

Table 4.4 – Benefits and Costs to Government from Phase 1a of tram.

£m Present Value, 2002 prices	Phase 1a Without EARL	Phase 1a With EARL
Public transport user benefits	415	395
Other road user benefits	212	34
Private sector provider effects	(23)	(44)
Accident effects	(12)	(12)
PV of scheme benefits (incl. accidents)	592	374
Investment costs	390	390
Public sector provider effects	(55)	(50)
PV of scheme costs	335	340
Net PV	257	34
Benefit Cost Ratio to Government	1.77	1.10

4.53 For comparison, the Benefit Cost Ratio (BCR) determined by the previous STAG reports presented during the Parliamentary process was calculated as 1.21 for Line 1 and 1.40 for Line 2. The parallel study of Lines 1 and 2 operating together as a network assessed the BCR as 1.51.

4.54 There is a healthy net present value (NPV) of **+£257m** and **£1.77** of benefits for each £1 of costs, for the Phase 1a scheme, in the absence of EARL, indicating a scheme that offers good value for money in transport economic efficiency terms. Total transport benefits are weighted in favour of those to public transport users; the case is not unreasonably reliant on benefits to other road users. It should also be noted that Phase 1a creates the spine of tram scheme through the city centre area that can be extended on a more efficient incremental cost basis. Therefore, Phase 1a bears a heavy burden of fixed costs.

4.55 The scenario and sensitivity testing detailed in the full STAG2 report and Revenue and Risk Report FBC (Appendices II and III), suggests that the planned development and forecast economic growth being achieved is central to maximising benefits and patronage.

‘Reference case’ compared to ‘do-minimum’

4.56 The main appraisal of the tram presented above (and that previously presented as part of the DFBC) was undertaken against a ‘reference case’ rather than a ‘do minimum’. The use of a ‘reference’ case rather than a conventional ‘do minimum’ continues to relate only to the second forecast year (2031) and is necessary because of the forecast scale of growth in trip demand. Very significant increases in the level of bus service provision would be necessary to accommodate the increased demand. It is considered that the performance of these services (in terms of journey time and reliability) would considerably reduce unless significant measures were taken to accommodate them on the road network.

4.57 The ‘reference case’ includes a representation of measures which might be required to maintain bus service performance at current levels. Therefore, the ‘reference case’ reflects the likely ‘real world’ application of CEC’s policies to support public transport if there were no tram. These measures were represented by introducing to the ‘reference case’ some of the impacts on car traffic designed to accommodate the tram – a mode of transport capable of conveying many more passengers per vehicle than buses.

4.58 The work underpinning the STAG appraisal also included an appraisal of the tram scheme against a conventional do minimum, which incorporated none of the impacts on car traffic mentioned above, but instead included a calculated deterioration of bus journey times from interaction with car traffic. This appraisal resulted in a higher BCR than the appraisal against the reference case reflecting additional public transport user benefits of the tram (relative to poorly performing buses in 2031), as well as increased highway decongestion benefits of restoring some of public transport’s modal share (together these outweighed the increased attribution of road congestion to the physical introduction of the tram onto the road network).

Interaction with EARL (sensitivity test)

- 4.59 On the 27th June 2007, the Scottish Parliament decided to review the proposals for EARL in its current form. This review resulted in the announcement on the 27th of Sept. 07 that the heavy rail link as proposed under EARL would not go ahead, however, an alternative option would be considered which proposes the building of a heavy rail station at Gogar which would connect with tram to provide a link to Edinburgh airport. It is too early in the consideration of this option to provide an assessment of the impact on the ETN, however, the proposal is may have a beneficial impact on tram's viability. It has to be understood, however, that any changes to the scope of the tram project resulting from this proposal would require additional funding as it does not form part of the core Business Case for tram.
- 4.60 The proposal will require appropriate assessment under STAG appraisal guidelines and, as such, be required to take into account the impact of the proposal on the existing transport infrastructure. No detailed work has so far been undertaken to assess this impact, given the relative recent announcement, however it is likely to have a net beneficial impact on the tram projections.
- 4.61 In light of these developments, EARL is no longer part of the 'do minimum' case against which the case for tram is assessed and it therefore has been considered as a sensitivity test as discussed below. This information is presented primarily to provide a clear audit trail for the development from the approved DFBC to the current FBC, particularly in terms of the BCR impact.
- 4.62 A qualitative market-based assessment of how EARL and the tram would have interacted reveals the following:
- EARL would provide direct routes to the national railway network and therefore be well placed to capture a good share of the public transport market for regional and national travel to / from the airport. This is a quite different market to that for travel by tram;
 - Although both EARL and the tram provide links to Haymarket and Waverley, EARL has the potential to capture a significant proportion of public transport trips between the airport and the city centre; and
 - However, the tram has the advantage of providing links to a wider range of destinations within the City of Edinburgh, as well as more wide-spread opportunities for transfer connections to bus services.
- 4.63 This FBC assumes that EARL will not be implemented as envisaged within the DFBC. In the absence of EARL, patronage and revenue outputs for the tram shows that the tram gains market share, particularly in respect of those travelling between the Airport and the City Centre where EARL would provide a shorter journey time. Additional tram patronage in the absence of EARL is forecast to be 0.5m in 2011 and 1.6m in 2031 against that reported in the DFBC.
- 4.64 In terms of Transport Economic Efficiency (TEE), sensitivity testing shows that in the absence of EARL the BCR for Phase 1a of the tram increases from 1.10 to 1.77. The increases reflect significant increased decongestion benefits to other road users (including cars) as a result of the tram in the absence of EARL, rather than a marked increase in benefits to public transport users. Further into the future, this relative increase in economic benefits due to decongestion become increasingly uncertain due to the unstable behaviour of a saturated road network.

5. PROJECT SCOPE

Purpose

- 5.1 This section provides a succinct reference within which the strategic functionality of Phase 1a of the tram project is captured. It also defines the baseline scope of the project from which any changes will be identified, considered and measured. Reference should also be made to the phasing plan for the project, as described in section 3.

Summary of Act powers

- 5.2 The Edinburgh Tram (Line One) Act 2006 and the Edinburgh Tram (Line Two) Act 2006 (the Acts) give the authorised undertaker various powers including:

- The power to construct the tram line, as authorised by the Acts or any part of it, and to operate it as a stand alone line or as part of a network;
- Compulsory purchase powers;
- The power to construct relates to works both within the Limits of Deviation (LOD) and outwith the LOD. Within the LOD there is the power to construct the authorised works i.e. the tram works. Outwith the LOD there are limited powers mainly restricted to ancillary road works required to amend kerb lines. There is also the power to carry out specific works within the Limits of Land to be Acquired or Used (LLAU) – e.g. the construction of a substation or landscaping; and
- The powers to operate include provisions in relation to fares, penalty fares, removal of obstructions along the tram line and the power to create bylaws.

The powers are to be exercised so as to comply with the Code of Construction Practice and the Noise and Vibration Policy and to ensure the residual impacts are no worse than those predicted in the Environmental Statements.

- 5.3 Despite the wide powers conferred on the authorised undertaker by the Acts, various other consents are partially completed or still require to be obtained including:

- Prior approvals – for structures, buildings including substations, tramstops; overhead line equipment (OLE) poles and fixings;
- Temporary traffic regulation orders (TTROs) for construction;
- Traffic Regulation Orders (TROs) for operation. Four Orders are planned to be made – the exact extent of the wider area effects is still to be determined and will be informed by the modelling outputs;
- Building fixings agreements with owners;
- Listed building consent (there are some powers in the Acts in this regard but this does not cover all listed buildings);
- Scheduled ancient monument consent;
- Environmental consents e.g. badger licences;
- Approval of the planning authority to the Landscape and Habitat Management Plan (LHMP); and
- Her Majesty's Railway Inspectorate (HMRI) consents (now superseded by ROGS requirements – Railway and Other Guided Transport Systems (Safety) Regulations, 2006).

- 5.4 The LOD and the LLAU, as approved by the Scottish Parliament and as restricted by side agreements entered into with various objectors, are shown on the baseline drawings produced by the System Design Services (SDS) designers and set out the geographical boundaries of the project.

Route alignment

Newhaven to Constitution Street

- 5.5 From the two side-platform tramstop at Newhaven on Lindsay Road to Ocean Terminal, the tram will run segregated parallel to the street and then on-street for a short section. A new retaining wall structure, approximately on the line of the existing pedestrian ramp, will provide

access from the regraded Lindsay Road to Dock Road. The alignment runs along the existing road, running to the tramstop at Ocean Terminal, which comprises both a centre island and side platform, where a turnback facility is provided. From Ocean Terminal, the tramline runs on-street along Ocean Drive, over the existing bridge at the Victoria Dock entrance and the existing Tower Place bridge, both of which will be modified to accommodate the tramway. An island platform tramstop will be provided off-street on Ocean Drive near the new casino and proposed residential developments, from where the alignment runs off-street as far as Tower Street.

- 5.6 From Tower Street to the Foot of the Walk, the tramway runs on-street, a mixture of segregated and non-segregated. Two side platforms will be provided at the south end of Constitution Street, with the southbound platform being used by both bus and tram. This tramstop serves the Foot of the Walk and provides a key interchange with revised bus services, with stopping locations on Great Junction Street and Duke Street situated as close as possible to the junction. These are to be linked by good pedestrian walking routes and real-time passenger information for bus and tram services.
- 5.7 General traffic and northbound buses will be excluded from the southernmost section of Constitution Street. Laurie Street and Academy Street will be the alternative routes available to this traffic.

Foot of the Walk to York Place

- 5.8 The tramlines will run on-street (centre running) for the length of Leith Walk from Foot of The Walk to Picardy Place. Platform stops, located centrally between tram lanes, are proposed at Balfour Street and McDonald Road. The London Road and Picardy Place junctions will be modified as necessary.
- 5.9 At London Road junction, the existing roundabout will be replaced by a conventional T-junction, with bus stops retained in Elm Row.
- 5.10 At Picardy Place, there will be a gyratory arrangement for general traffic, with two side platforms providing interchange with London Road corridor bus services at adjacent bus stops. The tram will cross the junction of Broughton Street, and will run in the centre of the street along York Place to the northeast corner of St Andrew Square.

City centre

- 5.11 The layout of the tramline through St Andrew Square will consist of a twin track running southbound and northbound on North St Andrew Street, the east side of the square and on South St Andrew Street. There will be an island tramstop on the east side of the square, facilitating interchange with the Bus Station and a bus stop on the north side of the square.
- 5.12 Buses and general traffic will be accommodated northbound and southbound in North St David Street, the west side of St Andrew Square and South St David Street. The transfer of southbound traffic from North and South St Andrew Streets and the east side of St Andrew Square will take place on a permanent basis before construction work starts on the east side of the square.
- 5.13 From the junction of South St David Street and Princes Street the tram will continue along Princes Street. In order to allow for future extensions to the network, passive provision, in terms of track geometry, is to be made for Line 3 to join the Phase 1a tram track at the St Andrew Street junction with Princes Street. Princes Street will be served by an island tramstop, located between Hanover Street and Frederick Street. The tram track will continue to the west of Princes Street across the junctions with South St. Charlotte Street and Lothian Road. From the West End the route will continue on a central alignment along Shandwick Place, with an island stop located between Atholl Crescent and Coates Crescent. Interchange with buses in the westbound direction will be facilitated by a bus stop at the west end of Coates Crescent. For special events which require curtailment of the tram service at

Shandwick Place there will be a temporary bus stop in the eastbound direction at the east end of Coates Crescent.

- 5.14 Buses will continue to use Shandwick Place, along with trams, while general traffic will no longer be routed via Shandwick Place. Traffic management measures will be introduced in order to accommodate general traffic which currently uses Shandwick Place on alternative routes, such as Palmerston Place, Morrison Street and the West Approach Road. In addition, Torphichen Place will become a two-way street to facilitate access for general traffic on the Tollcross-Queensferry Road axis by avoiding the need to negotiate Haymarket junction.
- 5.15 Continuing towards Haymarket the tram route will run in both directions along West Maitland Street. At Haymarket there will be a revised junction / crossroads configuration. Bus services that serve the Corstorphine Road corridor will also be routed westbound along West Maitland Street providing improved bus priority and easing the volume of traffic around the gyratory. Buses for the Dalry Road corridor may, subject to suitable junction timing permitting, also make use of West Maitland Street, westbound.
- 5.16 Eastbound, West Maitland Street will accommodate both buses and general traffic, as at present. Dalry corridor services will be able to continue to use the gyratory via Morrison Street. The roads around the junction, such as Morrison Street, Dalry Road and Grosvenor Street will also be re-configured. The tram will continue through the junction and through the site of the existing Caledonian Alehouse, which is to be demolished, towards Haymarket Yards. A twin side platform stop is proposed on a viaduct structure in front of Rosebery House that will carry the tram off street parallel to Haymarket Terrace. The stop will provide an interchange with the Haymarket heavy rail station and with buses. Bus services in the westbound direction will be split between a stop for local services in the extended forecourt of the Haymarket station building, providing good connectivity with eastbound services on Dalry Road, and a stop at the back of the westbound tram platform for longer distance bus services. A facility for tram crews to take rest periods will be incorporated underneath the viaduct structure at this location. West of this stop the alignment will make its way down through Haymarket Yards between Verity House and Elgin House to run parallel to the heavy rail track alongside Haymarket Yards and Balbirnie Place.

Roseburn to Carrick Knowe

- 5.17 The alignment continues parallel to the railway line and crosses Russell Road. From here the tramline skirts around the northern boundary of the ScotRail depot. The tram alignment will be supported by a retaining wall to the rear of the business properties fronting onto Roseburn Street. An elevated stop is proposed immediately opposite the Murrayfield stadium turnstiles to serve both the stadium and the surrounding area.
- 5.18 The tram route crosses Roseburn Street on a viaduct and continues to the south of the rugby stadium on a viaduct which will extend the existing rail embankment. The tram route continues to the south of the training pitches where the increased space allows for a steep grassed embankment in preference to a vertical wall. A new bridge will be provided over the Water of Leith, and to the west the tram continues on a grassed embankment. The residents of the adjacent properties in Baird Drive will be screened, as far as practicable, from the operation of the tram by planting on the embankment. The tram line crosses Balgreen Road on a bridge parallel to the railway. A tramstop to the west will be accessed by a ramp from Balgreen Road. The tram will continue along the south of Carrick Knowe Golf Course in the area reserved for a dedicated transport corridor, and then will rise to cross to the south of the railway on a new bridge at the west end of the golf course.

Carrick Knowe to Edinburgh Park

- 5.19 Between Carrick Knowe and South Gyle Access the tram will use the alignment of what is currently the guided busway which runs parallel to the railway. The existing busway will be adapted to allow the tram to use it. Two existing bridges over Saughton Road and Broomhouse Drive will also be converted for use by the tram. Stops will be provided adjacent to Saughton Road (two side platforms) and South Gyle Access (two side platforms). The tram

will cross South Gyle Access on a new bridge and then run in the verge beside Bankhead Drive and the railway. The bus services that are displaced from the guideway will be provided with bus priority measures in advance of the guideway undergoing conversion for tram use.

- 5.20 A tram stop, consisting of two side platforms, will be provided at Edinburgh Park Station to allow for interchange for passengers between light and heavy rail. Investigations are underway with a view to also providing a park and ride facility at this location. The tram alignment will then rise onto a viaduct and turn north to re-cross the railway and enter Edinburgh Park. The tram will run in a reserved public transport corridor, which has been included in the business park masterplan, and a tram stop, consisting of two side platforms, will be provided at the centre of the park.

Gogar Junction

- 5.21 The alignment crosses Lochside Avenue and South Gyle Broadway at signalised junctions and a tram stop comprising two side platforms and located at the edge of the car park, will provide access to the Gyle Centre. The tram will pass underneath the A8 and the roundabout slip roads in a new tunnel structure.

Depot

- 5.22 The depot is situated between the Fife rail line and the Gogar roundabout. This utilises a small triangle of waste ground and some agricultural land at the edge of the greenbelt. The depot will be constructed at a low level in order to facilitate the entry of trams from beneath the A8 underpass at an appropriate gradient to avoid infringing the runway approach envelope and, therefore, minimise visual impact from the A8. This has resulted in the requirement to remove existing earth bunds and the further requirement to undertake a significant amount of excavation to lower the existing ground level by approximately 4.5 metres. A depot building will house staff accommodation and control room for the system, together with maintenance facilities and storage. Stabling will be provided for the tram fleet, with provision for future fleet expansion. There will also be a tram stop for staff only for accessing the depot.

Gogarburn

- 5.23 The alignment continues west parallel to the A8 to a new stop at Gogarburn, which will serve the Royal Bank of Scotland plc's World Headquarters. The Gogar Burn will be crossed on a new bridge.

Ingliston and airport

- 5.24 The alignment will run west through farmland to Ingliston. The existing Park and Ride facilities at Ingliston will be extended and served by a tram stop consisting of two side platforms, replacing the X48 bus service. To the north the tram will run alongside the Gogar Burn, through the rear of the airport hotel car park and cross the airport service road. The terminus stop, which will be a centre platform, will be on the site of Burnside Road and will provide an integrated transport hub served by trams, buses and taxis.

Interchange

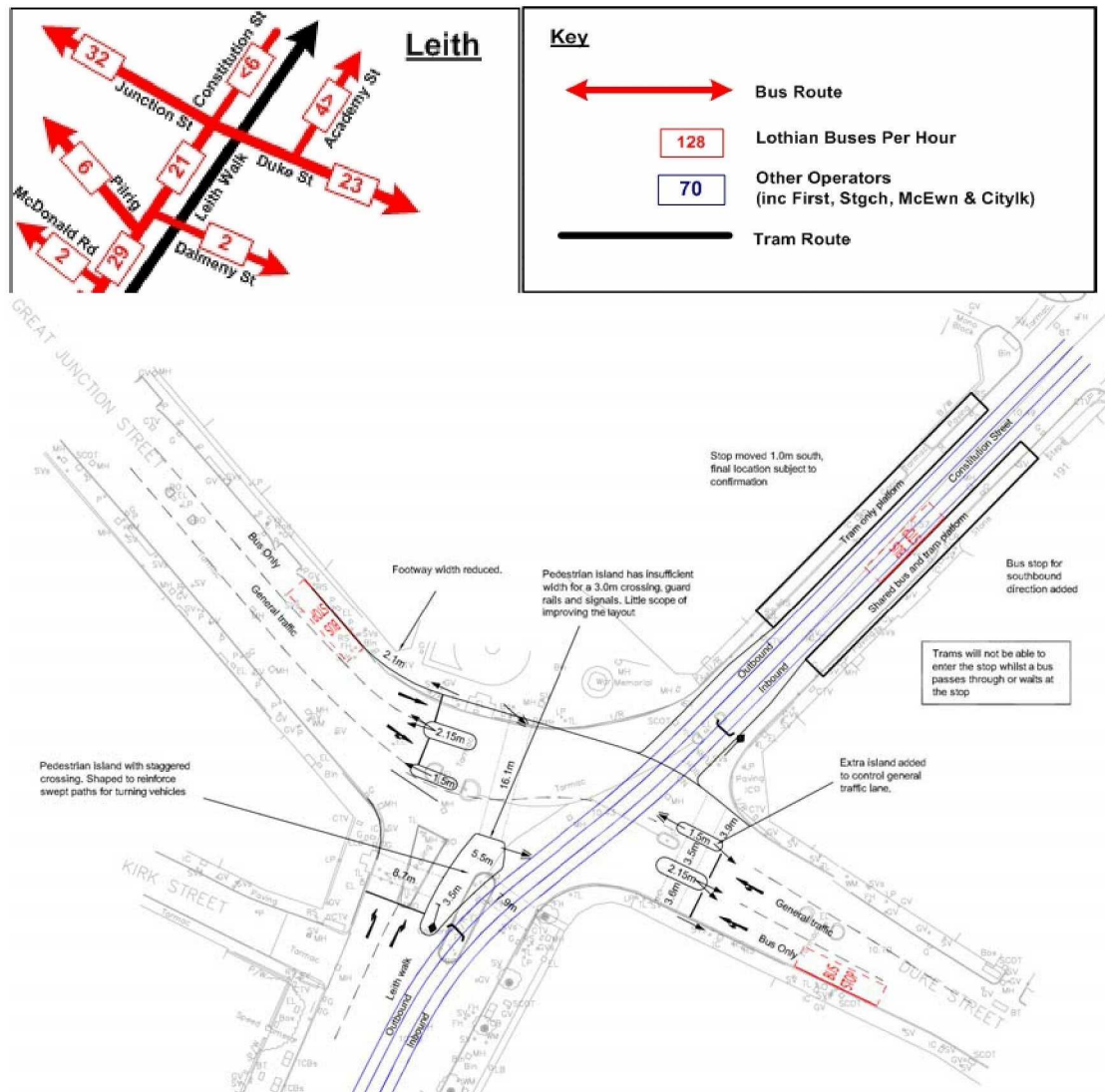
- 5.25 The integration with buses, achieved through service integration plans, is dependent on successful physical integration of bus and tramstops at key locations which have been identified as being critical for an effective interchange infrastructure and these now form part of the scope of the project.
- 5.26 Since Royal Assent, various options have been developed for interchanges. The base assumption for all interchanges is that, where possible, interchange should strive to be cross platform, under cover, timetabled and simple. It should seek to avoid the necessity for passengers to cross roads, walk distances greater than 50 metres or have gradients greater than 2.5%. However, specific characteristic of the location and / or design constraints may

make it impossible to comply with this. The principal bus / tram interchanges for Phase 1a and other opportunities for interchange are outlined below.

Foot of Leith Walk

5.27 This interchange (Figure 5.1) is the key to being able to curtail bus routes at the northern end of Leith Walk. As the numbers of passengers involved, in what will be enforced modal interchange, is significant, a high quality of design, minimising both walking distances and waiting times, must be achieved. The network design will address the issue in such a way as to minimise terminating buses.

Figure 5.1 Interchange at Foot of Leith Walk

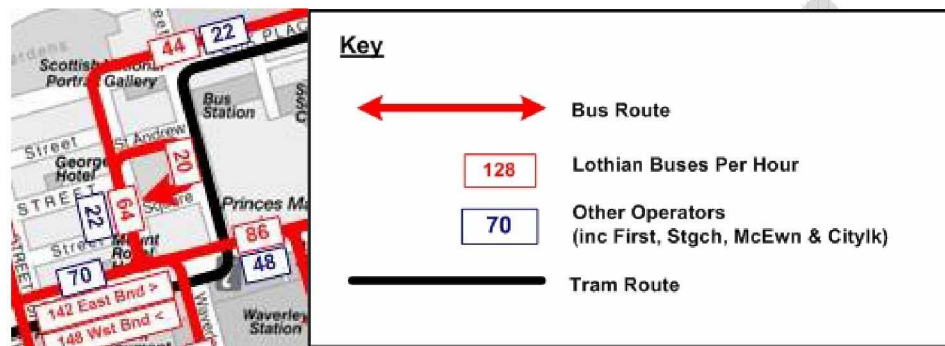


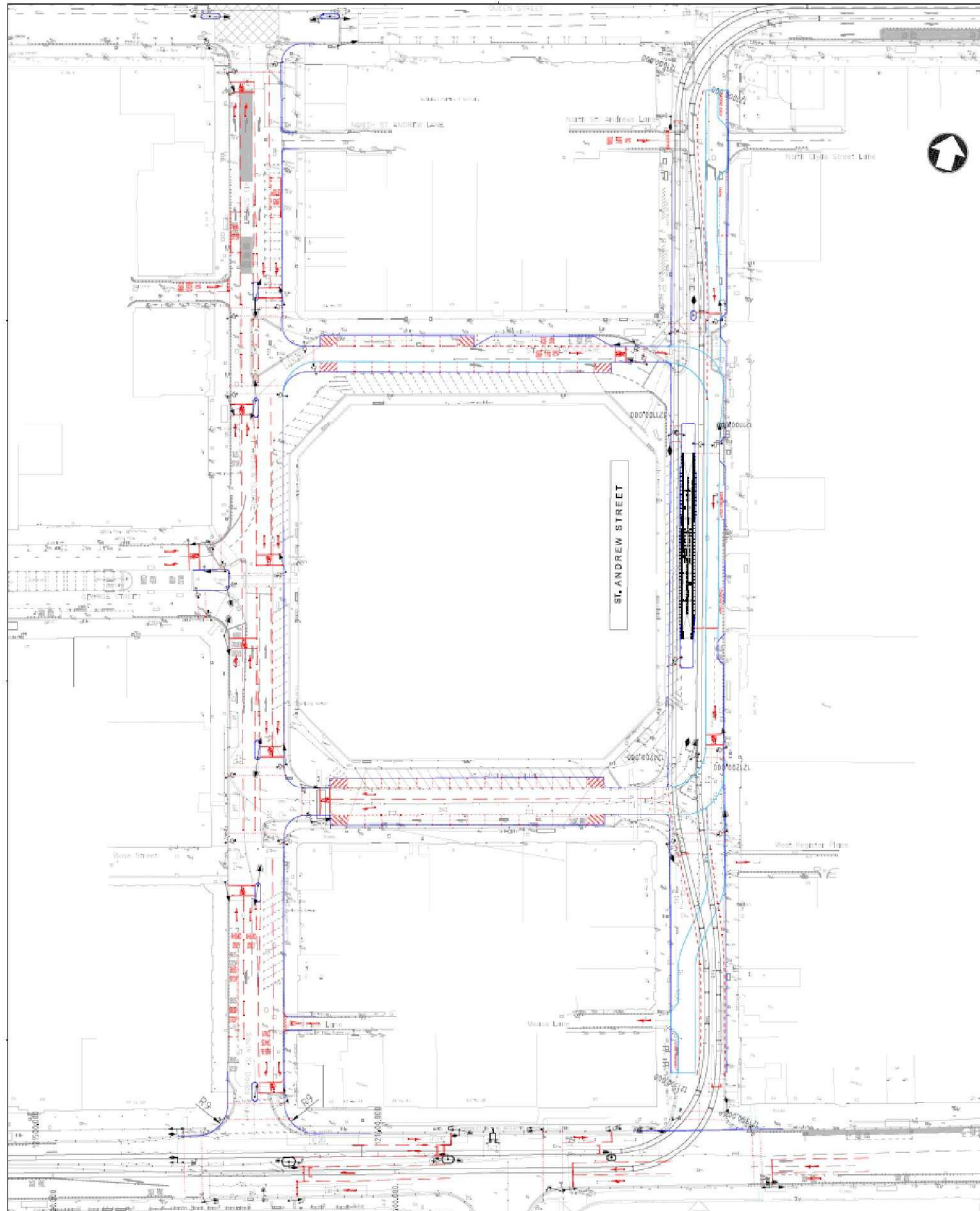
5.28 The interchange solution for the Foot of Leith Walk has now been developed, as indicated above, and further improvements are being developed in order to move the bus stops on Great Junction St and on Duke St closer to the junction to improve connectivity and visibility with the tramstop. Given the space available, road layout and traffic movements that constrain the area, the design has sought to optimise the interchange whilst providing safe traffic management and pedestrian movement. This is achieved through the use of tram lanes, bus only lanes and improved pedestrian crossings sighted along the walking desire lines.

St Andrew Square

- 5.29 An interchange at the east end of the city centre (Figure 5.2) is essential to accommodate buses reaching the city centre from points west and south of the West End which currently continue via Leith Walk. These are the routes which need to be truncated in order to achieve modal transfer on Leith Walk. In addition, there will be certain “through” bus services.
- 5.30 The design proposal involves reopening of South St. David Street for buses to run south to north and north to south, with trams accommodated in St. Andrew Street and the east side of the square. Interchange stops will be located on the north side of St. Andrew Square (buses) and close to the bus station (trams). The design proposals meet the operational requirements of both bus and tram, and the gradient and distance requirements for passengers.

Figure 5.2 Interchange at St. Andrew Square.

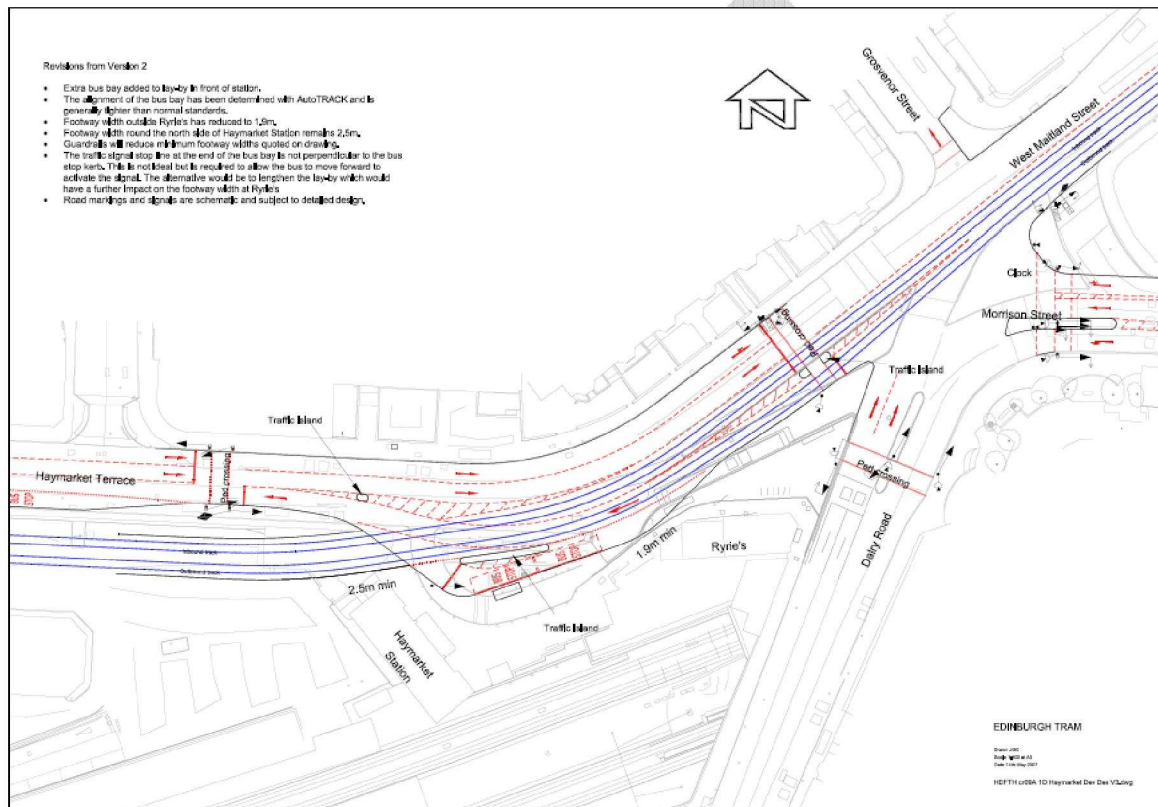
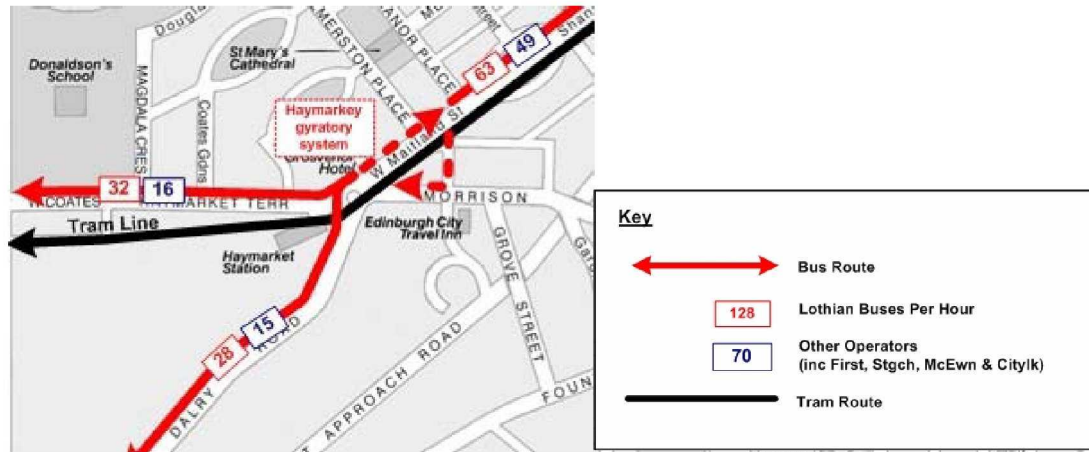




Haymarket

- 5.31 Interchange between tram and bus and, in some cases, heavy rail, is a key function to be taken into account in the design of all tramstops. However, locations other than those referred to above are not crucial to any alterations to bus services which are entailed in the service integration plans in section 9. While not a critical factor in relation to planned alterations to bus services, one interchange in particular is highly significant in regard to interchange between heavy rail and TEL bus and tram, namely, Haymarket (Figure 5.3).
- 5.32 In this case, there are no plans to curtail bus services to feed into trams. However, the separate objective of ensuring the best possible opportunity for interchange between heavy rail and both trams and buses necessitates the provision of appropriate interchange infrastructure at Haymarket. Therefore, it is essential that tramstop and bus stop locations at Haymarket are at the core of plans developed under the Haymarket interchange project. It is also vital that tram project work takes account, as far as is possible, bearing in mind the geographic constraints of the limits of deviation, of future plans for Haymarket redevelopment.

Figure 5.3 Interchange at Haymarket.



Ingliston Park and Ride

5.33 The tram service from / to Ingliston will be a direct replacement of the existing X48 bus service. The approved extension of the existing Park and Ride and potential future integration opportunities with regional bus services, necessitate high quality interchange facilities.

Edinburgh Park Station

5.34 The design locates the tramstop directly outside the rail station, thus allowing for interchange between tram and heavy rail. Investigations are underway for providing a park and ride facility adjacent to the tramstop.

Interfaces with other projects and functional boundary

5.35 In addition to the interchange considerations above, the tram has important interfaces with other projects as follows:

EARL and proposals for future interchange with heavy rail at Gogar

Following the announcement that EARL would not go ahead, the Scottish Government is proposing an alternative option which would include a heavy rail station at Gogar with connection to the tram to serve passengers from Fife and further north travelling to the airport. Given the relative recent announcement no detailed work has so far been undertaken to assess this impact, however it is likely to have a net beneficial impact on the tram projections.

Edinburgh Waverley infrastructure enhancement

- 5.36 This project commenced on site in January 2006 and has included the construction of a new bay platform at Haymarket Station in order to relieve congestion at Waverley during the works there. This is parallel to the tram alignment through Haymarket Yards and will be adjacent to the access to be created as part of Phase 1a to the Haymarket Station car park. To date there has been close interaction between the two projects and this has been incorporated into the tram alignment. Cooperation will need to continue to ensure that both projects can be fully implemented.

Edinburgh Airport Outline masterplan

- 5.37 Commitments have been made to Edinburgh Airport Limited, New Ingliston Limited and Meadowfield Limited regarding the need to ensure that any future access road to the airport can be accommodated alongside the tram depot at Gogar. The depot has been designed to ensure that this commitment can be achieved. In addition, the tramstop location at the airport and the interaction with the buses and taxis needs to continue to be coordinated to ensure that an integrated transport solution is delivered.

Ingliston Park and Ride Phase 2

- 5.38 Phase 2 of Ingliston Park and Ride lies adjacent to the Ingliston Park and Ride tramstop on Phase 1a, the future Phase 3 of the tram (the Newbridge Shuttle) and the existing Phase 1 of the Ingliston Park and Ride site. Due to these significant interfaces, careful consideration is being undertaken in the detailed design in order to ensure all of these projects benefit from the park and ride extension. In order to facilitate this, CEC and SESTRAN have instructed **tie** to commence construction of Ingliston Park and Ride Phase 2 as a standalone project. This will allow park and ride patronage to continue to increase in advance of the tram coming into service.

Haymarket masterplan

- 5.39 Given the potential for interchange at Haymarket, CEC have been provided with the tramstop location for use in developing the Haymarket Masterplan. It is also vital that the tram project takes account of, as far as is possible, the future plans of the Haymarket area. To this end a representative of the tram project team attends all of the Haymarket Interchange Masterplan Steering group meetings.

Waterfront Masterplan

- 5.40 This sets out the development aspirations for the Waterfront area. Some of the development is underway and has been completed, for example Telford College, with other schemes well under construction. However, to ensure that the Masterplan can be implemented in full, there will need to continue to be close interaction between the CEC Planning Authority, Waterfront Edinburgh and the tram project.



Leith Docks Development Framework

- 5.41 This framework sets out the development aspirations of the Leith Docks areas, which is one of the biggest development opportunities in Edinburgh. CEC has already been working closely with Forth Ports, the largest landowner in this area, in relation to the redevelopment of the area. The tram project continues to work closely with both CEC and Forth Ports to ensure that the wider redevelopment of this area fits with the tram alignment that has been developed following considerable consultation with Forth Ports.

St Andrew Square Capital Streets Plan

- 5.42 Given the status and importance of the St Andrew Square, and the plans to improve the streetscape and setting of this area in advance of the tram works, the project and CEC are working closely together to co-ordinate the works required for both the project and to minimise any unnecessary work. It has been planned for the MUDFA contractor to undertake the works necessary for buses, taxis and general traffic to be relocated to the west side of St Andrew Square in the first half of 2008. This paves the way for the Capital Streets Project contractor to undertake their works to all areas of the Square, except for the east side, during 2008. The Infracore will then complete the works on the east side of the square, using free-issue materials provided by the Capital Streets Project, so as to provide homogeneity in finish, in conjunction with the construction of the tram alignment. CEC's aim is to create a public realm space and the aim of the project is to create a transport interchange. These aims are complementary and, accordingly, continued careful interface will be required.

City centre management

- 5.43 Given the tram runs through the city centre, the project has been and will continue to consult and work with the City Centre Management Company to minimise any impacts to retailers from the construction, operation and maintenance of the tram and to continue to ensure buy-in for the project from the retailers.

Road Network / Road Traffic Management Interfaces

- 5.44 A large section of the tram network runs along / within the road network in the city centre. To avoid an unacceptable impact on road users and the road network, there has been close liaison with the roads authority during the design development. This has been both in respect of the impacts of construction and operation of the tram. Traffic management plans will be agreed with the roads authority and both TTROs and TROs are being prepared, in respect of the construction and operation phases, respectively.

NR interfaces

- 5.45 A large section of the tram runs alongside the main Edinburgh to Glasgow heavy rail main line. Liaison is underway with regard to NR agreements, licences and leases and given the proximity of the alignments it will be necessary to assess the requirements for whether any immunisation works to the heavy rail system is needed. Accordingly, there will need to be continued close interaction and collaboration with NR to try to ensure all of the necessary works are carried out as efficiently in terms of time and money as possible.

Vehicle capability

- 5.46 The tram provided by the selected bidder will comply with specific design criteria, including the following:
- High safety standards, compliance with HMRI tramway guidance;
 - High reliability, minimum maintenance required and ease of repair;
 - Proven design and technology and industry standard technology;
 - Track gauge of 1,435mm;
 - At least 230 passenger total carrying capacity with standees @ 4 passengers / m²;
 - At least 80 seats, of which a minimum of 16 seats must be accessible to passengers without using steps;
 - Up to 7.5 m² of floor area to be allocated to full height luggage racks;
 - Trams nominal 43m in length in order to be able to meet the passenger and luggage carrying capacity identified above;
 - Nominal width of 2.65m externally;
 - 100% of the floor area will be low floor with a height above rail level of between 300mm and 400mm;
 - Passenger doors will be situated on both sides. All doorways will allow for level boarding access at 300 – 350mm above the top of the rail.
 - The slope of the floor at the entrance shall be less than 5%;
 - Double door clearance width of no less than 1,300mm and clearance height of no less than 2,050mm;
 - Compliant with the Rail Vehicle Accessibility Regulations 1998, wheelchair spaces will be accessible directly from these doorways without steps;
 - Maximum operating speed of 80kph;
 - Operable from a nominal 750dc overhead power supply;
 - Modular construction (ease of maintenance);
 - Minimum operating capability of at least 100,000km per year;
 - Bi-directional;
 - Fitted with equipment to automatically indicate the trams position to and communicate with a central control centre;
 - Fitted with 'bus-tracker' GPS unit to allow tram locations to be seen and displayed on CEC 'bus-tracker' displays and in the bus control room to facilitate effective interchanges;
 - Internal flatscreen display panels for showing realtime passenger information;
 - Internal and external destination displays;
 - Provision for wheelchairs;
 - Capable of supporting a buffing load appropriate for segregated tramway operation without a physical connection with NR;
 - CCTV equipment to provide rear views for driving, front and internal recorded views for incident investigation and crime prevention;
 - Seats will be at least 450mm wide;
 - Headroom through the seating area will be at least 2.2m to ceiling in the low floor areas;
 - If loss of overhead supply, batteries will allow all essential systems to operate for a minimum of 30 minutes;
 - Door performance – 12 seconds cycle time for the doors to open and close which includes DDA (Disability Discrimination Act) requirements and passenger and driver reaction times;
 - Single roof mounted pantograph with maximum and minimum operating heights of 6.7m and 3.8m respectively;

- The pantograph will comprise a base frame, frame, horned slipper holder, pantograph spring and electrical raising / lowering device;
- Tram inspector to tram driver alarm device unique to each tram;
- Cash vault fitted to the cab for depositing ticket revenue;
- Flange lubrication on at least 20% of the fleet; and
- Passenger counting equipment on at least 20% of the fleet.

Route capability

- 5.47 The performance criteria of the route include the following:
- Phase 1a has a target journey time (including layover and dwell times of 25 seconds at each stop) of 44 minutes and 30 seconds in each direction.
 - The design of the network will enable 99% of monitored tram departures to be no earlier than one minute and no greater than two minutes late, compared to the scheduled headway. The reliability of the service will be measured at Edinburgh Airport where arrivals and departures will also be monitored to check the regularity of a tram waiting to be loaded, Edinburgh Park Station (departure), Haymarket (departure), Foot of the Walk (departure), Leith (departure) and Picardy Place (departure).
- 5.48 The scheme has been designed to allow a service frequency of eight tph in each direction for each of the two services. Eight tph between Ocean Terminal and the airport and eight tph between Newhaven and Haymarket, resulting in a frequency of 16 tph on the common section. There is capacity to enhance this service. Further details of the proposed tram service patterns are provided under 'Tram operations' below.
- 5.49 The general design principle is to provide the optimum segregation for the tram-way, which will allow for consistency of run-time and reduced interaction with other road traffic and which, in turn, leads to increased patronage and benefits. The route is all double track. There will be one depot which will provide maintenance and stabling facilities for the entire fleet of trams on the initial network. There will be turnback facilities at:
- Edinburgh Park Station;
 - Haymarket Yards;
 - Shandwick Place;
 - York Place;
 - Foot of the Walk; and
 - Ocean Terminal.
- 5.50 A tram will be timetabled to be present at the airport tramstop
- 5.51 The layover will be four minutes minimum or 10% of the timetabled runtime, whichever is the greater. There will be layover facilities at the airport and Ocean Terminal. The depot halt at Gogar will be the location where drivers changeover.
- 5.52 The system will operate as a "line of sight" tramway with tramway signalling provided at road junctions and at tram crossings as appropriate. The following assumptions have been made as part of the run time simulation model. However, it should be noted that these are for design purposes only and that the eventual speeds will be established and agreed with the independent competent person (ICP) prior to shadow running:
- maximum speed of 80 kph;
 - assumed reductions in speed due to horizontal and vertical alignment;
 - assumed reductions in speed due to line of sight conditions; and
 - road traffic speed limits.
- 5.55 Provision will be made in the design for a delta junction at Roseburn to allow flexibility in operations. However, for Phase 1a only plain line will be laid for the Airport to Haymarket route without the turnouts, but with provision for these to be retrofitted at a later date. Passive provision in the design has also been made for the connection of Line 3 at Princes St and at Ingliston for a future potential extension to Newbridge.

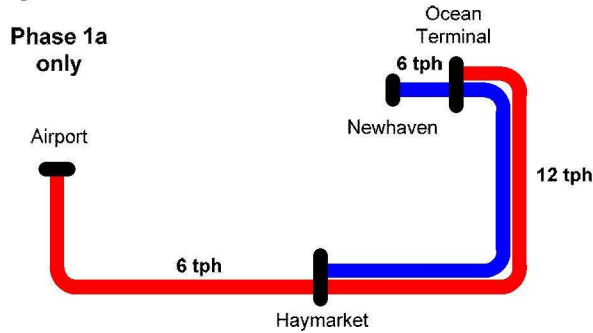
Operations and control functionality

- 5.56 The control room will be the focal point for the control and operation of the ETN. Its purpose shall be to provide a working place for supervisors to manage and coordinate day-to-day activities associated with tram system operations and will be linked by telephone to the bus, NR and CEC CCTV control rooms for coordination. The depot control room will be located on the first floor of the depot building.
- 5.57 The depot control room comprises of a number of workstations, at which control room staff sit and use equipment to remotely control or retrieve data from the system. The operator interface shall be designed to carry out control functions in an ergonomically efficient manner.
- 5.58 The depot control room workstations will provide indication and control of such auxiliary systems and services as follows:
- Operation of passenger help / passenger emergency help point system;
 - Tram position and detection system status and alarms;
 - Public address announcements, volume level control and indications;
 - 'No-break' power supply status and alarms;
 - Intruder and fire alarms;
 - Communications systems status and alarms;
 - Ticket vending machine alarm indications;
 - CCTV;
 - System plant / services status indications and alarms;
 - Traction power system;
 - Radio system;
 - Emergency telephones;
 - Performance monitoring system;
 - Central data recording and storage;
 - Security;
 - Passenger information display management;
 - Communications network monitoring;
 - Video / CCTV image printing; and
 - 'Bus tracker' overview display to indicate the locations of interconnecting bus services.
- 5.59 Equipment at, or near, tramstops and at road crossings will be needed to facilitate tram signal and traffic controls. This will include poles and signs, together with control boxes and electrical supply pillars. Control cabinets will be required close to all signals. Tram stop equipment cabinets will house all other control equipment. The tramway will be signalled using tramway signals. The road and tram signals will interface with the urban traffic controls (UTC) and will require pillars or cabinets to house the tram recognition system.

Tram operations

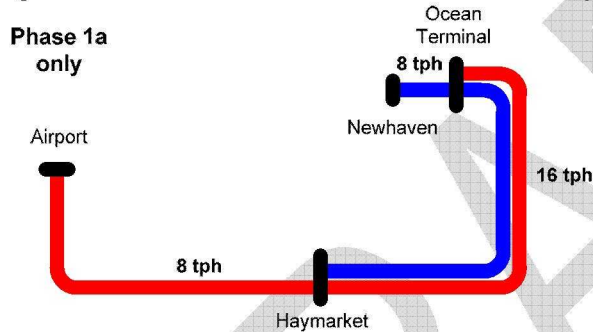
- 5.60 The JRC modelling work, in conjunction with the service integration plan, prepared for the DFBC produced the patronage forecast for the tram and for buses. For phase 1 it separately identified Phase 1a, although for completeness, the information for both Phase 1a and 1b is provided below. This allowed the tram and bus service plan to be validated and adjusted to ensure sufficient capacity is provided at an affordable level throughout the network. The service integration plan seeks to provide an integrated public transport network upon introduction of the tram.
- 5.61 The tram service provision is based upon the number of trams per hour (tph) necessary to carry the demand predicted by the model in the AM peak hour in the busiest direction. This tram service frequency is applied in 2011 when the tram opens and for up to the first four years of operation, dependent upon the rate of patronage ramp-up as shown in Figure 5.4 .

Figure 5.4 – 2011 tram services for Phase 1a



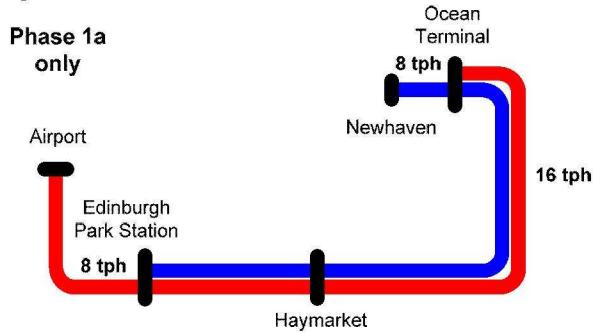
5.62 The modelling process indicates that, after the initial 'build-up' period, the tram services will require to be strengthened to provide sufficient capacity primarily to serve demand on the Ocean Terminal to Haymarket section of the network (Figure 5.5). On that basis, the services will increase to 8tph on each of the service routes, initially in the morning and evening peaks, Monday to Friday but building by 2016 to a whole day peak service, Monday to Friday, between 08:00 and 19:00.

Figure 5.5 – tram services for Phase1a after initial 'build-up' period



5.63 The modelled passenger projections indicate that, after the year 2027, the tram services will require to be strengthened further to provide sufficient capacity to serve demand on the Haymarket to Edinburgh Park section of the network (Figure 5.6). Consideration of this has led to a potential solution of extending, for Phase 1a, the Newhaven to Haymarket service to Edinburgh Park, providing 16tph between Ocean Terminal and Edinburgh Park.

Figure 5.6 – 2027 indicative tram services for Phase1a



5.64 The times of first and last tram services and the frequencies during the operating day for:

- 6 trams per hour initial timetable;
 - an 8 trams per hour morning and evening peak enhanced timetable, and
 - 8 trams per hour 07:00 to 19:00 enhanced timetable
- Are shown in Tables 5.1, 5.2 and 5.3 below.

5.65 These scenarios are based upon the following assumptions and conditions:

- The two balanced services combine to give a total of 12 or 16 trams per hour per direction on the common section between Ocean Terminal and Haymarket are required during the daytime to replace the withdrawn bus services (and therefore demand and capacity) on Leith Walk;
- For the purposes of ramping up / down service short workings between Edinburgh Airport, Haymarket Yards and St. Andrew Square are based on the ability to turn trams at St Andrew Square using the turnback in York Place;
- Edinburgh Airport service tram frequency is ramped up / down from Ocean Terminal or Haymarket service tram frequency is ramped up / down from Newhaven;
- Service proposals are based on the requirement to always have a tram present at the Airport tramstop.
- Trams going into service between the Gogar depot and Ocean Terminal / Newhaven will run "in service" from the Gyle (first tram Gyle to Ocean Terminal at approximately 05:15 Monday to Saturday);
- Haymarket service trams going out of service running between Newhaven and Gogar depot will run "in service" as far as the Gyle;
- Edinburgh Airport service trams going out of service will run "in service" from Ocean Terminal to Edinburgh Airport with a short "dead run" from Edinburgh Airport to Gogar depot; and
- The period of time between the last tram returning to the depot at night and the first tram leaving the depot in the morning Monday to Saturday is about 4hrs 30 minutes. Consequently the maintenance window will allow work on the system infrastructure for about 3 hours and 45 minutes, depending on location each night and allowing time for the implementation and withdrawal of isolations.

Table 5.1 First and last tram services and frequencies for 6 and 6 tram per hour Operational Timetable

		Monday - Friday (trams per hour)					
Network / Phasing	Service frequency commencing at:	first tram					last tram
		06:00	06:45	07:00	07:20	23:15	23:59
1a	Airport to Ocean Terminal	0	6	6	6	6 ^a	0
1a	Ocean Terminal to Airport	6	6	6	6	6	0
1a	Haymarket to Newhaven	0	0	6	6	0	0
1a	Newhaven to Haymarket	0	0	0	6	0	0
1b	Airport to Ocean Terminal	0	6			6 ^a	0
1b	Ocean Terminal to Airport	6	6			6	0
1b	Granton to Newhaven	0	6			6 ^b	0
1b	Newhaven to Granton	6	6			6 ^c	0
		Saturday (trams per hour)					
Network / Phasing	Service frequency commencing at:	first tram					last tram
		06:00	06:45	07:30	07:50	23:15	23:59
1a	Airport to Ocean Terminal	0	6	6	6	6 ^a	0
1a	Ocean Terminal to Airport	6	6	6	6	6	0
1a	Haymarket to Newhaven	0	0	6	6	0	0
1a	Newhaven to Haymarket	0	0	0	6	0	0
1b	Airport to Ocean Terminal	0	6			6 ^a	0
1b	Ocean Terminal to Airport	6	6			6	0
1b	Granton to Newhaven	0	6			6 ^b	0
1b	Newhaven to Granton	6	6			6 ^c	0
		Sunday (trams per hour)					
Network / Phasing	Service frequency commencing at:	first tram					last tram
		07:00	07:45	08:00	08:20	23:15	23:59
1a	Airport to Ocean Terminal	0	6	6	6	6 ^a	0
1a	Ocean Terminal to Airport	6	6	6	6	6	0
1a	Haymarket to Newhaven	0	0	6	6	0	0
1a	Newhaven to Haymarket	0	0	0	6	0	0
1b	Airport to Ocean Terminal	0	6			6 ^a	0
1b	Ocean Terminal to Airport	6	6			6	0
1b	Granton to Newhaven	0	6			6 ^b	0
1b	Newhaven to Granton	6	6			6 ^c	0

Notes:

^a from approx 23:15 trams run from Airport - City Centre only

^b from approx 23:15 trams run from Granton - City Centre only

^c from approx 23:15 Granton trams run from Newhaven - Haymarket continuing in service on TL2 to Gyle

Note: The numbers in individual cells give the service frequency starting from the time at the top of the relevant column.

Table 5.2 – First and last tram times for the enhanced AM and PM peak timetable

Networking (Phasing) and Service Frequency commencing at:		06:00	06:45	07:00	07:20	07:45	09:45	15:45	19:00	19:45
1a	Airport to Ocean Terminal	0	6	8	8	8	6	6	8	6
1a	Ocean Terminal to Airport	6	6	8	8	8	6	6	8	6
1a	Haymarket to Newhaven	0		6	8	8	6	6	8	6
1a	Newhaven to Haymarket	0		0	6	8	6	6	8d	6
1b	Airport to Ocean Terminal	0	6	8		8	6	6	8	6
1b	Ocean Terminal to Airport	6	6	8		8	6	6	8	6
1b	Granton to Haymarket	0	6	8		8	6	6	8	6
1b	Haymarket to Granton	6	6	8		8	6	6	8	6

Phase	Service Frequency commencing at:	Saturday (trams per hour)				
		First tram 06:00	06:45	07:30	07:50	23:15
1a	Airport to Ocean Terminal	0	6	6	6	6a
1a	Ocean Terminal to Airport	6	6	6	6	6
1a	Haymarket to Newhaven	0	0	6	6	0
1a	Newhaven to Haymarket	0	0	0	6	0
1b	Airport to Ocean Terminal	0	6	6	6	6a
1b	Ocean Terminal to Airport	6	6	6	6	6
1b	Granton to Newhaven	0	6	6	6	6b
1b	Newhaven to Granton	6	6	6	6	6c

		Sunday (trams per hour)									
		first tram									last tram
Networking (Phasing) and Service Frequency commencing at:		07:00	07:45	07:50	08:00	08:45	18:00	18:20	18:45	23:15	23:59

1 a	Airport to Ocean Terminal	0	6	<u>6</u>	<u>6</u>		<u>6</u>	<u>6</u>		<u>6a</u>	<u>0</u>
1 a	Ocean Terminal to Airport	<u>6</u>	<u>6</u>	<u>6</u>	<u>6</u>		<u>6</u>	<u>6</u>		<u>6</u>	<u>0</u>
1 a	Haymarket to Newhaven	<u>0</u>		<u>6</u>	<u>6</u>		<u>6</u>	<u>6</u>			<u>0</u>
1 a	Newhaven to Haymarket	<u>0</u>		<u>0</u>	<u>6</u>		<u>6</u>	<u>6d</u>			<u>0</u>

1 b	Airport to Ocean Terminal	0	6		<u>6</u>	<u>6</u>	<u>6</u>		<u>6</u>	<u>6a</u>	<u>0</u>
1 b	Ocean Terminal to Airport	<u>6</u>	<u>6</u>		<u>6</u>	<u>6</u>	<u>6</u>		<u>6</u>	<u>6</u>	<u>0</u>
1 b	Granton to Haymarket	<u>0</u>	<u>6</u>		<u>6</u>	<u>6</u>	<u>6</u>		<u>6</u>	<u>6b</u>	<u>0</u>
1 b	Haymarket to Granton	<u>6</u>	<u>6</u>		<u>6</u>	<u>6</u>	<u>6</u>		<u>6</u>	<u>6c</u>	<u>0</u>

Notes:

- a) from approx 23:15 trams run from Airport - St Andrew Sq only
- b) from approx 23:15 trams run from Granton - St Andrew Sq only
- c) from approx 23:15 Granton trams run from Newhaven - Haymarket continuing in service on to Gyle
- d) from approx 19:20 (18:50 Saturdays and 18:20 Sundays) Haymarket trams running from Newhaven - Haymarket continue in service to Gyle

Note: The numbers in individual cells give the service frequency starting from the time at the top of the relevant column.

Table 5.3 - First and last tram services and frequencies for 8 and 8 tram per hour enhanced timetable

Network (phasing) and service frequency commencing at:		Monday - Friday (trams per hour)									
		06:00	06:45	07:00	07:20	07:45	19:00	19:20	19:45	23:15	last tram 23:59
1a	Airport to Ocean Terminal	0	8	8	8		8	8		8 ^a	0
1a	Ocean Terminal to Airport	8	8	8	8		8	8		8	0
1a	Haymarket to Newhaven	0		8	8		8	8			0
1a	Newhaven to Haymarket	0		0	8		8	8 ^d			0
1b	Airport to Ocean Terminal	0	8	8		8	8		8	8 ^a	0
1b	Ocean Terminal to Airport	8	8	8		8	8		8	8	0
1b	Granton to Newhaven	0	4	4		8	8		4	4 ^b	0
1b	Newhaven to Granton	4	4	8		8	4		4	4 ^c	0
Network (phasing) and service frequency commencing at:		Saturday (trams per hour)									
		first tram 06:00	06:45	07:30	07:50	08:15	18:30	18:50	19:15	23:15	last tram 23:59
1a	Airport to Ocean Terminal	0	8	8	8		8	8		8 ^a	0
1a	Ocean Terminal to Airport	8	8	8	8		8	8		8	0
1a	Haymarket to Newhaven	0		8	8		8	8			0
1a	Newhaven to Haymarket	0		0	8		8	8 ^d			0
1b	Airport to Ocean Terminal	0	8	8		8	8		8	8 ^a	0
1b	Ocean Terminal to Airport	8	8	8		8	8		8	8	0
1b	Granton to Newhaven	0	4	4		8	8		4	4 ^b	0
1b	Newhaven to Granton	4	4	8		8	4		4	4 ^c	0
Network (phasing) and service frequency commencing at:		Sunday (trams per hour)									
		first tram 07:00	07:45	07:50	08:00	08:45	18:00	18:20	18:45	23:15	last tram 23:59
1a	Airport to Ocean Terminal	0	6	6	6		6	6		6 ^a	0
1a	Ocean Terminal to Airport	6	6	6	6		6	6		6	0
1a	Haymarket to Newhaven	0		6	6		6	6			0
1a	Newhaven to Haymarket	0		0	6		6	6 ^d			0
1b	Airport to Ocean Terminal	0	6		6	6	6		6	6 ^a	0
1b	Ocean Terminal to Airport	6	6		6	6	6		6	6	0
1b	Granton to Newhaven	0	6		6	6	6		6	6 ^b	0
1b	Newhaven to Granton	6	6		6	6	6		6	6 ^c	0

Notes:

^a from approx 23:15 trams run from Airport - St Andrew Sq only

^b from approx 23:15 trams run from Granton - St Andrew Sq only

^c from approx 23:15 Granton trams run from Newhaven - Haymarket continuing in service on to Gyle

^d from approx 19:20 (18:50 Saturdays and 18:20 Sundays) Haymarket trams running from Newhaven - Haymarket continue in service to Gyle

Note: The numbers in individual cells give the service frequency starting from the time at the top of the relevant column.

Operational integration with bus

5.66

It is a critical element of planning for the tram system that the operation of bus and tram (and other modes of transport) should be as fully integrated as possible. The principal bus operator in Edinburgh is LB, which is majority owned by the public sector. To facilitate tram / bus integration and maximise the operational and service opportunities this presents, CEC established Transport Edinburgh Limited.

- 5.67 The objective is to deliver an integration plan which:
- Creates a combined bus and tram network which will be financially viable from the start of tram operation;
 - Avoids unnecessary duplication of provision, and thereby maximises operating efficiencies; and
 - Minimises enforced passenger interchange between modes, except where interchange infrastructure is assumed to be deliverable.
- 5.68 TEL will plan and manage the two operations as a single unit to provide an integrated transport network. Operationally, TEL will retain its bus set-up and take full advantage of the appointment of Transdev as the operator for the tram system. Key areas for integration are set out in the TEL Business plan:
- Fares strategy;
 - Ticketing strategy and systems;
 - Revenue protection;
 - Service integration and service patterns;
 - Interchanges;
 - Operational support systems;
 - Safety and quality management; and
 - Risk management and insurance.
- 5.69 A summary of the TEL Business plan and the planned bus services to integrate with the tram service patterns above are provided in section 9.

Project constraints

- 5.70 The tram project will continue to address the effect on the World Heritage Status of Edinburgh. **tie** has sought to minimise or eliminate any adverse impact the tram system may have by working closely with the CEC Planning Authority to develop complementary solutions. The design work developed as part of the recommended procurement option is targeted on the most sensitive sections of the route, with the aim of facilitating planning solutions in these areas. The topography, layout, numerous ancient monuments and Sites of Special Scientific Interest, have all been evaluated and have shaped the alignment and detailed design of the tram system that is part way through the planning approvals process. **tie** is committed to minimising any adverse impact on these areas.
- 5.71 During the construction phase there are periods where 'restricted' or 'no construction' can be achieved in certain areas, primarily during the Edinburgh Festival and in the run up to Christmas. The scheduling of construction takes into account when areas will be curtailed, and minimises any potential down-time by pragmatic targeting of resources.
- 5.72 In addition, various documents were prepared during the Parliamentary process, which impose constraints on the construction and operation of the tram. These include:
- **Code of Construction Practice (CoCP)** – This was developed during the parliamentary process and the Bill amended to provide that the authorised undertaker must use all reasonably practicable means to ensure that the works are carried out in accordance with the CoCP. This document sets out the working hours, noise levels during construction, methods of minimising dust, vibration and the like during the construction period, consultation requirements etc.;
 - **Code of Maintenance Practice** – This has been developed from the CoCP specifically to cover maintenance activities after the tram becomes operational;
 - **Noise and Vibration Policy** – Again this was document was developed during the parliamentary process and the Bills were amended to provide that the authorised undertaker must use all reasonably practicable means to ensure that the Noise and Vibration Policy is applied to the operation of the tram. This imposes operational requirements during testing and commissioning on the tram supply and infrastructure contractors and, thereafter, the operator and maintainers. The scheme must be designed and constructed so as to endeavour to comply with the policy, failing which, there will be a need for further mitigation measures e.g. noise barriers following the operation of the