

# **Greater Bristol Bus Network**

## **Appendix 3E – Update to Economic Appraisal Report**

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# 1. Introduction

## BACKGROUND

- 1.1 This supporting document provides background information on the economic appraisal of the Greater Bristol Bus Network (GBBN) major scheme.
- 1.2 It updates the information provided to the Department for Transport (DfT) in July 2005 in support of the Programme Entry submission and provides the basis for the submission of the GBBN scheme for Full Approval under the DfT's Major Scheme approval process.
- 1.3 As described in the main Full Approval submission document, the Full Approval submission recognises that certain contexts and issues related to scheme design have moved on since the Programme Entry bid in 2005. The scheme has been refined as part of an ongoing process of minimising risks to delivery and maximising the achievement of the scheme's benefits.
- 1.4 Minor refinements to the scheme cost and specification have been made to maximise value for money and deliverability. These refinements have been made as part of a rigorous review of the scheme's elements and costs, and comprise:
  - A value management exercise that has scrutinised each of the scheme's infrastructure components to ensure that they add to the overall benefits of the scheme;
  - A detailed cost review of all scheme elements including not just the physical bus priority infrastructure but also bus stops, RTPI and marketing;
  - A further re-review in conjunction with First of all service and frequency enhancement assumptions;
  - An updated Quantified Risk Assessment (QRA) taking on board changes to scheme specification and risk; and
  - Overlaying the whole review process with an ongoing risk identification and management process, which ensured that where additional risks were identified actions were taken to refine elements such that design, cost and delivery risks have been mitigated.
- 1.5 Although the scheme specification changes are very minor we have, as required by the DfT's Major Scheme process, updated the forecasts of the scheme's business case.
- 1.6 This Appendix provides updated information on the economic appraisal of the refined scheme.

## Modelling and Appraisal Tools and Approach

- 1.7 The same detailed and comprehensive modelling framework has been employed in developing the Full Approval business case as was used for Programme Entry. The main modelling tool employed is the BATS2<sup>1</sup> model of the Greater Bristol area in

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<sup>1</sup> BATS - Bristol Area Transport Studies

conjunction with a number of supporting models for elements of the overall GBBN scheme outside the coverage of the BATS2 model. Outputs from the models have been input to TUBA alongside implementation and operating costs to provide estimates of the scheme's economic case in line with the DfT's appraisal guidance.

- 1.8 It is emphasised that the same modelling/appraisal tools and approaches have been used for the reappraisal as were applied for the programme entry bid – though the latest version of TUBA has been used in the reappraisal. This is discussed further below.

#### **DOCUMENT ROLE AND STRUCTURE**

- 1.9 This document does not repeat the detailed information on forecasting approach provided at Programme Entry stage. It focuses on describing any changes in appraisal assumptions and on presenting the updated Preferred GBBN scheme economic appraisal.
- 1.10 To aid understanding of the updated appraisal, comparisons against the Programme Entry stage assumptions and appraisal are provided where appropriate.
- 1.11 It is noted that no further analyses have been undertaken of the 'low cost alternative' (LCA) options presented in the Programme Entry submission. The reappraisal has concentrated on the preferred scheme. In addition, the reappraisal has focused on a central case scenario. The impact of alternative scenarios on the refined scheme's economic case is reported in a separate technical note.
- 1.12 The Appendix is structured in two parts.
- ◆ Chapter 2 presents details of the Updated Economic Assumptions adopted for the current appraisal;
  - ◆ Chapter 3 presents the Preferred Option Results (2007), focusing on the changes to key economic indicators since the 2005 PE submission, the results of the accident analysis, and the overall scheme value for money;
  - ◆ Chapter 4 presents a Summary of the Value for Money case.
  - ◆ Appendix A contains TEE Tables for the updated appraisal.

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## 2. Economic Assumptions

### OVERVIEW

- 2.1 Economic assumptions have been updated to reflect changes in DfT guidance, allowance for non-modelled (PM peak) benefits, and updated scheme costs.

### ECONOMIC & SCHEME PARAMETERS

- 2.2 Two sets of parameters are required by TUBA: (i) general economic parameters; and (ii) scheme-specific parameters.
- 2.3 TUBA provides a file containing default values for the general economic parameters, which includes all the necessary information relating to values of time, vehicle operating costs, journey purpose splits and vehicle occupancy factors, as presented in the DfT's current guidance (WebTAG Unit 3.5.6). These default economic parameters have been adopted for the GBBN appraisal, except where model user classes represent a specific journey purpose, in which case the default purpose splits are ignored. A copy of the economic file used in the appraisal has already been included as part of the main Business Case documentation for the GBBN; additional files can be produced on request.
- 2.4 Table 2.1 presents the list of scheme-specific requirements for the TUBA, along with the values adopted for the general scheme parameters in the GBBN appraisal.

**Table 2.1 – GBBN Scheme-Specific Parameters**

<b>Scheme-Specific Parameter</b>	<b>Description</b>	<b>GBBN Value</b>
TUBA Version	The version of the TUBA software at the time of assessment	1.7a
First Year	The first year of the appraisal period (i.e. the first year for which economic benefits will be calculated)	2011
Horizon Year	The last year of the appraisal period (normally First Year + 59 for a 60 year appraisal period)	2070
Modelled Years	A list of all modelled years (up to 6), which must lie between the First Year and Horizon Year	2011 2021
Current Year	The first year in which scheme costs are incurred	2007
RPI	Retail Price Index for use in converting costs to 2002.	198.1
Inflation Assumptions	Elements of scheme cost that are expected to increase in price at a faster rate than the rest of the economy are uplifted for scheme appraisal purposes. This uplift has been applied to construction costs (bus priority infrastructure), land costs and supervision costs.	2.0% in wider economy & 6.0% in construction sector for all years.

\*

## TIME PERIODS

- 2.5 Transport models have been developed for the GBBN to represent an AM peak hour (0800-0900) and an average inter-peak hour (where the inter-peak period is defined as 1000-1600). The economic benefits for the original submission were based solely on the traffic model outputs for these periods.
- 2.6 For the scheme reappraisal, PM peak benefits have been estimated. The AM peak demand matrices were transposed and factored down to realistic levels based on local roadside interview survey data. These matrices were assigned to the transport model and the outputs used in TUBA to derive an estimate of the economic benefits in the PM peak.
- 2.7 Factors are required in order to convert the 'modelled hour' benefits to annual benefits. In the absence of any locally-observed traffic data, default annualisation factors are input to TUBA. For example, an average AM peak hour model would usually have a factor of 759 attached, a factor of 3 to convert average peak hour benefits to peak period benefits (where the 'period' is as defined above), followed by an additional factor of 253, which represents the number of working days in the year. In the case of the average inter-peak hour, a factor of 1518 is ordinarily applied to represent the fact that the inter-peak period is twice as long in duration as the AM peak period. These factors have been applied to car and rail users for the GBMSB, as this retains consistency with the previous BATS appraisal.

- 2.8 In the case of bus users, however, sufficient observed data has been made available to calculate annualisation factors for the Bristol area. This has the benefit of representing more closely the bus travel patterns that exist in the local area, which is particularly important in this instance given the nature of the study.
- 2.9 The annualisation factors adopted for this study are shown in Table 3.1. The methodology for calculating the factors was explained in the original submission and remains unchanged for the current appraisal.

**Table 2.2 – GBBN Annualisation Factors**

Mode	Time Period	Annualisation Factor
Highway	AM Peak	759
	Inter-Peak	1518
Bus	AM Peak	630
	Inter-Peak	1577
Rail	AM Peak	759
	Inter-Peak	1518

#### UPDATES TO TUBA SINCE 2005

- 2.10 The economic appraisal has been undertaken using the latest version of TUBA, which is currently TUBA v1.7a. This version reflects the updates to DfT guidance on scheme appraisal, the latest of which include changes to vehicle operating cost formulae, the replacement of the relative price factor (RPF) with more explicit allowance for inflation on construction costs (see 'Scheme Costs' below), and the inclusion of carbon emissions as an economic (dis)benefit on the Transport Economic Efficiency (TEE) Table.

#### SCHEME COSTS

- 2.11 The latest guidance on WebTAG (updated October 2006) provides details on the treatment of costs in scheme appraisal. The requirement is for inflation in the construction sector to be explicitly accounted for in the economic appraisal. On this basis, Atkins has assumed inflation in the wider economy of 2.0% and inflation in the construction sector of 6.0%. These rates of inflation have been assumed for the whole construction period – this has been represented by a factor of  $(1.06/1.02)^n$ , applied for each successive year when costs are incurred (where 'n' represents the number of years beyond that used as the price base).
- 2.12 Table 2.1 provides a breakdown of the base costs, that is, undiscounted scheme costs excluding any allowance for inflation. The undiscounted scheme costs used in the 2005 submission are provided for comparative purposes, although it should be

noted that these costs were calculated for a 2004 price base, whereas the latest costs are calculated to a 2006 price base.

**Table 2.3 – Undiscounted ‘Base’ Scheme Costs**

Cost Component	Undiscounted Scheme Costs	
	2005 Submission (Excl. Inflation)	2007 Submission (Excl. Inflation)
Construction (bus priority infrastructure)	£20,095,377	£19,209,508
Construction (bus stops and RTPI)	£10,211,610	£8,780,920
Land	£1,801,920	£1,758,315
Supervision	£1,508,209	£1,369,354
Preparation (incl. Marketing & Consultancy)	£6,032,837	£4,756,964
Maintenance	£30,020,423	£30,020,423
Bus Operations (incl. cost of new buses and bus replacement costs)	£67,081,056	£62,136,040
Risk	£3,480,000	£2,872,000
Optimism Bias	£13,801,585	£1,162,412
Total	£154,033,017	£132,065,934

Note: Optimism bias of 32% was applied for Programme Entry, and 3% for Full Approval.

- 2.13 All components of scheme cost are lower than for Programme Entry, including optimism bias, which is set at 3% for the reappraisal compared to 32% for Programme Entry.
- 2.14 Table 2.4 provides the ‘real’ costs, that is, with allowances for future inflation in the construction sector. These represent the risk- and optimism bias-adjusted costs, which have been input to TUBA for the current reappraisal. Note that inflated costs are only provided for the current reappraisal, as no such adjustment was required for the 2005 submission.
- 2.15 To ensure that the assessment of scheme costs is robust, inflation has been applied to construction costs (bus priority infrastructure but not bus stops & RTPI), land, supervision and preparation costs. To retain consistency with the approach adopted for the Programme Entry, and in line with the guidance on WebTAG, optimism bias has not been applied to bus operating costs or maintenance costs.

**Table 2.4 – Undiscounted ‘Real’ Scheme Costs Input to TUBA**

<b>Cost Component</b>	<b>Undiscounted Scheme Cost (2007, Incl. Inflation)</b>
Construction (bus priority infrastructure)	£22,116,102
Construction (bus stops and RTPI)	£12,002,507
Land	£4,230,172
Supervision	£1,564,918
Preparation (incl. Marketing & Consultancy)	£5,203,564
Maintenance	£30,020,423
Bus Operations (incl. cost of new buses)	£62,136,040
<b>Total</b>	<b>£137,273,726</b>

### 3. Scheme Reappraisal

#### TRANSPORT ECONOMIC EFFICIENCY BENEFITS

- 3.1 The Transport Economic Efficiency (TEE) benefits are provided for the 'Programme Entry' and 'Full Approval' Central Case assessments in Table 3.1. It should be noted that the benefits produced in this table represent consumer and business user (and provider) benefits and costs, and exclude any benefits relating to carbon emissions and accidents (discussed later in this chapter). The full TEE Table for the Full Approval scheme is presented in Appendix A.

**Table 3.1 – Comparison of Programme Entry and Full Approval Central Case Results**

Economic Indicator	Programme Entry Economic Appraisal Results Value (£m)	Full Approval (Refined Scheme) Economic Appraisal Results Value (£m)
Consumer User Benefits	£200.4	£219.5
Business User & Provider Benefits	£21.6	£8.7
<b>Present Value of Benefits (PVB)</b>	<b>£222.0</b>	<b>£228.4</b>
Present Value of Costs (PVC)	£70.4	£65.7
Net Present Value	£151.6	£162.7
Benefit: Cost Ratio	3.15	3.48

- 3.2 The Central Case scheme produces a benefit to cost ratio (BCR) of 3.48, which is generated by significant bus user benefits of approximately £149 million. Benefits to car users – in the form of decongestion benefits – contribute approximately £53 million to overall scheme PVB.
- 3.3 Scheme costs for the reappraisal are based on 3% optimism bias, which has a significant impact on the NPV and BCR when compared to the Programme Entry results. The addendum to this document includes a sensitivity test with 32% optimism bias applied to scheme costs.

#### Consumer User Benefits

- 3.4 In the Central Case, consumer users will benefit from time savings and, for car users, vehicle operating cost savings across all modes, producing total consumer user benefits of almost £220 million. The majority (60%) of these benefits will accrue to bus users, although car users will accrue significant benefits, largely through decongestion following mode shift from car to bus, accounting for around 38% of total consumer benefits.

#### Business User & Provider Benefits

- 3.5 Business users are not expected to accrue the same level of benefits as consumer users, although they will still contribute approximately £9 million across all modes.

The negative contribution from business car user is more than offset by the £22 million and £18 million accruing to bus and rail users respectively.

- 3.6 Business providers will contribute an additional net benefit of £8 million, largely in the form of increased bus revenues (£30m), although this is offset to some extent by the increased operating costs incurred after the implementation of the new schemes. Revenues at city centre car parks will fall following the transfer of some existing car users to bus, although this disbenefit is expected to be just £2.5 million.
- 3.7 The scheme will generate a total net benefit to the private sector of £19 million.

### **ACCIDENT BENEFITS**

- 3.8 The impact of the GBBN schemes on accidents in the study area was conducted using a spreadsheet-based assessment. The spreadsheet itself is based on COBA link classifications and accident rates and values. The template was originally developed for the Bristol Area Transport Study (BATS) and has been deemed appropriate for a public transport study of this nature, where the impact on accidents is expected to be significantly lower than for a major highway scheme. For the Central Case, the net impact on accidents over the 60-year project lifetime is as follows:

- ◆ 0.17% reduction in Personal Injury Accidents (PIAs) per annum by 2011; and
- ◆ Net Benefit (accident savings) of £38.7 million.

- 3.9 Accident benefits are added to the 'Analysis of Monetised Costs and Benefits' section of the TEE Table, which increases the BCR from 3.48 to 4.07.

### **CARBON EMISSIONS**

- 3.10 The latest version of TUBA calculates the change in carbon emissions in the study area before and after scheme opening, and produces a monetised benefit that contributes to the overall scheme BCR.
- 3.11 Carbon emissions for the GBBN scheme are estimated at £1.638 million over the project lifetime, as a result of the mode shift from car to bus. This increases the accident-adjusted scheme BCR from 4.07 to 4.09.

## 4. Conclusions

### SUMMARY

The main findings from the Central Case Scheme Scenario are as follows:

- The Central Case scheme produces a PVB of £228m and a PVC of £65m which generates a scheme NPV of £162m. The BCR of 3.48 represents 'high' value for money' against DfT guidance;
- Bus user benefits account for 60% of the total PVB. Car user benefits account for a further 38% of total PVB, the remaining benefits stemming from rail and HGV users;
- Consumers user benefits account for the majority (90%) of the PVB. Business user benefits are negative for car users but positive for public transport users;
- Increased bus passenger revenues account for 14% of the total PVB;
- The scheme will reduce the number of accidents on the road network, contributing £38.5 million to PVB, and increasing the BCR from 3.48 to 4.07; and
- Carbon emissions will fall slightly as a result of the scheme, contributing £1.6 million to PVB and increasing the (accident-adjusted) BCR from 4.07 to 4.09.

## Appendix A TEE Table

Consumers	ALL MODES		ROAD	BUS & COACH	RAIL	OTHER	
User Benefits	TOTAL		Private Cars & LGVs	Passengers	Passengers		
Travel Time	202721		68975	132363	1383		
Vehicle Operating Costs	16829		16829	0	0		
User Charges	0		0	0	0		
During Construction & Maintenance	0		0	0	0		
<b>NET CONSUMER BENEFITS</b>	<b>219550</b>	(1)	<b>85804</b>	<b>132363</b>	<b>1383</b>	<b>0</b>	
<b>Business</b>							
User Benefits			Goods Vehicles	Business Cars & LGVs	Passengers	Passengers	Freight
Travel Time	-7196		5368	-31313	15956	2793	0
Vehicle Operating Costs	-2961		-1547	-1414	0	0	0
User Charges	0		0	0	0	0	0
During Construction & Maintenance	0		0	0	0	0	0
<b>Subtotal</b>	<b>-10157</b>	(2)	<b>3821</b>	<b>-32727</b>	<b>15956</b>	<b>2793</b>	<b>0</b>
<b>Private Sector Provider Impacts</b>							
				Passengers	Passengers		
Revenue	41591		-3082	29075	15598		
Operating Costs	-22538		0	-22538	0		
Investment Costs	0		0	0	0		
Grant/Subsidy	0		0	0	0		
<b>Subtotal</b>	<b>19053</b>	(3)	<b>-3082</b>	<b>6537</b>	<b>15598</b>		<b>0</b>
<b>Other Business Impacts</b>							
Developer Contributions	0	(4)	0	0	0		
<b>NET BUSINESS IMPACT</b>	<b>8896</b>	(5) = (2) + (3) + (4)					
<b>TOTAL</b>							
Present Value of Transport Economic Efficiency Benefits	228446	(6) = (1) + (5)					

Notes: Benefits appear as positive numbers, while costs appear as negative numbers

Table 2: Public Accounts

Local Government Funding	ALL MODES		ROAD	BUS & COACH	RAIL	OTHER
	TOTAL		INFRASTRUCTURE			
Revenue	0		0	0	0	
Operating Costs	10578		0	10578	0	
Investment Costs	0		0	0	0	
Developer & Other Contributions	0		0	0	0	
Grant/Subsidy Payments	0		0	0	0	
<b>NET IMPACT</b>	<b>10578</b>	(7)	<b>0</b>	<b>10578</b>	<b>0</b>	<b>0</b>
<b>Central Government Funding</b>						
Revenue	0		0	0	0	
Operating Costs	0		0	0	0	
Investment Costs	35083		0	35083	0	
Developer & Other Contributions	0		0	0	0	
Grant/Subsidy Payments	0		0	0	0	
Indirect Tax Revenues	20040		12827	4881	2332	
<b>NET IMPACT</b>	<b>55123</b>	(8)	<b>12827</b>	<b>39964</b>	<b>2332</b>	<b>0</b>
<b>TOTAL Present Value of Costs (PVC)</b>	<b>65701</b>	(9) = (7) + (8)				

Notes: Costs appear as positive numbers, while revenues and developer contributions appear as negative  
All entries are discounted present values, in 2002 prices and values

Table 3: Analysis of Monetised Costs and Benefits

Noise			
Local Air Quality			
Greenhouse Gases	1638		
Journey Ambience			
Accidents	38700		
Consumer Users	219550		
Business Users and Providers	8896		
Reliability			
Option Values			
<b>Present Value of Benefits (PVB)</b>	<b>268784</b>		
<b>Public Accounts</b>			
<b>Present Value of Costs (PVC)</b>	<b>65701</b>		
<b>OVERALL IMPACTS</b>			
Net Present Value (NPV)	203083		NPV = PVB-PVC
Benefit to Cost Ratio	4.09		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 the sole basis for decisions.