Annex 1

Value for Money Report

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Bath & North East Somerset, Bristol, North Somerset and South Gloucestershire Councils
working together to improve your local transport

North Fringe to Hengrove Package

Full Approval - Value for Money Appraisal

South Gloucestershire Council and Bristol City Council

14 November 2014

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1. Introduction

Background

1.1. The North Fringe to Hengrove (NFHP) scheme is part of a programme of transport improvements planned for the West of England sub-region. The scheme comprises three MetroBus routes with sections of new and realigned highway. The Scheme will connect key employment hubs (Cribbs Causeway, Aztec West, Science Park at Emersons Green and Bristol city centre) with key residential areas in the north and south of the city (such as Bradley Stoke, Stoke Gifford, Emersons Green, Bedminster, Knowle West and Hengrove). New and improved facilities for pedestrians and cyclists will be provided alongside sections of the MetroBus network, making it easier and safer to travel by foot or bike. The MetroBus plans include a significant redesign of Bristol city centre where large areas of the highway by the Cenotaph will be changed to pedestrian use and junctions will be remodelled to improve safety for pedestrians and cyclists.

1.2. The MetroBus network of services within the NFHP scheme would comprise the following three routes:

- Cribbs Causeway to Hengrove;
- Emersons Green to Hengrove; and
- Emersons Green to Bristol Parkway.

1.3. These MetroBus services will be fast, frequent and reliable with new, low-emission vehicles, high quality passenger facilities and interchanges, up-to-date passenger information and safe/secure access to stops. The weekday daytime frequencies for the three MetroBus services are assessed at six vehicles per hour on the Cribbs Causeway to Hengrove service and three vehicles per hour on the other two services.

1.4. A Programme Entry Major Scheme Business Case (MSBC) was submitted to the Department for Transport (DfT) by Bristol City Council and South Gloucestershire Council in March 2010. Following the completion of the Government's Comprehensive Spending Review in Autumn 2010, an Expression of Interest was submitted to the DfT in December 2010. The scheme was then included in the Development Pool of Local Major Transport Schemes, announced by the Minister in February 2011. Subsequently, the Best and Final Funding Bid for the scheme was submitted to the DfT in September 2011.

1.5. Funding approval and reconfirmation of Programme Entry for the Scheme was included within the Chancellor's Autumn Statement at the end of November 2011; this was confirmed by the DfT in December 2011.

1.6. Following the Best and Final Funding Bid, the scheme has been revised in Bristol City Centre as a result of a review of the scheme by Bristol City Council. The principal change was in the section between Prince Street and East Street/Dalby Avenue. In the BAFB, the route followed Prince Street, Prince Street Bridge, Wapping Road, a new bridge across the New Cut, St John's Road, and Lombard Street to East Street/Dalby Avenue. The revised scheme now runs along Prince Street, The Grove, Redcliffe Way, Redcliff Hill, Bedminster Parade and East Street to East Street/Dalby Avenue. Further alterations were made to the highway arrangements in The Centre, including the junction of Colston Avenue, Broad Quay and Baldwin Street. In addition, the design of the Stoke Gifford Transport Link was revised, including a reduction in the maximum speed limit on sections of the new link.

1.7. For the purpose of seeking planning permission, the overall NFHP scheme was divided into two elements:

- The Stoke Gifford Transport Link (SGTL); and
- The remainder of the NFHP scheme

1.8. The SGTL was given planning consent by South Gloucestershire Council in September 2013 and the remainder of NFHP was given planning consent by Bristol City Council on 27th August 2014

and by South Gloucestershire Council on 8th September 2014. The Full Approval submission considers the overall scheme comprising both SGTL and the rest of the NFH scheme.

Purpose of the Report

1.9. The Full Approval represents the final step within the DfT process for investment in Local Major Transport Schemes. The completion of the Full Approval enables the construction of the scheme to begin and funding to be claimed. In line with the DfT guidance, to be considered for Full Approval, schemes should have:

- Obtained all necessary statutory powers needed to enable construction;
- Completed the procurement process to a stage where there is a preferred bidder and a firm and final offer;
- Put in place plans for the evaluation of the scheme; and
- Appraised the remaining Distributional Impacts (formally Social and Distributional Impacts) in line with WebTAG unit A4.2.

1.10. In assembling the Value for Money evidence for the Full Approval submission, the emphasis is the comparison against the corresponding assessment for the BAFB, submitted in September 2011, highlighting the material changes to the scheme or its appraisal which have an impact on the overall performance in the Value for Money assessment. In this, the emphasis is on a proportionate appraisal, conducting assessments that are in line with the significance of the element within the overall scheme Value for Money appraisal. In providing the additional details of the Value for Money process, this report supplements the formal 'Application for Full Approval' form.

1.11. In preparing the Full Approval submission and the associated Value for Money assessment, discussions have been held with the DfT to establish the content and scope of a proportionate appraisal, including the specification of the sensitivity test. This included a period of email correspondence and a teleconference involving the DfT, Atkins and the West of England local authorities.

Structure of the Report

1.12. The reminder of this report is structured in the following chapters:

- Chapter 2 summarises which aspects of the scheme appraisal have been revised between the original BAFB submission and the Full Approval, with an indication of whether the revised assessment is quantitative or qualitative;
- Chapter 3 provides an overview of how the modelling and appraisal have changed since the BAFB submission, including:
  - how alterations to the scheme specification and changes to the DfT guidance which have been accommodated within the appraisal,
  - changes to LGV/HGV growth factors,
  - an analysis of the modelled base year and 2016 forecast year traffic flows with a comparison against observed traffic volumes,
  - specification of the sensitivity test involving the South Bristol Link (SBL); and
- Chapter 4 summarises the results of the revised Value for Money assessment.

1.13. The report is supplemented by the following appendices:

- Details of the accident analysis in Appendix A;
- Output from the TUBA process, in terms of the TEE, AMCB and PA tables, in Appendix B;
- Appraisal Summary Table in Appendix C;
- Analysis of TUBA Warnings in Appendix D;
- Checklist for the contents of the Value for Money assessment in Appendix E; and
- TUBA Sector analysis in Appendix F.

1.14. The Distributional Impacts report is included in Annex 2 of the main Full Approval submission and hence is not duplicated within the Value for Money report.

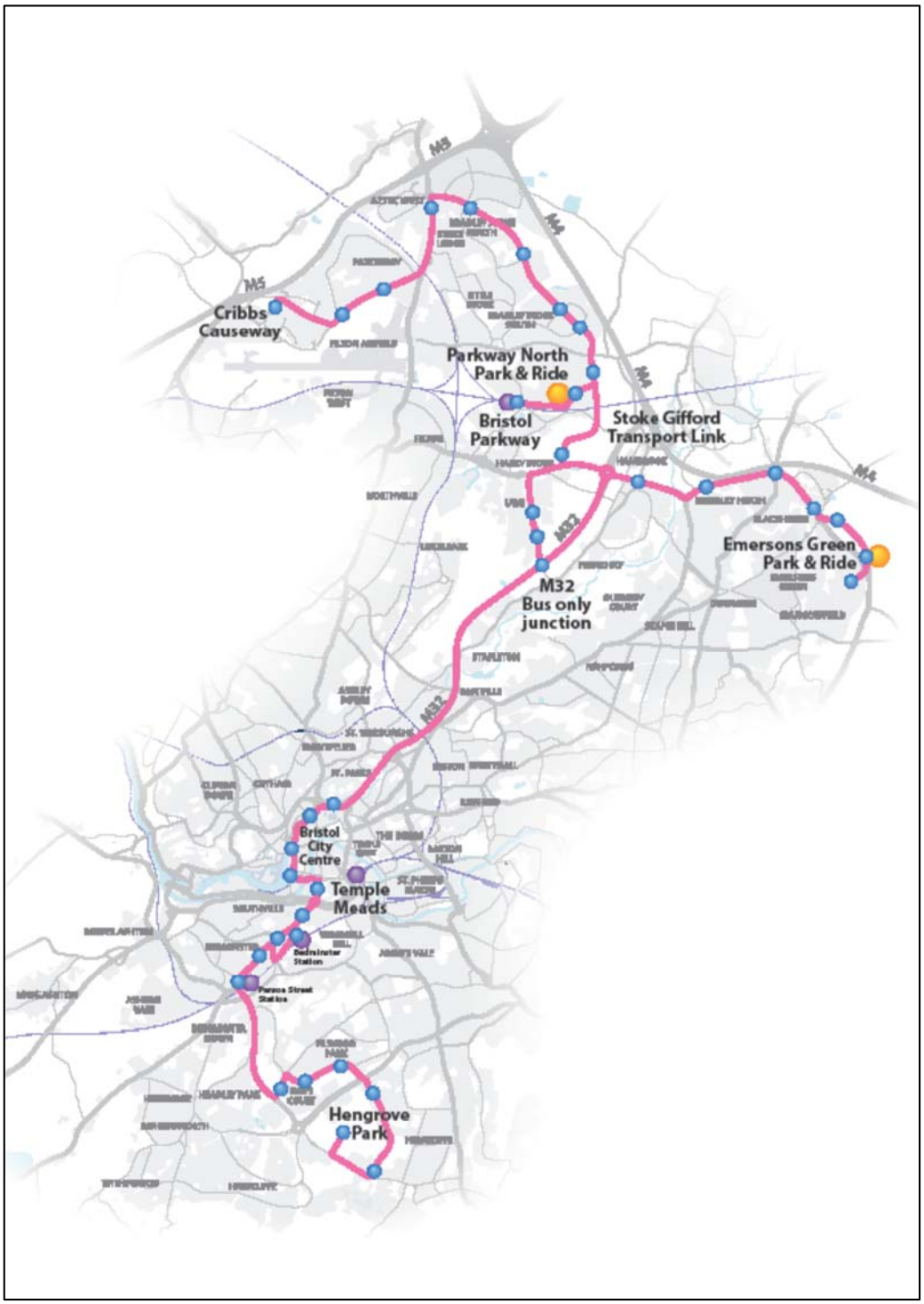
1.15. Attached to the submission in electronic format are input and output files from the TUBA process in electronic format including the TEE, PA and AMCB reports and the 'Errors and Warnings' file. In addition, the Appraisal Summary Table is attached in electronic format.

2. Summary of Aspects Included in the Appraisal

Introduction

2.1. The NFHP Scheme which forms the basis for the Full Approval submission and this Value for Money appraisal is shown in Figure 2-1.

Figure 2-1 NFHP Scheme



Content of the Appraisal

2.2. The completion of the original BAFB submission considered the range of impacts which were assessed through a mixture of quantitative and qualitative assessments. In preparing this Value for Money assessment for the Full Approval submission, the individual elements of the appraisal have been updated since the BAFB as summarised in Table 2.1. An updated Appraisal Summary Table has been prepared which reflects the combination of quantitative and qualitative assessments; this is included in Appendix C to this report.

Table 2-1 Summary of Appraisal Update

Impact	Sub-Impact	Appraisal Updated?	Reason for Update
Economy	Business users & transport providers	✓	• Updated modelling for Full Approval • Updated using TUBA V1.9
	Reliability impact on Business users	✓	• Updated modelling for Full Approval
	Regeneration	-	• N/A as regeneration benefits do not apply to NFHP – the Scheme does not affect any officially-designated regeneration areas.
	Wider Impacts	✓	• Updated modelling of Scheme for Full Approval • Approximation of revised benefits based on updated modelling - change in commuting travel time for labour market effects; change in commuting/ business travel time for agglomeration effects; and business user benefits for imperfect markets.
Environmental	Noise	✓	• Reviewed based on the Environmental Statement for planning applications for SGTL (April 2013/January 2014) and rest of NFHP (March 2014).
	Air Quality	✓	• Reviewed based on the Environmental Statement for planning applications for SGTL (April 2013/January 2014) and rest of NFHP (March 2014). • Marginal abatement costs assessed.
	Greenhouse gases	✓	• Reviewed based on the Environmental Statement for planning applications for SGTL (April 2013/January 2014) and rest of NFHP (March 2014).
	Landscape	✓	• Reviewed based on the Environmental Statement for planning applications for SGTL (April 2013/January 2014) and rest of NFHP (March 2014).
	Townscape	✓	• Reviewed based on the Environmental Statement for planning applications for SGTL (April 2013/January 2014) and rest of NFHP (March 2014).

Impact	Sub-Impact	Appraisal Updated?	Reason for Update
	Heritage of Historic resources	✓	• Reviewed based on the Environmental Statement for planning applications for SGTL (April 2013/January 2014) and rest of NFHP (March 2014).
	Biodiversity	✓	• Reviewed based on the Environmental Statement for planning applications for SGTL (April 2013/January 2014) and rest of NFHP (March 2014).
	Water Environment	✓	• Reviewed based on the Environmental Statement for planning applications for SGTL (April 2013/January 2014) and rest of NFHP (March 2014).
Social	Commuting and Other users	✓	• Updated modelling for Full Approval. • Updated using TUBA V1.9.
	Reliability impact on Commuting and Other users	✓	• Updated modelling for Full Approval
	Physical activity	-	• No change since the BAFB – no significant change of scope and not affected by modelling update.
	Journey quality	-	• No change since the BAFB – no significant change of scope and not affected by modelling update.
	Accidents	✓	• Updated COBALT-style modelling following changes to forecast traffic flows.
	Security	-	• No change since the BAFB – no significant change of scope and not affected by modelling update.
	Access to services	-	• No change since the BAFB – no significant change of scope and not affected by modelling update.
	Affordability	-	• No change since the BAFB – no significant change of scope and not affected by modelling update.
	Severance	-	• No change since the BAFB – no significant change of scope and not affected by modelling update.
	Option values	-	• No change since the BAFB – no significant change of scope and not affected by modelling update.
Public Accounts	Cost to Broad Transport Budget	✓	• Revised scheme costs (see Chapter 3 and main Full Approval submission).
	Indirect Tax Revenues	✓	• Updated modelling for Full Approval. • Updated using TUBA V1.9.

3. Modelling and Appraisal Update

Introduction

3.1. This chapter provides an overview of how the modelling and appraisal has been updated since the BAFB submission, detailing the assessment changes for individual sub-objectives and the reasons behind those changes. This includes a summary of how any changes to the scheme as part of the Full Approval have been reflected in the modelling of the scheme and the calculation of its benefits.

3.2. The three MetroBus schemes within the West of England (SBL, AVTM and NFHP) have a common modelling platform - G-BATS3. However, because of the specific detailed requirements and scheme development timescales, they each use a slightly different version of the model. All the core elements of the G-BATS3 model have been reviewed by the DfT at various stages during the development of the schemes and the model has been confirmed as being compliant with WebTAG guidance on the construction and application of multi-modal models, for schemes of the scale and nature of SBL, AVTM and NFHP.

Modelling Updates

Updating the G-BATS3 Model

3.3. A key element of the work programme for the NFHP Scheme since the BAFB has been the continued refinement and application of the transport models to provide information for scheme design and evidence for statutory processes, including the planning applications for SGTL and the rest of NFHP. The changes that have been made to the NFHP model since the BAFB have included:

- revisions by the local authorities of the housing and employment developments in 2016 and 2031 classified as 'more than likely'/'near certain';
- change in the base year for the model from 2009 to 2011;
- new Values of Time in line with updated WebTAG guidance;
- changes to the growth factors for LGVs and HGVs in line with updated WebTAG guidance (see below);
- revised factors for the growth factors for the Value of Time (Business VoT reduced by 28% by 2072 and non-business VoT reduced by 23% by 2072); and
- revised fuel cost changes.

3.4. The design of the NFHP scheme has been reviewed and revised in the period between the submission of the BAFB and the Full Approval. Many of the changes would not have a direct impact on the modelling of the scheme and the magnitude of the benefits. However, some of the more significant changes include:

- In line with changes to AVTM scheme, re-routeing of the scheme between Prince Street and East Street/Dalby Avenue – the BAFB route which followed Prince Street, Prince Street Bridge, Wapping Road, a new bridge across the New Cut, St John's Road, and Lombard Street to East Street/Dalby Avenue has been revised to run along Prince Street, The Grove, Redcliffe Way, Redcliff Hill, Bedminster Parade and East Street to East Street/Dalby Avenue
- Redesign of The Centre to alter the highway alignment at the junction of St Augustine's Parade, Colston Avenue, Broad Quay and Baldwin Street, resulting in a re-routeing of traffic in the area;
- Redesign of the junction of Bamfield and Whitchurch Lane;
- Reductions in the lengths of bus priority measures on Hartcliffe Way and A4174 in Emersons Green; and

- Reduction in the speed limit on sections of SGTL from 40 mph to 30 mph.

Impact of Revised LGV/HGV Growth Factors

3.5. An adjustment was made to the factors applied to LGV and HGV trip matrices within the G-BATS3 transport model used to assess the NFHP scheme. The new factors are presented including a summary of the impact of applying the revised factors, in terms of the number of trips by time period and forecast year.

3.6. Table 3.1 shows the revised factors corresponding to the 2013 NRTF which are applied within the current version of the model which forms the basis for the Full Approval submission.

Table 3-1 Full Approval Growth Factors for LGV and HGV

	2016	2031
LGV	1.067	1.513
HGV	0.977	1.087

3.7. The results of applying the factors above to the individual trip matrices, by time period, are summarised in Table 3.2 and Table 3.3 for 2016 and 2031 respectively. Each table shows the number of trips in the Base, original (BAFB) and the current (Full Approval) models, together with the absolute and proportional change from the BAFB to the Full Approval versions of the model.

Table 3-2 Change in Matrix Totals with Revised LGV/HGV Factors – 2016

Time Period	LGV/HGV	Base (2009)	BAFB	Base (2011)	Full Approval	Difference (FA-BAFB)	Change (FA/BAFB)
AM Peak	LGV	15,900	18,400	15,700	16,800	-1,600	-9%
	HGV	14,000	14,200	13,600	13,300	-900	-6%
Inter-Peak	LGV	14,400	16,700	14,100	15,000	-1,700	-10%
	HGV	15,100	15,300	14,700	14,400	-900	-6%
PM Peak	LGV	11,000	12,800	11,000	11,700	-1,100	-9%
	HGV	7,500	7,600	8,200	8,100	500	7%

Table 3-3 Change in Matrix Totals with Revised LGV/HGV Factors – 2031

Time Period	LGV/HGV	Base (2009)	BAFB	Base (2011)	Full Approval	Difference (FA-BAFB)	Change (FA/BAFB)
AM Peak	LGV	15,900	25,700	15,700	23,800	-1,900	-7%
	HGV	14,000	15,400	13,600	14,800	-600	-4%
Inter-Peak	LGV	14,400	23,300	14,100	21,300	-2,000	-9%
	HGV	15,100	16,600	14,700	16,000	-600	-4%
PM Peak	LGV	11,000	17,800	11,000	16,600	-1,200	-7%
	HGV	7,500	8,200	8,200	9,000	800	10%

Enhancing the G-BATS3 Model

3.8. In addition to responses to the alterations in DfT guidance, enhancements were made to the model including:

- revisions to the modelling of Park and Ride;
- inclusion of new data from driver and public transport surveys carried out in the North Fringe and South Bristol areas;
- update of the public transport services in the model and matching of journey times to timetabled times;

- recalibration of the public transport model;
- recalibration of the demand model;
- improvements to the highway model calibration and validation within the NFHP corridor and Bristol City Centre;
- further junction optimisation for the forecast highway networks; and
- improvements to model convergence.

3.9. These changes to the model were included in the planning applications for NFH and SGTL.

3.10. In addition to the direct modelling issues, the economic appraisal of the scheme includes further changes since the BAFB submission which are reflected in the application of TUBA V1.9 to replace TUBA V1.8 and directly impact on the Benefit Cost Ratio and the Value for Money assessment. These include:

- alteration to the base year and price base for appraisal to 2010;
- revised factors for the growth factors for the Value of Time;
- revised fuel cost changes;
- changes to the NFHP scheme capital and operating costs and scheme opening date; and
- changes to accident rates and valuations.

Comparison of Model Outputs and Observed Flows

3.11. The objective of the analysis is to summarise the comparison of the observed traffic flows with forecast traffic volumes generated by the G-BATS3 transport model used to assess the NFHP scheme. The analysis considers the following comparisons:

- base year (2011) modelled flows and observations; and
- 2014 observations compared with modelled 2014 flows – the modelled flows are based on a linear interpolation between the base year and forecast year (2016) Do Minimum model outputs. The objective of this comparison is to provide an indication of how the growth expected by the 2016 forecast year has already been achieved based on the latest observations

3.12. The following locations across the NFHP scheme were identified for the purpose of the assessment, based on the availability of observed traffic flow data:

- A38 Gloucester Road (south of Shellmor Avenue) – Table 3.4;
- Bradley Stoke Way (east of Woodlands Lane) – Table 3.5;
- Hatchet Road (north of Sandringham Road) – Table 3.6;
- A4174 Avon Ring Road (west of B4058 Bristol Road) – Table 3.7;
- A4174 Avon Ring Road (east of Maules Lane) – Table 3.8;
- A4174 Avon Ring Road (west of A432 Badminton Road) – Table 3.9;
- M32 (Junction 2 to Junction 3) – Table 3.10;
- Prince Street (north of The Grove) – Table 3.11; and
- A38 Bridgwater Road (east of Yanley Lane) – Table 3.12.

3.13. The counts are derived from a combination of weekday ATC and MCC data, with the data relating to a neutral month of May or October in each year. In each case, school holidays and public holidays were excluded from the data. The selection of the counts took into account the following factors:

- Availability of comprehensive count data over the period covered by the analysis; and
- Sites unaffected by significant roadworks or other major developments.

3.14. In cases where observed data was not available for a specific year, an estimate was derived based on an interpolation of the values from adjacent years.

3.15. The analysis compares the traffic volumes for the three time periods covered by the G-BATS3 model, i.e.:

- Morning peak hour (0800-0900);
- Average inter-peak hour (average of 1000 – 1600); and
- Evening peak hour (1700-1800).

3.16. In general, there is a consistent relationship between the observed and modelled flows at the individual sites/time periods, well within the variation of each. As would be expected, the model generates both over- and under-estimates of the observed values, but there is not a discernible trend of consistent under- or over-estimation.

Table 3-4 A38 Gloucester Road (south of Shellmor Ave) - Comparison of Observed and Modelled Flows (vehicles)

	Modelled Flows			Observed Flows				Model/Observed	
	2011	2014	2016	2011	2012	2013	2014	2011	2014
Southbound									
0800-0900	1285	1375	1436	1333	1393	1327	1261	96.4%	109.1%
1000-1600 (ave)	940	969	988	1037	1080	1072	1064	90.7%	91.1%
1700-1800	1023	1139	1216	992	1112	1098	1074	103.2%	106.1%
Northbound									
0800-0900	1550	1642	1703	1504	1537	1517	1497	103.0%	109.6%
1000-1600 (ave)	853	938	995	938	938	980	1023	90.9%	91.7%
1700-1800	1383	1572	1698	1258	1323	1397	1472	110.0%	106.8%

Table 3-5 Bradley Stoke Way (east of Woodlands Lane) - Comparison of Observed and Modelled Flows (vehicles)

	Modelled Flows			Observed Flows				Model/Observed	
	2011	2014	2016	2011	2012	2013	2014	2011	2014
Eastbound									
0800-0900	549	558	563	499	516	513	509	110.0%	109.6%
1000-1600 (ave)	605	627	643	633	646	649	652	95.6%	96.3%
1700-1800	944	985	1012	944	934	930	927	100.1%	106.3%
Westbound									
0800-0900	933	958	974	931	974	1006	1038	100.2%	92.3%

	Modelled Flows			Observed Flows				Model/Observed	
	2011	2014	2016	2011	2012	2013	2014	2011	2014
1000-1600 (ave)	682	730	762	673	680	692	704	101.3%	103.7%
1700-1800	870	932	972	891	827	845	864	97.7%	107.8%

Table 3-6 Hatchet Road (north of Sandringham Road) - Comparison of Observed and Modelled Flows (vehicles)

	Modelled Flows			Observed Flows				Model/Observed	
	2011	2014	2016	2011	2012	2013	2014	2011	2014
Northbound									
0800-0900	652	716	759	632	680	684	689	103.2%	104.0%
1000-1600 (ave)	524	571	603	632	644	653	661	82.9%	86.4%
1700-1800	864	857	853	961	993	961	928	89.9%	92.3%
Southbound									
0800-0900	747	762	772	779	825	797	770	95.9%	99.0%
1000-1600 (ave)	448	433	423	488	465	488	510	91.9%	84.9%
1700-1800	671	707	732	771	776	765	755	87.0%	93.7%

Table 3-7 A4174 Avon Ring Road (west of B4058 Bristol Road) - Comparison of Observed and Modelled Flows (vehicles)

	Modelled Flows			Observed Flows				Model/Observed	
	2011	2014	2016	2011	2012	2013	2014	2011	2014
Eastbound									
0800-0900	2081	2259	2378	2236	2200	2139	2077	93.0%	108.8%
1000-1600 (ave)	1641	1797	1900	1828	1855	1851	1847	89.8%	97.3%
1700-1800	2835	3051	3196	3149	3216	3067	2918	90.0%	104.6%
Westbound									
0800-0900	1895	2057	2165	1996	1988	1941	1895	94.9%	108.6%
1000-1600 (ave)	1504	1687	1810	1620	1595	1592	1588	92.8%	106.2%
1700-1800	1649	1806	1912	1824	1716	1711	1707	90.4%	105.9%

Table 3-8 A4174 Avon Ring Road (east of Maules Lane) - Comparison of Observed and Modelled Flows (vehicles)

	Modelled Flows			Observed Flows				Model/Observed	
	2011	2014	2016	2011	2012	2013	2014	2011	2014
Eastbound									
0800-0900	1055	1094	1121	1097	1110	1101	1092	96.2%	100.2%
1000-1600 (ave)	1109	1079	1059	1152	1160	1170	1181	96.3%	91.4%
1700-1800	2028	2183	2287	2070	2110	2017	1924	98.0%	113.5%
Westbound									
0800-0900	1845	1927	1981	1891	2038	2062	2086	97.6%	92.4%

	Modelled Flows			Observed Flows				Model/Observed	
	2011	2014	2016	2011	2012	2013	2014	2011	2014
1000-1600 (ave)	902	871	850	933	932	958	985	96.7%	88.4%
1700-1800	734	741	745	864	921	915	909	84.9%	81.5%

Table 3-9 A4174 Avon Ring Road (west of A432 Badminton Road) - Comparison of Observed and Modelled Flows (vehicles)

	Modelled Flows			Observed Flows				Model/Observed	
	2011	2014	2016	2011	2012	2013	2014	2011	2014
Eastbound									
0800-0900	1188	1284	1348	1237	1232	1187	1212	96.0%	105.9%
1000-1600 (ave)	1120	1236	1314	1214	1242	1250	1258	92.3%	98.2%
1700-1800	1602	1877	2061	1722	1763	1750	1738	93.0%	108.0%
Westbound									
0800-0900	984	1193	1332	1096	1134	1082	1091	89.8%	109.3%
1000-1600 (ave)	1060	1172	1247	1115	1138	1155	1173	95.1%	100.0%
1700-1800	1188	1266	1318	1307	1183	1247	1312	90.9%	96.5%

Table 3-10 M32 (Junction 2 to Junction 3) - Comparison of Observed and Modelled Flows (vehicles)

	Modelled Flows			Observed Flows				Model/Observed	
	2011	2014	2016	2011	2012	2013	2014	2011	2014
Northbound									
0800-0900	3547	3953	4224	4084	4108		4015	86.8%	98.4%
1000-1600 (ave)	2538	2709	2822	2421	2402		2437	104.8%	111.2%
1700-1800	3989	4178	4304	3792	3803		3807	105.2%	109.8%
Southbound									
0800-0900	3226	3382	3486	3088	3117		3163	104.5%	106.9%
1000-1600 (ave)	2218	2406	2531	2492	2506		2496	89.0%	96.4%
1700-1800	2994	3466	3780	3535	3543		3560	84.7%	97.3%

Note – no data available for 2013

Table 3-11 Prince Street (north of The Grove) - Comparison of Observed and Modelled Flows (vehicles)

	Modelled Flows			Observed Flows				Model/Observed	
	2011	2014	2016	2011	2012	2013	2014	2011	2014
Northbound									
0800-0900	406	468	484	371	363	383	402	109.6%	116.5%
1000-1600 (ave)	259	292	301	251	239	252	265	103.4%	110.3%
1700-1800	264	342	362	302	316	325	334	87.6%	102.5%
Southbound									
0800-0900	275	281	282	227	221	238	254	121.1%	110.5%

	Modelled Flows			Observed Flows				Model/Observed	
	2011	2014	2016	2011	2012	2013	2014	2011	2014
1000-1600 (ave)	232	253	258	205	195	221	246	113.2%	102.7%
1700-1800	321	436	465	270	297	323	348	119.1%	125.3%

Note – 2011 and 2013 observed flows derived from interpolation of counts for adjacent years

Table 3-12 A38 Bridgwater Road (east of Yanley Lane) - Comparison of Observed and Modelled Flows (vehicles)

	Modelled Flows			Observed Flows				Model/Observed	
	2011	2014	2016	2011	2012	2013	2014	2011	2014
Northbound									
0800-0900	721	818	914	719	725	745	764	100.3%	107.0%
1000-1600 (ave)	618	670	722	642	629	657	686	96.3%	97.7%
1700-1800	921	949	977	1026	1007	1026	1045	89.8%	90.8%
Southbound									
0800-0900	852	904	955	901	900	888	875	94.6%	103.3%
1000-1600 (ave)	593	620	646	612	606	629	651	97.0%	95.2%
1700-1800	823	853	884	833	845	856	867	98.8%	98.4%

Note – 2011 and 2013 observed flows derived from interpolation of counts for adjacent years

Appraisal Updates

3.17. The following sections consider specific aspects in the approach used to assess particular aspects in the appraisal of the scheme.

Economic Appraisal Adjustments – NFHP August 2014

3.18. The economic appraisal has been undertaken through the use of TUBA 1.9, which uses 2010 as the base year. The PVB and PVC are therefore presented in 2010 prices. The BAFB submission was based on TUBA 1.8 with the associated 2002 base year. In order to provide a comparison in the economic appraisal for the BAFB and Full Approval submissions, the Full Approval appraisal has also been estimated for 2002 prices, i.e. equivalent to BAFB. This latter approach provides an indication of the appraisal for comparison purposes.

3.19. Table 3-13 outlines the adjustments that have been made to overall scheme costs for the purposes of the economic appraisal. The scheme costs used in the Full Approval Value for Money assessment are derived from the recently received tender prices, adapted as necessary for the economic appraisal to take into account factors such as optimism bias, sunk costs, etc.

Table 3-13 Economic Appraisal Assumptions

Element	Update
Investment costs	Investment costs have been grouped into the following four categories, with each category treated separately in terms of inflation and real terms cost changes over time: • Construction (including preliminaries); • Preparatory costs (including project management and scheme evaluation); • Site supervision; and • Land and property costs (including estimated Part 1 claims). The costs have been profiled by financial year, aligned with the information provided in Section 3.5 of the main Full Approval submission. The total scheme investment cost (2014 prices), **excluding inflation, risk and optimism bias**, is £97.689 million.
Cost Amendments	The purpose of the economic appraisal is to assist with the decision as to whether continuing with the scheme offers value for money. Sunk costs, which were spent before the current financial year and which cannot be recouped through any means, are therefore excluded from the appraisal. Sunk preparatory costs of £7.695 million have been excluded. The total future scheme investment cost (2014 prices) that has been carried through to the economic appraisal, excluding inflation, risk and optimism bias, is therefore £89.994 million.
Operating, maintenance and capital renewal costs	The assumptions on the following aspects have been reviewed and reassessed as part of the Full Approval submission: • Periodic resurfacing / replacement of new highway infrastructure; • Periodic replacement and renewal of bus stops/shelters, CCTV, RTI, traffic signals; and • Annual maintenance of new highway infrastructure and landscaping, including lighting, ITS, bus stops, culverts/ditches and bridge inspections. Total operating, maintenance and capital renewal costs over the 60 year appraisal period are estimated to be £67.086 million (2014 prices, excluding optimism bias). The total future 60-year costs that have been carried through to the economic appraisal, excluding inflation, risk and optimism bias, are £157.080 million (2014 prices).
Inflation and Real Terms Cost Changes	The investment costs are based on tender prices; hence the project is protected against inflation for all investment cost elements except for ITS costs. To cater for the small number of unprotected elements, a total 2.5% uplift has been applied to the ITS construction costs for the three year period to 2017. The ongoing inflation assumptions for renewals and maintenance are set against a general base inflation rate which varies by year between 1.8% and 2.5% to estimate the real terms cost changes over time for each cost category. An additional inflation allowance of £1.089 million has been included to cover real cost inflation over the appraisal period.

Element	Update
Risk Adjustment	Scheme investment costs have been adjusted to include an additional P(50) risk budget of £3.728 million (outturn prices).
Optimism Bias	An allowance for Optimism Bias has been added at the rate of 3% for all risk-adjusted investment cost categories, except for bridge structures aspects of the construction costs where the rate of 6% was applied. Overall average optimism bias for investment costs is therefore 3.28%. The Optimism Bias adjustment totals £3.661 million. The total cost carried through to the appraisal is £165.558 million (in 2014 prices) before discounting, including risk, inflation and Optimism Bias.
Discounting and Appraisal Period	Standard HM Treasury discounting procedures have been applied to the costs over the full appraisal period: • 3.5% for the first 30 years of the appraisal period (2014-2043 inclusive), including the additional two years prior to scheme opening (2015-2016); and • 3.0% for the remainder of the appraisal period (2044-2076). The opening year is 2017. The appraisal period ends 60 years after scheme opening (2017-2076).

<table>
<tr><th>Element</th><th>Update</th></tr>
<tr><td>Time periods and Annualisation Rates</td><td>The factors used for the BAFB to ensure a full account is taken of potential benefits across all time periods over a year have continued to be used for the Full Approval submission.
BAFB Annualisation formula =
253 x ((a x AM Peak Hour)+(b x IP Hour)+(c x PM Peak Hour))+
52 x (d x IP Hour) +
365 x (e x IP Hour) +
8 x (d/2 x IP Hour)
Where:
• 253 = No. of 12hr Weekdays;
• 52 = No. of Weekends;
• 365 = No. of Off-peak periods;
• 8 = Bank holidays

The annualisation rates are presented in the table below.
<table>
<tr><th>Hours</th><th>Highway</th><th>Bus</th><th>Rail</th></tr>
<tr><td>a) AM Peak Hour to Period (0700-1000)</td><td>2.80</td><td>2.40</td><td>2.70</td></tr>
<tr><td>b) IP Hour to Period (1000-1600)</td><td>6.00</td><td>6.00</td><td>6.00</td></tr>
<tr><td>c) PM Peak Hour to Period (1600-1900)</td><td>2.90</td><td>2.80</td><td>2.10</td></tr>
<tr><td>d) IP Hour to 0800-1800 Saturday + 1000-1600 Sunday</td><td>6.54</td><td>17.23</td><td>17.23</td></tr>
<tr><td>e) IP Hour to Off Peak (0600-0700 +1900-2400)</td><td>0.48</td><td>0.28</td><td>0.42</td></tr>
</table></td></tr>
</table>

3.20. In addition to the aspects summarised in Table 3.13, the approach followed in other areas of the appraisal (reliability, accidents, marginal abatement costs and wider impacts) are described in the sections below.

Reliability

3.21. Using DfT's WebTAG guidance (unit A1.3) on highway reliability for urban road networks, an assessment has been carried out using data extracted from the G-BATS3 SATURN model for the level of reliability benefit which will be generated for highway users as a result of the NFHP scheme.

3.22. This guidance makes use of a demonstrated relationship between the Do Minimum and Do Something journey times and distances and the related change in the standard deviation of journey time.

3.23. Reliability benefits have been assessed across the SATURN network, measuring benefits by Origin Destination pair and calculating the cumulative benefit over the 60 year appraisal period in the same way as TUBA measures journey time saving benefits.

3.24. These changes in reliability have been monetised according to the 'reliability ratio' which provides a proportional relationship between changes in the standard deviation of journey time and changes in average journey time.

3.25. As local data concerning reliability of journey times is not readily available, the relationship between times, distances and reliability in this assessment has been based on the approach for 'urban roads' outlined in WebTAG unit A1.3 which uses a model to forecast changes in the standard deviation of travel time from changes in journey time and distance. Local data concerning reliability of public transport is also not available and no similar common relationship exists between modelled values and journey time reliability for buses or rail. It has therefore been assumed conservatively that no change to reliability occurs for public transport users as a result of the Scheme.

3.26. In more detail, highway time, distance and demand matrices, as used in TUBA, were used to calculate and monetise the value of changes in highway journey time variability. Changes in time variability were calculated using the equation:

$$\Delta\sigma_{ij} = 0.0018\ (t_{ij2}^{\ 2.02} - t_{ij1}^{\ 2.02})\ d_{ij}^{\ -1.41}$$

Where:

$\Delta\sigma_{ij}$ = change in standard deviation of journey time for journey from i to j (seconds)
t_{ij1} = Do minimum time (seconds)
t_{ij2} = Do something time (seconds)
d_{ij} = Do minimum distance (km)

3.27. The parameters used were drawn from the generic urban model specified in the WebTAG guidance as the data required for local calibration and validation was not available. This calculation was performed across matrices for all highway user-classes, in all time periods and for both modelled years.

3.28. The monetary value of the reliability benefit associated with the identified change in journey time variability was then calculated using the following equation:

$$Benefit = -\sum_{ij} \Delta\sigma_{ij} * \left(\frac{T_{ij2} + T_{ij1}}{2}\right) * VOR$$

Where T_{ij1} and T_{ij2} were the trip numbers in the DS and DM scenarios respectively and the value of reliability (VOR) was defined as the value of time of the specific user-class, multiplied by the reliability ratio, which is set at 0.8 for all highway trip purposes.

3.29. As the assessment of benefits was required over the full appraisal period of the scheme rather than for just a single year, the calculation was first performed excluding the VOR factor. Based on values for the two modelled years (2016 and 2031), the reliability value was then interpolated and extrapolated over the 60 year period according to the same principles adopted in TUBA for the calculation of all other user benefit types.

3.30. Having quantified the reliability improvement in this way for each OD pair, time period, user-class and year, the VOR values, incorporating values of time, growth rates and vehicle occupancies from TAG Unit A1.3, were used to calculate the monetised value of that benefit to the affected users.

3.31. These benefits were then annualised using the hourly and daily factors which have been applied to the TEE table user benefits and discounted to 2010 values, in line with the benefit calculations performed in TUBA.

3.32. Although the scheme will contribute to improved public transport reliability, the impacts were not assessed, because the necessary detailed data on lateness of existing services was unavailable.

Accidents

3.33. The approach to the estimation of accident benefits has been to apply a spreadsheet-based technique which mimics the operation of COBA and, more recently, COBALT. This approach has been adopted for the appraisal of a number of schemes, including the BAFB for SBL, AVTM and NFHP and the Full Approval for AVTM and SBL. A description of the approach is provided in Appendix A which includes a validation of the output from the spreadsheet-based approach against a corresponding COBA appraisal.

3.34. The assessment of the accident benefits using this approach produces an estimate of annual accident increase in 2031 of 21 accidents comprising 1 personal injury accidents and 20 damage-only accidents. This compares with the previous BAFB assessment which showed savings of 83 accidents comprising 5 personal injury accidents and 78 damage-only accidents in 2031. In terms of the value of the increase in accidents, the PVB in 2010 prices amounts to disbenefits of £2.493m which compares to the corresponding disbenefits at the BAFB stage of £5.574m in 2002 prices. The disbenefits reflect the net impact of a number of changes to the highway network including the construction of the SGTL, the creation of bus priority measures and the reconfiguration of The Centre.

Marginal Abatement Costs

3.35. The assessment of the marginal abatement costs is a new requirement since the preparation of the BAFB submission in September 2011.

3.36. To assist the assessment, DEFRA Pollution Climate Mapping (PCM) forecasts for NO_2 concentrations by road link covering major urban roads in the Bristol area have been requested from Ricardo-AEA[1]; however, these data are currently unavailable.

3.37. In the absence of the appropriate forecast data, we utilised the PCM data for roadside published by DEFRA for 2012 (http://uk-air.defra.gov.uk/data/gis-mapping). These data show where DEFRA predicts the EU Limit Value for annual mean NO_2 concentrations (i.e. 40µg/m^3) to be exceeded (or not) at roadside in 2012. In terms of the relevant Affected Road Network (ARN), which has a total link length of approximately 23km, approximately 7km corresponds to PCM links. Of these, approximately 4km correspond to PCM links with exceedances in 2012; this length is expected to have reduced by 2016 due to gradual replacement over time of more polluting technologies across the vehicle fleet.

3.38. An assessment of NO_x emissions has been undertaken using traffic model data from the G-BATS3 transport model and the alternative approach, where the NO_2 limit value is exceeded, offered in Appendix C of the TAG Unit A3 guidance note.

3.39. Annual NO_x emissions in 2016 (opening year) and 2031 (design year) for the relevant ARN road links have been calculated using DEFRA's Emission Factor Toolkit (EFT) version 6.0.1; these are given in Table 3-14. The EFT has been run assuming a basic spilt traffic format (i.e. for light duty and heavy vehicle types) and the road type 'Urban (not London)' has been used in the calculation. Since the EFT can only forecast emissions up to the year 2030, the 2031 forecast year scenario assumes 2030 emissions.

3.40. The valuation calculation has been undertaken using the DfT TAG Air Quality Valuation Workbook (November 2014). For this calculation, the 'urban' exceedance method has been used because a substantial proportion of the ARN is within an urban environment. MAC has been estimated for the proportion of NO_x emissions that the method assumes to be within areas of exceedance and Damage Cost (DC) has been estimated for the proportion in compliance; the resultant monetary values thus represent the sum MAC + DC.

3.41. The predicted monetary value of the change can be seen in Table 3.15, in 2010 prices and values, discounted over the 60 year appraisal period. The values of the MAC have not been

[1] The nearest PCM projection to the NFHP opening year is for 2015. Other available PCM projections are for 2020, 2025 and 2030.

included in the calculation of the Present Values of Benefits and the Benefit Cost Ratio but are provided as a supplementary assessment.

Table 3-14 Marginal Abatement Cost – Total NO_x Emissions (tonnes per year)

Year	Without Scheme	With Scheme	Change
2016	79.2	82.2	3.0
2031	33.2	34.7	1.5

Table 3-15 Marginal Abatement Cost – Value of Change in NO_x Emissions (discounted, 2010 prices)

Central Estimate	Lower Estimate	Upper Estimate
£132,558	£114,234	£250,239

Estimate of Wider Impacts

3.42. The original BAFB submission in September 2011 included the preparation of estimates for the benefits of wider impacts including the use of the WITA software. This showed the following build-up of the total of £13.031m benefits from wider impacts:

- Agglomeration benefits – £4.329m;
- Labour market benefits – £1.327m; and
- Imperfectly competitive markets – £7.375m.

3.43. For the purposes of the Full Approval submission, it was not considered appropriate or proportionate to repeat the full WITA-based approach. The revised estimates for the three components of the wider impacts were therefore derived by:

- Agglomeration benefits – change in benefits estimated from the change in combined commuting and business travel time benefits between BAFB and Full Approval schemes;
- Labour market benefits – change in benefits estimated from the change in commuting travel time benefits between BAFB and Full Approval schemes; and
- Imperfectly competitive markets – based on 10% of the business user benefits from the TEE table output from TUBA for the Full Approval scheme.

3.44. For the agglomeration and labour market benefits, the original BAFB appraisal had been based on TUBA 1.8. Hence, the equivalent values for Full Approval scheme were developed as in TUBA 1.8 and a factor of 1.668 was used to convert the resulting benefits to 2010 values and prices, equivalent to TUBA 1.9.

3.45. The resulting benefits from Wider Impacts, in 2010 values and prices are:

- Agglomeration benefits – £2.799m;
- Labour market benefits – £1.333m; and
- Imperfectly competitive markets – £2.965m.

3.46. The overall benefits from Wider Impacts therefore amount to £7.097m in 2010 prices.

Sensitivity Test

3.47. Following the discussions with the DfT in the preparation of the Full Approval, it was identified that a sensitivity test should be included in the assessment of NFHP. For this test, the SBL scheme would be added to the NFHP Do Something model. The NFHP Scheme includes cross-Bristol MetroBus operations and hence covers a large part of the Greater Bristol area, and potentially it therefore has close links with the SBL Scheme in south Bristol. In particular, the SBL MetroBus service (provided by an extension to the AVTM MetroBus service) and two of the NFHP MetroBus services (Cribbs Causeway to Hengrove and Emersons Green to Hengrove) would share the southern terminal at Hengrove. In addition, the SBL scheme provides some relief to sections of the highway network served by NFHP MetroBus services including the Parson Street gyratory and Hartcliffe Way. Hence, the sensitivity test considered the addition of the SBL scheme onto the NFHP Do Something network.

3.48. The impact of the SBL scheme on the operation of the NFHP scheme is highlighted by the series of network plots from the highway model which present the change in flows on the highway network between the core NFHP scheme and the situation with the addition of SBL:

- 2016 AM Peak in Figure 3-1;
- 2016 Inter-Peak in Figure 3-2;
- 2016 PM Peak in Figure 3-3;
- 2031 AM Peak in Figure 3-4;
- 2031 Inter-Peak in Figure 3-5; and
- 2031 PM Peak in Figure 3-6.

3.49. As would be expected, the main changes in flows occur on the parallel routes in the immediate vicinity of the SBL alignment, for example A38 Bridgwater Road and B3130 Barrow Street. The impact is dissipated somewhat on the NFH corridor although there are nevertheless some small reductions in traffic volumes on Bedminster Parade, Dalby Avenue, West Street and Hartcliffe Way.

3.50. With the additional traffic attracted to the SBL corridor, the access to the corridor from south Bristol produces additional traffic on the A4174 Hengrove Way, which reaches an additional 200 vehicles in the 2016 AM Peak and 2031 PM Peak hours. The NFH route crosses Hengrove Way at the junction with Creswicke Road and Bamfield and hence there may be a small impact on the priority at this junction.

3.51. All of the impacts noted above occur in the peak hours; there are negligible effects in the inter-peak hours.

Figure 3-1 NFHP Sensitivity Test with SBL – Change in Traffic Volumes in 2016 AM Peak

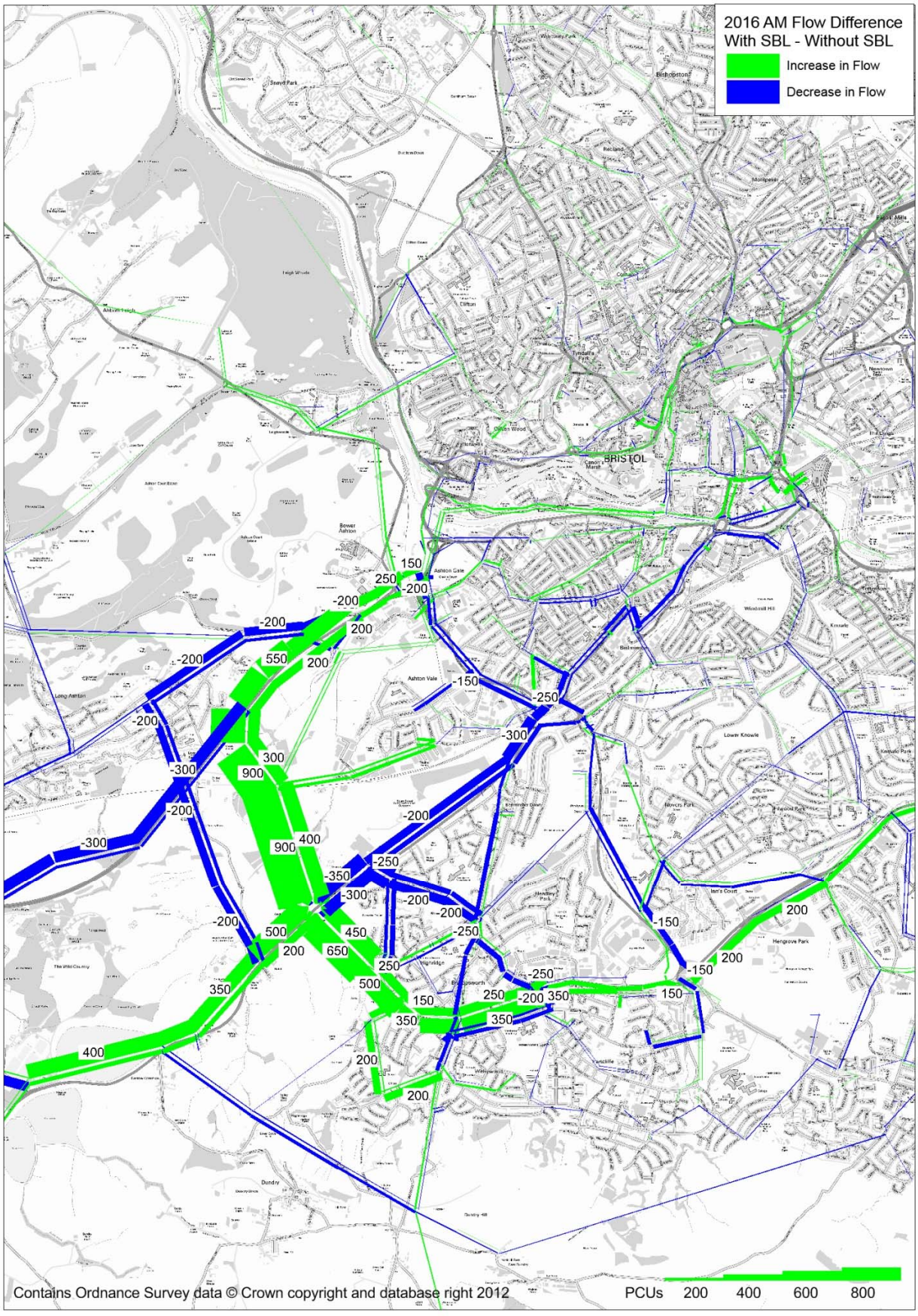


Figure 3-2 NFHP Sensitivity Test with SBL – Change in Traffic Volumes in 2016 Inter-Peak

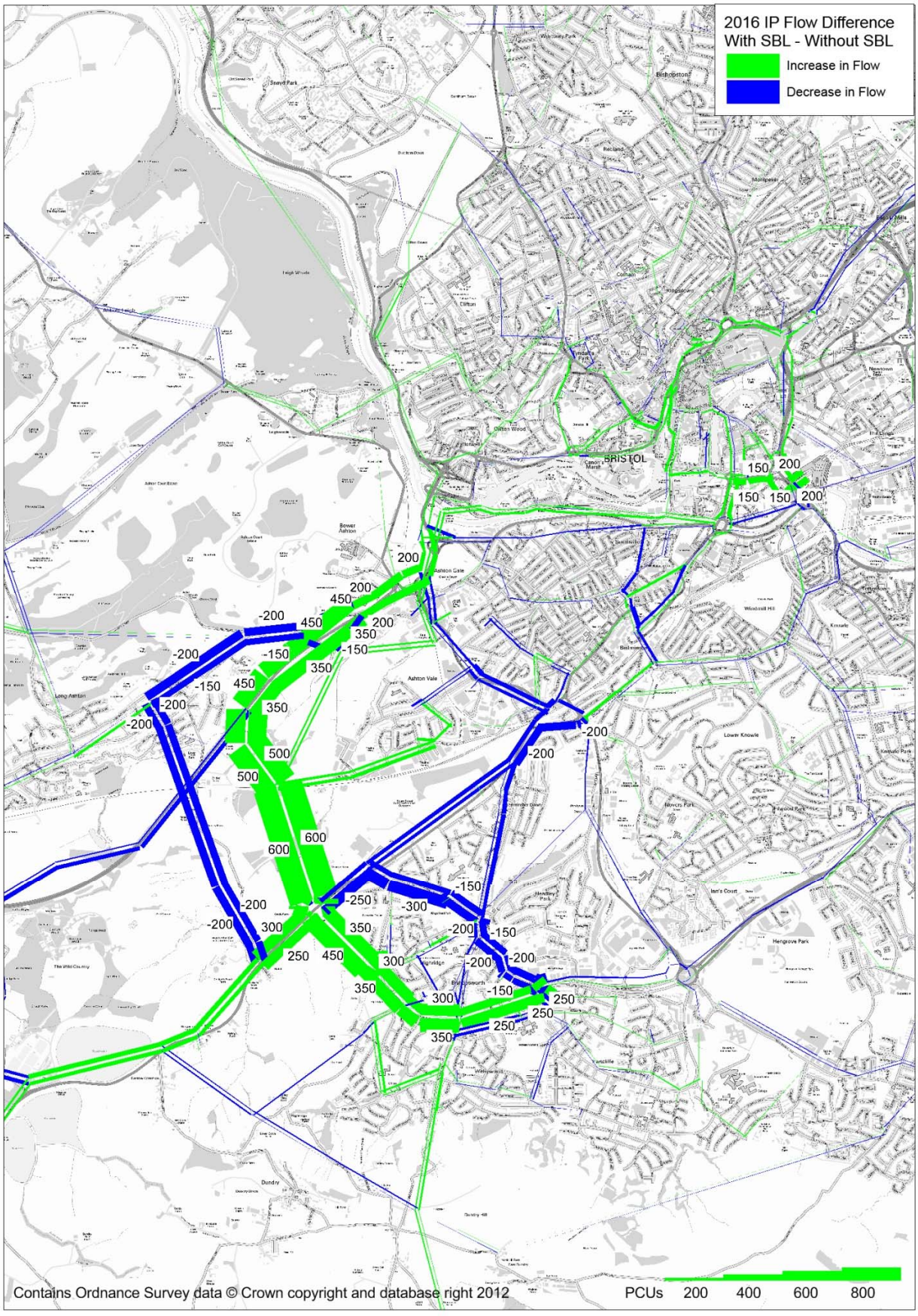


Figure 3-3 NFHP Sensitivity Test with SBL – Change in Traffic Volumes in 2016 PM Peak

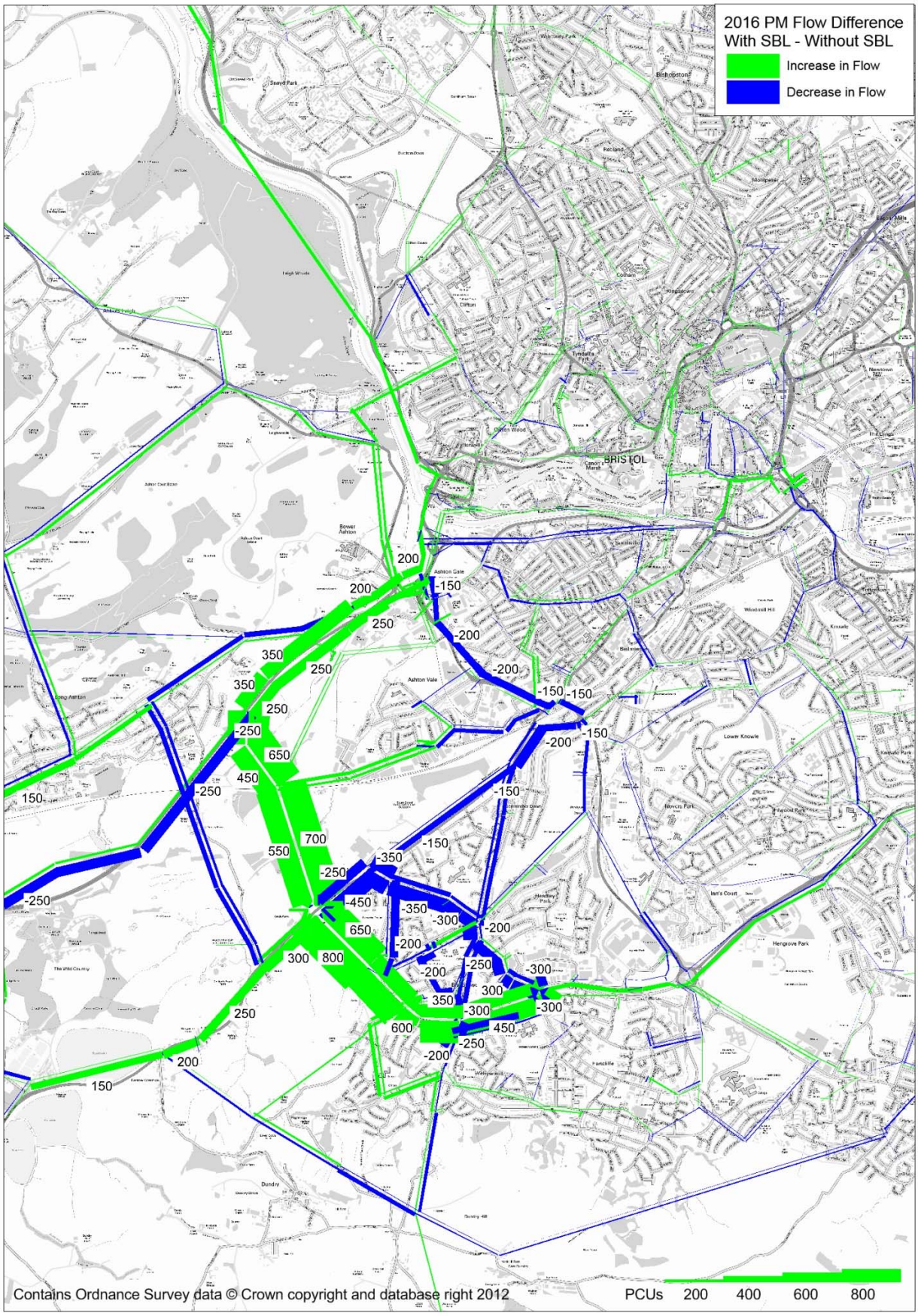


Figure 3-4 NFHP Sensitivity Test with SBL – Change in Traffic Volumes in 2031 AM Peak

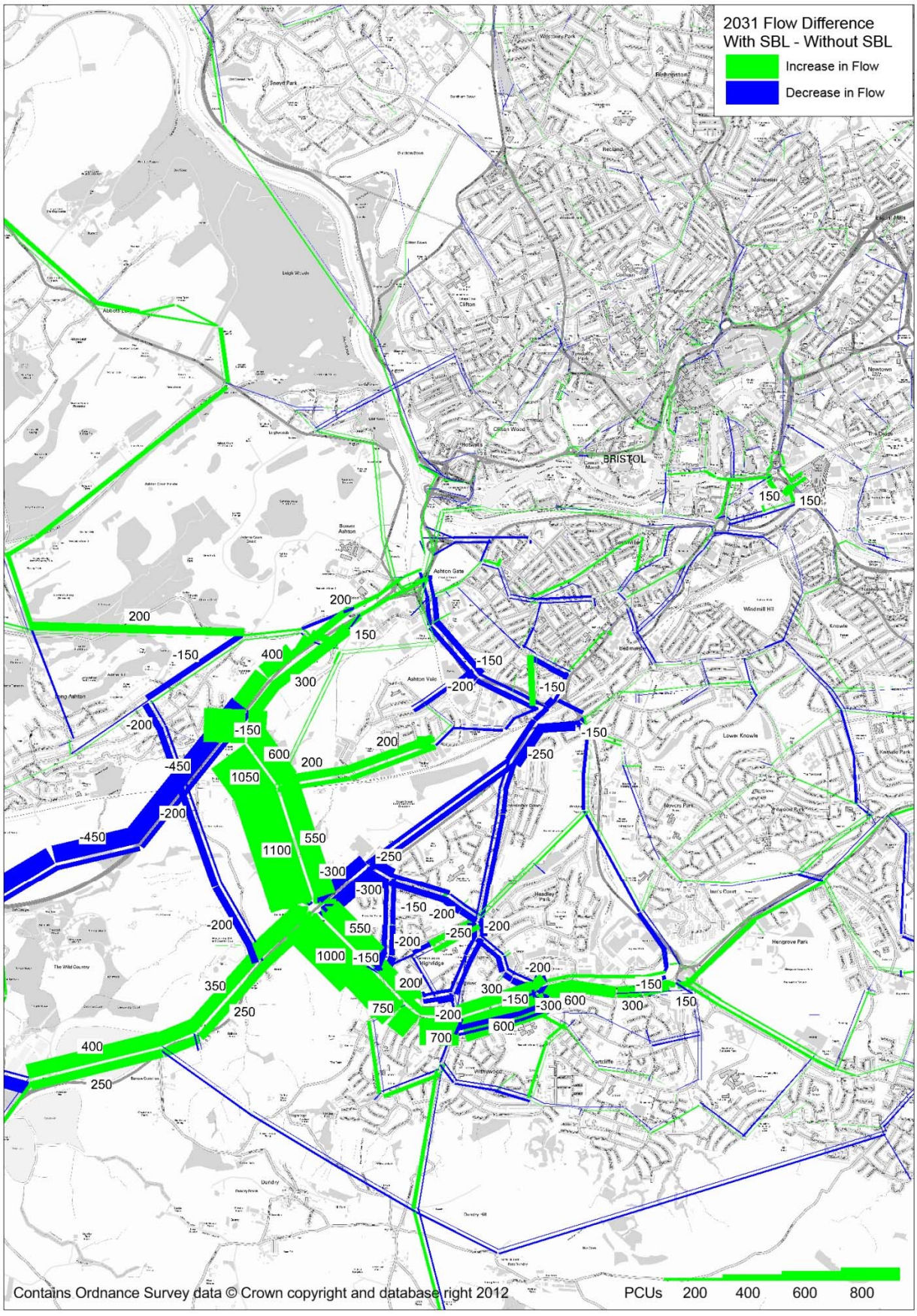


Figure 3-5 NFHP Sensitivity Test with SBL – Change in Traffic Volumes in 2031 Inter-Peak

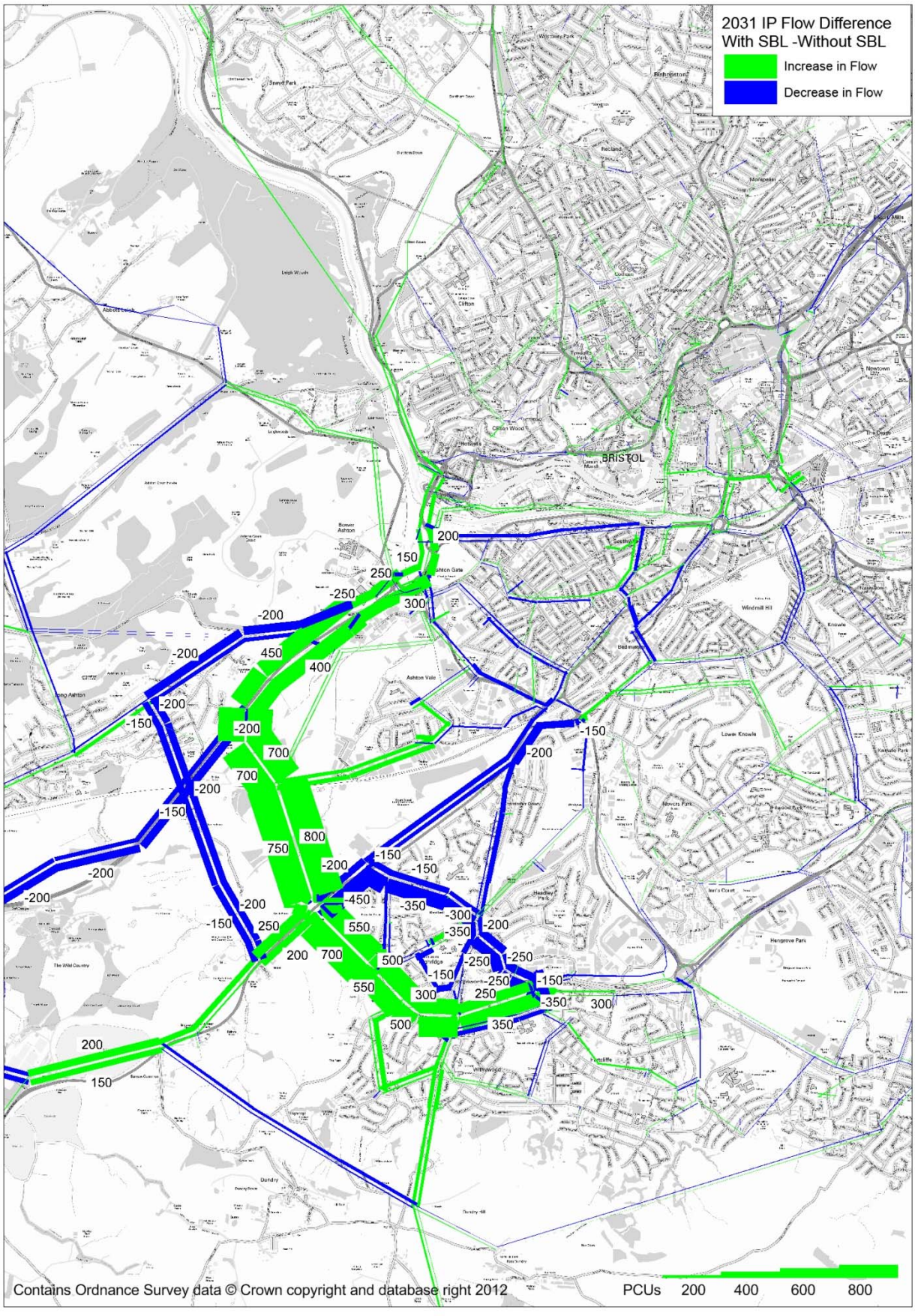
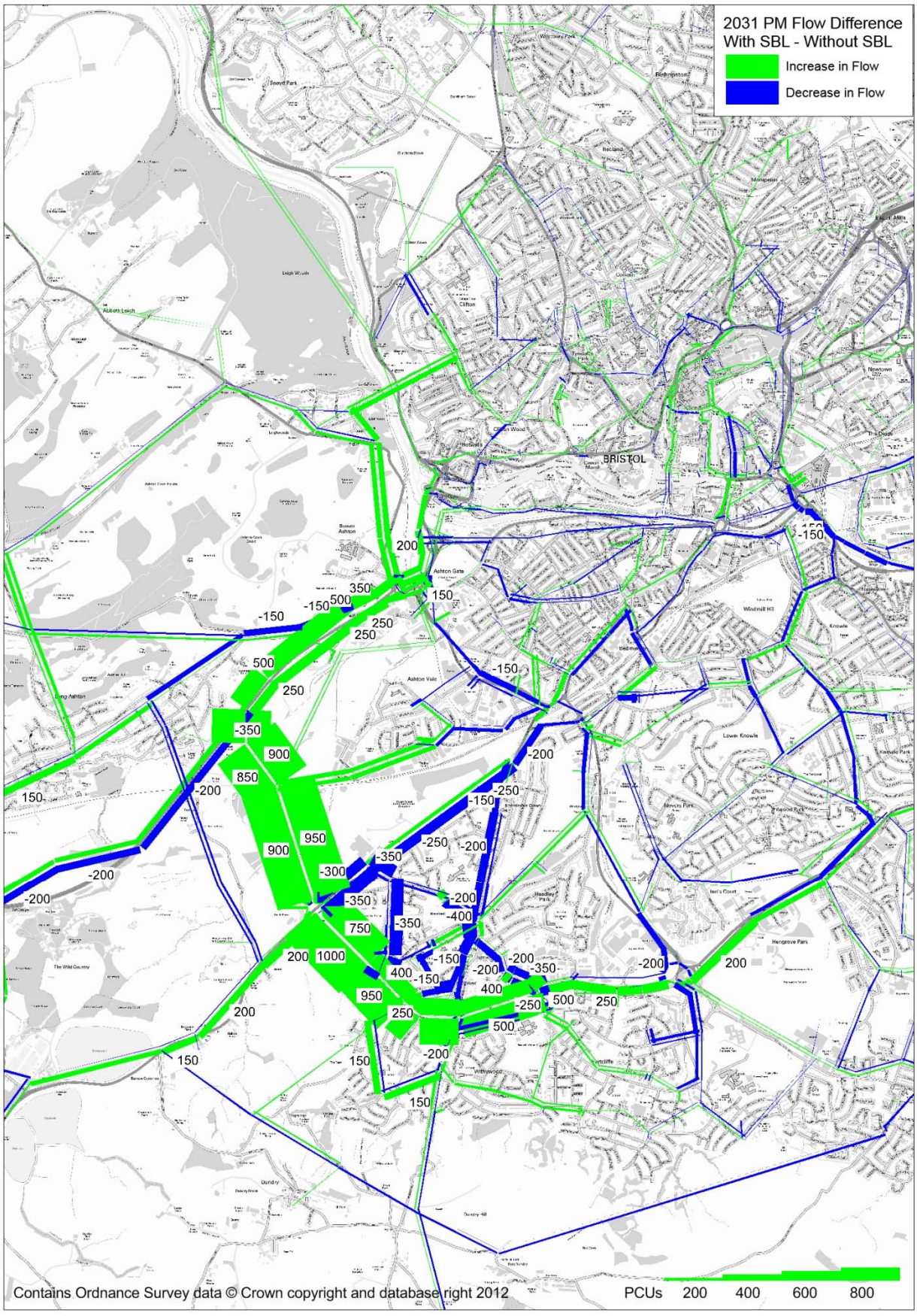


Figure 3-6 NFHP Sensitivity Test with SBL – Change in Traffic Volumes in 2031 PM Peak



4. Revised Economic Appraisal Results

Introduction

4.1. This chapter explains how the modelling and estimation of scheme benefits and costs has changed since the BAFB submission, focusing on the revised economic appraisal.

Transport Economic Efficiency (Benefits)

4.2. The Transport Economic Efficiency (TEE) table in Appendix B shows the costs and benefits to users of the transport system and the private sector. A summary of the key information from the TEE table is provided in Table 4-1.

4.3. The original BAFB submission was prepared using TUBA 1.8 while the Full Approval submission has been based on TUBA 1.9 which includes, amongst other differences, the use of 2010 as the base for prices and values compared with 2002 which formed the basis for TUBA 1.8. In order to provide an indication of the relative changes to the benefits between the BAFB and Full Approval assessments, the Full Approval scheme from TUBA 1.9 has been converted to 2002 prices, i.e. corresponding to the TUBA 1.8 situation.

4.4. In addition to the change in the price base from 2002 to 2010 between TUBA 1.8 and 1.9, there are a number of changes between the BAFB and Full Approval situations, as outlined in section 3, covering factors such as scheme design, specification of the modelling and parameters for the appraisal. In addition, the appraisal contained in the original BAFB submission was revised during the subsequent DfT review; this assessment reflects the contents of the revised BAFB submission. The estimation of the quantified benefits concentrates on the benefits gained by road users (drivers and public transport users) included in the transport model and therefore does not take into account benefits received by cyclists and pedestrians which would gain some significant time savings especially through the construction of the SGTL with the additional links that it creates. Furthermore, the rationale for the redesign of The Centre includes significant public realm benefits which are not captured by the appraisal process.

4.5. Comparing the benefits forecast for the Full Approval scheme to the revised benefits forecast for the BAFB, the following key points can be noted:

- **Public transport travel time benefits** have reduced from £162.095m to £108.633m due to the combined effect of the change to the NFHP scheme (with the longer journey time via Redcliff Hill rather than Prince Street Bridge), SGTL speeds, the revised modelling and the new version of TUBA;
- **Highway travel time benefits** have reduced from £82.861m to £73.858m. **Vehicle operating cost benefits** have reduced slightly from £23.590m to £19.569m.
- **Carbon** savings, as output from TUBA, have changed slightly from a small saving of £3.587m to £2.090m;
- Although **Marginal abatement costs** were not required to be estimated at the time of the BAFB, they are now a necessary component of the current appraisal and hence have been estimated (in the central case) as a slight disbenefit of £0.133m (discounted over 60 years) as indicated in the previous section;
- Whilst **accident disbenefits** have decreased slightly (from £5.574m to £2.493m), this reflects the net impact of a number of changes to the highway network including the construction of the SGTL, the creation of bus priority measures and the reconfiguration of The Centre;
- The estimated **reliability** benefits decrease from £37.020m to £6.042m;
- **Indirect Tax Revenue** loss has decreased from £13.698m in the BAFB to £8.314m in the Full Approval;

- rather than modelled directly using WITA, as described in Section 3, **Wider Impacts** have been estimated using the change in commuting travel time (for labour market effects) and commuting/business travel time (for agglomeration effects) and 10% of business user benefits (for imperfectly competitive markets). On this basis, as described in the previous section, benefits have decreased from £13.031m to £7.097m, reflecting the changes in the price base and well as alterations to the scheme:
  - Agglomeration benefits worth £2.799m, reduced from £4.329m;
  - Labour market benefits, worth £1.333m, showing negligible change from £1.327m; and
  - £2.965m benefits from increased output in imperfectly competitive markets, a decrease from £7.375m.

Public Accounts (Costs)

4.6. The Public Accounts table (see Appendix B) shows the impact of the NFHP scheme on local and central government accounts. Comparing the discounted costs for the Full Approval with the BAFB, the key point is that the costs for the 60-year appraisal period are 10% higher than the BAFB costs.

4.7. This is a net result of:

- Changes to the base year for discounting and presentation of price base from 2002 to 2010; and
- New tender prices, revised operating and capital renewal costs, optimism bias, and the change in the start date for the Scheme.

Benefit-Cost Ratio (BCR)

4.8. Table 4-1 shows the monetised costs and benefits associated with the NFHP Full Approval scheme compared with the BAFB. The Full Approval results for 2010 contain the latest values from the TUBA 1.9 appraisal with the additional analysis described earlier for reliability, accidents and wider impacts. The Full Approval values in 2002 prices are based on the same assignment as the 2010 run and therefore use 2010 values of time; hence it is provided simply for information purposes as an indication of the change between BAFB and Full Approval. The outputs from the 2010 model were input directly into TUBA 1.8 to derive the TUBA-based values; the other elements of the appraisal (accidents, reliability wider impacts and broad transport budget) are derived by the application of factor of 0.5984 which reflects the impact of changing the price base and base year between 2010 and 2002.

4.9. The revised BCR for the NFHP Full Approval is 2.34, compared to 3.54 in the BAFB, and hence still offering **high value for money**. The change in the BCR is due to a number of factors outlined in Section 3 including changes to the scheme, amended long term maintenance and operating cost inflation assumptions, optimism bias, the changed price base and alterations to scheme opening.

Table 4-1 Analysis of Monetised Costs and Benefits (PE BAFB vs Full Approval) (£M)

Item	BAFB	Full Approval	Full Approval
	£m, 2002 prices discounted		£m, 2010 prices discounted
Benefits			
Greenhouse Gases	£3.587	£1.400	£2.090
Accidents	-£5.574	-£1.492	-£2.493

Item	BAFB	Full Approval	Full Approval
	£m, 2002 prices discounted		£m, 2010 prices discounted
Economic Efficiency: Consumer Users (Commuting and Other)	£180.078	£95.276	£185.843
Economic Efficiency: Business Users and Providers	£82.469	£21.153	£26.084
Wider Public Finances (Indirect Taxation Revenues)	-£13.698	-£5.475	-£8.314
Reliability Impact	£37.020	£3.616	£6.042
Wider Impacts	£13.031	£4.247	£7.097
Net Present Value of Benefits (PVB)	**£296.912**	**£118.726**	**£216.349**
Costs			
Broad Transport Budget	£83.808	£55.348	£92.489
Net Present Value of Costs (PVC)	**£83.808**	**£55.348**	**£92.489**
Overall Impacts			
Net Present Value (NPV= PVB-PVC)	£213.104	£63.378	£123.860
Benefit to Cost Ratio (BCR=PVB/PVC)	**3.54**	**2.15**	**2.34**

Non-Monetised Impacts

4.10. The NFHP scheme would be likely to give rise to additional non-monetised impacts, in addition to those which are presented in Table 4-1 for the Full Approval appraisal. There are minor changes to these impacts from the BAFB submission, reflecting revisions to the Scheme.

- **Physical Activity:** The scheme would encourage additional walking and cycling journeys as a result of the segregated route along the SGTL alignment and increased public transport trips (potentially accessed by foot or cycle) through the switching from car – ***Moderate Beneficial***;
- **Journey Quality:** The high quality facilities, MetroBus vehicles, views, surrounding environment and passenger information provided with the MetroBus element of the Scheme will reduce stress and improve traveller care and therefore improve journey ambience for those passengers using the route. The new direct journey opportunities between the North and East Fringes and central/south Bristol will further improve journey quality – ***Moderate Beneficial***;
- **Security:** Particular attention and importance is attributed to the personal security of public transport passengers while making their way to and from the stops, waiting for services, and travelling on the vehicle. Increased use of CCTV and high standard of lighting at stops and CCTV on the vehicles will provide high levels of security for MetroBus passengers – ***Moderate Positive***;
- **Access to Services:** The NFHP MetroBus services provide some significant connections between areas directly served by the scheme. The direct cross-centre services provide improved links between south/central Bristol and UWE, East Fringe and North Fringe increasing the range of employment opportunities for residents of south Bristol.

Walking/cycling components improve access to the existing cycling and walking network – ***Moderate Beneficial***;

- **Affordability:** The assumptions for fares policy underlying the modelling and appraisal of NFHP are to mirror existing public transport fares – ***Neutral***;
- **Severance:** The new infrastructure will create new links with the SGTL element providing additional connections for drivers, public transport passengers, cyclists and walkers and the bus only junction removing severance for public transport journeys – ***Slight Beneficial***; and
- **Option Values:** The scheme will increase the transport options available across all modes in the North Fringe and by public transport in south/central Bristol and the North and east Fringes – ***Moderate Beneficial***;

4.11. The NFHP does not have any severe adverse environmental impacts, and is expected to have a ***Slight Beneficial*** impact on **greenhouse gases** and ***Slight Adverse*** on **air quality** and **noise**.

4.12. The Scheme would be likely to give rise to the following additional **Slight Adverse** environmental impacts, with the inclusion of suitable remedial measures:

- **Landscape** – some long term impacts on landscape through new highway infrastructure formed by SGTL and new bus only junction although mitigation measures will reduce some impacts; and
- **Ecology** – construction of SGTL and M32 bus-only junction will result in some loss of trees, hedgerow, scrub and grassland habitats. Elsewhere, some loss of green field and limited chance of damage to SNCIs and LNR. Mitigation measures in place to resolve impacts on vulnerable species during construction and operation.

4.13. The impact on the other environmental designations of **townscape**, **heritage** of historic resources and **water environment** was assessed as **neutral**, with the inclusion of anticipated remedial measures.

Details of the Maintenance Delay Costs/Savings

4.14. The impacts of Maintenance Delay Costs/Savings and Construction Delays have been assessed qualitatively (i.e. non monetised). The NFHP scheme would be designed to dovetail with any maintenance works that are programmed along affected sections of highway.

Details of the Delays during Construction

4.15. Any delays during construction have not been captured in the appraisal of the Scheme. The bulk of the scheme is new construction off the existing highway network and hence the impact on the operation of the highway network will be limited.

Appendices

Appendix A. Accident Impact Calculation Spreadsheet Note

A.1. Introduction

A.1.1. This Appendix provides further details on the approach used to calculate the accident impacts included in the main Value for Money assessment for the Best and Final Bid and the Full Approval submission.

A.1.2. The analysis was produced using a spreadsheet that replicates the calculations used within the DfT's COBALT software for combined link and junction accident rates. The approach was originally developed as an alternative to COBA because it allows accidents to be calculated directly on the basis of output from the existing highway model, avoiding the need for the development of a separate COBA model for the calculations. This spreadsheet model has since been brought up to date with COBALT values based on the current WebTAG databook.

A.1.3. The spreadsheet uses input information on traffic volumes, distance and road type by link from the main SATURN highway model, along with the accident and casualty rates, monetary values and change rates and the calculations set out in the COBALT manual, to provide an estimate of accidents on the study network in the Do Minimum and Do Something in each forecast year.

A.1.4. The parameters and calculations used are directly comparable with those set out in the COBALT manual[2] and the remainder of this note summarises the results of a test carried out to confirm the equivalence of the results produced by the spreadsheet model with those produced by COBA for a given test network and scenario. Details of the comparison made and COBA model created are provided in the following section and the subsequent sections then summarise the results of the comparison.

A.1.5. The only differences between the accident analysis methodology applied by COBA and that applied by COBALT are the removal of the need to generate an operational network in COBALT and exclusion of any other details which are not relevant to accident analysis. Therefore a demonstration that the spreadsheet model is consistent with COBA also implies consistency with COBALT.

A.2. Test Details

A.2.1. The comparison between COBA and the accident spreadsheet calculations was made on the basis of a small section of the highway model used to represent the South Bristol Link scheme in its submission for Programme Entry in 2010, as shown schematically in Figure A.1. The network selected ensured that all elements of the calculation process in COBA were tested in the comparison through the inclusion of links of different types and with differing speed limits, those with local and default accident rates as well as examples that were either new or removed in the Do Something (relative to the Do Minimum).

A.2.2. Version 11, Release 10 of COBA was used for consistency with the spreadsheet used at the time of the Programme Entry submission and the spreadsheet used in the comparison also retained the equivalent parameters.

A.2.3. Data on link lengths, characteristics, speed limits and AADT flows were extracted from SATURN and used to build the Do Minimum and Do Something Networks in COBA. Local accident rates were included in the COBA network for the relevant links (calculated on the basis of annual flows and five years of accident records, in line with the guidance in the COBA manual) and default values were used throughout the rest of the network, allocated on the basis of road type as coded within the SATURN model. Table A.1 summarises the key COBA characteristics for each link.

[2] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/262973/cobalt-user-manuel.pdf

Figure A.1 - COBA Network with Link IDs

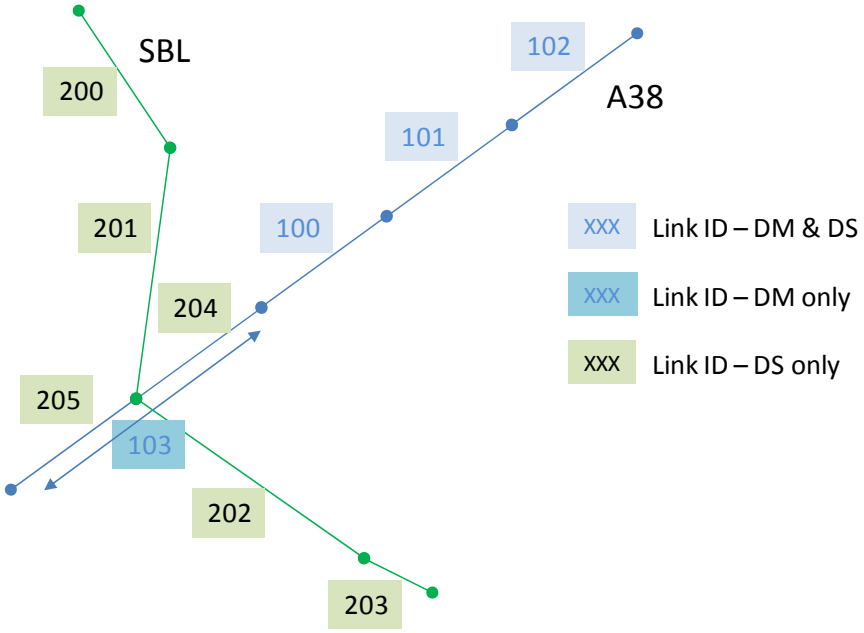


Table A.1 - COBA Link Details

Link	Carriageway	Speed limit	Accident Rate
100	Single	>40mph	Default
101	Dual	</=40mph	Local
102	Dual	</=40mph	Local
103	Single	>40mph	Default
200	Single	</=40mph	Default
201	Single	</=40mph	Default
202	Single	</=40mph	Default
203	Single	</=40mph	Default
204	Single	>40mph	Default
205	Single	>40mph	Default

A.2.4. AADT data was entered by link for the two forecast years of 2016 and 2031 and each intervening year (based on linear interpolation), to allow growth rates to be applied by link. No further growth in traffic was assumed beyond 2031.

A.2.5. The COBA Do Minimum and Do Something scenario was then run and the output file compared with the results for the equivalent run in the spreadsheet.

A.3. Test Results

A.3.1. The spreadsheet results were compared with each element of the COBA results presented in the PM output file for individual years (i.e. accident rate, AADT and accident number by year and link for 2016 and 2030/31)

A.3.2. The comparison confirmed that results matched at each stage, leading to the close match between final results of the total net present value of forecast accidents by link and scenario shown in Table A.2.

Table A.2 - Monetary Value of Accidents by Scenario, £000, NPV (2002 prices/values) as forecast by COBA and the Spreadsheet Approach

Scenario	Link ID	COBA Output	Spreadsheet Output	Difference (Spreadsheet/ Output)
DM	100	6353	6369	0%
	101	3174	3171	0%
	102	1103	1104	0%
	103	4354	4350	0%
	Total	14984	14994	0%
DS	100	4350	4358	0%
	101	1856	1841	-1%
	102	650	650	0%
	200	9120	9095	0%
	201	11560	11518	0%
	202	4932	4922	0%
	203	1644	1641	0%
	204	1367	1361	0%
	205	2983	2981	0%
	Total	38461	38335	0%

(Note that the small variations shown are due to rounding, for instance distances are entered to COBA with fewer decimal places than are used in the spreadsheet).

A.4. Summary

A.4.1. The test described above confirms that the accident spreadsheet successfully replicates the calculations carried out in COBA and by proxy those carried out in COBALT. It therefore provides a suitable basis for carrying out future combined link and junction accident analysis for schemes for which relatively minor accident impacts are expected.

A.4.2. On this basis, the spreadsheet was updated for consistency with the latest version of COBALT (May 2014 WebTAG Databook)[3]. This revised version of the spreadsheet provided the basis for the accident analysis presented in the Value for Money assessment for the Full Approval Bid.

[3] This process involved updating the values in the parameter tables only – no changes in the calculation processes checked by the test were required.

Appendix B. TUBA Output

B.1. Economic Efficiency of the Transport System (TEE)

B.2. Analysis of Monetised Costs and Benefits (AMCB)

B.3. Public Accounts (PA)

Economic Efficiency of the Transport System ('Adjusted TEE')

Non-business: Commuting	**ALL MODES**		**ROAD**		**BUS and COACH**	**RAIL**	**OTHER**
User benefits	**TOTAL**		**Private Cars and LGVs**		**Passengers**	**Passengers**	
Travel time	99,146		59,639		42,184	-2,677	
Vehicle operating costs	12,319		12,319				
User charges	3,723		264		0	3,459	
During Construction & Maintenance	0		0		0	0	
COMMUTING	115,188	*(1a)*	72,223		42,184	782	

Non-business: Other	**ALL MODES**		**ROAD**		**BUS and COACH**	**RAIL**	**OTHER**
User benefits	**TOTAL**		**Private Cars and LGVs**		**Passengers**	**Passengers**	
Travel time	69,126		0		68,927	199	
Vehicle operating costs	0		0				
User charges	1,529		0		0	1,529	
During Construction & Maintenance	0		0		0	0	
NET NON-BUSINESS BENEFITS: OTHER	70,655	*(1b)*	0		68,927	1,728	

Business								
User benefits			**Goods Vehicles**	**Business Cars & LGVs**	**Passengers**	**Freight**	**Passengers**	
Travel time	20,980		12,868	1,350	7,343		-581	
Vehicle operating costs	7,250		6,431	819				
User charges	1,418		0	0	0		1,418	
During Construction & Maintenance	0		0	0	0		0	
Subtotal	29,648	*(2)*	19,299	2,169	7,343		837	
Private sector provider impacts					**Passengers**	**Freight**	**Passengers**	
Revenue	16,309		-	91	24,506		-8,106	
Operating costs	-9,094			-	-9,094		0	
Investment costs	-3,469			-	-3,469		0	
Grant/subsidy	0			-	0		0	
Subtotal	3,746	*(3)*	-	91	11,943		-8,106	
Other business impacts								
Developer contributions	-7310	*(4)*	0					
NET BUSINESS IMPACT	26,084	*(5) = (2) + (3) + (4)*						

TOTAL		
Present Value of Transport Economic Efficiency Benefits ('Adjusted TEE')	211,927	*(6) = (1a) + (1b) + (5)*

Notes: Benefits appear as positive numbers, while costs appear as negative numbers.
All entries are discounted present values, in 2002 prices and values

Analysis of Monetised Costs and Benefits

Noise	N/A	*(12)*
Local Air Quality	N/A	*(13)*
Greenhouse Gases	2090	*(14)*
Reliability	6042	*(15)*
Accidents	-2493	*(16)*
Economic Efficiency: Consumer Users (Commuting)	115188	*(1a)*
Economic Efficiency: Consumer Users (Other)	70655	*(1b)*
Economic Efficiency: Business Users and Providers	26084	*(5)*
Wider Public Finances (Indirect Taxation Revenues)	-8314	*- (11) - sign changed from PA table, as PA table represents costs, not benefits*
Wider Impacts	7097	*(17)*
Present Value of Benefits (see notes) (PVB)	216349	*(PVB) = (12) + (13) + (14) + (15) + (16) + (1a) + (1b) + (5) + (17) - (11)*
Broad Transport Budget	92489	*(10)*
Present Value of Costs (see notes) (PVC)	92489	*(PVC) = (10)*
OVERALL IMPACTS		
Net Present Value (NPV)	123860	NPV=PVB-PVC
Benefit to Cost Ratio (BCR)	2.34	BCR=PVB/PVC

Note : This table includes costs and benefits which are regularly or occasionally presented in monetised form in transport appraisals, together with some where monetisation is in prospect. There may also be other significant costs and benefits, some of which cannot be presented in monetised form. Where this is the case, the analysis presented above does NOT provide a good measure of value for money and should not be used as the sole basis for decisions.

Public Accounts for the Appraisal of Major Highway Schemes

	ROAD INFRASTRUCTURE TOTAL	
Local Government Funding		
Operating Costs	15,804	
Investment Costs	36,122	
Developer and Other Contributions	- 7,310	
NET IMPACT	44,616	(7)
Central Government Funding: Transport		
Operating costs	-	
Investment Costs	47,873	
Developer and Other Contributions		
NET IMPACT	47,873	(8)
Central Government Funding: Non-Transport		
Indirect Tax Revenues	5,468	(9)
TOTALS		
Broad Transport Budget	92,489	(10) = (7) + (8)
Wider Public Finances	8,314	(11) = (9)

Appendix C. Appraisal Summary Table

Appraisal Summary Table

Date produced:	14	11	2014

Contact:	
Name	Rob Thompson
Organisation	Atkins
Role	Consultant

Name of scheme:	North Fringe to Hengrove Package
Description of scheme:	The NFHP scheme comprises a number of major elements: three MetroBus bus transit routes between Cribbs Causeway / North Fringe; East Fringe and South Bristol via Bristol City Centre providing rapid cross-city links; new bus-only junction on M32; public realm improvements to Bristol City Centre; and new transport link at Stoke Gifford (Stoke Gifford Transport Link).

Impacts		Summary of key impacts	Assessment: Quantitative	Qualitative	Monetary £(NPV)	Distributional 7-pt scale/ vulnerable grp
Economy	Business users & transport providers	Business users experience travel time benefits resulting from the improved journey times provided by different elements of the scheme. The MetroBus services with the bus-only junction and other priority measures generate journey time savings particularly between North/East Fringe and city centre/south Bristol. The SGTL element creates highway benefits through journey time and operating cost savings. The reduction in highway capacity in The Centre offsets some of the travel time savings especially for business users travelling to/from/through Bristol city centre.	**Value of journey time changes(£)** £21.0m **Net journey time changes (£)** 0 to 2min: £1.447m; 2 to 5min: £7.778m; > 5min: £11.792m	Moderate Beneficial	£26.084m	Moderate Beneficial
	Reliability impact on Business users	The provision of dedicated priority measures, the bus-only junction and the new SGTL scheme will provide improved reliability for the MetroBus services as well as other bus services using the new infrastructure. Similarly SGTL will improve the reliability of drivers' journeys in the North Fringe. Reduced capacity on the highway network in The Centre tends to worsen reliability in this area which therefore affects business travel. Hence, the net impact is a slight worsening of reliability for business users.	PVB = -£2.933m	Slight Adverse	-£2.933m	
	Regeneration	Not assessed as the scheme will not affect a designated regeneration area.	Not Applicable	Not Applicable	Not Applicable	
	Wider Impacts	The journey time improvements generated by the package produce Wider Impacts valued at an estimated £7.097m PVB (2010 prices) over the appraisal period (agglomeration benefits of £2.799m, labour market impacts of £1.333m and benefits of increased output in imperfect markets, £2.965m) .	PVB = £7.097m	Slight Beneficial	£7.097m	
Environmental	Noise	The most significant increases in noise are expected in the vicinity of the Stoke Gifford Transport Link and in the Hengrove Park areas. Adverse impacts in these areas may be limited with mitigation. Effects in the vicinity of the other scheme elements are negligible or minor. Overall, in opening year, more perceptible increases in noise than decreases, but by 2031 there are more properties predicted to receive a perceptible decrease in noise than increase.	Not Applicable	Slight Adverse	Not Applicable	Slight beneficial
	Air Quality	Relocation of traffic between parallel corridors causes some adverse and beneficial effects which tend to balance out. Bristol city centre includes some local moderate adverse impacts due to the measures in The Centre which causes diversion of traffic. This will require some small-scale remedial measures in the detailed design including the retiming of traffic signals. Similarly, slight net adverse impacts at Parson Street area will require mitigation. Scheme will improve air quality at some locations and worsen at others. Scheme does not have a significant effect in terms of 24 hour PM10 concentrations. The SGTL element of the scheme would not have significant impacts on NOx or PM10 concentrations.	Not Applicable	Slight Adverse	Not Applicable	Not Applicable
	Greenhouse gases	Decrease in overall vehicle-kilometres per day travelled over the 60 year appraisal period resulting in overall decrease in carbon emissions and a positive net present value .	Change in non-traded carbon over 60y (CO2e) -43,240 Change in traded carbon over 60y (CO2e) -91	Slight Beneficial	£2.090m	
	Landscape	Some long term impacts on landscape character where new road infrastructure is introduced into existing open farmland. Neutral to slight adverse impacts on visual amenity. Potential short term adverse impacts on landscape character and visual amenity through the loss of existing vegetation and construction activities. Mitigation measures will reduce some impacts to neutral at design year. Some impacts will remain e.g. Stoke Park and SGTL and hence overall assessment of slight adverse.	Not Applicable	Slight Adverse	Not Applicable	
	Townscape	No long term impact on townscape character. Neutral to slight adverse impacts on visual amenity. Potential short term adverse impacts on townscape character and visual amenity during construction. Mitigation measures will reduce impacts to neutral at design year.	Not Applicable	Neutral	Not Applicable	
	Heritage of Historic resources	The NFH Package proposals pass through areas of known cultural heritage value – Stoke Park, Bristol City Centre, the Harbourside and Bedminster are areas of particular high value, which is reflected in the high number of designations (including 283 Listed Buildings, 8 Conservation Areas, and 1 Registered Park and Garden. Overall throughout the whole scheme, the potential impact is likely to result in a negligible negative impact or no change.	Not Applicable	Neutral	Not Applicable	
	Biodiversity	Construction of the SGTL and M32 bus only junction will result in some loss of trees, hedgerow, scrub and grassland habitats. Elsewhere, there would be some loss of green field habitat and limited chance of damage to SCNIs and LNR. Mitigation measures are in place to resolve any impacts on vulnerable species during construction and operation.	Not Applicable	Slight Adverse	Not Applicable	
	Water Environment	As well as the local watercourses affected by the scheme, there will be impacts on the River Frome, the River Avon and the floodplain. The works are generally considered as minor in nature and the impact of the NFH Package proposals is generally classed as neutral. Without mitigation, however, there would be some negative effects on the River Frome which is declared a "salmonid" water. If appropriate mitigation is proved, the effect of the NFH Package proposals on the water environment will be neutral.	Not Applicable	Neutral	Not Applicable	
Social	Commuting and Other users	Users experience travel time benefits resulting from the improved journey times provided by different elements of the scheme. The MetroBus services with the bus-only junction and other priority measures generate journey time savings particularly between North/East Fringe and city centre/south Bristol. The SGTL element creates highway benefits through journey time and operating cost savings. Capacity reductions in The Centre offset the benefits in travel time savings to some extent.	**Value of journey time changes(£)** £168.3m **Net journey time changes (£)** 0 to 2min: £23.141m; 2 to 5min: -£25.713m; > 5min: £170.865m	Large Beneficial	£185.843m	Moderate Beneficial
	Reliability impact on Commuting and Other users	The provision of dedicated priority measures, the bus-only junction and the new SGTL scheme will provide improved reliability for the MetroBus services as well as other bus services using the new infrastructure. Similarly SGTL will improve the reliability of drivers' journeys in the North Fringe. Although the measures in The Centre reduce highway capacity, this does not have a dominant impact on commuting/other trips and hence the net impact on reliability is beneficial.	PVB = £8.975m	Slight Beneficial	£8.975m	
	Physical activity	The scheme would encourage additional walking and cycling journeys alongside the SGTL alignment as well as other segments of the scheme. Increased public transport trips with the associated access by foot or cycle.	Not Applicable	Moderate Beneficial	Not Applicable	
	Journey quality	The NFH Package will increase the transport options available to households across the Greater Bristol area. Modern vehicle designs with good heating, ventilation, seating, luggage space and ride quality will improve traveller care and the provision of better travel information, including real time public transport information, and improvements in personal security, will reduce stress for travellers. Passengers will also benefit from new and better designed waiting and boarding facilities, giving a less stressful, smoother journey. The NFH Package will have a beneficial impact on transport passenger interchange through the provision of quality waiting facilities and greatly improved public transport information. Operation and ease of use of the public transport system will be improved by creating new direct journey opportunities with new MetroBus routes as well as providing greater interchange opportunities with the remainder of the public transport network and other modes.	Not Applicable	Moderate Beneficial	Not Applicable	
	Accidents	Where they change transport mode to MetroBus services, car users will benefit from switching to a safer mode; car users who continue to use the car may benefit from lower accident risk due reduced road traffic levels; and pedestrians and cyclists will benefit from reduced car traffic. Additionally, the scheme is expected to contribute to improved safety for pedestrians as a result of the priority measures and provision of improved access to bus stops and new and improved pedestrian crossing facilities. Cyclists will also benefit from greater segregation from general traffic by being able to use new and improved cycle lanes alongside the MetroBus alignments. The construction of SGTL will increase the length of the highway network and hence the volume of vehicle-kms travelled which in turn would raise the accident levels on this part of the network.	21 additional accidents in 2031, comprising 1 personal injury and 20 damage only.	Slight Adverse	-£2.493m	Neutral
	Security	Particular attention and importance is attributed to the personal security of MetroBus passengers while making their way to and from the stops, waiting for services and travelling on the vehicle. Improvements such as increased CCTV systems; passenger information; good lighting; safe and secure access to stops, etc will benefit MetroBus passengers.	Not applicable	Moderate Positive	Not Applicable	Moderate Beneficial
	Access to services	The MetroBus services will provide benefits from improved access between North/East Fringe, Bristol city centre and south Bristol. In particular, the low car ownership areas of south Bristol gain from improved public transport accessibility to employment areas in the North and East Fringes including Emersons Green East, SPark, UWE and Bristol Business Park. The construction of the SGTL will improve local highway access between Bradley Stoke and UWE, MoD and Bristol Business Park.	Not Applicable	Moderate Beneficial	Not Applicable	Moderate Beneficial
	Affordability	The scheme would have no significant impact on affordability - the assumptions are that MetroBus fares policy will mirror existing public transport fares.	Not Applicable	Neutral	Not Applicable	Not Applicable
	Severance	The infrastructure associated with the MetroBus element of the NFH Package is unlikely to have a detrimental impact on severance as the majority of the route will follow existing roads, using on-street infrastructure (i.e. bus lanes, priority at traffic signals). The SGTL element will provide new parallel pedestrian and cycle facilities, including dedicated crossing points. Significant benefits to pedestrian and cyclists in the city centre through improved streetscape, public realm and the provision of significantly enhanced pedestrian and cycle facilities. The ability to integrate the design of the MetroBus proposals within the city centre strategy will reduce the likely level of severance.	Not Applicable	Slight Beneficial	Not Applicable	Moderate Beneficial
	Option values	The overall NFH Package will increase the transport options available to households across the Greater Bristol area but particularly between North/East Fringe and city centre/south Bristol	Not applicable	Moderate Beneficial	Not Applicable	
Public Accounts	Cost to Broad Transport Budget	The public sector experiences costs associated with scheme construction, ongoing maintenance and operation of the scheme.	PVC = £92.489m	Not Applicable	£92.489m	
	Indirect Tax Revenues	Loss of indirect taxation through reductions in fuel duty paid and loss of VAT due to consumers switching expenditure to public transport fares which are zero rated for VAT. Also there are changes to traffic speeds in North Fringe as a result of construction of the SGTL leading to reduced fuel consumption.	PVB = -£8.314m	Not Applicable	-£8.314m	

Appendix D. Analysis of TUBA Warnings

D.1. Introduction

D.1.1. This Appendix summarises the analysis of the warnings reported by the TUBA appraisal of the scheme for the modelled years of 2016 and 2031.

D.1.2. The TUBA warnings generated by TUBA for the economic analysis on the NFHP Scheme have been examined for each time period (AM, IP and PM hours). In particular, the serious warnings have been investigated as part of the modelling process and where these indicated a problem the model was checked and if necessary amended.

D.1.3. Following all such amendments, the remaining warnings which did not suggest any modelling error, but appeared to be consistent with the impacts of the scheme are reported in this Appendix along with any necessary commentary. The TUBA input and output files that support these comments have been included in the Full Approval submission to the DfT.

D.1.4. A summary spreadsheet has also been provided to the DfT electronically which gives a comprehensive summary of all serious warning messages. These have each been investigated to ensure they do not indicate any problems with the model and the associated appraisal. An explanation is provided of the reason for the warnings. In many cases, a large number of warnings relate to very similar issues, in which case warnings have been categorised and given a group explanation.

D.1.5. The TUBA warnings which represent serious warnings within the TUBA definition are split into a number of categories, with a separate table presented for each modelled time period, due to segregation of TUBA runs.

D.1.6. In investigating the patterns of warnings, the reasons why the differences occurred have been noted and a brief commentary for these is given below. It should also be noted that many of the serious warnings that have been generated correspond to origin-destination pairs with very low demand (less than 0.005 trips) and therefore, where appropriate, these warnings were subsequently downgraded if it was assessed that the changes would not result in significant benefit or disbenefit.

D.1.7. In addition, many of the movements highlighted by TUBA as having large changes in time or distance related to the Park and Ride mode. These warnings occur as a result of an effective mode switch for trips which are made directly by car or by bus in the Without Scheme scenario, but are made in two legs via the Park & Ride site in the With Scheme scenario (or vice versa).

D.1.8. The assignment stage of the modelling for Park & Ride trips treated the car leg and bus leg independently with a zone in the model used to represent the Park & Ride site. For the appraisal, these two legs were recombined to allow accurate measurement of the change in consumer surplus for new Park & Ride users.

D.1.9. The variation in composition of the trip types results in large changes in distance because the bus leg of a Park & Ride trip has no measurement of distance. A trip for a single OD pair may therefore be modelled to have:

- full distance (if made by car);
- zero distance (if made by bus); or
- partial distance (if made by Park and Ride).

D.1.10. Large variations can also occur in trip time because the weighting of wait time can greatly increase a perceived trip time while conversely the use of a bus priority lane can significantly reduce journey time.

D.1.11. Warnings for Park & Ride trips have not been individually investigated, as the number of trips involved is very low in comparison to other modes and the overall time benefits to the Park & Ride users amount to less than 0.1% of the car benefits and so do not impact directly on the value for money of the scheme. The notable impacts of the Park & Ride mode are decongestion on the network and generation of revenue, neither of which are affected by these warnings.

D.1.12. A key overall finding from the analysis is that all of the serious warnings of significance for each warning type were for the highway mode of travel. The subsequent comments in the lists below therefore refer to trips and routing only within the highway mode, with the exception of that particular issue with charges.

D.2. Tables D1 – modelled time and distance

D.2.1. The D1 tables for the three time periods (AM, IP and PM) contain those warnings where the ratio of Without Scheme to With Scheme travel times or distances are lower or higher than the limit. These have been categorised into four types:

- Type (1) Ratio of DM to DS travel time lower than limit;
- Type (2) Ratio of DM to DS travel time higher than limit;
- Type (3) Ratio of DM to DS travel distance lower than limit; and
- Type (4) Ratio of DM to DS travel distance higher than limit.

D.2.2. The assessment of the warnings has identified the following principal groups:

- The serious TUBA warnings of type (1) and type (2), which relate to large changes in journey time between scenarios, are predominantly related to short movements across the NFHP route, where either new routes become available or existing/upgraded junctions become either more or less congested. There are also a number of OD pairs which are significantly worsened by the introduction of banned turns in the city centre, particularly when a trip end is in close proximity to the banned turn and hence rerouting on longer routes around the city centre or on Cumberland Road is necessary.
- There are also a number of bus journeys that are also worsened as a result of banning turns in the city centre – in this case, it is usually just the inbound or outbound service that is impacted due to minor re-routing to the new bus only link.
- With the introduction of NFHP there are a number of OD pairs, particularly those long distance journeys which see significantly quicker journey times as a result of being able to use a single service to reach their destination rather than interchanging in the city centre.
- Significant warnings of type (3) and type (4) have been found to generally be a result of rerouting for certain movements. In many cases alternative routes between particular OD pairs exist for which generalised journey costs are very similar. These particularly occur for trips which can be made directly via the city centre, or taking the faster but longer route around the M32, M4 and M5. In some cases this rerouting occurs directly as a result of the scheme, but in other cases the variation in generalised costs of the two routes is so similar that the change may be triggered by minor variations in performance of individual junctions. This effect is experienced for all time periods. Again there are a number of OD pairs which are significantly worsened by the banned turns resulting in a longer distance to reach their destination.
- Other warnings of type (3) and type (4) relate to the Park & Ride mode and the reason for these warnings being downgraded is given above.

D.3. Tables D2 – modelled speeds

D.3.1. The D2 tables for the three time periods (AM, IP and PM) contain those warning where the Without Scheme or With Scheme speeds are lower or higher than the limit. These have been categorised into four types;

- Type (5) DM speeds less than limit;
- Type (6) DM speeds greater than limit;
- Type (7) DS speeds less than limit; and
- Type (8) DS speeds greater than limit.

D.3.2. The assessment of the warnings has identified the following principal groups:

- The significant warnings of type (5) and type (6) mostly result from very short movements, for which access to the network forms a significant part of journey time. In these cases, it has been demonstrated that the same high or low speeds occur in both the Without Scheme or With Scheme scenarios, resulting in no significant contribution to user benefit. In most cases, equivalent warnings appear for both type (5) and type (6) warnings on the same OD pairs. The remainder display speeds very close to the limit which would generate warnings and investigation of the model confirms the speed difference to be very low between scenarios.
- Warnings of type (7) and type (8) have similar causes but with distances for access to the network defined as being proportionally large compared to journey time. Again these are identically defined in both the Without Scheme or With Scheme scenarios in each case.

D.4. Tables D3 – modelled new mode

D.4.1. The D3 tables for the three time periods (AM, IP and PM) contain those warnings concerning the possible introduction of a new mode. Only a single category is required for these as they are based on a comparison between the Without Scheme and With Scheme scenarios.

D.4.2. The warnings in Table D3 which indicate a possible new mode all relate to P&R movements. While Park & Ride does exist as a mode in the Without Scheme model, the improvement to service generated by the NFHP Scheme results in certain OD pairs generating P&R trips when there is no corresponding P&R demand for those movements in the Without Scheme scenario. P&R is therefore effectively a new mode for those OD pairs with the NFHP scheme.

D.4.3. In a small number of cases the same effect occurs in the other direction, with demand for P&R existing in the Without Scheme scenario but not in the With Scheme scenario.

D.4.4. In addition, P&R sites have been modelled as independent zones, with P&R trips split between a car leg in the SATURN model and a bus leg in the EMME model.

D.4.5. In order to avoid the distorting effects of this ‘new mode’ and capture benefits on an actual OD basis, rather than assessing the change to 2 legs of a trip, which may not actually go via the P&R site in one scenario, an additional mode, specific to P&R users has been generated for the appraisal.

D.4.6. This mode includes all P&R demand from both Without Scheme and With Scheme scenarios with optimal route choice selected in each case, whether that be a direct car trip, a direct bus trip or a combined car and bus trip via the P&R site.

D.4.7. In the case of the majority of these trips highlighted by the TUBA warnings, a direct bus service is being used in the Without Scheme scenario, but in the With Scheme scenario, access to P&R is improved resulting in journeys transferring to this mode. In some other cases a P&R service is being used in the Without Scheme scenario, while the improved bus services in the With Scheme scenario result in whole trips being made by bus.

D.4.8. Distance is only attributed to highway movements; the trips made by bus therefore have a zero distance value, while those using P&R include the distance from trip origin to the P&R site, which is covered by car, but not the distance from the P&R site to destination, which is covered by bus.

D.4.9. Similar changes occur within the model which are not highlighted in this set of warnings, but many are captured in other warning types discussed above, in which the mode shift being made is from car to P&R, rather than from bus to P&R. For trips changing from car to P&R, the OD distance output by the model will be non-zero in both cases, but will differ significantly as the car trip includes the full trip distance, while the P&R trip includes only the distance of one of the two legs of the journey.

D.5. Conclusion

D.5.1. In summary, the analysis has identified that the serious TUBA warnings have mostly been found to be a result of either:

- re-routing required due to scheme-specific changes in the city centre, hence a direct consequence of adding in the scheme;
- specific modelling methodology designed to improve accuracy of appraisal results; or
- very small variations, not directly linked to the scheme, which result in a trade-off between journey time and vehicle operating costs with no net benefit or disbenefit.

D.5.2. Tables containing the warnings discussed above and setting out the individual conclusions of their cause are presented in the spreadsheet file provided.

Appendix E. Checklist for Value for Money Assessment

Table E.1 – Checklist of Appraisal and Modelling Supporting Material

	Material Required	Section/ Page	Comments
1	**Cost Benefit Analysis**		
1.1	A clear explanation of the underlying assumptions used in the Cost Benefit Analysis.	3 / p16-p18	See Value for Money Report (Table 3.13).
1.2	Information on local factors used. For example the derivation of growth factors, M factors in COBA and annualisation factors in TUBA (to include full details of any calculations).	3 / p16-p18	See Value for Money Report (Table 3.13).
1.3	A diagram of the network (if COBA used).	-	Not applicable – COBA not used (see Appendix A of the Value for Money Report for validation of alternative approach).
1.4	Information on the number of junctions modelled (if COBA used), for both the do-minimum and the do-something.	-	Not applicable – COBA not used (see Appendix A of the Value for Money Report for validation of alternative approach).
1.5	Details of assumptions about operating costs and commercial viability (e.g. public transport, park and ride, etc.).	3 / p16-p18	See Value for Money Report (Table 3.13).
1.6	Full appraisal inputs/outputs (when used, COBA and/or TUBA input and output files should be supplied).	-	TUBA input/output files provided separately to the DfT in electronic format.
1.7	Evidence that TUBA/COBA warning messages have been checked and found to be acceptable	Appendix D	See Appendix D of the Value for Money Report, and attachments in electronic format.
1.8	Spatial (sectoral) analysis of TEE benefits	Appendix F	See Appendix F of the Value for Money Report.
1.9	Details of the maintenance delay costs/savings.	4 / p32	Qualitative statement provided in Value for Money Report.
1.10	Details of the delays during construction.	4 / p32	Qualitative statement provided in Value for Money Report.
2	**Economic Case Assessment**		
2.1	Assessment of Environmental impacts, to include an environmental constraints map.	Appendix C	See AST in Appendix C of the Value for Money Report.

	Material Required	Section/ Page	Comments
2.2	Assessment of Safety impacts and the assumed accident rates presented (COBA output should be provided if an accident only COBA has been run).	3/ p20 Appendix A Appendix C	General approach described in Appendix A of the Value for Money Report. Results summarised in section 3 and AST table in Appendix C. Safety also considered in separate Distributional Impacts Report.
2.3	Assessment of Economic impacts.	4 / p29-32 Appendix B Appendix C	See section 4 of the Value for Money Report (with TUBA outputs in Appendix B and AST in Appendix C).
2.4	Assessment of Accessibility impacts.	4 / p31 Appendix C	See section 4 of the Value for Money Report (with AST in Appendix C) with details in separate Distributional Impacts Report.
2.5	Assessment of Integration impacts.	4 / p31 Appendix C	See section 4 of the Value for Money Report (with AST in Appendix C).
2.6	A comprehensive Appraisal Summary Table.	Appendix C	See Appendix C of the Value for Money Report.
2.7	AST worksheets.	N/A	Not updated for Full Approval submission
3	**Modelling**		
An Existing Data and Traffic Surveys Report to include:			
3.1	Details of the sources, locations (illustrated on a map), methods of collection, dates, days of week, durations, sample factors, estimation of accuracy, etc.	SBL DCR 2 / p5 3 / p12 4 / p14 NFH HAM 5 / p23 NFH PTAM 5 / p17	No specific Data Collection Report for NFHP. SBL Data Collection Report (Chapter 2 – Road Side Interview Surveys, Chapter 3 – Journey Time Surveys, Chapter 4 – Traffic Counts) covers data collection in South Bristol. NFHP HAM LMVR (Chapter 5) and PTAM Development Report (Chapter 5) cover other data collection

	Material Required	Section/ Page	Comments
3.2	Details of any specialist surveys (e.g. stated preference).	N/A	Not applicable.
3.3	Traffic and passenger flows; including daily, hourly and seasonal profiles, including details by vehicle class where appropriate.	SBL DCR 2 / p5 4 / p14 Appendix A & C 7 / p33 NFH HAM 5 / p23 NFH PTAM 5 / p17	See SBL Data Collection Report Chapter 2 and 4 and Appendix A and C for highway data for South Bristol NFHP HAM LMVR (Chapter 5) and PTAM Development Report (Chapter 5) cover other data collection
3.4	Journey times by mode, including variability if appropriate.	SBL DCR 3 / p12 Appendix B 6 / p31 Appendix A NFH HAM 5 / p27 Appendix A NFH PTAM 5 / p17 Appendix A	See SBL Data Collection Report Chapter 3 and Appendix B for highway data for South Bristol NFHP HAM LMVR (Chapter 5) and PTAM Development Report (Chapter 5) cover other journey time data collection
3.5	Details of the pattern and scale of traffic delays and queues.	N/A	Not applicable.
3.6	Desire line diagrams for important parts of the network.	N/A	Not applicable.
3.7	Diagrams of existing traffic flows, both in the immediate corridor and other relevant corridors.	N/A	Not applicable.

	Material Required	Section/ Page	Comments
An Assignment Model Validation Report to include:			
3.8	Description of the road traffic and public transport passenger assignment model development, including model network and zone plans, details of treatment of congestion on the road system and crowding on the public transport system.	4 / p17 6 / p30 7 / p31 4 / p12 6 / p24 7 / p33	See HAM LMVR See PTAM Development Report
3.9	Description of the data used in model building and validation with a clear distinction made for any independent validation data.	5 / p23 7 / p31 5 / p17 7 / p33	See HAM LMVR See PTAM Development Report
3.10	Evidence of the validity of the networks employed, including range checks, link length checks, and route choice evidence.	8 / p37 8 / p51	See HAM LMVR See PTAM Development Report
3.11	Details of the segmentation used, including the rationale for that chosen.	4 / p20	See HAM LMVR
3.12	Validation of the trip matrices, including estimation of measurement and sample errors.	9 / p38 8 / p51	See HAM LMVR See PTAM Development Report
3.13	Details of any 'matrix estimation' techniques used and evidence of the effect of the estimation process on the scale and pattern of the base travel matrices.	9/ p38	See HAM LMVR

	Material Required	Section/ Page	Comments
3.14	Validation of the trip assignment, including comparisons of flows (on links and across screenlines/cordons) and, for road traffic models, turning movements at key junctions.	10 / p53 11 / p59 8 / p51 Appendix C	See HAM LMVR See PTAM Development Report
3.15	Journey time validation, including, for road traffic models, checks on queue pattern and magnitudes of delays/queues.	10 / p55 11 / p60 Appendix A	See HAM LMVR
3.16	Detail of the assignment convergence.	10 / p58	See HAM LMVR
3.17	Present year validation if the model is more than 5 years old.	N/A	Not applicable.
3.18	A diagram of modelled traffic flows, both in the immediate corridor and other relevant corridors.	N/A	Not applicable.
A Demand Model Report to include:			
3.19	Where no Variable Demand Model has been developed evidence should be provided to support this decision (e.g. follow guidance in WebTAG Unit 3.10.1 Variable Demand Modelling -Preliminary Assessment Procedures).	N/A	Not applicable – Variable Demand Model has been developed.
3.20	Description of the demand model.	2 / p10	See Demand Model Development Report.
3.21	Description of the data used in the model building and validation.	2 / p10	See Demand Model Development Report.
3.22	Details of the segmentation used, including the rationale for that chosen. This should include justification for any segments remaining fixed.	2 / p13	See Demand Model Development Report.
3.23	Evidence of model calibration and validation and details of any sensitivity tests.	4 / p37	See Demand Model Development Report.

	Material Required	Section/ Page	Comments
3.24	Details of any imported model components and rationale for their use.	N/A	Not applicable.
3.25	Validation of the supply model sensitivity in cases where the detailed assignment models do not iterate directly with the demand model.	N/A	Not applicable.
3.26	Details of the realism testing, including outturn elasticities of demand with respect to fuel cost and public transport fares.	4 / p38	See Demand Model Development Report.
3.27	Details of the demand/supply convergence.	4 / p37	See Demand Model Development Report.
A Forecasting Report to include:			
3.28	Description of the methods used in forecasting future traffic demand.	1 / p6	See Forecasting Report Chapter 1 for outline with details in subsequent chapters.
3.29	Description of the future year demand assumptions (e.g. land use and economic growth -for the do minimum, core and variant scenarios).	2 / p9 4 / p22	See Forecasting Report Chapter 2 for the description of the Reference Case with Chapter 4 outlining the Without Intervention situation.
3.30	An uncertainty log providing a clear description of the planning status of local developments	2 / p14 Appendix B	See Forecasting Report Chapter 2 and Appendix B.
3.31	Description of the future year transport supply assumptions (i.e. networks examined for the do minimum, core scenario and variant scenarios).	4 / p22 5 / p41	See Forecasting Report Chapter 4 outlining the Without Intervention situation and Chapter 5 for the With Intervention situation.
3.32	Description of the travel cost assumptions (e.g. fuel costs, PT fares, parking).	3 / p17	See Forecasting Report Chapter 3.
3.33	Comparison of the local forecast results to national forecasts, at an overall and sectoral level.	4 / p22	See Forecasting Report.

	Material Required	Section/ Page	Comments
3.34	Presentation of the forecast travel demand and conditions for the core scenario and variant scenarios including a diagram of forecast flows for the do-minimum and the scheme options for affected corridors.	4 / p22 5 / p41	See Forecasting Report Chapter 4 for Without Intervention and Chapter 5 for the With Intervention situations.
3.35	If the model includes very slow speeds or high junction delays evidence of their plausibility.	N/A	Not applicable.
3.36	An explanation of any forecasts of flows above capacity, especially for the do-minimum, and an explanation of how these are accounted for in the modelling/appraisal.	N/A	Not applicable.
3.37	Presentation of the sensitivity tests carried out (to include high and low demand tests).	3 / p22	As agreed with DfT, low and high growth sensitivity tests were not required. See Chapter 3 of Value for Money Report (Figures 3.1 to 3.6) for cumulative impact of NFHP with SBL.

Appendix F. TUBA Sector Analysis

Figure F.1 – Highway User Time Benefits – Full Day

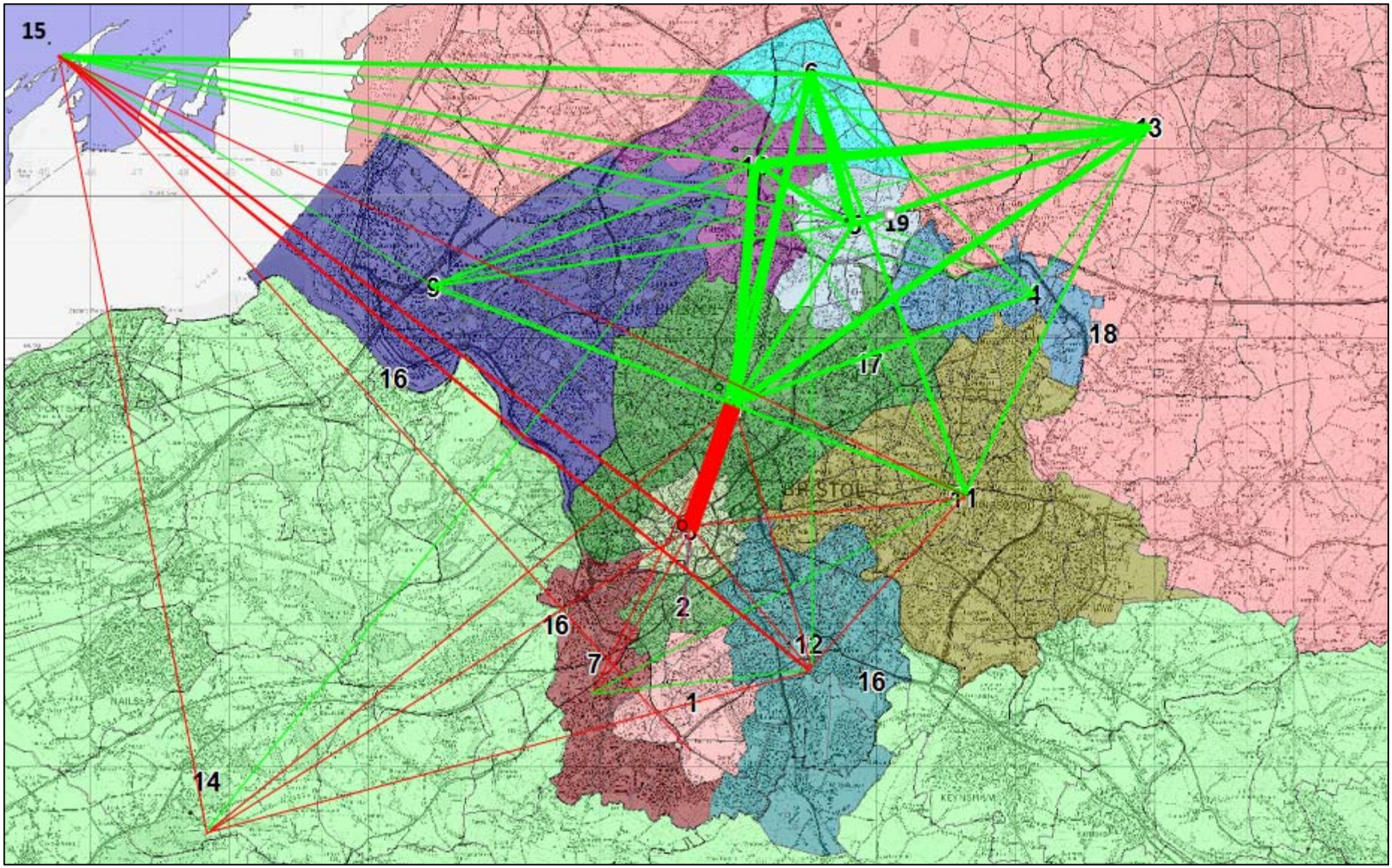


Figure F.2 – Highway User Time Benefits – AM Peak

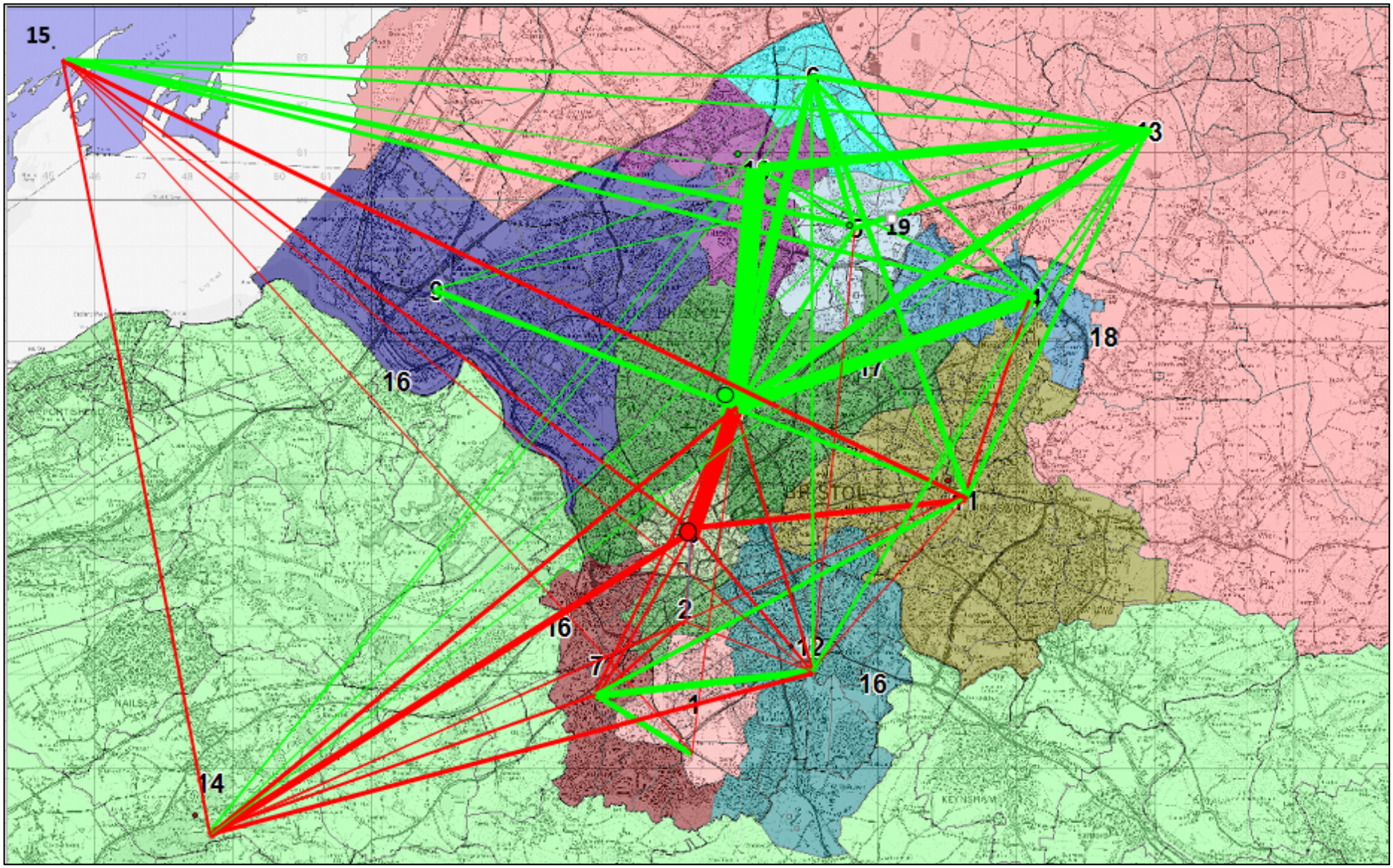


Figure F.3 – Highway User Time Benefits – Inter-Peak

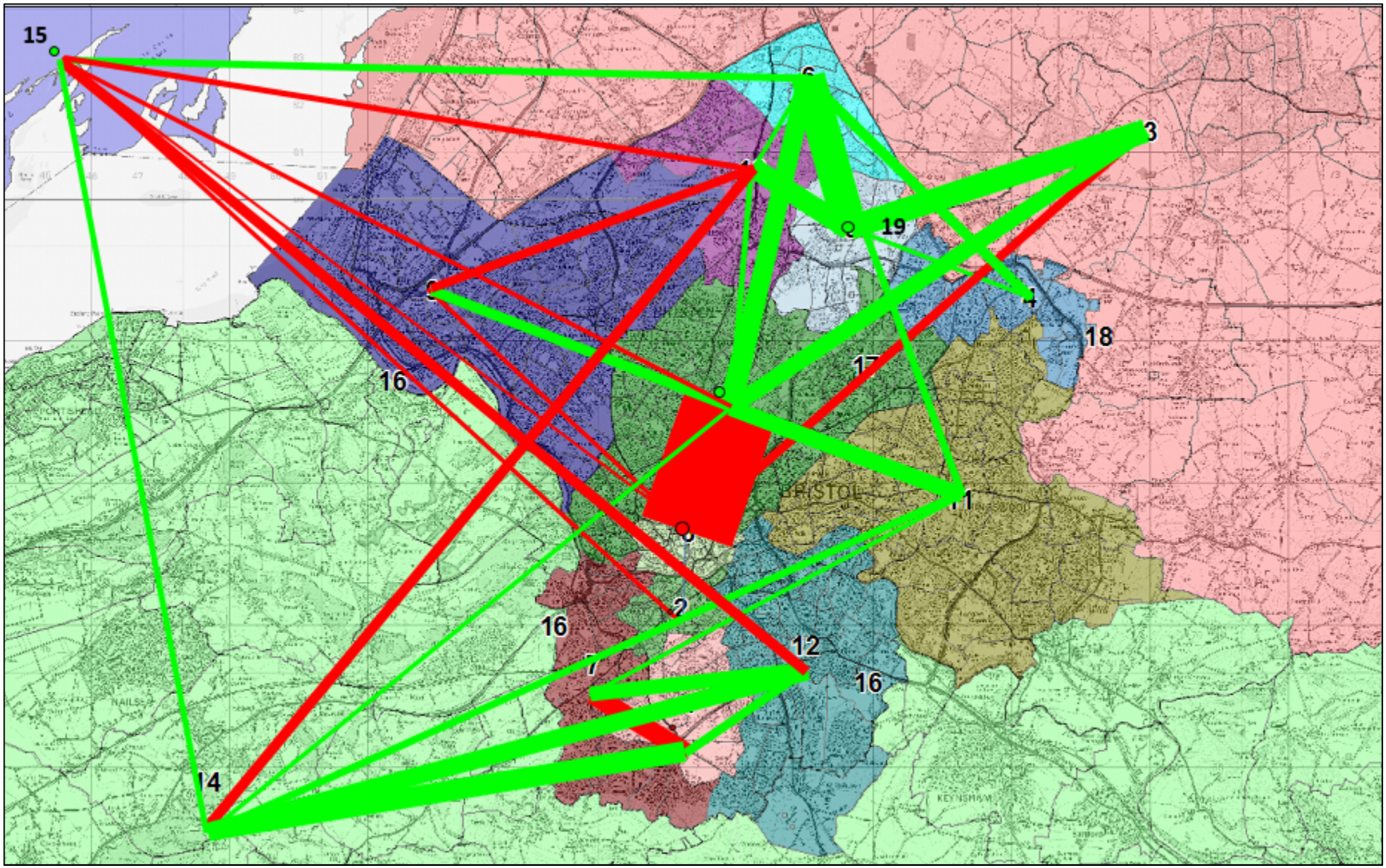


Figure F.4 – Highway User Time Benefits – PM Peak

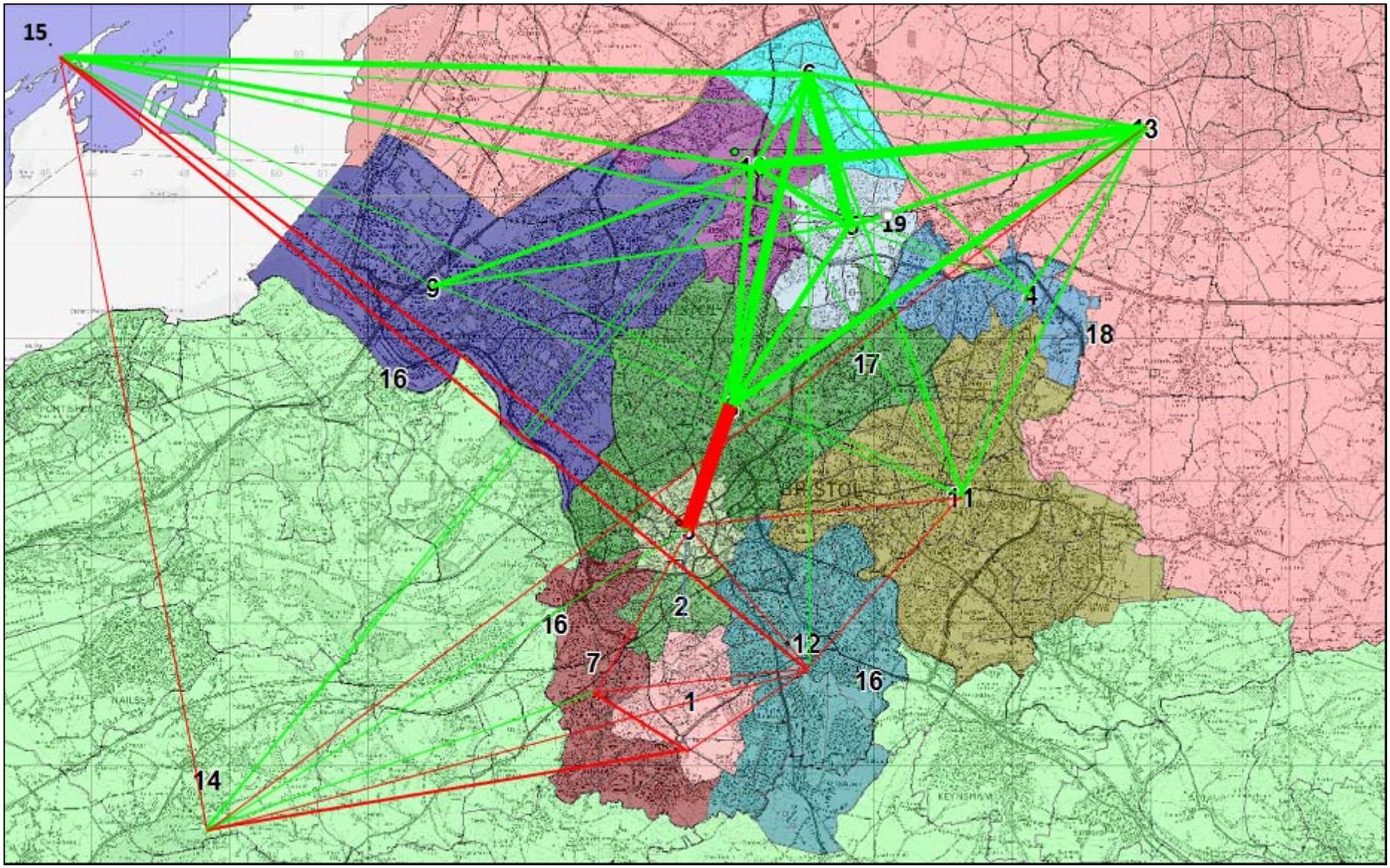


Figure F.5 – Public Transport User Time Benefits – All Day

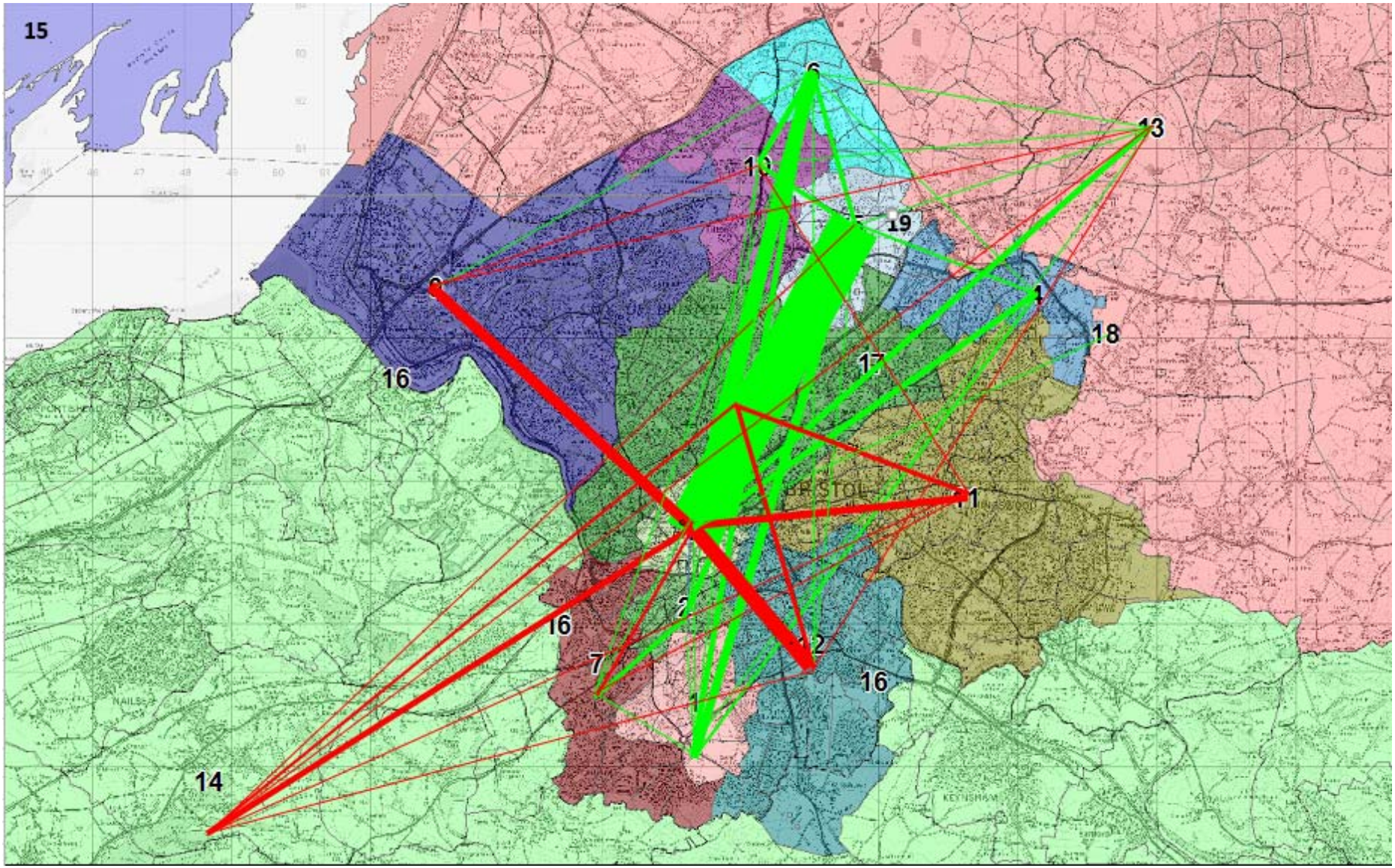


Figure F.6 – Public Transport User Time Benefits – AM Peak

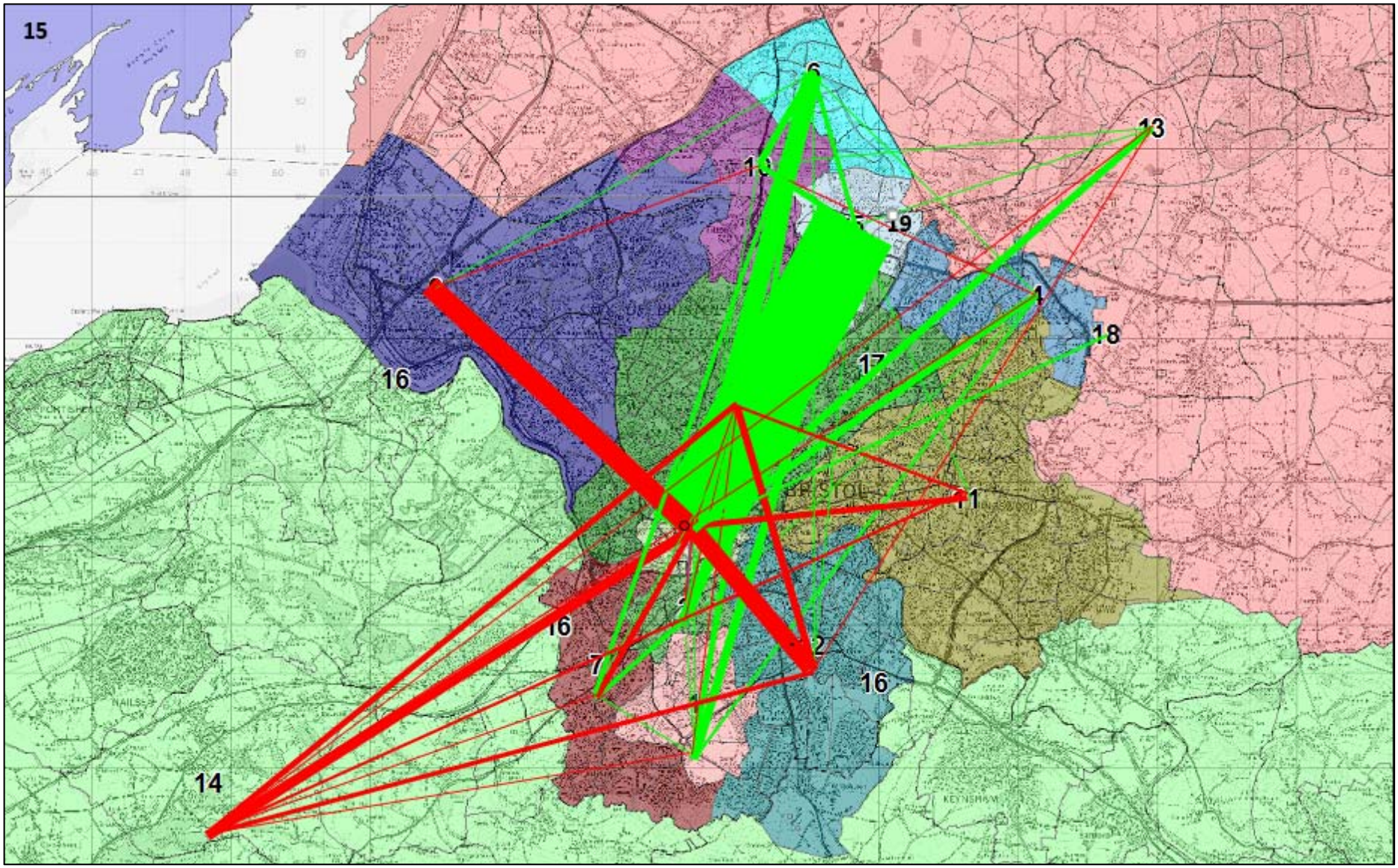


Figure F.7 – Public Transport User Time Benefits – Inter-Peak

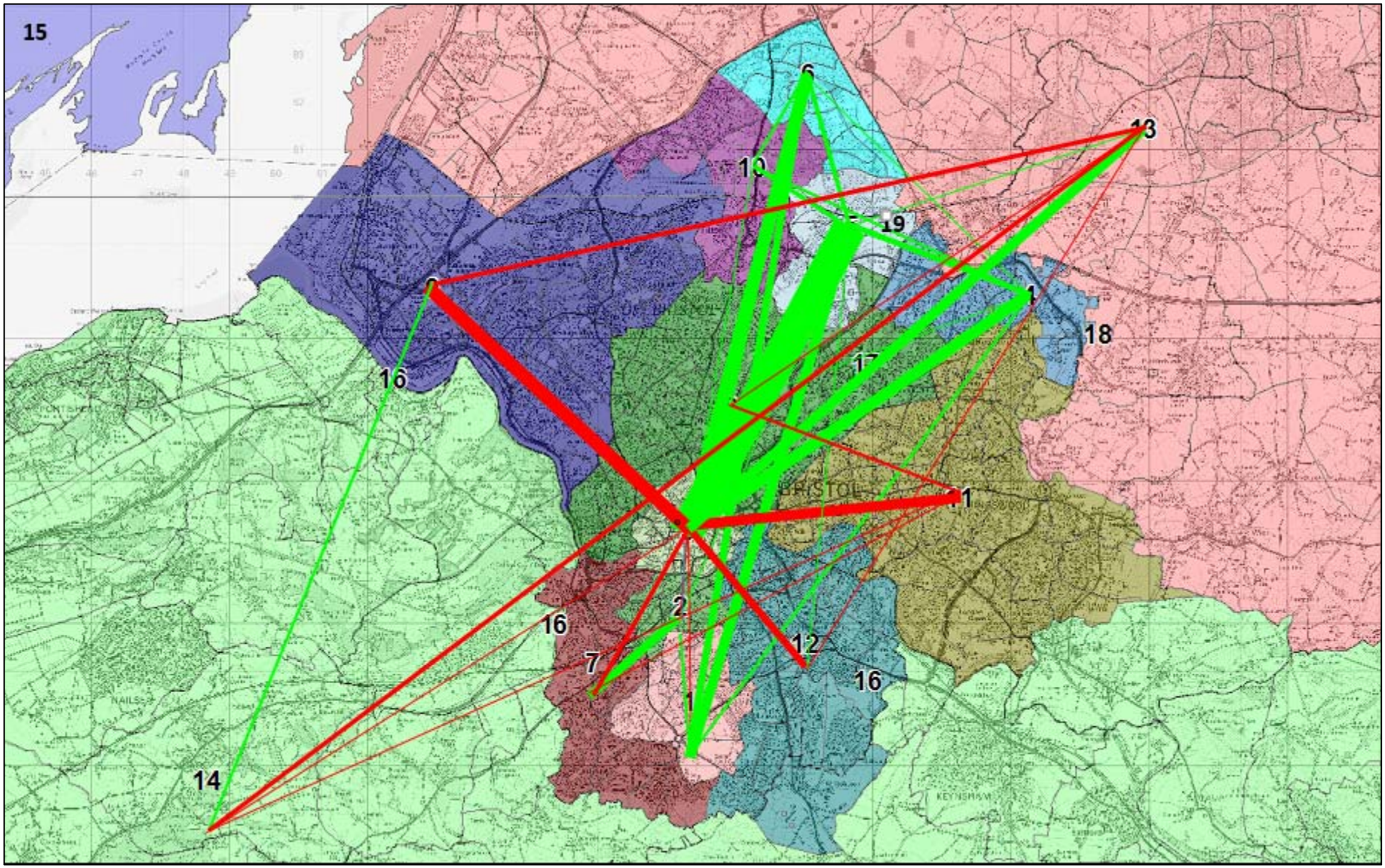
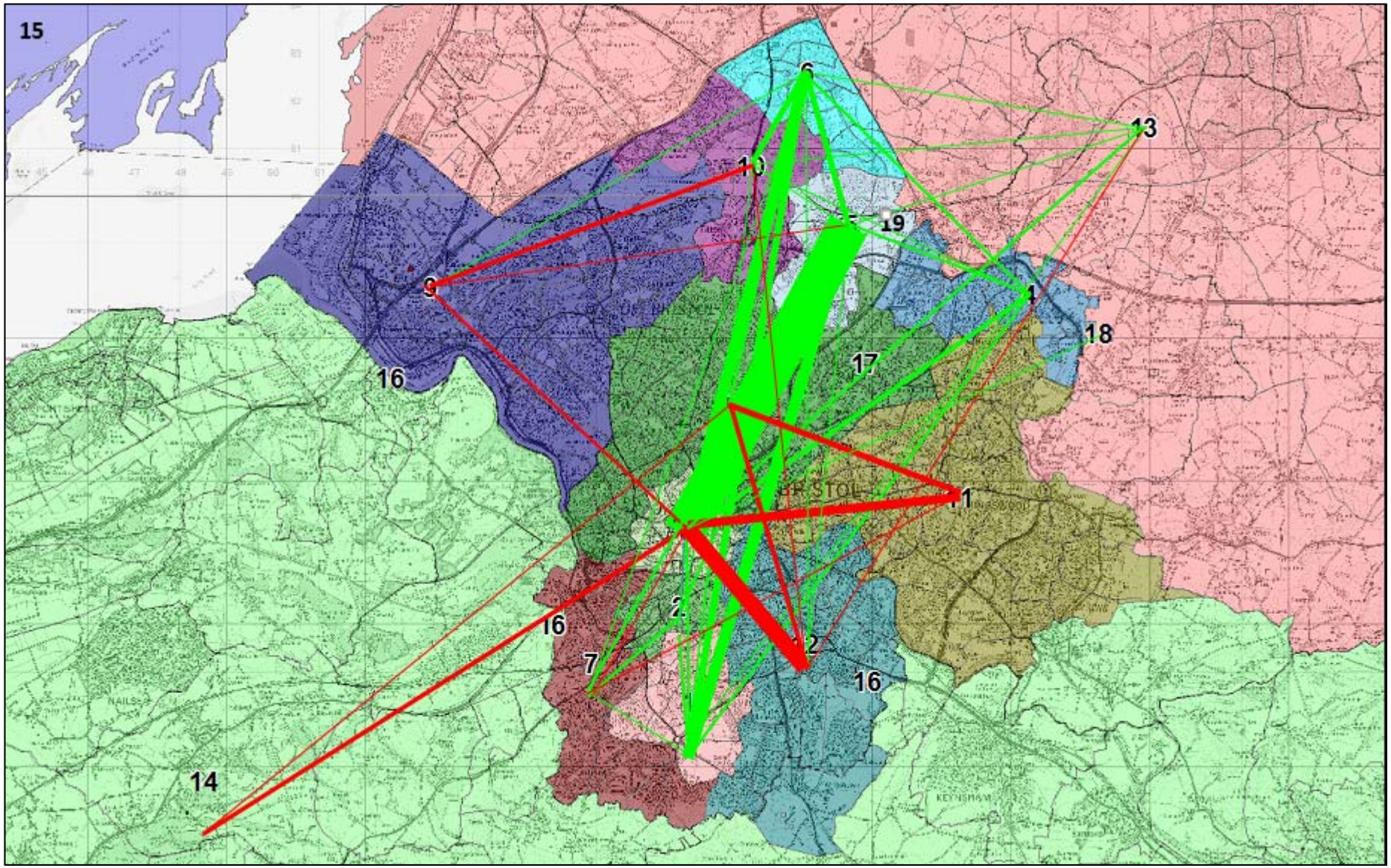


Figure F.8 – Public Transport User Time Benefits – PM Peak



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