

1 Safety Assessment

Methodology

Spreadsheet Model

The scheme's impact on the number of accidents in the study area was estimated using a spreadsheet model based on the COBA11¹ recommended methodology for calculating road accident numbers and costs using combined link and junction accident rates.

Accident and Casualty Rates

COBA defines rates in terms of accidents per million vehicle kilometres and casualties per accident and assumes a general decline in the incidence and severity of accidents through time, in line with recent trends in and policies for road safety. The standard COBA rates and trends were assumed to apply for all roads in the study area.

Default COBA casualty rates by road type, average costs per accident and casualty were also used for all roads.

Model Output

The first stage in assessing the impacts of the scheme involved categorising each road in the modelled highway network as belonging to one of the 27 COBA road types (based on road classification, age, speed limit and number of lanes).

Forecasts of the number of vehicle kilometres travelled on each road during the modelled hours (AM peak, inter-peak and PM peak) were then extracted from the model and converted into annual values using the expansion factors developed for the TUBA assessment (see Annualisation Factors in Section 2).

Finally, the forecast annual vehicle kilometres for each model link were multiplied by the corresponding accident and severity rates for the relevant road type to estimate total numbers of accidents and casualties for both the Do Minimum and Do Something scenarios.

Economic Appraisal

COBA identifies average costs per accident and casualty, varying by severity and assumes that they increase in real terms through time in line with growth in incomes (or GDP).

These values were applied to the estimated total number of accidents and casualties in each scenario to produce a total estimated monetary cost of the accidents occurring. The accident cost impacts of the scheme were then estimated by comparing the total Do Something costs with the Do Minimum costs.

This process was repeated for both forecast years and the estimated accident impacts calculated were then converted into an estimated Net Present Value (NPV) of accident costs over a 60 year appraisal period (2014 – 2073) using the same principles as are applied in TUBA i.e:

- The estimated savings for the two modelled years were used to produce estimated savings in each of the 60 years using linear interpolation between the modelled years (2016 and 2031), with this linear trend being extrapolated back to the opening year and an assumption of no change in savings beyond the final forecast year (apart from the increase due to the rise in the real value of accident costs);
- The stream of benefits over the 60 years was represented in terms of 2002 values by discounting future year benefits at the rate of 3.5% p.a. for the first 30 years from the current year, and then 3% p.a. for all subsequent years.

¹ COBA Manual: DMRB, *Volume 13*, Section 1, Part 4, Highways Agency, Revised 2006

Results

Accident Numbers

Table 3G.1 shows the number of personal injury accidents (PIAs) and casualties along with the cost of all accidents and casualties under each scenario in 2016. The figures show that the scheme is forecast to cause a slight decrease in the numbers of PIAs occurring (around 0.1% when considered across the study area as a whole). The reductions are focused on the area around the BRT route and largely reflect the decrease in vehicle kilometres caused by the mode switch encouraged by the scheme.

Table 3G.1 – Accident Numbers, Severity and Costs, 2016

Scenario	No. of Personal Injury Accidents (PIAs)	No. of Casualties by Severity			Accident Costs (£million 2002 prices, 2016 values undiscounted)	
		Fatal	Serious	Slight	Non-Casualty	Casualty
Do Minimum	3,890	41	406	5,337	130	226
Do Something	3,885	41	406	5,331	130	225

Accident Impact Value

Although relatively slight in percentage terms, the overall decrease in accidents has a large monetary value equating to an NPV of £14.8m (2002 prices and values, 60 year appraisal period 2014 to 2073).

2 Economic Efficiency and Public Accounts

TUBA

The DfT's Transport User Benefit Appraisal (TUBA) software (v1.7b) was used to produce the Transport Economic Efficiency (TEE) and Public Accounts (PA) tables for the scheme. The assessment was based on the following inputs:

- **Trips, Time, Distance and Charge Matrices:** for respective modes, time periods, forecast years and scenarios;
- **Parameters and Assumptions:** such as values of time and annualisation factors used by TUBA to convert the model output into an estimate of monetised impacts across the appraisal period; and
- **Scheme Costs:** Also discussed in detail in Appendix 3A

Trip and Cost Matrices

Matrices Required

User benefits for the Rapid Transit Scheme were extracted from the Bristol Area Transport Studies model (G-BATS3), a five-stage demand modelling system which forms part of the Greater Bristol Modelling Framework and consists of a demand model, SATURN highway assignment model and EMME/2 public transport assignment model.

The central assessment process involved extracting matrices for each of:

- **Two Scenarios:**
 - *Do-Minimum(DM)*; all schemes and network alterations planned to be implemented in the modelled area by the forecast years, excluding the Rapid Transit Scheme;
 - *Do Something (DS)*: DM + Rapid Transit Scheme.

In line with DfT guidance, the same land use scenario is assumed to apply in both the Do-Minimum and Do-Something scenarios.

- **Three time periods:**
 - *AM peak* (peak hour of 08.00-09.00);
 - *Inter-peak* (average hour between 10.00 and 16.00); and
 - *PM peak* (peak hour of 17.00-18.00)
- **Two forecast years:**
 - 2016 and
 - 2031
- **Twenty user classes:**
 - Car;
 - Business
 - Non business with income <£17,500
 - Non business with income between £17,500 and £35,000
 - Non business with income >£35,000
 - Light Goods Vehicle (LGV)
 - Heavy Goods Vehicle (HGV);

- Rail;
 - Business
 - Commuter with income <£17,500
 - Commuter with income between £17,500 and £35,000
 - Commuter with income >£35,000
 - Other with income <£17,500
 - Other with income between £17,500 and £35,000
 - Other with income >£35,000
- Bus/Rapid Transit (described further below)
 - Business
 - Commuter with income <£17,500
 - Commuter with income between £17,500 and £35,000
 - Commuter with income >£35,000
 - Other with income <£17,500
 - Other with income between £17,500 and £35,000
 - Other with income >£35,000

The matrices required for one time period, scenario and forecast year are summarised in Table 3G.2 below. Public transport demand, journey time and fares matrices were extracted from the EMME/2 Strategic Transport Model whilst the SATURN Local Highway Model provided the highway demand, time and distance matrices.

Table 3G.2– Input Matrices, Single Year, Time Period and Scenario

Mode	Generalised Time	Distance	Trip	Fare	Charge
Car	✓	✓	✓(Vehicle)	-	✓
LGV	✓	✓	✓(Vehicle)	-	✓
HGV	✓	✓	✓(Vehicle)	-	✓
Bus/BRT	✓	-	✓(Person)	✓	-
Rail	✓	-	✓(Person)	✓	-

- not applicable

Matrix Processing

The highway matrices required were output directly from the Local Highway Model. However, additional processing (using automated visual basic applications) was required to convert the public transport matrices output from the EMME/2 Strategic Transport Model into a suitable format and to generate the two following sets of additional matrices which were not directly used in the model:

- *Public transport generalised time matrices*: calculated from the constituent time components using the following formulae:

Non Business Generalised Time	=	Access/Egress Walk*2.0 + Wait*2.5 + Interchange Walk*10 ⁽¹⁾ + In vehicle Time
Business Generalised Time	=	Access/Egress Walk+ Wait + In vehicle Time

(1) This term represents the interchange penalty

- *Combined Bus and BRT matrices:* created as a response to the new mode issue, as described in the following section.

New Mode Issue

The TUBA approach is based on a comparison of the DM and the DS demand and journey costs between each modelled origin and destination for each mode. Consequently where a new mode is introduced in the DS scenario, the approach fails and additional analysis is required to complete the TUBA assessment. The recommended approach is to develop a third scenario, the pseudo Do-Minimum². This represents a hypothetical situation with very low demand for the new mode, allowing the associated travel costs to be estimated, providing a basis for comparison for the Do Something.

Since rapid transit did not exist in the DM scenario, the implementation of the Rapid Transit Scheme in the DS resulted in the introduction of a new mode. However, it was judged that there was sufficient similarity between the bus and Rapid Transit modes (with both involving similar travel costs and serving similar journey types) for both to be considered as a single amalgamated mode. This combined 'Bus and Rapid Transit'³ mode then existed in both the DM and DS scenarios, fulfilling the requirements of the TUBA assessment.

The combined mode outputs were created from the bus and Rapid Transit matrices output from the PT model using the following approaches:

- ***Demand Matrices:*** straightforward summation of bus and Rapid Transit demand matrices for each O/D pair
- ***Time Matrices:*** calculation of a weighted average as follows:

$$\frac{(\text{Bus Demand}) \times (\text{Bus Time}) + (\text{Rapid Transit Demand}) \times (\text{Rapid Transit Time})}{(\text{Bus Demand}) + (\text{Rapid Transit Demand})}$$
- ***Fare Matrices:*** no adjustments required as bus and Rapid Transit matrices were identical.

Park and Ride

Park and Ride existed as a mode in Bristol in both the DM and DS scenarios but was not represented as a separate mode/user class within the TUBA assessment. This was a recognised divergence from standard TUBA guidance. However, the impacts of the scheme on Park and Ride users were fully captured in the assessment as the car legs of each Park and Ride journey were combined with the main car mode matrices and the public transport legs were included in the Bus/BRT mode. Park and Ride sites were represented as individual zones in the model allowing the benefits to be separately identified, if necessary, by selecting those journeys starting or ending in the relevant zones.

Parameters and Assumptions

TUBA uses a number of parameters to convert the input model and cost information into a 60 year economic appraisal.

TUBA defaults were used for the majority of values including:

- Values of time (non-segmented by income group) and associated growth
- Vehicle occupancy and associated change rates

However a number of scheme specific assumptions were required and these are set out in more detail below.

² An onerous method that can significantly delay assessment of the scheme

³ Combining bus and Rapid Transit into a generic PT mode did not allow the production of separate TUBA results for Bus and Rapid Transit

Matrix Input Factors

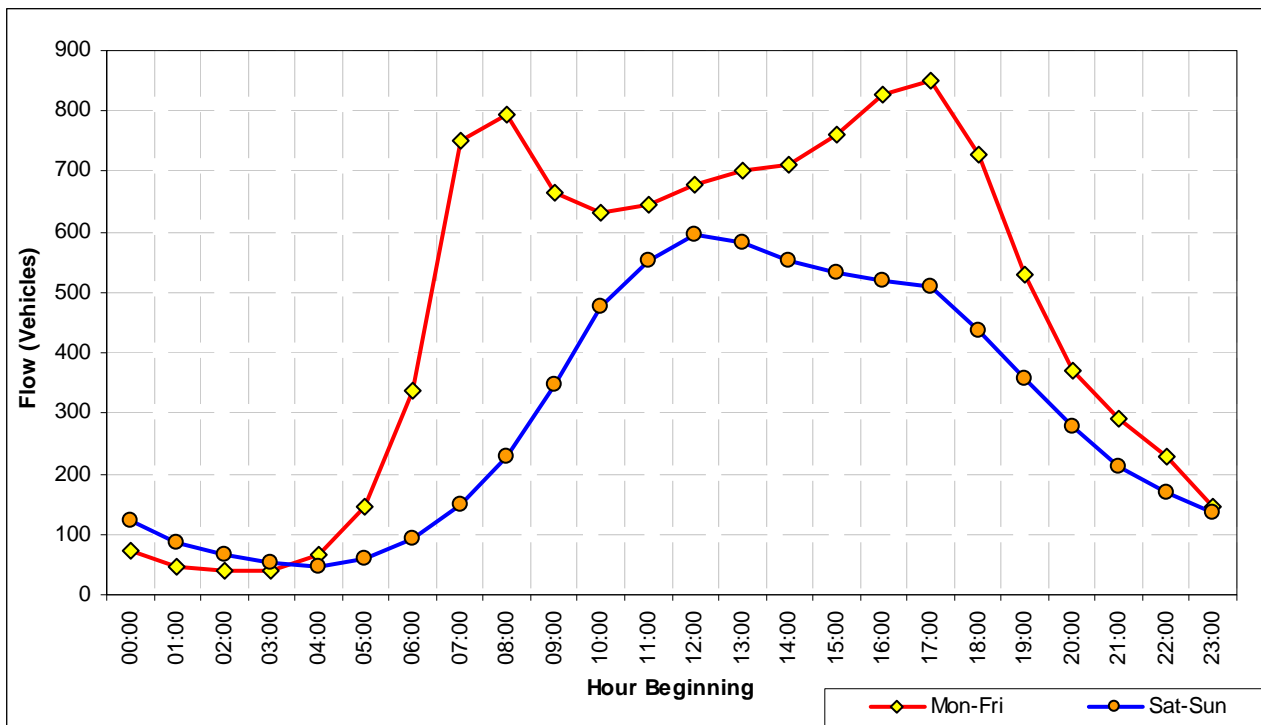
A series of factors were applied to the input matrices to convert them to the units required by TUBA. These include:

- 1/1000 to convert distance from metres to kilometres
- 1/3600 to convert seconds to hours (for SATURN matrices)
- 1/60 to convert minutes to hours (for EMME/2 matrices)
- 1/2.3 to convert HGV matrices from pcu trips to vehicle trips
- 0.889 to convert fares from the 2006 price base used in the model to the 2002 prices required by TUBA (based on RPI).

Annualisation Factors

Annualisation factors were used to convert estimates of demand related costs and benefits experienced during the three modelled time periods into estimates of total annual costs and benefits for each modelled year. Figure 3G.1 shows average weekly traffic profile data (from more than ninety traffic count locations within Bristol area) for 2005/06. It can be seen that both AM/PM peak shoulders are except for the morning peak hour, both the inter-peak and evening peak hours have flows lower than their shoulder peak flows.

Figure 3G.1 Average Weekly Traffic Flow Distribution in Bristol (2005/2006)



To convert AM and PM peak hourly modelled benefits to average weekday AM/PM benefits, a factor of 2 was used. This was assumed to be a conservative assumption but is in line with demand modelling, wherein a flat profile was assumed for AM and PM peak in 2016. Assuming 253 working days a year, an annualisation factor of 506 was thus estimated for the modelled AM and PM peak hours.

A factor of 6 was used to convert IP peak hourly benefits to daily benefits since the modelled output for this peak was reported for the average of six hours. Assuming 253 working days a year, an annualisation factor of 1,518 was therefore estimated for the modelled inter-peak hours. The annualisation process at this stage therefore excludes any benefits occurring in the evenings and at weekends and therefore represents a conservative view of overall benefits.

60 Year Appraisal

The default TUBA profile was used to convert the benefits for the two modelled years into a benefit stream for the full 60 year appraisal period (between the opening year of 2014 and 2073) i.e.:

- Linear interpolation between the two modelled years;
- An extension of the linear trend to the years before the first modelled year to estimate benefits for the years between the opening year of 2014 and first modelled year of 2016;
- A flat profile beyond the second forecast year of 2031 with no further growth in benefits assumed.

3 NATA Worksheets

Tables, 3G.4 – 3G.27, provide full details of economic efficiencies of the transport systems (TEEs), public accounts and analysis of monetised costs and benefits for the central case⁴ and the following sensitivity tests:

- AM and PM peak Rapid Transit frequency reduced to 6 per hour, IP reduced to 3 per hour;
- The Rapid Transit mode constant changed from 9 minutes to 4.5 minutes;
- AM and PM peak hour annualisation factors reduced from 506 to 253
- Operating costs increased by 20%
- The Rapid Transit journey times increased by 25%
- Stop prior to starting the anti-clockwise loop removed; and
- Additional BRT link added from P&R site to the area of the SW urban extension development

The key outcomes of each of the above sensitivities are first summarised in Table 3G.3. It should be noted that the DfT also advised to conduct two additional sensitivity tests, delay in opening year of the scheme by 1 year and annualising carbon impacts of the scheme. It was recommended to understand any uncertainties attached with the scheme opening year delays and carbon dis-benefits. However, in line with the central case, the tests returned with very high value for money outcomes and hence were not deemed feasible for reporting.

⁴ Lower cost Alternative Assessment is shown in Tables 3G.28-3G.30.

Table 3G.3 – Sensitivity Analysis Impact on TEE values for Main Option

Scenario	Consumer User Benefits (£m)	Business User Benefits (£m)	Private Sector Benefits (£m)	Total Present Value Benefits (PVB- £m)**	Public Sector Costs (PVC -£m)***	Net Present Value (NPV- £m)	Benefit to Cost Ratio (BCR)
Central Scenario	177.3	109.5	58.8	345.5	87.5	258.0	3.95
AM and PM Peak frequency reduced to 6 per hour (as current P&R service), IP reduced to 3 per hour	127.8	66.3	-49.3	144.8	70.0	74.8	2.07
Rapid Transit mode constant changed from 9 minutes to 4.5 minutes	131.2	39.9	-12.3	158.8	76.6	82.1	2.07
Annualisation Factors for AM (253) and PM (253)	122.6	86.2	38.1	246.8	84.3	162.6	2.93
20% Increase in Operating and Maintenance Cost	177.3	109.5	57.0	343.7	93.6	250.1	3.67
Rapid Transit journey times increased by 25%	168.8	106.7	53.3	328.8	87.2	241.6	3.77
Stop prior to starting the anti clockwise loop removed	175.6	103.9	56.7	336.5	87.3	249.2	3.86
Additional Rapid Transit link added from P&R site to the area of the SW Urban Extension development	464.6	306.3	120.4	891.9	140.9	751.0	6.33

*Includes Carbon disbenefits but excludes safety benefits; ** Includes risk adjustment, optimism bias, adjustment to real cost increase, local government and indirect tax revenues; Note: All entries, except BCR, are present values discounted to 2002, in 2002 prices;

Ashton Value to Temple Meads and Bristol City Centre Rapid Transit Scheme – Central Case

Table 3G.4 – Economic Efficiency of the Transport System (TEE)

Consumers	ALL MODES	ROAD	BUS & COACH	RAIL	OTHER	
<i>User benefits</i>	TOTAL	Private Cars and LGVs	Passengers	Passengers		
Travel time	179092	-86092	258567	6617		
Vehicle operating costs	-2205	-2205				
User charges	393	209	0	184		
During Construction & Maintenance	0	0	0	0		
NET CONSUMER BENEFITS	177281 ⁽¹⁾	-88088	258567	6801		
Business						
<i>User benefits</i>		Goods Vehicles	Business Cars & LGVs	Passengers	Freight	Passengers
Travel time	112630	-57080	-32472	202761	0	-578
Vehicle operating costs	-3163	-1729	-1434	0	0	0
User charges	48	2	3	0	0	43
During Construction & Maintenance	0	0	0	0	0	0
Subtotal	109516 ⁽²⁾	-58807	-33903	202761	0	-535
<i>Private sector provider impacts</i>				Freight	Passengers	
Revenue	68859			105975	0	-37115
Operating costs	-8843			-8843	0	0
Investment costs	-1242			-1242	0	0
Grant/subsidy	0			0	0	0
Subtotal	58774 ⁽³⁾			97132	0	-37115
<i>Other business impacts</i>						
Developer contributions	0	0		0		0
NET BUSINESS IMPACT	168290 ^{(5) = (2) + (3) + (4)}					
TOTAL						
Present Value of Transport Economic Efficiency Benefits	345571 ^{(6) = (1) + (5)}					

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

Table 3G.5 – Public Accounts

	ALL MODES TOTAL	ROAD INFRASTRUCTURE	BUS AND COACH	RAIL	OTHER
Local Government Funding					
Revenue	81	81	0	0	0
Operating Costs	30804	0	30804	0	0
Investment Costs	7759	0	7759	0	0
Developer and Other Contributions	0	0	0	0	0
Grant/Subsidy Payments	0	0	0	0	0
NET IMPACT	38644	-7	38563	0	
Central Government Funding					
Revenue	0	0	0	0	0
Operating costs	0	0	0	0	0
Investment Costs	39118	0	39118	0	0
Developer and Other Contributions	0	0	0	0	0
Grant/Subsidy Payments	0	0	0	0	0
Indirect Tax Revenues	9719	-331	15205	-5155	
NET IMPACT	48837	-8	54323	-5155	
TOTAL Present Value of Costs (PVC)	87481	<i>(9) = (7) + (8)</i>			

Notes: Costs appear as positive numbers, while revenues and 'Developer and Other Contributions' appear as negative numbers.

All entries are discounted present values, in 2002 prices and values

Table 3G.6 – Analysis of Monetised Costs and Benefits

Noise	Not assessed by TUBA	
Local Air Quality	Not assessed by TUBA	
Greenhouse Gases		-57
Journey Ambience	Not assessed by TUBA	
Accidents ⁽¹⁾	Not assessed by TUBA	
Consumer Users		177281
Business Users and Providers		109516
Reliability	Not assessed by TUBA	
Option Values	Not assessed by TUBA	
Present Value of Benefits <i>(see notes)</i> (PVB)		345514
Public Accounts		87481
Present Value of Costs <i>(see notes)</i> (PVC)		87481
OVERALL IMPACTS		
Net Present Value (NPV)	258032	<i>NPV=PVB-PVC</i>
Benefit to Cost Ratio (BCR)	3.95	<i>BCR=PVB/PVC</i>
<p>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. (1) Accident benefits have been calculated as £14.8 million for the central case, giving a BCR of 4.12. These benefits have been excluded from this analysis to allow like for like comparison.</p>		

AM and PM Peak Rapid Transit Frequency Reduced to 6 per Hour (as current P&R service), IP Reduced to 3 per Hour

Table 3G.7 – Economic Efficiency of the Transport System (TEE)

Consumers	ALL MODES	ROAD	BUS & COACH	RAIL	OTHER	
	TOTAL	Private Cars and LGVs	Passengers	Passengers		
<i>User benefits</i>						
Travel time	129595	-86092	209070	6617		
Vehicle operating costs	-2205	-2205	0	0		
User charges	393	209	0	184		
During Construction & Maintenance	0	0	0	0		
NET CONSUMER BENEFITS	127783	-88088	209070	6801		
Business						
<i>User benefits</i>		Goods Vehicles	Business Cars & LGVs	Passengers	Freight	Passengers
Travel time	69442	-57080	-32472	159572	0	-578
Vehicle operating costs	-3163	-1729	-1434	0	0	0
User charges	48	2	3	0	0	43
During Construction & Maintenance	0	0	0	0	0	0
Subtotal	66327	-58807	-33903	159572	0	-535
<i>Private sector provider impacts</i>				Freight	Passengers	
Revenue	-50211			-13095	0	-37115
Operating costs	-89			-89	0	0
Investment costs	1031			1031	0	0
Grant/subsidy	0			0	0	0
Subtotal	-49269			-13184	0	-37115
<i>Other business impacts</i>						
Developer contributions	0	(4)	0	0	0	0
NET BUSINESS IMPACT	17058	(5) = (2) + (3) + (4)				
TOTAL Present Value of Transport Economic Efficiency Benefits	144842	(6) = (1) + (5)				

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

All entries are discounted present values, in 2002 prices and values

Table 3G.8 – Public Accounts

	ALL MODES TOTAL	ROAD INFRASTRUCTURE	BUS AND COACH	RAIL	OTHER
Local Government Funding					
Revenue	81	81	0	0	0
Operating Costs	30804	0	30804	0	0
Investment Costs	7759	0	7759	0	0
Developer and Other Contributions	0	0	0	0	0
Grant/Subsidy Payments	0	0	0	0	0
NET IMPACT	38644	-7	38563	0	
Central Government Funding					
Revenue	0	0	0	0	0
Operating costs	0	0	0	0	0
Investment Costs	39118	0	39118	0	0
Developer and Other Contributions	0	0	0	0	0
Grant/Subsidy Payments	0	0	0	0	0
Indirect Tax Revenues	-7755	-331	-2269	-5155	
NET IMPACT	31363	-8	36849	-5155	
TOTAL Present Value of Costs (PVC)	70007	<i>(9) = (7) + (8)</i>			

Notes: Costs appear as positive numbers, while revenues and 'Developer and Other Contributions' appear as negative numbers.

All entries are discounted present values, in 2002 prices and values

Table 3G.9 – Analysis of Monetised Costs and Benefits

Noise	Not assessed by TUBA	
Local Air Quality	Not assessed by TUBA	
Greenhouse Gases		-57
Journey Ambience	Not assessed by TUBA	
Accidents	Not assessed by TUBA	
Consumer Users		127783
Business Users and Providers		66327
Reliability	Not assessed by TUBA	
Option Values	Not assessed by TUBA	
Present Value of Benefits (see notes) (PVB)		144785
Public Accounts		70007
Present Value of Costs (see notes) (PVC)		70007
OVERALL IMPACTS		
Net Present Value (NPV)		74777 <i>NPV=PVB-PVC</i>
Benefit to Cost Ratio (BCR)		2.07 <i>BCR=PVB/PVC</i>

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.

BRT mode constant changed from 9 minutes to 4.5 minutes

Table 3G.10 – Economic Efficiency of the Transport System (TEE)

Consumers	ALL MODES	ROAD	BUS & COACH	RAIL	OTHER	
<i>User benefits</i>	TOTAL	Private Cars and LGVs	Passengers	Passengers		
Travel time	133386	-90251	216974	6663		
Vehicle operating costs	-2666	-2666	0	0		
User charges	467	285	0	182		
During Construction & Maintenance	0	0	0	0		
NET CONSUMER BENEFITS	131188	-92631	216974	6845		
Business						
<i>User benefits</i>		Goods Vehicles	Business Cars & LGVs	Passengers	Freight	Passengers
Travel time	42466	-52293	-31950	127336	0	-627
Vehicle operating costs	-2629	-1622	-1008	0	0	0
User charges	111	41	28	0	0	42
During Construction & Maintenance	0	0	0	0	0	0
Subtotal	39947	-53874	-32930	127336	0	-585
Private sector provider impacts						
				Freight	Passengers	
Revenue	-2179			27741	0	-29919
Operating costs	-8843			-8843	0	0
Investment costs	-1242			-1242	0	0
Grant/subsidy	0			0	0	0
Subtotal	-12264			18898	0	-29919
Other business impacts						
Developer contributions	0	(4)	0	0	0	0
NET BUSINESS IMPACT	27684	(5) = (2) + (3) + (4)				
TOTAL Present Value of Transport Economic Efficiency Benefits	158871	(6) = (1) + (5)				

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

Table 3G.11 – Public Accounts

	ALL MODES TOTAL	ROAD INFRASTRUCTURE	BUS AND COACH	RAIL	OTHER
Local Government Funding					
Revenue	257	257	0	0	0
Operating Costs	30804	0	30804	0	0
Investment Costs	7759	0	7759	0	0
Developer and Other Contributions	0	0	0	0	0
Grant/Subsidy Payments	0	0	0	0	0
NET IMPACT	38820	-7	38563	0	0
Central Government Funding					
Revenue	0	0	0	0	0
Operating costs	0	0	0	0	0
Investment Costs	39118	0	39118	0	0
Developer and Other Contributions	0	0	0	0	0
Grant/Subsidy Payments	0	0	0	0	0
Indirect Tax Revenues	-1302	-663	3543	-4181	0
NET IMPACT	37816	-8	42661	-4181	0
TOTAL Present Value of Costs (PVC)	76636				

(9) = (7) + (8)

Notes: Costs appear as positive numbers, while revenues and 'Developer and Other Contributions' appear as negative numbers.

All entries are discounted present values, in 2002 prices and values

Table 3G.12 – Analysis of Monetised Costs and Benefits

Noise	Not assessed by TUBA	
Local Air Quality	Not assessed by TUBA	
Greenhouse Gases	-100	
Journey Ambience	Not assessed by TUBA	
Accidents	Not assessed by TUBA	
Consumer Users	131188	
Business Users and Providers	39947	
Reliability	Not assessed by TUBA	
Option Values	Not assessed by TUBA	
Present Value of Benefits (see notes) (PVB)	158771	
Public Accounts	76636	
Present Value of Costs (see notes) (PVC)	76636	
OVERALL IMPACTS		
Net Present Value (NPV)	82135	<i>NPV=PVB-PVC</i>
Benefit to Cost Ratio (BCR)	2.07	<i>BCR=PVB/PVC</i>

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.

AM and PM Peak Hour Annualisation Factors Reduced from 506 to 253

Table 3G.13 – Economic Efficiency of the Transport System (TEE)

Consumers	ALL MODES	ROAD	BUS & COACH	RAIL	OTHER	
<i>User benefits</i>	TOTAL	Private Cars and LGVs	Passengers	Passengers		
Travel time	124047	-60041	179448	4640		
Vehicle operating costs	-1673	-1673	0	0		
User charges	274	161	0	113		
During Construction & Maintenance	0	0	0	0		
NET CONSUMER BENEFITS	122647	-61553	179448	4753		
Business						
<i>User benefits</i>		Goods Vehicles	Business Cars & LGVs	Passengers	Freight	Passengers
Travel time	88808	-49999	-24376	162763	0	419
Vehicle operating costs	-2686	-1556	-1130	0	0	0
User charges	32	-5	7	0	0	30
During Construction & Maintenance	0	0	0	0	0	0
Subtotal	86153	-51560	-25499	162763	0	449
<i>Private sector provider impacts</i>				Freight	Passengers	
Revenue	48207			75469	0	-27263
Operating costs	-8843			-8843	0	0
Investment costs	-1242			-1242	0	0
Grant/subsidy	0			0	0	0
Subtotal	38122			66626	0	-27263
<i>Other business impacts</i>						
Developer contributions	0	(4)	0	0	0	0
NET BUSINESS IMPACT	124275	(5) = (2) + (3) + (4)				
TOTAL Present Value of Transport Economic Efficiency Benefits	246922	(6) = (1) + (5)				

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

Table 3G.14 – Public Accounts

	ALL MODES TOTAL	ROAD INFRASTRUCTURE	BUS AND COACH	RAIL	OTHER
Local Government Funding					
Revenue	90	90	0	0	0
Operating Costs	30804	0	30804	0	0
Investment Costs	7759	0	7759	0	0
Developer and Other Contributions	0	0	0	0	0
Grant/Subsidy Payments	0	0	0	0	0
NET IMPACT	38653	-7	38563	0	
Central Government Funding					
Revenue	0	0	0	0	0
Operating costs	0	0	0	0	0
Investment Costs	39118	0	39118	0	0
Developer and Other Contributions	0	0	0	0	0
Grant/Subsidy Payments	0	0	0	0	0
Indirect Tax Revenues	6494	-461	10633	-3678	
NET IMPACT	45612	-8	49751	-3678	
TOTAL Present Value of Costs (PVC)	84265	<i>(9) = (7) + (8)</i>			

Notes: Costs appear as positive numbers, while revenues and 'Developer and Other Contributions' appear as negative numbers.

All entries are discounted present values, in 2002 prices and values

Table 3G.1 Error! No text of specified style in document.5 – Analysis of Monetised Costs and Benefits

Noise	Not assessed by TUBA	
Local Air Quality	Not assessed by TUBA	
Greenhouse Gases	-76	
Journey Ambience	Not assessed by TUBA	
Accidents	Not assessed by TUBA	
Consumer Users	122647	
Business Users and Providers	86153	
Reliability	Not assessed by TUBA	
Option Values	Not assessed by TUBA	
Present Value of Benefits (see notes) (PVB)	246846	
Public Accounts	84265	
Present Value of Costs (see notes) (PVC)	84265	
OVERALL IMPACTS		
Net Present Value (NPV)	162582	$NPV = PVB - PVC$
Benefit to Cost Ratio (BCR)	2.93	$BCR = PVB / PVC$

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.

Operating and Maintenance Costs Increased by 20%

Table 3G.16 – Economic Efficiency of the Transport System (TEE)

Consumers	ALL MODES	ROAD	BUS & COACH	RAIL	OTHER	
<i>User benefits</i>	TOTAL	Private Cars and LGVs	Passengers	Passengers		
Travel time	179092	-86092	258567	6617		
Vehicle operating costs	-2205	-2205	0	0		
User charges	393	209	0	184		
During Construction & Maintenance	0	0	0	0		
NET CONSUMER BENEFITS	177281	-88088	258567	6801		
Business						
<i>User benefits</i>		Goods Vehicles	Business Cars & LGVs	Passengers	Freight	Passengers
Travel time	112630	-57080	-32472	202761	0	-578
Vehicle operating costs	-3163	-1729	-1434	0	0	0
User charges	48	2	3	0	0	43
During Construction & Maintenance	0	0	0	0	0	0
Subtotal	109516	-58807	-33903	202761	0	-535
<i>Private sector provider impacts</i>				Freight	Passengers	
Revenue	68859			105975	0	-37115
Operating costs	-10612			-10612	0	0
Investment costs	-1242			-1242	0	0
Grant/subsidy	0			0	0	0
Subtotal	57006			95363	0	-37115
<i>Other business impacts</i>						
Developer contributions	0	(4)	0	0	0	0
NET BUSINESS IMPACT	166521	(5) = (2) + (3) + (4)				
TOTAL						
Present Value of Transport Economic Efficiency Benefits	343802	(6) = (1) + (5)				

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

All entries are discounted present values, in 2002 prices and values

Table 3G.17 – Public Accounts

	ALL MODES TOTAL	ROAD INFRASTRUCTURE	BUS AND COACH	RAIL	OTHER
Local Government Funding					
Revenue	81	81	0	0	
Operating Costs	36965	0	36965	0	
Investment Costs	7759	0	7759	0	
Developer and Other Contributions	0	0	0	0	
Grant/Subsidy Payments	0	0	0	0	
NET IMPACT	44805	-7	44724	0	
Central Government Funding					
Revenue	0	0	0	0	
Operating costs	0	0	0	0	
Investment Costs	39118	0	39118	0	
Developer and Other Contributions	0	0	0	0	
Grant/Subsidy Payments	0	0	0	0	
Indirect Tax Revenues	9719	-331	15205	-5155	
NET IMPACT	48837	-8	54323	-5155	
TOTAL Present Value of Costs (PVC)	93642				

$(9) = (7) + (8)$

Notes: Costs appear as positive numbers, while revenues and 'Developer and Other Contributions' appear as negative numbers.

All entries are discounted present values, in 2002 prices and values

Table 3G.18 – Analysis of Monetised Costs and Benefits

Noise	Not assessed by TUBA	
Local Air Quality	Not assessed by TUBA	
Greenhouse Gases		-57
Journey Ambience	Not assessed by TUBA	
Accidents	Not assessed by TUBA	
Consumer Users		177281
Business Users and Providers		109516
Reliability	Not assessed by TUBA	
Option Values	Not assessed by TUBA	
Present Value of Benefits (see notes) (PVB)		343745
Public Accounts		93642
Present Value of Costs (see notes) (PVC)		93642
OVERALL IMPACTS		
Net Present Value (NPV)		250103 <i>NPV=PVB-PVC</i>
Benefit to Cost Ratio (BCR)		3.67 <i>BCR=PVB/PVC</i>

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.

BRT journey times increased by 25%

Table 3G.19 – Economic Efficiency of the Transport System (TEE)

Consumers	ALL MODES	ROAD	BUS & COACH	RAIL	OTHER	
	TOTAL	Private Cars and LGVs	Passengers	Passengers		
<i>User benefits</i>						
Travel time	170576	-86092	250051		6617	
Vehicle operating costs	-2205	-2205	0		0	
User charges	393	209	0		184	
During Construction & Maintenance	0	0	0		0	
NET CONSUMER BENEFITS	168764	-88088	250051		6801	
		-1				
Business						
<i>User benefits</i>		Goods Vehicles	Business Cars & LGVs	Passengers	Freight	Passengers
Travel time	109841	-57080	-32472	199972	0	-578
Vehicle operating costs	-3163	-1729	-1434	0	0	0
User charges	48	2	3	0	0	43
During Construction & Maintenance	0	0	0	0	0	0
Subtotal	106727	-58807	-33903	199972	0	-535
		-2				
<i>Private sector provider impacts</i>					Freight	Passengers
Revenue	67008			104123	0	-37115
Operating costs	-11194			-11194	0	0
Investment costs	-2481			-2481	0	0
Grant/subsidy	0			0	0	0
Subtotal	53333			92929	0	-37115
		-3				
<i>Other business impacts</i>						
Developer contributions	0	(4)	0	0		0
NET BUSINESS IMPACT	160060	(5) = (2) + (3) + (4)				
TOTAL Present Value of Transport Economic Efficiency Benefits	328824	(6) = (1) + (5)				

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

Table 3G.20 – Public Accounts

	ALL MODES TOTAL	ROAD INFRASTRUCTURE	BUS AND COACH	RAIL	OTHER
Local Government Funding					
Revenue	81	81	0	0	
Operating Costs	30804	0	30804	0	
Investment Costs	7759	0	7759	0	
Developer and Other Contributions	0	0	0	0	
Grant/Subsidy Payments	0	0	0	0	
NET IMPACT	38644	-7 81	38563	0	
Central Government Funding					
Revenue	0	0	0	0	
Operating costs	0	0	0	0	
Investment Costs	39118	0	39118	0	
Developer and Other Contributions	0	0	0	0	
Grant/Subsidy Payments	0	0	0	0	
Indirect Tax Revenues	9413	-331	14899	-5155	
NET IMPACT	48531	-8 -331	54017	-5155	
TOTAL Present Value of Costs (PVC)	87176	<i>(9) = (7) + (8)</i>			

Notes: Costs appear as positive numbers, while revenues and 'Developer and Other Contributions' appear as negative numbers.

All entries are discounted present values, in 2002 prices and values

Table 3G.21 – Analysis of Monetised Costs and Benefits

Noise	Not assessed by TUBA	
Local Air Quality	Not assessed by TUBA	
Greenhouse Gases		-57
Journey Ambience	Not assessed by TUBA	
Accidents	Not assessed by TUBA	
Consumer Users		168764
Business Users and Providers		106727
Reliability	Not assessed by TUBA	
Option Values	Not assessed by TUBA	
Present Value of Benefits (see notes) (PVB)		328767
Public Accounts		87176
Present Value of Costs (see notes) (PVC)		87176
OVERALL IMPACTS		
Net Present Value (NPV)		241591 <i>NPV=PVB-PVC</i>
Benefit to Cost Ratio (BCR)		3.77 <i>BCR=PVB/PVC</i>

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.

Stop Prior to Starting the Anti-clockwise Loop Removed so Passengers can't Board or Alight

Table 3G.22 – Economic Efficiency of the Transport System (TEE)

Consumers	ALL MODES	ROAD	BUS & COACH	RAIL	OTHER	
	TOTAL	Private Cars and LGVs	Passengers	Passengers		
<i>User benefits</i>						
Travel time	177397	-86092	256872	6617		
Vehicle operating costs	-2205	-2205	0	0		
User charges	393	209	0	184		
During Construction & Maintenance	0	0	0	0		
NET CONSUMER BENEFITS	175585	-88088	256872	6801		
		-1				
Business						
<i>User benefits</i>		Goods Vehicles	Business Cars & LGVs	Passengers	Freight	Passengers
Travel time	107022	-57080	-32472	197152	0	-578
Vehicle operating costs	-3163	-1729	-1434	0	0	0
User charges	48	2	3	0	0	43
During Construction & Maintenance	0	0	0	0	0	0
Subtotal	103907	-58807	-33903	197152	0	-535
		-2				
<i>Private sector provider impacts</i>				Freight	Passengers	
Revenue	66793			103908	0	-37115
Operating costs	-8843			-8843	0	0
Investment costs	-1242			-1242	0	0
Grant/subsidy	0			0	0	0
Subtotal	56708			95065	0	-37115
		-3				
<i>Other business impacts</i>						
Developer contributions	0	(4)	0	0	0	0
NET BUSINESS IMPACT	160615	(5) = (2) + (3) + (4)				
TOTAL Present Value of Transport Economic Efficiency Benefits	336200	(6) = (1) + (5)				

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

Table 3G.23 – Public Accounts

	ALL MODES TOTAL	ROAD INFRASTRUCTURE	BUS AND COACH	RAIL	OTHER
Local Government Funding					
Revenue	81	81	0	0	
Operating Costs	30804	0	30804	0	
Investment Costs	7759	0	7759	0	
Developer and Other Contributions	0	0	0	0	
Grant/Subsidy Payments	0	0	0	0	
NET IMPACT	38644	-7 81	38563	0	
Central Government Funding					
Revenue	0	0	0	0	
Operating costs	0	0	0	0	
Investment Costs	39118	0	39118	0	
Developer and Other Contributions	0	0	0	0	
Grant/Subsidy Payments	0	0	0	0	
Indirect Tax Revenues	9510	-331	14996	-5155	
NET IMPACT	48628	-8 -331	54114	-5155	
TOTAL Present Value of Costs (PVC)	87272	<i>(9) = (7) + (8)</i>			

Notes: Costs appear as positive numbers, while revenues and 'Developer and Other Contributions' appear as negative numbers.

All entries are discounted present values, in 2002 prices and values

Table 3G.24 – Analysis of Monetised Costs and Benefits

Noise	Not assessed by TUBA	
Local Air Quality	Not assessed by TUBA	
Greenhouse Gases		253
Journey Ambience	Not assessed by TUBA	
Accidents	Not assessed by TUBA	
Consumer Users		175585
Business Users and Providers		103907
Reliability	Not assessed by TUBA	
Option Values	Not assessed by TUBA	
Present Value of Benefits (see notes) (PVB)		336453
Public Accounts		87272
Present Value of Costs (see notes) (PVC)		87272
OVERALL IMPACTS		
Net Present Value (NPV)		249181 <i>NPV=PVB-PVC</i>
Benefit to Cost Ratio (BCR)		3.86 <i>BCR=PVB/PVC</i>

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.

Additional BRT link added from P&R site to the area of the SW Urban Extension development

Table 3G.25 – Economic Efficiency of the Transport System (TEE)

Consumers	ALL MODES	ROAD	BUS & COACH	RAIL	OTHER	
	TOTAL	Private Cars and LGVs	Passengers	Passengers		
<i>User benefits</i>						
Travel time	469435	-50829	461955	58309		
Vehicle operating costs	2548	2548	0	0		
User charges	-7338	220	0	-7558		
During Construction & Maintenance	0	0	0	0		
NET CONSUMER BENEFITS	464645	-48061	461955	50751		
Business						
<i>User benefits</i>		Goods Vehicles	Business Cars & LGVs	Passengers	Freight	Passengers
Travel time	308462	-27901	-15395	348670	0	3089
Vehicle operating costs	-664	-687	23	0	0	0
User charges	-1502	38	27	0	0	-1567
During Construction & Maintenance	0	0	0	0	0	0
Subtotal	306296	-28550	-15344	348670	0	1521
<i>Private sector provider impacts</i>				Freight	Passengers	
Revenue	141147			200166	0	-59019
Operating costs	-17036			-17036	0	0
Investment costs	-3720			-3720	0	0
Grant/subsidy	0			0	0	0
Subtotal	120391			183130	0	-59019
<i>Other business impacts</i>						
Developer contributions	0	(4)	0	0	0	0
NET BUSINESS IMPACT	426688	(5) = (2) + (3) + (4)				
TOTAL Present Value of Transport Economic Efficiency Benefits	891333	(6) = (1) + (5)				

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

Table 3G.26 – Public Accounts

	ALL MODES TOTAL	ROAD INFRASTRUCTURE	BUS AND COACH	RAIL	OTHER
Local Government Funding					
Revenue	187	187	0	0	
Operating Costs	46292	0	46292	0	
Investment Costs	11678	0	11678	0	
Developer and Other Contributions	0	0	0	0	
Grant/Subsidy Payments	0	0	0	0	
NET IMPACT	58157	-7 187	57970	0	
Central Government Funding					
Revenue	0	0	0	0	
Operating costs	0	0	0	0	
Investment Costs	58875	0	58875	0	
Developer and Other Contributions	0	0	0	0	
Grant/Subsidy Payments	0	0	0	0	
Indirect Tax Revenues	23886	3586	28720	-8420	
NET IMPACT	82761	-8 3586	87595	-8420	
TOTAL Present Value of Costs (PVC)	140918	<i>(9) = (7) + (8)</i>			

Notes: Costs appear as positive numbers, while revenues and 'Developer and Other Contributions' appear as negative numbers.

All entries are discounted present values, in 2002 prices and values

Table 3G.27 – Analysis of Monetised Costs and Benefits

Noise	Not assessed by TUBA	
Local Air Quality	Not assessed by TUBA	
Greenhouse Gases		553
Journey Ambience	Not assessed by TUBA	
Accidents	Not assessed by TUBA	
Consumer Users		464645
Business Users and Providers		306296
Reliability	Not assessed by TUBA	
Option Values	Not assessed by TUBA	
Present Value of Benefits (see notes) (PVB)		891886
Public Accounts		140918
Present Value of Costs (see notes) (PVC)		140918
OVERALL IMPACTS		
Net Present Value (NPV)		750967 <i>NPV=PVB-PVC</i>
Benefit to Cost Ratio (BCR)		6.33 <i>BCR=PVB/PVC</i>

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.

Lower Cost Alternative

Table 3G.28 – Economic Efficiency of the Transport System (TEE)

Consumers	ALL MODES TOTAL	ROAD		BUS & COACH	RAIL	OTHER	
		Private Cars and LGVs		Passengers	Passengers		
<i>User benefits</i>							
Travel time	19931		488	17238		2206	
Vehicle operating costs	1045		1045	0		0	
User charges	34		-27	0		61	
During Construction & Maintenance	0		0	0		0	
NET CONSUMER BENEFITS	21011	-1	1506	17238		2267	
Business							
<i>User benefits</i>			Goods Vehicles	Business Cars & LGVs	Passengers	Freight	Passengers
Travel time	2680		-8253	-2391	13517	0	-193
Vehicle operating costs	-74		-163	90	0	0	0
User charges	32		0	18	0	0	14
During Construction & Maintenance	0		0	0	0	0	0
Subtotal	2639	-2	-8416	-2284	13517	0	-178
<i>Private sector provider impacts</i>					Freight	Passengers	
Revenue	-5307				7065	0	-12372
Operating costs	-1073				-1073	0	0
Investment costs	-2481				-2481	0	0
Grant/subsidy	0				0	0	0
Subtotal	-8861	-3			5992	0	-12372
<i>Other business impacts</i>							
Developer contributions	0	(4)	0	0	0	0	0
NET BUSINESS IMPACT	-6222		(5) = (2) + (3) + (4)				
TOTAL Present Value of Transport Economic Efficiency Benefits	14788		(6) = (1) + (5)				

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

Table 3G.29 – Public Accounts

	ALL MODES TOTAL	ROAD INFRASTRUCTURE	BUS AND COACH	RAIL	OTHER
Local Government Funding					
Revenue	-50	-50	0	0	
Operating Costs	3437	0	3437	0	
Investment Costs	2967	0	2967	0	
Developer and Other Contributions	0	0	0	0	
Grant/Subsidy Payments	0	0	0	0	
NET IMPACT	6354	-7	6404	0	
Central Government Funding					
Revenue	0	0	0	0	
Operating costs	0	0	0	0	
Investment Costs	13699	0	13699	0	
Developer and Other Contributions	0	0	0	0	
Grant/Subsidy Payments	0	0	0	0	
Indirect Tax Revenues	284	989	1014	-1718	
NET IMPACT	13983	-8	14713	-1718	
TOTAL Present Value of Costs (PVC)	20337	<i>(9) = (7) + (8)</i>			

Notes: Costs appear as positive numbers, while revenues and 'Developer and Other Contributions' appear as negative numbers.

All entries are discounted present values, in 2002 prices and values

Table 3G.30– Analysis of Monetised Costs and Benefits

Noise	Not assessed by TUBA	
Local Air Quality	Not assessed by TUBA	
Greenhouse Gases		151
Journey Ambience	Not assessed by TUBA	
Accidents	Not assessed by TUBA	
Consumer Users		21011
Business Users and Providers		2639
Reliability	Not assessed by TUBA	
Option Values	Not assessed by TUBA	
Present Value of Benefits (see notes) (PVB)		14939
Public Accounts		20337
Present Value of Costs (see notes) (PVC)		20337
OVERALL IMPACTS		
Net Present Value (NPV)	-5397	<i>NPV=PVB-PVC</i>
Benefit to Cost Ratio (BCR)	0.73	<i>BCR=PVB/PVC</i>

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.