

Croxley Rail Link

Economic Appraisal

Report

September 2011

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1 Introduction

Background

- 1.1 The Croxley Rail link is a major transport project that will achieve a range of transport, economic and regeneration objectives in Watford and the wider county of Hertfordshire. The project will improve accessibility, encourage the use of sustainable modes, reduce congestion, improve the quality of transport interchange and generate significant savings in journey times for a large number of new and existing users. The project requires public funding to be delivered and assessing the scale of benefits against the costs is critical to the overall appraisal of the project to ensure value for public money and to secure funding.
- 1.2 The project was last assessed in the 2009 Major Scheme Business Case (MSBC) Submission, in which it was estimated to provide a Net Present Value (NPV) of £193.6m and a Benefit Cost Ratio (BCR) of 2.55:1. This report provides an updated cost-benefit analysis of the project, incorporating the changes to costs and benefits that have occurred throughout the Best and Final Funding Bid (BAFB) Process, as well as the technical modelling and appraisal updates required by the Department for Transport (DfT).

Objectives

- 1.3 The objectives of this report are:
- To explain the methodology used to carry out the cost-benefit analysis detailing all relevant assumptions.
 - To document the costs of each option used in appraisal, the assumed spend profile, inflation and the level of quantified risk and optimism bias applied to project costs.
 - To explain the results of the cost-benefit analysis including the impacts on consumer and business users, public accounts and other groups.
 - To examine the sensitivity of the economic case to key assumptions and risks through sensitivity tests.

Report Structure

- 1.4 The rest of this report is structured as follows:
- Section 2 - **Scenario Description and Costs**- provides a description of the Do Minimum and Do Something scenario used in the appraisal, and the associated capital and operating costs;
 - Section 3 - **Benefit Assessment** - provides a description of the methodology and assumptions used to appraise the economic benefits of the project;
 - Section 4 - **Cost-Benefit Analysis** - provides the results of the cost-benefit analysis including the Transport Economic Efficiency, Public Accounts, and Analysis of Monetised Cost and Benefits tables;
 - Section 5 - **Sensitivity Tests** - provides the results of a range of sensitivity tests on the results of the cost-benefit analysis.
- 1.5 The report is accompanied by the full appraisal model and TUBA files which have been provided separately.

2 Scenario Description & Costs

Overview

- 2.1 The DfT's Transport Appraisal Guidance (WebTAG) methodology has been applied to assess the economic benefits of the project. This process has involved several steps:
- Modelling and comparing the “Do Something” preferred option scenario against the “Do-Minimum” scenario;
 - Estimating the capital and operating costs of the project based on a detailed design and quantity assessment;
 - Using TUBA v1.8 to assess the impacts of the project on business and consumer user benefits;
 - Using a spread sheet model to appraise the capital and operating costs, and non-user benefits including:
 - Reduced accidents;
 - Reduced noise;
 - Reduced congestion;
 - Reduced greenhouse gasses and vehicle emissions;
 - Reduced infrastructure costs;
 - Non-use and option values; and
 - Using a suite of spread sheet models and stop to stop fare matrix to analyse changes in fare revenue across different services.

Scenario Descriptions

Do Minimum

- 2.2 The Do Minimum scenario involves a theoretical future service pattern at Watford Metropolitan of 6 trains per hour in the peak and 4 trains per hour in the interpeak which reflect the most likely future service pattern following the Metropolitan Line route enhancement and subsequent revision of services. Sensitivity tests have been undertaken to show the economic case with alternative Do Minimum scenarios including:
- The continuation of existing LUL underground peak service to Watford Metropolitan station at the current levels of frequency with an average 7 trains per hour and LUL's planned reduction in off peak services to 4 trains per hour.
 - 8 trains per hour in the peak and 4 trains per hour in the interpeak; and
 - 10 trains per hour in the peak and 4 trains per hour in the interpeak.

Preferred Option - The Croxley Rail Link

- 2.3 The preferred option involves the closure of Watford Metropolitan station to passenger services and the creation of two new stations; Ascot Road and Watford Hospital. The project will reinstate the Croxley Green rail alignment, linking services from Croxley station to Watford High Street station and on to Watford Junction. All Do Minimum services will be diverted to Watford Junction, our central estimate provides a frequency of 6 trains per hour in the peak and 4 per hour in the off peak. Sensitivity tests have been undertaken based on the alternative frequencies described above.

Capital Costs

2.4 The scope of work required to deliver the Croxley Rail link includes the following:

- A viaduct and embankment linking the current Metropolitan Line 1.3km south of the existing Watford terminus to the disused rail alignment between Croxley and Watford High Street;
- Reinstatement of double track on the disused Croxley alignment, including a new junction with the Watford junction to London Euston DC route at Watford High Street;
- Work to bring the bridges, cuttings and embankments on the disused Croxley alignment into operational use;
- New stations at Ascot Road and Watford General Hospital; and
- An additional rolling stock unit to deliver the extended services.

2.5 The scheme costs also include other items including land acquisition, design and construction of the viaduct, new stations, and the purchase of the rolling stock. Table 2.1 presents the costs in 2011 prices showing the changes between MSBC and BAFB. These figures represent the 'base' costs and exclude VAT and optimism bias. The risk allowance is included in the table and is estimated at £5.1m, a significant reduction on the previous estimates.

TABLE 2.1 CONSTRUCTION COST SUMMARY (£000s, 2011 PRICES)

	MSBC (@2007)	MSBC (@2011)	BAFB (@2011)	Increase / Saving
Infrastructure costs	£51,873	£57,060	£65,895	£8,835
Preliminaries	£11,023	£12,125	£10,320	-£1,805
Profit and overhead	£4,717	£5,189	£2,965	-£2,224
Design	£4,000	£4,400	£3,300	-£1,100
Project Management	£3,354	£3,690	£2,150	-£1,540
Assurance	£1,887	£2,076	£500	-£1,576
Third Party Costs	£7,781	£8,559	£0	-£8,559
Possession Costs	£500	£550	£540	-£10
Land costs	£2,500	£2,750	£4,240	£1,490
Land transfer from BRB	£1,500	£1,650	£0	-£1,650
Other service costs to TWA	£1,000	£1,100	£0	-£1,100
LRVs	£8,301	£9,132	£9,000	-£132
Third Party Compensation	£250	£275	£160	-£115
Monitoring and Evaluation	£426	£468	£200	-£268
Quantified Risk Assessment	£12,700	£13,970	£5,100	-£8,870
Total Capital Costs	£111,813	£122,994	£104,370	-£18,624

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2.6 Overall the capital cost of the project is estimated at £104.4m. These costs will be incurred over several years between 2012 and 2016. As a result prices will rise from the current estimate due to inflation.

Inflation Assumptions

2.7 For RPI inflation we have used the latest estimates from the Treasury. For construction costs we have used estimates from the Franklin & Andrews Rail Tender Indices. Our inflation assumptions from 2012 to 2017 and onwards are shown in Table 2.2.

TABLE 2.2 INFLATION ASSUMPTIONS

Index	2012	2013	2014	2015	2016	2017 - On
RPI Index ^{1&2}	243	251	259	267	274	-
RPI % Change ^{1&2}	3.4%	3.1%	3.3%	3.2%	2.5%	2.5%
Station & Civils ³	2.0%	4.3%	4.9%	5.0%	4.9%	2.5%
Permanent Way ³	1.9%	4.5%	5.5%	5.6%	5.7%	2.5%
Electrification ₃	2.2%	4.4%	5.5%	5.6%	5.6%	2.5%
Signalling ³	2.5%	4.5%	5.5%	5.5%	5.5%	2.5%
Telecomms ³	2.6%	4.6%	5.5%	5.5%	5.5%	2.5%
Rail Tender Index ³	2.4%	4.3%	5.2%	5.2%	5.0%	2.5%
Fares ⁴	6.4%	6.1%	4.3%	4.2%	3.5%	3.5%

¹ ONS RP02 Table July 2011

² HM Treasury Forecasts for the UK economy: a comparison of independent forecasts (August 2011)

³ F&A Rail tender indices July 2011

⁴ Assumption based on the McNulty Review

2.8 The table shows that inflation across most items is lower than RPI in 2012. This implies a deflation in real costs related to the general decline in construction demand following the recession. After 2013 the indices increase above RPI implying real cost inflation. After 2017 we assume that inflation across all items converges to RPI. This assumption has a very limited impact of the level of project costs, as only a very small proportion of capital costs are incurred after 2016 when the link becomes operational. Table 2.3 shows the capital cost profile of the project and outturn cost in each year.

TABLE 2.3 CAPITAL COST PROFILE (% OF TOTAL)

Capital Costs	Total 2011 £k	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/ Onward
Infrastructure costs	£65,895	0%	10%	20%	30%	40%	0%	0%
Preliminaries	£10,320	0%	10%	20%	30%	40%	0%	0%
Profit and overhead	£2,965	0%	10%	20%	30%	40%	0%	0%
Design	£3,300	0%	10%	20%	30%	40%	0%	0%
Project Management	£2,150	0%	10%	20%	30%	40%	0%	0%
Assurance	£500	0%	10%	20%	30%	40%	0%	0%
Third Party Costs	£0	0%	10%	20%	30%	40%	0%	0%
Possession Costs	£540	0%	10%	20%	30%	40%	0%	0%
Land costs	£4,240	0%	10%	20%	20%	40%	10%	0%
Land transfer from BRB	£0	0%	10%	20%	20%	40%	10%	0%
Other service costs to TWA	£0	0%	10%	20%	20%	40%	10%	0%
LRVs	£9,000	0%	10%	20%	20%	40%	10%	0%
Third Party Compensation	£160	0%	0%	0%	0%	0%	40%	60%
Monitoring and Evaluation	£200	0%	0%	0%	0%	40%	10%	50%
Quantified Risk Assessment	£5,100	0%	10%	20%	29%	40%	1%	0%
Subtotal	£104,370	0	10,399	20,798	29,805	41,681	1,480	17
Outturn Costs	£116,812	0	10,612	22,119	33,243	48,783	1,798	257

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2.9 Based on the inflation assumptions and the cost profile we estimate that the project costs will inflate by around £12.4m in total. The total out-turn cost is therefore estimated at £116.8m including risk.

Capital Renewal Costs

2.10 It is assumed that the major civil engineering works will not require full renewal over the 60 year appraisal period. The structures & permanent way will require on-going maintenance, and this cost is included within the operating cost estimates.

Optimism Bias

2.11 The optimism bias on capital costs applied within the economic appraisal is 22%. The planning and design of the rail link has advanced from RIBA stage C and GRIP 3 for the London underground and Network Rail project sections respectively. This level of optimism bias is therefore believed to be appropriate considering the current stage of the project and has not changed from the MSBC submission.

Operating Costs

2.12 The estimated incremental increase in operating costs of the project are shown in Table 2.4. These costs relate to the incremental increase in the on-going cost of running the project including station staffing, maintenance and power relative to the current operational requirements. It includes the cost of operating additional train miles (it is further to Watford Junction than currently to Watford Met) and maintaining the additional infrastructure while also including the cost saving from removing services to Watford Met and closing the existing station. The largest component of the incremental operating costs is increased power and maintenance which equal £886k per year.

TABLE 2.4 INCREMENTAL OPERATING COST SUMMARY (£2011 PRICES)

Item	Preferred Option
Station Staffing	£173,269
Station Maintenance	£51,685
Energy	£16,800
Gateline	£39,628
Power/maintenance	£886,081
Train Operators	£109,814
Access charges for track	£64,181
Access charges for station	£325,621
Uniforms	£1,400
Total	£1,668,480

3 Benefit Assessment

Demand Modelling

- 3.1 The project has been modelled using CUBE Voyager software. It includes an AM and Inter-Peak period for the forecast years 2016 and 2031; time periods 0700-1000 and 1000-1400; and three user classes; business, consumer and other.
- 3.2 The demand forecasts are based upon a 2010 base year model that satisfies the DfT's validation criteria. The evidence and details of the model validation and the process and results of demand forecasting are provided in the accompanying Local Model Validation Report (LMVR) and Demand Modelling reports.
- 3.3 The model includes rail, bus and underground modes of travel. It does not include highway trips in assignment, however it does model mode split and highway abstraction effects. Trips are modelled as individual passenger movements and include multi leg journeys between different forms of public transport.
- 3.4 The base year (2010) travel demand matrix has been developed using data from ticket sales, LENNON data and station user surveys. Future year demand has been estimated using growth rates from the latest NTEM 6.2 population and employment forecasts.

Assumptions

Patronage Build Up

- 3.5 The Metropolitan Line currently serves Watford Metropolitan station and there is an existing patronage base. The project will create two new stations; Ascot Road and Watford Hospital and serve the existing stations at Watford High Street and Watford Junction. Most existing users will divert to use these stations following opening of the Croxley Rail Link and closure of Watford Metropolitan station. New users will be attracted to use the rail link because of the improved journey opportunities offered. New users will build up over time as awareness of the services increases. To account for this gradual change, we have applied a 'build up' factor to the new user modelled impacts between 2016 and 2020 (existing users are assumed to switch instantly). We have assumed that in the first four years of operation the new patronage of the service grows from 70% to 100% of the full modelled effect.

Appraisal Parameters

Within the TUBA model, all economic parameters have been set as standard and all users are classified as Light Rail passengers. This is a slight simplification as some of the trips within the model will actually use other modes, such as bus. The mode distinction only affects the value of time for business users and user surveys indicate that the number of such users travelling by bus is very small. The bus network has not been altered as part of the project and this assumption is therefore likely to have a minimal effect on the accuracy of the results. Table 3.1 provides a summary of the base value of times applied to each modelled user class.

TABLE 3.1 APPRAISAL USER CLASSES

User Class	Mode	Purpose	Value of Time (£/hour, 2002 prices)
1	Light Rail	Business	£29.74
2	Light Rail	Commuter	£5.04
3	Light Rail	Other	£4.46

Annualisation Factors

- 3.6 Annualisation factors were derived from Watford Metropolitan LUL and Watford High Street station usage data¹. This data contains information on weekday entries and exits by time period, weekend days and total demand. The data used to derive these factors are shown in Table 3.2.

TABLE 3.2 ANNUALISATION FACTORS

	Period	Station usage	Factor	Annual demand
Watford Met	AM Peak	1,673	442	738,760
	PM Peak	1,247	-	
	Interpeak	1,194	621	741,240
	Total		-	1,480,000
Watford High Street	AM Peak	655	553	362,043
	PM Peak	776	-	
	Interpeak	977	679	662,957
	Total		-	1,025,000

- 3.7 To derive annualisation factors we have assumed the AM peak forecasts are representative of both the weekday AM and PM peaks; all other time periods are assumed to be represented by the modelled interpeak period. For Watford Metropolitan, the observed average AM peak demand is 1,673 and total annual peak demand is 738,760. We therefore derive an annualisation factor for the AM peak forecasts of 442. The total annual Interpeak demand is 741,240 and the observed interpeak period demand is 1,194, thus an annualisation factor of 621 is derived.
- 3.8 The same process was applied to the Watford High Street data, yielding annualisation factors of 553 and 679 for the AM and Interpeak respectively.
- 3.9 It is expected that much of the existing demand at Watford Metropolitan station will transfer to the Croxley rail link via Ascot Road or Watford Hospital. However, the link will also serve Watford as an attractor, for employment, shopping and leisure purpose trips; this is the current role of London Overground services to Watford. On that basis, the demand patterns will, in part, come to reflect that of London Overground services and of

¹ Available at <http://www.tfl.gov.uk/tfl/corporate/modesoftransport/tube/performance/default.asp?onload=entryexit>

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Watford High Street in particular. On that basis, an average of the annualisation factors for the two stations was employed for the BAFB submission: 497 for the AM peak and 650 for the Interpeak.

Option and Non-Use Values

- 3.10 We have included an estimate of the option and non-use value generated by the project. Option values are related to the value that users place on having the option of travelling via a new transport service, even if they don't choose to use it on a regular basis. Non-Use values are related to the value that users place on a service being provided for others even if they choose not to use it. WebTAG unit 3.6.1 states that Option and Non-Use values are applicable to public transport projects which substantially change the availability of transport services within the study area. The Croxley Rail link will provide a significant improvement in access for central Watford and therefore we have included these benefits within the project appraisal. We have applied a combined option and non-use value of £170 (2010 values 2002 prices) per household gaining access to public transport.

Wider Economic Impacts

- 3.11 Wider economic impacts were assessed as part of the 2009 MSBC. A spreadsheet model was developed to appraise the impacts of the project on agglomeration, labour supply and imperfect competition benefits using the DfT guidance set out in WebTAG 3.5.14. We have assumed that the impacts will be similar as a proportion of the overall benefits for the BAFB submission. Wider Economic Impacts do not form part of the core appraisal, but have been included as a potential uplift.

Compliance with WebTAG

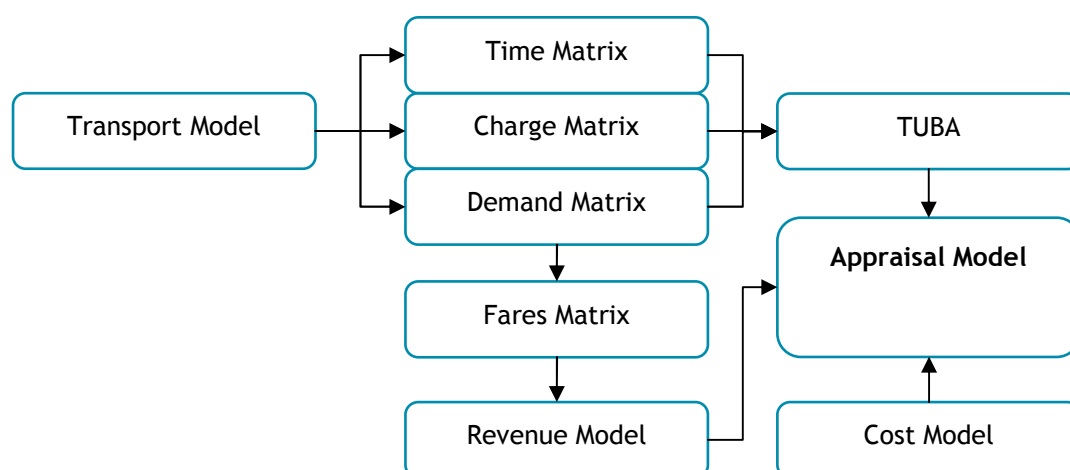
- 3.12 We have used the latest TUBA v1.8 economics file to appraise the economic benefits. The economic, scheme, and output files are provided in Appendix A. Where costs and benefits have been calculated outside of TUBA all parameters are based on the latest WebTAG guidance.

4 Cost-Benefit Analysis

Appraisal Modelling

- 4.1 The preferred option has been appraised using time, cost and demand ‘skim’ outputs from the transport model for the Do Minimum and Do Something scenarios. These skims have been analysed in TUBA to assess the user benefits of the project. Non-User benefits have been estimated using a unit rate approach (with value taken from WebTAG guidance) based on the change in vehicle kilometres between the Do Something and Do Minimum scenarios.
- 4.2 Revenues have been assessed using a stop to stop fare matrix in conjunction with Do Minimum and Do Something demand outputs from the transport model. This approach has been used to enable a detailed breakdown of revenues accruing to the different service providers which include Transport for London, national rail operators and private bus services. The approach also allows a more detailed analysis of movements to take into account two leg trips, fare growth inflation and other factors.
- 4.3 The project costs have been modelled within a spreadsheet. This has been necessary to distinguish between eligible and ineligible costs as part of the BAFB process and to apply separate rates of inflation to the different costs elements. This model has also been used to assess the overrun, nominal and real costs of the project
- 4.4 Benefits, revenues and costs have been integrated within a final appraisal model which provides outputs for the Transport Economic Efficiency (TEE), Public Accounts (PA) and Analysis of Monetised Costs and Benefits (AMCB) tables and cost worksheet. The process is illustrated in Figure 4.1.

FIGURE 4.1 APPRAISAL PROCESS



Transport Economic Efficiency

- 4.5 The most significant monetised economic benefit of the project is the generation of journey time savings for new and current consumer and business travellers on the public transport system. The project will link the centre of Watford to the London underground

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network and provide two new stations that will significantly improve the accessibility, travel options and journey times for local residents and visitors.

- 4.6 This will increase the attractiveness of the service and result in a significant increase in underground patronage from other modes including bus and leading to a reduction in bus fares, car travel and decongestion benefits. In 2016 the project is likely to abstract 139,000 car trips per year. There will therefore be some impact on private transport providers from a reduction in patronage and bus revenues, these impacts are described later within this section.

TABLE 4.1 SCENARIO TRIP TOTALS (000s)

Year	Time Period	DO MIN	Croxley Rail Link	Change
2016	AM peak 0700-1000	5,263	5,326	63
2016	Inter-peak 1000-1600	5,582	5,657	75
2016	Annual	10,845	10,984	139
2031	AM peak 0700-1000	5,519	5,579	60
2031	Inter-peak 1000-1600	6,051	6,127	76
2031	Annual	11,569	11,706	137

Source: TUBA Outputs

- 4.7 The project will also have some impact on the average level of fare paid by users, by encouraging travellers to transfer between public transport modes. The level of fares in the Do Minimum and Do Something scenarios is the same, meaning that generally existing users of the underground service will see little impact on the level of fare paid. Some users who switch from national rail services will pay a lower fare for some trips, for example to and from London and these users will see a fare benefit.

Commuter and Other Users

- 4.8 For commuter users the total present value of benefits is £41.2m. For other consumer users the total present value of benefits is £43.5m. Journey time benefits account for the majority of economic benefits for both types of user. There is also a net positive user charge benefit for consumer users.

Business Users

- 4.9 The total present value of benefits accruing to business users is £85.8m. The majority of the user benefits are attributable to a reduction in journey times for trips, particularly from central Watford to London and other destinations. Journey time benefits account for £79.6m of benefits for the preferred option.

Private Sector Providers

- 4.10 The increase in underground patronage will be partially abstracted from bus services. This will have a £18m impact on private provider revenues in the preferred option as fewer users will travel by bus in the Do Something Scenario.

TABLE 4.2 TRANSPORT ECONOMIC EFFICIENCY TABLE - PREFERRED OPTION

<u>Commuter User Benefits</u>	TOTAL	Road / Bus		Rail	
Travel time	31,599	0		31,599	
Vehicle operating costs	0	0		0	
User charges	9,613	0		9,613	
During Construction & Maintenance	0	0		0	
Net Commuter Benefits	41,212	0		41,212	
<u>Other User Benefits</u>	TOTAL	Road / Bus		Rail	
Travel time	43,239	0		43,239	
Vehicle operating costs	0	0		0	
User charges	224	0		224	
During Construction & Maintenance	0	0		0	
Net Other Benefits	43,463	0		43,463	
<u>Business User Benefits</u>	TOTAL	Passengers	Freight	Passengers	Freight
Travel time	79,571	0	0	79,571	0
Vehicle operating costs	0	0	0	0	0
User charges	6,251	0	0	6,251	0
During Construction & Maintenance	0	0	0	0	0
Subtotal	85,822	0	0	85,822	0
<u>Private Sector Provider Impacts</u>	TOTAL	Road / Bus		Rail	
Revenue	-17,914	-17,914		0	
Operating costs	0	0		0	
Investment costs	0	0		0	
Grant/subsidy	0	0		0	
Subtotal	-17,914	-17,914		0	
<i>Other business impacts</i>	TOTAL	Road / Bus		Rail	
Developer contributions	0	0		0	
NET BUSINESS IMPACT	67,908				

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

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TEE - Present Value of Benefits	152,583	(6) = (1a) + (1b) + (5)
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Public Accounts

- 4.11 The public sector in the form of TfL will directly operate the rail link and will benefit from an increase in public transport revenues from higher patronage on London Underground services. There will be a slight loss to some other public transport providers due to the abstraction of trips from other modes.
- 4.12 We have assumed that for the first three years of the appraisal, rail fares growth will be RPI+3% after which growth will revert to the standard of RPI+1%. This assumption reflects recent changes to fares policy as part of the government's deficit reduction plan. The revenue growth assumptions are shown in Table 2.2 in the earlier section. The impact on different public transport providers in 2016 and 2031 is shown in Table 4.3.

TABLE 4.3 SERVICE PROVIDER FARE REVENUE IMPACTS (2011 PRICES £000s)

Service Provider	2016	2031
London Overground	-£408	-£1,154
Other Rail Services	-£763	-£2,143
LUL	£2,515	£6,813
Private Bus Revenue	-£706	-£1,615
TfL Revenue (Overground & LUL)	£2,107	£5,659
Total Revenues	£638	£1,900
Public Sector Revenues	£1,344	£3,516
TfL Operating Cost	£1,958	£2,836
TfL Operating Position	£149	£2,823

- 4.13 The table shows that the net impact on provider revenues in 2016 is £638k in 2011 prices, this includes the increase in TfL revenues and the decrease in bus and other rail service providers. By 2031 the impact increases to £1.9m. The effect on public sector revenues is positive overall, however there is a negative impact on Overground and other rail services.
- 4.14 Due to the ramp up period the total operating costs of the project are higher than the public sector revenues for the first years of operation. This is reversed between 2018 and 2019 as patronage increases, by 2031 there will be a net increase in public sector revenues of £0.6m per year as a result of the project. Overall including operating costs, TfL is expected to see an improvement in its operating position of around £149k per year in 2016, rising to £2.8m in 2031.
- 4.15 The total net increase in public sector revenue is £39.2m in present value. This revenue includes both fares and other station related income such as advertising, ATM charges and retail unit concessions in the new stations.

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- 4.16 This increase in revenue is offset by the costs of providing the service. The present value of costs of operating the new service is £26.8m over the 60 year appraisal period. Overall the impact on the broad transport budget is £64.9m in present values. Table 4.4 provides a summary of the Public Accounts impact of the preferred option.
- 4.17 There is an additional costs to central government from reductions in indirect tax revenues. This impact is a result of the redirected expenditure on non-taxable public transport fares, and a reduction in the level of car travel and fuel consumption. This impact is equal to £4.9m and is included as a reduction in project benefits as required by the latest appraisal guidance.

TABLE 4.4 PUBLIC ACCOUNTS - PREFERRED OPTION

	ALL MODES	ROAD	BUS & COACH	RAIL
<u>Local Government Funding</u>	TOTAL			
Revenue	-39,207	0	0	-39,207
Operating Costs	26,758	0	0	26,758
Investment Costs	77,387	0	0	77,387
Developer and Other Contributions	0	0	0	0
Grant/Subsidy Payments	0	0	0	0
NET IMPACT	64,939 (7)	0	0	64,939
<u>Central Government Funding: Transport</u>				
Revenue	0	0	0	0
Operating costs	0	0	0	0
Investment Costs	0	0	0	0
Developer and Other Contributions	0	0	0	0
Grant/Subsidy Payments	0	0	0	0
NET IMPACT	0 (8)	0	0	0
<u>Central Government Funding: Non-Transport</u>				
Indirect Tax Revenues	4,863 (9)	661	0	4,202
<u>TOTALS</u>				
<u>Broad Transport Budget</u>	64,939 (10) = (7) + (8)			
<u>Wider Public Finances</u>	4,863 (11) = (9)			

Analysis of Monetised Benefits and Costs

Non-Users

- 4.18 The project will abstract users from other modes including cars. This will generate decongestion benefits related to reduced car trips, noise and pollution. We have estimated that in the preferred option the scheme will result in 139,000 fewer car trips per year equating to 607,000 fewer vehicle kilometres.
- 4.19 Based on per kilometre benefit transfer rates provided in WebTAG unit 3.9.5, we estimate that this reduction in car travel will result in significant non-user benefits. These impacts are summarised in Table 4.5. Overall the most significant non-user impact is a reduction in congestion which generates a £2.4m present value impact. The project will also reduce vehicle emissions by around 95,000 tonnes over the appraisal period, however this is partially offset by a 27,404 increase in emission as a result of increased power consumption from train operations. Overall non-user impacts are worth £2.8m in present value benefits.

Option and Non-Use Values

- 4.20 The project will provide a significant improvement in access to public transport services to a large number of people in Watford. We estimate that the project will increase the number of homes within walking distance (800m) of a rail station from 3,459 to 6,177 (including the reduction in access at Watford Metropolitan station). Therefore 2,718 households will gain a significant increase in option and non-use values as a result of the project. This impact is valued at £18.7m present value.

Overall Assessment

- 4.21 Overall the preferred option will generate £169m in present value benefits at a present cost of £65m. The net present value of the option is £104m and the benefit cost ratio is 2.61:1.

TABLE 4.5 ANALYSIS OF MONETISED COSTS AND BENEFITS - PREFERRED OPTION

<u>Non-User Benefits</u>		
Noise	18	(12)
Local Air Quality	73	(13)
Greenhouse Gases	55	(14)
Journey Ambience	0	(15)
Accidents	275	(16)
Infrastructure	18	(17)
Congestion	2,405	(18)
<u>Economic Efficiency</u>		
Consumer Users (Commuting)	41,212	(1a)
Consumer Users (Other)	43,463	(1b)
Business Users and Providers	67,908	(5)
Wider Public Finances (Indirect Taxation Revenues)	-4,863	(11) - sign changed from PA table
Option & Non Use Values	18,686	(17)
Present Value of Benefits ^(see notes) (PVB)	169,252	(12) + (13) + (14) + (15) + (16) + (1a) + (1b) + (5) + (17) + (18) - (11)
Broad Transport Budget	64,939	(10)
Present Value of Costs ^(see notes) (PVC)	64,939	(PVC) = (10)
<u>OVERALL IMPACTS</u>		
<u>Net Present Value (NPV)</u>	104,313	NPV=PVB-PVC
<u>Benefit to Cost Ratio (BCR)</u>	2.61	BCR=PVB/PVC

Wider Economic Impacts

- 4.22 The project will provide a significant increase in transport accessibility for the centre of Watford to areas of economic activity along the Metropolitan line including London. This will increase in the ‘effective density’ of businesses and employees located within Watford resulting in ‘thicker’ labour markets and providing better access to customers and suppliers. Previous analysis of the wider economic impacts undertaken for the 2009 MSBC submission identified that productivity might improve by 24.8% of conventional benefits. We have applied this factor to the scheme benefits in the BAFB.
- 4.23 The project will also expand the labour market catchment area of businesses within Watford by reducing commuting costs. This reduction in travel costs will effectively increase the perceived value of real wages within the area and increase the supply of labour generating an increase in tax revenue. The previous analysis estimated that this impact will generate a 0.5% uplift on conventional benefits.
- 4.24 Adopting a monopolistic competition model for the appraisal (in place of the standard perfectly competitive model) it can be shown that business user benefits are undervalued in conventional appraisal. Based on WebTAG guidance (Unit 3.5.14) we estimate that imperfect competition benefits are equivalent to 10% of conventional business user benefits. In, total wider economic impacts are worth £45.4m, incorporating these benefits into the appraisal raises the NPV of the project from £104m to £149m and the BCR from 2.61 to 3.31.

TABLE 4.6 WIDER ECONOMIC IMPACTS

Wider Impact	Preferred Option
Agglomeration	37,840
Labour Supply Impacts	763
Imperfect Competition Benefits	6,791
Total Wider Impact	45,394
PVB Including WEIs	214,646
PVC Including WEIs	64,939
NPV Including WEIs	149,707
BCR Including WEIs	3.31

Analysis of Results

Sector Analysis

- 4.25 Table 4.7 on the following page provides an analysis of the sector to sector journey time benefits of the preferred option and showing the percentage of total times benefits accruing to individual sector origin destination pairings.
- 4.26 The table shows that 58% and 23% of the total time saving benefits accrue to trips which respectively terminate and originate within Central Watford. The largest sector to sector gain in economic terms is for trips from Harrow and Brent to Central Watford. These trips receive 16.7% of the total journey time impact. The next largest sector of benefit are for

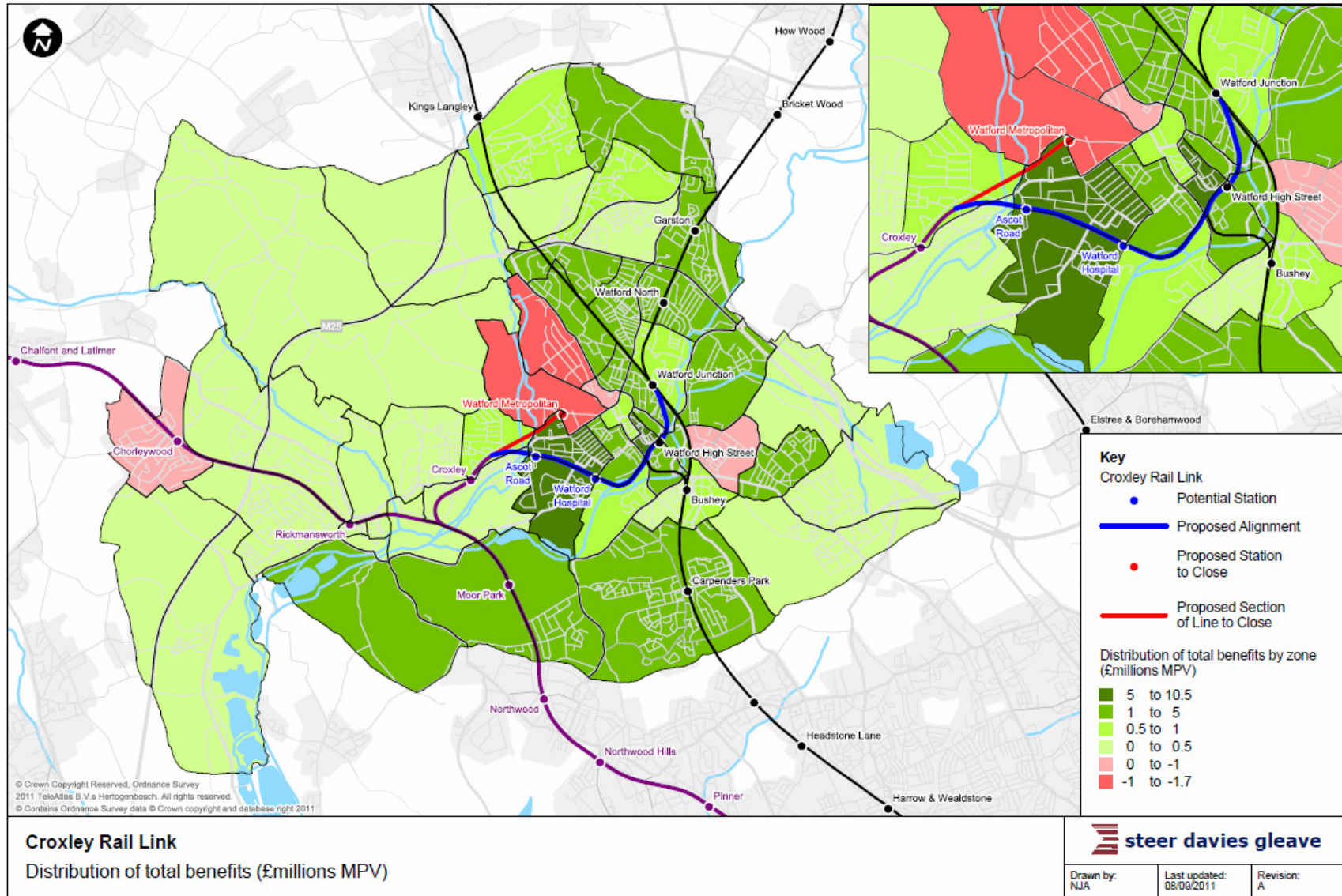
Economic Appraisal

trips travelling from the 'rest of London' to central Watford which receive 8.4% of the total journey time impact.

- 4.27 Overall, all sectors see a net time benefit on an origin / destination basis. Some individual sector to sector movements will receive a negative impact on journey times as a result of the closure of Watford Metropolitan station.
- 4.28 On a zone to zone basis the benefits are highly focused around the new stations. The map on the following page provides a more detailed spatial analysis of the total benefits accruing to each zone. The zones surrounding Watford Metropolitan station receive a disbenefit related to the increased walking access time from this area. Most other zones gain a significant benefit, particularly around Ascot Road and Watford Hospital.

TABLE 4.7 PREFERRED OPTION SECTOR BENEFITS ANALYSIS (% OF TOTAL TIME BENEFITS)

Origin / Destination	Bushey	Central London	Central Watford	Harrow and Brent	Hillingdon	North Watford	Rest of London	Rickmansworth	The East	The North	The South	The West	Grand Total
Bushey	0.0%	-0.1%	2.5%	-0.2%	0.0%	0.0%	-0.2%	2.7%	0.3%	0.0%	0.0%	0.1%	5.1%
Central London	0.1%	0.0%	5.2%	0.0%	0.0%	0.2%	0.0%	1.7%	0.1%	0.0%	0.0%	0.0%	7.3%
Central Watford	-0.5%	6.9%	1.9%	4.4%	0.8%	0.0%	2.1%	5.7%	1.1%	0.0%	0.1%	0.9%	23.4%
Harrow and Brent	0.0%	0.0%	16.7%	0.0%	0.0%	-0.1%	0.0%	0.1%	0.1%	0.0%	0.0%	0.0%	16.8%
Hillingdon	0.1%	0.0%	3.1%	0.0%	0.0%	0.1%	0.0%	0.2%	0.1%	0.0%	0.0%	0.0%	3.6%
North Watford	0.1%	0.3%	5.5%	0.5%	0.0%	0.6%	0.0%	1.8%	0.4%	0.1%	0.0%	0.1%	9.3%
Rest of London	0.9%	0.0%	8.4%	0.0%	0.0%	0.1%	0.0%	0.1%	0.1%	0.1%	0.0%	0.0%	9.6%
Rickmansworth	0.6%	0.3%	5.1%	0.0%	0.1%	1.0%	0.0%	0.1%	0.1%	0.4%	0.0%	0.0%	7.6%
The East	0.4%	0.0%	0.5%	0.1%	0.0%	0.5%	0.0%	0.1%	0.3%	0.2%	0.0%	0.0%	2.1%
The North	0.0%	0.0%	6.7%	0.3%	0.1%	0.0%	0.1%	3.1%	0.2%	0.0%	0.0%	0.5%	11.1%
The South	0.0%	0.0%	0.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.7%
The West	0.1%	0.0%	2.3%	0.1%	0.0%	0.2%	0.0%	0.0%	0.5%	0.2%	0.0%	0.0%	3.4%
Grand Total	1.8%	7.4%	58.5%	5.2%	1.0%	2.7%	2.0%	15.7%	3.2%	0.9%	0.0%	1.6%	100.0%



Time Breakpoint Analysis

- 4.29 Table 4.8 shows the time breakpoint TUBA analysis for the preferred option. The table shows that the vast majority of time savings are over five minutes and the total value of small time savings is therefore relatively small. Less than 7% of the total positive time savings are under 5 minutes.

TABLE 4.8 PREFERRED OPTION - PERSON HOURS BY SIZE OF TIME SAVING

Purpose	< -5m	-5 to -2m	-2 to 0m	0 to 2m	2 to 5m	> 5m
Business	-200	-78	-109	163	360	4,682
Commuting	-1,974	-999	-258	104	1,187	16,424
Other	-1,413	-712	-181	144	629	24,869
Total	-3,587	-1,789	-548	411	2,176	45,975
%	-8.4%	-4.2%	-1.3%	1.0%	5.1%	107.8%

Warnings & Errors

- 4.30 The TUBA results show that there are 718 warnings in the model results, none of these warnings are classed as serious. These warnings have been examined and are have been generally found to occur for origins and destinations outside the core study area where the time and costs results become sensitive to small changes in the scenario. Accordingly none of these zones has a high level of demand and the impact on the economic benefits of the project is therefore likely to be negligible.

5 Sensitivity Tests

5.1 The assessment in the previous sections has been based upon our best estimate of the ‘state of the world’ in the forecast years based on several key assumptions and established forecasts of population and employment demand. The project has been appraised on this central case, however there is a possibility that other scenarios may occur. This section provides a summary of these scenarios and uses appropriate sensitivity tests to examine the impact on the projects outcomes.

Scenarios

5.2 The following points summarise the list of sensitivity tests undertaken for the scheme:

- Wider Economic Impacts;
- Increase in capital costs;
- Increase in operating costs;
- Alternative frequency patterns and;
- A split service option in which Watford Metropolitan station is retained.

Scenario Impacts

Capital Costs

5.3 Based on the central demand case, increasing capital costs by 20% would reduce the net present value of the project to £83.9m and the BCR to 1.98. Capital costs would have to increase by 128% for the BCR of the project to equal one. On this basis the project is relatively insensitive to increases in capital costs.

Operating Costs

5.4 Based on the central demand case, increasing operating costs by 20% would reduce the net present value of the project to £94.1m and the BCR to 2.25. Operating costs would have to increase by 370% for the BCR of the project to equal one. The economic case is therefore relatively insensitive to changes in operating cost.

Alternative Frequency Patterns

5.1 The central case is based on our best estimate of the service frequency for the underground services in the Do Minimum scenario. There is a possibility that the service frequency could change to a higher or lower pattern. We have examined the effect of this change in trains per hour (tph) frequency in a series of sensitivity tests described in the table below.

TABLE 5.1 ALTERNATIVE FREQUENCY SCENARIOS

Scenario	Do Minimum - Trains to Watford Metropolitan	Do Something - Trains to Watford Junction	NPV	BCR
A	7tph peak 4tph offpeak	7tph peak 4tph offpeak	105.1	2.53
B	7tph peak 4tph offpeak	6tph peak 4tph offpeak	95.4	2.57
C	10tph peak 4tph offpeak	6tph peak 4tph offpeak	78.0	2.23

5.2 Increasing the frequency of the service increases the benefits to passengers, but also increases operating costs changing the NPV and BCR of the option. Option C would also require the provision of an additional train set which would increase the capital costs of the project by £9m.

5.3 The results of these sensitivity tests show that the central case performs best overall in terms of the BCR, however the differences between the scenarios are not significant. This demonstrates that the project is not sensitive to changes in the Do Minimum service frequency.

Split Service Option

5.4 We have tested the impact of retaining Watford Metropolitan station as part of the project. In this scenario half the underground services would be directed to Watford Metropolitan and the other half to Watford Junction based on the service frequencies assumed within the central case. Table 5.2 provides a summary of the results of the sensitivity tests.

TABLE 5.2 SENSITIVITY TEST RESULTS

Scenario	Uplift	NPV (£m)	BCR
Central Case		104.3	2.61
Central Case + Wider Impacts		149.7	3.31
Capital Cost	+20%	94.9	2.10
Capital Cost	+135%	0	1.00
Operating Cost	+20%	94.1	2.25
Operating Cost	+490%	0	1.00
Frequency Scenario A - 7tph DM, 7tph DS		105.1	2.53
Frequency Scenario B - 8tph DM, 6tph DS		95.4	2.57
Frequency Scenario C- 10tph DM, 6tph DS		78.0	2.23
Split Service Option		30.7	1.43

- 5.5 The sensitivity tests indicate that the economic case for the project is very robust. The project will provide good value for money in a variety of circumstances including different Do Minimum frequency outcomes. It would also require a significant increase in capital or operating costs to undermine the economic case.
- 5.6 The split service scenario test shows that this option provides an overall positive impact but the total economic benefits and value for money case is significantly lower than for the preferred option.

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