

# Cambridgeshire Transport Innovation Fund

## Economic Appraisal Report

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# 1. INTRODUCTION

## OVERVIEW

- 1.1 This document presents supplementary information relating to the Economic Appraisal of Iteration 2b (fixed land-use) forecasts for the Package Outline Proposal for Funding to the Department for Transport (DfT) Transport Innovation Fund (TIF). It is one of a suite of documents and should be read in conjunction with the:
- Package Level Outline Proposal for Funding
  - Congestion Charging Scheme Report
  - Transport Improvements Report
  - Options Assessment Report
  - Environmental Appraisal Report
  - Economic Appraisal Report
  - Social and Distributional Impacts Report
- 1.2 The Economic Appraisal forms part of the Council's outline proposal for TIF funding. The scheme assumed in developing this report and described in the Outline Proposal for Funding represents an initial proposal, which will be subject to development and refinement as a result of consultation and further technical study relating to the Package Proposal.
- 1.3 The purpose of this report is to support the Package Level Outline Proposal for Funding to the Department for Transport by presenting more detailed information regarding the Economic Appraisal of the Package, as required by the Department. This report has been prepared in accordance with Department guidance for TIF bids and provides the information required by that guidance presented in the recommended form and structure. In order to provide the analyses and information required by the Department, the report may contain considerations that, in reality, the Council would never consider. It should not therefore be regarded as Council policy but as the Council's response in compliance with the guidance for TIF bids.
- 1.4 The economic assessment has been undertaken using the DfT's Transport User Benefit Analysis (TUBA) software<sup>1</sup> for a 60 year appraisal period, in accordance with current guidance. The basis of the TUBA assessment are the model outputs from the A14 multi-modal model. It is intended that this assessment will be updated when a revised model is completed for use in 2008.
- 1.5 The TUBA assessment has been supplemented with additional inputs to the Analysis of Monetised Costs and Benefits that are not calculated by TUBA. Further detail on these is presented below.
- 1.6 Following this introduction, the remainder of this document focuses on the TUBA analysis. The following sections address:

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<sup>1</sup> The results reported here are from the set of TUBA runs referenced as "5w\_7"

- ◆ TUBA appraisal assumptions;
- ◆ Transport Economic Efficiency (TEE) Table<sup>2</sup>;
- ◆ Public Accounts (PA) Table<sup>3</sup>;
- ◆ Analysis of Monetised Costs and Benefits (AMCB) Table<sup>4</sup>;

1.7 The final section of the report provides an overview of the sensitivity tests that have been undertaken.

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<sup>2</sup> WebTAG 3.5.2 Table 1

<sup>3</sup> WebTAG 3.5.1 Table 1

<sup>4</sup> WebTAG 3.5.1 Table 2. Note that many of the categories given here have not been included in the economic appraisal presented herein. The appraisal undertaken to date is based on TUBA outputs (v1.7a) supplemented by 'offline' analyses of the additional benefits listed above.

## 2. TUBA Assessment

### OVERVIEW

- 2.1 There are two different models used to generate the inputs for the economic appraisal:
- ◆ The Local Highway Model (LHM) was used to produce demand, time and distance matrices for the highway side of the study. The toll matrices were also derived from this model.
  - ◆ The Strategic Transport Model (STM) was used to generate the Public Transport demand, journey times and fares for TUBA input.
- 2.2 The version of TUBA used in the assessment was V1.7a. The economics file it that supplied with TUBA v1.7a with the required amendments to ensure compatibility with the TUBA scheme file structure.
- 2.3 In line with guidance, the assessment was based on an appraisal of the impacts without segmenting users on the basis of income and applying different values of time. Additional income-segmented analyses have been undertaken for sensitivity purposes. In all cases, the demand modelling of the scheme has used values of time which differ by income segment and purpose (in accordance with TIF guidance).

### User Benefit Assumptions

- 2.4 The assumed traffic mix has been based on data collected for previous studies using the CHUMMS model, including RSI surveys and traffic counts. These assumptions include the observed purpose types and car occupancies for direct input to TUBA, and the proportion of light vehicles in each LHM user class that are cars and LGVs,<sup>5</sup>
- 2.5 Where business user types have been defined for specific drivers and passengers and hence passenger proportions and splits have already been accounted for within the inputs, the occupancy factors within the economics file are set to 1.0 because these factors should not be applied again by TUBA. For consumers the occupancy factors are taken from previous RSI data collected for the A14 improvements study.
- 2.6 Similarly the purpose splits are already defined due to the user class definitions. Therefore they should not be specified again within the economic files. The factors have been set to 100% in the economics file. Several different factors were applied to check the effect on the results, indicating that the factors had no effect; they are only used if a purpose type is not set.

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<sup>5</sup> The details of the calculations showing the splits for vehicles and purposes are shown in [Occupancy factors.xls](#). The factors for the input matrices have been derived as outlined in the spreadsheet [Factors Working AM.xls](#) and [Factors Working IP.xls](#)

- 2.7 A HGV vehicle is assumed to be 2.3 pcu and the input matrices are factored accordingly by dividing the pcu matrix by 2.3.
- 2.8 The distance input matrices are not input for passenger person types, as these are used to calculate vehicle operating costs which are not relevant to passenger.
- 2.9 The default person factors for Business users in the economic input file have all been changed to 1.0, as driver and passenger demands are input to TUBA as separate user classes, in order to apply different values of time. However, for Consumer purposes it is possible to define user classes based on the default zero person type, recognised as driver and passenger by TUBA. For these user classes, occupancies have been defined for each vehicle type, purpose and time period in the default person factors section of the economics parameter file.
- 2.10 Person factors do not change over the appraisal period.
- 2.11 The value of time used is the same within each user class, regardless of whether they are cars or LGV's.
- 2.12 The central case appraisal assumes that values of time are un-segmented by income. However, where sensitivity tests have been undertaken that include the effect of income segmentation, the values of time are taken from WebTAG 3.12.2 Annex A. This section has VOT split by income and purpose. The values for 'Business' driver and passenger are defined separately, whereas for 'Consumers' a generic 'Car User' value is used for both drivers and passengers.
- 2.13 The public transport model provides demand matrices in which rail/HQPT (High Quality Public Transport) and mass rapid transit are all in the same matrix and cannot be separated. When appraising this in TUBA the mode used has been labelled "rail".

### **Congestion Charging Assumptions**

- 2.14 The charges modelled in the AM peak hour model tests represent half the total charge on the basis that the charge is spread across the outward and return journeys. The annualisation of results from the AM peak hour model doubles the time savings and toll revenues occurring to travellers in the AM peak period (to represent the PM peak period) and therefore correctly reflects the total charge.
- 2.15 The charge has been input in current prices without further factoring and is therefore interpreted by TUBA as a perceived £4 charge in 2002 prices or £4.61 in 2007 prices. This charge is assumed to be in "factor prices"; consequently charge

revenues are automatically uplifted by the average rate of indirect taxation (20.9%) within TUBA.

- 2.16 The charge is not assumed to rise in real terms over time and therefore its effectiveness diminishes as values of time rise.
- 2.17 Passengers do not pay any charges.
- 2.18 The charges applied generate local government revenue, not central government revenue.

### **Annualisation Assumptions**

- 2.19 The AM peak period has been assumed to be 2 hours (representing 1.85 times the demand in the peak hour), for 253 days per year. This has been doubled to reflect PM peak costs and benefits and leads to an annualisation factor of 936 for the year.
- 2.20 To reflect the impact of trip-retiming, it is assumed that 7.5% of morning peak users will retime to the interpeak, therefore all input demand matrix files are factored by 0.925.
- 2.21 To reflect the fact that some users make more than one journey in the morning peak period (accounting for an estimated 15% of trips) and will only pay the area licence once, all input charge matrix files are factored by 0.85.
- 2.22 The Inter-Peak has been assumed to be for 6 hours a day, for 253 days per year. This gives an annualisation factor of 1518 hours. There are no charges applied within the inter-peak model.
- 2.23 To reflect the impact of trip-retiming, interpeak input demand matrix files are factored upwards to balance the absolute number of trip-retimers implied by the 7.5% reduction in morning peak demand. There is therefore no net change in the number of trips, but the implied trip distribution is slightly different and the number of trips in each time period is different.

### **Park & Ride Assumptions**

- 2.24 Several assumptions are made when dealing with the Park and Ride (P&R) car leg trips as addressed below.
  - ◆ The vehicles in the demand matrix for the P&R car leg are only cars. Therefore the occupancy is not a weighted average of car and LGV; it is taken from the RSI data on car occupancy from the previous A14 study.
  - ◆ The VOT and VOC for the P&R car leg are the same as for car.

- ◆ The P&R car leg trips are split by purpose and by income in the following way. The total highway demand over the nine car and LGV user classes is summed. The demand for each user class was calculated as a fraction of the total, and multiplied by the total P&R car leg demand. The resulting matrix total over all purposes and incomes was then checked for consistency with the input P&R car leg matrix.
  - ◆ The P&R car leg time and distance matrices are the same as for car.
  - ◆ The P&R car speed input was changed from the default value of 65km/h to 39km/h. This was calculated by using the sum of the trips multiplied by the distance, over the sum of the trips multiplied by time. The derived speed is more appropriate for an urban trip in the AM peak than 65 km/h.
- 2.25 It is assumed that P&R users do not incur charges to access P&R sites.

### **Cost Assumptions**

- 2.26 Where applicable scheme costs include some or all of the following elements:
- ◆ Preparation;
  - ◆ Supervision;
  - ◆ Construction;
  - ◆ Risk;
  - ◆ Land; and,
  - ◆ Optimism Bias.
- 2.27 Optimism bias is applied at the maximum relevant rate for the Transport Improvements schemes (i.e. as schemes in the first stages of development). The optimism bias for the Congestion Charging Scheme has been calculated as a weighted average of the optimism bias for the individual components, based on information available on DfT's website. This results in an optimism bias of 95% for the congestion charging element of the Package.
- 2.28 It has been assumed that 10% of the Package schemes' investment costs are paid through developer contributions, via Local Government, with the remainder funded by Central Government. All Congestion Charging Scheme operating costs are borne by Local Government and PT scheme operating costs borne by the operators. Central Government is assumed to fund the start-up costs of the smart-ticketing scheme, which are defined as operating costs.
- 2.29 The temporal profile of scheme costs has been assumed to be that which would yield the modelled profile of scheme openings.
- 2.30 Values have been calculated and input as 2007 prices with a conversion to 2002 prices undertaken within TUBA.

- 2.31 The most significant ongoing cost is the replacement cost of the congestion charging technology. This has been assumed to be replaced every 7 years, which when combined with other operating costs for the Package of schemes gives operating costs which are slightly below the initial investment costs for the Package.

### **Non-Cost Assumptions**

- 2.32 A key assumption is that the forecasting model from which future demand and congested travel costs are taken is adequately converged. To this end checks on the supply-demand convergence have been undertaken and the resulting statistic found to be within the limits specified in current guidance.
- 2.33 Within TUBA there are limits set on the number of user classes and purposes that can be defined. TUBA states that the maximum number of user classes is 32, however the highway scheme file requires 38, and the public transport requires 33. The inputs from user classes above 32 have been checked and it appears that there is no problem with having more than 32 user classes, and it is assumed that problem was from a previous version of TUBA and is no longer relevant. The same principle applies to purposes. Within the economics file used for both highway and public transport, the documentation states that the maximum number of purposes is 9. However 13 are required for this analysis, consisting of 9 for purpose and income split, 1 for HGV drivers and 3 for public transport users with no car available. Again the results have been tested to ensure that user classes with purpose types greater than 9 are processed correctly by TUBA.

## 3. Transport Economic Efficiency Table

### STRUCTURE OF THE TEE TABLE

- 3.1 The TEE table is based directly on the TUBA output with two amendments:
- ◆ Walking, Cycling and Smarter Choices (WCS) benefits are included as a separate mode that is not modelled directly in the TUBA and are instead assessed separately 'offline'. It is important to highlight this element of the presentation of the analysis as the benefits from WCS are significant;
  - ◆ The benefits from the Chesterton station scheme have also been assessed 'offline' separately<sup>6</sup>. The benefits from this scheme are then amalgamated within the TUBA model run undertaken for The Package.
- 3.2 The table has been expanded as far as possible to distinguish between the costs of the Congestion Charging Scheme as opposed to the other road schemes in the Package and between High Quality PT (HQPT) scheme costs as opposed to other PT scheme costs. This is primarily for consistency with the Public Accounts table.
- 3.3 It should be stressed that all costs and benefits referred to in this section are expressed in terms of 2002 prices and present values, and should not be viewed as real 'cash' values.

### RESULTS: CONSUMER USERS

- 3.4 The headline results for consumer users are that the Package would provide a positive PVB of £805.0m. However the separate WCS analysis provides a contribution of £523.4m of benefit to this value, and hence the level of PVB for consumer users excluding WCS would be £281.6m.
- 3.5 These totals mask a large benefit for PT consumers and disbenefit for highway consumers; road consumer users would have a negative PVB of £410.3m. This reflects the £658.5m in user charges (congestion charging tolls) which are treated as a dis-benefit and offset the value of time saving benefits (£177.4m) and vehicle operating cost savings (£70.8m). In simple terms the value of the congestion charging toll that the consumer users would pay is more than the valuation by those users of the resulting time and operating cost savings.
- 3.6 Public transport (including park and ride) consumer users would have benefits of £691.9m which is comprised primarily of time savings (£679.8m) with a small element of fare savings (user charges at £12.1m) through more direct journeys which incur a smaller distance based fare.

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<sup>6</sup> This is because while the costs of the scheme are included in the appraisal, the benefits are not reflected in the standard model output, owing to the scheme's inclusion in both the modelled Reference Case and with Package scenarios.

### **RESULTS: BUSINESS USERS**

- 3.7 Business users have a net benefit of £125.6m. This comprises £238.4m of travel time savings and £5.2m of VOC savings which are then offset by £117.9m of additional user charges. In contrast to the consumer user benefits, the business road users value their time savings at a greater level and hence these alone outweigh the additional cost of the congestion charging tolls (£123.9m versus £118.1m). Additionally there are small VOC savings to Business road users.
- 3.8 The net benefit to business road users is supplemented by net benefits for public transport business users of £54.1m (split across bus, rail and park and ride) plus £60.6m for business time savings due to the walk, cycle and smarter choices measures.

### **RESULTS: PRIVATE SECTOR PROVIDERS**

- 3.9 The private sector providers represent the public transport operators. Across the three PT modes the operators would have an increase in revenue of £457.2m offset by £363.4m of additional operating costs and £93.8m of investment costs primarily in the form of new buses. The net effect is a very small positive benefit of £0.06m.

### **OTHER BUSINESS IMPACTS**

- 3.10 The other business impacts represent the developer contributions that would accrue to local government. These represent a negative PVB of -£60.7m to business. It should be emphasised that this dis-benefit would accrue to developers as distinct to private sector operators.

### **SUMMARY**

- 3.11 The overall Present Value of Benefits from the TEE table is positive at £870.0m.
- 3.12 The PVB from the TEE table excludes other sources of benefit as detailed in Section 1 of this document. These sources include accident benefits, carbon benefits, noise benefits and air quality benefits. These benefits are evaluated separately where possible and are incorporated into the Analysis of Monetised Costs and Benefits Table (AMCB) which is presented below.

## Transport Economic Efficiency Benefits

### Consumers

	ALL MODES TOTAL
User Benefits	1,380,596
Travel Time	1,380,596
Vehicle Operating Costs	70,790
User Charges	-646,404
During Construction & Maintenance	0
<b>NET CONSUMER BENEFITS</b>	<b>804,982</b>

(1)

Road	Road Pricing	HQPT	Bus	Rail	Park & Ride	Walk, Cycle & Smarter Choices
177,404	0	0	366,497	265,845	47,450	523,400
70,790	0	0	0	0	0	0
-658,525	0	0	3,393	5,056	3,672	0
0	0	0	0	0	0	0
-410,331	0	0	369,890	270,901	51,122	523,400

### Business

User Benefits	238,363
Travel Time	238,363
Vehicle Operating Costs	5,182
User Charges	-117,934
During Construction & Maintenance	0
<b>Subtotal</b>	<b>125,611</b>

(2)

Personal	Freight	Personal	Freight	Personal	Freight	Personal	Freight	Personal	Freight	Personal	Freight	Personal	Freight
78,159	45,713			0	0	28,927	0	23,254	0	1,710	0	60,600	0
3,593	1,589			0	0	0	0	0	0	0	0	0	0
-58,797	-59,310			0	0	47	0	131	0	-5	0	0	0
0	0			0	0	0	0	0	0	0	0	0	0
22,955	-12,008	0	0	0	0	28,974	0	23,385	0	1,705	0	60,600	0

### Private Sector Provider Impacts

Revenue	457,248
Operating Costs	-363,388
Investment Costs	-93,797
Grant/Subsidy	0
<b>Subtotal</b>	<b>64</b>

(3)

0	0	0	138,019	275,890	43,339	0
0	0	-106,064	-191,695	-17,899	-47,730	0
0	0	-32,047	-40,583	0	-21,167	0
0	0	0	0	0	0	0
0	0	-138,111	-94,259	257,992	-25,558	0

### Other Business Impacts

Developer Contributions	-60,692
<b>NET BUSINESS IMPACT</b>	<b>64,983</b>

(4)

(5) = (2) + (3) + (4)

-10,572	-2,997	-22,678	-3,228	-3,840	-9,693	-7,684
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### TOTAL

Present Value of Transport Economic Efficiency Benefits	869,965
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(6) = (1) + (5)

## 4. Public Accounts Table

### STRUCTURE OF THE PUBLIC ACCOUNTS TABLE

- 4.1 The Public Accounts (PA) table is output directly by the TUBA assessment and is not subject to any alteration due to 'offline' analysis. In particular it should be noted that the costs associated with WCS have been included in the cost estimates and are presented within the analysis for the separate WCS 'mode'. This is in contrast to the assessment of WCS benefits which have been calculated offline and were incorporated into the TEE separately following the TUBA model run.
- 4.2 Similarly the costs of the Congestion Charging Scheme as opposed to the other road schemes in the Package and the costs of the High Quality PT (HQPT) schemes as opposed to other PT scheme costs are identified separately<sup>7</sup>.
- 4.3 Within the PA table all costs are presented as positive values. Any negative costs, such as revenues to providers, can therefore be viewed as 'benefits'. Furthermore it should be stressed that all costs and benefits referred to in this section are expressed in terms of 2002 prices and present values, and should not be viewed as real 'cash' values.

### LOCAL GOVERNMENT FUNDING

- 4.4 With regard to local government funding the Package is forecast to provide revenue of £730.5m in the form of congestion charging tolls from road users. This is offset by Local Government's share of operating costs of £397.0m and investment costs of £57.2m (10% of the total investment cost for the Package). In this context operating costs include; annual maintenance, annual operating costs and whole life renewal costs associated with all of the Transport Improvements schemes as well as the Congestion Charging Scheme<sup>8</sup>. It is assumed that the Local Government investment cost will be offset by developer contributions; hence the net impact of local government funding will be a negative cost (a 'benefit') of over £330m in the form of congestion charging toll revenue<sup>9</sup>.

### CENTRAL GOVERNMENT FUNDING

- 4.5 The impact on central government funding would comprise three elements:

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<sup>7</sup> by defining cost-only modes in the TUBA analysis.

<sup>8</sup> As a conservative estimate, all costs associated with the congestion charging scheme have optimism bias applied to them.

<sup>9</sup> In reality it is anticipated that the developer contributions will exactly offset the Local Government investment costs, resulting in a net benefit of £333.5m. However, due to limitations in the way TUBA deals with temporal cost profiles, it has not been possible to show this. Instead the Local Government investment costs are underestimated by £3.5m, with a balancing overestimate of investment costs elsewhere. The scheme NPV is unaffected by this shortcoming.

- ◆ Operating Costs: These comprise the set up costs for the smart card ticketing systems at £5.0m.
- ◆ Investment Costs: This represents central government's assumed 90% share of investment costs at £514.5m.
- ◆ Indirect Tax Revenue: This represents the taxation impact to government. The net value is a cost of £134.9m which is composed primarily of £85.4m of lost revenue from fuel taxation due to the reduction in road traffic from the Package.

4.6 The net impact to Central Government funding is a cost of £654.3m.

*Net Impact*

4.7 The overall impact on both central and local government is a PVC of £317.3m.

**Public Accounts**

Local Government Funding	All modes
Revenue	-730,512
Operating costs	396,993
Investment costs	57,166
Developer Grant/Subsidy	-60,691
NET IMPACT	<b>-337,044</b>

Road	Road Pricing	HQPT	Bus	Rail	Park & Ride	Walk, Cycle & Smart Choices
-730,512	0	0	0	0	0	0
32,081	273,678	11,379	1,729	9,171	45,473	23,482
10,572	2,997	21,120	2,175	3,840	8,782	7,681
-10,572	-2,997	-22,678	-3,228	-3,840	-9,693	-7,684
0	0	0	0	0	0	0
<b>-698,431</b>	<b>273,678</b>	<b>9,821</b>	<b>676</b>	<b>9,171</b>	<b>44,562</b>	<b>23,479</b>

Central Government Funding	All modes
Revenue	0
Operating costs	4980
Investment costs	514496
Developer Grant/Subsidy	0
Indirect tax	134,856
NET IMPACT	<b>654,332</b>

Road	Road Pricing	HQPT	Bus	Rail	Park & Ride	Walk, Cycle & Smart Choices
0	0	0	0	0	0	0
0	0	1,672	1,664	0	1,644	0
95,144	26,972	190,083	19,572	34,557	79,038	69,129
0	0	0	0	0	0	0
0	0	0	0	0	0	0
85,395	0	0	23,443	18,638	7,380	0
<b>180,539</b>	<b>26,972</b>	<b>191,755</b>	<b>44,679</b>	<b>53,195</b>	<b>88,062</b>	<b>69,129</b>

<b>Total</b>	
TOTAL Present Value	<b>317,288</b>

## 5. Analysis of Monetised Costs and Benefits

### STRUCTURE OF THE ANALYSIS OF MONETISED COSTS AND BENEFITS TABLE

- 5.1 The AMCB table presents a combination of information presented in the TEE and PA tables, supplemented with other estimates of benefits which otherwise would not be included in the TUBA calculations. Consequently the table has been amended from that output by the TUBA assessment with the addition of new elements to account for accident benefits, air quality benefits and noise benefits. In addition the effects associated with WCS and also the Chesterton Station scheme, which have been evaluated offline, are also included.
- 5.2 It should be stressed that all costs and benefits referred to in this section are expressed in terms of 2002 prices and present values, and should not be viewed as real 'cash' values.

### NON-EXCHEQUER IMPACTS

- 5.3 These are as detailed in the TEE table.

### ADDITIONAL BENEFITS

- 5.4 Carbon benefits, representing the monetised valuation of the reduction of green house gases due to the Package have been estimated by TUBA at -£3.5m. It is arguable that this small difference between a large benefit in the morning peak and dis-benefit in the interpeak is not significant and instead figures from a specialist environmental assessment of air quality impacts should be used when available.
- 5.5 The additional benefits calculated separately to the TUBA assessment are:
- ◆ Accidents: Changes in accident numbers have been assessed using a spreadsheet based approach to evaluate changes in veh-km totals for different road types. The benefits have been monetised in accordance with TAG guidance at £95.8m;
  - ◆ Walk and Cycle Strategy (WCS): The benefits associated with these measures have been assessed in accordance with TAG guidance. The costs of WCS measures are included in the scheme cost profiles input into TUBA. The values are consistent with those incorporated in the TEE table;
- 5.6 Noise and Air Quality Benefits were not available for inclusion in this submission. A revision including these benefits (anticipated to be a small proportion of the overall total) will be provided.
- 5.7 The additional benefits include accident benefits of £95.8m and carbon benefits of -£3.5m. Noise benefits and more accurate air quality benefits have also been

calculated but are currently the subject of a review and as such are not included here. It is intended that these will be included in any revision to this submission.

- 5.8 The impact of the additional benefits is to increase the net present value of benefits to £962.3m.

#### *Costs*

- 5.9 The net present value of costs is as reported in the PA table at £317.3m.

#### *Summary*

- 5.10 Comparing the PVB against the PVC provides a net present value (NPV) of £645.0m, with a benefit to cost ratio (BCR) of 3.03.

### Analysis of Monetised Costs and Benefits

	PT	Road	Walking, Cycling and Smarter Choices	Total
<b>Non-Exchequer Impacts</b>				
Consumer User Benefits	691,913	-410,331	523,400	804,982
Business User Benefits	54,064	10,947	60,600	125,611
Private Sector Provider Impacts	64	0	0	64
Other Business Impacts	-39,439	-13,569	-7,684	-60,692
<b>Additional Benefits</b>				
Accident Benefits	0	95,821	0	95,821
Carbon Benefits	0	-3,518	0	-3,518
Air Quality Benefits	0	0	0	0
Noise Benefits	0	0	0	0
<b>Net present Value of Benefits (PVB)</b>	<b>706,602</b>	<b>-320,650</b>	<b>576,316</b>	<b>962,268</b>
Local Government Funding	64,230	-424,753	23,479	-337,044
Central Government Funding	377,691	207,511	69,129	654,331
<b>Net present Value Costs (PVC)</b>	<b>441,921</b>	<b>-217,242</b>	<b>92,608</b>	<b>317,287</b>
<b>Overall Impact</b>				
Net present Value (NPV)	264,681	-103,408	483,708	<b>644,981</b>
Benefit to Cost Ratio (BCR)				<b>3.03</b>

## 6. Sensitivity Tests

6.1 Sensitivity tests have been undertaken regarding the following elements of the appraisal:

- ◆ Congestion Charging Scheme only sensitivity test;
- ◆ Comparison of income segmented and non-income segmented results.

6.2 The specification for these tests and the results from them are reported below in turn.

### CONGESTION CHARGING ONLY

#### Test Specification

6.3 With fixed land use assumptions, both the Strategic Transport Model and Local Highway Model were run assuming only the congestion charging scheme was implemented. All additional transport improvements have been omitted from the tests and the model outputs passed to TUBA for appraisal.

6.4 Additional off-line benefits from Walking, Cycling and Smarter Choices and from the Chesterton Station Scheme are not included.

6.5 The results are presented below.

#### Transport Economic Efficiency

6.6 The TEE table is based directly on the TUBA output. The table has been expanded for consistency with the Package appraisal. Again, all costs and benefits referred to in this section are expressed in terms of 2002 prices and present values, and should not be viewed as real 'cash' values.

6.7 The headline results for consumers is that the Congestion Charging scheme would provide a negative PVB of -£613.3m. The primary differences with the Package results are the absence of the £527m of WCS consumer benefits and also the substantial PT consumer benefits resulting from the Package. Road consumer users would pay £686.3m in user charges (congestion charging tolls) which would be slightly offset by the value of time saving benefits (£32.8m) and vehicle operating cost savings (£40.4m). In simple terms the value of the congestion charging toll that the consumer users would pay is more than the valuation by those users of the resulting time and operating cost savings.

6.8 Business users have a net dis-benefit of -£41.6m. This comprises of £69.3m of travel time savings and £4.6m of VOC savings which are then offset by £115.5m of additional user charges. The extent to which business users lose out in the trade-off between savings and charges is far less than for consumer users. This trend is consistent with the Package results.

6.9 The position for road users appears far worse than in the Package as the user charges are slightly greater while the user benefits are far less. This is consistent with the reduced alternatives offered in the Congestion Charging only scenario,

resulting in more traffic – hence more charges – and more congestion – hence less time and VOC savings.

- 6.10 Private sector providers represent the public transport operators. Across the three PT modes the operators would have an increase in revenue of £143.0m caused by additional passengers avoiding the Congestion Charging scheme. Fare rates and operating costs do not change.
- 6.11 There are developer contributions towards the Congestion Charging scheme of £3.0m.
- 6.12 For the Congestion Charging only scheme the overall Present Value of Benefits from the TEE table is negative at -£514.8m.

**Transport Economic Efficiency Benefits**

**Consumers**

**User Benefits**

Travel Time	32,770
Vehicle Operating Costs	40,358
User Charges	-686,386
During Construction & Maintenance	0

ALL MODES
TOTAL
32,770
40,358
-686,386
0
-613,258

(1)

Road	Road Pricing	HQPT	Bus	Rail	Park & Ride	Walk, Cycle & Smarter Choices
32,770	0	0	0	0	0	0
40,358	0	0	0	0	0	0
-686,386	0	0	0	0	0	0
0	0	0	0	0	0	0
-613,258	0	0	0	0	0	0

**Business**

**User Benefits**

Travel Time	69,326
Vehicle Operating Costs	4,586
User Charges	-115,468
During Construction & Maintenance	0
<b>Subtotal</b>	<b>-41,556</b>

69,326
4,586
-115,468
0
-41,556

(2)

Personal	Freight	Personal	Freight	Personal	Freight	Personal	Freight	Personal	Freight	Personal	Freight	Personal	Freight
49,145	20,181			0	0	0	0	0	0	0	0	0	0
3,342	1,244			0	0	0	0	0	0	0	0	0	0
-56,111	-59,357			0	0	0	0	0	0	0	0	0	0
0	0			0	0	0	0	0	0	0	0	0	0
-3,624	-37,932	0	0	0	0	0	0	0	0	0	0	0	0

**Private Sector Provider Impacts**

Revenue	143,048
Operating Costs	0
Investment Costs	0
Grant/Subsidy	0
<b>Subtotal</b>	<b>143,048</b>

143,048
0
0
0
143,048

(3)

0	0	67,582	42,260	33,206	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	67,582	42,260	33,206	0	0

**Other Business Impacts**

Developer Contributions

-2,997
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-2,997
--------

(4)

0	-2,997	0	0	0	0	0
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**NET BUSINESS IMPACT**

98,495
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(5) = (2) + (3) + (4)

**TOTAL**

Present Value of Transport Economic Efficiency Benefits

-514,763
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(6) = (1) + (5)

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

## Public Accounts

- 6.13 The Public Accounts (PA) table is output directly by the TUBA assessment and is not subject to any alteration due to 'offline' analysis. The table has been expanded for consistency with the Package appraisal. Within the PA table all costs are presented as positive values. Any negative costs, such as revenues to providers, can therefore be viewed as 'benefits'. Again, all costs and benefits referred to in this section are expressed in terms of 2002 prices and present values, and should not be viewed as real 'cash' values.
- 6.14 With regard to local government funding the package is forecast to provide revenue of £759.3m in the form of congestion charging tolls from road users, slightly more than in the Package owing to the slightly greater number of users. This revenue is offset by Local Government's share of operating costs<sup>10</sup> of £273.7m and investment costs of £3.0m (10% of the investment cost for the Congestion Charging scheme). It is assumed that this latter cost element will be offset by developer contributions; hence the net impact on local government funding will be a negative cost (a 'benefit') of £485.6m in the form of congestion charging toll revenue.
- 6.15 The impact on central government funding comprises two elements:
- ◆ Investment Costs: This represents central government's assumed 90% share of investment costs at £27.0m.
  - ◆ Indirect Tax Revenue: This represents the taxation impact to government. The net value is a cost of £90.9m, primarily due to lost revenue from fuel taxation (£66.5m) owing to the reduction in road traffic compared to the Reference Case<sup>11</sup>. This is a smaller loss than in the Package owing to the scheme's reduced impact on the level of traffic.
- 6.16 The net impact to central government funding is a cost of £117.9m.
- 6.17 The overall impact on both central and local government is a negative PVC (a benefit) of £367.7m.

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<sup>10</sup> As a conservative estimate all costs associated with the Congestion Charging Scheme have optimism Bias Applied.

<sup>11</sup> there are indirect tax impacts for the PT modes also. This is due to increased fare revenues, which do not incur VAT – and the implied reduction in VAT takings compared to this money being spent on VAT rated goods or services.

**Public Accounts**

Local Government Funding	All modes
Revenue	-759,280
Operating costs	273,678
Investment costs	2,997
Developer	-2,997
Grant/Subsidy	0
<b>NET IMPACT</b>	<b>-485,602</b>

Road	Road Pricing	HQPT	Bus	Rail	Park & Ride	Walk, Cycle & Smart Choices
-759,210	0	0	0	0	-70	0
0	273,678	0	0	0	0	0
0	2,997	0	0	0	0	0
0	-2,997	0	0	0	0	0
0	0	0	0	0	0	0
<b>-759,210</b>	<b>273,678</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>-70</b>	<b>0</b>

Central Government Funding	All modes
Revenue	0
Operating costs	0
Investment costs	26,972
Developer	0
Grant/Subsidy	0
Indirect tax	90,910
<b>NET IMPACT</b>	<b>117,882</b>

Road	Road Pricing	HQPT	Bus	Rail	Park & Ride	Walk, Cycle & Smart Choices
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	26,972	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
66,475	0	11,519	7,222	5,694	0	0
<b>66,475</b>	<b>26,972</b>	<b>11,519</b>	<b>7,222</b>	<b>5,694</b>	<b>0</b>	<b>0</b>

<b>Total</b>	
TOTAL Present Value	<b>-367,720</b>

## Analysis of Monetised Costs and Benefits

- 6.18 The AMCB table presents a combination of information presented in the TEE and PA tables, supplemented with other estimates of benefits which otherwise would not be included in the TUBA calculations. Consequently the table has been amended from that output by the TUBA assessment with the addition of new elements to account for 'carbon benefits' and accident benefits.
- 6.19 Again, costs and benefits referred to in this section are expressed in terms of 2002 prices and present values, and should not be viewed as real 'cash' values.
- 6.20 Non-Exchequer Impacts are as detailed in the TEE table.
- 6.21 The additional benefits in the AMCB table comprise:
- ◆ Carbon benefits, representing the monetised valuation of the reduction of green house gases due to the Package have been estimated by TUBA at -£6.8m. It is arguable that this small difference between a large benefit in the morning peak and dis-benefit in the interpeak is not significant and instead figures from a specialist environmental assessment of air quality impacts should be used when available.
  - ◆ Accidents: Changes in accident numbers have been assessed using a spreadsheet based approach to evaluate changes in veh-km totals for different road types. The figure of £95.8m quoted here is an overestimate as it is based on the traffic impacts of the Package, pending more accurate calculation for the Congestion Charging only scenario.
- 6.22 As with the Package appraisal additional noise benefits are not currently included while any Wider Economic Benefits should not be included in the assessment here. WCS benefits are of course omitted, as in the TEE table.
- 6.23 The impact of the additional benefits is to increase the net present value of benefits to -£425.7m. This value is negative and hence can be viewed as a 'cost'.
- 6.24 The net present value of costs is as reported in the PA table at -£367.7m. This too is negative and can be viewed as a 'benefit'.
- 6.25 Comparing the PVB against the PVC provides a net present value (NPV) of (minus) £58.0m. The benefit to cost ratio is in this instance not a useful measure owing to the negative numbers.

### Analysis of Monetised Costs and Benefits

	PT	Road	Walking, Cycling and Smarter Choices	Total
<b>Non-Exchequer Impacts</b>				
Consumer User Benefits	0	-613,258	0	-613,258
Business User Benefits	0	-41,556	0	-41,556
Private Sector Provider Impacts	143,048	0	0	143,048
Other Business Impacts	0	-2,997	0	-2,997
<b>Additional Benefits</b>				
Accident Benefits	0	95,821	0	95,821
Carbon Benefits	0	-6,777	0	-6,777
Air Quality Benefits	0	0	0	0
Noise Benefits	0	0	0	0
<b>Net present Value of Benefits (PVB)</b>	<b>143,048</b>	<b>-568,767</b>	<b>0</b>	<b>-425,719</b>
Local Government Funding	-70	-485,532	0	-485,602
Central Government Funding	24,435	93,447	0	117,882
<b>Net present Value Costs (PVC)</b>	<b>24,365</b>	<b>-392,085</b>	<b>0</b>	<b>-367,720</b>
<b>Overall Impact</b>				
Net present Value (NPV)	118,683	-176,682	0	<b>-57,999</b>
Benefit to Cost Ratio (BCR)				<b>1.16</b>

## INCOME SEGMENTED APPRAISAL

### Test Specification

- 6.26 The test is identical to the central Package appraisal except that different values of time have been used to appraise the value of time savings, according to the household income of the users concerned. Note that the demand modelling from which the TUBA inputs have been derived is unchanged – different values of time have been assumed for the different income groups throughout the modelling process; it is only in the central case appraisal that values of time are assumed not to vary by income group, in line with WebTAG guidance.
- 6.27 The format of the output tables and the components they include are exactly as discussed for the central case economic assessment already presented. The following sections therefore concentrate solely on the output values and how they compare with the non-income segmented appraisal.
- 6.28 Once again, note that all costs and benefits referred to in this section are expressed in terms of 2002 prices and present values, and should not be viewed as real ‘cash’ values.

### *Transport Economic Efficiency*

- 6.29 The headline results for consumer users are that the Package would provide a positive PVB of £791.0m. However the separate WCS analysis provides a contribution of £523.4m of benefit to this value, and hence the level of PVB for consumer users excluding WCS would be £267.6m. This is marginally less than in the non-income segmented central case.
- 6.30 These figures include benefits for PT consumers and dis-benefits for highway consumers. This reflects the user charges which are treated as a dis-benefit and offset the value of time saving benefits and vehicle operating cost savings.
- 6.31 Public transport consumer user benefits of £691.9m are unchanged from the central case, as it assumed the value of time for PT consumer users does not vary by income; values are taken from WebTAG 3.5.6 Table 2.
- 6.32 Business users have a net benefit of £158.1m. This comprises of £270.8m of travel time savings and £5.2m of VOC savings which are then offset by £117.9m of additional user charges. These results represent a 26% increase in net Business user benefits compared to the non-income segmented central case.
- 6.33 In contrast to the consumer user benefits, the business road users value their time savings at a greater level and hence these alone outweigh the additional cost of the congestion charging tolls (£147.0m versus £118.1m). Additionally there are small VOC savings to Business road users.

- 6.34 The net benefit to business road users is supplemented by net benefits for public transport business users of £63.4m (split across bus, rail and park and ride) plus £60.6m for business time savings due to the walk, cycle and smarter choices measures. Rail business user benefits are unchanged from the central case, using constant values of time from WebTAG 3.5.6 Table 1. Bus and Park & Ride business users are appraised as having significantly greater time savings in the income segmented case, owing to the use of “PSV Passenger” income segmented values of time from WebTAG 3.12.2 Table A4.
- 6.35 There are no differences between the income segmented test and the central case in terms of private sector provider impacts and developer contributions.
- 6.36 The overall Present Value of Benefits from the TEE table is positive at £888.5m, some 1% greater than in the non-income segmented central case. This includes a 1% fall in the valuation of consumer time savings and a 14% increase in the valuation of business time savings.

## Transport Economic Efficiency Benefits

### Consumers

#### User Benefits

ALL MODES TOTAL
Travel Time
Vehicle Operating Costs
User Charges
During Construction & Maintenance

#### NET CONSUMER BENEFITS

1,366,654
70,790
-646,404
0
791,040

(1)

Road	Road Pricing	HQPT	Bus	Rail	Park & Ride	Walk, Cycle & Smarter Choices
163,462	0	0	366,497	265,845	47,450	523,400
70,790	0	0	0	0	0	0
-658,525	0	0	3,393	5,056	3,672	0
0	0	0	0	0	0	0
-424,273	0	0	369,890	270,901	51,122	523,400

### Business

#### User Benefits

Travel Time
Vehicle Operating Costs
User Charges
During Construction & Maintenance
Subtotal

270,821
5,182
-117,934
0
158,069

(2)

Personal	Freight	Personal	Freight	Personal	Freight	Personal	Freight	Personal	Freight	Personal	Freight	Personal	Freight
76,707	70,313			0	0	37,696	0	23,254	0	2,251	0	60,600	0
3,593	1,589			0	0	0	0	0	0	0	0	0	0
-58,797	-59,310			0	0	47	0	131	0	-5	0	0	0
0	0			0	0	0	0	0	0	0	0	0	0
21,503	12,592	0	0	0	0	37,743	0	23,385	0	2,246	0	60,600	0

### Private Sector Provider Impacts

Revenue
Operating Costs
Investment Costs
Grant/Subsidy
Subtotal

457,248
-363,388
-93,797
0
64

(3)

0	0	0	138,019	275,890	43,339	0
0	0	-106,064	-191,695	-17,899	-47,730	0
0	0	-32,047	-40,583	0	-21,167	0
0	0	0	0	0	0	0
0	0	-138,111	-94,259	257,992	-25,558	0

### Other Business Impacts

#### Developer Contributions

-60,692
---------

97,441
--------

(4)

(5) = (2) + (3) + (4)

-10,572	-2,997	-22,678	-3,228	-3,840	-9,693	-7,684
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### TOTAL

Present Value of Transport Economic Efficiency Benefits

888,481
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(6) = (1) + (5)

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

### **Public Accounts**

- 6.37 The introduction of income segmentation to the appraisal of the Package has no impact on the scheme costs. Consequently the PA table is not reproduced below.

### **Analysis of Monetised Costs and Benefits**

- 6.38 The appraisal of the Non-Exchequer Impacts has been addressed by the above commentary of the TEE table. Differences are limited to the valuation of time savings.
- 6.39 The test is no different from the central case in terms of the valuation of Additional Benefits. In consequence the overall Package Present Value of Benefits is £980.8m, 2% greater than in the non-income segmented central case.
- 6.40 The net present value of costs remains as reported for the central case at £317.3m. Comparing the PVB against the PVC provides a net present value (NPV) of £663.5m, with a benefit to cost ratio (BCR) of 3.09. This is £18.5m greater than the central case (for which the equivalent BCR is 3.03).

### Analysis of Monetised Costs and Benefits

	PT	Road	Walking, Cycling and Smarter Choices	Total
<b>Non-Exchequer Impacts</b>				
Consumer User Benefits	691,913	-424,273	523,400	791,040
Business User Benefits	63,374	34,095	60,600	158,069
Private Sector Provider Impacts	64	0	0	64
Other Business Impacts	-39,439	-13,569	-7,684	-60,692
<b>Additional Benefits</b>				
Accident Benefits	0	95,821	0	95,821
Carbon Benefits	0	-3,518	0	-3,518
Air Quality Benefits	0	0	0	0
Noise Benefits	0	0	0	0
<b>Net present Value of Benefits (PVB)</b>	<b>715,912</b>	<b>-311,444</b>	<b>576,316</b>	<b>980,784</b>
Local Government Funding	64,230	-424,753	23,479	-337,044
Central Government Funding	377,691	207,511	69,129	654,331
<b>Net present Value Costs (PVC)</b>	<b>441,921</b>	<b>-217,242</b>	<b>92,608</b>	<b>317,287</b>
<b>Overall Impact</b>				
Net present Value (NPV)	273,991	-94,202	483,708	<b>663,497</b>
Benefit to Cost Ratio (BCR)				<b>3.09</b>