	102.7
2002/03	104.5
2003/04	105.6
2004/05	107.7
2005/06	110.4
2006/07	115.3
2007/08	118.8
2008/09	122.7

Tolls and Road User Charges

3.2.14. Tolls on Clifton Suspension Bridge were assumed to increase in line with inflation and therefore remained constant in real terms for all the forecasts cases..

Parking Charges

3.2.15. Parking charges were assumed to increase in line with inflation and therefore remained constant in real terms or there were no changes in parking supply for all the forecast cases.

4. Without-Intervention Case

4.1. Introduction

4.1.1. The specification of the Without Intervention Case followed the guidance provided in TAG Unit 3.15.5 'The Treatment of Uncertainty in Model Forecasting' (April 2011). The transport schemes to be included within the Without Intervention Case were developed by the West of England Partnership. An 'Uncertainty Log' was created to enable a systematic review each proposed scheme and determine whether it should be included in the Without Intervention Case according to its certainty of being delivered..

4.1.2. The Without Intervention Case was produced by running the SBL model using the Reference Case demand, the changes to the generalised cost assumptions and the revised highway and public transport networks to achieve equilibrium of the demand and the travel costs.

4.2. Transport Schemes

4.2.1. The Without-Intervention Case represents those elements of the planned package that are either near certain or more than likely to be delivered by either 2016 or 2031 forecast years. The transport schemes to be included in the Without Intervention Case have been determined based on the Uncertainty Log which allocated the transport schemes to one of four categories as follows:

- Near Certain: The outcome will happen or there is a high probability that it will happen;
- More than likely: The outcome is likely to happen but there is some uncertainty;
- Reasonably Foreseeable: The outcome may happen but there is significant uncertainty; and
- Hypothetical: There is considerable uncertainty whether the outcome will ever happen.

4.2.2. Based on the Uncertainty Log, the Without-Intervention Case included only the schemes that were considered 'near certain' or 'more than likely'. It is important to note that the Without-Intervention Case should represent a realistic view of what is likely to happen in the absence of any specific scheme proposals. It should focus on maintaining present transport facilities and implementing the more certain aspects of regional and local transport strategies.

4.2.3. The Without-Intervention Case network included the following modifications to the public transport and highways networks:

- Recent highway improvements – Newfoundland Circus Gyratory, M32 J3 signalisation, Jacobs Wells signalisation, M5 J19 capacity enhancements;
- Greater Bristol Bus Network – bus priority schemes and proposed service enhancements. This includes the developer-funded schemes within South Gloucestershire.
- A38 to Cribbs Causeway Distributor Road – part of the Filton Northfield development, includes associated bus links through the development site.
- M4/M5 Managed Motorways – peak period capacity enhancements through dynamic hard shoulder running and variable speed limits (this is a new addition to the Reference Case compared with previous submissions).

4.2.4. In addition traffic signal optimisation was undertaken at a number of junctions both within and outside the SBL corridor in response to the changes in traffic flows between the base year and the Without Intervention case.

Uncertainty Log

4.2.5. The status of the transport schemes in the West of England sub-region is summarised in the Uncertainty Log located in Appendix B based on the data provided by the West of England Partnership Organistion.

4.3. Model Outputs

4.3.1. The standard set of model reports was produced to assess the impact of the growth in the demand for travel between 2012 and the 2016 and 2031 forecast years. The outputs from the SBL model system for the 'Without Intervention' case in both the 2016 and 2031 forecast years are summarised in the remainder of this section and compare the change in network performance over time for the following performance measures:

- the forecast growth in travel demand by the SBL Demand model;
- the resulting changes in the performance of the Public Transport network; and
- the resulting changes in the travel conditions on the Highway network.

4.4. Forecast Year

Demand Model

4.4.1. Table 13 summarises the forecast growth in the all-day trip ends between the 2012 base year and the 2016 and 2031 Without Intervention cases. It should be noted that these will not be the same as reference case levels of demand as the growth shown below has taken account of the changing costs of travel that has been introduced by the without-intervention case schemes and adjusted demand accordingly.

4.4.2. The SBL demand model forecasts that the total number of trips made will increase by around 5% between 2012 and 2016 and by around 21% by 2031. The forecast numbers are consistent with the projections from the TEMPRO v6.2 dataset (as previously summarised in section 2) with forecast growth of 4% by 2016 and 21% by 2031.

Table 13. Growth in Travel Purposes (2012 to 2016 and 2031)

	Commute	Other	Employers	Total
2012 Base Year	320,518	1,067,959	147,419	1,535,896
2016 Without Intervention	334,697	1,126,694	156,845	1,618,236
2031 Without Intervention	366,920	1,305,952	178,245	1,851,118
Growth 2012 - 2016	4%	5%	6%	5%
Growth 2012 - 2031	14%	22%	21%	21%

Note: (i) Units – person trips; (ii) P/A trips

Growth in Travel Demand

4.4.3. Table 14 summarises the growth in travel demand between 2012 and the 2016 and 2031 forecast years. By 2016, overall travel demand is forecast to grow by 4.6% in the AM peak hour, 6.2% in the Inter-peak and 9.4% in the PM peak hour. The overall growth in bus patronage will be lower reflecting the increase, in real terms, of bus fares over time and increasing highway congestion levels. By 2031, overall travel demand is forecast to grow by 17% in the AM peak hour, 25.1% in the Inter-peak and 22.6% in the PM peak hour as congestion in the highway peak hours increases over time (as discussed later in this section).

Table 14. Growth in Travel by Mode and Time Period (2012 to 2016 and 2031 Without Intervention)

Time Period / Mode	2012 Base Year	2016	2031	Change by 2016	Change by 2031
AM Peak					
Car	129,800	136,300	154,100	5.0%	18.7%
Park and Ride	800	900	1,200	12.5%	50.0%
Bus	13,400	13,600	14,300	1.5%	6.7%
Rail	6,700	6,900	6,700	3.0%	0.0%
Total	150,700	157,700	176,300	4.6%	17.0%

Time Period / Mode	2012 Base Year	2016	2031	Change by 2016	Change by 2031
Inter-peak					
Car	108,700	115,700	137,600	6.4%	26.6%
Park and Ride	100	400	400	300.0%	300.0%
Bus	10,000	10,000	10,800	0.0%	8.0%
Rail	1,700	1,900	2,000	11.8%	17.6%
Total	120,500	128,000	150,800	6.2%	25.1%
PM Peak					
Car	132,300	145,600	164,500	10.1%	24.3%
Park and Ride	700	800	1,000	14.3%	42.9%
Bus	11,500	11,700	12,900	1.7%	12.2%
Rail	7,000	7,600	7,400	8.6%	5.7%
Total	151,500	165,700	185,800	9.4%	22.6%

Note: (i) Numbers may not sum due to rounding;

Overall Mode Share

4.4.4. Table 15 summarises the changes in overall mode share by time period. The overall mode share of bus in the AM peak is forecast to reduce from around 8.9% to 8.6% by 2016 and to around 8.1% by 2031. A larger reduction is forecast for the Inter-peak with the bus mode share reducing by around 0.5% by 2016 and 1.1% by 2031. In all three time periods, the mode share undertaken by car increases by similar amounts reflecting the continuing rise in levels of car ownership (as discussed in section 2).

Table 15. Change in Mode Share by Time Period (2012 to 2016 and 2031 Without Intervention)

Time Period / Mode	2012 Base Year	2016	2031	Change by 2016*	Change by 2031*
AM Peak					
Car	86.6%	86.4%	87.4%	-0.2%	+0.8%
Park and Ride	0.5%	0.6%	0.7%	+0.0%	+0.1%
Bus	8.9%	8.6%	8.1%	-0.3%	-0.8%
Rail	4.5%	4.4%	3.8%	-0.1%	-0.6%
Total	100.0%	100.0%	100.0%	+0.0%	+0.0%
Inter-peak					
Car	90.3%	90.4%	91.2%	+0.1%	+0.9%
Park and Ride	0.1%	0.3%	0.3%	+0.2%	+0.1%
Bus	8.3%	7.8%	7.2%	-0.5%	-1.1%
Rail	1.4%	1.5%	1.3%	+0.1%	-0.1%
Total	100.0%	100.0%	100.0%	+0.0%	+0.0%
PM Peak					
Car	87.7%	87.8%	88.5%	+0.1%	+0.8%
Park and Ride	0.5%	0.5%	0.5%	+0.0%	+0.1%
Bus	7.6%	7.1%	6.9%	-0.6%	-0.7%
Rail	4.7%	4.6%	4.0%	+0.0%	-0.7%
Total	100.0%	100.0%	100.0%	+0.0%	+0.0%

*Note: change in percentage points

Highway Mode

4.4.5. Travel demand on the highway network is forecast to increase between 2012 base year and the 2016 and 2031 forecast years. The performance of the highway network over time is summarised by reporting on the:

- overall network performance in terms of the total number of trips, travel distance, travel time and delay;
- changes in traffic volumes across the Fully Modelled Area (as previously defined in the HAM and PTAM development reports); and
- node delays in the vicinity of the scheme.

Overall Network Performance

4.4.6. Table 16 summarises the changes in travel conditions on the highway network between the 2012 base year and 2016 and 2031 forecast years. Overall highway demand will increase by 7% in the AM peak by 2016 with rise of 9% in the Inter-peak and 8% in the PM peak. By 2031, the further growth is forecast with increases of up to 27% in the AM peak and 33% in the Inter-peak and 26% in the PM peaks. This increase in travel demand increases the levels of congestion with average speeds falling by between 2% (IP) and 3% (PM peak) by 2016 and by between 5% (IP) and 11% (PM peak) by 2031.

Table 16. Growth in Travel by Road (2012 to 2016 and 2031 Without Intervention Case)

	2012 Base Year	2016 Without Intervention	2031 Without Intervention	%Change by 2016	%Change by 2031
AM Peak					
Trips (pcus/hr)	120,177	128,574	152,201	7%	27%
Travel Distance (pcu-kms)	3,968,808	4,320,425	5,217,151	9%	31%
Travel Time (pcu-hrs)	56,464	63,145	82,627	12%	46%
Delay (pcu-hrs)	7,772	9,838	18,259	27%	135%
Average speed (km/h)	70.3	68.4	63.1	-3%	-10%
Inter-Peak					
Trips (pcus/hr)	97,241	105,474	129,726	8%	33%
Travel Distance (pcu-kms)	3,746,298	4,111,551	4,973,706	10%	33%
Travel Time (pcu-hrs)	48,463	54,061	68,026	12%	40%
Delay (pcu-hrs)	4,449	5,490	8,949	23%	101%
Average speed (km/h)	77.3	76.1	73.1	-2%	-5%
PM Peak					
Trips (pcus/hr)	112,231	120,105	141,584	7%	26%
Travel Distance (pcu-kms)	3,798,347	4,142,055	4,999,231	9%	32%
Travel Time (pcu-hrs)	54,408	61,390	80,314	13%	48%
Delay (pcu-hrs)	7,830	10,283	18,566	31%	137%
Average speed (km/h)	69.8	67.5	62.2	-3%	-11%

Overall Network Performance

4.4.7. Table 169 summarises the changes in travel conditions on the simulated highway network between the 2012 base year and 2016 and 2031 forecast years. There is a larger fall in average speeds in the simulation area compared with the whole modelled area, with decreases of 8% in the Inter-peak and 19% in the PM peak hours by 2031.

Table 19. Growth in Travel by Road within Detailed Modelled Area (2012 to 2016 Without Intervention Case)

	2012 Base Year	2016 Without Intervention	2031 Without Intervention	%Change by 2016	%Change by 2031
AM Peak					
Travel Distance (pcu-kms)	1,034,488	1,130,338	1,367,840	9%	32%
Travel Time (pcu-hrs)	22,926	26,420	36,913	15%	61%
Delay (pcu-hrs)	6,914	8,631	15,492	25%	124%
Average speed (km/h)	45.1	42.8	37.1	-5%	-18%
Inter-Peak					
Travel Distance (pcu-kms)	783,576	863,869	1,083,856	10%	38%
Travel Time (pcu-hrs)	15,832	18,088	23,948	14%	51%
Delay (pcu-hrs)	3,951	4,752	7,219	20%	83%
Average speed (km/h)	49.5	47.8	45.3	-3%	-8%
PM Peak					
Travel Distance (pcu-kms)	1,010,178	1,109,960	1,346,554	10%	33%
Travel Time (pcu-hrs)	22,443	26,414	37,033	18%	65%
Delay (pcu-hrs)	6,955	9,105	16,108	31%	132%
Average speed (km/h)	45.0	42.0	36.4	-7%	-19%

Flow Differences

4.4.8. Figure 9 to Figure 14 show the forecast changes in traffic flows on the highway network between the 2012 base year and 2016 and 2031 forecast years. The figures show the growth in highway flows across all three time periods, particularly for the movements on the strategic road network. The significant changes in traffic flow, over above the background growth in travel demand, occur along:

- A370 corridor;
- A38 corridor; and
- Hengrove Way corridor.

Figure 9 - Changes in Highway Flows (2012 to 2016 Without Intervention - AM Peak)

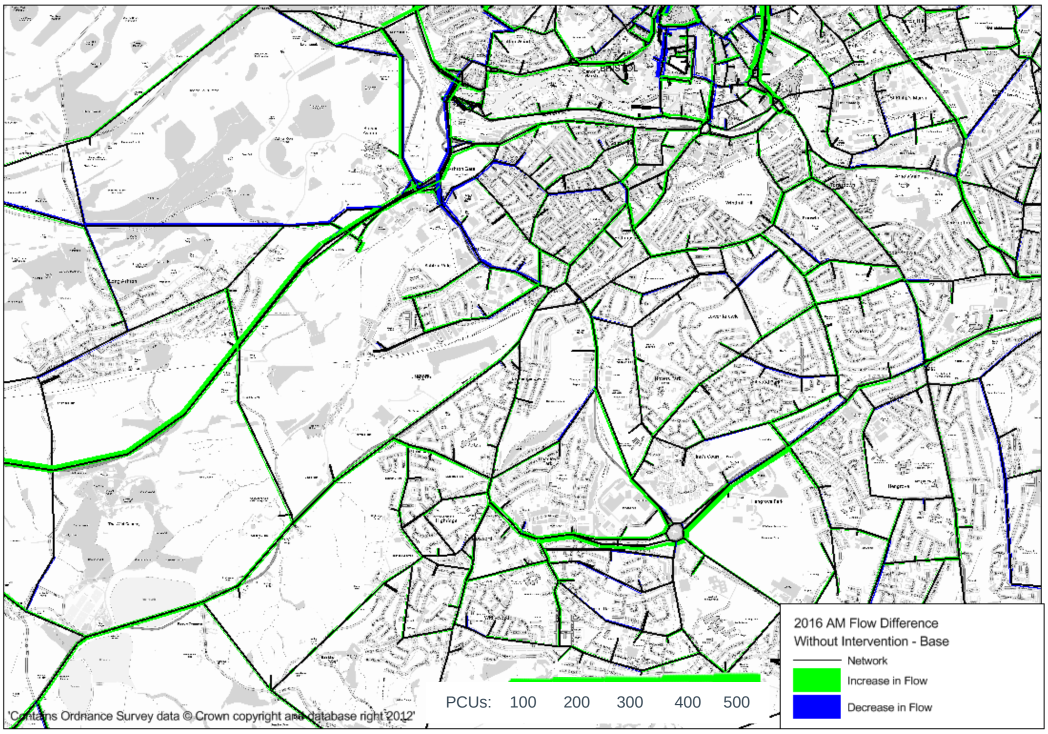


Figure 10 - Changes in Highway Flows (2012 to 2016 Without Intervention - Inter Peak)

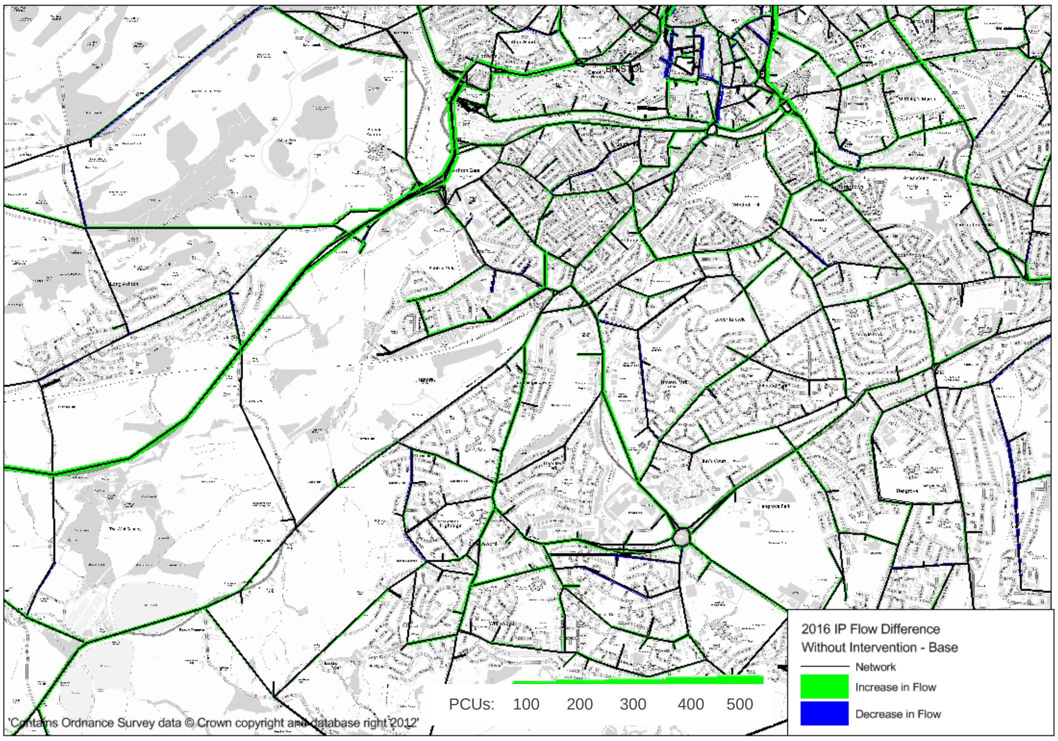


Figure 11 - Changes in Highway Flows (2012 to 2016 Without Intervention - PM Peak)

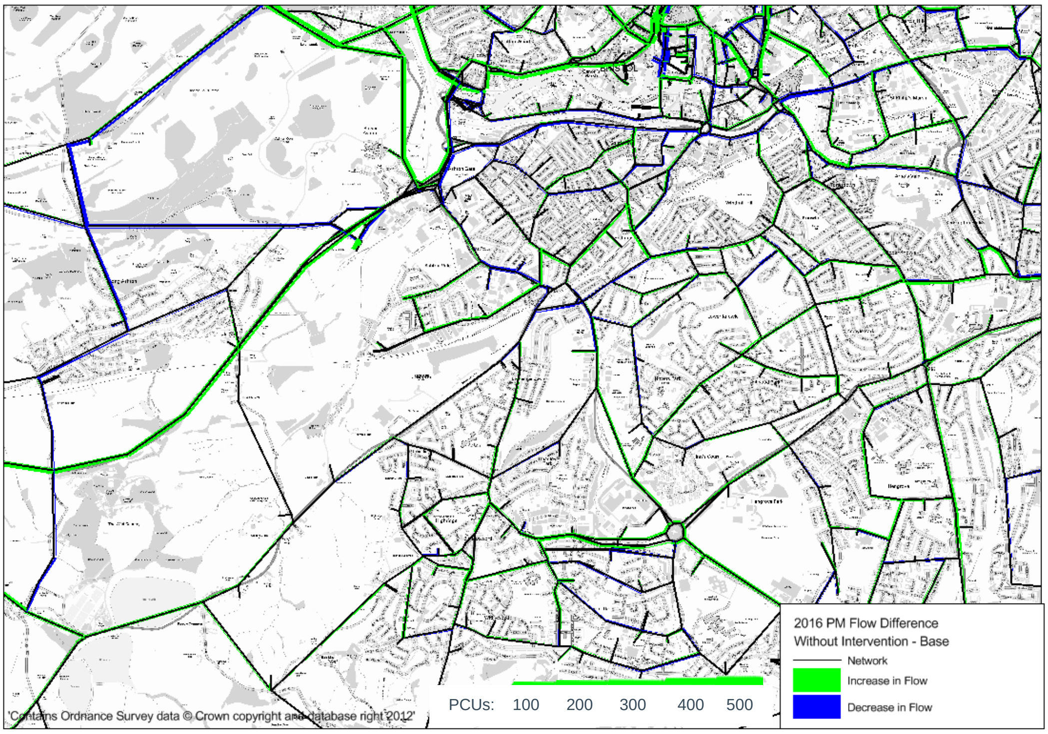


Figure 12 - Changes in Highway Flows (2012 to 2031 Without Intervention - AM Peak)

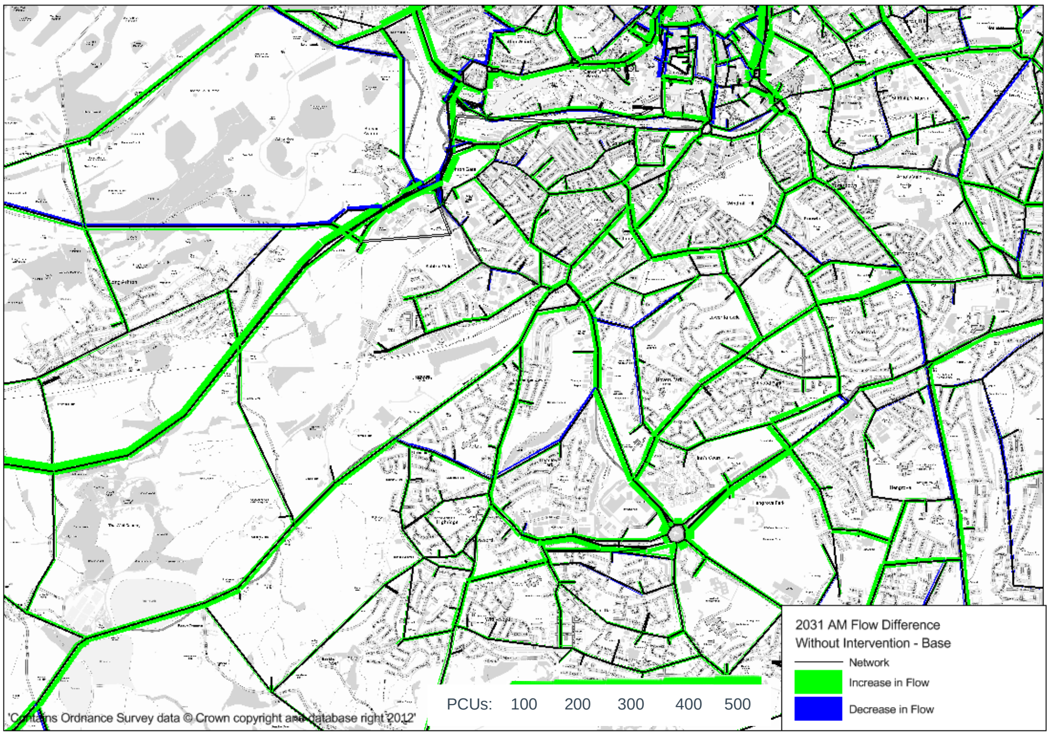


Figure 13 - Changes in Highway Flows (2012 to 2031 Without Intervention - Inter Peak)

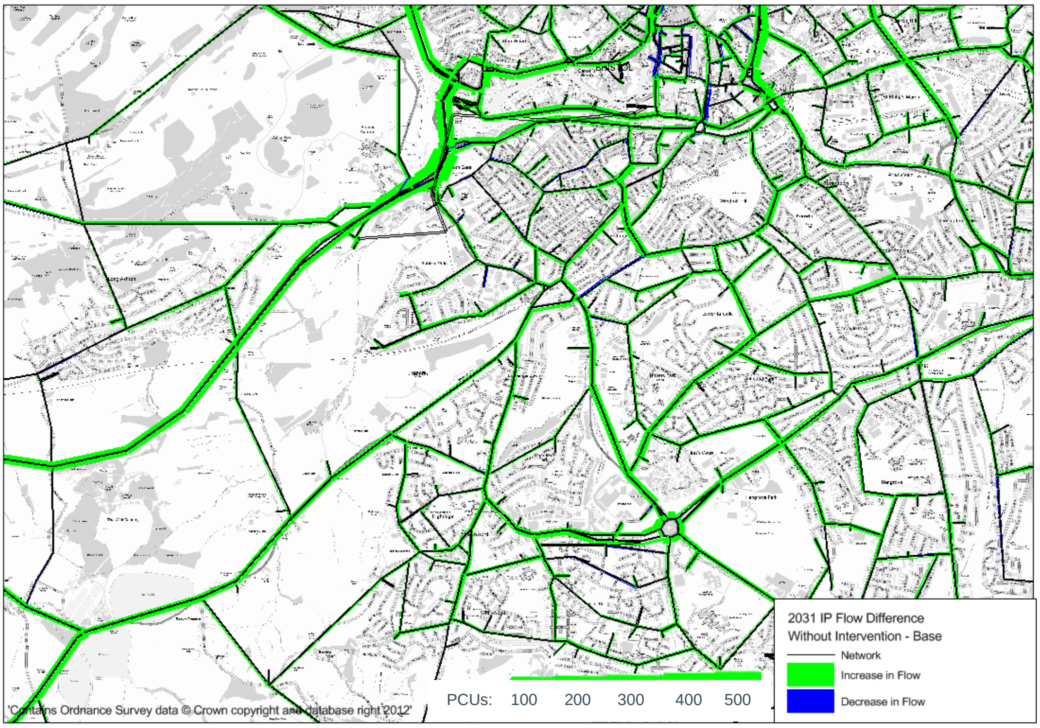
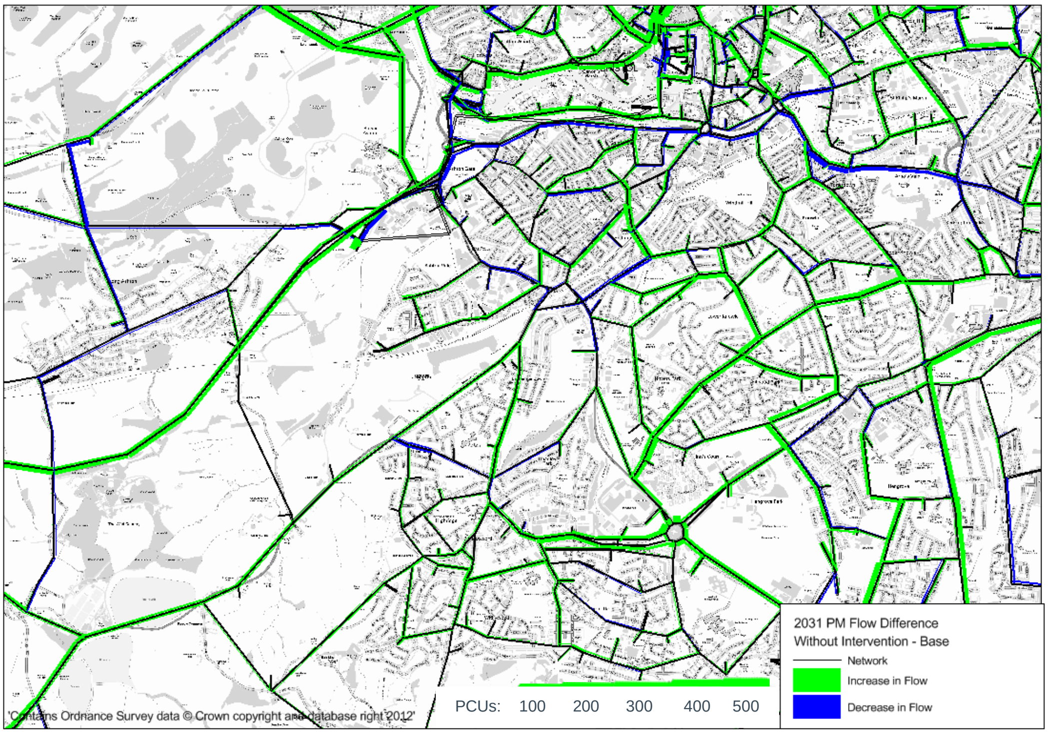


Figure 14 - Changes in Highway Flows (2012 to 2031 Without Intervention - PM Peak)



Junction Delays

4.4.9. Figures 15 to 20 show the delays at junctions in each of the time periods within the vicinity of the SBL scheme. In 2016 AM and Inter-peak hours the delay at junctions in the area surrounding the SBL scheme is restricted to between 1 and 2 minutes, with the exception of the A37/A4174 junction which is slightly higher at between 2 – 3 minutes in the AM peak. The PM peak has more junctions that have a 3 or more minute delay.

4.4.10. In line with the growth in traffic and increase in congestion, the junction delays in 2031 are larger and more common in all three time periods, with the PM peak in particular experiencing more delay around the city centre.

Figure 15 - Junction Delays (2016 Without Intervention - AM Peak)

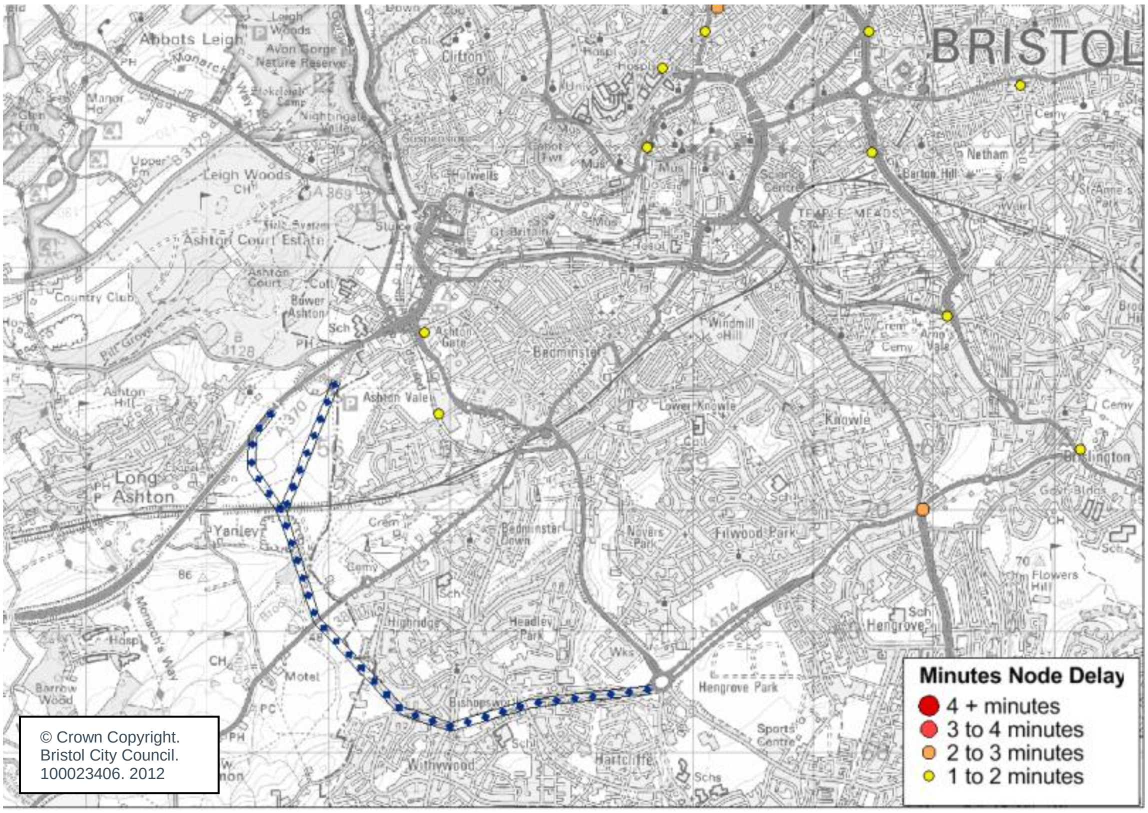


Figure 16 - Junction Delays (2016 Without Intervention - Inter-Peak)

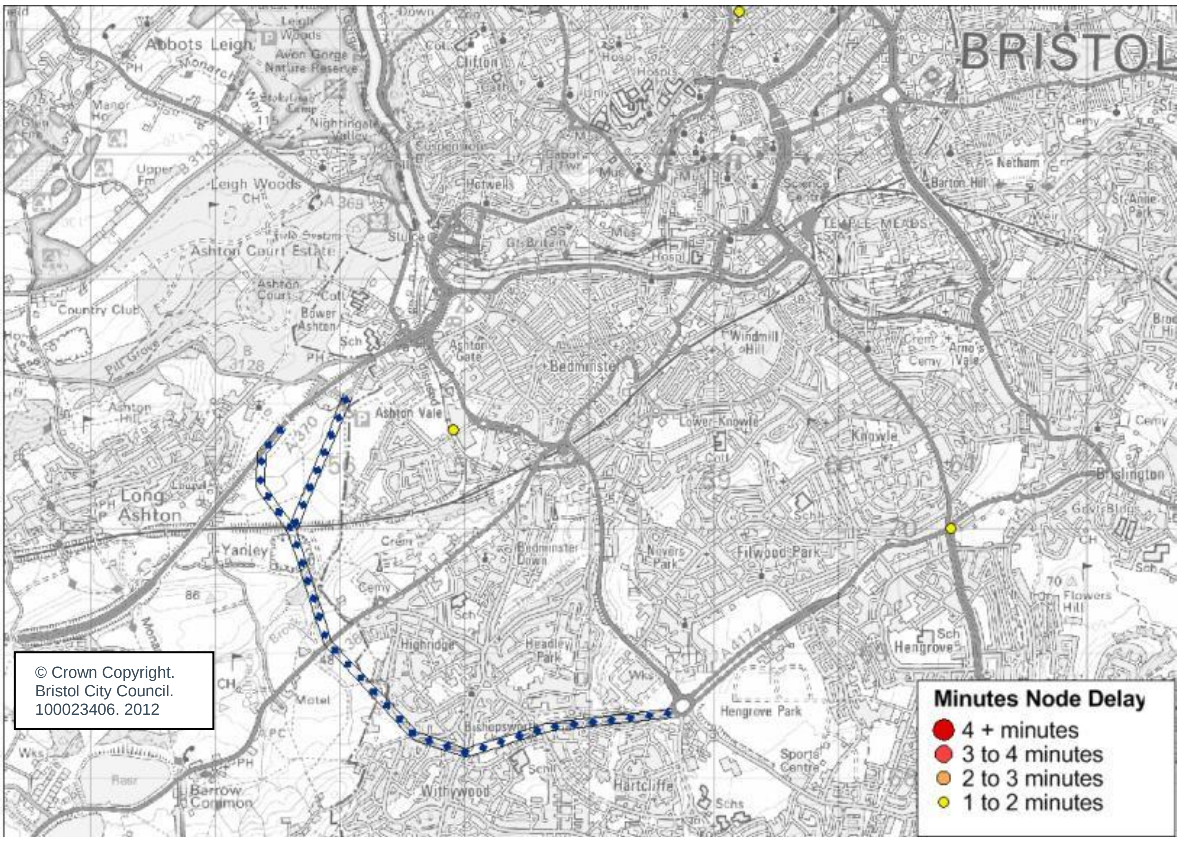


Figure 17 - Junction Delays (2016 Without Intervention - PM Peak)

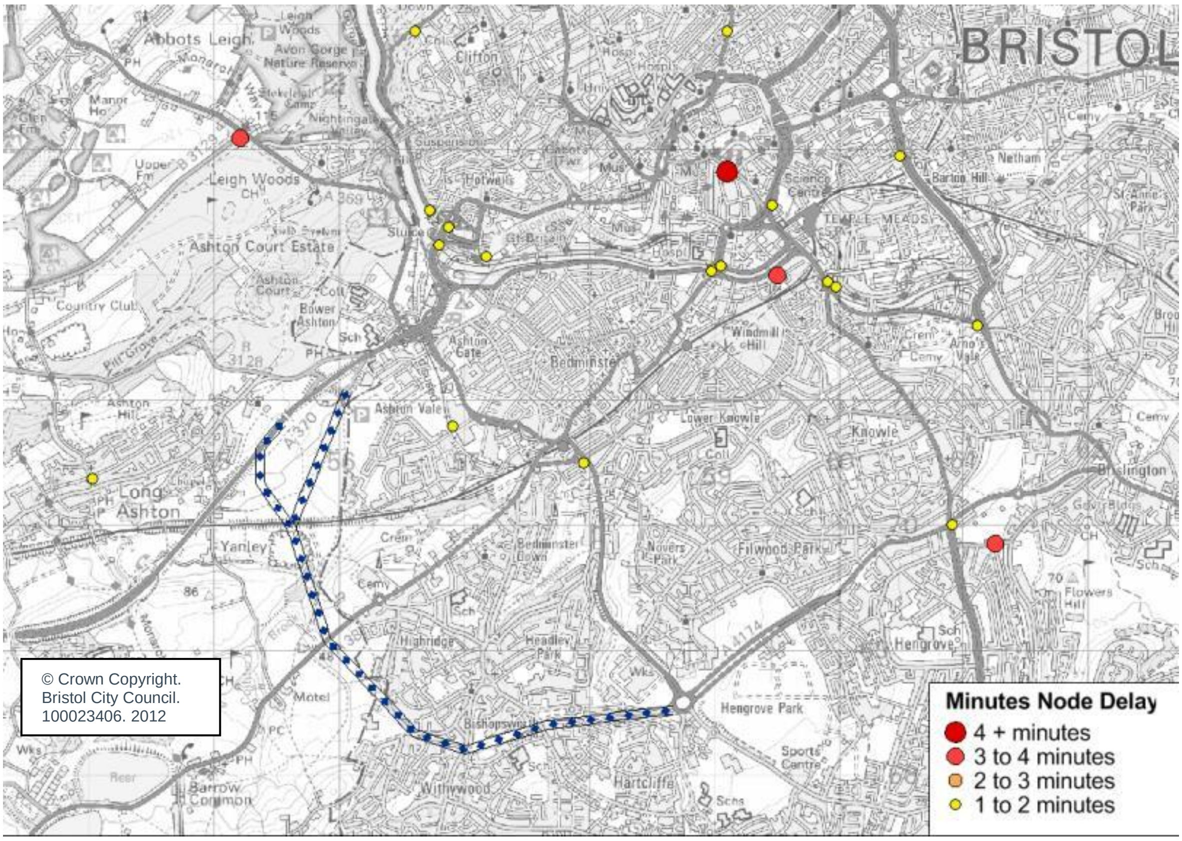


Figure 18 - Junction Delays (2031 Without Intervention - AM Peak)

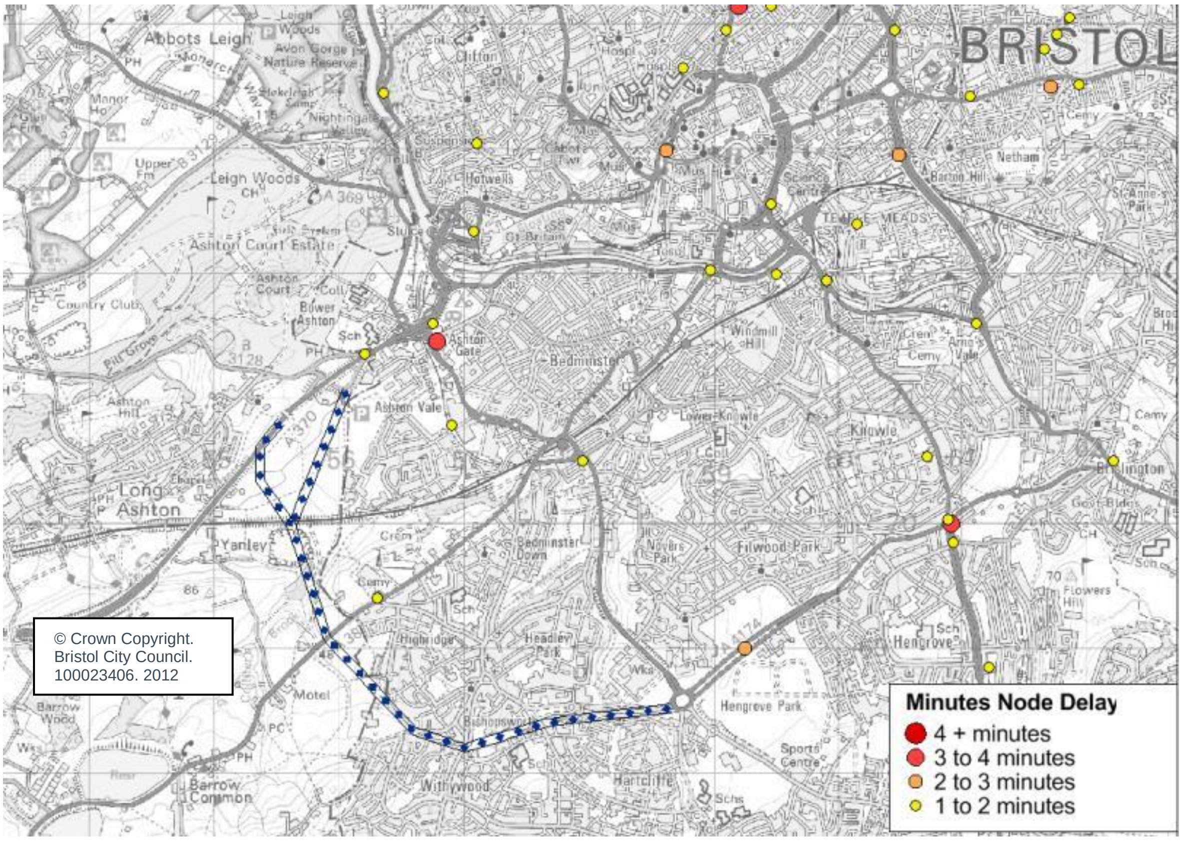


Figure 19 - Junction Delays (2031 Without Intervention - Inter-Peak)

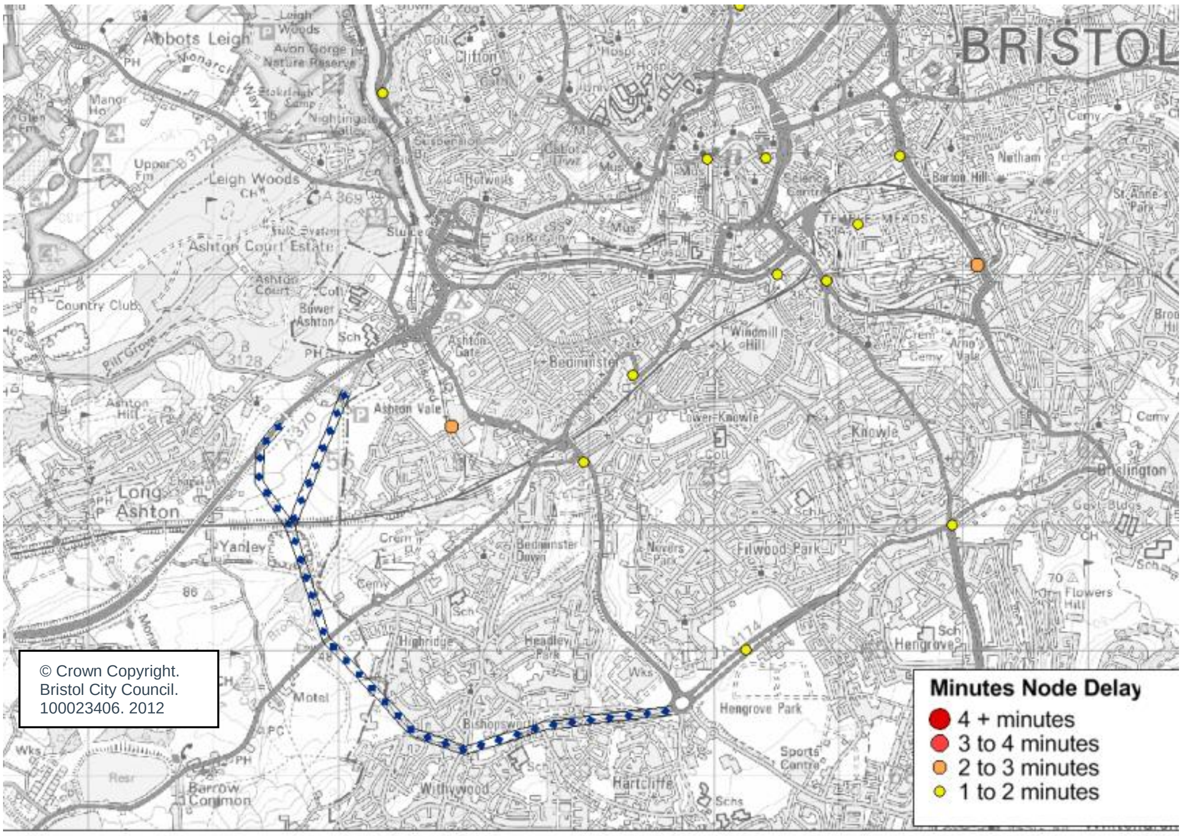
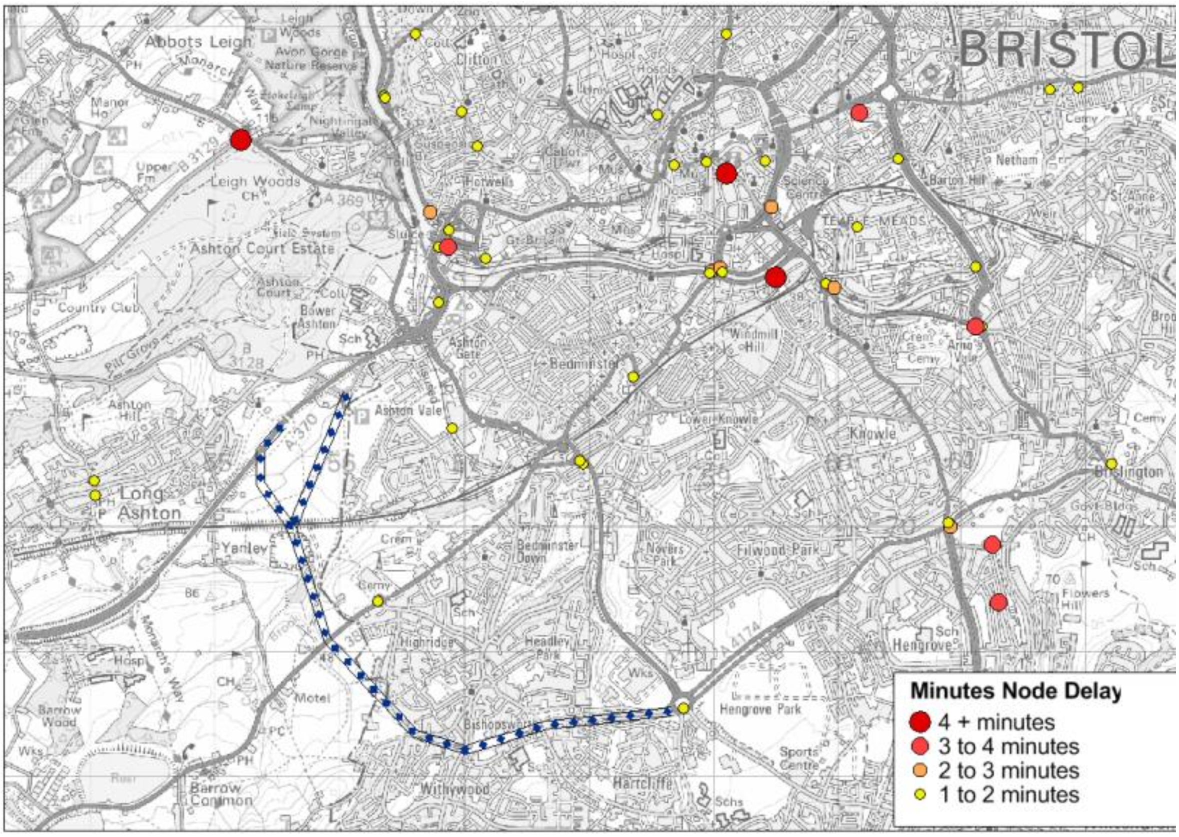


Figure 20 - Junction Delays (2031 Without Intervention - PM Peak)



Public Transport Mode

4.4.11. Travel demand on the public transport network is forecast to increase between 2012 base year and the 2016 and 2031 forecast years. The performance of the public transport network over time is summarised by reporting on the:

- overall network performance in terms of the number of boardings, travel distance and travel by bus, Park and Ride and rail services; and
- changes in network flows

Overall Network Performance

4.4.12. Table 17 summarises the overall performance on the public transport network between 2012 and the 2016 and 2031 forecast years. Across all three time periods, the total number of boardings increases by up to 17% (AM peak) by 2016 and by between 26% and 29% by 2031 (AM and PM peaks). The total number of passenger-kilometres travelled and passenger-hours spent on the network also increase.

Table 17 – Growth in Travel by Public Transport (2012 to 2016 and 2031 Without Intervention)

	Base Year 2012	2016 Without Intervention	2031 Without Intervention	%Change by 2016	%Change by 2031
AM Peak					
Boardings	18,600	21,800	23,400	17%	26%
Passenger-kms	89,900	144,700	155,600	61%	73%
Passenger-hours	5,000	6,900	7,700	38%	54%

	Base Year 2012	2016 Without Intervention	2031 Without Intervention	%Change by 2016	%Change by 2031
Inter-Peak					
Boardings	13,500	13,700	15,300	1%	13%
Passenger-kms	75,300	91,500	105,900	22%	41%
Passenger-hours	3,600	4,200	4,900	17%	36%
PM Peak					
Boardings	15,900	17,900	20,500	13%	29%
Passenger-kms	82,500	125,700	142,100	52%	72%
Passenger-hours	4,500	5,800	6,900	29%	53%

Note: (i) Numbers may not sum to 100due to rounding; (ii) Local rail services only

Other Outputs

Model Convergence

4.4.13. The model convergence for the Demand model and highway assignment sub-model for the With Intervention scenario are summarised in Appendix C. All the forecasts achieved the recommended convergence targets.

5. With-Intervention Case

5.1. Introduction

5.1.1. The proposed SBL scheme was assessed using the SBL Demand Modelling system using the same Reference Case and generalised cost assumptions (as previously defined in Sections 2 and 3 respectively) and previously used to produce the Without Intervention case described in Section 4.

5.1.2. In this section, the changes made to the SBL modelling system to develop the With Intervention case are described followed by a summary of the forecast impact of the SBL scheme on the transport network.

5.2. Scheme Details

5.2.1. The proposed development comprises the construction of a section of highway 4.45 kilometres in length from the A370 Long Ashton bypass within North Somerset to the Hartcliffe (Cater Road) Roundabout within the Bishopsworth area of South Bristol. This incorporates the minor realignment of sections of existing highway at Highridge Green, King George's Road and Whitchurch Lane. The entire route is to be classed as an Urban All-Purpose Road (UAP) in accordance with TA 79/99.

5.2.2. The route includes the construction of new junctions with the A370, Brookgate Road, A38, Highridge Road, Queens Road and Hareclive Road. New bridges will be constructed to cross Ashton Brook, Colliter's Brook and to pass under the Bristol to Taunton Railway Line. The route corridor will incorporate a bus-only link to connect with the Ashton Vale to Temple Meads (AVTM) spur into the Long Ashton Park and Ride site, and dedicated bus lanes between the railway and the new A38 roundabout junction. New bus stops and shelters, and a continuous shared cycleway and footway will be provided along the route corridor. Associated proposals include drainage facilities, landscaping and planting.

5.2.3. The route will form part of the West of England rapid transit network (Metro Bus) and will be used by buses and other motorised vehicles. The route will link with the AVTM at the Long Ashton Park and Ride site, and within the South Bristol section, once buses have reached the Hartcliffe Roundabout, services will follow existing roads via Hengrove Way to Imperial Park and onwards to Whitchurch Lane and Hengrove Park.

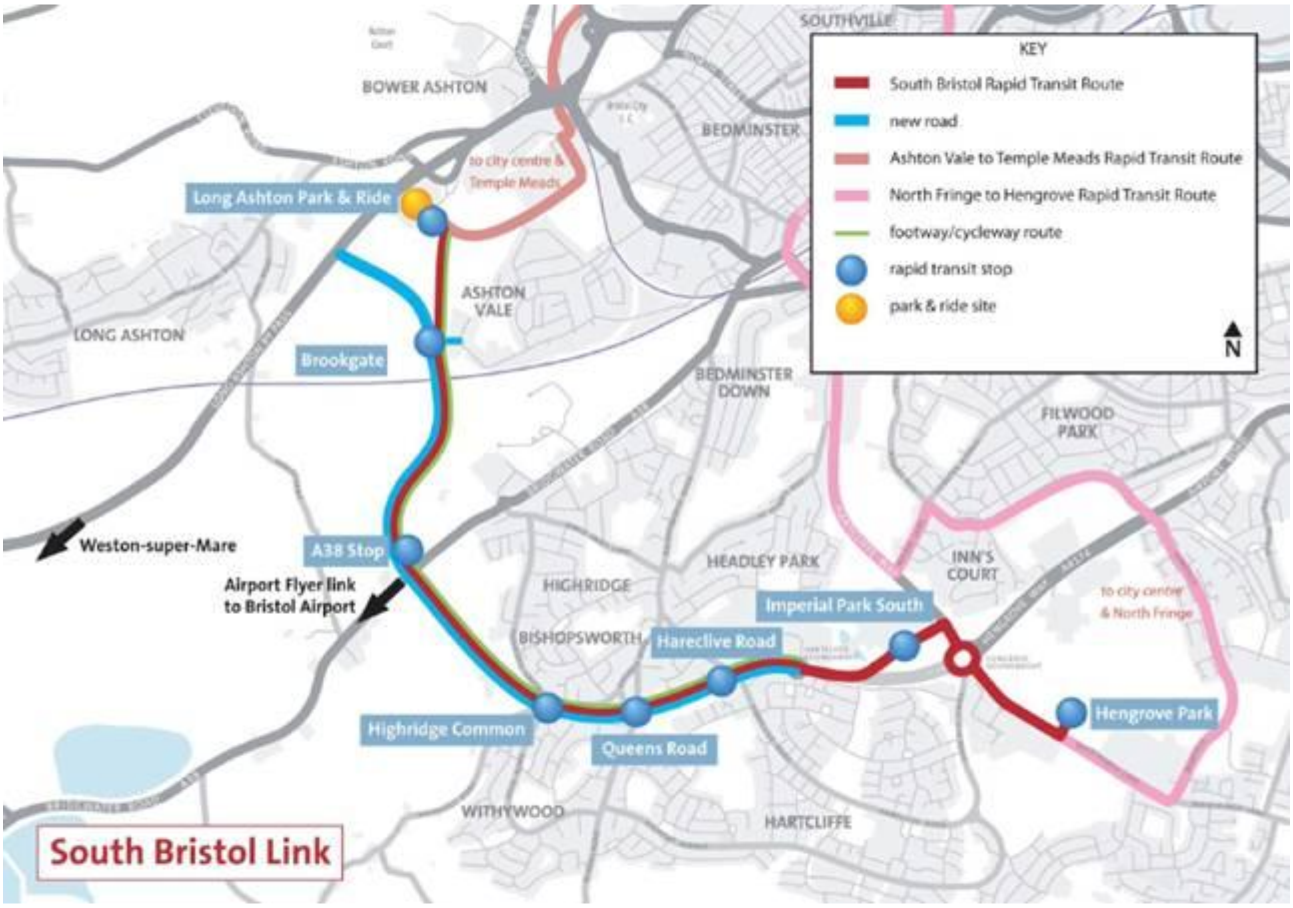
5.2.4. In addition, the Bristol Airport services have been adopted based upon the S106 agreement in 2031 (assuming 10mppa by this date) as follows:

- Eight flyer services per hour;
- Enhanced 121 service (every 30 minutes);
- Weston flyer service (every 30 minutes); and
- Bath service via Bristol city centre and then A38 (hourly)

5.2.5. Once SBL opens we assume the following changes

- Six Flyer services an hour into the city centre via SBL;
- Two services an hour into the city centre via Bedminster (as existing); and
- Bath service re-routed via Hengrove and SBL.

Figure 21 - Overview of the SBL Scheme



5.3. Model Outputs

5.3.1. The standard set of model reports was produced to assess the impact of the proposed SBL scheme. The outputs from the SBL model system for the 2016 and 2031 forecast years are separately summarised in the remainder of this section and compare the Without and Without Intervention cases using the following performance measures:

- the changes in travel demands forecast by the SBL Demand model;
- the changes in the travel conditions on the highway network; and
- the changes in the performance of the Public Transport network including examination of the Metro Bus service and airport buses.

5.4. 2016 Forecast Year

Demand Model

Overall Mode Share

5.4.1. For 2016, there is very little shift in overall mode shares (across the larger modelled area), shown in Table 21 below.

Table 18. Travel by Mode (2016 With Intervention)

	Without Intervention		With Intervention		Change in	
	Trips	Mode Share	Trips	Trips	Trips	Mode Share*
AM Peak						
Car	136,300	86.4%	136,400	86.4%	100	0.02%
Park and Ride	900	0.6%	900	0.6%	-	0.00%
Bus	13,600	8.6%	13,600	8.6%	-	0.00%
Rail	6,900	4.4%	6,900	4.4%	-	-0.02%
Total	157,800	100.0%	157,800	100.0%	-	0.00%
Inter-peak						
Car	115,700	90.4%	115,600	90.4%	-100	0.00%
Park and Ride	400	0.3%	400	0.3%	-	0.00%
Bus	10,000	7.8%	10,000	7.8%	-	0.00%
Rail	1,900	1.5%	1,900	1.5%	-	0.00%
Total	128,000	100.0%	127,900	100.0%	-100	0.00%
PM Peak						
Car	145,600	87.8%	145,600	87.8%	-	0.00%
Park and Ride	800	0.5%	800	0.5%	-	0.00%
Bus	11,700	7.1%	11,700	7.1%	-	0.00%
Rail	7,600	4.6%	7,600	4.6%	-	-0.01%
Total	165,800	100.0%	165,800	100.0%	-	0.00%

Note: (i) Numbers may not sum due to rounding; (ii) * change in percentage points

Highway Mode

5.4.2. The impact of the SBL scheme on the highway mode for the 2016 forecast year is summarised by comparisons of the:

- overall network performance in terms of the total number of trips, travel distance, travel time and delay;
- node delays across the Fully Modelled Area; and
- changes in traffic volumes across the Fully Modelled Area.

The comparisons are presented below.

Overall Network Performance

5.4.3. Table 19 summarises the overall performance on the highway network in the 2016 forecast year. Across all three time periods, the overall change in total number of highway trips, travel distance and time are small with differences of less than 0.2% between the With and Without Intervention Cases. There is a decrease in travel delays which is marginally higher with an decrease of 100 pcu-hours (1%) for the PM peak hour.

Table 19. Travel by Road (2016 With Intervention Case)

	Without Intervention	With Intervention	Difference	%Difference
AM Peak				
Trips (pcus/hr)	128,600	128,700	100	+0.1%
Travel Distance (pcu-kms)	4,320,400	4,323,300	2,900	+0.1%
Travel Time (pcu-hrs)	63,100	63,100	0	+0.0%
Delay (pcu-hrs)	9,800	9,800	0	+0.0%

	Without Intervention	With Intervention	Difference	%Difference
Inter-Peak				
Trips (pcus/hr)	105,500	105,400	-100	-0.1%
Travel Distance (pcu-kms)	4,111,600	4,112,500	900	+0.0%
Travel Time (pcu-hrs)	54,100	54,000	-100	-0.2%
Delay (pcu-hrs)	5,500	5,500	0	+0.0%
PM Peak				
Trips (pcus/hr)	120,100	120,200	100	+0.1%
Travel Distance (pcu-kms)	4,142,100	4,143,400	1,300	+0.0%
Travel Time (pcu-hrs)	61,400	61,300	-100	-0.2%
Delay (pcu-hrs)	10,300	10,200	-100	-1.0%

Flow Differences

5.4.4. Figures 25 to 27 show the forecast changes in traffic flows on the highway network occurring with the introduction of the SBL scheme in the 2031 forecast year. There are approximately 1100 pcus northbound on the SBL in the AM peak hour, rerouted from the surrounding roads with similar patterns in the Inter-peak and PM peak.

Figure 25 - Changes in Traffic Flows on the Highway Network (2016 AM Peak)

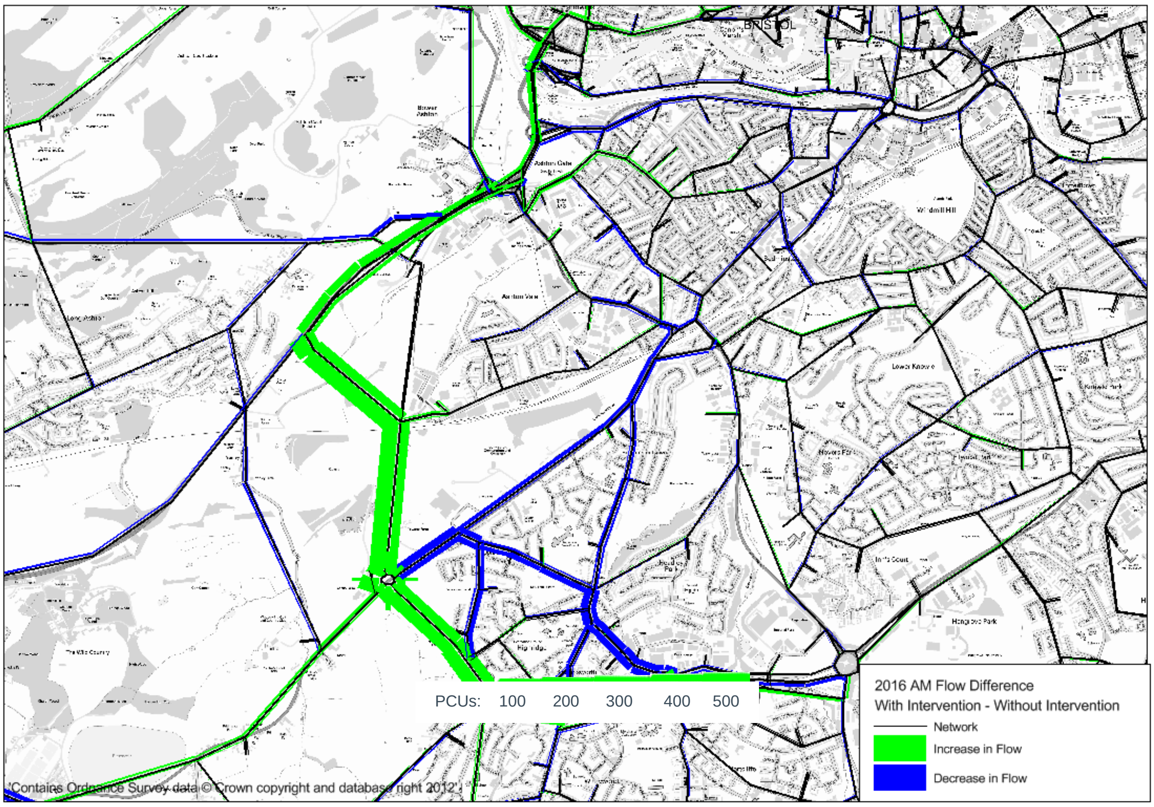


Figure 26 - Changes in Traffic Flows on the Highway Network (2016 Inter Peak)

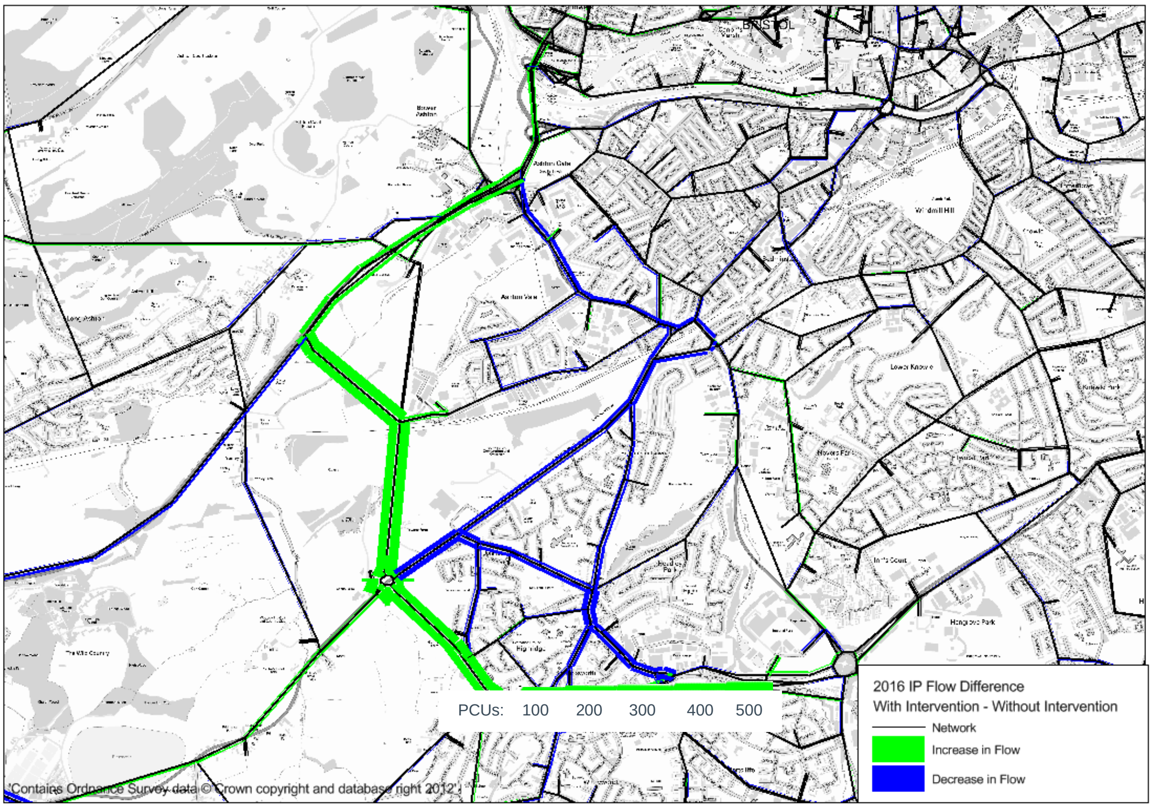
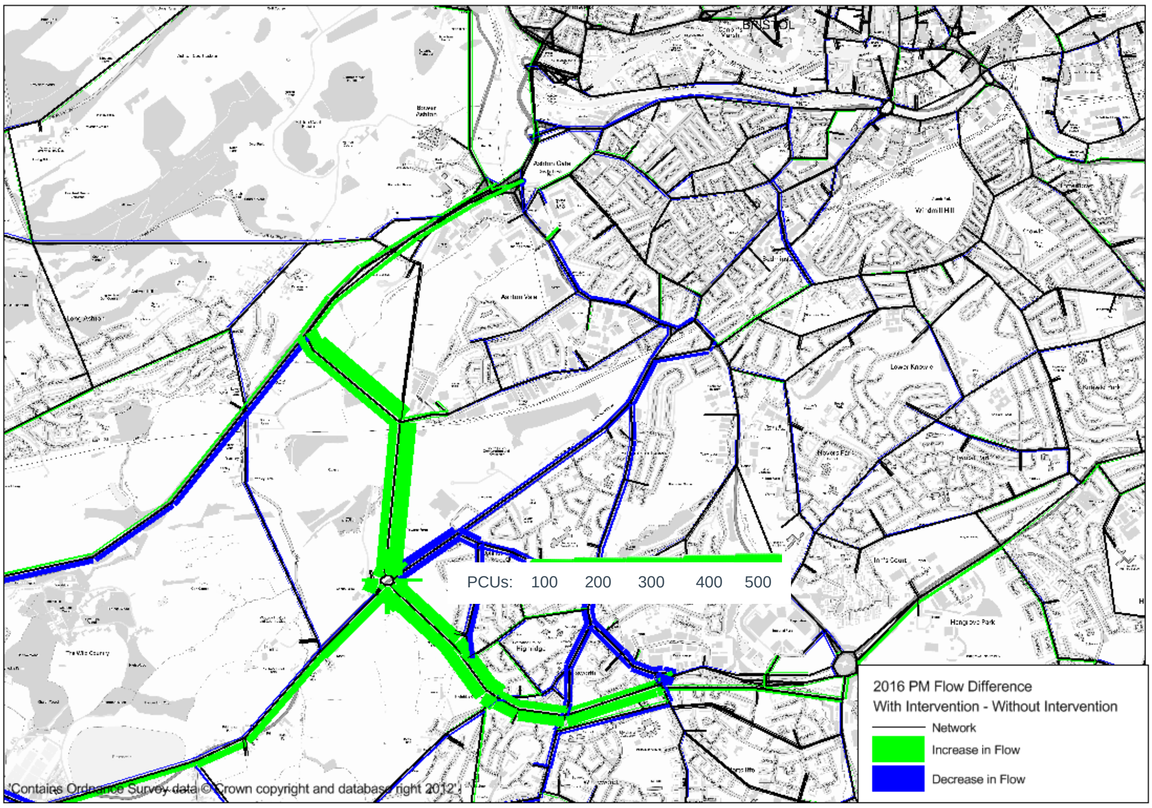


Figure 27 - Changes in Traffic Flows on the Highway Network (2016 PM Peak)



Junction Delays

5.4.5. Figures 28 to 30 show the delays at junctions in each of the time periods within the vicinity of the SBL scheme for 2016. Similarly to the Without Intervention scenario the AM and Inter-peak hours delay at junctions in the area surrounding the SBL scheme is restricted to between 1 and 2 minutes, with the exception of the A37/A4174 junction which is slightly higher at between 2 – 3 minutes in the AM peak. The more congested PM peak has more junctions that have a 3 or more minute delay.

Figure 28 - Junction Delays on the Highway Network (2016 AM Peak)

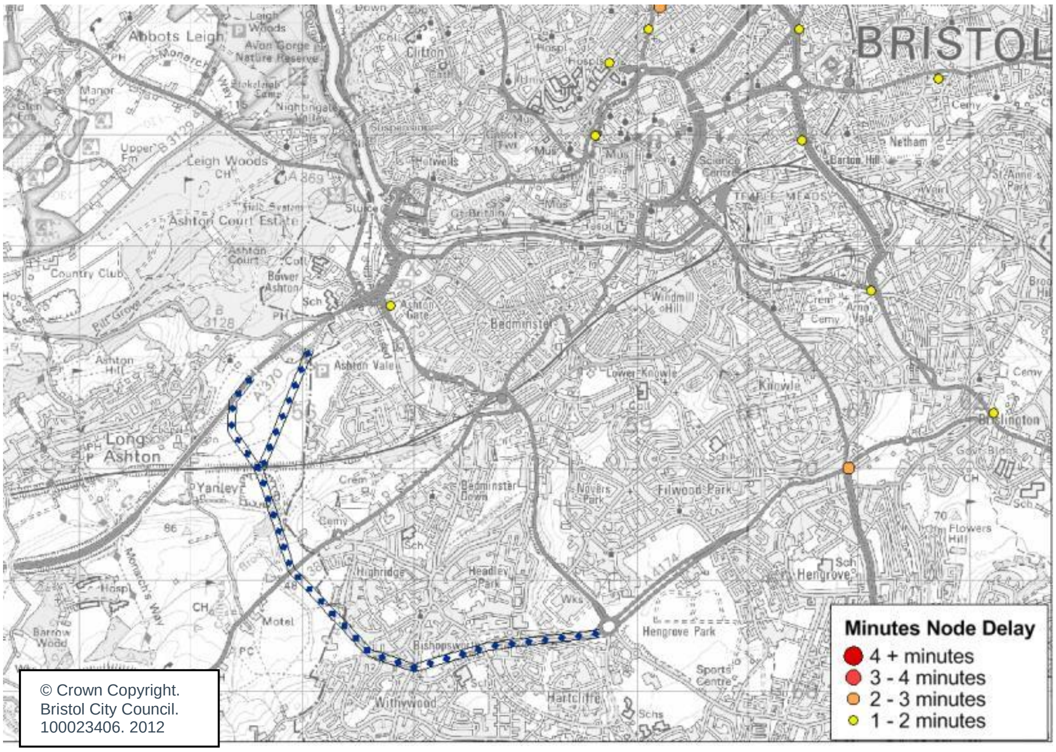


Figure 29 - Junction Delays on the Highway Network (2016 Inter Peak)

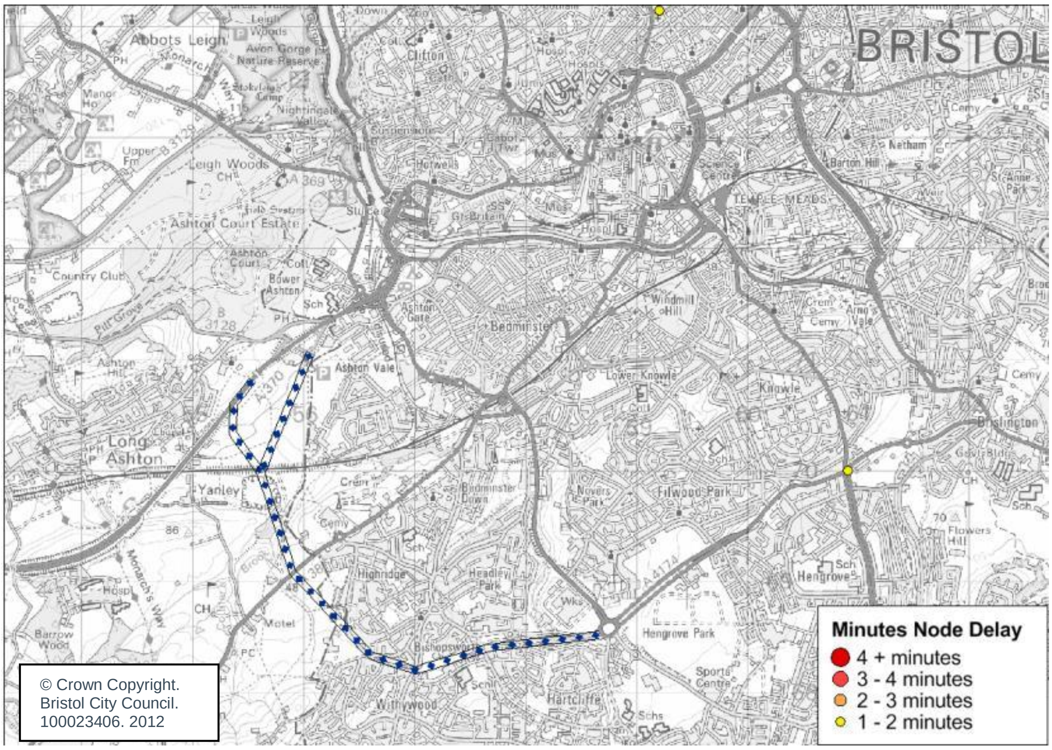
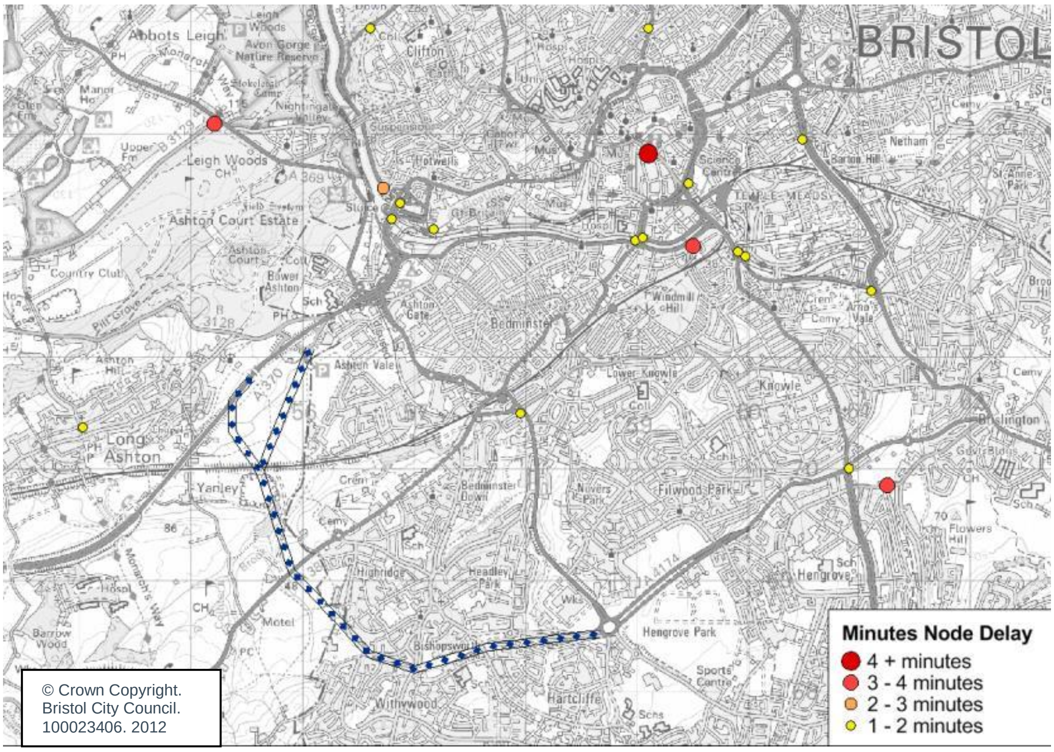


Figure 30 - Junction Delays on the Highway Network (2016 PM Peak)



Public Transport Mode

5.4.6. The impact of the SBL scheme on the Public Transport mode for the 2016 forecast year is summarised below by comparisons for each time period of the:

- overall network performance in terms of the number of boardings, travel distance and travel by bus and Metro Bus services;
- RT flow volumes along the SBL route;

Overall Network Performance

5.4.7. **Error! Reference source not found.**0 summarises the overall performance on the public ransport network in the 2016 forecast year. There is no change in the number of boardings in any of the three time periods. The total distance travelled increases by less than 1% across all three time periods, and travel time increases by just under 2% in the AM and PM peaks.

Table 20. Travel by Public Transport (2016 With Intervention Case)

	Without Intervention	With Intervention	Difference	%Difference
AM Peak				
Boardings	21,300	21,300	0	0.0%
Passenger-kms	115,300	115,800	500	0.4%
Passenger-hours	6,300	6,400	100	1.6%
Inter-Peak				
Boardings	13,600	13,600	0	0.0%
Passenger-kms	79,000	79,000	0	0.0%
Passenger-hours	4,000	4,000	0	0.0%

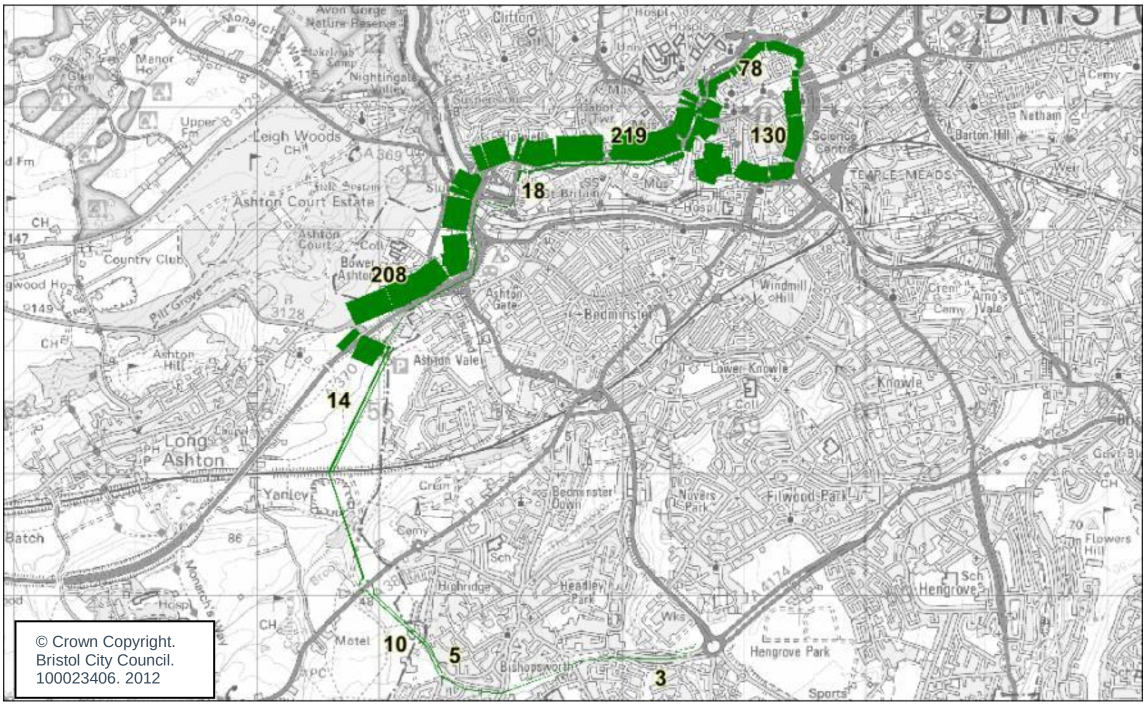
	Without Intervention	With Intervention	Difference	%Difference
PM Peak				
Boardings	17,700	17,700	0	0.0%
Passenger-kms	96,200	96,700	500	0.5%
Passenger-hours	5,300	5,400	100	1.9%

Note: (i) Numbers may not sum due to rounding; (ii) Local rail services only

SBL Bus Route Flows

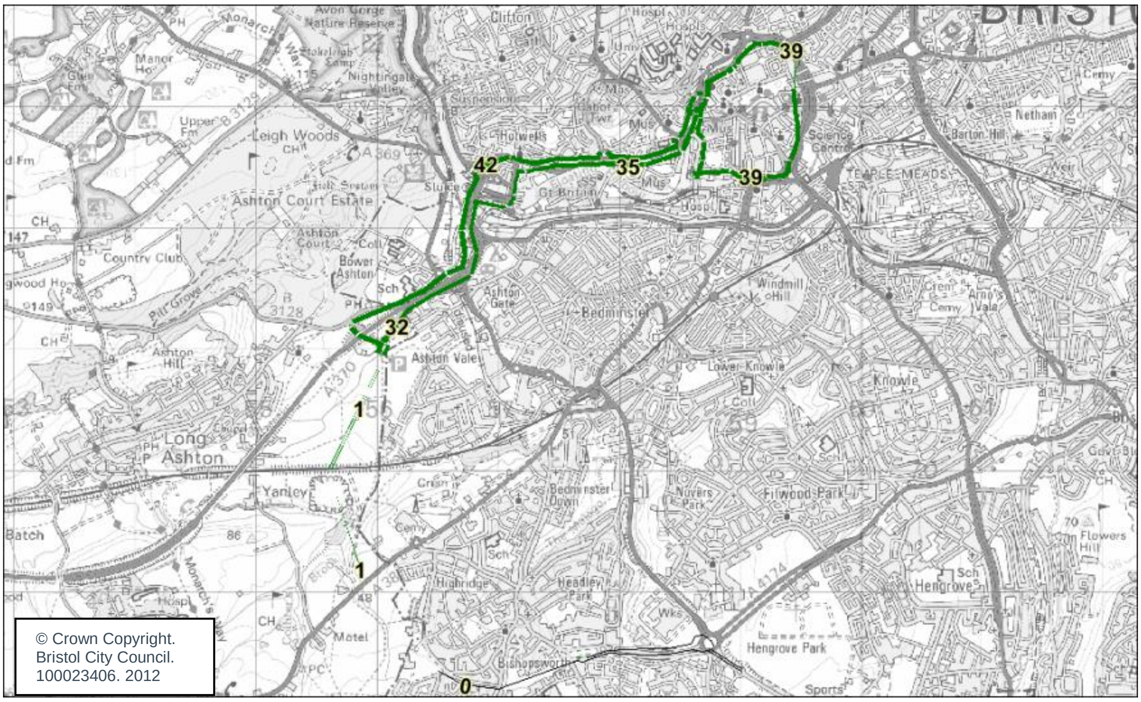
5.4.8. Figures 22 to 24 shows the hourly volume of passengers on the bus service in each time period. Most passengers use the SBL section of the Metro Bus route in the AM peak hour, with only a couple in the Inter-peak hour and a similar volume to the AM peak in the PM peak hour.

Figure 22 - Metro Bus Peak Hour Passenger Volume (2016 AM Peak Hour)



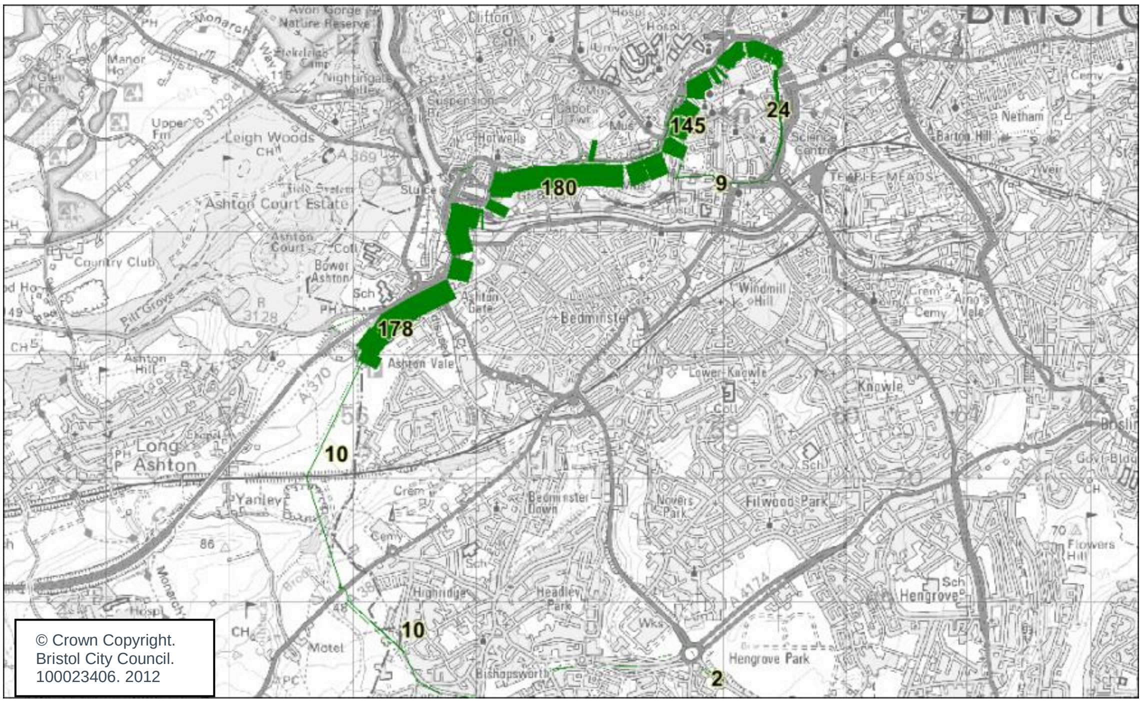
Units: persons per hour

Figure 23 - Metro Bus Peak Hour Passenger Volume (2016 Inter Peak Hour)



Units: persons per hour

Figure 24 - Metro Bus Peak Hour Passenger Volume (2016 PM Peak Hour)



Units: persons per hour

Other Outputs

Model Convergence

5.4.9. The model convergence for the Demand model and highway assignment sub-model for the With Intervention scenario are summarised in Appendix C. All the forecasts achieved the recommended convergence targets.

5.5. 2031 Forecast Year

Demand Model

Overall Mode Share

5.5.1. For 2031, there is very little shift in overall mode shares (across the large modelled area), shown in Table 21 below.

Table 21. Travel by Mode (2031 With Intervention Case)

	Without Intervention		With Intervention		Change in	
	Trips	Mode Share	Trips	Mode Share	Trips	Mode* Share
AM Peak						
Car	154,100	87.4%	154,200	87.4%	100	0.02%
Park and Ride	1,200	0.7%	1,200	0.7%	-	0.01%
Bus	14,300	8.1%	14,300	8.1%	-	-0.01%
Rail	6,700	3.8%	6,700	3.8%	-	-0.02%
Total	176,300	100.0%	176,300	100.0%	-	0.00%
Inter-peak						
Car	137,600	91.2%	137,400	91.2%	-200	-0.01%
Park and Ride	400	0.3%	400	0.3%	-	0.00%
Bus	10,800	7.2%	10,800	7.2%	-	0.00%
Rail	2,000	1.3%	2,000	1.3%	-	0.01%
Total	150,800	100.0%	150,600	100.0%	-200	0.00%
PM Peak						
Car	164,500	88.5%	164,600	88.5%	100	0.01%
Park and Ride	1,000	0.5%	1,000	0.5%	-	0.00%
Bus	12,900	6.9%	12,900	6.9%	-	-0.02%
Rail	7,400	4.0%	7,400	4.0%	-	0.00%
Total	185,900	100.0%	186,000	100.0%	100	0.00%

Note: (i) Numbers may not sum to 100%due to rounding; (ii) * change in percentage points

Highway Mode

5.5.2. The impact of the SBL scheme on the highway mode for the 2031 forecast year is summarised by comparisons of the:

- overall network performance in terms of the total number of trips, travel distance, travel time and delay; and
- changes in traffic volumes across the Fully Modelled Area.

The comparisons are presented below.

Overall Network Performance

5.5.3. Table 22 summarises the overall performance on the highway network in the 2031 forecast year. Across all three time periods, the overall change in total number of highway trips, travel distance and time are small with differences of less than 0.5% between the With and Without Intervention Cases. The reduction in travel delays is marginally higher with reductions of between 200 and 400 pcu-hours for the three time periods with the largest reduction of 2.2% in the PM peak hour.

Table 22. Travel by Road (2031 With Intervention Case)

	Without Intervention	With Intervention	Difference	%Difference
AM Peak				
Trips (pcus/hr)	152,200	152,300	100	0.1%
Travel Distance (pcu-kms)	5,217,200	5,218,200	1,000	0.0%
Travel Time (pcu-hrs)	82,600	82,400	-200	-0.2%
Delay (pcu-hrs)	18,300	18,100	-200	-1.1%
Inter-Peak				
Trips (pcus/hr)	129,700	129,700	0	0.0%
Travel Distance (pcu-kms)	4,973,700	4,976,100	2,400	0.0%
Travel Time (pcu-hrs)	68,000	67,900	-100	-0.1%
Delay (pcu-hrs)	8,900	8,800	-100	-1.1%
PM Peak				
Trips (pcus/hr)	141,600	141,700	100	0.1%
Travel Distance (pcu-kms)	4,999,200	5,000,500	1,300	0.0%
Travel Time (pcu-hrs)	80,300	80,000	-300	-0.4%
Delay (pcu-hrs)	18,600	18,200	-400	-2.2%

Flow Differences

5.5.4. Figures 37 to 39 show the forecast changes in traffic flows on the highway network occurring with the introduction of the SBL scheme in the 2031 forecast year. There are approximately 1500 pcus northbound on the SBL in the AM peak hour, rerouted from the surrounding roads with similar patterns in the Inter-peak and PM peak. The flows on SBL are greater in 2031 compared with 2016 as may be expected with higher traffic growth

Figure 37 - Changes in Traffic Flows on the Highway Network (2031 AM Peak)

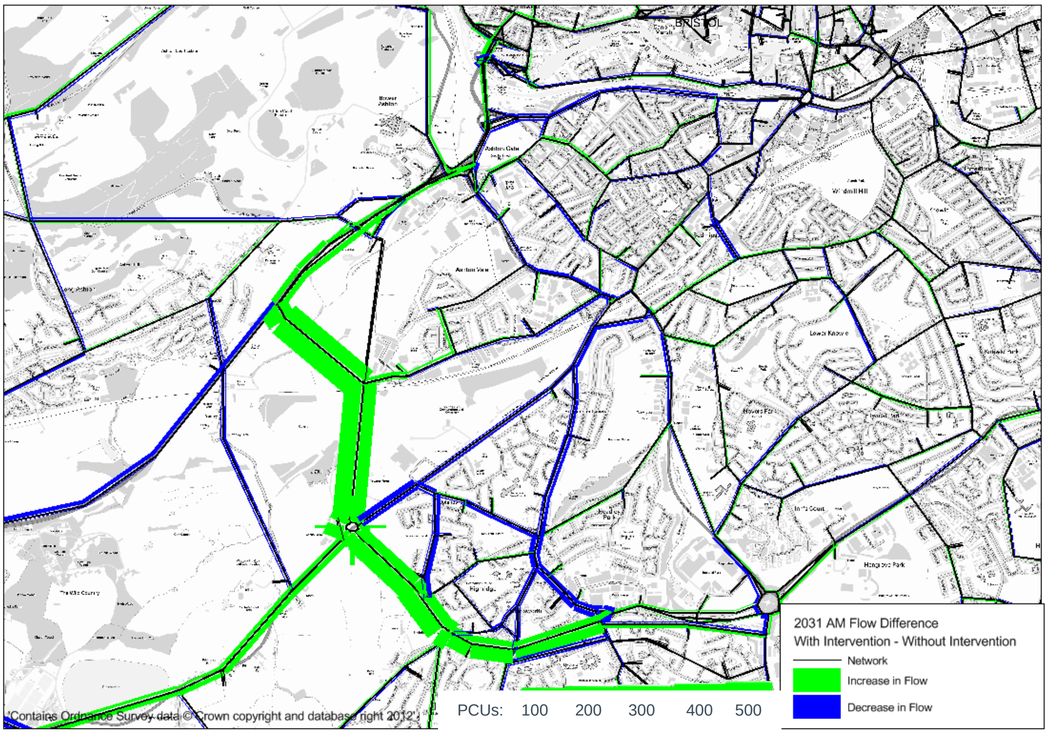


Figure 38 - Changes in Traffic Flows on the Highway Network (2031 Inter Peak)

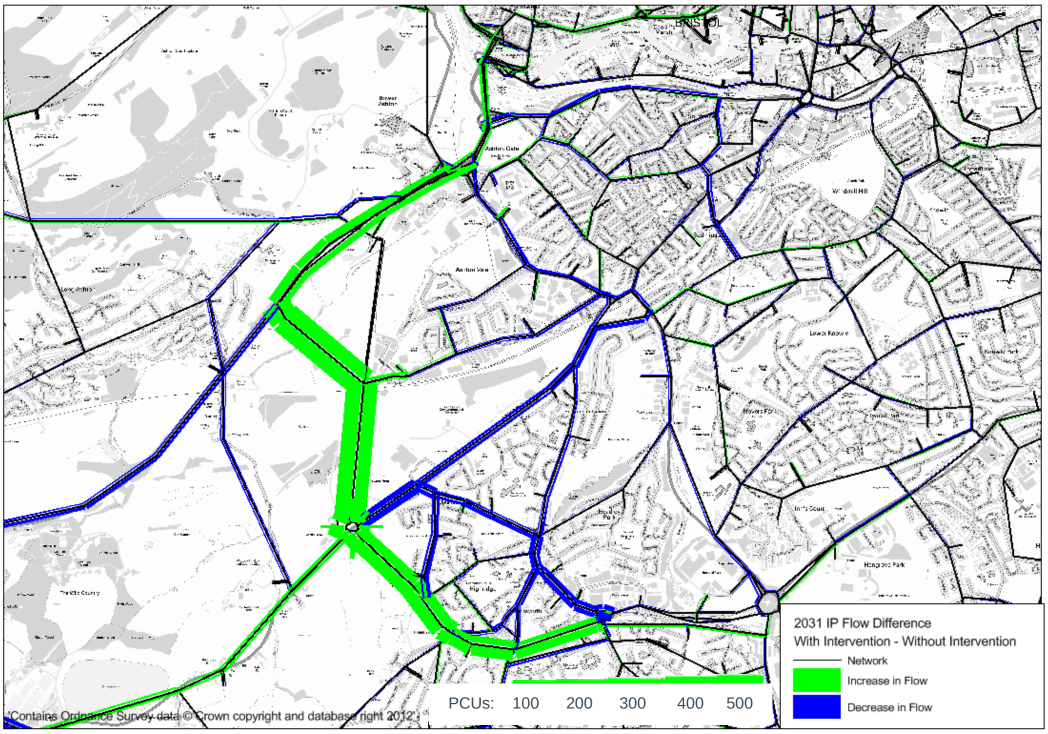
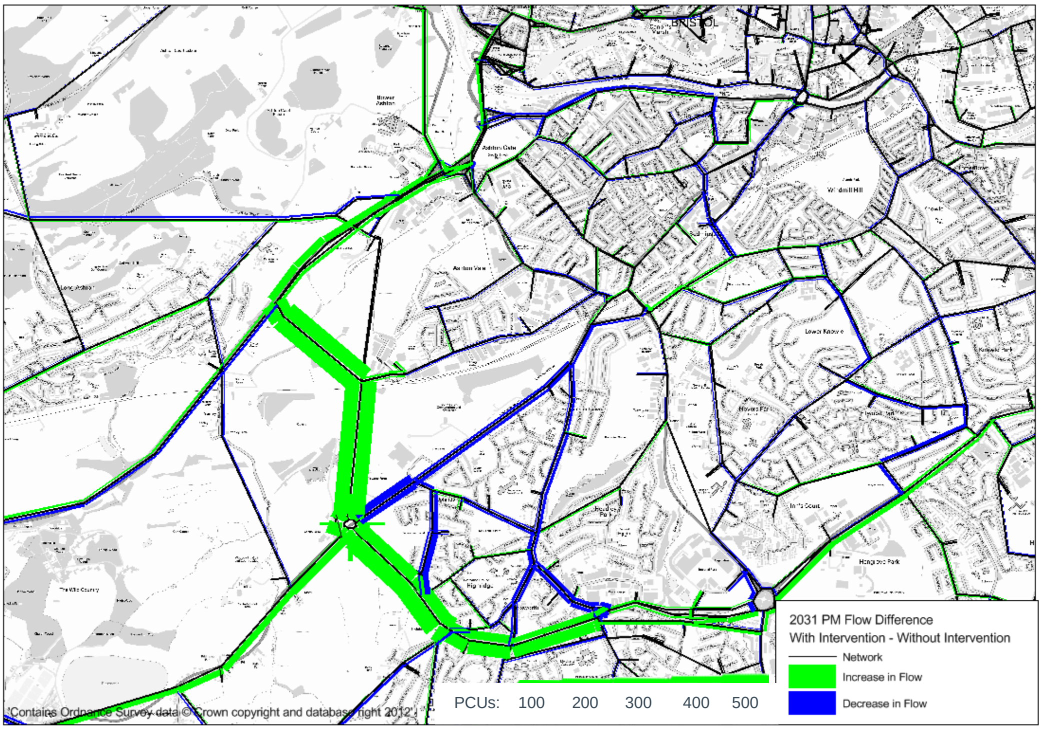


Figure 39 - Changes in Traffic Flows on the Highway Network (2031 PM Peak)



Junction Delays

•

5.5.5. Figure 9 Figures 40 to 42 show the delays at junctions in each of the time periods within the vicinity of the SBL scheme. In line with the growth in traffic and increase congestion, the junction delays in 2031 are larger than 2016 and more common in all three time periods, with the PM peak in particular experiencing more delay around the city centre.

Figure 40 - Junction Delays on the Highway Network (2031 AM Peak)

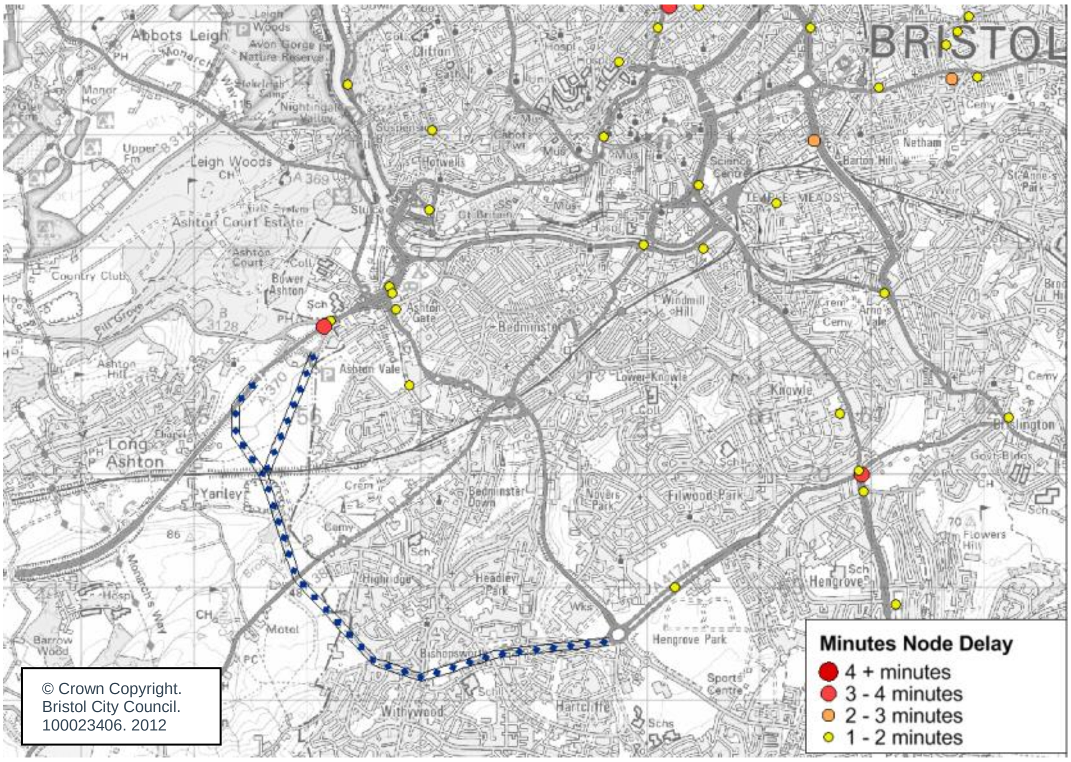


Figure 41 - Junction Delays on the Highway Network (2031 Inter Peak)

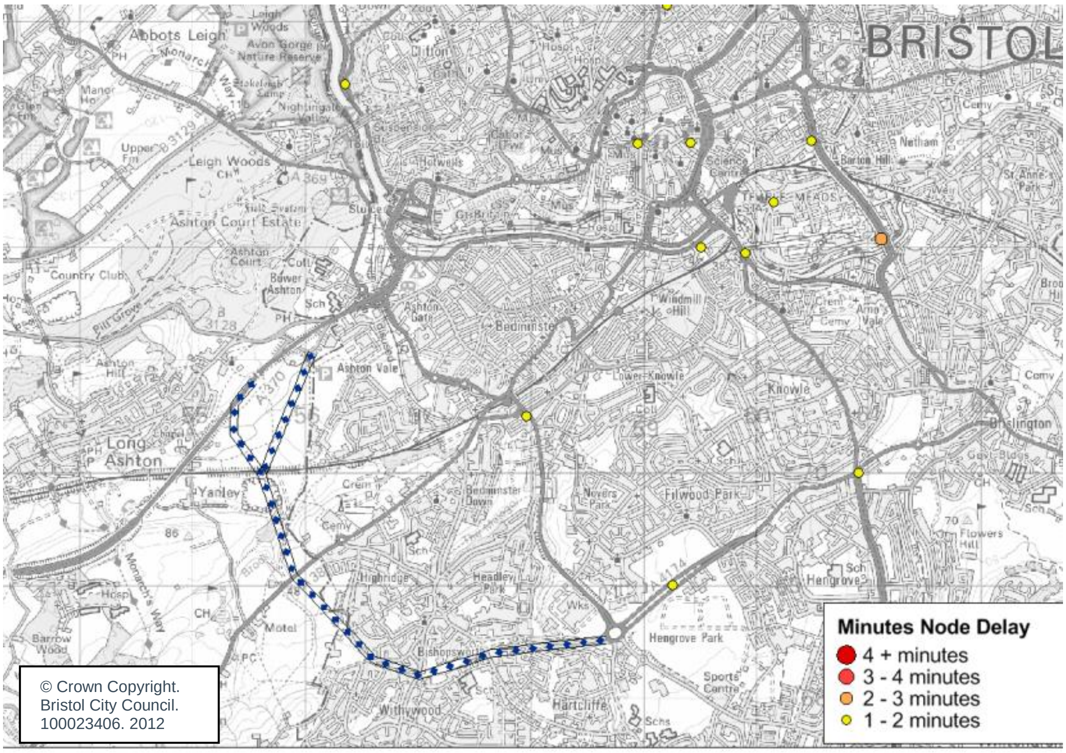
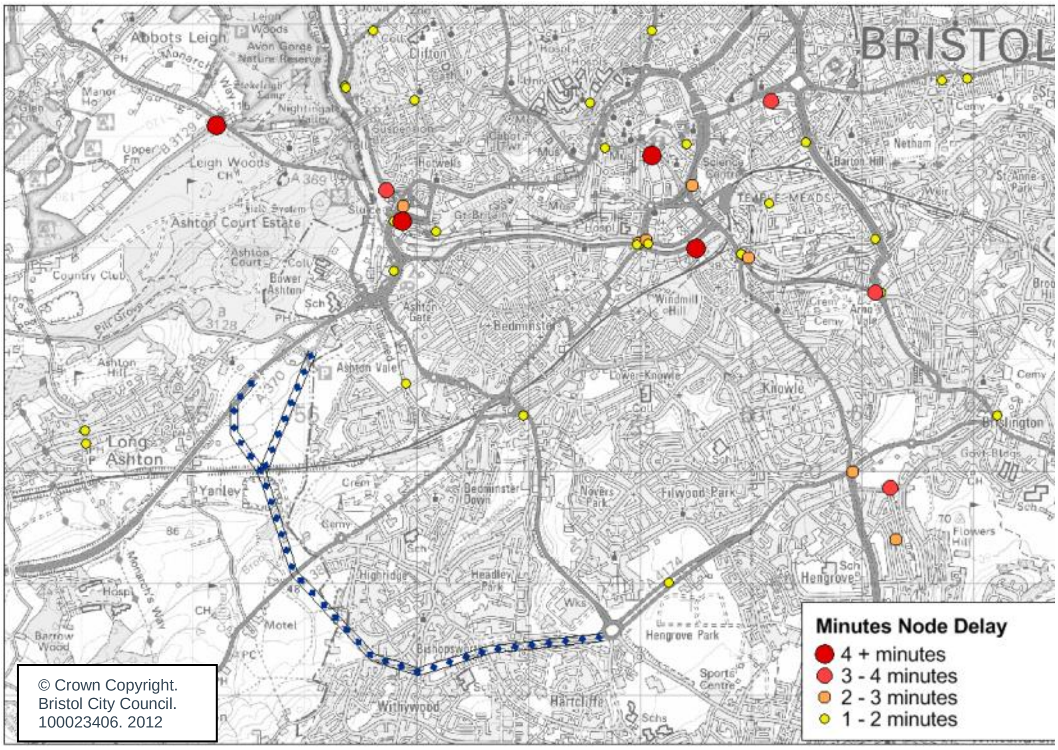


Figure 42 - Junction Delays on the Highway Network (2031 PM Peak)



Public Transport Mode

5.5.6. The impact of the SBL scheme on the Public Transport mode for the 2031 forecast year is summarised below by comparisons for each time period of the:

- overall network performance in terms of the number of boardings, travel distance and travel by bus and Metro Bus services;
- RT and Airport flow volumes along the SBL route;

Overall Network Performance

5.5.7. Table 23 summarises the overall performance on the public transport network in the 2031 forecast year. The total number of boardings doesn't change in any of the time periods. The total distance travelled increases across all three time periods with the largest change occurring in the AM Peak hour. The total passenger hours reduces in the Inter-peak by 6.3%.

Table 23. Travel by Public Transport (2031 With Intervention Case)

	Without Intervention	With Intervention	Difference	%Difference
AM Peak				
Boardings	22,900	22,900	0	0.0%
Passenger-kms	128,700	129,700	1,000	0.8%
Passenger-hours	7,200	7,200	0	0.0%
Inter-Peak				
Boardings	15,200	15,200	0	0.0%
Passenger-kms	94,100	94,200	100	0.1%
Passenger-hours	4,800	4,500	-300	-6.3%
PM Peak				
Boardings	20,400	20,400	0	0.0%
Passenger-kms	116,700	117,600	900	0.8%

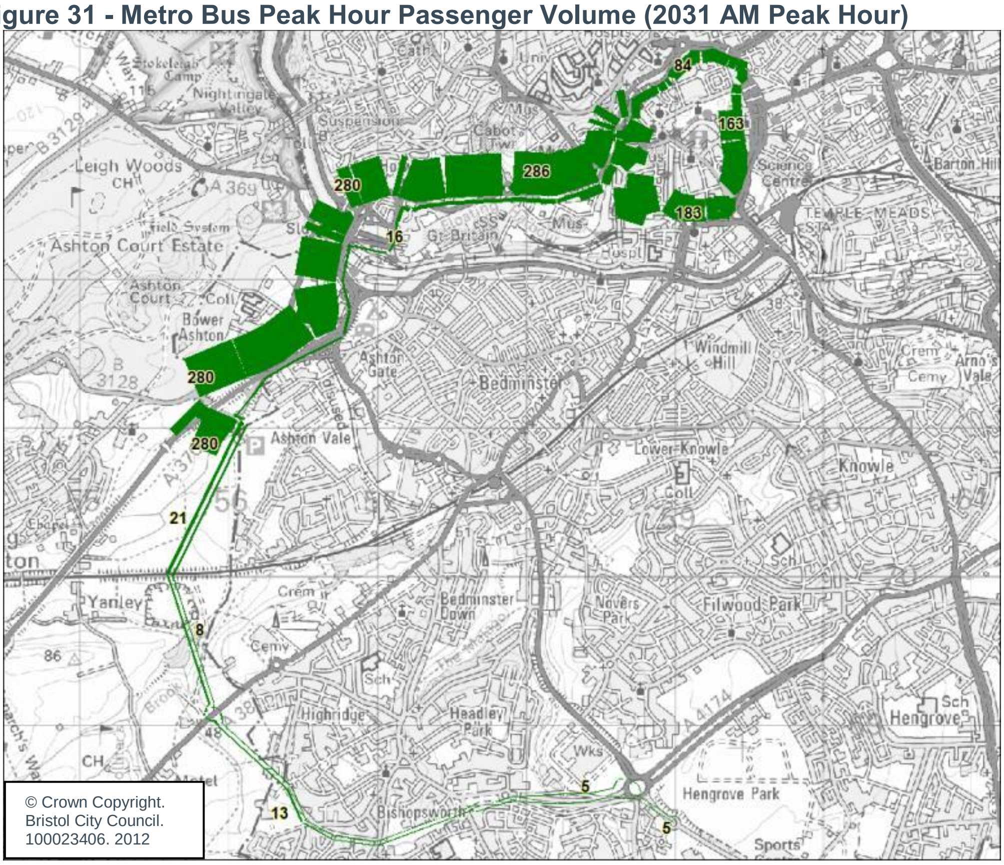
Passenger-hours	6,600	6,600	0	0.0%

Note: (i) Numbers may not sum to 100% due to rounding; (ii) Local rail services only

Metro Bus Route Flows

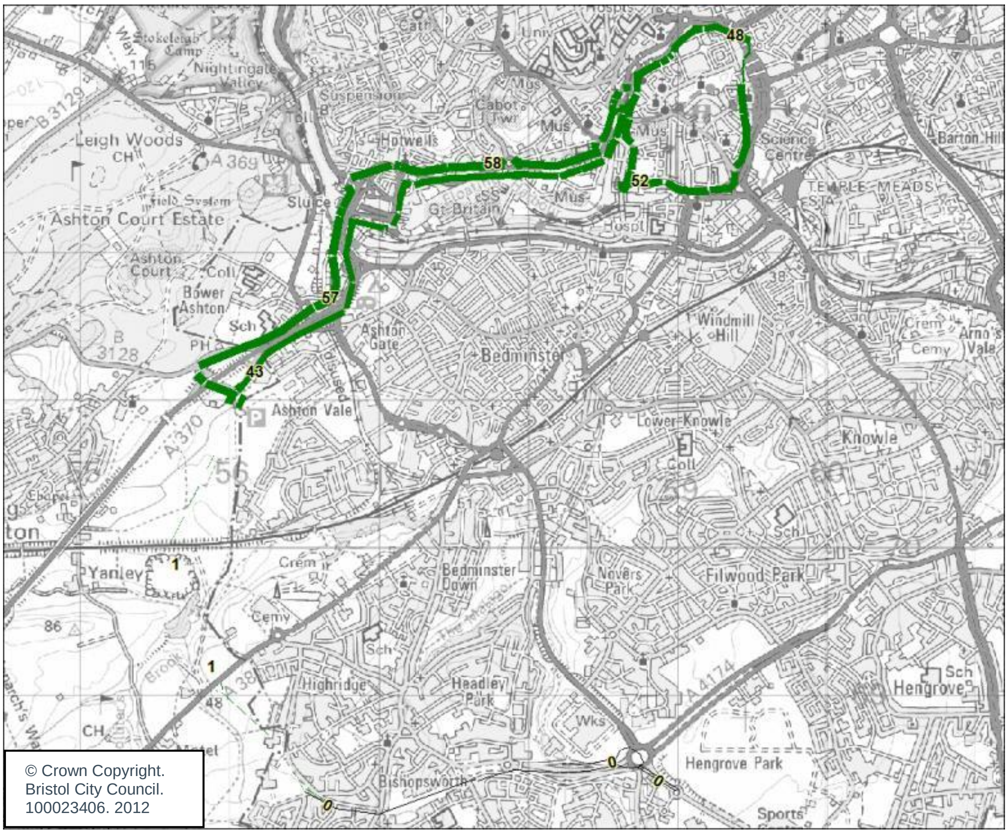
5.5.8. Figures 31 to 33 shows the hourly volume of passengers on the Metro Bus service in each time period. The AM peak hour has the highest patronage of the three time periods, with a significant proportion of passengers travelling from the Long Ashton Park and Ride site to Bristol City Centre. 32 passengers use the SBL section of the route in the AM peak hour and 39 passengers use it in the PM peak hour.

Figure 31 - Metro Bus Peak Hour Passenger Volume (2031 AM Peak Hour)



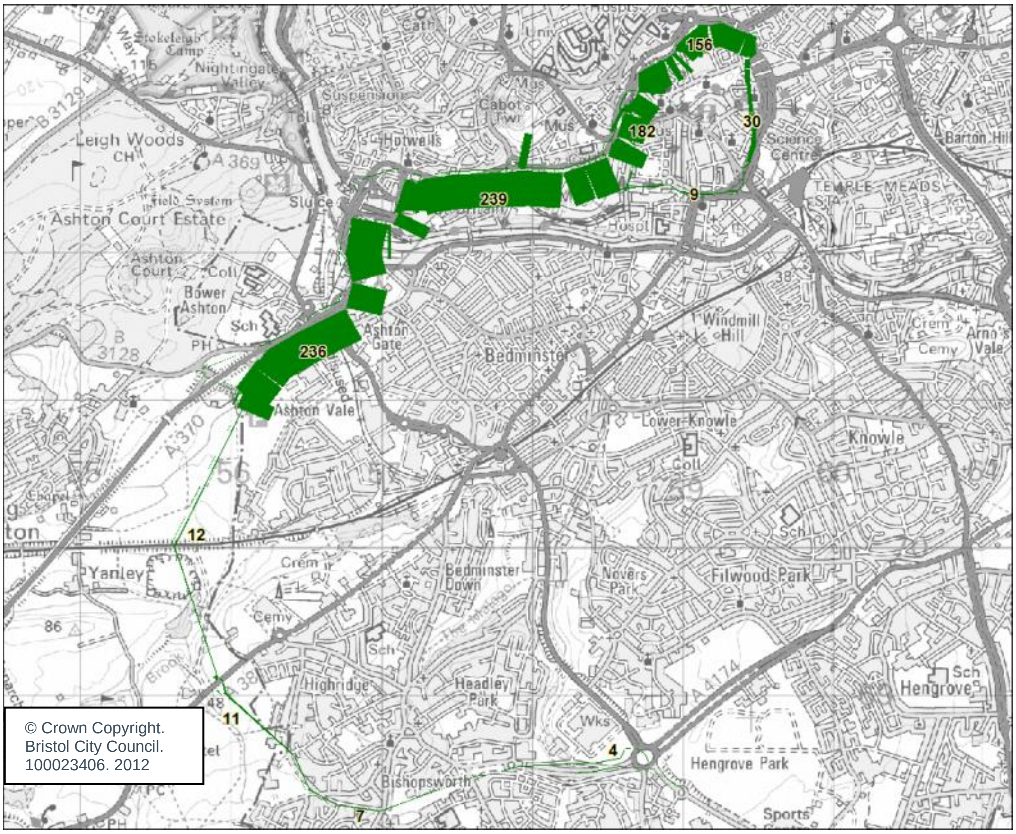
Units: persons per hour

Figure 32 - Metro Bus Peak Hour Passenger Volume (2031 Inter Peak Hour)



Units: persons per hour

Figure 33 - Metro Bus Peak Hour Passenger Volume (2031 PM Peak Hour)



Units: persons per hour

Other Outputs

Model Convergence

5.5.9. The model convergence for the Demand model and highway assignment sub-model for the With Intervention scenario are summarised in Appendix C. All the forecasts achieved the recommended convergence targets.

6. Summary

SBL Modelling System

6.1.1. The South Bristol Link (SBL) Model was developed to assess the transport impacts of the proposed SBL Highway and Metro Bus scheme. The model consists of three key elements:

- a Highway Assignment Model (HAM) representing vehicle-based movements across the Greater Bristol Area for a 2012 September weekday morning peak hour (08:00 – 09:00), an average inter-peak hour (10:00 – 16:00) and an evening peak hour (17:00 – 18:00);
- a Public Transport Assignment Model (PTAM) representing bus and rail-based movements across the same area and time periods, month and year; and
- a five-stage multi-modal Variable Demand Model that forecasts changes in trip frequency and choice of main mode, time period of travel, and destination, and sub-mode choice, in response to changes in generalised costs across the 24-hour period (07:00 – 07:00).

6.1.2. The model development took account of the Department for Transport's Transport Appraisal Guidance (TAG) Units as described in their respective Model Development Reports.

Forecasting Methodology

6.1.3. The SBL Model was used to assess the impacts of the Highway and Metro Bus scheme for two forecast years, namely 2016 to represent the Opening Year and 2031 for the Design Year.

6.1.4. The forecasting approach followed the methodology described in TAG Unit 3.15.1 'Forecasting Using Transport Models' and the other TAG Units referred to therein including TAG Unit 3.15.5 'The Treatment of Uncertainty in Model Forecasting'. The approach may be summarised as the development of:

- a reference case in which demands are forecast on the assumption of unchanged costs;
- a without-intervention case in which the reference case demands are modified so that they are consistent with the without-intervention forecast year networks and travel costs; and
- a with-intervention case in which the reference case demands are modified so that they are consistent with the with-intervention forecast year networks and travel costs;

Developing the Reference Case

6.1.5. The reference case was developed from the base year case by taking into account the growth in demand arising from changes in demographics and macro-economic factors between the 2012 base year and 2016/31 forecast years. The forecast growth in travel demand is described in more detail within this section.

6.1.6. The growth in demand between the base year and the two forecast years was derived using two datasets:

- Central Government forecasts provided by TEMPRO v6.2 dataset; and
- Local planning data provided in May 2011 by the West of England Partnership including the identified development sites within the sub-region.

6.1.7. The trip end growth was controlled to TEMPRO growth forecasts at the TEMPRO district level within the West of England sub-region but distributed on the basis of the more detailed local planning data provided by the West of England Partnership.

Generalised Cost Assumptions

6.1.8. The generalised cost assumptions were updated to reflect the changes in the model parameters between the 2012 base year and the 2016 and 2031 forecast years. The changes principally related to:

- Values of time;
- Vehicle occupancy;
- Vehicle operating costs;
- Public Transport Fares;
- Tolls and Road user charges; and
- Parking charges.

Without Intervention Case

6.1.9. There were a large number of proposed infrastructure improvements to the public transport and highway networks in the sub-region. A review undertaken by the West of England Partnership Organisation identified the proposed schemes that were either near certain or more than likely expected to be delivered by either the 2016 or 2031 forecast years. The Reference Case was updated with these infrastructure improvements and the SBL model used to develop the 'Without Intervention' Case for the 2016 and 2031 forecast years.

6.1.10. The SBL model was run using the Reference Case demand, the changes to the generalised cost assumptions and the revised highway and public transport networks to achieve equilibrium of the demand and the travel costs.

6.1.11. The model outputs from the 'Without Intervention' Case were reviewed with comparisons undertaken to understand how the existing travel conditions (as represented in the base case) changed over time. The review of the model outputs included the changes in the travel demand by mode and time period on the highway and public transport networks using a range of common performance indicators.

6.1.12. The review concluded that the performance of the highway and public transport networks in the 'Without Intervention' Case were credible and the model forecasts were robust.

With Intervention Case

6.1.13. The proposed Highway and Metro Bus scheme was added to the 2016 and 2031 'Without Intervention' case to create the 'With Intervention' case for each year. The changes to public transport and highway networks were as follows:

- the additional public transport links representing the new segregated alignment of the SBL scheme;
- changes to existing highway links to reflect the alterations in city centre priorities as part of the scheme;
- revisions to the existing walk links which connect zones to the SBL stops and link the SBL stops to others in the public transport network;
- a SBL service headways of 6 minutes in the peak periods and 10 minutes at other times were used in the model; and
- further optimisation of the traffic signals within the SBL corridor and the surrounding area in response to the revised traffic flows.

6.1.14. The SBL model was re-run using the Reference Case demand, the changes to the generalised cost assumptions and the revised highway and public transport networks to achieve equilibrium of the demand and the travel costs. The model outputs from the 'With Intervention' Case were reviewed with comparisons undertaken to understand how the existing travel conditions (as represented in the base case) changed over time. The review of the model outputs included the changes in the travel demand by mode and time period on the highway and public transport networks using a range of common performance indicators.

6.1.15. The review concluded that the performance of the highway and public transport networks in the 'With Intervention' Case were credible and robust.

6.1.16. The cumulative impacts of adding the Ashton Vale to Temple Meads (AVTM) scheme to the SBL scheme described in this report are contained in Appendix D, The AVTM scheme tested is consistent with that submitted for Public Inquiry in spring 2012.

Conclusions

6.1.17. The outputs from the assessment of the proposed South Bristol Link scheme using the SBL Model were suitable to be taken forward for use in the economic and environmental appraisal processes.

Appendices

Appendix A. Local Trip End Generation Rates

A.1. Trip Rates

A.1.1. The trip rates calculated from TRICS v6.8.1 are presented below for each of the land use categories required from the planning data. This includes the sub-categories for development type, e.g. residential, industrial etc and development location e.g. suburban, city centre and rural. The rates are presented as they are used in the model in 12 hour totals for both car and public transport (PT) modes.

Table A.1 Trip Generation Rates by Land-Use and Mode

Location	Development Type		12 Hour Productions		12 Hour Attractions	
			Car	PT*	Car	PT*
City Centre	Residential		1.774	0.127	1.585	0.066
	Retail		55.482	14.532	55.434	12.661
	Employment					
		Office	4.718	1.087	5.069	1.113
		Industrial	0.929	0.028	0.881	0.031
		Other	0.773	0.141	0.813	0.145
		School	2.650	1.047	2.638	1.101
Suburban	Residential		2.952	0.147	2.774	0.135
	Retail		93.503	1.147	92.339	1.046
	Employment					
		Office	7.722	1.604	7.938	1.603
		Industrial	3.543	0.013	3.412	0.012
		Other	2.516	0.131	2.477	0.136
		School	4.967	1.147	5.253	1.132
Rural	Residential		3.451	0.136	3.287	0.122
	Retail		67.683	0.566	67.254	0.790
	Employment					
		Office	7.237	0.420	7.462	0.436
		Industrial	4.320	0.026	4.174	0.017
		Other	2.332	0.039	2.315	0.044
		School	4.094	1.740	3.781	1.763

All rates are stated per 100 sq meters except for Other and School employment subcategories which are stated per job. This was in response to a number of developments within the planning data that were specified in this way.

Appendix B. Uncertainty Log

Changes between Base Year and 2031 Assumptions

	2031 DM	Completion of Planned Completion Date	Updated Level of Certainty
Newfoundland Circus Gyratory (Cabot Circus)	N/A	2008	Completed
M32 J3 signalisation	N/A	2008	Completed
Jacobs Wells signalisation	N/A	2008	Completed
M5 J19 capacity enhancements	Y	2011	Completed
Hartcliffe Roundabout signalisation	Y	2010/11	Completed
Callington Road/West Town Lane/Bath Road signals	N/A	2008/09	Completed
A38 to Cribbs Causeway distributor - part of the Filton Northfield development, includes associated bus links through the development site and conversion of existing Highwood Road to bus only.	Y	2010	Completed
Bristol to Avonmouth Rail - increased frequency from hourly to every 40 mins	N/A	2009	Certain
A432 - Kendleshire Southbound Bus Lane (non-GBBN)	N/A	2008	Completed
B4051 - Ashley Rd/Sussex Place signals (non-GBBN)	N/A	2009	Completed
Highwood Road eastbound bus lane (non-GBBN)	N/A	2008	Completed
Greater Bristol Bus Network - bus priority schemes and proposed service enhancements. This includes the developer-funded schemes within South Gloucestershire - see below:	*Y' see below.*	Various (all by 2013) - see below.	See below.
M32 southbound bus lane (GBBN).	N/A	2008	Completed
A4018/Lysander Road rbt bus lane (GBBN).	N/A	2008	Completed
New Road bus link (GBBN).	N/A	2008	Completed
Abbeywood rbt eastbound bus lane + rbt amendments (GBBN).	N/A	2009	Completed
A4/A4174 hicks gate rbt signalisation (GBBN).	N/A	2009	Completed
Lysander Road soutbound bus lanes (GBBN).	Y	2011	Completed
A38 Aztec West northbound bus lane (GBBN).	Y	2011	Completed
Great Stoke Way southbound bus lane (GBBN).	Y	2010	Completed
Filton Avenue Northbound Bus Lane (GBBN).	Y	2010	Completed
A4174 priority vehicle lanes, west of M32 J1 (GBBN).	Y	2011	Near Certain
Coldharbour Lane **northbound** bus lane (GBBN).	Y	2011	Near Certain
Cheswick and Romney Ave bus links (GBBN).	Y	2012	Near Certain
A4018 westbury rd southbound bus lane (GBBN).	Y	2012	Near Certain
Blackboy hill gyratory signalisation (GBBN).	Y	2012	Near Certain
Whiteladies road northbound bus lane (GBBN).	Y	2012	Near Certain
Whiteladies road/Cotham hill signalisation (GBBN).	Y	2012	Near Certain
A432 Stapleton Road southbound bus lane (GBBN).	Y	2012	Near Certain
A432/Muller Road signalisation (GBBN).	Y	2012	Near Certain
A432 Fishponds Rd southbound bus lanes (GBBN).	Y	2012	Near Certain
A432 Fishponds Rd/Manor Rd signalisation (GBBN).	Y	2012	Near Certain
A4 eastbound bus lanes at Brislington (GBBN).	Y	2012	Near Certain
A4 Bath Rd westbound bus lane at Totterdown (GBBN).	Y	2012	Near Certain
Portbury High St junction signal control (GBBN).	Y	2011	Near Certain
A369 Wesbound HOV lane (GBBN).	Y	2011	Near Certain
St Georges Hill junction signalisation (GBBN).	Y	2011	Near Certain
Bus Lane - M5 Junction 21 westbound Approach. Operational during peak hours (GBBN).	Y	2010	Completed
Bus Lane - Congresbury (Southbound 24 hour bus lane on A370, on approach to junction with the B3133). Existing 30mph speed limit will has been extended throughout Congresbury (GBBN).	Y	2010	Completed
A369 eastbound HOV lane at Beggar Bush Lane (GBBN)	N	2010	Abandoned
A369 Portbury Hundred widening (GBBN).	Y	2011	Near Certain
Pegasus Road eastbound bus lane (GBBN)	N	N/A	Abandoned
Aztec West bus link (GBBN)	N	N/A	Abandoned
A38 Northbound bus lane at Filton Rbt (GBBN)	N	N/A	Abandoned
Clifton triangle bus lanes (GBBN)	N	N/A	Abandoned
Aztec West east-west bus lanes (GBBN)	N	N/A	Abandoned

A4174 priority vehicle lanes, Bromley Heath to Emerson's Green (GBBN)	N	N/A	Abandoned
A4174 Rosary Rbt signalisation (GBBN)	Y	2014/15	Near Certain
A4174 widening west of Coldharbour lane (GBBN)	N	N/A	Abandoned
A432/A4320 junction amendments (GBBN).	N	N/A	Abandoned
City Centre to Emerson's Green rapid transit (cycle path) (non-GBBN)	N	N/A	Deferred
M5 J21 improvements (modelled in G-NSM).	Y	2011	Completed
Access to the Weston Airfield Development by roundabout junctions on Winterstoke Road and A371 Locking Moor Road.	Y	Expected by 2012	Near Certain
30 minute headway service between Locking Parklands and Weston-Super-Mare town centre; serving the Weston Airfield Development (PT model).	Y	Expected by 2015	Near Certain
30 minute headway service between Locking Parklands and Morrison's via the Weston Airfield Development (PT model).	Y	Expected by 2015	Near Certain
60 minute headway service between Wick Wick and Weston-Super-Mare town centre (PT model).	Y	2009	Completed
HA M4/M5 Managed Motorway - peak period capacity enhancements through dynamic hard shoulder running and variable speed limits.	Y	2014	Near Certain
Harry Stoke/A4174 - New junction and roads as part of Harry Stoke development	Y	Expected by 2016	Near Certain
Emerson's Green East Park & Ride	Y	Expected by 2016	Near Certain
Callington Road Link.	N	By 2031	Reasonably foreseeable
Portishead to Bristol Rail Line	N	By 2031	Reasonably foreseeable
Ashton Vale Infrastructure - supporting infrastructure for the South West Urban Extension Development	N	N/A	Abandoned
Barrow Gurney Bypass - Road linking A37 and A370	N	By 2031	Reasonably foreseeable
Banwell Bypass	N	2031	Reasonably Forseeable
ABL cycle link - Bridge between Airfield and Winterstoke Rd	N	2016	Reasonably Forseeable

Appendix C. Model Convergence

C.1. Introduction

C.1.1. The stability of the SBL demand and highway models for the Without-Intervention and With Intervention are summarised below. All the models were achieved the recommended convergence targets namely:

- Demand model: %GAP < 0.1% (TAG Unit 3.10.4c); and
- Highway Assignment: %GAP < 0.35% and %Flows (+/-1%) > 98% (TAG Unit 3.19c).

C.2. Without Intervention

Table C.1 SBL Demand Model Convergence

Criteria	2016 (24 hr)	2031 (24 hr)
Convergence after Loop #	11	14
% Supply-Demand Gap	0.0788	0.0802

Source: 16/31SB0018

Table C.2 SBL Highway Model Convergence

Criteria	AM Peak			Inter Peak			PM Peak		
	2012	2016	2031	2012	2016	2031	2012	2016	2031
Convergence after loop #	37	27	51	19	31	38	14	65	73
% Flows differing by<1%	98.8	99.1	99.4	99.2	99.8	99.1	99.1	99.3	99.4
% GAP	0.009	0.009	0.009	0.004	0.001	0.009	0.05	0.008	0.008

Source: 16/31SB0018

C.3. With Intervention

Table C.3 SBL Demand Model Convergence (With Intervention)

Criteria	2016 (24 hr)	2031 (24 hr)
Convergence after Loop #	11	14
% Gap	0.0877	0.0929

Source: 16/31SB1019

Table C.4 SBL Highway Model Convergence (With Intervention)

Criteria	AM Peak			Inter Peak			PM Peak		
	2012	2016	2031	2012	2016	2031	2012	2016	2031
Convergence after loop #	37	24	46	19	18	36	14	38	68
% Flows differing by<5%	98.8	98.6	99.6	99.2	99	98.9	99.1	99.2	99.6
% GAP	0.009	0.007	0.008	0.004	0.004	0.006	0.05	0.009	0.008

Source: 16/31SB1019

Appendix D. Cumulative Impacts of SBL with AVTM

D.1. Introduction

D.1.1. This appendix describes the cumulative impacts of adding the Ashton Vale to Temple Meads (AVTM) rapid transit scheme to the SBL scheme. All comparisons are made against the SBL with intervention scenario described in the main body of the report. The AVTM scheme tested is consistent with that submitted for Public Inquiry in spring 2012.

D.2. The Scheme

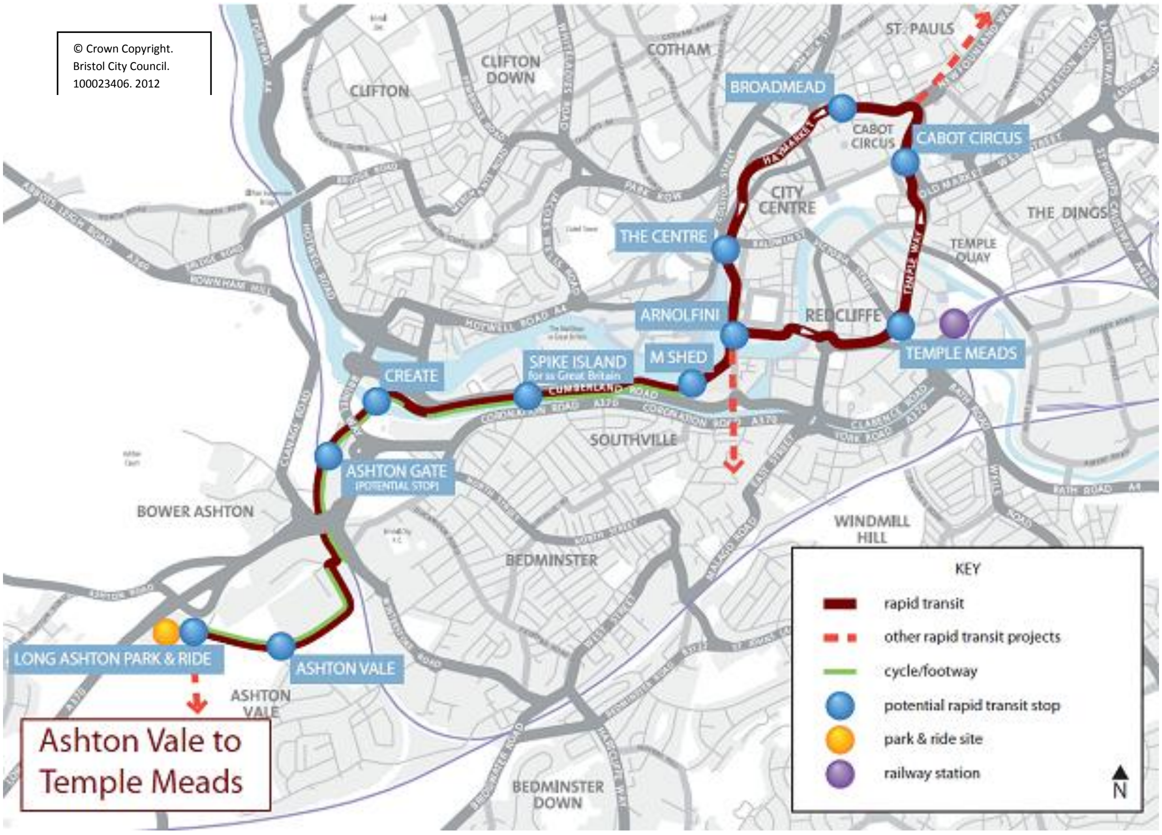
D.2.1. This cumulative impact assessment includes the addition of the Ashton Vale to Temple Meads scheme as a Rapid Transit service replacing the current P&R bus service from Long Ashton to the SBL scheme. It improves journey times into the city centre and also serves key tourist attractions along Cumberland Road.

D.2.2. The Ashton Vale – Temple Meads scheme (Figure D1) comprises:

- a new partially off-line Rapid Transit (RT) service between Long Ashton P&R site and the City Centre;
- interchange and urban realm improvements within the City Centre; and
- rerouting of existing buses from North Somerset to utilise the offline section of the RT route.

D.2.3. The addition of the AVTM scheme enables the existing park and ride service extension from Ashton Vale to Hengrove to be replaced with the rapid transit service.

Figure D1 - AVTM Scheme



D.2.4. The standard set of model reports was produced to assess the impact of the proposed cumulative impacts of adding AVTM to the SBL scheme. The outputs from the SBL model system for the 2016 and 2031 forecast years are separately summarised in the remainder of this section and compare the Without and Without Intervention cases using the following performance measures:

- the changes in travel demands forecast by the SBL Demand model;

- the changes in the performance of the Public Transport network including examination of the Metro Bus service and airport buses; and
- the changes in the travel conditions on the highway network.

D.3. 2016 Forecast Year

Demand Model

Overall Mode Share

D.3.1. For 2016, there is very little shift in overall mode shares (across the larger modelled area), shown in Table D1 below. The only changes being a small decrease in car tips and an increase in park and ride and bus trips, as would be expected with the addition of the AVTM scheme.

Table D1 - Travel by Mode (2016 SBL With AVTM)

	With SBL only		SBL With AVTM		Change in	
	Trips	**Mode Share**	**Trips**	**Mode Share**	**Trips**	**Mode Share***
AM Peak						
Car	136,400	86.4%	136,200	86.2%	-200	-0.24%
Park and Ride	900	0.6%	1,200	0.8%	300	0.19%
Bus	13,600	8.6%	13,700	8.7%	100	0.05%
Rail	6,900	4.4%	6,900	4.4%	-	-0.01%
Total	**157,800**	**100.0%**	**158,000**	**100.0%**	200	0.00%
Inter-peak						
Car	115,600	90.4%	115,600	90.4%	-	0.00%
Park and Ride	400	0.3%	400	0.3%	-	0.00%
Bus	10,000	7.8%	10,000	7.8%	-	0.00%
Rail	1,900	1.5%	1,900	1.5%	-	0.00%
Total	**127,900**	**100.0%**	**127,900**	100.0%		0.00%
PM Peak						
Car	145,600	87.8%	145,500	87.7%	-100	-0.17%
Park and Ride	800	0.5%	1,100	0.6%	300	0.18%
Bus	11,700	7.1%	11,800	7.1%	100	0.05%
Rail	7,600	4.6%	7,600	4.6%	-	-0.01%
Total	**165,800**	**100.0%**	**166,000**	**100.0%**	200	0.00%

Note: (i) Numbers may not sum due to rounding; (ii) * change in percentage points

Public Transport Impact

D.3.2. The impact of the SBL with AVTM scheme on the Public Transport mode for the 2016 forecast year is summarised below by comparisons for each time period of the:

- overall network performance in terms of the number of boardings, travel distance and travel by bus and Metro Bus services; and
- passenger volumes along the SBL route;

Overall Network Performance

D.3.3. The overall performance on the public transport network in the 2016 forecast year is summarised in Table D2. There is no change in the number of passenger boardings in any of the three time periods. The total distance travelled increases by less than 1% across all three time periods, and travel time decreases by just over 3% in all three peaks, indicating that slightly longer routes are being taken but that these routes are quicker than routes taken in the with SBL only scenario.

Table D2 - Travel by Public Transport (2016 SBL With AVTM Case)

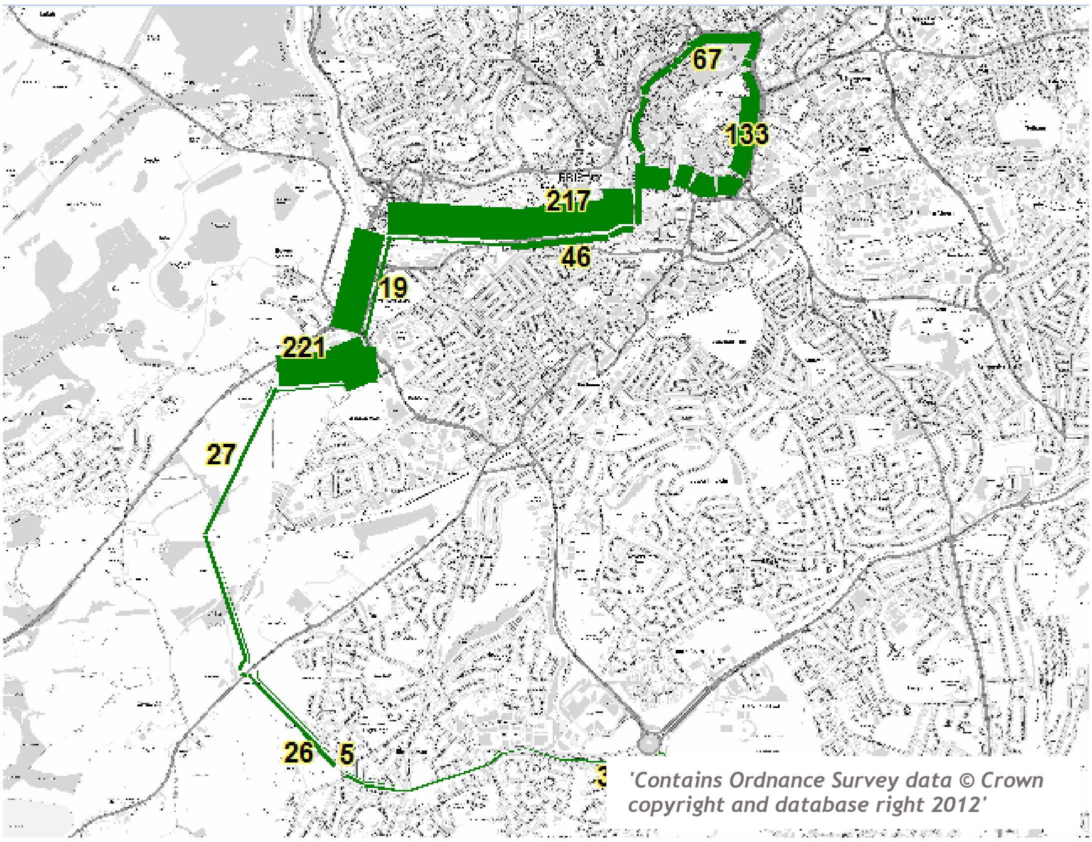
	With SBL Only	SBL With AVTM	Difference	%Difference
AM Peak				
Boardings	21,300	21,300	0	0.0%
Passenger-kms	115,800	116,300	500	0.4%
Passenger-hours	6,400	6,200	-200	-3.1%
Inter-Peak				
Boardings	13,600	13,500	0	-1%
Passenger-kms	79,000	78,500	0	-1%
Passenger-hours	4,000	3,900	0	-3%
PM Peak				
Boardings	17,700	17,700	0	0%
Passenger-kms	96,700	97,300	600	0.6%
Passenger-hours	5,400	5,200	-200	-3.7%

Note: (i) Numbers may not sum due to rounding; (ii) Local rail services only

SBL Bus Route Flows

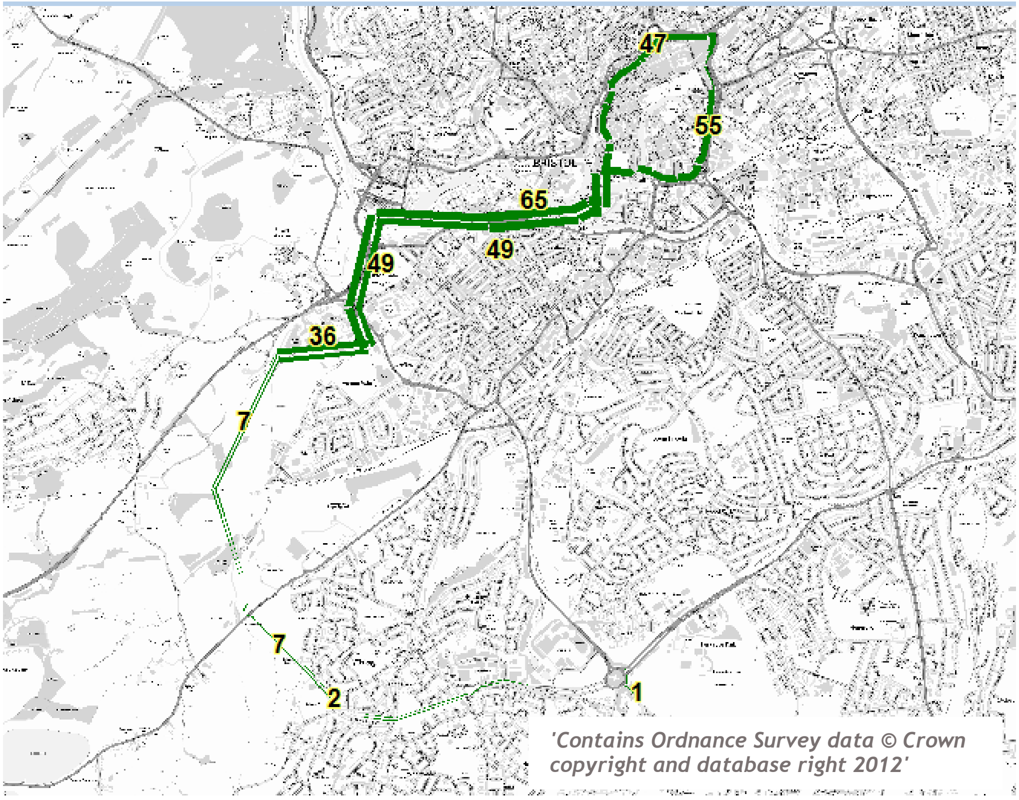
D.3.4. The hourly volumes of passengers on the bus service in each time period are shown in Figure d2 to D4. More passengers use the SBL section of the Metro Bus route in the AM peak hour than in the Inter-peak hour although a similar volume to the AM peak uses the service in the PM peak hour.

Figure D2 - Metro Bus Peak Hour Passenger Volume (2016 AM Peak Hour)



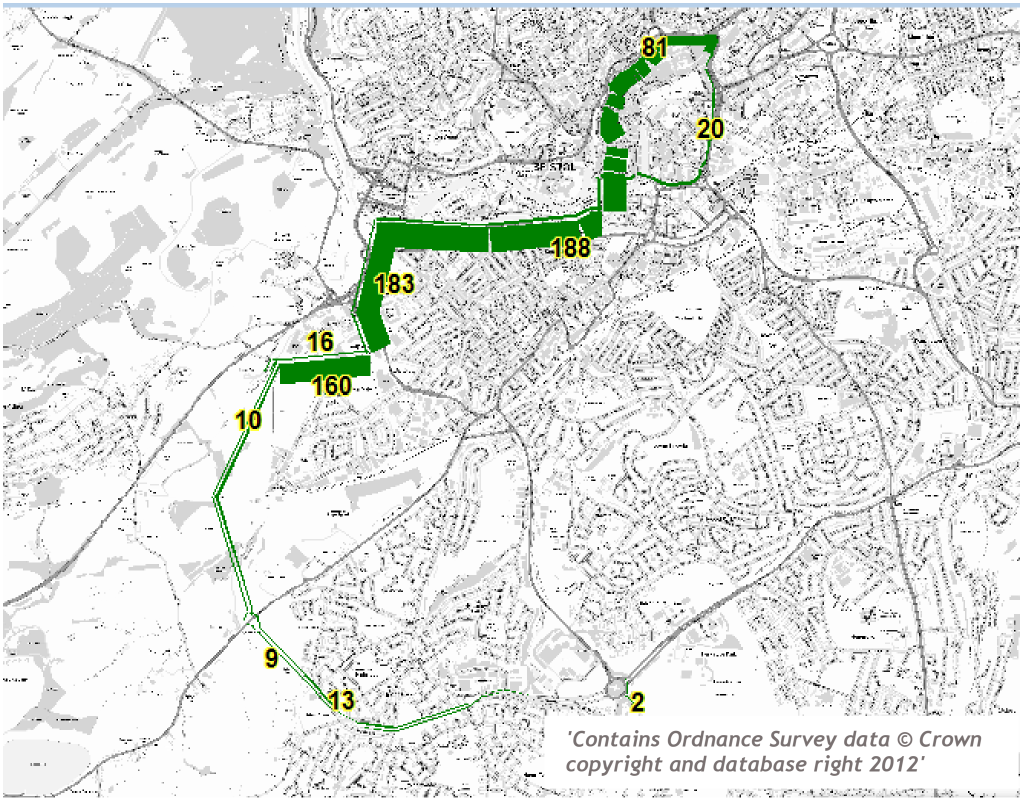
Units: persons per hour

Figure D3 - Metro Bus Peak Hour Passenger Volume (2016 Inter Peak Hour)



Units: persons per hour

Figure D4 - Metro Bus Peak Hour Passenger Volume (2016 PM Peak Hour)



Units: persons per hour

Highway Mode

D.3.5. The impact of the SBL with AVTM scheme on the highway mode for the 2016 forecast year is summarised by comparisons of the:

- overall network performance in terms of the total number of trips, travel distance, travel time and delay;
- node delays across the Fully Modelled Area; and
- changes in traffic volumes across the Fully Modelled Area.

The comparisons are presented below.

Overall Network Performance

D.3.6. Table 19 summarises the overall performance on the highway network in the 2016 forecast year. Across all three time periods, the overall change in total number of highway trips, travel distance and time are small with differences of less than 0.2% between the With SBL Only and SBL With AVTM Cases.

Table D3 - Travel by Road (2016 SBL With AVTM Case)

	SBL Only	SBL With AVTM	Difference	%Difference
AM Peak				
Trips (pcus/hr)	128,700	128,700	0	0.0%
Travel Distance (pcu-kms)	4,323,300	4,322,700	-600	0.0%
Travel Time (pcu-hrs)	63,100	63,100	0	0.0%
Delay (pcu-hrs)	9,800	9,800	0	0.0%
Inter-Peak				
Trips (pcus/hr)	105,400	105,400	0	-0.1%
Travel Distance (pcu-kms)	4,112,500	4,112,400	-100	+0.0%
Travel Time (pcu-hrs)	54,000	54,100	100	+0.2%
Delay (pcu-hrs)	5,500	5,500	0	+0.0%
PM Peak				
Trips (pcus/hr)	120,200	120,200	100	+0.1%
Travel Distance (pcu-kms)	4,143,400	4,145,500	2,100	+0.1%
Travel Time (pcu-hrs)	61,300	61,400	100	+0.2%
Delay (pcu-hrs)	10,200	10,200	0	+0.0%

Flow Differences

D.3.7. The forecast changes in traffic flows on the highway network occurring with the introduction of the SBL with AVTM scheme in the 2016 forecast year are shown in Figure D5 to D7. The only notable change is re-routing around the city centre due to the closure of Prince Street Bridge to general traffic and a slight increase in traffic through Long Ashton to access the Ashton Vale park and ride site. Elsewhere there is very little change in the network especially along SBL.

Figure D5 - Changes in Traffic Flows on the Highway Network (2016 AM Peak)

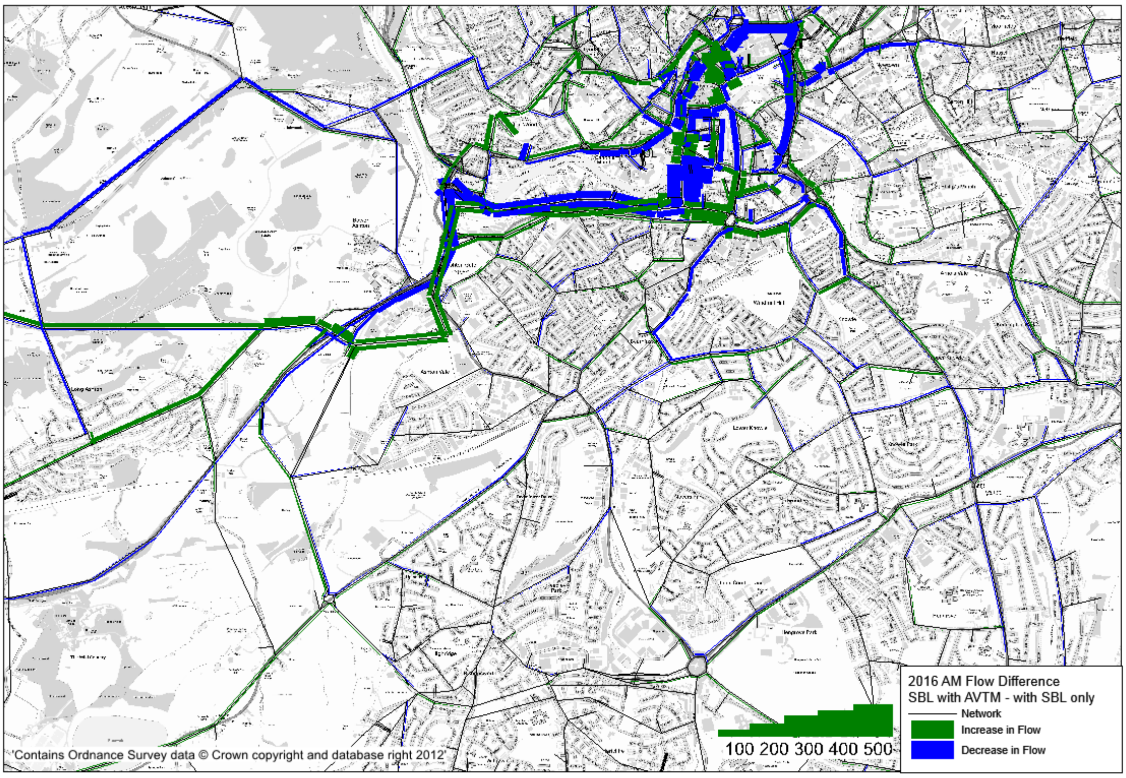


Figure D6 - Changes in Traffic Flows on the Highway Network (2016 Inter Peak)

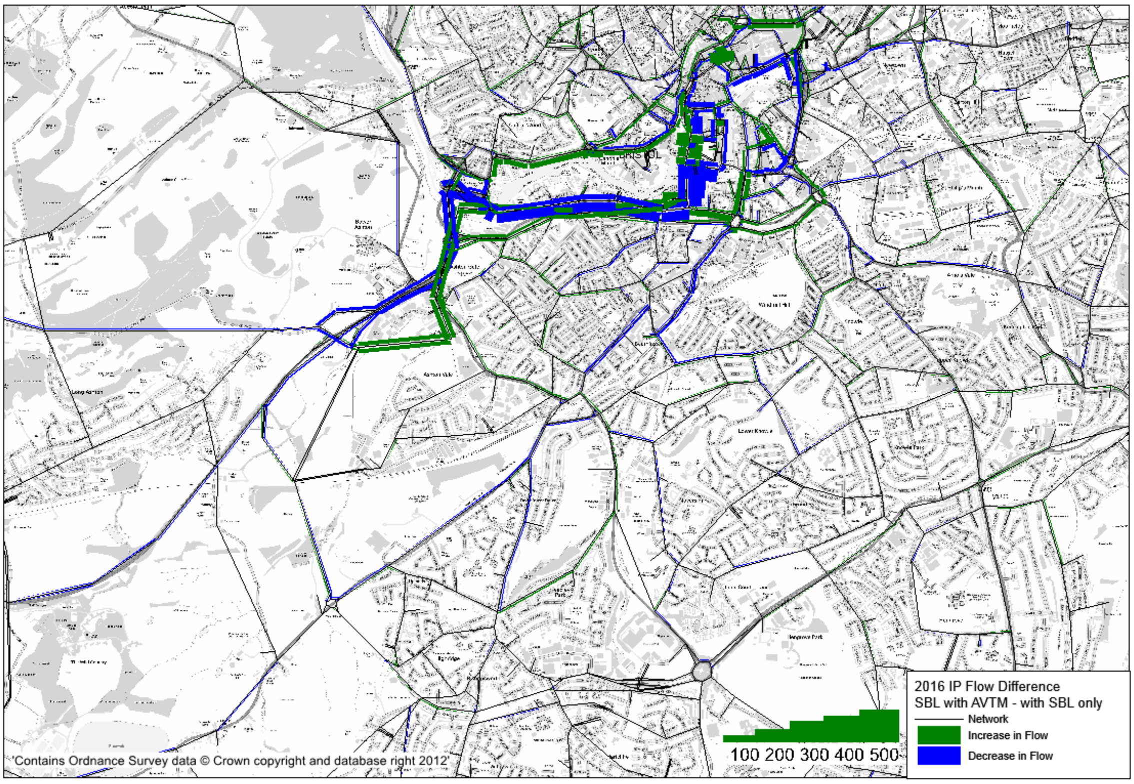
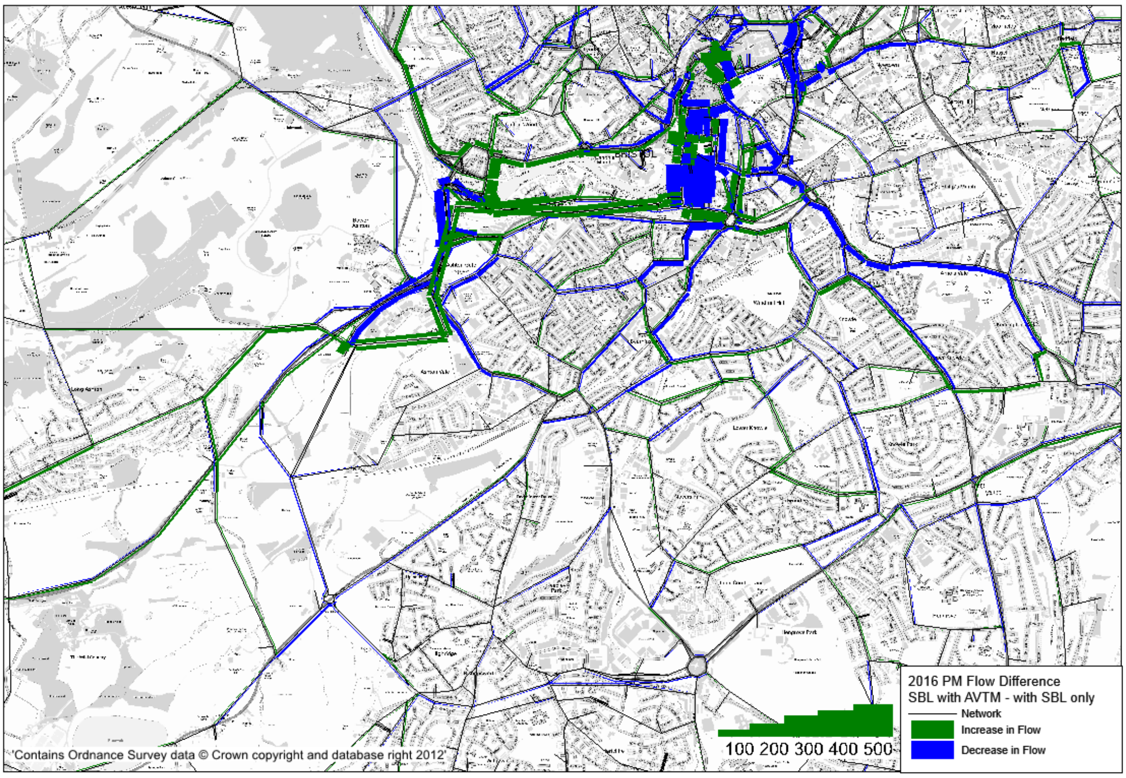


Figure D7 - Changes in Traffic Flows on the Highway Network (2016 PM Peak)



D.4. 2031 Forecast Year

Demand Model

Overall Mode Share

D.4.1. For 2031, there is very little shift in overall mode shares (across the large modelled area), shown in Table D4 below. The only changes being a small decrease in car tips and an increase in park and ride and bus trips, as would be expected with the addition of the AVTM scheme.

Table D4 - Travel by Mode (2031 SBL With AVTM Case)

	With SBL Only		SBL With AVTM		Change in	
	Trips	Mode Share	Trips	Mode Share	Trips	Mode* Share
AM Peak						
Car	154,200	87.5%	154,000	87.2%	-200	-0.31%
Park and Ride	1,200	0.7%	1,600	0.9%	400	0.22%
Bus	14,300	8.1%	14,400	8.1%	100	0.04%
Rail	6,700	3.8%	6,700	3.8%	0	-0.01%
Total	176,300	100.0%	**176,700**	**100.0%**	400	0.00%
Inter-peak						
Car	137,400	91.2%	137,300	91.2%	-100	-0.07%
Park and Ride	400	0.3%	500	0.3%	100	0.07%
Bus	10,800	7.2%	10,800	7.2%	0	0.00%
Rail	2,000	1.3%	2,000	1.3%	0	0.00%
Total	150,600	100.0%	**150,600**	100.0%	0	0.00%

	With SBL Only		SBL With AVTM		Change in	
	Trips	Mode Share	Trips	Mode Share	Trips	Mode* Share
PM Peak						
Car	164,600	88.5%	164,600	88.3%	0	-0.14%
Park and Ride	1,000	0.5%	1,300	0.7%	300	0.16%
Bus	12,900	6.9%	13,000	7.0%	100	0.04%
Rail	7,400	4.0%	7,400	4.0%	0	-0.01%
Total	186,000	100.0%	**186,300**	**100.0%**	300	0.00%

Note: (i) Numbers may not sum due to rounding; (ii) * change in percentage points

Public Transport Mode

D.4.2. The impact of the SBL with AVTM scheme on the Public Transport mode for the 2031 forecast year is summarised below by comparisons for each time period of the:

- overall network performance in terms of the number of boardings, travel distance and travel by bus and Metro Bus services;
- RT and Airport flow volumes along the SBL route;

Overall Network Performance

D.4.3. Table D5 summarises the overall performance on the public transport network in the 2031 forecast year. The total number of boardings increases in the AM and PM peaks and decreases in the Inter-peak. Although the model does not link trips, the inference from these results is that some trips in the inter-peak are switching to the morning peak as the addition of the AVTM scheme provides a public transport route into central Bristol that is predominantly off-road and not affected by congestion. The total distance travelled increases in the AM and PM peaks and decreases in the Inter-peak. The total passenger hours reduces in all three peaks, reflecting the enhanced service offered by AVTM.

Table D5 - Travel by Public Transport (2031 SBL With AVTM Case)

	With SBL Only	SBL With AVTM	Difference	%Difference
AM Peak				
Boardings	22,900	23,100	200	0.9%
Passenger-kms	129,700	131,400	1,700	1.3%
Passenger-hours	7,200	6,900	-300	-4.2%
Inter-Peak				
Boardings	15,200	15,000	-200	-1.3%
Passenger-kms	94,200	93,500	-700	-0.7%
Passenger-hours	4,500	4,500	0	-6.3%
PM Peak				
Boardings	20,400	20,600	200	1.0%
Passenger-kms	117,600	118,900	1,300	1.1%
Passenger-hours	6,600	6,400	-200	-3.0%

Note: (i) Numbers may not sum due to rounding; (ii) Local rail services only

Metro Bus Route Flows

D.4.4. The hourly volumes of passengers on the Metro Bus service in each time period are shown in Figure D8 to Figure D11. The AM peak hour has the highest patronage of the three time periods, with approximately 300 passengers travelling from the Long Ashton Park and Ride site to Bristol City Centre in the morning peak.

Figure D8 - Metro Bus Peak Hour Passenger Volume 2031 AM Peak Hour (persons per hour)

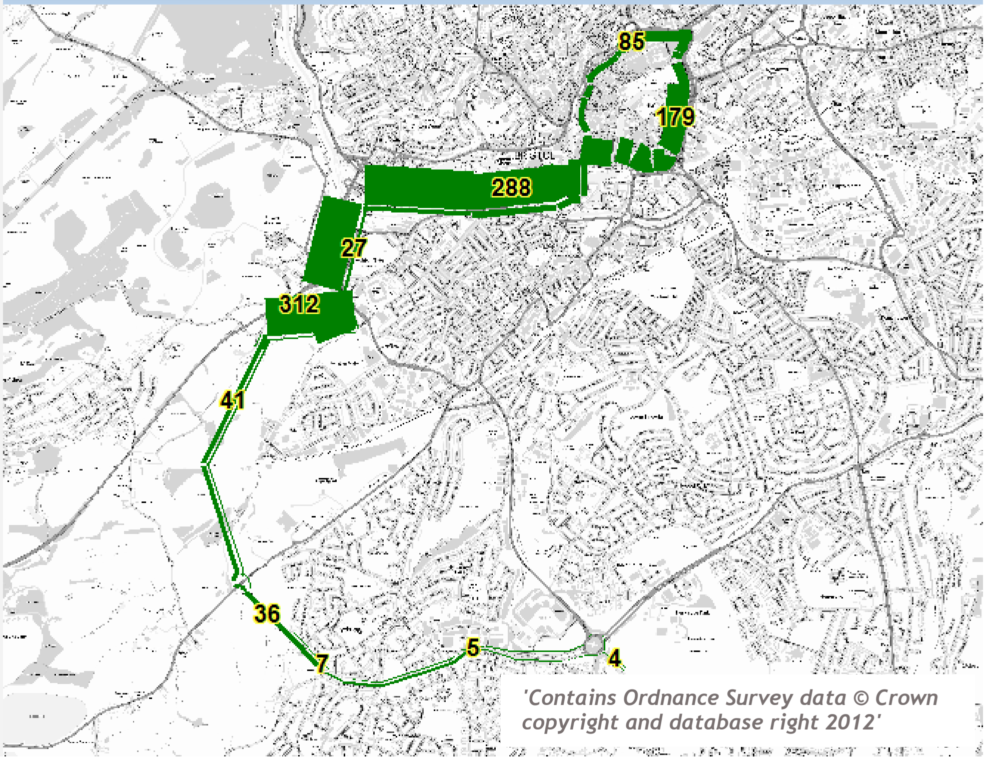


Figure D9 - Metro Bus Peak Hour Passenger Volume 2031 Inter-Peak Hour (persons per hour)

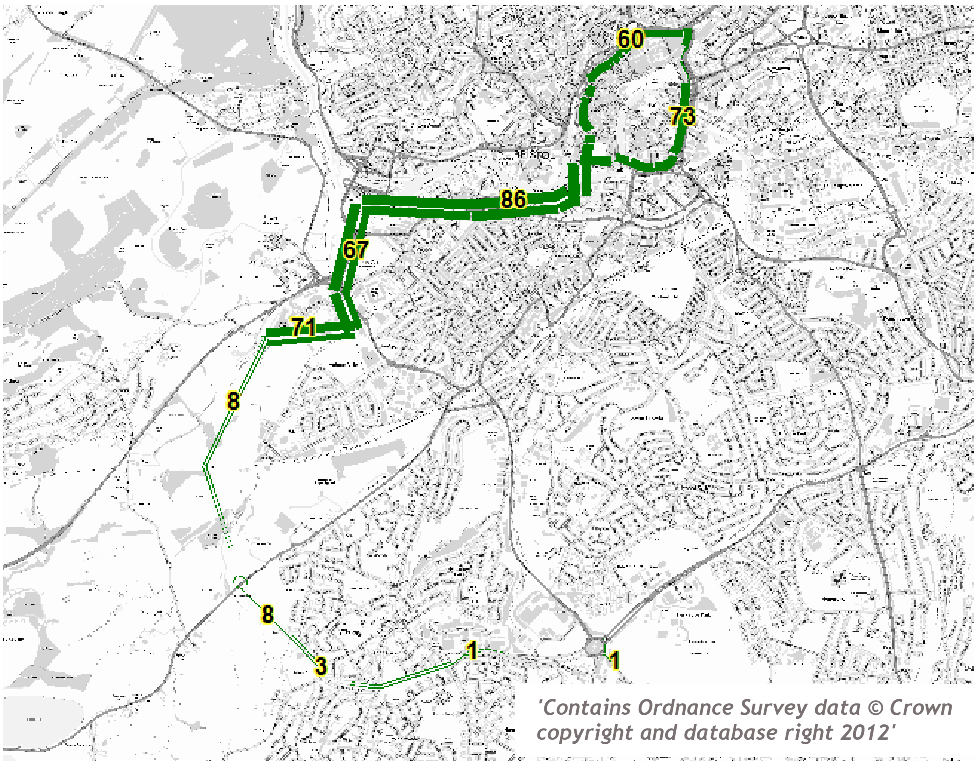
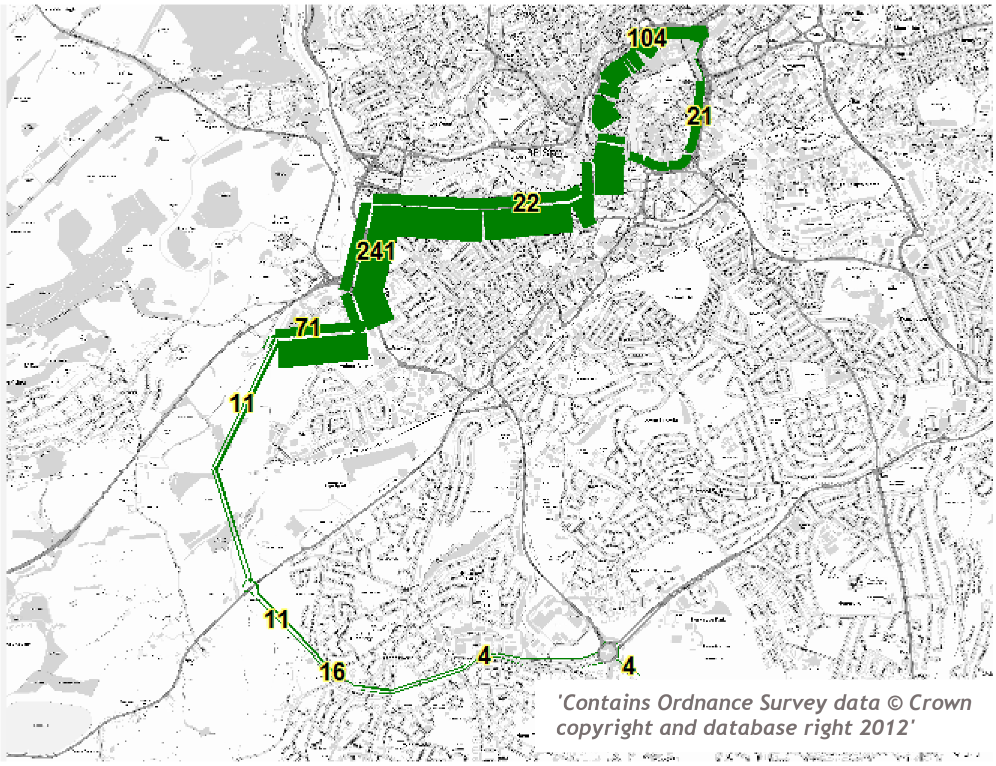


Figure D10 - Metro Bus Peak Hour Passenger Volume 2031 PM Peak Hour (persons per hour)



Highway Mode

D.4.5. The impact of the SBL with AVTM scheme on the highway mode for the 2031 forecast year is summarised by comparisons of the:

- overall network performance in terms of the total number of trips, travel distance, travel time and delay; and
- changes in traffic volumes across the Fully Modelled Area.

D.4.6. The comparisons are presented below.

Overall Network Performance

D.4.7. Table D6 summarises the overall performance on the highway network in the 2016 forecast year. Across all three time periods, the overall change in total number of highway trips, travel distance and time are small with differences of less than 0.2% between the With SBL Only and SBL With AVTM Cases.

Table D6 - Travel by Road (2031 With Intervention Case)

	With SBL Only	SBL With AVTM	Difference	%Difference
AM Peak				
Trips (pcus/hr)	152,300	152,400	100	0.1%
Travel Distance (pcu-kms)	5,218,200	5,219,400	1,200	0.0%
Travel Time (pcu-hrs)	82,400	82,500	100	0.1%
Delay (pcu-hrs)	18,100	18,200	100	0.6%

	With SBL Only	SBL With AVTM	Difference	%Difference
Inter-Peak				
Trips (pcus/hr)	129,700	129,500	-200	-0.2%
Travel Distance (pcu-kms)	4,976,100	4,974,000	-2,100	0.0%
Travel Time (pcu-hrs)	67,900	67,900	0	0.0%
Delay (pcu-hrs)	8,800	8,800	0	0.0%
PM Peak				
Trips (pcus/hr)	141,700	141,900	200	0.1%
Travel Distance (pcu-kms)	5,000,500	5,005,400	4,900	0.1%
Travel Time (pcu-hrs)	80,000	80,400	400	0.5%
Delay (pcu-hrs)	18,200	18,600	400	2.2%

Flow Differences

D.4.8. The forecast changes in traffic flows on the highway network occurring with the introduction of the AVTM scheme in the 2031 forecast year are shown in Figure D11 to Figure D13. Similarly to 2016 there is a lot of re—routing around the city centre due to the closure of Prince Street Bridge, the rest of the network sees only a small change and an increase in traffic through Long Ashton accessing the park and ride. There are some very small changes in traffic volumes on the SBL between the A38 and A370 between the different time periods, reflecting some very minor change in traffic routing. Overall the impact of the addition of AVTM in traffic terms is very limited.

Figure D11 - Changes in Traffic Flows on the Highway Network (2031 AM Peak)

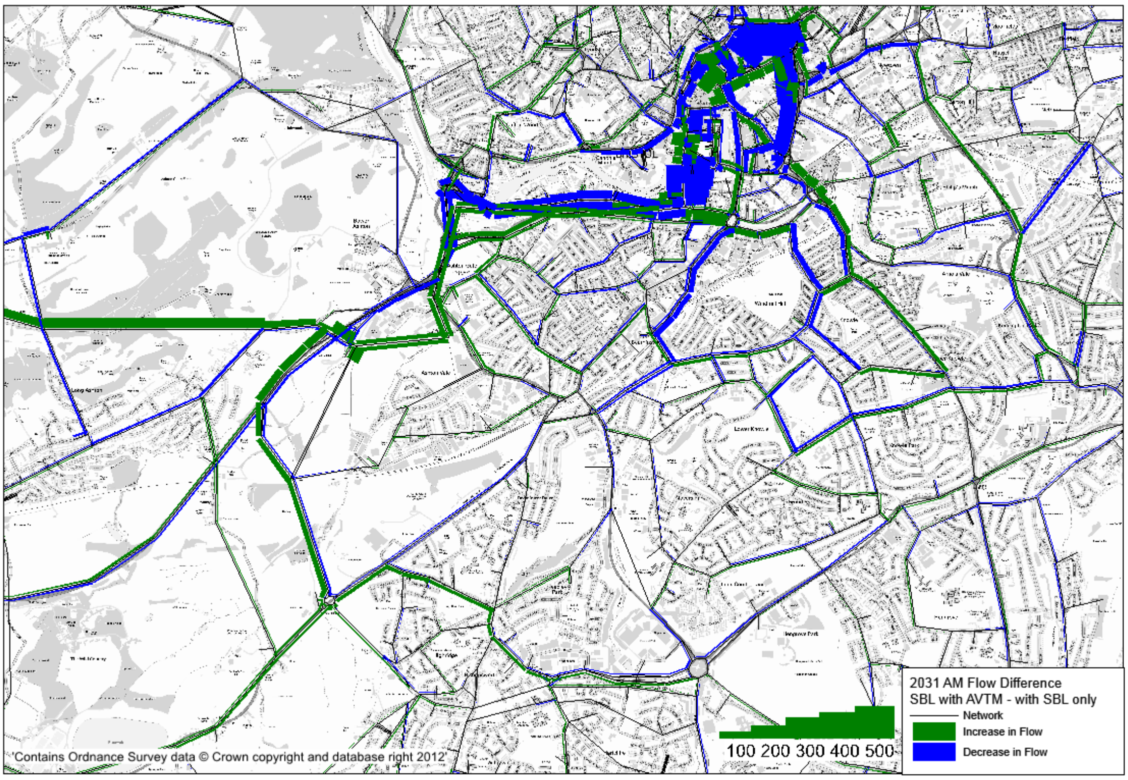


Figure D12 - Changes in Traffic Flows on the Highway Network (2031 Inter Peak)

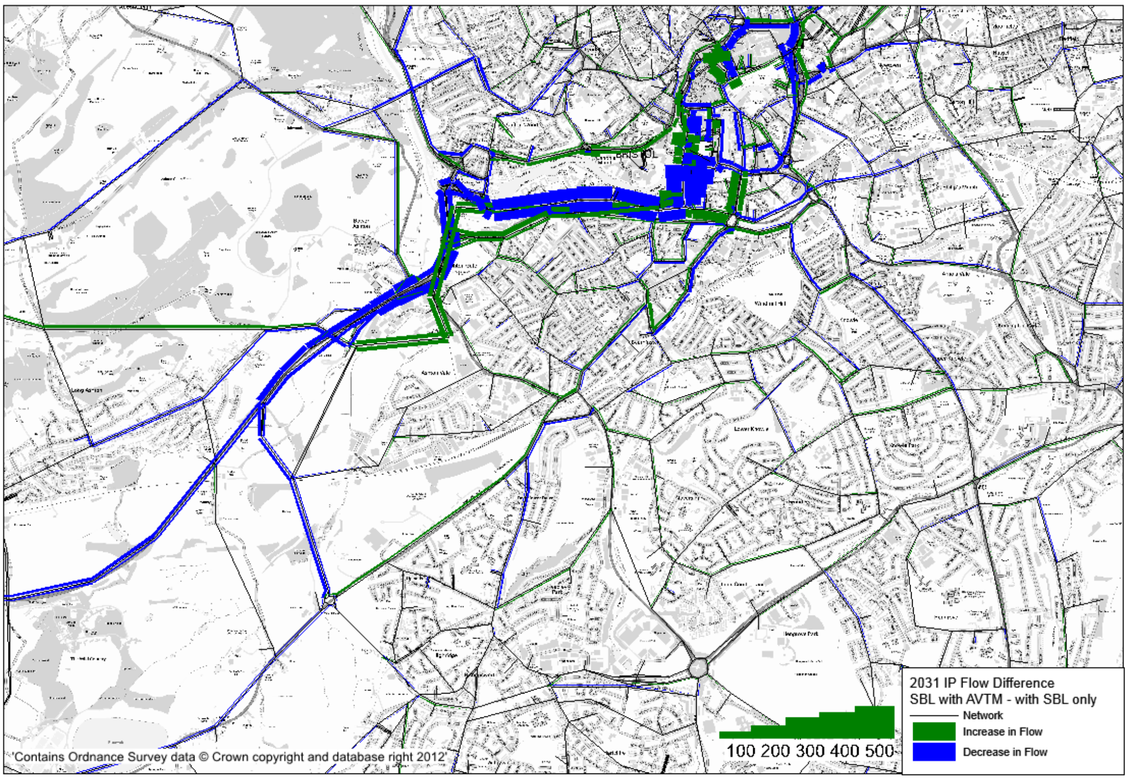
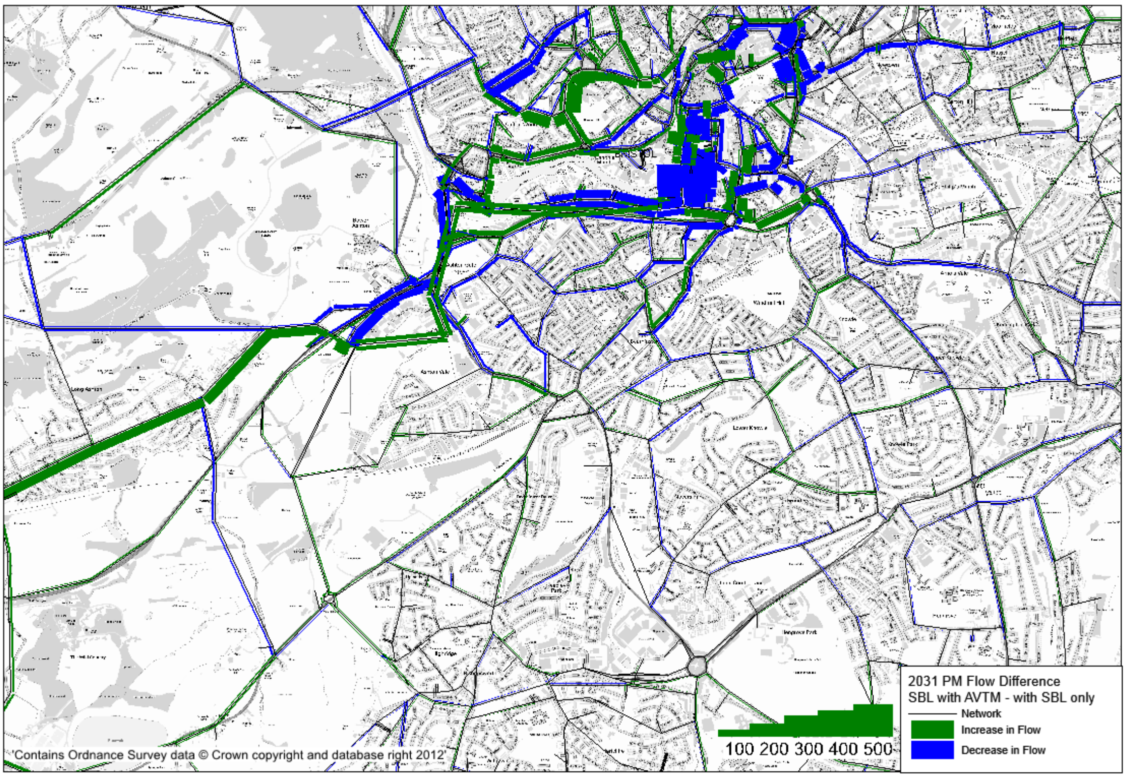


Figure D13 - Changes in Traffic Flows on the Highway Network (2031 PM Peak)



D.5. Summary

D.5.1. The addition of the AVTM scheme to the SBL scheme is forecast to have very little impact in traffic terms. The AVTM scheme provides an enhanced public transport service to central Bristol and results in small decreases in car trips and slightly larger increases in the number of park and ride and bus trips.

D.5.2. The traffic impacts are largest in central Bristol, where traffic routes following the closure of Prince Street Bridge. Within south Bristol the impacts are very small.

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