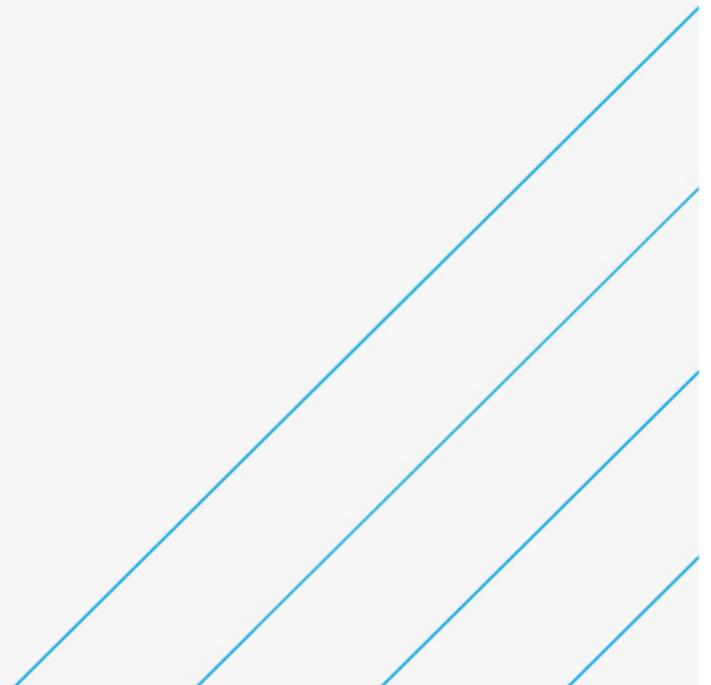


# Edinburgh Tram Completion Project - Full Business Case

Audit Report

The City of Edinburgh Council

25 January 2019



# Notice

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## Document history

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## Client signoff

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# Contents

Chapter	Page
<b>1. Introduction</b>	<b>4</b>
<b>2. Approach to the Audit</b>	<b>5</b>
<b>3. Content of the Audit</b>	<b>6</b>
<b>4. Summary and Conclusions</b>	<b>8</b>
Summary	8
Conclusions	9
<b>Appendix A. Future Enhancements</b>	<b>10</b>

# 1. Introduction

- 1.1. Edinburgh Tram opened in May 2014, operating between Edinburgh Airport and York Place in Edinburgh city centre. Line 1 of the tram service was envisaged to be part of a wider tram network including the York Place to Newhaven Project. As part of an assessment of four alternatives, a new business case was prepared by the Joint Revenue Commission (JRC) in May 2015 to assess and compare the benefits that could be gained from each of four options for progressing the York Place to Newhaven Project. Atkins undertook an audit of the 2015 business case including a review of the transport model used to inform the business case.
- 1.2. Following the assessment of the four alternatives, the York Place to Newhaven Project was selected as the preferred option by The City of Edinburgh Council (CEC) for a more detailed assessment leading to the preparation of an Outline Business Case (OBC). Atkins was appointed in April 2017 to refresh its audit of the York Place to Newhaven Project business case. Atkins completed this audit and reported in June 2017.
- 1.3. The development of the scheme then moved forward as the Tram Completion Project, in which the preferred option for the section between York Place and Newhaven was taken forward to the preparation of the Full Business Case (FBC). Atkins was appointed in January 2019 to undertake a further audit of the Economic Case of the FBC document for the Project prepared for CEC by the JRC.
- 1.4. This report documents the conclusions from the Atkins audit of the FBC. In view of the limited time available to complete the audit, it represents a focussed review of the main features of the Tram Completion Project appraisal. As part of this summary, the review:
  - Identifies the documents prepared by the JRC which have formed the basis for this review;
  - Highlights the principal assumptions which have underpinned the preparation of the FBC;
  - Considers the robustness of the appraisal; and
  - Makes recommendations for refinements to the process.
- 1.5. The subsequent chapters of the audit consider the following aspects:
  - Chapter 2 summarises the approach to the audit;
  - Chapter 3 outlines the contents of the audit including the inputs that have been reviewed, with particular emphasis on the assumptions that have been made in preparing the FBC and changes from the 2017 OBC; and
  - Chapter 4 documents the conclusions.
- 1.6. In the review of the draft FBC, a number of comments and suggestions were made by Atkins to the JRC concerning potential detailed clarification and drafting changes to the Economic Appraisal Report, which provides the technical detail underpinning the Economic Case presented within the FBC, for the JRC's consideration for possible inclusion in the final version of the document. We believe that the outcome of this was an improvement to the FBC document,

## 2. Approach to the Audit

- 2.1. The audit was a high-level review building upon the Atkins 2017 audit to provide conclusions that were timely for the CEC decision-making timetable. Hence, the aim in the approach was to focus attention on the key elements of the FBC, and the transport modelling that underpinned it. Within this, the review has concentrated on the reports and materials provided by the JRC and supporting material JRC provided within the tight timescale. Hence, there was a combined objective by Atkins and the JRC to avoid superfluous analysis, with attention on the main aspects that influence the FBC's conclusions and to confirm whether the modelling and appraisal for the FBC is sound and appropriate.
- 2.2. This is the third audit undertaken by Atkins into the business case for different stages of the Edinburgh Tram extension to Newhaven. This audit therefore builds on the earlier work and, as a result, makes reference to the conclusions and recommendations of the preceding work, particularly the more recent audit of the OBC which reported in June 2017.
- 2.3. This audit of the FBC was undertaken in line with some core principles to guide the achievement of the required outcome within the available time. These included:
- Technical pragmatism – not concentrating on technical 'purity' but reflecting the JRC's remit;
  - Open lines of communication between Atkins and the JRC with inputs provided in a timely basis, transparency in the process and 'no surprises' in the emerging conclusions from the audit;
  - Informal conversations between Atkins and the JRC to understand, clarify, and comment on JRC documents; and
  - Concentration on the issues that are material to the strength of the Project's business case and identify whether a particular factor would significantly influence the overall strength of the business case for the Project.
- 2.4. Communications between Atkins and the JRC were mainly in the form of emails and Skype conversations, with the latter occurring on 22<sup>nd</sup> and 24<sup>th</sup> January.
- 2.5. The following documents formed the foundation for the audit:
- Edinburgh Tram: Full Business Case for the Tram Completion Project (draft, 21<sup>st</sup> December 2018);
  - Edinburgh Tram Newhaven Project Full Business Case Scoping Report (24<sup>th</sup> April 2018); and
  - Edinburgh Tram Evaluation Report (September 2018)
- 2.6. Within the available time for the audit, it was not feasible or practical to consider additional background technical notes or similar documents. With the attention directed at the main elements of the FBC and building on the experience and conclusions from the previous audits prepared by Atkins, this was a pragmatic approach. The main emphasis was in examining the main differences and changes from the OBC which was subject to the previous audit in June 2017.

## 3. Content of the Audit

- 3.1. In order to build on Atkins' experience from the two previous audits and to focus efforts in the limited time available, attention was directed at the main changes that were introduced to the modelling and appraisal within the Tram Completion Project and preparation of the FBC, and to consider their impact and appropriateness for the content of the FBC. This is considered in the table below within a series of headings.
- 3.2. In addition, as part of our review of the approach outlined in the FBC, we identified two issues in the modelling and appraisal which might have an impact, albeit small, on the size of the benefits.
- 3.3. The appraisal is based on the outputs from the two modelled years – 2022 and 2032. In the 2022 model, the Newhaven to Haymarket service has a frequency of 4 trams per hour which rises to 8 trams per hour in the 2032 model. The calculation of benefits includes an interpolation between 2022 and 2032 to derive the benefits for the intervening years. This therefore assumes a gradual ramping of the service from 4 to 8 trams per hour over the 10 year period. However, the corresponding cost profile assumes that the increase in costs occurs in 2032, i.e. the increase to 8 trams occurs in 2032. The benefits profile therefore represents a more optimistic level of service over the 2022 to 2032 period than reflected by the costs and there is a consequent small overestimate in the benefits.
- 3.4. The Newhaven corridor will experience a growth in housing and, to a lesser extent employment, as demonstrated by the development forecasts provided by CEC which have formed the foundation for the overall demand forecasts for 2022 and 2032. However, in the Do Minimum situation, there is no change in the bus services along the Newhaven corridor between 2022 and 2032 to meet the additional demand generated by the developments. The model does not include a crowding or bus capacity constraint function which would reflect the impact on decision-making of any overcrowding on buses. Alternatively, the frequency of bus services might need to be increased by 2032 with associated higher operating costs. When the Do Something including the tram is compared against an amended Do Minimum, there would be either a lower saving in operating costs or slightly reduced benefit from journey time savings. In both cases the impact will be very small, given the high frequency of services along the Newhaven corridor.

Element	Change	Impact
<b>Tram Specification</b>		
Alignment	Variation following consultation and design review including revised journey times for the tram with AM Peak time for York Place to Newhaven reduced from 19 mins in OBC to 17 mins	Some alteration to passenger volumes, although small overall impact
Year of opening	From 2022 to 2023	Slight reduction in benefits through the discounting process
Bus fares	Small increases in fares for Tram especially to airport, reflecting changes in actual fares	Small increase in tram operator revenue in economic appraisal
<b>Modelling</b>		
CEC housing and employment forecasts	Change in balance between residential and employment developments – more residential in Waterfront	Small change in balance of travel by direction in AM Peak with less outbound demand

Element	Change	Impact
Change in development buildout	Increased growth by 2022, similar buildout in 2032 as OBC	Increased demand and benefits in opening year. Slight reduction in 2032
Value of time	Changes to DfT WebTAG values and growth forecasts, reflecting DfT updated guidance since the OBC	Reduction in discounted user benefits by about 15%
Bus services	Following review for FBC, Newhaven to Airport services added	Negligible impact on tram demand.
<b>Appraisal</b>		
Annualisation factors	Revised based on observed tram data for full year. AM Peak reduced from 702 to 652 Off Peak increased from 1788 to 1823	Overall reduced in annual demand and benefits by about 5%
Growth factor for future demand 2033 to 2042	Reduced from 1.5%pa to 1.0%pa	Reduction in demand and user benefits
Scheme Costs	Outturn capital costs increased between the OBC and FBC	PVC for capital costs rises from between the OBC and FBC – rise is reduced by lower Optimism Bias (see below)
Optimism Bias	Reduced from 20% in OBC to 6% based on WebTAG guidance for FBC	Reduction in increase in discounted scheme costs (see above)
Tram operating costs	Reduced PVC from £167.3m in OBC to £155.3m in FBC, based on updated CEC opex forecasts.	Reduction of costs in appraisal
Tram lifecycle costs	Reduced PVC from £41.4m in OBC to £38.2m in FBC	Reduction of costs in appraisal

## 4. Summary and Conclusions

### Summary

- 4.1. The modelling and appraisal techniques used by the JRC in the preparation of the FBC have followed the same broad approach as previously undertaken for the options assessment in 2015 and the OBC in 2017, with relatively minor refinements. These adjustments fall under a number of different headings:
- required changes e.g. updates to the DfT's value of time;
  - revisions to the scheme's specification, e.g. tram travel times and year of opening;
  - updates to planning (housing and employment) forecasts – location of developments and speed of build out;
  - growth forecasts – passenger growth between 2033 and 2042 reduced from 1.5% to 1%; and
  - change in scheme costs with increase in capital costs (although magnitude reduced by drop in Optimism Bias) and decrease in Tram operating and lifecycle costs.
- 4.2. The overall appraisal, in terms of the headline Benefit Cost Ratio, shows a reduction from 1.6 in the OBC to 1.4 in the FBC. There are a number of valid reasons, some of which are identified above, which explain the basis for the reduction.
- 4.3. In drawing conclusions from our audit of the FBC, we have used as a starting point the recommendations from our previous audit of the OBC in June 2017. The overall conclusion from the previous audit was that the demand and revenue forecasts were reasonable; if anything, the projections might be understated or conservative, which was a prudent approach. The series of sensitivity tests provided some confidence to the robustness of the forecasts. The conclusion from the FBC audit reiterates this position.
- 4.4. The conclusions were considered under three main headings.

### Are the tools fit for purpose?

- 4.5. The conclusion from the previous work was that, considering the position of the Project in the development process, the modelling was an appropriate tool for the purpose of informing the economic appraisal and OBC for the Project.
- 4.6. With the approach with the FBC broadly following that used for the OBC, we would come to the same conclusion. The 2017 audit highlighted measures that should be included with a general revision to the modelling approach and the progress against these tasks is summarised in the Appendix to this report.
- 4.7. However, given the constraints in producing the FBC it would not have been sensible to jeopardise the preparation of the FBC by embarking on a programme of model development. The team therefore wisely made relatively minor enhancements to the model. The contents of the Appendix therefore remain as a check for model developments in the future.

### Are the assumptions reasonable?

- 4.8. Assumptions which had been included in the demand modelling and economic appraisal for the Project's business case were considered in the previous audit to be appropriate for the scale and nature of the business case. Assumptions in the forecasting of network supply are sensible for the purpose of the current FBC but there are aspects that will need further development or rationalisation in the use of the model to assess any further extensions to the tram network. These include:
- Optimisation of highway network performance;
  - Bus provision in the Do Minimum scenario;
  - Interpolation of benefits between 2023 and 2032;
  - Approximation of the highway disbenefits as proportion of public transport user benefits; and
  - The re-cast of the bus services within the tram corridor.

## Do the outputs look credible?

- 4.9. The previous audit of the OBC in 2017 concluded that the model and subsequent analysis were generally consistent and in line with expectations. Our refresh of the FBC confirms these conclusions.
- 4.10. On balance, the distribution of boardings and alightings along the new section of route between York Place and Newhaven and the resulting patronage profile are plausible and show minor variations from earlier forecasts. Any slight alterations are reasonable given the changes to the input forecasts for the magnitude and location of developments along the Leith corridor.
- 4.11. In the previous 2015 and 2017 Audits, it was noted that the model underestimated the tram's share of public transport demand to and from the airport. Since then, improvements have been made to the approach, with a new airport component to the model although this is more pertinent to the Financial Case rather than the Economic Case for the Project.
- 4.12. The changes in the components of both the Present Value of Benefits and Costs have changed between the OBC and FBC align in both direction and size with the changes to the inputs and assumptions and hence are logical.
- 4.13. As with the 2015 and 2017 audits, we have not reviewed the detailed capital costs (Bidder costs are used for the FBC) or the lifecycle costs prepared by Turner and Townsend, which contribute to the Present Value of Costs in the economic appraisal. The increase in these costs contributes in part to the reduction in the BCR within the FBC compared with the OBC.

## Conclusions

- 4.14. In line with previous audits, we have sought to concentrate our review on the principal elements of the business case prepared for the Project. This has been particularly true on this occasion with the limited time available which has meant that a full detailed review was not feasible. At the same time, in preparing the FBC the JRC has followed the same basic approach to that adopted in the OBC.
- 4.15. Considering the position of the Project in the development process, our overall assessment concludes that the updated modelling is an appropriate tool for the purposes of informing the economic appraisal and FBC for the Project.
- 4.16. A comparison against the 2017 audit demonstrates that, while not all recommendations to the modelling and appraisal have been implemented, there has been some enhancement to details in the approach. This must therefore be reflected in improvements to the robustness of the overall business case.
- 4.17. Where there continue to be outstanding issues, for example in the approximation of the highway disbenefits as a proportion of the public transport benefits, it is to be hoped that future use of the model to assess the impact of further extensions will rectify the shortfall in the approach.
- 4.18. When reviewing the content of the Business Case, there is a temptation to look immediately and only at the BCR and to compare its value with earlier estimates. Although the size of the BCR has fallen since 2017, there are valid external factors which would explain the change, notably the changes to the DfT's prescribed value of time forecasts and the change in overall scheme costs. The underlying merit of the Project has not altered between the previous OBC in June 2017 and the current FBC which has been the focus of this review.

# Appendix A. Future Enhancements

## Model Enhancements

The 2017 audit identified some areas with room for further improvement with the recommendation that they should be considered in subsequent development and refinement of the Project. They are summarised in the bullet points below.

These should probably be considered as part of a general revision to the modelling and appraisal framework, in line with an overall review of the future processes. As such it would not be expected that the measures identified would be implemented at a time when the model is being used to complete the appraisal of a scheme approaching the FBC stage.

Nevertheless, for completeness, we record the measures identified in the 2017 audit with an update in bold on the current status

- Tram modal constant – adjustment of the modal constant could be explored based on the actual tram patronage and observed journey time. The adjusted constant can then be applied in subsequent forecasts of tram projects to assess its impact on the patronage.  
**Update – no new data collection or associated update to the modal constant. There is some evidence from the evaluation of the existing Edinburgh Tram operation which indicates that the model generates good forecasts of tram demand when necessary adjustments are made to the scheme specification. This therefore suggests that the modal constant may be appropriate.**
- The base prior trip matrices were developed in 2005/6 and are now rather old and may not reflect the current distribution of trips, given new developments which have occurred in the interim – there would therefore be merit in refreshing the prior matrices.  
**Update – no opportunity for new surveys in the work for the FBC or use of other data sources such as mobile phone data.**
- The use of matrix estimation is key to the development of the base year trip matrices, and it would therefore be useful to have more details of the impact of matrix estimation in changing the distribution of trips, at a basic sector level.  
**Update – no further analysis available.**
- Base model calibration / validation – analysis of the modelled and observed origin / destination pattern in tram demand would be welcome to strengthen the robustness of the model forecasts.  
**Update – no further analysis available.**
- Base model validation – there is a general understatement of demand in the base year model compared with the observed across all time periods and for both highways and public transport.  
**Update – the FBC version of the model has largely resolved the issue with modelled and observed flows being more in line.**
- The use of counts for the calibration and validation stages should be reviewed such that there is a clear distinction between the two components with counts being set aside for the validation stage – perhaps associated with the collection of new count data.  
**Update – no further development in the FBC stage.**
- The highway journey time validation involves the comparison of modelled journey times against observations made before 2005. It is recommended that attention is directed at assembling up-to-date journey time data, perhaps through sources such as Trafficmaster, rather than bespoke surveys.  
**Update – although there has been no further development in the FBC work, the issue is perhaps not significant on the Newhaven corridor because the overwhelming (87%) source of tram patronage is abstraction from bus. Hence the robustness of highway journey time data is not critical for the tram demand forecasts along the Newhaven corridor. A different response might be necessary when further tram services are assessed along corridors with higher car demand.**
- The demand model has been unchanged and has not been revalidated since the original audit in 2015.

***Update – no revalidation has been undertaken since 2015 and hence there would be merit in undertaking a revalidation before any future application of the model, especially if it is used to assess the impact of the tram in new corridors.***

## Appraisal Enhancements

Turning to the appraisal assumptions, the 2017 audit recommended improvements in the following appraisal areas. They are summarised in the bullet points below, with an update in bold on the status in the current work:

- Highway user impacts based on modelling results – the current business case is based on a range estimate of highway user impacts as a percentage of the public transport users benefits, instead of actual output from the transport model.  
***Update – no change made to the approach.***
- An assumption has been made to increase the patronage growth (and therefore revenue and benefits) beyond the final modelled year of 2032 – by 1.5% p.a. between 2033 and 2042 and 1.0% p.a. between 2043 and 2052, with no growth beyond 2052. While it is not unreasonable to expect there to be patronage growth into the future, the source of the assumption is not clear; for example, whether it is linked to growth in development, population or employment within the corridor.  
***Update – growth forecasts have been reduced to 1% throughout***
- Annualisation – different annualisation factors for highway user impacts should be derived if the action in the point above is undertaken.  
***Update – no change made to the approach.***
- Other quantifiable appraisal criteria – information on other scheme impacts such as reliability, local air quality, greenhouse gases, investment and employment impacts should be presented.  
***Update – no change made to the approach.***

Rob Thompson  
**Atkins Limited**  
The Hub  
500 Park Avenue  
Aztec West  
Bristol  
BS32 4RZ

Tel: +44 (0)1454 662000  
Fax: +44 (0)1454 663333  
rob.thompson@atkinsglobal.com

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