South Bristol Link
Forecasting Report

April 2013

Plan Design Enable

Notice

This document and its contents have been prepared and are intended solely for *West of England Partnership's* information and use in relation to the *South Bristol Link project*.

Atkins Limited assumes no responsibility to any other party in respect of or arising out of or in connection with this document and/or its contents.

This document has 76 pages including the cover.

Document history

Job number: 5103087			**Document ref: Forecasting Report**			
Revision	Purpose description	Originated	Checked	Reviewed	Authorised	Date
1.0	Draft	LW			GB	06/11/12
1.10	Draft – v18/9 model outputs	LW	GB		GB	11/12/12
1.20	Draft – No AVTM v27/8 outputs	LW	GB	DC	GB	19/4/13

Client signoff

Client	West of England Partnership
Project	South Bristol Link
Document title	5103087 SBL Forecasting Report
Job no.	5103087
Copy no.	
Document reference	Forecasting Report

Table of contents

Chapter	Pages
1. Introduction	**6**
1.1. Background	6
1.2. The Scheme	6
i. The Scheme	**Error! Bookmark not defined.**
1.3. SBL Modelling System	7
1.4. Forecasting Approach	7
1.5. Scope of Report	8
2. Developing the Reference Case	**9**
2.1. Introduction	9
2.2. Growth in Demand	9
3. Generalised Cost Assumptions	**16**
3.1. Introduction	16
3.2. Cost Components	16
4. Without-Intervention Case	**20**
4.1. Introduction	20
4.2. Transport Schemes	20
4.3. Model Outputs	21
4.4. Forecast Year	21
5. With-Intervention Case	**33**
5.1. Introduction	33
5.2. Scheme Details	33
5.3. Model Outputs	34
5.4. 2016 Forecast Year	34
5.5. 2031 Forecast Year	42
6. Summary	**51**
Appendices	**54**
Appendix A. Local Trip End Generation Rates	**56**
A.1. Trip Rates	56
Appendix B. Uncertainty Log	**58**
Appendix C. Model Convergence	**60**
C.1. Introduction	60
C.2. Without Intervention	60
C.3. With Intervention	60
Appendix D. Cumulative Impacts of SBL with AVTM	**62**
D.1. Introduction	63
D.2. The Scheme	63
D.3. 2016 Forecast Year	64
D.4. 2031 Forecast Year	69
D.5. Summary	75

Tables

Table 1.	Population and Household Growth Forecasts (2012 - 2016/31)	10
Table 2.	Employment Growth Forecasts (2012 – 2016/31)	10
Table 3.	Change in Car Ownership in West of England Sub-Region (2012 – 2016/31)	11
Table 4.	Forecast Growth in Trip Ends (2012 – 2016/31)	11
Table 5.	Growth for Light and Heavy Goods Vehicles	15
Table 6.	Forecast Growth in the Working and Non-Working Values of Time	16
Table 7.	Values of Time by Forecast Year and Purpose (£ / hour, 2002 prices and values)	17
Table 8.	Annual Percentage Change in Car Passenger Occupancy (% pa)	17
Table 9.	HAM Time -based Assignment Coefficients (PPM)	17
Table 10.	HAM Distance-based Assignment Coefficients (PPK)	18
Table 11.	Bus Fare Index (Constant Prices, Outside London)	19
Table 12.	Rail Fare Index (Constant Prices, GB)	19
Table 13.	Growth in Travel Purposes (2012 to 2016 and 2031)	21
Table 14.	Growth in Travel by Mode and Time Period (2012 to 2016 and 2031 Without Intervention)	21
Table 15.	Change in Mode Share by Time Period (2012 to 2016 and 2031 Without Intervention)	22
Table 16.	Growth in Travel by Road (2012 to 2016 and 2031 Without Intervention Case)	23
Table 17.	Growth in Travel by Public Transport (2012 to 2016 and 2031 Without Intervention Case)	31
Table 18.	Travel by Mode (2016 With Intervention)	35
Table 19.	Travel by Road (2016 With Intervention Case)	35
Table 20.	Travel by Public Transport (2016 With Intervention Case)	39
Table 21.	Travel by Mode (2031 With Intervention Case)	42
Table 22.	Travel by Road (2031 With Intervention Case)	43
Table 23.	Travel by Public Transport (2031 With Intervention Case)	47

Figures

Figure 1. SBL Scheme **Error! Bookmark not defined.**
Figure 2 - Forecasting Methodology 7
Figure 3 - TEMPRO Zones in West of England Sub-Region 12
Figure 4 - Developments in the West of England (2012 – 2016) 13
Figure 5 - Developments in the West of England (2012 – 2031) 14
Figure 9 - Changes in Highway Flows (2012 to 2016 Without Intervention - AM Peak) 25
Figure 10 - Changes in Highway Flows (2012 to 2016 Without Intervention - Inter Peak) 25
Figure 11 - Changes in Highway Flows (2012 to 2016 Without Intervention - PM Peak) 26
Figure 12 - Changes in Highway Flows (2012 to 2031 Without Intervention - AM Peak) 26
Figure 13 - Changes in Highway Flows (2012 to 2031 Without Intervention - Inter Peak) 27
Figure 14 - Changes in Highway Flows (2012 to 2031 Without Intervention - PM Peak) 27
Figure 15 - Junction Delays (2016 Without Intervention - AM Peak) 28
Figure 16 - Junction Delays (2016 Without Intervention - Inter-Peak) 29
Figure 17 - Junction Delays (2016 Without Intervention - PM Peak) 29
Figure 18 - Junction Delays (2031 Without Intervention - AM Peak) 30
Figure 19 - Junction Delays (2031 Without Intervention - Inter-Peak) 30
Figure 20 - Junction Delays (2031 Without Intervention - PM Peak) 31
Figure 21 - Overview of the SBL Scheme 34
Figure 25 - Changes in Traffic Flows on the Highway Network (2016 AM Peak) 36
Figure 26 - Changes in Traffic Flows on the Highway Network (2016 Inter Peak) 37
Figure 27 - Changes in Traffic Flows on the Highway Network (2016 PM Peak) 37
Figure 28 - Junction Delays on the Highway Network (2016 AM Peak) 38
Figure 29 - Junction Delays on the Highway Network (2016 Inter Peak) 38
Figure 30 - Junction Delays on the Highway Network (2016 PM Peak) 39
Figure 22 - Metro Bus Peak Hour Passenger Volume (2016 AM Peak Hour) 40
Figure 23 - Metro Bus Peak Hour Passenger Volume (2016 Inter Peak Hour) 41
Figure 24 - Metro Bus Peak Hour Passenger Volume (2016 PM Peak Hour) 41
Figure 37 - Changes in Traffic Flows on the Highway Network (2031 AM Peak) 44
Figure 38 - Changes in Traffic Flows on the Highway Network (2031 Inter Peak) 44
Figure 39 - Changes in Traffic Flows on the Highway Network (2031 PM Peak) 45
Figure 40 - Junction Delays on the Highway Network (2031 AM Peak) 45
Figure 41 - Junction Delays on the Highway Network (2031 Inter Peak) 46
Figure 42 - Junction Delays on the Highway Network (2031 PM Peak) 46
Figure 31 - Metro Bus Peak Hour Passenger Volume (2031 AM Peak Hour) 48
Figure 32 - Metro Bus Peak Hour Passenger Volume (2031 Inter Peak Hour) 49
Figure 33 - Metro Bus Peak Hour Passenger Volume (2031 PM Peak Hour) 49
Figure D2 - Metro Bus Peak Hour Passenger Volume (2016 AM Peak Hour) 65
Figure D3 - Metro Bus Peak Hour Passenger Volume (2016 Inter Peak Hour) 66
Figure D4 - Metro Bus Peak Hour Passenger Volume (2016 PM Peak Hour) 66
Figure D5 - Changes in Traffic Flows on the Highway Network (2016 AM Peak) 68
Figure D6 - Changes in Traffic Flows on the Highway Network (2016 Inter Peak) 68
Figure D7 - Changes in Traffic Flows on the Highway Network (2016 PM Peak) 69
Figure D8 - Metro Bus Peak Hour Passenger Volume 2031 AM Peak Hour (persons per hour) 71
Figure D9 - Metro Bus Peak Hour Passenger Volume 2031 Inter-Peak Hour (persons per hour) 71
Figure D10 - Metro Bus Peak Hour Passenger Volume 2031 PM Peak Hour (persons per hour) 72
Figure D11 - Changes in Traffic Flows on the Highway Network (2031 AM Peak) 74
Figure D12 - Changes in Traffic Flows on the Highway Network (2031 Inter Peak) 74
Figure D13 - Changes in Traffic Flows on the Highway Network (2031 PM Peak) 75

1. Introduction

1.1. Background

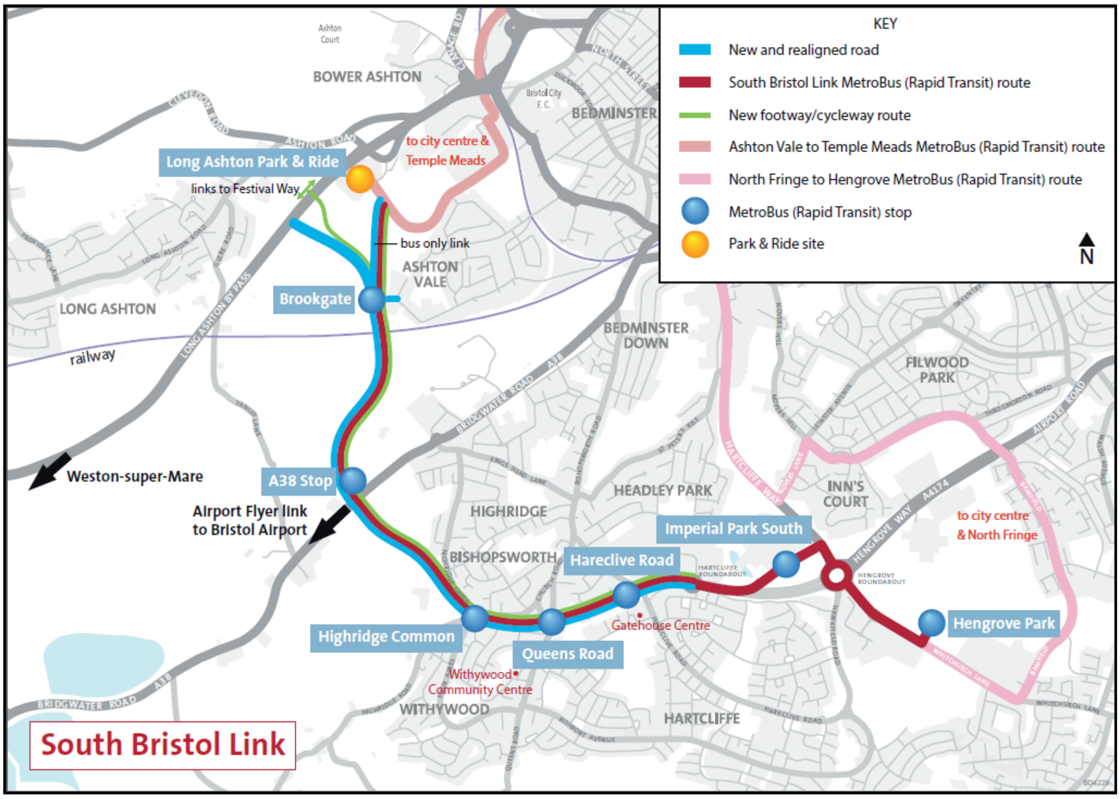
1.1.1. The West of England (WEPO) Partnership Organisation local authorities: Bath and North East Somerset (B&NES), Bristol City (BCC), North Somerset (NSC) and South Gloucestershire Council (SGC) are delivering the South Bristol Link (SBL), a major transport scheme to address current and future transport 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

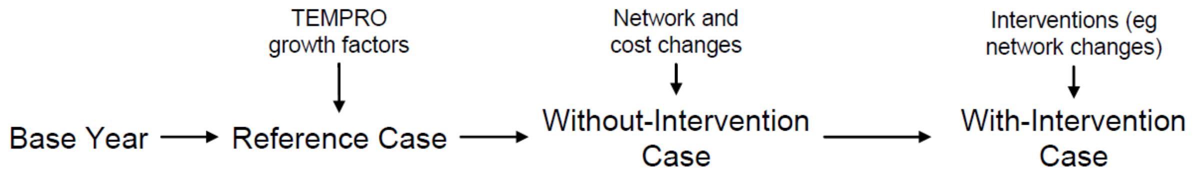
1.4.1. The SBL forecasting methodology closely follows the current DfT's Transport Appraisal Guidance (TAG), in particular:

- 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

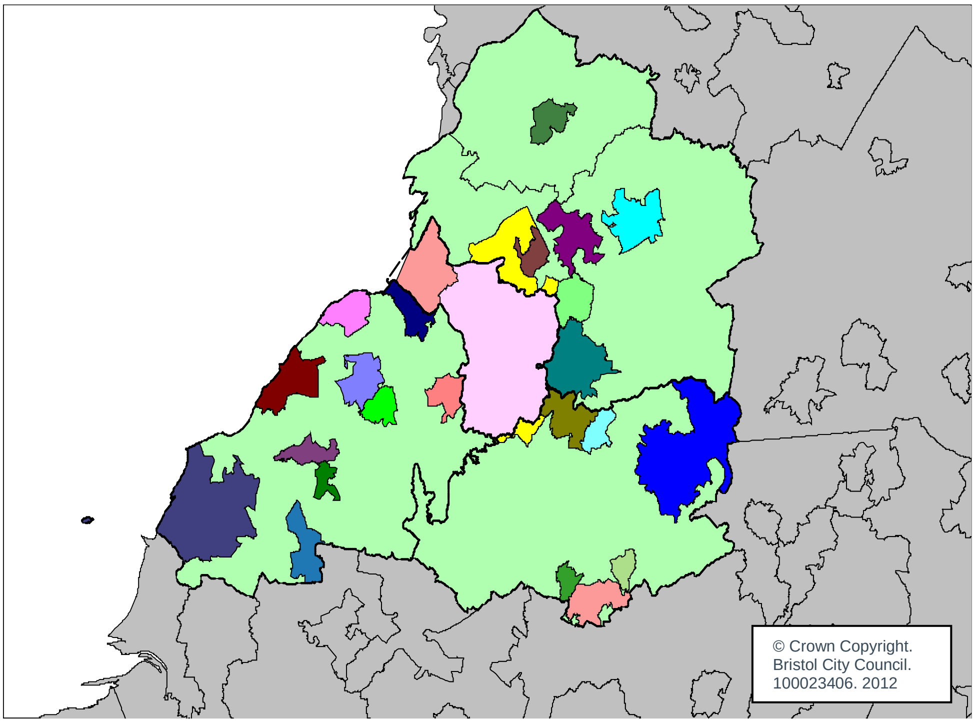
2.2.12. The TEMPRO growth was applied to the base year trip ends at the TEMPRO zone level using the following process:

- 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

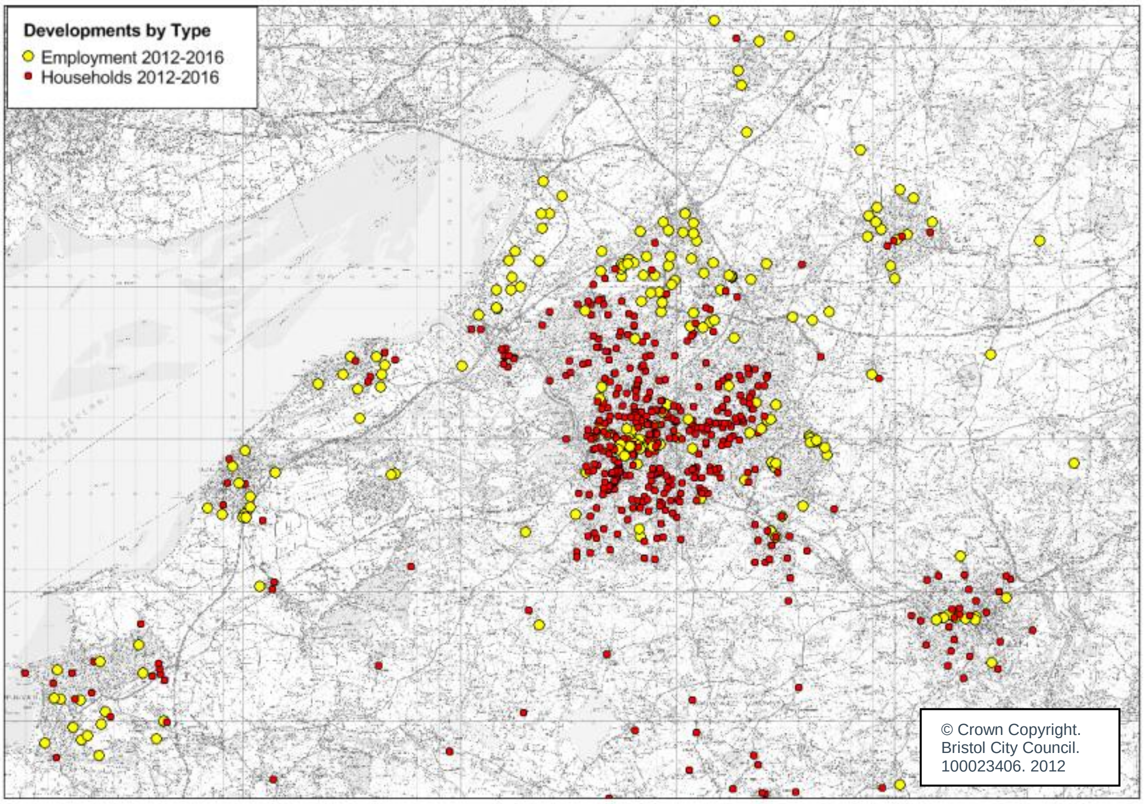
2.2.14. The West of England Partnership provided information regarding the identified land use developments planned for the Greater Bristol area up to 2016 and 2031 to enable the TEMPRO growth to be distributed across the sub-region.

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.

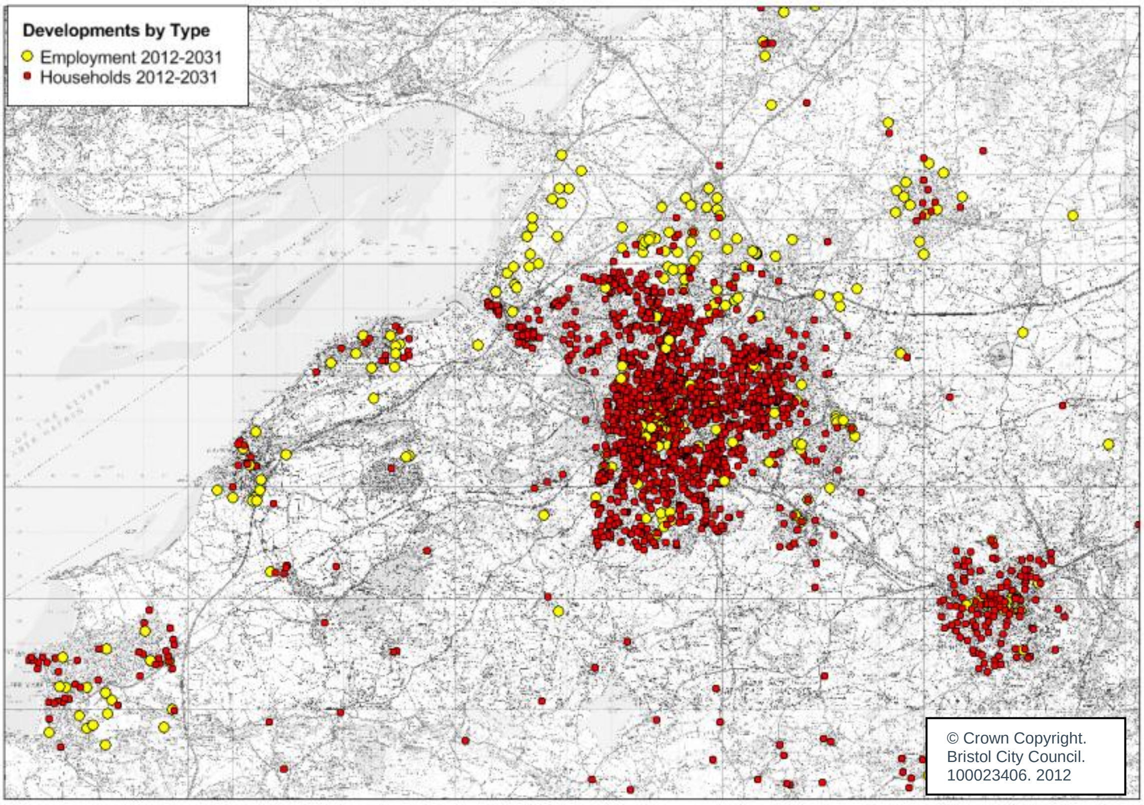
2.2.16. The locations of the identified developments in the West of England area are summarised below shown in Figure 4 and Figure 5 for 2012 to 2016 and 2012 to 2031, respectively.

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)

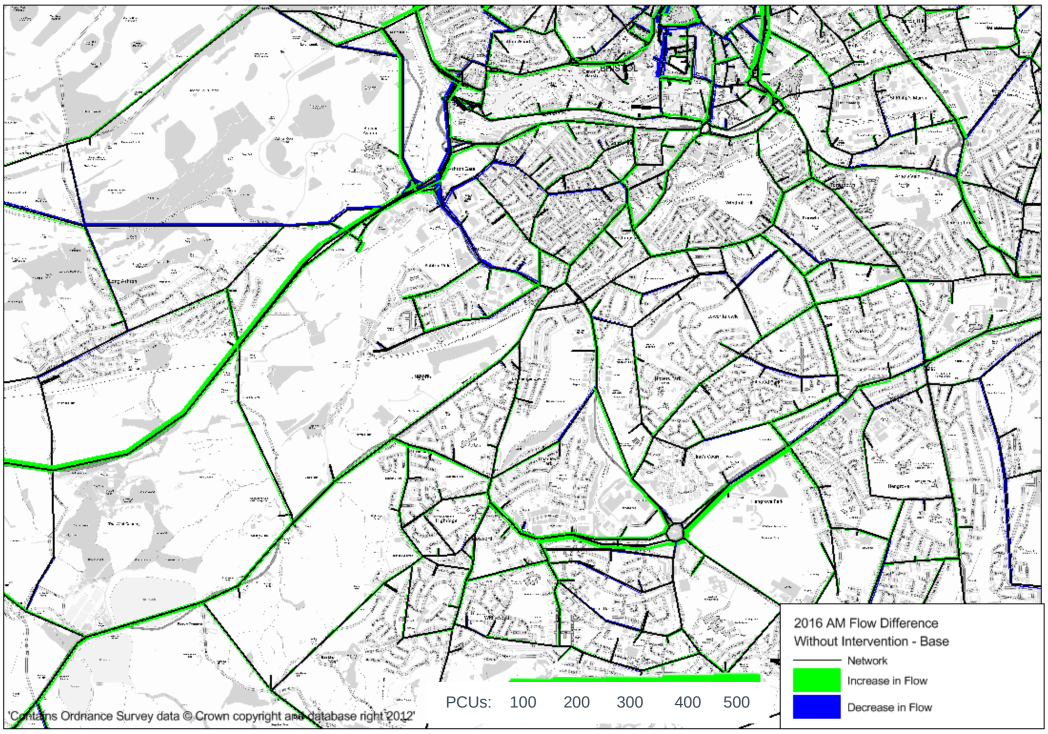


Figure 10 - Changes in Highway Flows (2012 to 2016 Without Intervention - Inter Peak)

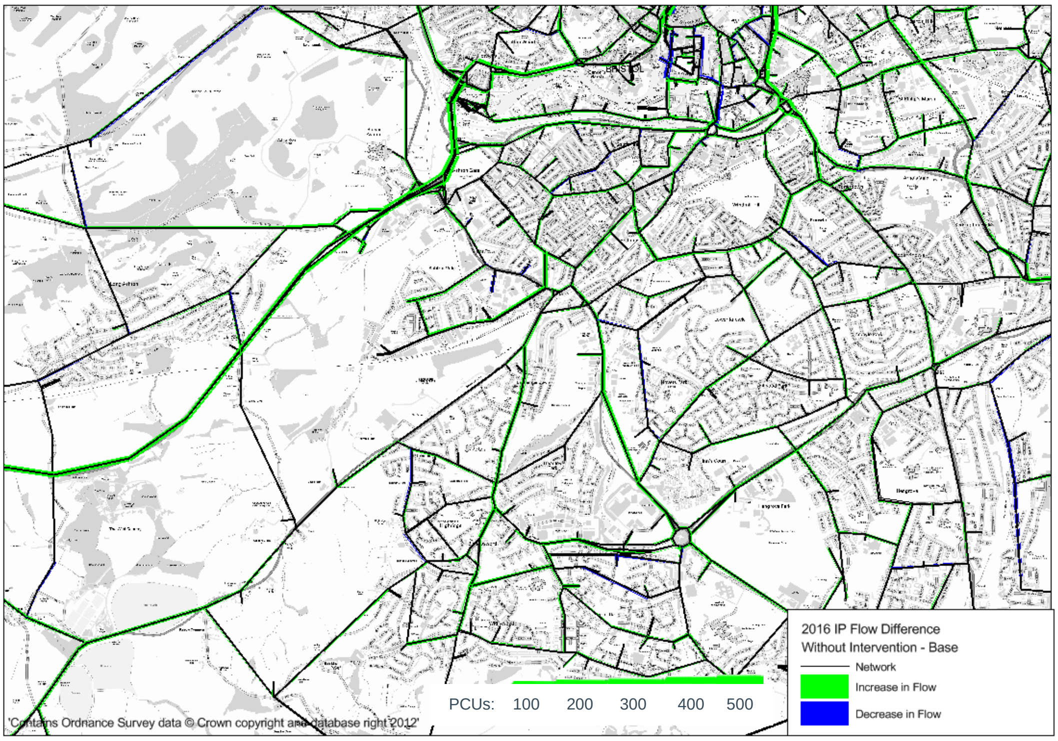


Figure 11 - Changes in Highway Flows (2012 to 2016 Without Intervention - PM Peak)

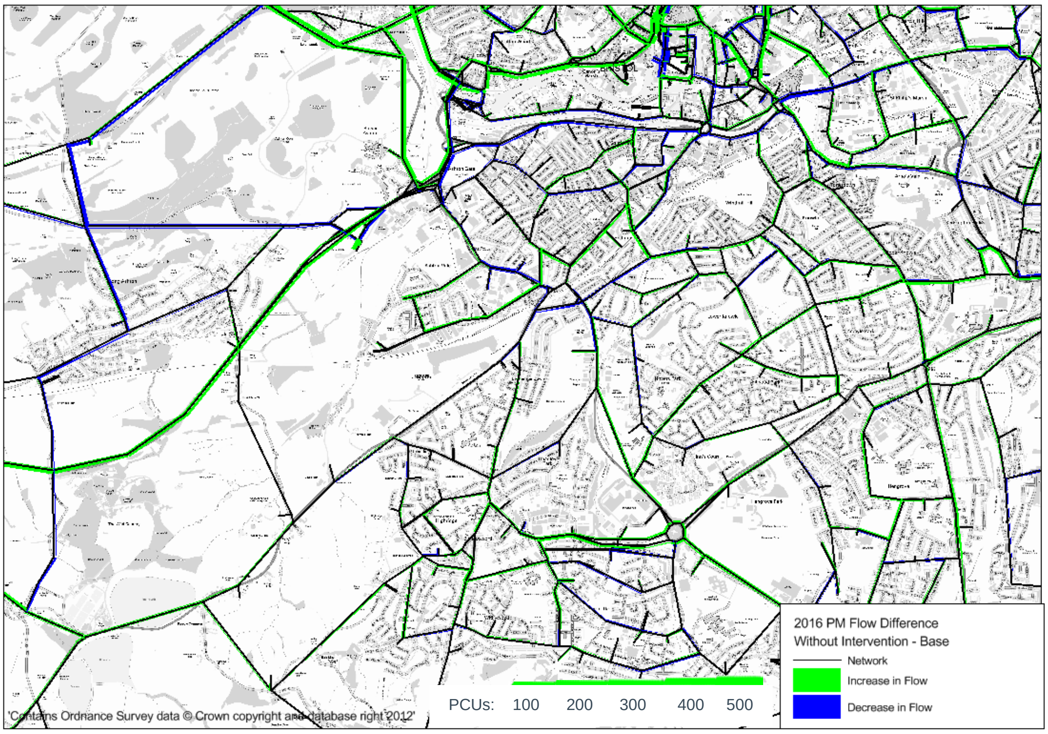


Figure 12 - Changes in Highway Flows (2012 to 2031 Without Intervention - AM Peak)

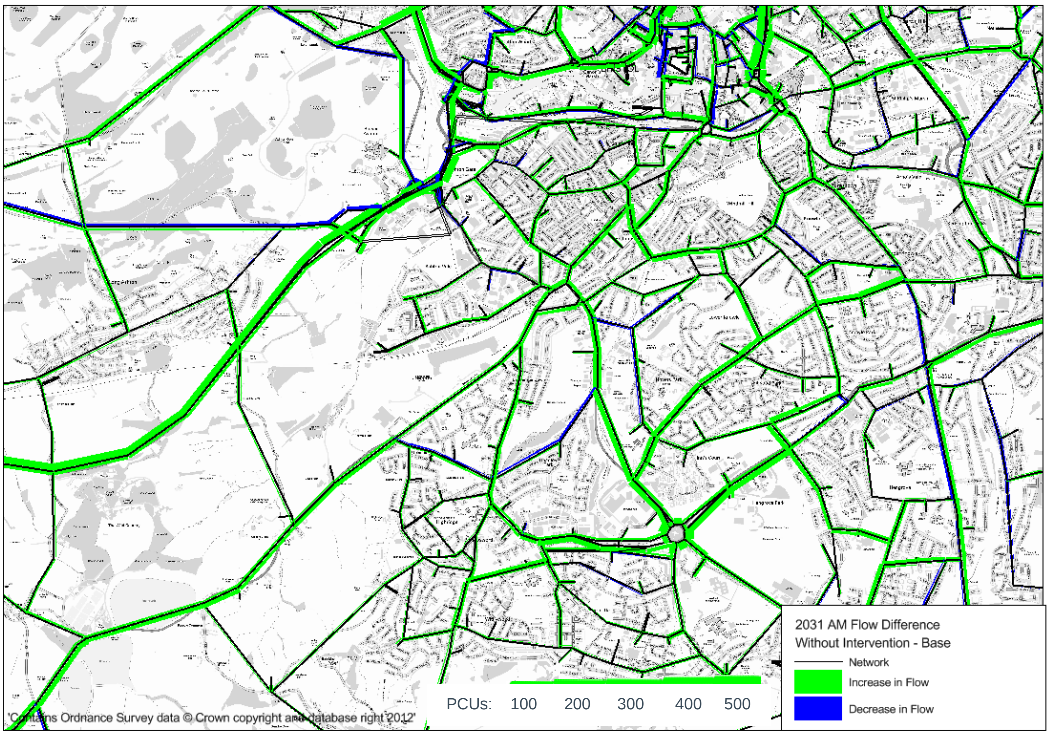


Figure 13 - Changes in Highway Flows (2012 to 2031 Without Intervention - Inter Peak)

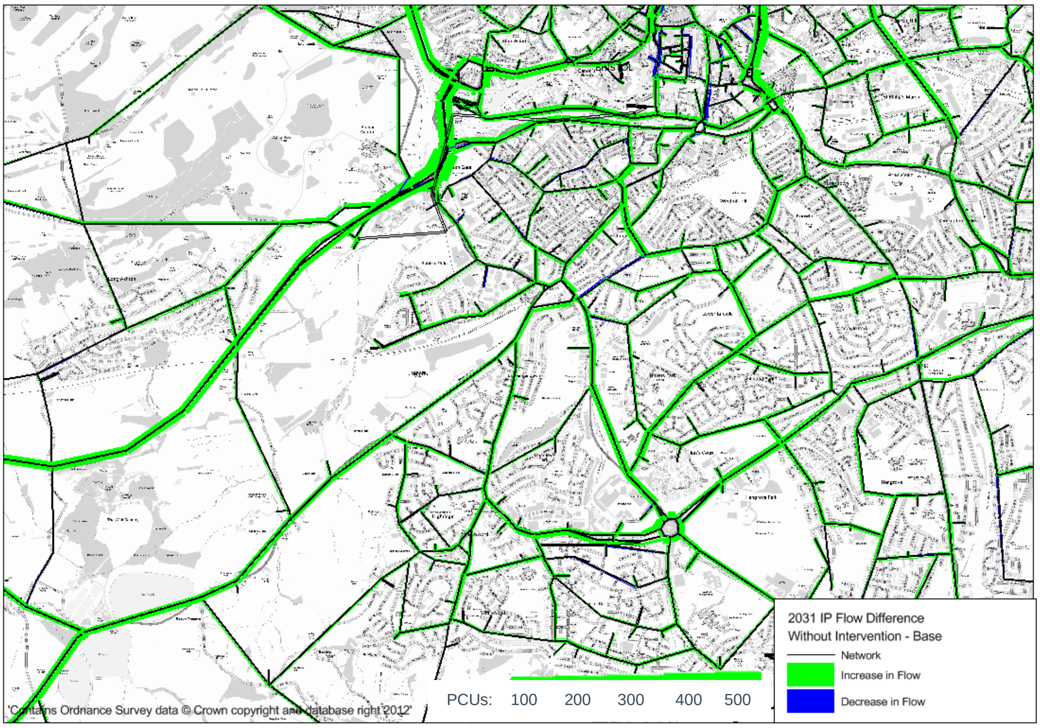
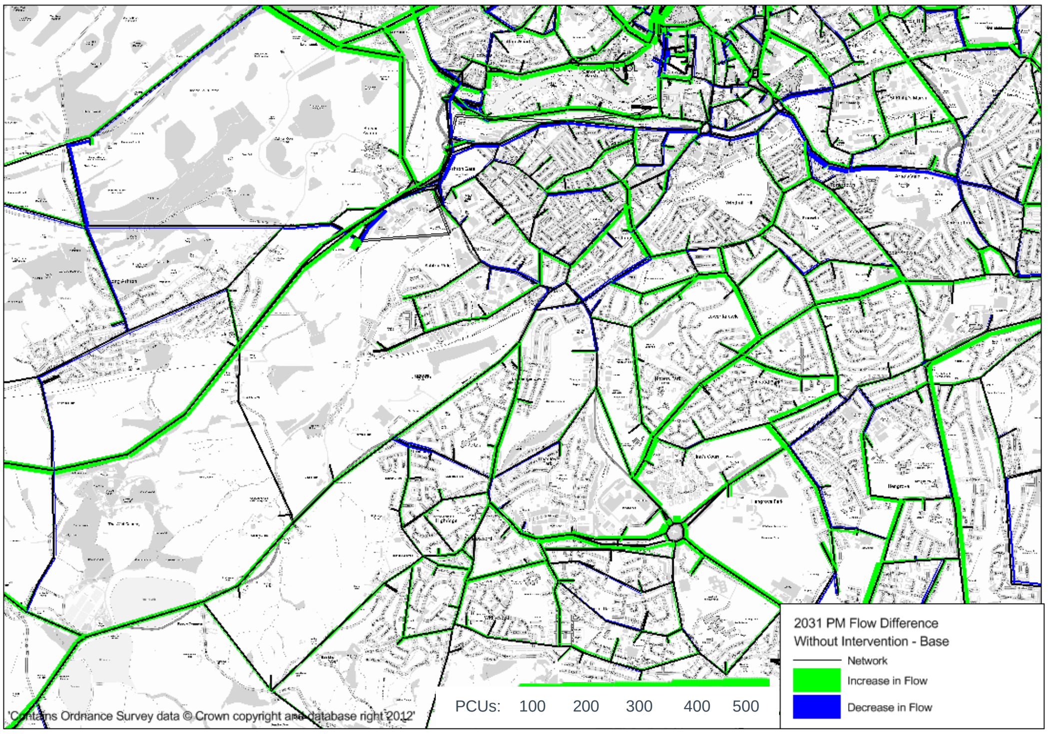


Figure 14 - Changes in Highway Flows (2012 to 2031 Without Intervention - PM Peak)



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)

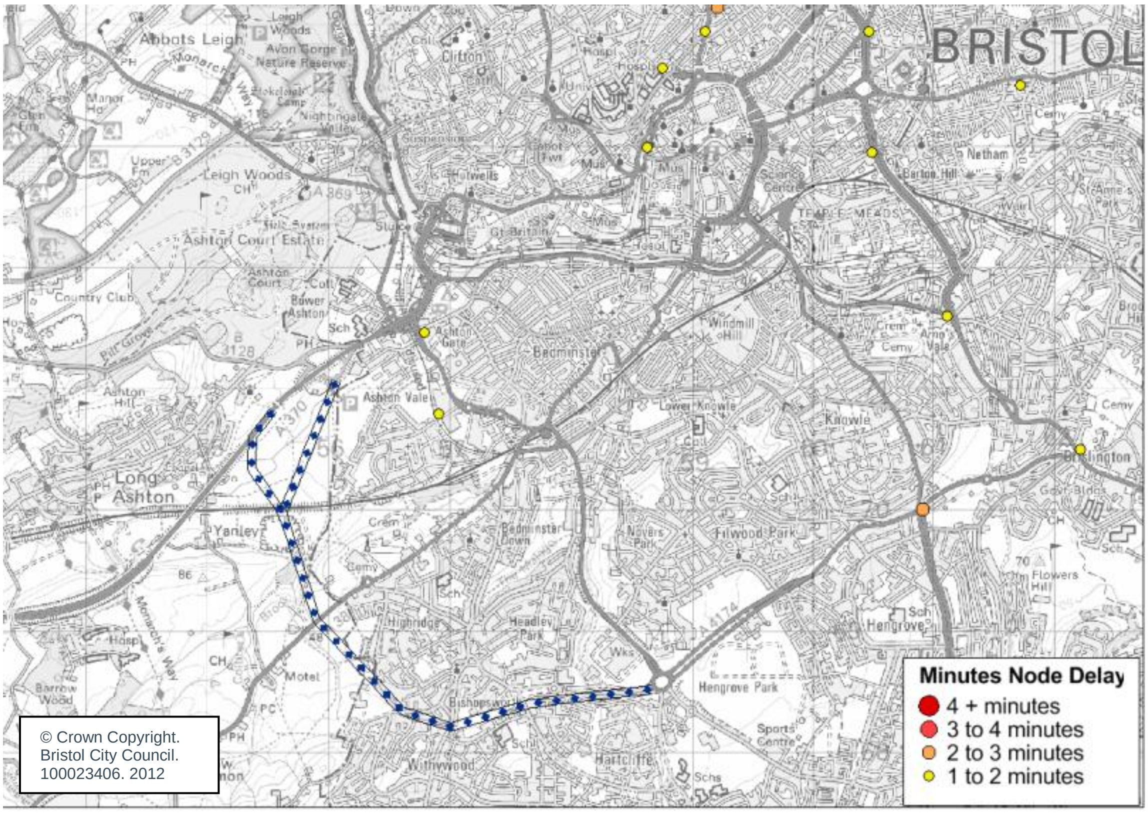


Figure 16 - Junction Delays (2016 Without Intervention - Inter-Peak)

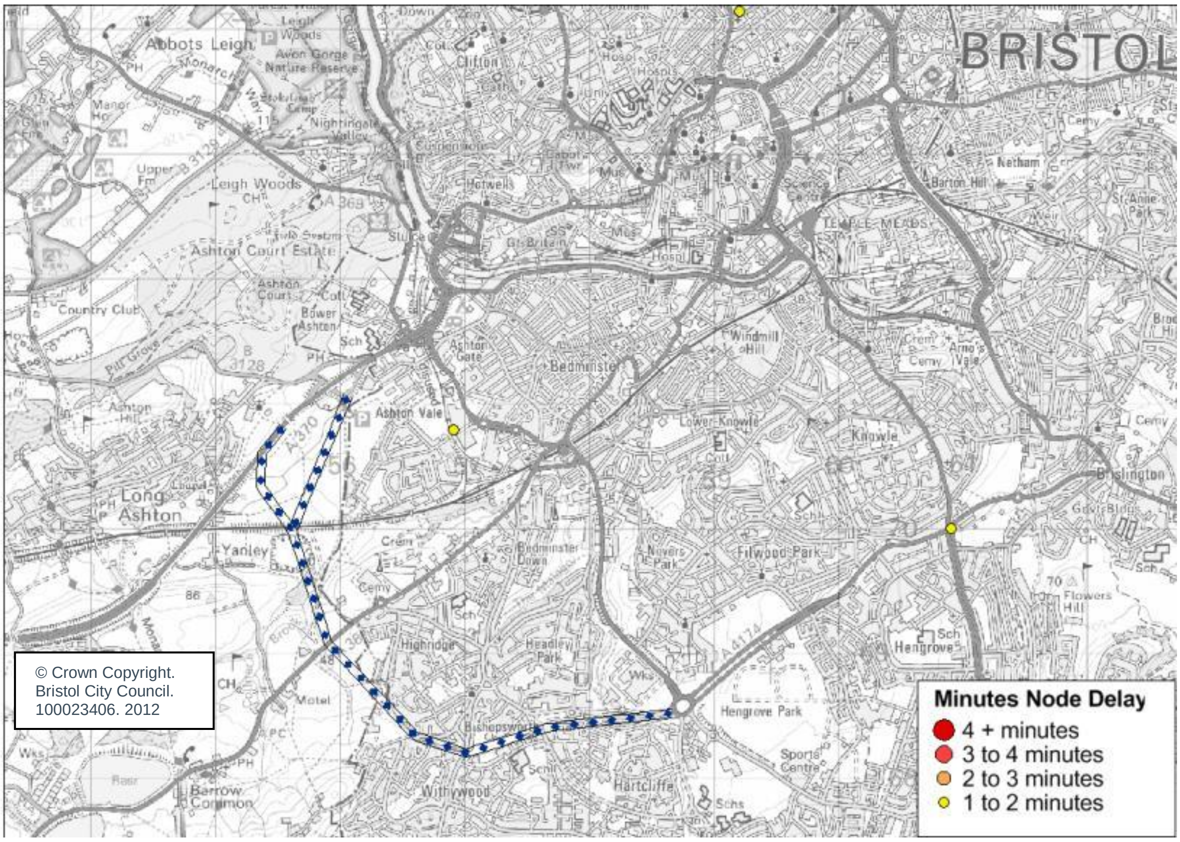


Figure 17 - Junction Delays (2016 Without Intervention - PM Peak)

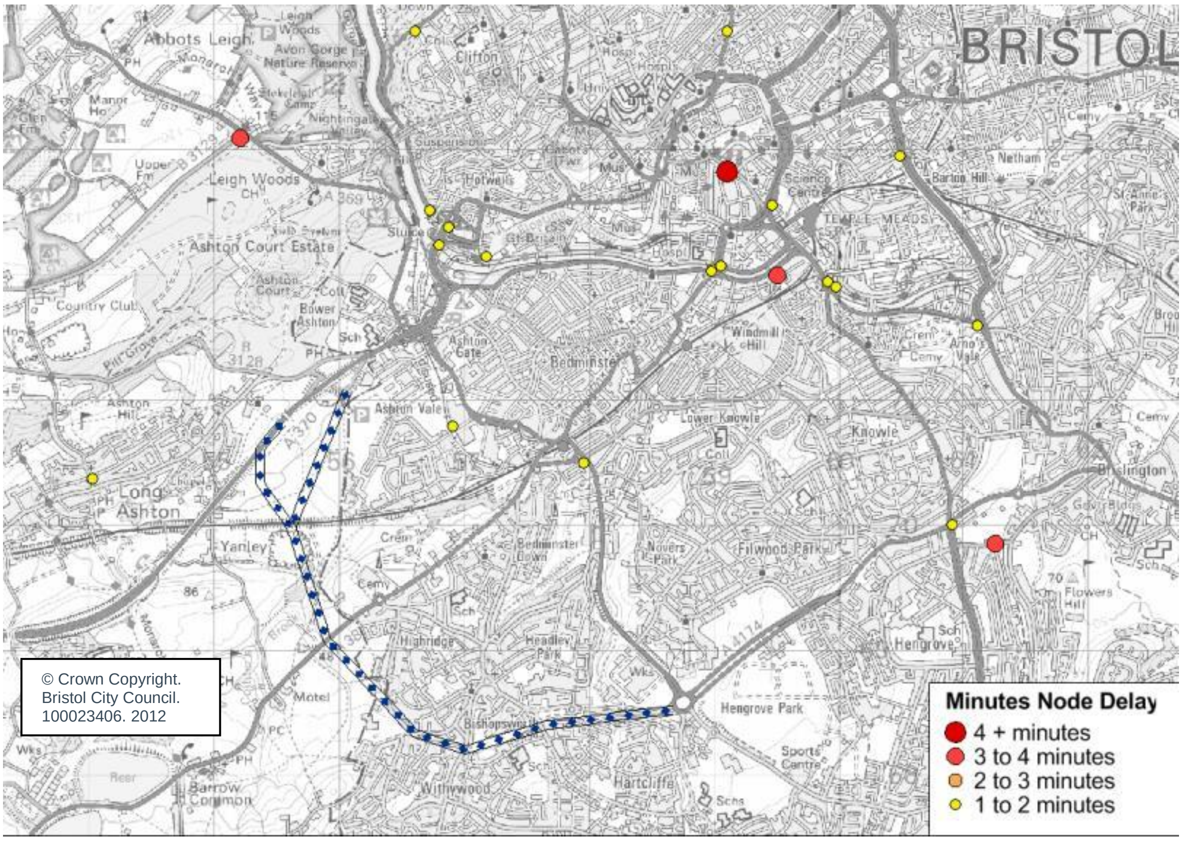


Figure 18 - Junction Delays (2031 Without Intervention - AM Peak)

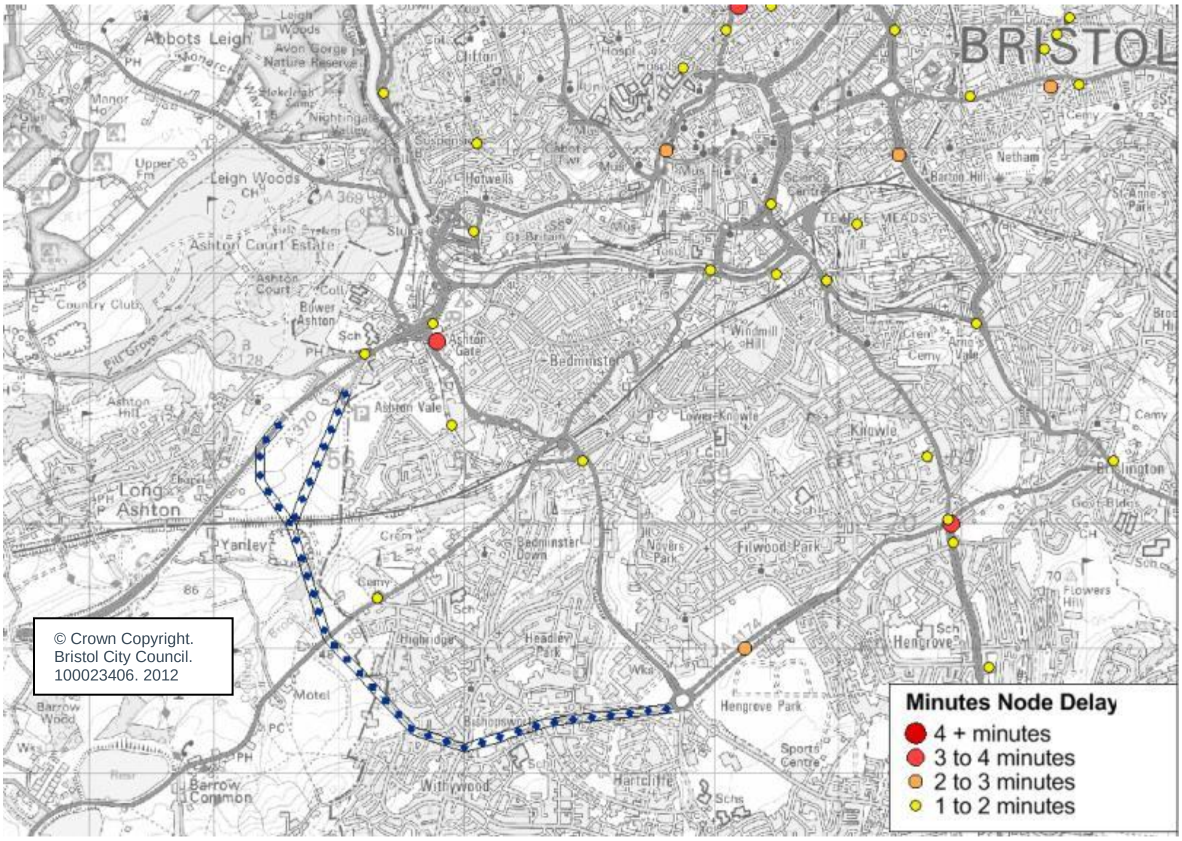


Figure 19 - Junction Delays (2031 Without Intervention - Inter-Peak)

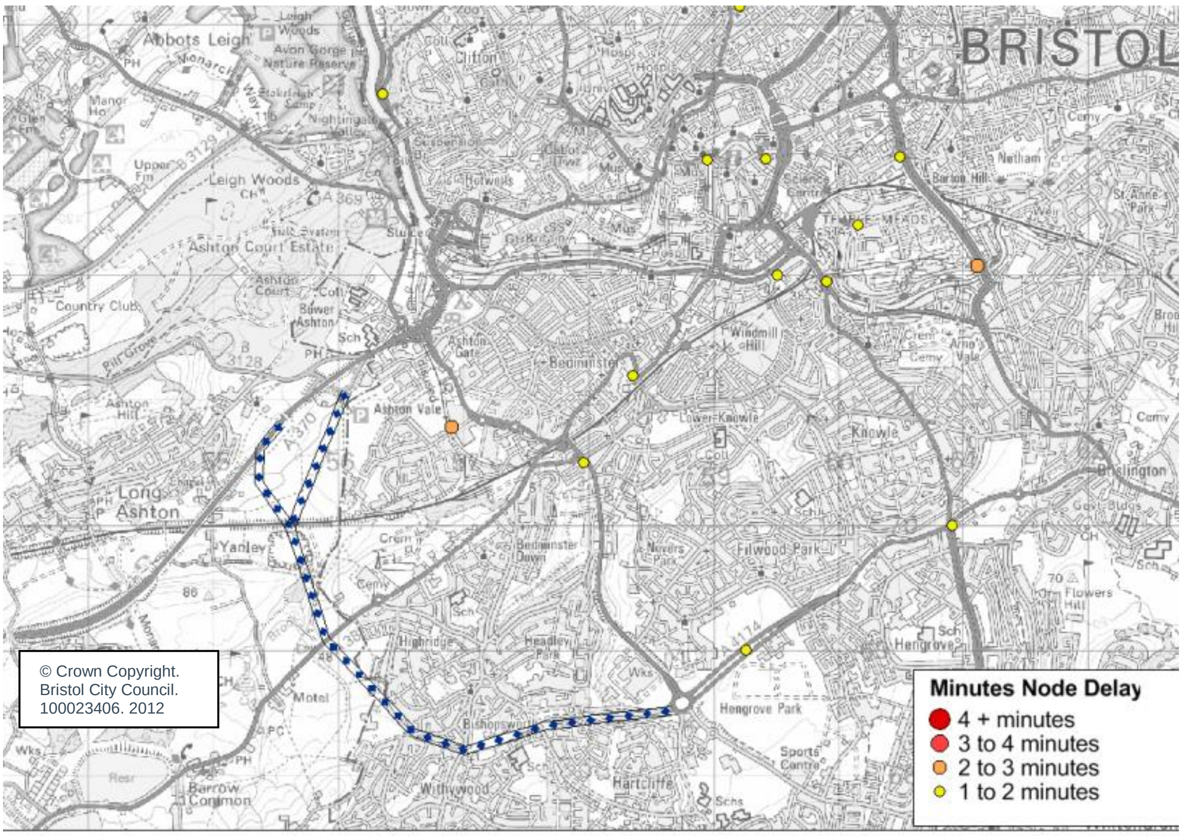
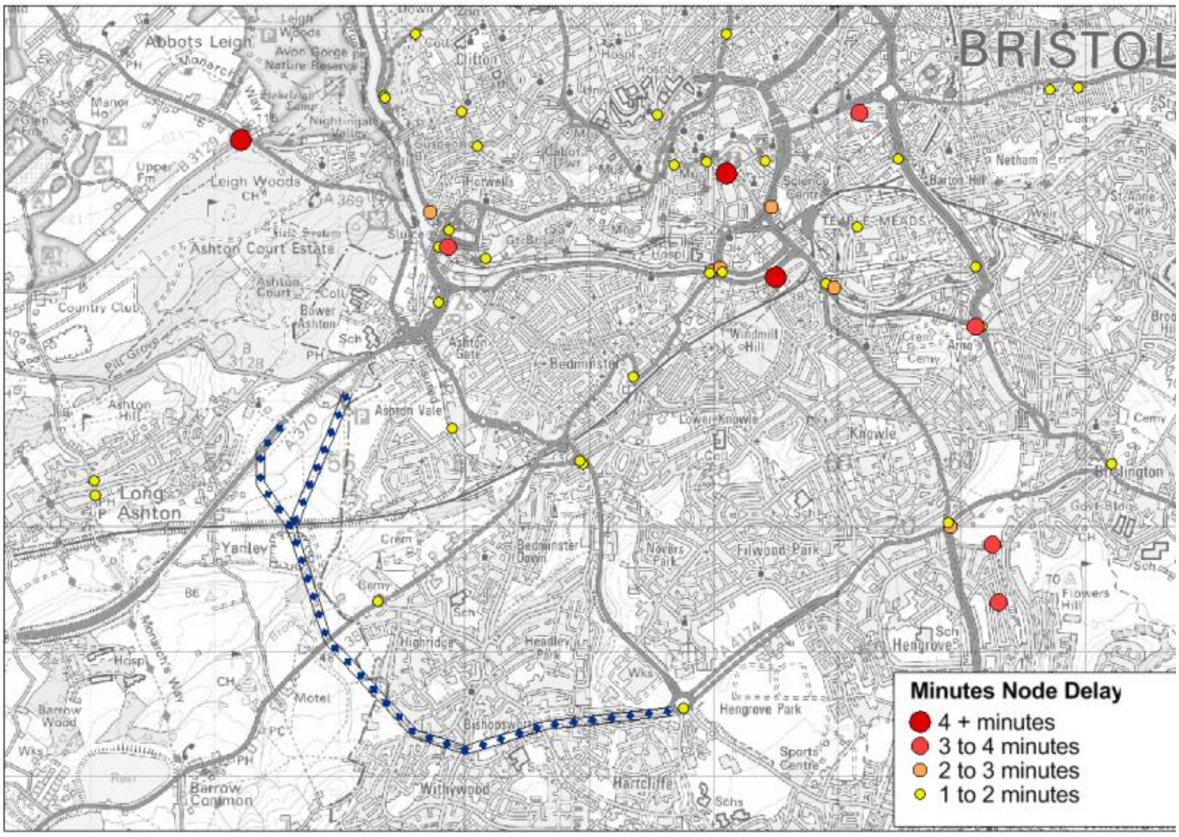


Figure 20 - Junction Delays (2031 Without Intervention - PM Peak)



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.