letter of closure, to indicate that everything possible had been done to negotiate with the objector and that no agreement was able to be reached. Where negotiations had come to a standstill **tie** issued a position statement, informing the objector what had been done so far, and inviting them to continue negotiations. A summary of this is set out in Table 6.3.

TABLE 6.3 OBJECTION MANAGEMENT

	Number of objections	Objections withdrawn	Agreement made	Letters of Comfort	Letters of Closure
Line 1	192	33	21	5	3
Line 2	77	49	36	5	11

6.32 For those whose objections were not resolved by agreement, or withdrawn, there is ongoing stakeholder consultation. Essentially the consultation exercise provides these remaining residents and businesses that still have issues with the opportunity to attend meetings and have input into the various stages of the design process.

Side Agreements

6.33 As a result of the objection management process, side agreements have been put in place with a number of objectors. These are managed by **tie**'s land and property team.

Update on consultation – recent developments

6.34 In late 2003, as the Private Bills for Tram Lines 1 and 2 were prepared for introduction to Parliament, a number of Community Liaison Groups (CLGs) were set up in key areas along the proposed routes[50].

6.35 **tie** and CEC recognise the importance of effective community liaison during the design process, and through to implementation of the tram network. As such, **tie** and partners are working with residents, businesses and others along the route to develop the best possible opportunities for consultation, discussion and explanation. In November 2005, a questionnaire was sent out to all those who attended the existing CLG meetings, asking for detailed feedback on the meetings, and asking for ideas on how meetings could be arranged in the future.

6.36 This feedback lead to a change in approach, following Royal Assent. This new approach has been put in place to ensure that those frontagers directly impacted by trams are dealt with on an individual basis so their specific thoughts and concerns can be fed into the design process. The wider public will also be consulted through larger meetings and exhibitions.

6.37 A Business Liaison Group has been set up for traders on Leith Walk and Constitution

[50] The CLG areas are Ratho Station, Baird Drive, West End, Leith Walk/Constitution Street, Trinity/Starbank, Lower Granton Road and Craigleith.

Street.

6.38 The Frontager Survey originally completed by Mott MacDonald in early 2005, which covered Leith Walk and Constitution Street, has been repeated and validated by Halcrow. Halcrow have undertaken a route wide frontager survey of all businesses and residents around the proposed route, excluding Princes Street and St Andrew's Square, which will be the subject of a separate consultation.

6.39 The Systems Design Services (SDS) consultants (Parsons Brinkerhoff) provide a team which provides stakeholder support by way of a stakeholder relationship manager and design manager responsible for stakeholder relations who have worked with **tie** to formulate a design specific consultation programme.

6.40 The aim of these design consultations is to enable direct, face-to-face discussion between the design team and affected individuals and **tie** to ensure that those affected by the tram have the opportunity for individual input. Other aims are to increase understanding of the decision-making process and the means by which individuals can influence the design, to increase knowledge and awareness, to encourage those affected by the tram to focus on practical issues and options, to collect detailed records of issues, concerns, ideas and preferences and to use these to inform the design, to maintain a dialogue throughout the design process in which each decision can be explained with reference to the documented concerns of the individuals who have contributed and finally to foster a direct, open and constructive relationship between **tie** and individuals around the route.

6.41 Meetings have been organised at 3 key stages in the design process:

- To feed information into the preliminary design (April-June 2006)
- To present and explain the preliminary design and collect further feedback (August-September 2006)
- To present and explain the final design and take comments on any aspects which may still be modified (November-December 2006)

6.42 Meetings have been organised for every section of the route, and invitations sent to all individual frontagers abutting the LOD, both residential and business. Separate, additional consultation events for the wider community to be organised at stage 2 (preliminary design), as mentioned below.

6.43 After a presentation by SDS and general question-and-answer session, attendees are invited to talk through and document their own issues, concerns and ideas on the consultation forms provided. These are transmitted directly to the individual designers working on each section, and provide an unambiguous record of the meeting.

6.44 The initial design consultation started on 24th April, and for the purposes of consultation, phases 1a and 1b of the route were divided into 14 sectors[51]. The

[51] The 14 sectors are: Foot of the Walk - Constitution Street; Constitution Street – Leith Waterfront; MacDonald Road – Foot of the Walk; Picardy Place – MacDonald Road; Haymarket – Shandwick Place; Balbirnie Place; Roseburn Maltings; Craigleith – Crewe Toll; Roseburn – Craigleith; Granton; Murrayfield – Balgreen Road;

preliminary design review started in July 2006 and will finish by the end of 2006. Feedback from businesses and residents from the design review will feed into the final design, and final design meetings will be held in late 2006.

6.45 In addition separate consultation is taking place with the residents of Baird Drive based on **tie**'s obligations according to the Edinburgh Tram Line 2 Act 2006, in particular regarding plans for the construction of the network in that area.

6.46 Completed questionnaires which had been submitted to designers will be available for reference so that frontagers can see where their comments had been taken into account for the next stage of design, or if they had not they will be provided with an explanation.

6.47 Alongside the frontager meetings, the SDS stakeholder team have visited individual frontagers who had specific issues in order to discuss on a one to one basis.

6.48 At the moment, the next step is to receive comment from the frontagers on preliminary design.

6.49 At the same time as the second set of design consultation meetings in Sept – Nov 2006, there will be 6 further public consultations[52]. These will be exhibitions staffed by members of **tie** and the design team, who will provide project information and give members of the public on the background on why Edinburgh needs a tram network and the benefits it will bring. There is also the opportunity to look at the detail of the preliminary design and talk one to one with designers.

6.50 Further consultation groups have been convened for other stakeholders.

6.51 The Disability Access consultation group was set up in December 2005 and is held once every two months. **tie** has convened its own forum for the purposes of disability consultation by making contact with various disability interest groups.

6.52 The Cycling consultation group has also been ongoing since December 2005, and is made up from representatives from the Cyclists' Touring Club (the UK's national cyclists' organisation), SPOKES (a local cyclists' group also referred to as the Lothian Cycle Campaign) and SUSTRANS (a UK wide charity for the promotion of sustainable transport).

6.53 All of the objections in respect of the amendment at the Gyle were subsequently withdrawn and although not all of the objections in relation to the route change at Haymarket were withdrawn, the Committee agreed in its Consideration Stage Report published on 21 December 2005 that the route be amended as sought.

6.54 The Emergency Services Consultation, ongoing since the beginning of 2006, is made

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Haymarket – Murrayfield; St Andrew Square – York Place; Shandwick Place – Princes Street East and Princes Street East – St Andrew Square.

[52] These 6 consultations will cover the areas of Leith, Roseburn, New Town, Airport, Granton, Edinburgh Park (Western Approach).

up from representatives from Fire and Rescue, Lothian and Borders Police, the Coastguard, The Ambulance Service and CEC Emergency Planning Office.

7. DESCRIPTION OF PROPOSED SCHEME

This Chapter sets out a high level description of the proposed scheme for a number of areas, providing the basis for the appraisal set out in the next Chapter:

- Route alignment - noting stop locations, elements of major infrastructure and integration with the road network;
- Infrastructure – detailing key elements of infrastructure associated with the tramway;
- Tram vehicle specification;
- Tram operations;
- Capital and operating costs; and
- Bus network integration – setting out the proposals for the integration of Lothian Buses with Edinburgh tram.

Introduction

7.1 The proposed scheme now comprises a combination of elements of the former Line 1 and Line 2 proposals. These are described below.

Route Alignment

Phase 1a

Newhaven to Constitution Street

7.2 From Newhaven Stop on Lindsay Road to Ocean Terminal the tram will run segregated parallel to the street 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 Lindsay Road to Dock Road. The alignment runs parallel to the existing road, segregated running to the tramstop at Ocean Terminal, where a turnback facility is provided.

7.3 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. A 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.

7.4 From Tower Street to Foot of the Walk, the tramway runs on-street, a mixture of segregated and non-segregated. Platform stops are provided between Bernard and Queen Charlotte Streets.

Foot of The Walk to York Place

7.5 The tramlines will run on-street (centre running) for the length of Leith Walk from Foot of The Walk to Picardy Place.

7.6 Platform stops, located centrally between tram lanes, are proposed at Foot of The Walk, Balfour Street, and McDonald Road.

7.7 The London Road and Picardy Place junctions will be modified as necessary, possibly retaining roundabouts, and there will be a platform tramstop at Picardy Place, within the general area of the existing car park fronting the Holiday Inn Hotel.

7.8 The tram will cross the junction of Broughton Street, and will be centre running along York Place, to the northeast corner of St Andrew Square

City Centre

7.9 The layout of the tramline through St Andrew Square will consist of either a single track around a loop consisting of St Andrew Sq West (South and North St David Street), Queen St, St Andrew Sq East (North and South St Andrew Street), and Princes Street, or a twin track running along the east side of the square in St Andrew Street. Under the former arrangement, there will be two stops one serving eastbound and one west bound passengers; under the latter, there will be a bi-directional stop close to the Bus Station. (These options are under development with CEC, with finalisation and identification of the preferred option expected in Q1 2007.)

7.10 From the junction of South St David Street and Princes Street the tram will continue along Princes Street, as double track, on a specially developed public transport route closed to general traffic. There will be a single stop located between Hanover Street and Frederick Street. The alignment 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. Continuing towards Haymarket along West Maitland Street the tram will be centre running reaching Haymarket Junction, where there will be a revised roundabout configuration. The roads around the junction, such as Morrison Street and Dalry Road will also be re-configured. A stop is proposed on a viaduct structure which will carry the tram off street parallel to Haymarket Terrace. The stop will provide an interchange with the Haymarket heavy rail station.

7.11 West of this stop the alignment will make its way between Rosebery and Elgin House to run parallel to the heavy rail track alongside Balbirnie Place.

Roseburn to Carrick Knowe

7.12 The alignment continues parallel to the railway line to bridge over 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 turnstiles, which will service the stadium and the surrounding area.

7.13 The tram will cross Roseburn Street on a viaduct and then continues to the south of the rugby stadium on a retaining wall, 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 from the operation of the tram by planting at the foot of the embankment and noise barriers at the top. The tram will cross Balgreen Road on a bridge at the same level as 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 rises 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

7.14 Between Carrick Knowe and South Gyle Access the tram will follow the alignment of and will replace the guided busway, which currently runs parallel to the railway. Two existing bridges over Saughton Road and Broomhouse Drive will be converted for use by the tram. Stops will be provided adjacent to Saughton Road and South Gyle Access.

7.15 The tram will cross South Gyle Access on a new bridge and then run in the verge beside Bankhead Drive and the railway. A stop will be provided at Edinburgh Park Station to allow for interchange for passengers between light and heavy rail.

7.16 The tram alignment will then rise onto a viaduct and turn north to recross the railway and enter the Edinburgh Park development area. The tram will run in a reserved public-transport corridor, which has been included in the business park masterplan, and a stop will be provided at the centre of the park.

Gogar Junction

7.17 The alignment crosses Lochside Avenue and South Gyle Broadway at signalised junctions and a stop will provide access to the Gyle shopping centre. The Tram will pass underneath the A8 and the roundabout slip roads in a new tunnel structure.

Depot

7.18 A depot site has been identified between the Fife Rail Line and Gogar Roundabout. This utilises a small triangle of waste ground and some agricultural land at the edge of the greenbelt. The depot site is bounded to the north by the line of the proposed Edinburgh Airport Rail Link. The depot will be constructed at a low level in order to minimise visual impact and to avoid disruption to the airport runway flight path, hence a significant amount of excavation will be required to lower the existing ground level by approximately 7metres.

7.19 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 an allowance for future fleet expansion.

Gogarburn

7.20 The alignment continues west parallel to the A8 to a new stop at Gogarburn, which will serve the Royal Bank of Scotland's World Headquarters. The alignment around Gogar Church has been selected to minimise impact on expected archaeological remains, the setting of listed buildings and a scheduled ancient monument, along with the ecological issues along the Gogar Burn, which will be crossed on a new bridge.

Ingliston and Airport

7.21 The alignment will run west through farmland to Ingliston, crossing the proposed EARL line on a bridge. The existing Park and Ride facilities at Ingliston will be extended to serve a tramstop. 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 will be on the site of Burnside Road and will allow for future inclusion within a transport interchange hub including access to the heavy rail link, the tram, buses and taxis. A covered walkway, constructed by Edinburgh Airport, will provide access to the airport terminal building.

Phase 1b

Granton Square to Ferry Road

7.22 The tram will run through the Granton Waterfront development area from Granton Square to the junction of West Granton Access and West Granton Road, at the northern edge of Pilton. This area is currently undergoing comprehensive redevelopment and as such the tram alignment has been determined primarily through the development master-planning process. The tram alignment continues along West Granton Access and through the junction at Ferry Road. Stops are planned at Granton Square, Waterfront Avenue, West Granton Access, Caroline Park and Ferry Road (Crewe Toll).

7.23 The planned stop at Granton Square has a potential positive effect on the townscape by reinforcing what is currently a rather neglected nodal point in the urban fabric. From Granton Square to the junction between West Harbour Road and the new spine road, the tram will run on a segregated alignment along the north side of West Harbour Road.

7.24 Through much of the Granton development area, the tram will form part of a transport boulevard along the new spine road. The design for this area will be developed in conjunction with the planners and developers so that the tram forms an integral part of the development. In particular the materials used will reflect the design intentions of the masterplan. Midway along Waterfront Avenue there will be a tramstop (Granton Waterfront) and also a stop at Caroline Park near the junction with Waterfront Broadway. Both stops will be designed to fit with the surrounding landscape, with platforms slightly raised and blending with the surrounding pavements.

7.25 The redevelopment of the Granton Waterfront area is so extensive that its character is primarily one of change, so it is only slightly sensitive to further change. The introduction of the tram system has already been designed in the masterplan.

7.26 The tram route through Pilton is along a reserved corridor on the west verge of the newly constructed West Granton Access from West Granton Road to Ferry Road, with a stop positioned approximately mid-way along West Granton Access.

7.27 The tram will be constructed along the broad grass verge to the new road, temporary infill opened up under part of the span of the bridge carrying Crewe Road Gardens over West Granton Access.

7.28 To improve what is currently a fairly bleak townscape it is envisaged that the track-bed will be in-filled with grass and the route will be landscaped with any vegetation removed during construction replaced with areas of trees and decorative shrub planting.

7.29 The Crewe Toll stop located next to the junction between West Granton Access and Ferry Road will form a bus - tram interchange between the north-south orientated tramway and the main road extending east-west.

Ferry Road to Haymarket

7.30 This section provides for residential areas through Craigleith and Roseburn and offers a connection for the rapidly expanding transport needs of the major development area in Granton to the major modal interchange at Haymarket and the City Centre. This section makes use of a former railway corridor, providing a rapid, segregated section of route, which has very little impact upon and from other modes of transport.

7.31 The tram will follow the former railway corridor from Ferry Road to the point where it meets the existing heavy rail corridor just west of Haymarket. South of the Crewe Toll stop at Ferry Road, stops are planned at Telford Road, Craigleith, Ravelston Dykes and Roseburn.

7.32 Alterations will be required to all the smaller bridges that the tram runs over, including the bridge over the A8 at Roseburn. Works will be required to widen the Groathill Avenue and Craigleith Drive underbridges, and also the Coltbridge viaduct. The design for the Coltbridge Viaduct will promote a sympathetic solution within this conservation area.

7.33 At both ends of the former railway corridor, the existing footpath is on embankment some five metres above the surrounding land. Significant slope strengthening works will be required to support the tramline over a length of about 150 metres.

7.34 The former railway surface was converted to a combined cycleway and footpath in the 1980's and is now a well-used and popular recreational facility. The embankment and cutting slopes have become very dense with many mature and semi-mature trees, which are predominately self-seeded, forming a lush enclosed landscape that is distinctly separate from the surrounding primarily residential areas. The area has been maintained against the background of the route being reserved as a public transport corridor.

7.35 The tram and the replacement cycleway/footpath will be constructed on the line of the old trackbed. The tram will run on the east side of the track-bed and the cycle and foot path to the west, with formal crossings as required to allow public accesses to the east.

7.36 The combined width of the tram tracks and the cycleway and footpath will be approximately 11 metres, compared to the original railway of 8 metres and the current cycleway of 3 metres. Through the majority of the existing cutting and embankments retaining structures will be required to accommodate the required widening.

7.37 Where the railway corridor passes under narrow and low arched bridges, the track bed will be lowered to allow the tram tracks to be offset from the bridge centre-line and thus allow room for a narrower cycleway/footpath.

7.38 The safety clearances required for the Overhead Line Equipment (OLE), combined with the increased width of track, mean that extensive tree clearance will be required, opening up the current enclosed nature of the railway corridor. The disturbed slopes will be landscaped and removed vegetation replaced with suitable trees and shrubs.

7.39 The cycleway and footpath will be surfaced in a fine grade blacktop as existing, while the tram track, with the exception of crossings, incorporating a grass finish.

7.40 The stops at Telford Road, Craigleith, Ravelston Dykes and Roseburn are entirely within the railway corridor and will be designed as well-detailed low platforms, with the shelters, seating, signage and other equipment designed as an integrated whole. The level differences between the stops and the adjacent cycleway and accesses will be dealt with by the incorporation of ramps and steps with commensurate lighting and security measures. The Telford Road stop will facilitate access to the nearby hospital while the stop at Craigleith will be positioned to fit with the surrounding access paths to the residential areas and Retail Park. The Roseburn stop will be located close to the A8 serving local residents and properties in the vicinity of the main road.

Tram Infrastructure

Rails, trackslab and surfacing

7.41 The nature of tramline surfacing (track, swept path, affected roads and footpaths) is dependent upon its environment. On street, trackslab construction (reinforced concrete) must provide strength to support the traffic / tram loads (including risk of voids beneath) together with appropriate stray current protection. Steel rails precoated with a resilient material are fixed within the trackslab. The trackslab may also be designed for specific circumstances to mitigate ground borne vibrations and noise. Off-street the rails may be fixed within "grasstrack" (usually a "lawned" type slab or unit construction) or traditional ballast and sleeper type arrangement.

7.42 The extent of surfacing works assumed is based on the following reinstatement criteria:

- typically the tramline width will be a minimum of around 3.5m per lane within street-running sections;
- increased lane width and centre line separation will be required on bends;
- increased centre line to accommodate centre poles where necessary;
- carriageway and footpath width provision should include for the necessary street furniture including signage & signalling, poles, barriers, etc;
- where no existing pavement offers space or access for specific maintenance purposes, additional surfaced pavement may be required; and
- footpaths will generally not be less than 2.0m wide.

Cycleways

7.43 Where practically possible, cycleways and cycle lanes will be provided as segregated routes for cyclists, with the aim of reducing perceived and actual danger from other road users, thus improving the user experience and encouraging their use. Their provision has been an important factor in the design of the Edinburgh Tram system.

Parking bays

7.44 Parking bays will be provided, where possible, along the Edinburgh Trams route for the purposes of loading, residential parking, drop off points, taxi ranks and bus stops, when appropriate.

Trackside equipment

7.45 The provision of trackside equipment, required for the safe and effective operation and maintenance of the tram scheme, will be designed to achieve the appropriate balance between operational use and impact on the setting.

7.46 Trackside equipment may be divided into various categories:

- Power supply - sub-stations, overhead line equipment, trackside isolators and return circuits for OLE;
- Stop equipment cabinets;
- Communications and signalling, including telephones and emergency call buttons;
- Track controls;
- Signage;
- Lighting;
- Fare collection mechanisms;
- Closed circuit television systems (security) and PA; and
- Shelters, seating and balustrading;

Substations

7.47 Twelve new 11kV substations will be built along the route to accommodate the infrastructure's power supply. They will be spaced along the route at approximately 2km spacing, as dictated by the needs to supply power to the system. The substation buildings will be approximately 15m by 4 m plan area, which includes a provision for DNO supply.

Overhead Line Equipment

7.48 Overhead copper cabling supplying power to the vehicles will be supported by either side poles, centre poles or building fixings, as appropriate to the particular location

Stop equipment cabinets

7.49 Each stop will be provided with a Stop Equipment Cabinet, which will house the majority of the control equipment such as communication and signalling equipment. Where possible this would be co-located with a sub-station. Such cabinets are generally metal units with a 1-2m frontage, up to 1m depth and 1.5m high.

Communications and signalling

7.50 Equipment at or near stops and at all road crossings will be needed to facilitate tram signal and traffic controls, this will include poles and signs, together with control boxes and a small electrical supply pillar. Small control cabinets will be required close to all signals (including telephones and emergency call buttons) for power supply controls. Stop equipment cabinets will house all other control equipment. The tramline will be signalled using road type signals. The road signals will interface with the urban traffic controls and will require small pillars or cabinets to house the vehicle recognition system.

7.51 A PA system will be provided at each stop and will be controlled from the Operations Centre at the Depot.

7.52 All communication equipment will be sited on the platforms or where the tram crosses roads in the usual position to warn tram and other vehicles of the right of way at a given junction.

Track controls

7.53 Points at turnouts will be electrically activated either from track circuits, vehicle recognition system or transponders relaying from the control centre. A small power supply pillar will normally be sited close to these to isolate the supply, should it be required. An emergency point lever will be supplied to each vehicle.

7.54 Point motors will be located in pits within the road at the points location.

Signage

7.55 Typical signage at a stop will be stop name boards (perhaps illuminated, usually two per platform), direction signs and local map information, real time information boards, destination signs, timetable, disabled boarding point sign, braille information panel and Edinburgh Tram Logo.

Lighting

7.56 Typically, lighting at the stop will differentiate it from the local street scene and provide adequate levels of illumination for safety.

Fare collection equipment

7.57 It is currently the policy of **tie** and CEC to use inspectors for fare collection in addition to a ticket vending machine at all platforms. The level of redundancy will be subject to review.

Closed circuit television systems (security) and PA

7.58 Closed circuit television cameras are normally mounted on poles strong enough to resist vibrations etc. A public address system and emergency call buttons can be attached to these or other poles such as street lighting columns.

7.59 The cameras will have a point, tilt and zoom facility and will be interfaced to the emergency call button, such that the camera will turn to the location of the call button when the button is pressed. All controls will be contained within the stop equipment cabinet.

Shelters, seating and balustrading

7.60 The type and style of shelters and seating will be determined from the design guide. Their location relative to other stop equipment will vary from stop to stop. Balustrading will be provided as required, in accordance with design guidelines.

Vehicle specification

Introduction

7.61 The procurement of appropriate tram vehicles to operate the Edinburgh Tram Network is underway, with the expectation that a supplier will be appointed following a competitive tendering process in mid 2007. The specification for this procurement process sets out the requirement for the highest quality of design and construction which must comply with the following general design criteria:

- high safety standards, compliance with Railway Safety Principles and Guidance and Rail Vehicle Accessibility Regulations;
- high reliability, minimum maintenance requirement and ease of repair;
- the Tram will be designed to operate in conjunction with a track gauge of 1,435mm and a flange back-to-back dimension consistent with the rail types to be used on the system;
- proven design and technology;
- low floor access;
- ease of cleaning;
- modern and attractive appearance;
- low weight;
- low environmental impact;
- meets access requirements for the disabled;
- minimum use of energy; and
- the Trams will be required to have a minimum operating capability of at least 100,000 km per year.

7.62 The trams will be articulated in order to negotiate the track alignment. They will be fully bi-directional and capable of being driven from either end and will have passenger doors on both sides.

Specific Technical Requirements

7.63 The Tram body will be a nominal width of 2.65m externally and the total Tram length will be a nominal value of 40m.

7.64 The following loading conditions apply in the Specification:

- AW0 = Tram tare weight (empty car)
- • AW1 = AW0 + full load of seated passengers

- • AW2 = AW1 + weight of standing passengers at 4 persons/m2
- • AW3 = AW1 + weight of standing passengers at 5 persons/m2
- • AW4 = AW1 + weight of standing passengers at 6 persons/m2
- • AW5 = AW1 + weight of standing passengers at 8 persons/m2

where the mean passenger weight is taken to be 70.5kg.

7.65 The passenger capacity of the tram will be at least 230 persons, of which a minimum of 80 will be seated, on fixed seats. There will in addition be provision for wheelchairs in accordance with Rail Vehicle Accessibility Regulations. There will also be provision for luggage racks.

7.66 At least 70% of the floor area will be low-floor, with have a height above rail level between 300mm and 400mm. High floor areas will be minimised and all doorways will allow for level boarding access at a height between 300-350mm above the top of the rail.

7.67 The Tram will have a maximum operating speed of up to 80km/h.

Noise and Vibration

7.68 The Tram will be compliant with the Noise and Vibration Policy of the Edinburgh Tram Project and it is important that the proposed Tram should be as quiet as is reasonably possible. This is likely to mean that the proposed design will incorporate wheel damping, side skirts with sound-deadening linings and resilient mounting of electrical equipment likely to generate noise.

7.69 In meeting these requirements, it is a requirement of the tram supplier to carry out noise tests in Edinburgh to determine the frequency peaks generated, in particular by the wheels. The results of these tests will be used to determine the type and extent of any tuned vibration dampers that should subsequently be fitted to the wheels.

Interior

7.70 Care and attention will be given to provide a safe passenger environment within the tram vehicles. In regard to this, passenger movement within the Tram will be made as safe as practicable, and able-bodied passengers will be able to move along the entire length of the passenger saloon of the Tram.

7.71 The free and safe movement and loading of passengers will be facilitated by the incorporation of handrails, grab-poles and an interior free of tripping hazards and sharp corners throughout the Tram and hand-holds will be provided to maximise the use of standing space, particularly in vestibules and articulations.

7.72 Steps may be included to permit the movement of passengers to or from areas where there is a difference in the height of the floor of the Tram. Steps will not exceed 180mm in height and the quantity should be as few as possible. There will be a minimum of 16 seats accessible to passengers without using steps.

7.73 All seats will be at least 450mm wide, ergonomically designed, resistant to damage and soiling and have easily replaceable covers. The seats will as far as possible not be placed on pedestals, i.e. will not require a step up for passengers when taking a seat.

7.74 The actual floor area available for standing passengers will be clearly identified by the Tram Supplier and this has yet to be determined. From this the total standing capacity will be calculated, respecting Rail Vehicle Accessibility Regulations and the limitations of standing room in areas such as articulations. The Tram Supplier will propose alternative seating layouts, incorporating luggage racks and wheelchair spaces. Seating will generally be arranged transversely with minimum longitudinal seating. The Tram Supplier will also indicate any space that might be used for the carriage of bicycles.

7.75 The tram will be fitted with luggage racks, distributed evenly about the vehicle and situated as close as practicable to the vestibules. This will be particularly practical for those passengers travelling with cases or bags to or from the Airport. The luggage racks will occupy a floor space of up to 10m^2 and extend the full height of the interior and have two intermediate shelves. At floor level a horizontal bar will extend across the opening into the saloon to prevent objects rolling out of the luggage space. In addition, and wherever practicable, the tram will be provided with overhead luggage racks in the saloon area, for holding small items of luggage. This provision may account for up to 20% of the required luggage space.

7.76 Headroom throughout the seating areas will be at least 2.3m to ceiling in the low floor areas and where uneven floor height is proposed, then 2.1m to ceiling in the high floor areas.

7.77 All passenger areas of Trams will be provided with a heating and ventilation system that maintains a constant acceptable ambient temperature during transit between Tram stops and during boarding and alighting at Tram stops when operating in all prevailing climatic and environmental conditions on the proposed route.

Bogies

7.78 The bogies are the non-powered sections of the tram located between the traction units and will incorporate suspension systems to give a high-quality ride characteristic. The suspension system will be self-adjusting or adjustable for wheel wear so that ride heights can be closely maintained. The ground clearance (from top of rail) fully laden with worn wheels will not be less than 65mm to any part of the bogie structure except a track guard.

7.79 Each axle will have a spring-applied friction brake. It will be possible to release the spring-applied brake manually in the event of failure of the actuation system. Under normal operation the parking brake will release and apply automatically when the driver's controller is activated. Each bogie will have two electro-magnetic track-brakes, one suspended over each rail between the wheels.

7.80 The wheels will incorporate resilience and damping in order to minimise noise and vibration. Tuned vibration absorbers will be fitted after carrying out tests to determine their most effective parameters. The end bogies will carry adjustable track guards on their outer ends, to conform to Railway Safety Principle and Guidance requirements for under-run protection. The motor bogies will be interchangeable with each other.

7.81 The ride comfort levels measured according to the ISO 2631 Standard on a ballasted straight and level track in good condition are set out in Table 7.1.

TABLE 7.1 RIDE COMFORT LEVELS

Location	Speed	Wz vertical	Wz lateral
Drivers Cab	40 km/h	2,32	1,58
	70 km/h	2,96	2,36
Passenger Compartment	40 km/h	2,24	1,64
	70 km/h	2,82	2,28

Propulsion Equipment

7.82 The Tram will not export additional risk onto Network Rail infrastructure. In particular the harmonic generation from the propulsion and control equipment will not interfere with train-borne or trackside systems or other third party systems and infrastructure.

7.83 Table 7.2 sets out the Trams performance when motoring, on straight and level track and with a nominal line voltage of 750V dc:

TABLE 7.2 TRAM PERFORMANCE

Speed (km/h)	Load	Performance	Notes
0 – 30	Up to AW4	1.2 m/s^2	Instantaneous
0 - 70	Up to AW4	0.8m/s^2	Average

7.84 The Trams will provide safe operation on all gradients under degraded performance modes as imposed by the traction equipment. In particular the Trams will be able to complete any journey on the System with one complete traction drive unit isolated.

7.85 The traction and braking control system will be optimised to provide smooth and low jerk values in starting from rest, acceleration, braking and stopping, on level track and on all gradients that are encountered, under all loading and environmental conditions, while protecting against unintended downhill movement.

Braking Equipment

7.86 The service brake application will be capable of retardation at an acceptable rate (as defined in Railway Safety Principles and Guidance) at all specified tare and laden conditions and the jerk rate will be limited so as to not cause discomfort to standing passengers. The service brake will normally consist of a regenerative electro-dynamic brake, (that as far as is practicable will return the braking energy to the overhead line) and a friction brake. The electro-dynamic brake will normally take precedence over the friction brake.

7.87 The braking performance of the Tram is set out in Table 7.3

TABLE 7.3 TRAM BRAKING PERFORMANCE

Mode	Means of initiation	Effective mean braking rate on level and straight track at AW2 loading	Comments
Service brake	Master controller	1.2m/s^2	1.3m/s^2 maximum instantaneous. Predominantly electro-dynamic brake
Parking brake	Parking brake switch Release of dead man's switch Tram shut-down	N/A	Hold a laden Tram (to AW4), plus an unladen and unbraked Tram on a 8.5% maximum gradient. Friction brake
Hazard brake (Revocable)	Master controller Dead man's switch	2.5m/s2	3 to 4m/s2 instantaneous. Electro-dynamic, friction brakes and track brakes. Sand, continuous audible warning wheel slide correction system active
Emergency brake (Irrevocable)	Red mushroom switch	At least 1.2m/s^2 as per the service brake.	Friction brakes and track brakes Sand

Passenger Doors

7.88 The Tram will be equipped with at least four pairs of bi-parting sliding-plug doors on each side of the vehicle for the passenger saloon and one internal cab door per cab with a clear opening of not less than 610mm. The passenger saloon doors will be fitted on both sides of the vehicle in the low-floor area.

7.89 The doors will be opened and closed by the driver or simply released by the driver so that the passengers will be able to open the doors themselves using door push buttons. The push buttons will be illuminated when they are activated. The doors will stay open for a fixed time before closing automatically. A warning tone will be sounded when the doors are released and a different tone will sound to give warning of door closure.

Passenger Information System

7.90 The Tram will be fitted with six external destination displays, one at each end above the cab and two on each side, one near each end. These displays will be capable of displaying as a minimum a service number and the ultimate destination of the Tram. Internal saloon displays will be used to show information concerning the next stop and additionally a "Tram Stopping" sign. They will also display the local time, and should also be able to display public service information. The number and location of these displays will be such that the information will be easily visible to passengers within any part of the Tram.

7.91 The size of the Passenger Information Display font will conform to the requirements of the Rail Vehicle Access Regulations 1998. The brightness of the displays will compensate for ambient light quality.

Traction Power Supply and Overhead Line Equipment ("OLE")

7.92 The Trams will operate from a nominal 750V dc overhead power supply, and traction return current will be via the running rails. The minimum and maximum supply voltages will be 500V and 900V respectively. The Trams will be fitted with an electrically-raised, roof-mounted pantograph compatible with the overhead line equipment.

7.93 The maximum and minimum wire heights will be determined during the detail design process, and its is anticipated that support to the OLE will be provided as a combination of poles and building fixings, dictated by design and broader planning considerations.

Supervisory, Control & Communications Systems

7.94 The Trams will be fitted with equipment to automatically indicate their position to, and communicate with, a central control centre. A voice radio system will be permanently available between the driver and the control centre.

Tram operations

7.95 The JRC modelling work in conjunction with the service integration plan has produced the latest patronage forecast for the Edinburgh Tram Network. This has 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.

7.96 The service integration plan seeks to provide an integrated public transport network upon introduction of the tram.

7.97 Optimising the TEL bus and TEL tram services has been developed using a number of JRC model runs to refine the network services, and the costs of their provision in terms of operating hours and frequencies of tram and bus services.

7.98 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.

Figure 7.1and Figure 7.2 show the predicted tram loadings against capacity in 2011 in the Eastbound and Westbound directions respectively.

FIGURE 7.1 PHASE 1A+1B 2011 AM PEAK EASTBOUND FLOW

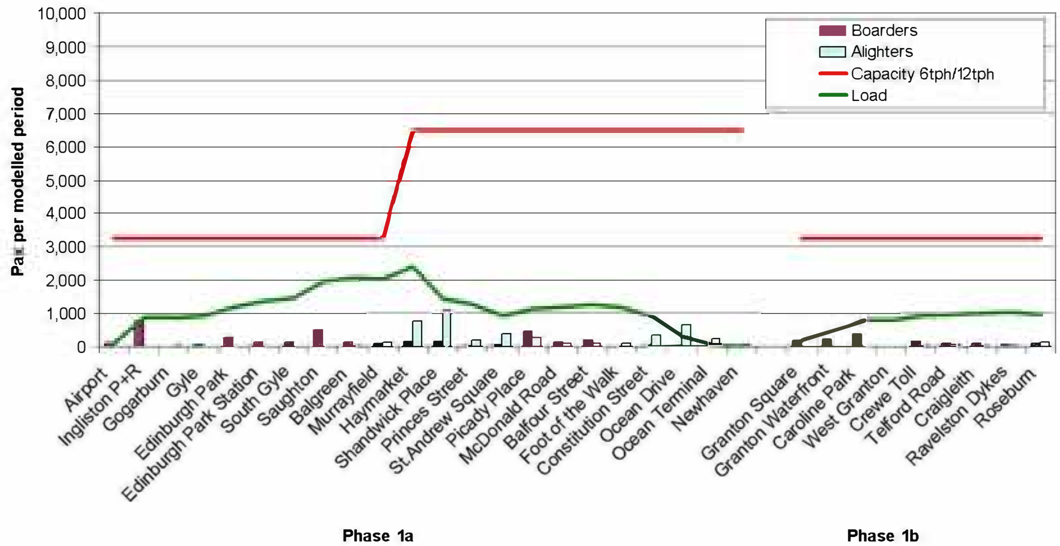
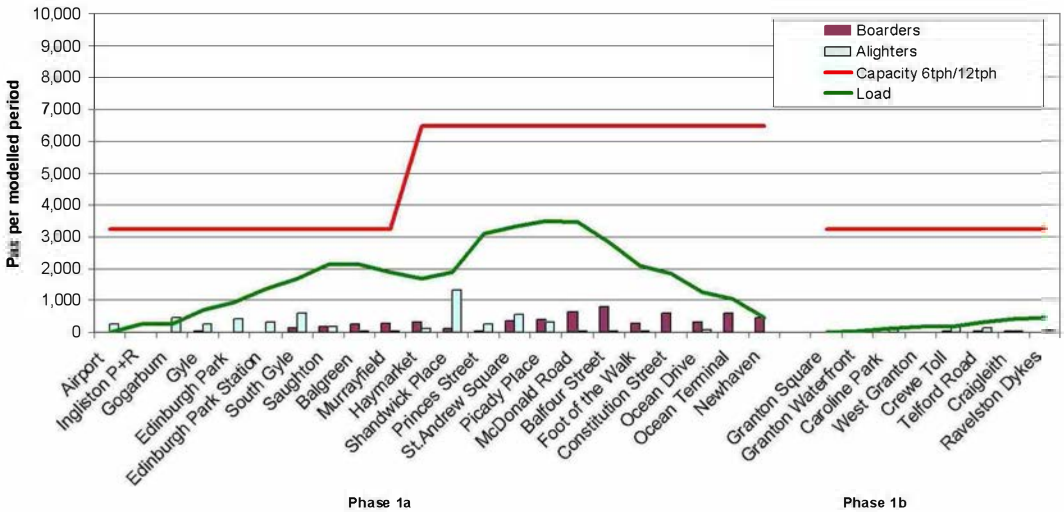


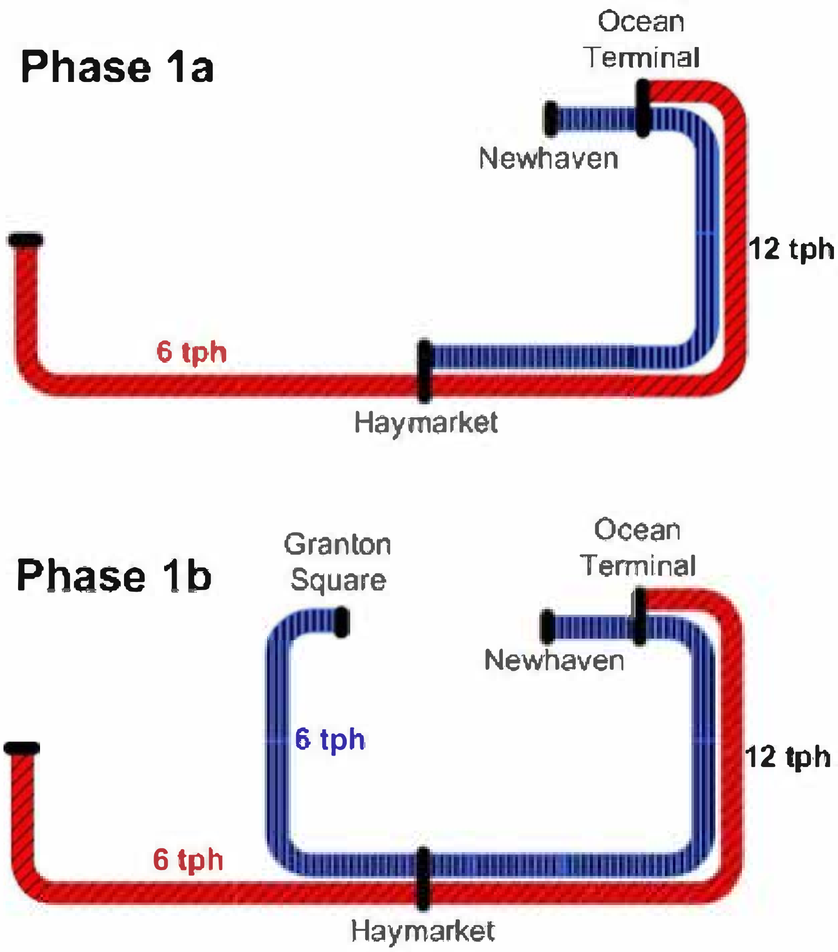
FIGURE 7.2 PHASE 1A+1B 2011 AM PEAK WESTBOUND FLOW



7.99 The busiest direction in the AM peak hour is Westbound, which can be met with a tram service frequency of 6 tph on the Airport branch combined with 6 tph on the Granton branch to provide 12 tph on the combined section.

7.100 This tram service frequency is applied in 2011 when the Edinburgh Tram Network opens and for the first four years of operation. It operates as shown in Figure 7.3 with the services on the common section terminating at Newhaven and Ocean Terminal to ensure services can be turned back efficiently and consistently.

FIGURE 7.3 TRAM OPERATING PATTERN IN 2011



7.101 The JRC model for 2031, as shown in Figure 7.4 and Figure 7.5 for eastbound and westbound respectively, show that there is significant growth in passenger demand arising from both specific developments along the tram corridors and across the whole integrated network.

FIGURE 7.4 PHASE 1A+1B 2031 AM PEAK EASTBOUND FLOW

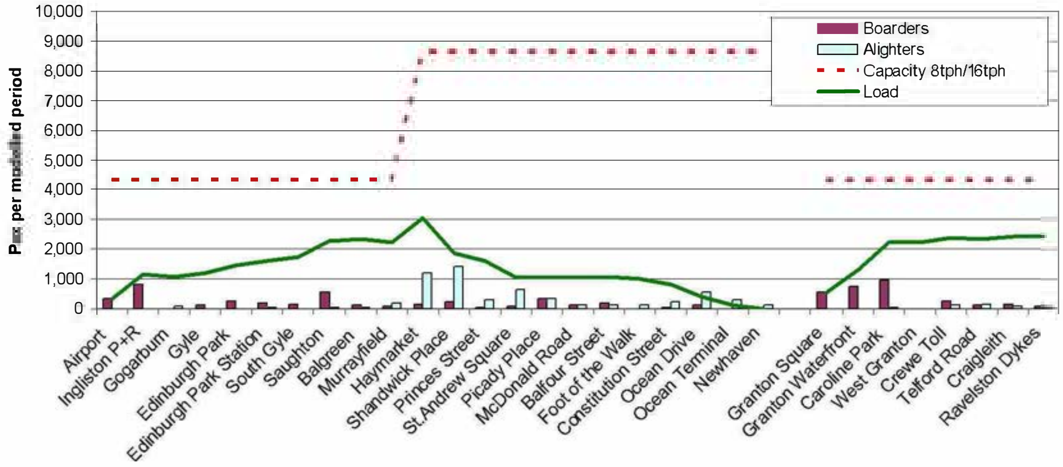
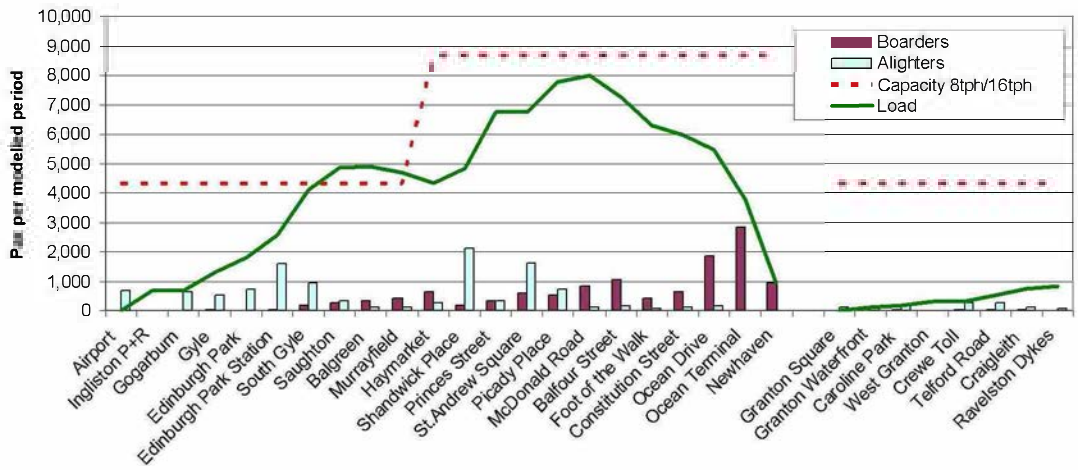
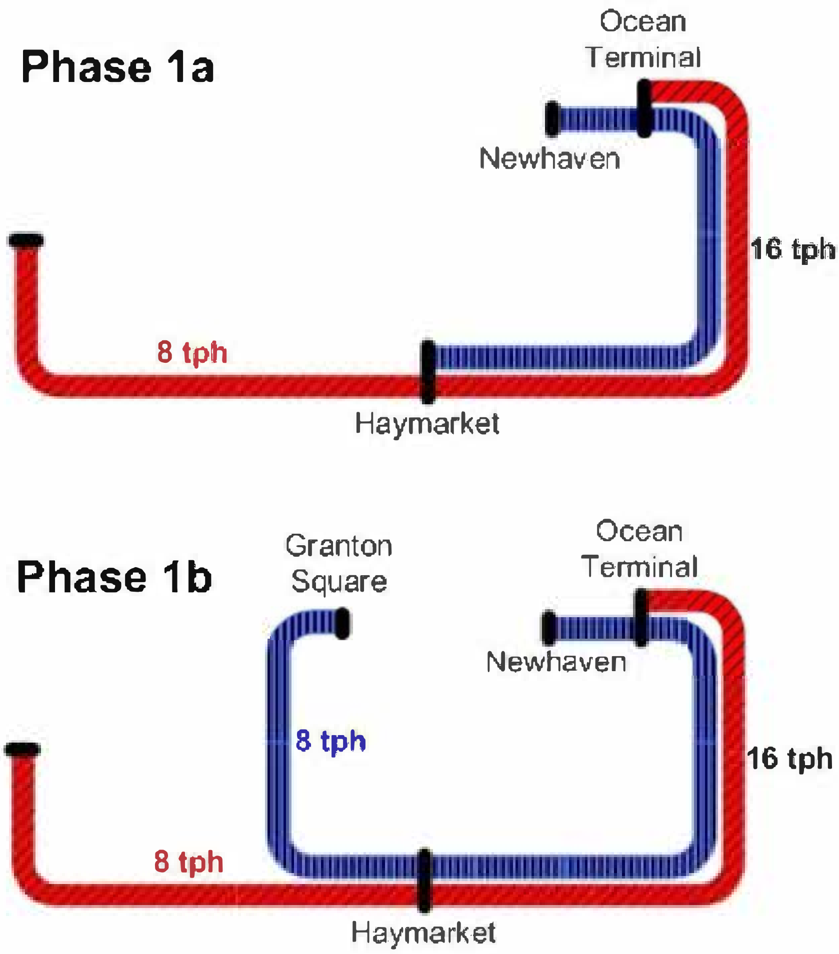


FIGURE 7.5 PHASE 1A+1B 2031 AM PEAK WESTBOUND FLOW



7.102 The modelling process indicates that after the initial four year '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 tram network. On that basis, the services will increase to 8tph as shown in Figure 7.6.

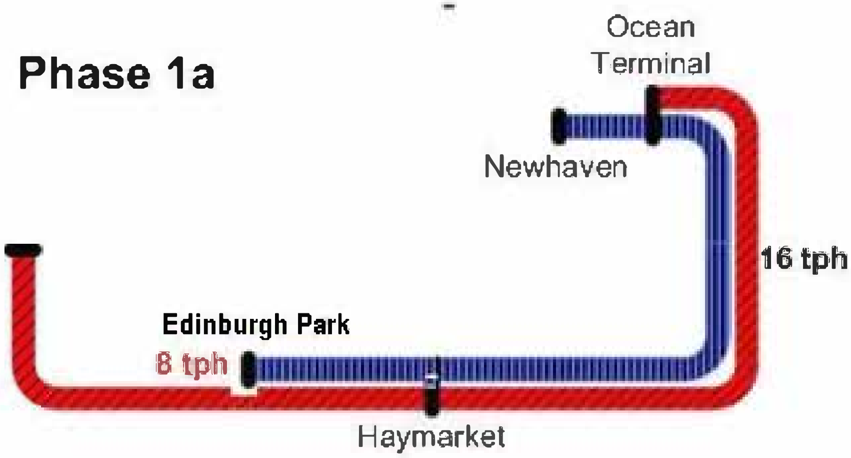
FIGURE 7.6 2015 TO 2027 SERVICE PATTERNS

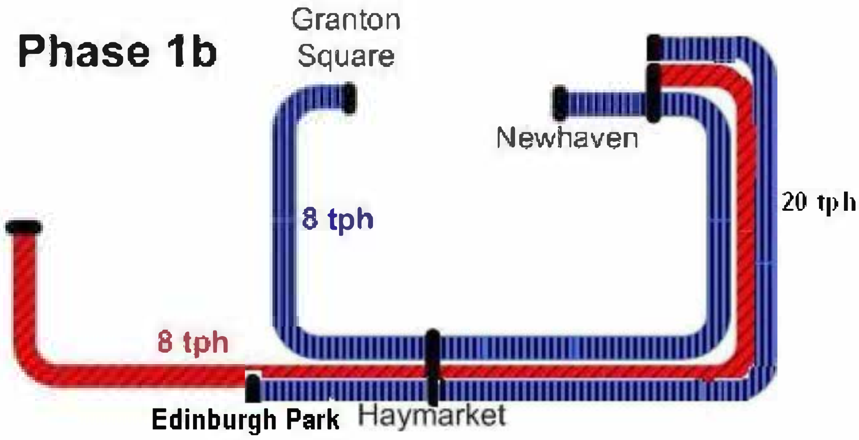


7.103 The modelling passenger projections indicate that after the year 2027 the tram services will require to be strengthened further to provide sufficient capacity to serve demand on the Haymarket to Edinburgh Park section of the tram network. Consideration of this has led to a potential solution of extending, for Phase 1a, the Newhaven to Haymarket service to Edinburgh Park providing 16 tph between Ocean Terminal and Edinburgh Park. For the Phase 1a and 1b network, the demand could be met by overlaying an additional service operating between Ocean Terminal and Edinburgh Park at a frequency of 4 tph which would raise the tram service on Ocean Terminal to Haymarket to 20 tph and Haymarket to Edinburgh Park to 12 tph. These service patterns are shown in Figure 7.7.

7.104 (Note that, notwithstanding the consideration given to service patterns in the longer term, for TEE and appraisal purposes, we have used an 8/16 tph regime as our central case assumption in 2031.)

FIGURE 7.7 2028 ONWARDS TRAM SERVICE PATTERNS





7.105 The first and last tram services and frequencies for 6 & 12 tram per hour scenario are shown in Table 7.4 and for 8 & 16 tram per hour scenario in Table 7.5. These scenarios are based upon the following assumptions and conditions:

- A basic frequency of 6 or 8 trams per hour per service (combined to give a total of 12 or 16 trams per hour) is required during the daytime to replace withdrawn bus services (and therefore demand and capacity) on Leith Walk.
- Short workings between Edinburgh Airport/Granton Square and St. Andrew Square are based on the ability to turn trams at St Andrew Square. The precise location and feasibility of the turnback is currently under review.
- Edinburgh Airport service tram frequency is ramped up/down from Ocean Terminal. Granton Square or Haymarket service tram frequency is ramped up/down from Newhaven.
- Trams going into service between Gogar depot and Ocean Terminal / Newhaven will run "in service" from the Gyle (first tram Gyle to Ocean Terminal approx. 05:15).
- Haymarket or Granton Square 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.
- The period of time between the last tram returning to the depot at night and the first tram leaving the depot in the morning is about 4hrs 30 min. 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.
- Service proposals are based on the requirement to always have a tram present at the Airport tramstop.

TABLE 7.4 FIRST & LAST TRAM SERVICES AND FREQUENCIES FOR 6 & 12 TRAM PER HOUR SCENARIO

Network / Phasing	Service frequency commencing at:	Monday - Friday (trams per hour)					
		first tram 06:00	06:45	07:00	07:20	23:15	last tram 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

Network / Phasing	Service frequency commencing at:	Saturday (trams per hour)					
		first tram 06:00	06:45	07:30	07:50	23:15	last tram 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

Network / Phasing	Service frequency commencing at:	Sunday (trams per hour)					
		first tram 06:00	06:45	08:00	08:20	23:15	last tram 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 New haven - Haymarket continuing in service on TL2 to Gyle

TABLE 7.5 FIRST & LAST TRAM SERVICES AND FREQUENCIES FOR 8 & 16 TRAM PER HOUR SCENARIO

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 06:00	06:45	07:50	08:00	08:45	18:00	18:20	18:45	23:15	last tram 23:59
1a	Airport to Ocean Terminal	0	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

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

Capital and operating costs

Capital costs

7.106 The Project Estimate for capital works has been updated for the completion of the Preliminary Design Stage of the Project. The estimate for the various elements has been prepared on the following basis:

- Project management, administration and supervision costs – a costed resource plan for the project delivery structure based on a delivery into revenue service date of summer 2011 plus project overhead costs (accommodation and IT etc)
- Design costs – the fixed price design contract with SDS plus changes thereto.
- Utility Diversions – A measured estimate applying rates derived from the contract awarded to quantities derived from the preliminary design drawings plus the quotes obtained for the diversion of other utilities outside the scope of the awarded contract.
- Tram vehicles supply and commissioning – An allowance based on the returned tenders for the tram supply and commissioning contract.
- Infrastructure provision - A measured estimate applying rates from specialist consultants (SDS and Cyril Sweet Limited) to quantities derived from the preliminary design drawings
- Risk allowance – A quantified risk assessment applied to risks identified from risk workshops with designers and commercial personnel.
- Optimism bias – By applying the standard process.

7.107 This estimate has been reviewed by a peer group selected from senior members within the project to confirm the robustness of the estimate.

7.108 The capital costs for Edinburgh Tram are presented in Table 7.6.

TABLE 7.6 EDINBURGH TRAM CAPITAL COSTS (2006 PRICES)

Item	Cost (£m)
Scheme 1a + 1b Costs	
Out-turn costs, assuming 6% construction price inflation	499
Of which	
Risk and optimism bias component	81
% risk and OB	16%
Total – out-turn – Scheme 1a + 1b Costs	**580**
Total – out-turn – Scheme 1a only	**495**

Note: These were the capital costs at the point of a 'freeze' in their development. Further work has since been done on costs, resulting in marginal changes, the results of which are reflected in tie's Financial Business Plan. The differences have a relatively marginal impact on the economic appraisal, the results of which are available in a technical note.

Lifecycle costs

7.109 The Life Cycle Cost models have been developed to reflect a total system working Life cycle of 60 years. Within this, two aspects of life cycle have been modelled:

- Planned Renewal - replacement/renewal of systems/sub systems at the end of their anticipated life expectancy
- Day-to-day – daily maintenance and operational maintenance of systems/sub systems which may include replacement of defective minor components

7.110 Planned renewal will take place at pre determined time intervals dictated by the specified performance criteria of the individual system. In addition, planned refurbishment of major systems has been considered for the Tram Fleet in order to achieve the required overall 30 year life span for these units. This refurbishment, undertaken at 15 year intervals would cover livery, upholstery, motors, pantographs, etc. At 30 years service the complete tram unit is replaced.

7.111 The Life Cycle Models adopt a structure consistent with that used in estimating the capital costs, identifying particular systems and sub systems for analysis in the model. The models then make use of the base line cost information to provide life cycle cost information against the system and sub system headings therein. This information is augmented with additional knowledge derived from tram projects which are already operational in the UK and Ireland.

7.112 Within each element of this structure the systems identified have been analysed and basic assumptions made regarding annual, day-to-day maintenance items and planned replacement items. Generally, day-to-day maintenance includes for such items as daily inspection, cleaning, standard daily maintenance regimes, etc. Assumptions regarding replacement of components take into consideration the frequency of replacement and the percentage of the base quantity that may require replacement.

Operating costs

7.113 Operating costs are a significant component in the economic and financial assessment of the business case. The main tram operating costs estimates have been developed by the appointed operator, TRANSDEV, based on the cost model prepared for the DPOFA. Key operating costs outside the DPOFA are Electricity, Insurance and Marketing costs. All operating cost projections, including the ones provided by TRANSDEV, have undergone an iterative process of evaluation, involving input from TEL and benchmarking against other UK tram schemes.

7.114 The operating costs cover day to day costs which will be incurred in the running of the ETN, and include the operator's management fee. The costs are driven by the operating requirements of the different service patterns which will be implemented during the life of the ETN to meet travel demand. The service pattern assumptions are fully aligned to the service integration plan for TEL tram and TEL bus.

7.115 The largest single component is staff costs, with drivers and inspectors comprising around 50% of the total operating costs. These costs are part of the TRANSDEV cost projection model and are pegged against current TEL bus driver rates.

7.116 The other largest single costs item is electricity which represents some 10% of the operating cost for trams. As there are high uncertainties around the future change in the underlying energy prices, real cost inflation has been applied to the projections. Electricity does not form part of the agreement with TRANSDEV.

7.117 The operating costs projections are a reflection of the integrated system in which the ETN will operate, thus taking advantage of potential synergies with TEL bus operations. Areas where there are significant synergies to be had are primarily administration, marketing, cash collection and security as well as other back office functions.

7.118 The operating costs for 2012 are set out in Table 7.7.

TABLE 7.7 EDINBURGH TRAM - OPERATING COSTS 2012 (OUT-TURN)

Operating Cost Impacts		2012 - 12/6 1a + 1b	2012 - 12/6 1a only
Management Costs	TEL - with tram	15.1	15.1
	TEL - no tram (LB)	14.1	14.1
	Net increase	*1.1*	*1.1*
	Tram mgmt	2.0	2.0
Tram Opex		12.8	11.3
Bus operating costs	with tram	94.5	94.5
	no tram	103.9	103.9
	Net saving	*9.4*	*9.4*
Advertising / other income		1.9	1.9
Summary Costs			
Net Operating Cost	Tram costs	15.82	14.37
	Bus savings	9.4	9.4
	Advertising	1.9	1.9
	Net cost	**4.48**	**3.10**

7.119 The following growth assumptions have been employed:

- RPI assumed at 3%
- Above RPI increases assumed (+1% wages throughout appraisal period, +10% electricity 2006-08 p.a)

Bus Network Changes

7.120 Complementary to the introduction of Edinburgh Tram, it is envisaged that the bus network operated by Lothian Buses (under the TEL umbrella) would be reconfigured and integrated with the tram so as to:

- avoid unnecessary duplication of provision, and thereby maximise operating efficiencies;
- avoid enforced passenger interchange between modes, except where interchange infrastructure is assumed to be deliverable; and
- create a combined bus and tram network which will be financially viable from the start of tram operation.

7.121 The purpose of detailing the integrated service pattern is to provide the network of services to be coded into the JRC patronage and revenue model and to provide the basis for the operating cost projections for both the bus and tram divisions.

7.122 The following details the proposed pattern of service integration of TEL buses with trams, which has been prepared with input from Transdev and **tie**.

7.123 The plan for alterations to bus services was based originally on services in operation as at August 2005. It was systematically updated to take account of subsequent network changes such as the introduction of Service X48, operation of which requires 8 buses. Assumptions were then made on future changes which could be necessitated by specific, known developments in the period 2006-2011. These changes were then taken into account in the final service integration plan.

7.124 The bus service changes proposed have been used to calculate operating cost savings which would arise on the introduction of trams.

Phase 1a

7.125 Both the 6/12 and 8/16 frequency options are based on big trams (capacity c265). On the basis of a capacity ratio of 2.6 buses per big tram, or 2 buses per small tram, both frequency options lead to the same assumption in terms of the consequential changes to the bus network. (In other words, lower frequency with larger trams displaces the same volume of buses as higher frequency with smaller trams.) The planning of service tram service levels was based on matching capacity to demand while assuming that the impact of service frequency on demand would be a secondary effect for marginal changes to a relatively high service level. In practice it is envisaged that variant service patterns could be created (without additional fleet requirement) in order to address particular peak period capacity issues that may emerge with time.

7.126 The primary objective of the Service Integration Plan is to derive a combined network which is financially viable from the start. In view of the lead time for ordering more trams, the difficulty in purchasing small numbers and the likely unavailability of small numbers of trams to the same specification as those already in the fleet, the need to provide capacity for future growth has led to the decision to procure larger trams as well as to procure sufficient vehicles at the outset to provide an 8/16 tram per hour service pattern when required.

7.127 The main scope for reducing bus service provision is where the tram route runs parallel or very close to existing bus routes. Where the tram route follows a different alignment, along which or in the vicinity of which there are no existing bus routes, there will be no reduction as bus service reductions are assumed only where the tram offers an acceptable replacement facility. The tram route varies in its proximity to bus routes, hence the changes to bus services also vary according to the sections of tram route. These can be summarised as follows:

Ocean Terminal – Foot of Leith Walk

7.128 The section of tramline between Ocean Terminal and Bernard Street, via the Docks and Ocean Drive, does not closely mirror or replace any existing bus route. Hence bus services on this section will be maintained, feeding into the tram at the foot of Leith Walk.

Foot of Leith Walk – St Andrew Square

7.129 This section offers great potential for bus service reductions. On a rule of thumb bus:tram ratio of 2.6 to 1, for every 1 tram per hour, the objective is to take out 2.6 buses per hour. Table 7.8 shows current inter-peak buses per hour and the volume reductions that it is hoped will be achievable.

TABLE 7.8 LEITH WALK BUS AND TRAM HOURLY FREQUENCIES

Route	Current	Proposed	Change
Tram	0	12	+12
		(32 bus equivalent)	
7	6	6	0
10	6	0	-6
12	4	0	-4
14	4	4	0
16	6	6	0
22	12	0	-12
25	6	0	-6
49	3	3	0
Total bus	47	19	28

7.130 Service 16 will be retained in order to preserve a limited number of buses linking Leith Walk with Princes Street.

7.131 This shows that the target bus volume reduction is virtually identical to the volume currently operating the full length of the Leith Walk – Princes Street axis. For that reason, Services 10, 12, 22 and 25 will be removed from Leith Walk. As most Princes Street / Leith Walk bus services are replaced by tram, the remaining buses on Leith Walk run on the Leith Walk – Bridges – ERI axis, as the tram will not offer a service on this corridor.

7.132 This proposal assumes high-quality interchanges are deliverable at the foot of Leith Walk and at St Andrew Square. The 'interchanges' section below expands on implications for bus services which are truncated at both St Andrew Square and the foot of Leith Walk.

St Andrew Square – Haymarket

7.133 The scope for reducing bus volumes on this section, which largely comprises Princes Street, is limited as the tram route does not offer any substantial cross-city link currently offered by bus. This means that, while most routes serving Leith Walk can be removed from Leith Walk, because the western or southern ends of those routes are not replaced by trams, they still need to traverse Princes Street.

7.134 For example, passengers travelling from, say, the Fairmilehead / Morningside / Bruntsfield corridor cannot be expected to transfer on to tram at the West End to complete their journey to, say, Waverley, as there is no suitable tram stop expected at the West End, nor is there space to locate an interchange. In any case, it is not considered a sensible option to introduce an enforced interchange for the very large numbers of passengers who would be affected only a very short distance from their trip destination or origin; neither would it be sensible to decant bus passengers at the foot of Lothian Road and expect them to walk along Princes Street.

7.135 For these reasons, the potential for reduction in buses on Princes Street itself comprises the reduction in frequencies of Services 22 and 100.

Haymarket – Airport

7.136 There are two facilities offered by the tram which yield the potential to reduce significantly the volume of bus service provision:

- Airport – City Centre passenger demand
- The section of route from Broomhouse to Saughton Mains, currently comprising the Fastlink guided busway

7.137 As far as the Airport is concerned, it is assumed that many passengers who currently use Airlink 100 will transfer to the tram. Those who will definitely not do so are those who use Airlink to travel between the Airport and points not served by the tram, namely all stops between Maybury and Wester Coates. To serve those passengers, a reduced-frequency Airlink will continue to run. For passengers travelling between the Airport and the Haymarket – Waverley section, the majority are assumed to choose the tram. The working assumption for present purposes is that the volume of service on Airlink will be cut by at least 50% to 4 per hour though this can be reviewed further.

7.138 As far as the Fastlink section between Broomhouse and Saughton Mains is concerned, it is assumed that virtually all passengers travelling between this section and Princes Street will switch to the tram. This volume of demand is, however, a relatively small proportion of the total demand on the existing service (22). Hence, a reduction in Service 22 frequency has been assumed. (The northern half of the 22 is withdrawn in toto between St. Andrew Square and the foot of Leith Walk.)

7.139 As far as the other Fastlink service (the 2) is concerned, it offers no links which will be provided by the tram, so no reduction in provision on Service 2 is assumed.

7.140 Specifically, the following heavily used sections of the 22 do not offer any potential for tram substitution:

- Lothian Road – Fountainpark – Westfield – Stenhouse
- Broomhouse – South Gyle Crescent – Edinburgh Park

7.141 Between Lothian Road and Stenhouse, the existing Service 22 follows a route which is outside an acceptable walking distance from the tram stops (with the exception of the East Whitson area, from where residents can access the tram stop at Balgreen Halt via the Balgreen Road pedestrian tunnel). While the reduction in Service 22 frequency referred to above will affect this section of route, there is unlikely to be any further impact on bus services on this section.

7.142 Between Broomhouse and Edinburgh Park, the bus route crosses under the railway line and serves South Gyle Crescent and Redheughs Avenue. There is only one walking link between the tram stops south of the railway to South Gyle Crescent, and no tram stops will be within acceptable walking distance of Redheughs Avenue. The tram does not therefore affect the bus services on this section, so no changes are assumed, other than the frequency reduction on the 22 resulting from modal transfer on the Broomhouse / Saughton Mains section.

Bus network changes

7.143 The proposed bus network changes are set out in Table 7.9.

TABLE 7.9 BUS NETWORK CHANGES

Route	Currently	Proposed
10	Torphin – Newhaven	Torphin – St. Andrew Square
12	Gogarburn – The Jewel	Gogarburn – St. Andrew Square. Section between The Jewel and between King's Road and Foot of Leith Walk replaced by new Service 40
16	Colinton – Silverknowes	Colinton – Silverknowes but diverted via Henderson St to replace service 22
21	Gyle – Duke Street	Gyle – Restalrig
22	Gyle – Ocean Terminal	Gyle – Leith Street at reduced frequency. Replaced between Ocean Terminal and Foot of Leith Walk by diversion of Services 16 and 35 via Commercial Street, Shore and Henderson Street
25	Riccarton – Restalrig	Riccarton – Leith Street. Section between Restalrig and Foot of Leith Walk replaced by Service 21, terminating at Restalrig
32	Clovenstone – RIE	Clovenstone – Kings Road Replaced between King's Road and RIE by new service 40
35	Airport – Ocean Terminal	Airport – Ocean Terminal, but diverted via Henderson Street, Shore and Commercial Street to replace Service 22
40	n/a	New service, Ocean Terminal – RIE, to replace Service 22 on Shore, service 12 via between Foot of Leith Walk and The Jewel and service 32 between Kings Road and RIE
100	Airport – Waverley	Frequency reduced to every 15 mins

Phase 1b

7.144 Under Phase 1b, the trams planned to terminate at Haymarket under Phase 1a will extend to Granton Waterfront. As this section does not run parallel to any bus routes, it does not lead to bus service withdrawals. However, during the parliamentary process, a commitment was given to the effect that feeder buses would be provided linking Crewe Toll with the Western General Hospital. The feeder service will take the form of simply providing interchange at Crewe Toll with existing bus services or with a free-standing shuttle bus service. Such a service will cost two buses to operate.

Interchanges

Foot of Leith Walk (Phase 1a)

7.145 This interchange is the key to being able to curtail bus routes at the northern end of Leith Walk. Without it, there is no practical way in which buses approaching the foot of Leith Walk from Great Junction Street or Duke Street can be curtailed such that they no longer continue up Leith Walk. An effective interchange at this location must be delivered. Otherwise, bus volume reductions on Leith Walk (and the consequential cost savings) will not be realised. 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.

7.146 On the assumption that a sufficiently good design can and will be delivered, a network design was developed which matches routes curtailed at Great Junction Street with routes curtailed at Duke Street, so they can be linked into through routes, thereby reducing what would otherwise be an absolute requirement to accommodate terminating buses at this awkward location. This design has subsequently been modified to retain a limited number of buses per hour linking Leith Walk with Princes Street to ensure that those with restricted mobility have an alternative to enforced interchange.

St Andrew Square (Phase 1a)

7.147 An interchange at the east end of the city centre is also required 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. Various options have been considered and a design arrived at which accommodates the following:

- provision for passenger interchange between bus and tram; and
- provision for terminating buses and essential layover.

Crewe Toll (Phase 1b)

7.148 This interchange is necessary to accommodate the provision of the feeder buses linking the tram route to the Western General Hospital. A free-standing shuttle bus may be provided to meet this requirement for feeder buses or existing bus services 29 and 37 may be sufficient.

Operator competition

7.149 A third party operator response to the service integration plan which resulted in the introduction of new bus services competing with the TEL network (where changes have been made to integrate bus and tram) would necessitate a revision to this plan. However, the assessment at present is that the current plan does not open up gaps for such an operator to exploit, provided crucially that the interchange infrastructure referred to above is provided.

8. THE DO-MINIMUM AND REFERENCE CASE

Introduction

8.1 The appraisal of any transport scheme is usually made against a Do-Minimum situation, the situation that would exist without the transport scheme under consideration. The Do-Minimum normally includes only committed schemes, essentially all schemes and proposals under construction or for which statutory powers exist to develop the proposal and the funding mechanism has been approved or funding is available.

8.2 There are occasions, however, where this approach may not be appropriate and where some consideration of probable changes to the transport network beyond this are appropriate; such a scenario is typically referred to as a Reference Case.

8.3 As part of the demand forecasting and appraisal process for Edinburgh Tram, a thorough and robust review of planning opportunities has been undertaken involving CEC planners in conjunction with the stakeholders group. The results show that strong growth in population, employment and the economy is expected, placing the transport network under increasing strain.

8.4 This Chapter therefore examines whether a Reference Case is a more appropriate comparator for Edinburgh Tram. In summary, this Chapter:

- describes the Do-Minimum and sets out the appraisal of Edinburgh Tram against this Do-Minimum;
- develops the definition and rational of the Reference Case and sets out the performance of the Reference Case against the Do-Minimum in appraisal terms, to understand more about the validity of the Reference Case; and
- provides an appraisal of Edinburgh Tram against this Reference Case.

8.5 Such incremental appraisals are a requirement of STAG guidance. The appraisals presented focus on the Transport Economic Efficiency appraisal and the associated Cost to Government analysis.

EARL

8.6 In each of these three appraisals, EARL has been excluded. This scheme is currently passing through the Parliamentary Bill process and thus has no formal legal status, nor has funding been approved. However, EARL is in Transport Scotland's Priority List and hence for the main appraisal of Edinburgh Tram set out in the next Chapter, EARL has been added to the Reference Case.

Edinburgh Tram

8.7 The changes to the transport network modelled to represent Edinburgh Tram for Phase 1a are as follows:

- A tram service running between Edinburgh Airport and Ocean Terminal via the City Centre at 6tph in 2011 and 8tph in 2031, and a service running from Haymarket to Newhaven, also at 6tph in 2011 and 8tph in 2031 (making 12tph and 16tph respectively in total on the section between Haymarket and Ocean Terminal) ;

- Fares parity with buses;
- Bus network changes as set out in Chapter 7; and
- Associated remodelling of the highway network to accommodate tram, including closure of Shandwick Place to general traffic, the signalisation and reconfiguration of Picardy Place roundabout and the banning of right turns on Leith Walk.

8.8 For Phase 1a+1b, the definition is as per Phase 1a, but with the tram service terminating at Haymarket extended to Granton.

Do-Minimum definition

2011

8.9 The 2011 Do-Minimum changes from the 2005 Base are concentrated on public transport, as follows:

- Additional rail services
  - Airdrie - Bathgate
  - Stirling – Alloa – Kincardine
  - Glasgow Airport Rail Link
  - Borders Rail Link
- Revised / Additional bus services
  - Revisions to routes/frequencies for services 1, 7, 8, 10, 11, 12, X12, 14, 15, 16, 17, 21, 22, 25, 30, 32, 34, 35, 37, 37A (withdrawn), 47, X47, X48, 49, 100 using information supplied by Lothian Buses.
  - Expansion of Ingliston Park and Ride site to 1500 spaces (from current 535 spaces)
  - 80p bus fares removed
  - Bus timetabled journey times as well as reliability have been assumed to be as in the base year (2005).

2031

8.10 The Do-Minimum specification for 2031 is as for 2011, with the addition of the following:

- Additional bus services
  - 14A (as 14 south of the foot of Leith Walk and serving the Docks north of this point)
  - 22A (as 22 south of the foot of Leith Walk and serving the Docks north of this point)
  - 25A (as 25 between Waverley and the foot of Leith Walk. No service south of Waverley and serving the Docks north of the foot of Leith Walk)
  - 49A (as 49 south of the foot of Leith Walk and serving the Docks north of this point)

- Slower bus journey times, with a journey time increment derived from increases to delay at key junctions forecast by 2031;
- The application of a bus in-vehicle time weight to be applied to represent an increase in the standard deviation of journey times equal to 10% of in-vehicle time. This increment is then weighted by 1.3 to reflect the penalty associated with this increase in unreliability[53]; and

Reference Case definition

8.11 The high demand growth expected in Edinburgh has necessitated a commensurate increase in bus service provision. Because of these significant changes and without accommodating network enhancements, significant uncertainty would exist as to the journey time performance, reliability and operability of buses in the future.

8.12 However, it is the stated policy of CEC that public transport should be supported through the provision of priorities to deliver journey time improvements to bus, and that the policy of maintaining public transport journey time and reliability will continue into the future.

8.13 While bus improvements are usually developed incrementally to meet relatively short term targets and objectives (e.g. priorities to enable bus journey times and reliability to be maintained or improved), the definition of a tram comparator for 2031 requires consideration of what type of measures might be required to deliver fast and reliable bus journey times well into the future.

8.14 Accordingly, a Reference Case has been developed that incorporates measures of the scale and type it is believed will be present in 2031, which will facilitate the accommodation of increased bus services and maintain their current levels of journey times and reliability. In essence, it is reasoned that such a Reference Case provides a more credible and realistic assessment of transport network conditions in 2031, than a Do-Minimum does.

8.15 It is not intended actually to represent a committed masterplan for traffic management; instead it is to illustrate the appraisal of the scheme against a more credible background of highway network performance than would be possible with a conventional Do Minimum.

8.16 A Reference Case has therefore been developed, which includes a selection of discrete measures thought to be consistent with the scale and impact of the sort of measures that would be likely in practice. CEC has expressed support for this principle The measures included in the 2031 Reference Case are:

- The banning of right turns on Leith Walk
- The implementation of signal priorities in Picardy Place
- The closure of Shandwick Place to general traffic.

[53] Based on data presented in Table 8.14, The Demand for Public Transport: a practical guide, TRL Report TRL593, TRL, 2004

8.17 These measures are equivalent to some of the measures that would be implemented as part of the tram scheme, a mode of transport capable of conveying many more passengers per vehicle than buses.

8.18 Clearly the measures identified in the Reference Case do not represent firm commitments at a scheme level, but they do reflect the scale and type of measure that would be required to deliver CEC's policy commitments. In transport, these are encapsulated in the Local Transport Strategy (LTS) and the forthcoming draft LTS sets out the policy objectives for bus priorities. This text, set out in Appendix C, supports the implementation of the measures listed in paragraph 8.16 and confirms that the measures proposed accurately reflect the nature and type of scheme that CEC would consider in support of achieving such objectives. It is therefore considered that they are appropriate for the purposes of this appraisal.

8.19 It should also be noted that, were measures not taken to accommodate the necessary levels of public transport service in the future, it is likely that the expected demand growth scenario would not be achieved.

TEE appraisals

8.20 TEE and Cost to Government analysis has been undertaken to illustrate the incremental benefits of moving to a Reference Case comparator for the appraisal of Edinburgh Tram, rather than the more traditional Do-Minimum. The results are set out in Table 8.1. These results include the appraisal of the (Option 1a+1b) scheme against the Reference Case with EARL added and this is the basis for the remainder of the STAG appraisal. The results indicate that, with the Reference Case and EARL in place (both of which are expected to deliver significant benefits in themselves) the Option 1a+1b tram scheme is expected to provide an additional Net Present Value of £273m.

Edinburgh Tram vs Do-Minimum (no EARL)

8.21 Edinburgh Tram delivers strong economic benefits, totalling £1,177m. Of this, some £997m relates to public transport benefits, with highway benefits totalling some £183m. Direct scheme costs are supported by significant public transport revenues accruing to TEL. Overall, a Benefit : Cost ratio of 3.01 is achieved.

8.22 In the 1a only case, benefits are reduced by around 30%-40%, leading to an overall scheme benefit of £719m. Costs fall by a more modest 20%, giving a lower Benefit : Cost ratio of 2.32.

8.23 The appraisal against the formal Do-Minimum, as required by STAG, therefore shows high value for money against Transport Economic Efficiency criteria.

TABLE 8.1 APPRAISAL OF EDINBURGH TRAM (FOR 1A+1B CASE UNLESS OTHERWISE STATED)

Economic impacts (£m PV, 2002 prices)	Edinburgh Tram vs Do-Minimum (no EARL)	Edinburgh Tram vs Do-Minimum (no EARL), 1a only	Reference Case vs Do-Minimum (no EARL)	Edinburgh Tram vs Reference Case (no EARL)	Edinburgh Tram vs Reference Case (with EARL)
PT User Benefits	997	660	1,233	669	657
Highway User benefits	183	103	297	328	72
Private sector provider impacts	10	-9	-118	6	-15
Accident benefits[54]	-13	-36	-22	-24	-5
Present Value of Scheme Benefits	*1,177*	*719*	*1,390*	*980*	*709*
Present Value of Scheme Costs	*390*	*310*	*-98*	*424*	*436*
Net Present Value (£ m)	786	409	1,488	556	273
Benefit : Cost Ratio	3.01	2.32	n/a	2.31	1.63

Reference Case vs Do-Minimum (no EARL)

8.24 The appraisal demonstrates that the Reference Case would, as expected, deliver significant benefits to public transport users, equivalent to £1,233m in PV terms. In addition to this, the appraisal suggests that the reference case would also deliver benefits to highway users of £296m PV. This stems from a greater retention of public transport usage in the Reference Case rather than transfer per se, whereas on the Do-Minimum bus journey time increases would encourage greater car use; this effect more than offsets the impact of decreased highway capacity.

8.25 Because the physical measures of the Reference Case are illustrative rather than specific and are expected to be relatively small in scale, cost estimates have not been undertaken. But it is evident that the benefits (including long-term additional revenues to public transport of the Reference Case) are substantial. Were the direct cost to be less than the £98m of monies gained by the Public Sector from an increase in public transport revenues, then the scheme would be financially viable in its own right, leading to an 'all gain' Benefit : Cost ratio.

[54] The Do-Something scenario includes a higher level of development along the tram corridor than in the Do-Minimum/Reference Case. The effect of this is to increase the overall volume of movements in the 'with tram' case, which could potentially include a higher number of car trips than in the 'no tram' case even after the switch from car to tram has taken place.

The implication of this is that the model and appraisal will be underestimating the positive benefits of Edinburgh Tram associated with changes in highway demand, including road accident benefits. Without tram, it is likely that the developments would take place elsewhere, most likely in peripheral locations with a higher proportion of car usage and longer trip lengths. We are not accounting for the 'disbenefits' of this traffic.

Overall, therefore, the appraisal of Edinburgh Tram is considered to be on a conservative basis.

Edinburgh Tram vs Reference Case (no EARL)

8.26 The move to a Reference case as the comparator for Edinburgh Tram reduces the public transport benefits, to £669m, as a result of the higher bus speeds in the Reference case compared to the Do-Minimum. Conversely, highway benefits increase to £328m, since the definition of the highway networks are similar and hence the impact is more about the benefits of modal shift from highway on those remaining on the highway network.

8.27 The net benefits fall compared to the Do-Minimum appraisal, to £980m. The impact on the Benefit : Cost ratio is higher though, due to an increase in costs due to lower additional public transport revenues accruing to TEL. This arises from the Reference Case capturing the higher public transport share from the maintenance of bus journey times compared to the Do-Minimum. The Benefit : Cost ratio is 2.31.

Summary

8.28 As part of the demand forecasting and appraisal for Edinburgh Tram, a review of planning assumptions has revealed that there is expected to be strong growth in travel demands in the city. This is expected to give rise to a significant increase in bus network provision to accommodate this growth, and commensurate growth in highway traffic levels and hence congestion in a Do-Minimum situation.

8.29 Given the adverse impact this will have bus operations, a Reference case has been developed which seeks to recognise CEC's policy objectives of mitigating such trends. It is considered that such a Reference Case provides a more robust and credible basis for appraisal than a Do-Minimum.

8.30 This Chapter set out TEE appraisal results for Edinburgh Tram against both a Do-Minimum and a Reference Case, as well as the benefits of moving from a Do-Minimum to a Reference Case. Positive cases have been demonstrated for each of these appraisals. Edinburgh Tram performs best against a Do-Minimum, with a Benefit : Cost ratio of 3.01; against the Reference case, this falls to 2.31. However, it is considered that, whilst lower, this provides a more robust basis for appraisal.

8.31 For the main appraisal of Edinburgh Tram, set out in the next Chapter, EARL is added to the Reference Case.

9. STAG PART 2 APPRAISAL

This Chapter sets out the STAG Part 2 appraisal for the Edinburgh Tram scheme, essentially appraisal against the five Government objectives in detail, namely:

- Environment;
- Safety;
- Economy;
- Integration; and
- Accessibility and Social Inclusion.

The appraisal will be preceded by some commentary on the transport impacts of Edinburgh Tram (such as tram ridership and attendant impacts on bus and car travel) and an appraisal against the planning objectives. Following the Part 2 appraisal, the Cost to Government and STAG Part 2 Appraisal Summary Tables will be presented.

Planning assumptions

Growth

9.1 As part of the demand forecasting and appraisal process for Edinburgh Tram, a thorough and robust review of planning opportunities has been undertaken involving CEC planners in conjunction with the stakeholders group. This has considered the likely range of development possible at the various sites identified and the potential impact that Edinburgh Tram might have on the overall scale of development. The resultant development levels were set out in Chapter 2.

9.2 The Central Case forecasts for Edinburgh Tram presented in this Chapter utilise an associated set of 'most likely' planning assumptions. This ensures that the case for tram is robust and credible.

9.3 Growth as far as 2021 is calculated using observed trip making rates, driven by the aforementioned development planning data provided by CEC planning department. Assumptions regarding likely rates of development 'take-up' were established through a workshop process with CEC planners and other stakeholders. Growth outside of the City of Edinburgh was based on appropriate local factors from the TEMPRO database.

9.4 The following growth assumptions were then implemented beyond the current planning horizon:

- 2021 – 2031: 2.0% per year;
- 2031 – 2041: 1.5% per year;
- 2041 – 2051: 1.0% per year; and
- 2051 – 2070: No further growth.

9.5 Given the confidence and policy led intention that Edinburgh Tram will stimulate additional development, the Do-Something situation includes a higher level of development along the tram corridor than in the Do-Minimum/Reference Case. This is focused in the Granton redevelopment area.

The Impact of Land Use

9.6 The Do-Something scenario includes a higher level of development along the tram corridor than in the Do-Minimum/Reference Case. The effect of this is to increase the overall volume of movements in the 'with tram' case, which could potentially include a higher number of car trips than in the Do-Minimum even after the switch from car to tram has taken place.

9.7 Without tram, it is likely that the developments would take place elsewhere, most likely in peripheral locations with a higher proportion of car usage and longer trip lengths. While some locally adverse impacts of this relocated traffic are reflected in the appraisal, the benefits of traffic reductions elsewhere (outside of the study area) are not fully accounted for. The implication of this is that the appraisal slightly underestimates the positive benefits of Edinburgh Tram associated with changes in highway demand (such as highway benefits, road accident benefits and noise and air quality).

9.8 Overall, therefore, the appraisal of Edinburgh Tram is considered to be on a conservative basis.

Transport Impacts

9.9 This sections sets out the demand for Edinburgh Tram and the associated impacts on other public transport demand and on the highway network. The information presented here is based on the outputs from the comprehensive computer based JRC transport model; demand forecasts and other outputs from the transport model are used in calculating the economic impacts of the scheme (such as travel time savings), as well as some environmental (such as air quality) and safety impacts (the number of road accidents).

Central Case Definition

9.10 The changes to the transport network modelled to represent Edinburgh Tram are as follows:

- For Phase 1a:
  - A tram service running between Edinburgh Airport and Ocean Terminal via the City Centre at 6tph in 2011 and 8tph in 2031, and a service running from Haymarket to Newhaven, also at 6tph in 2011 and 8tph in 2031 (making 12tph and 16tph respectively in total on the section between Haymarket and Ocean Terminal) ;
  - Fares parity with buses; and
  - Bus network changes as set out in Chapter 7.
- For Phase 1a+1b
  - A tram service running between Edinburgh Airport and Newhaven via the City Centre at 6tph in 2011 and 8tph in 2031 and an additional service between Granton and Ocean Terminal at 6tph in 2011 and 8tph in 2031

(making 12tph and 16tph respectively in total on the section between Haymarket and Ocean Terminal);

- Fares parity with buses; and
- Bus network changes as set out in Chapter 7.

Phase 1a transport impacts

9.11 The impact on overall travel demand in Edinburgh and its environs arising from Phase 1a is presented in Table 9.1. The increase in public transport trips is significant, reaching over 4,000 in the 2031 AM Peak period. The impact on car appears mixed, with the peak periods experiencing a reduction, but with a small increase in the Interpeak periods. However, these figures are reflective of the differential planning assumptions for the Reference and Edinburgh Tram cases; the reductions in car travel resulting from the introduction of the tram are obscured by the increases caused by the additional development assumed in the with-tram situation.

TABLE 9.1 TRAVEL DEMAND BY PUBLIC AND PRIVATE TRANSPORT (PHASE 1A)

(Trips per 2-Hour Period)		2011		2031	
		AM	IP	AM	IP
Reference Case	Public transport	94,993	54,707	135,845	80,648
	Private car	114,303	72,680	140,042	100,693
Edinburgh Tram	Public transport	96,920	55,570	140,115	82,508
	Private car	114,068	72,756	139,591	101,114
Differences	Public transport	1,927	862	4,270	1,860
	Private car	-235	76	-451	421

9.12 Table 9.2 presents the aggregate demand by modelled period and year. In the AM peak, the demand is heaviest in the westbound direction; in the Interpeak, the demand is more balanced, with flows not significantly different from the lower directional peak demand. Annual demand is forecast at 10.61 million in 2011 (including a 25% reduction for the ramp up period[55]), rising to 24.32 million by 2031.

TABLE 9.2 EDINBURGH TRAM PHASE 1A DEMAND

(Trips per 2-Hr Period)	2011		2031	
	AM	IP	AM	IP
Eastbound	2,689	2,005	3,967	4,331
Westbound	4,041	1,696	11,876	3,956
Total	6,730	3,701	15,843	8,287
Annual (m)	10.61		24.32	

[55] The ramp up period reflects the fact that the full impacts of a major transport scheme take several years to materialise and therefore a reduction is applied to forecasts to account for this. For Edinburgh Tram, the assumption is 75%, 85%, 92%, 97%, and 99% for the five years from opening. Hence, a reduction of 25% is applied to the forecasts for 2011 to obtain the actual demand expected in the opening year.

9.13 The sources of demand for Edinburgh Tram are set out in Table 9.3. As expected, the majority of the demand is accounted for by transfer from bus. Transfer from rail is proportionately smaller, principally being abstraction from EARL and local rail trips to Edinburgh Park, with some growth in other rail trips interchanging to tram. The remainder is accounted for by demand new to public transport, which is equal to 19% and 25% of tram demand in 2011 and 2031 respectively. These proportions are consistent with empirical evidence from existing systems and an increasing share from car is consistent with the higher congestion levels and hence attractiveness of tram expected and forecast in the later year.

TABLE 9.3 IMPACT OF EDINBURGH TRAM ON DEMAND, BY MODE (PHASE 1A)

	2011	2031
Bus	8.02	16.66
Rail	0.58	1.66
Mode shift from car / new development	2.01	6.00
Tram	10.61	24.32

9.14 Edinburgh Tram demand profiles for Phase 1a are presented in Figure 9.1 to.Figure 9.8 Key points to note are:

- The peak AM peak demand flow occurs in the westbound direction on Leith Walk, consistent with the overall demand by direction previously reported;
- The general pattern of demand is of boarding approaching the city centre, with alighting in the city centre and beyond;
- The impact of development in the Leith area is evident when comparing the AM Peak westbound boardings in 2011 with 2031; and
- Line capacity is forecast to be exceeded by 2031during the AM peak in the westbound direction.

FIGURE 9.1 PHASE 1A 2011 AM PEAK EASTBOUND FLOW

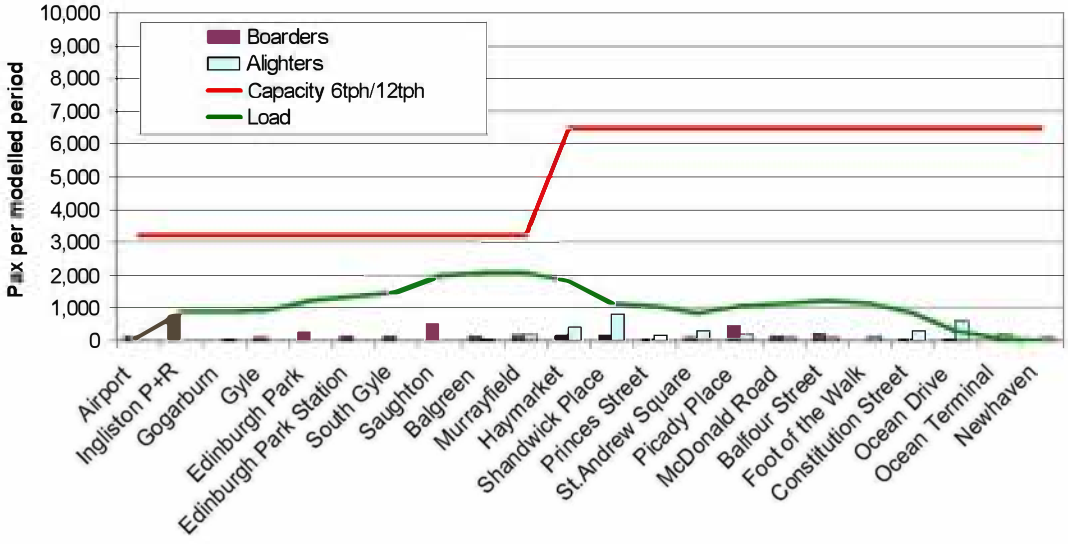


FIGURE 9.2 PHASE 1A 2011 AM PEAK WESTBOUND FLOW

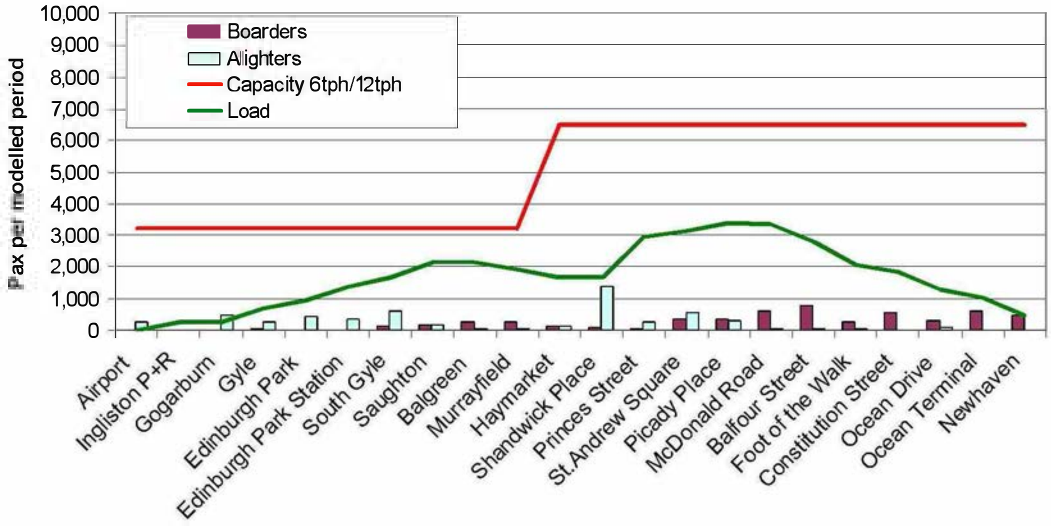


FIGURE 9.3 PHASE 1A 2011 INTERPEAK EASTBOUND FLOW

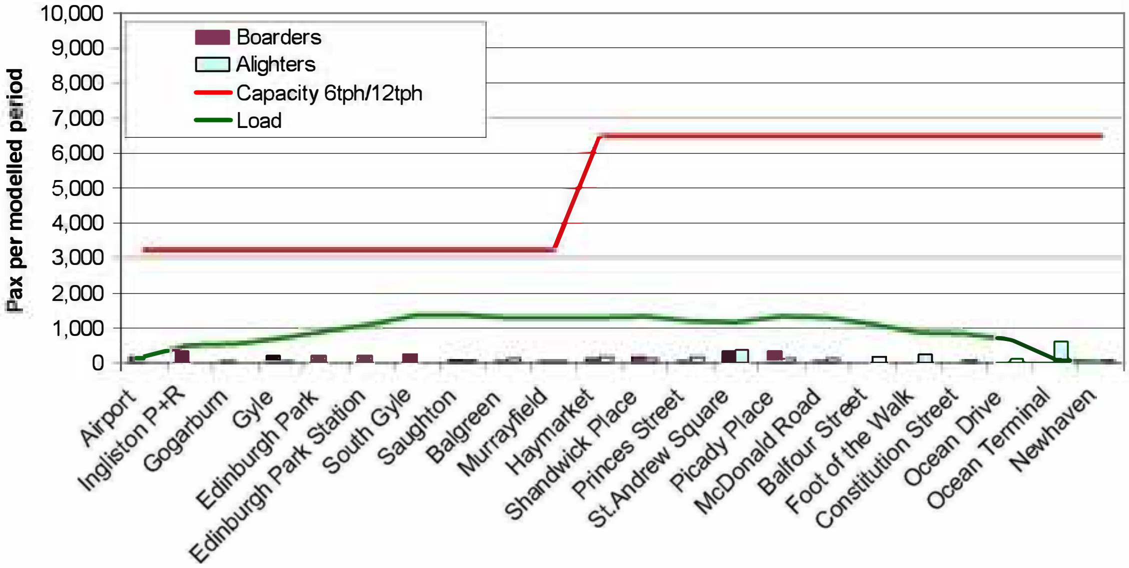


FIGURE 9.4 PHASE 1A 2011 INTERPEAK WESTBOUND FLOW

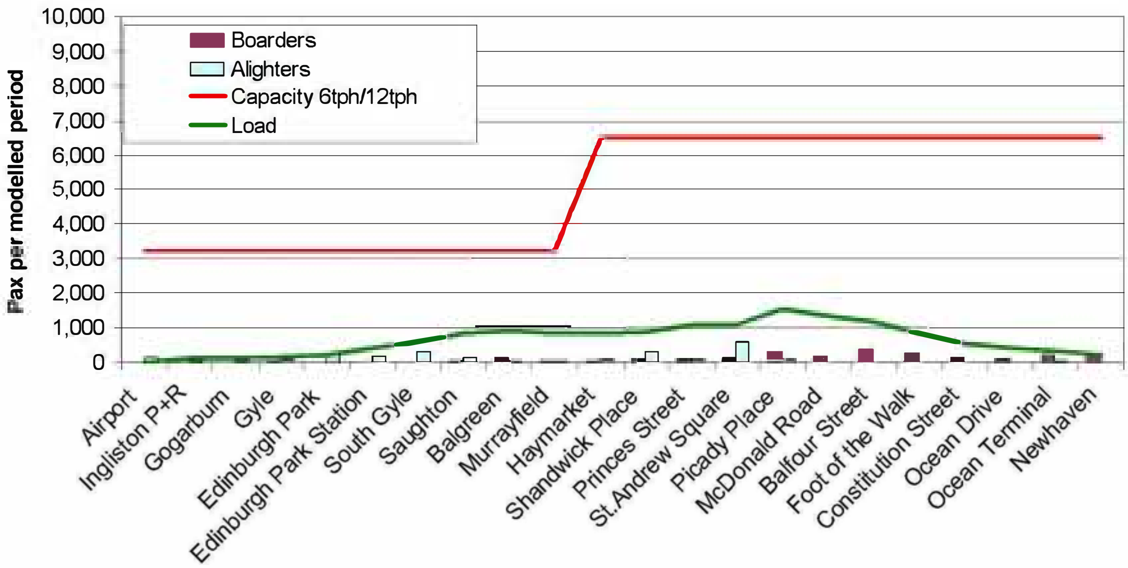


FIGURE 9.5 PHASE 1A 2031 AM PEAK EASTBOUND FLOW

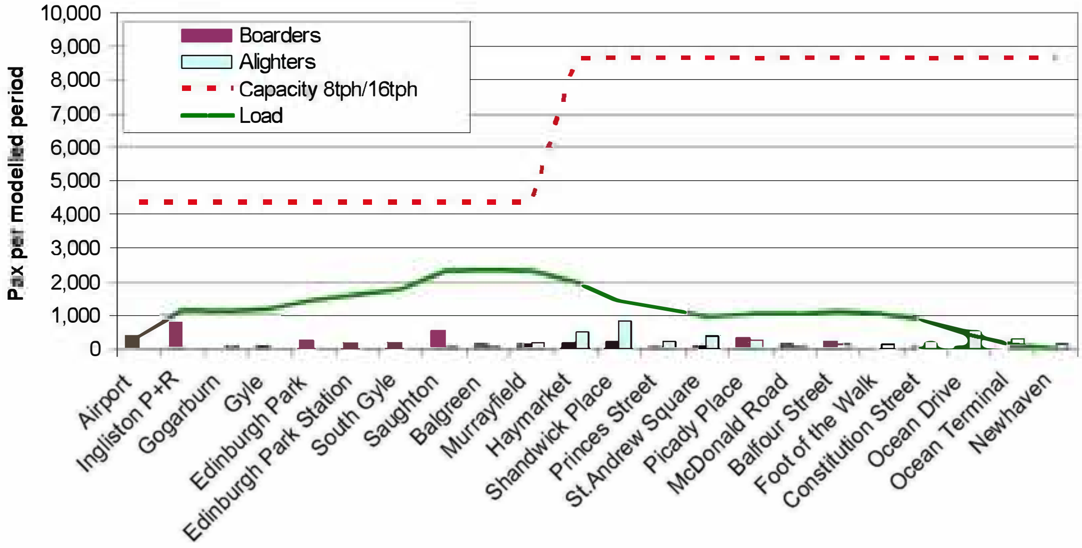


FIGURE 9.6 PHASE 1A 2031 AM PEAK WESTBOUND FLOW

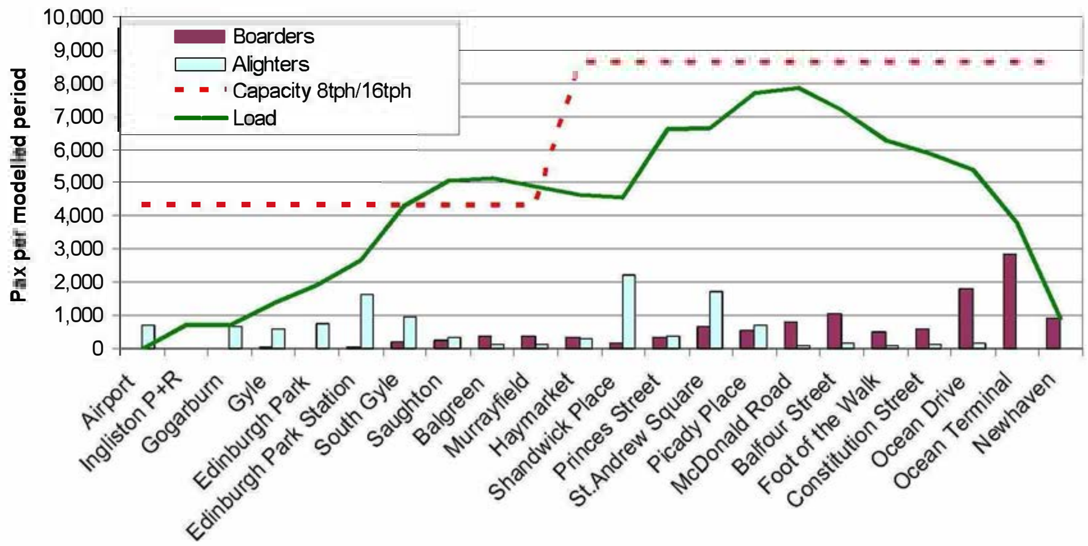


FIGURE 9.7 PHASE 1A 2031 INTERPEAK EASTBOUND FLOW

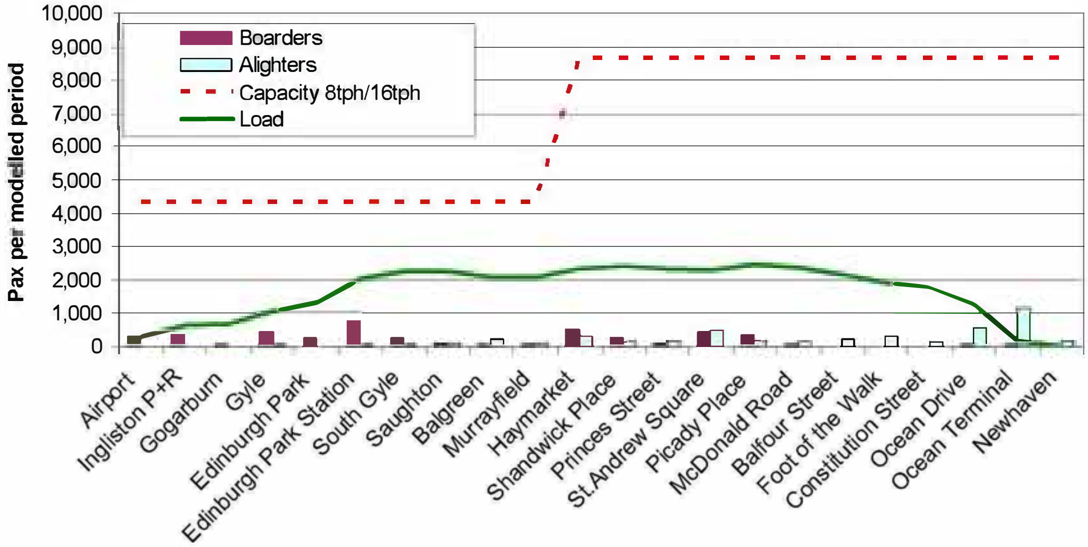
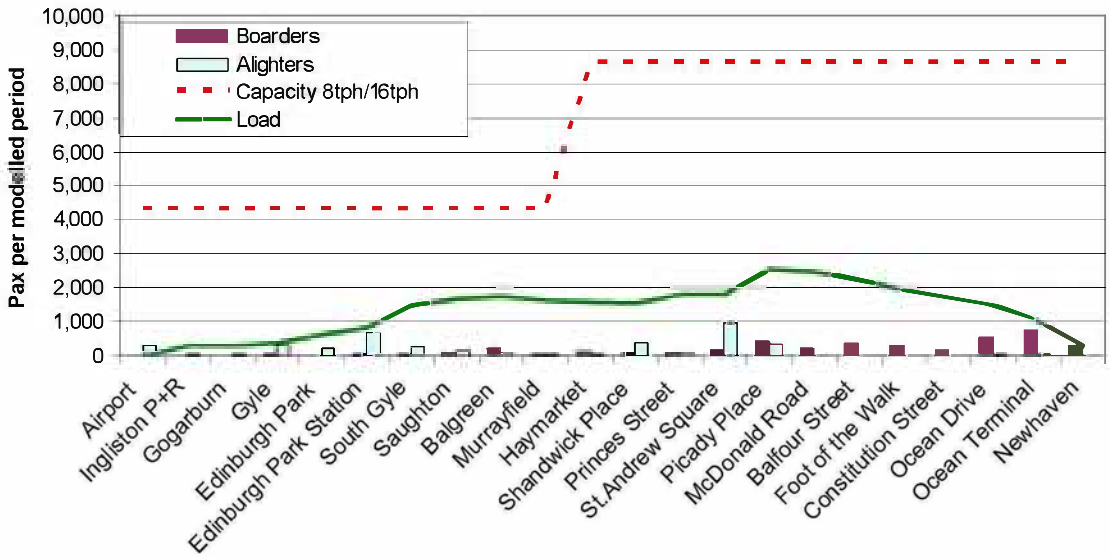


FIGURE 9.8 PHASE 1A 2031 INTERPEAK WESTBOUND FLOW



Phase 1a+1b transport impacts

9.15 The impact on overall travel demand in Edinburgh and its environs arising from Phase 1a+1b is presented in Table 9.4. The increase in public transport trips is significant, reaching over 4,000 in the 2031 AM Peak period. The impact on car is mixed, with the peak periods experiencing a reduction, but with a small increase in the Interpeak periods. (Note that given the differential planning assumptions for the Reference and Edinburgh Tram cases, the impact on the highway network is diluted, since the additional land uses will generate some car demand.)

TABLE 9.4 TRAVEL DEMAND BY PUBLIC AND PRIVATE TRANSPORT (PHASE 1A+1B)

		2011		2031	
		AM	IP	AM	IP
Reference Case	Public transport	94,993	54,707	135,845	80,648
	Private car	114,303	72,680	140,042	100,693
Edinburgh Tram	Public transport	97,183	55,642	139,989	82,754
	Private car	113,918	72,718	139,753	100,935
Differences	Public transport	2,190	935	4,144	2,106
	Private car	-385	38	-289	242

9.16 Table 9.5 presents the aggregate demand by modelled period and year. In the AM peak, the demand is heaviest in the westbound direction; in the Interpeak, the demand is more balanced, with flows not significantly different from the lower directional peak demand. Annual demand is forecast at 13.18 million in 2011 (including a 25% reduction for the ramp up period[56]), rising to 31.62 million by 2031.

TABLE 9.5 EDINBURGH TRAM PHASE 1A+1B DEMAND

	2011		2031	
	AM	IP	AM	IP
Eastbound	3,664	2,607	6,839	6,276
Westbound	4,433	2,154	12,485	5,911
Total	8,098	4,761	19,324	12,187
Annual (m)	13.18		31.62	

9.17 The sources of demand for Edinburgh Tram are set out in Table 9.6. As expected, the majority of the demand is accounted for by transfer from bus. Transfer from rail is proportionately smaller, principally being abstraction from EARL and local rail trips to Edinburgh Park, with some growth in other rail trips interchanging to tram. The

56 The ramp up period reflects the fact that the full impacts of a major transport scheme take several years to materialise and therefore a reduction is applied to forecasts to account for this. For Edinburgh Tram, the assumption is 75%, 85%, 92%, 97%, and 99% for the five years from opening. Hence, a reduction of 25% is applied to the forecasts for 2011 to obtain the actual demand expected in the opening year.

remainder is accounted for by demand new to public transport, which is equal to 17% and 20% of tram demand in 2011 and 2031 respectively. These proportions are consistent with empirical evidence from existing systems and an increasing share from car is consistent with the higher congestion levels and hence attractiveness of tram expected and forecast in the later year. The proportion of demand new to public transport is higher for the scheme with only Phase 1a, than also with Phase 1b, principally because Phase 1a includes the park and ride site at Ingliston.

TABLE 9.6 SOURCES OF DEMAND FOR EDINBURGH TRAM (PHASE 1A+1B)

	2011	2031
Bus	10.29	23.55
Rail	0.59	1.68
Mode shift from car / new development	2.29	6.39
Tram	13.18	31.62

9.18 Edinburgh Tram demand profiles for Phase 1a are presented in Figure 9.9 to Figure 9.16. Key points to note are:

- The peak AM peak demand flow occurs in the westbound direction on Leith Walk, consistent with the overall demand by direction previously reported;
- The general pattern of demand is of boarding approaching the city centre, with alighting in the city centre and beyond;
- The impact of development in the Leith area is evident when comparing the AM Peak westbound boardings in 2011 with 2031;
- Similarly, the impact of development in the Granton area is evident when comparing the AM Peak eastbound boardings in 2011 with 2031; and
- Line capacity is forecast to be exceeded by 2031during the AM peak in the westbound direction.

FIGURE 9.9 PHASE 1A+1B 2011 AM PEAK EASTBOUND FLOW

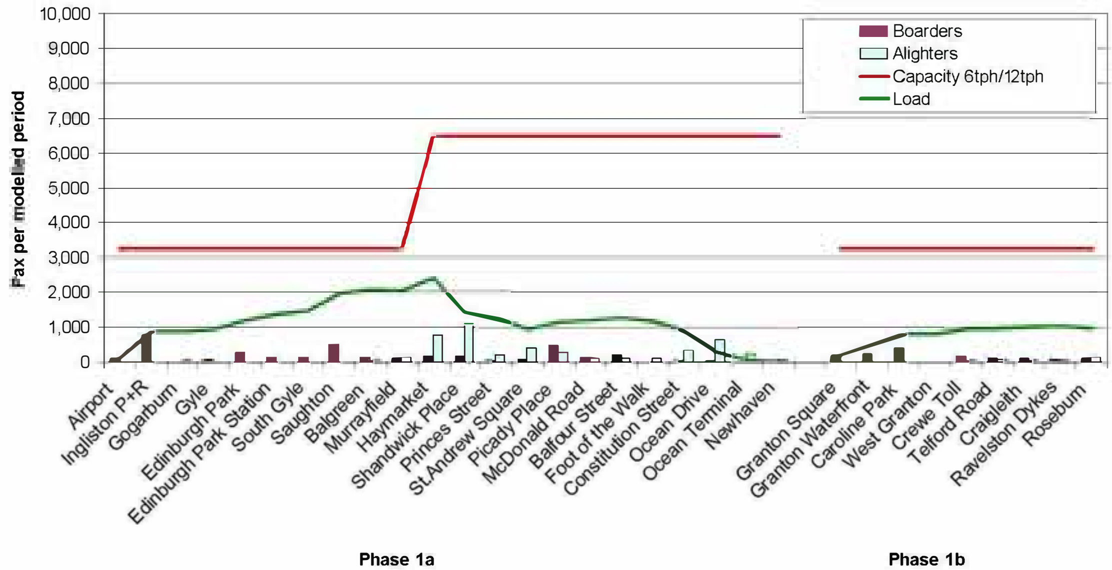


FIGURE 9.10 PHASE 1A+1B 2011 AM PEAK WESTBOUND FLOW

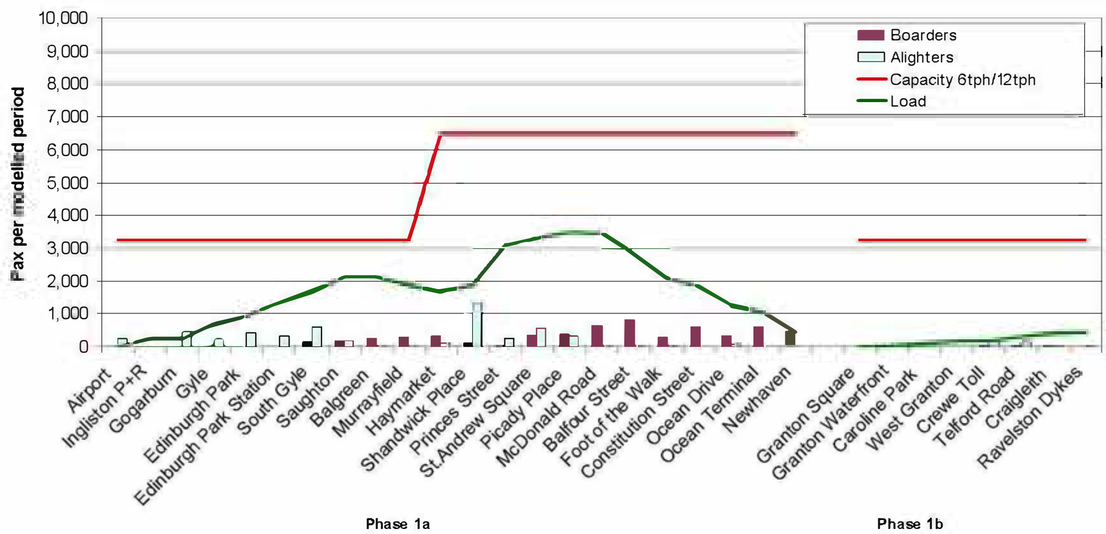


FIGURE 9.11 PHASE 1A+1B 2011 INTERPEAK EASTBOUND FLOW

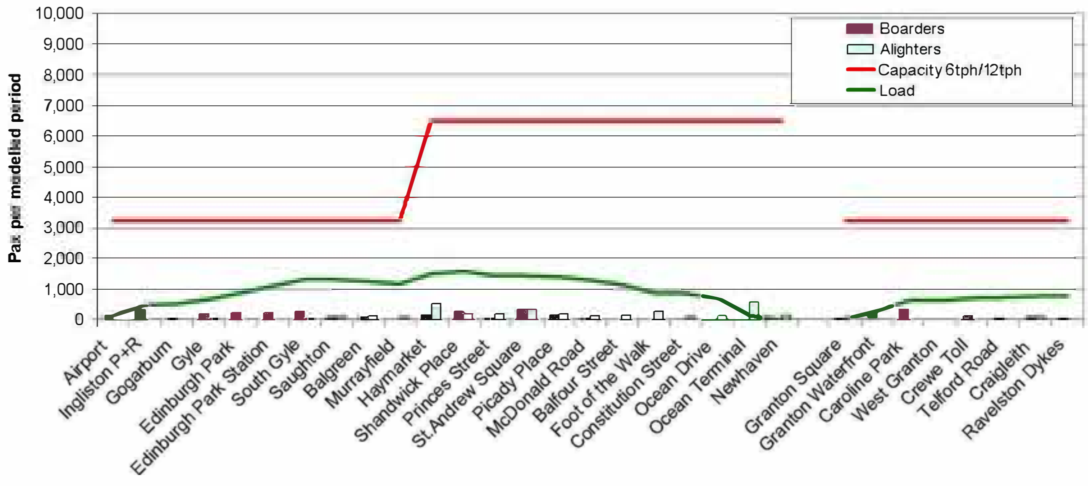


FIGURE 9.12 PHASE 1A+1B 2011 INTERPEAK WESTBOUND FLOW

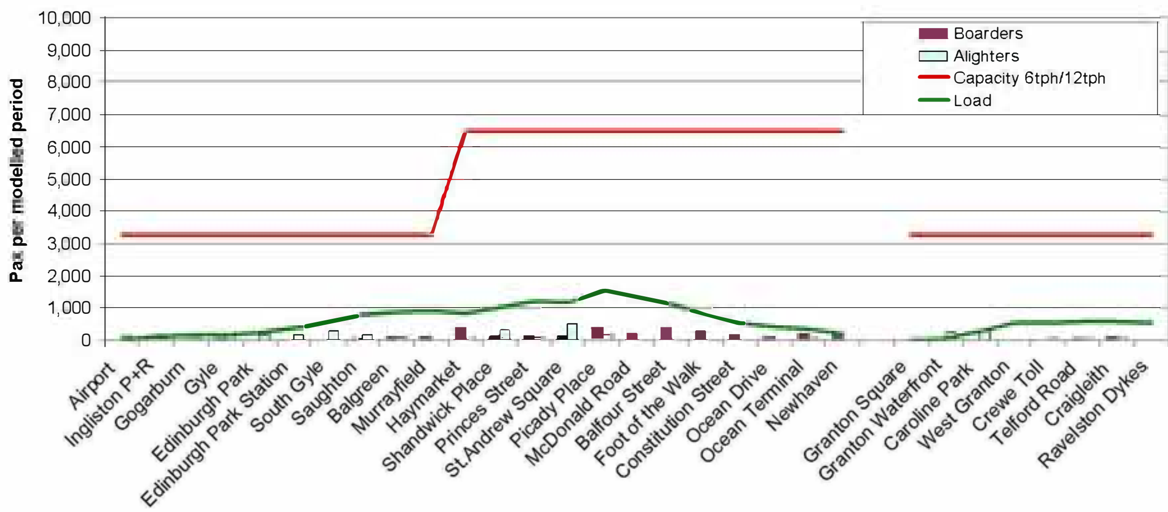


FIGURE 9.13 PHASE 1A+1B 2031 AM PEAK EASTBOUND FLOW

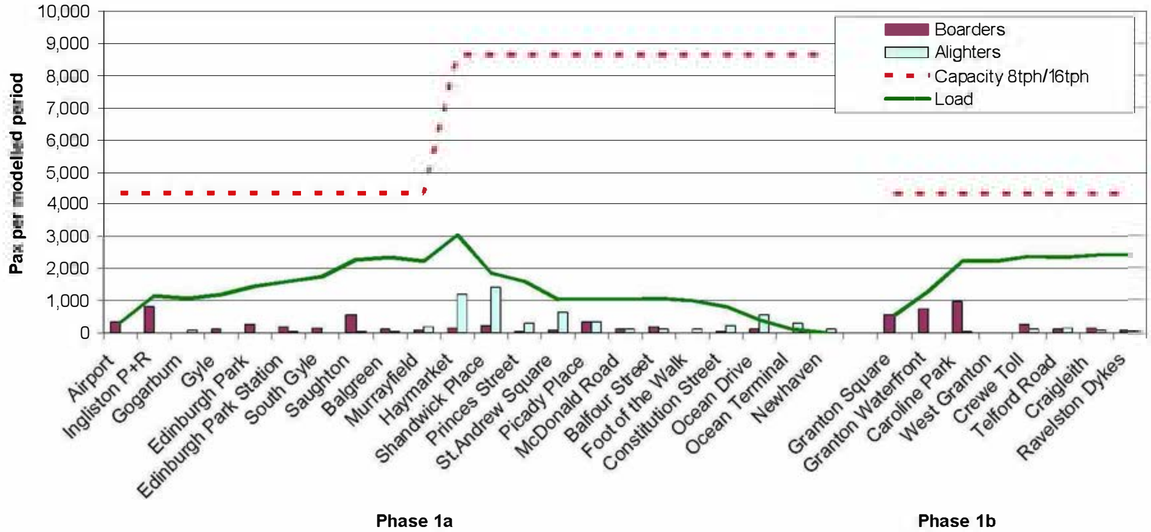


FIGURE 9.14 PHASE 1A+1B 2031 AM PEAK WESTBOUND FLOW

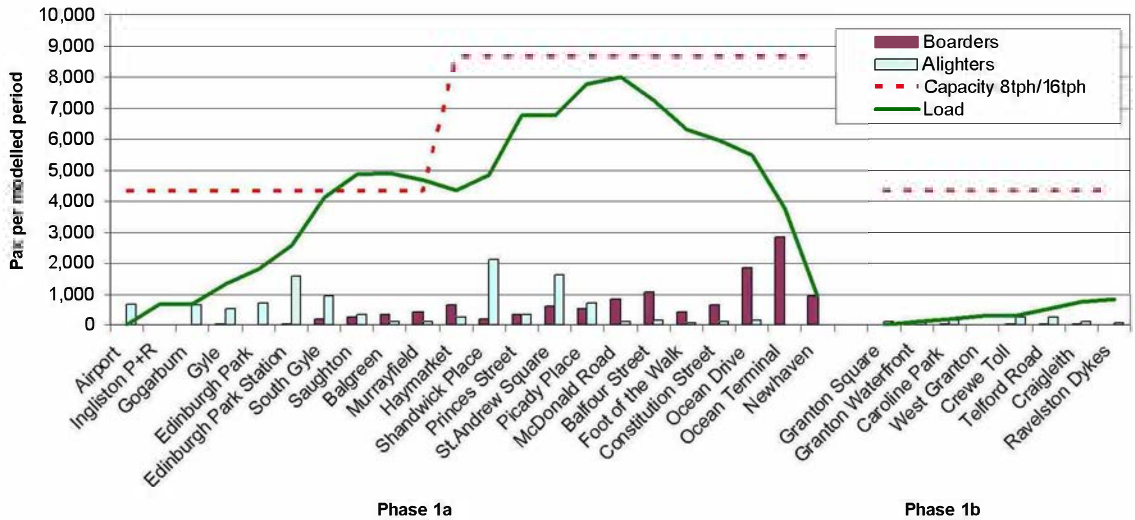


FIGURE 9.15 PHASE 1A+1B 2031 INTERPEAK EASTBOUND FLOW

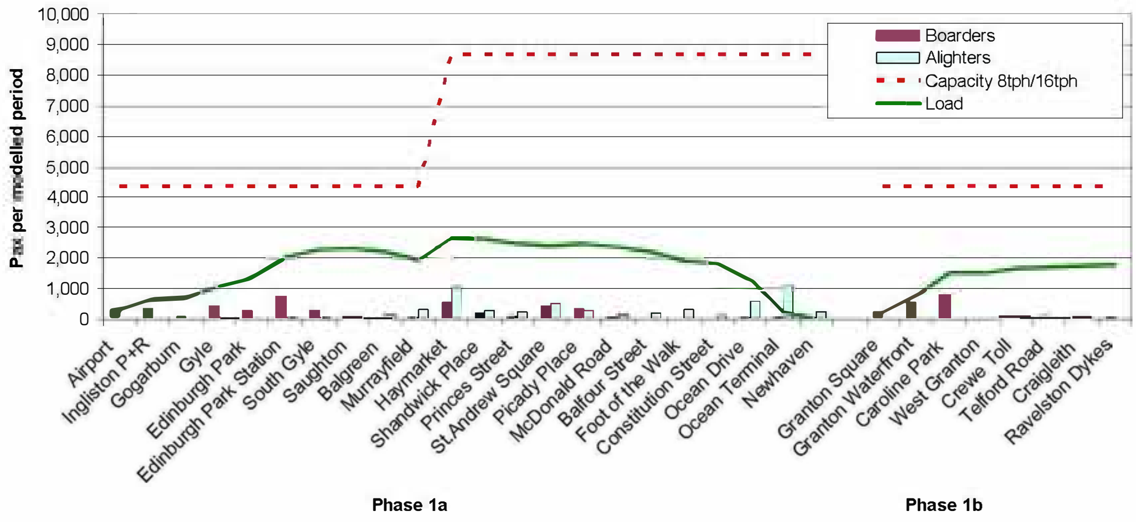
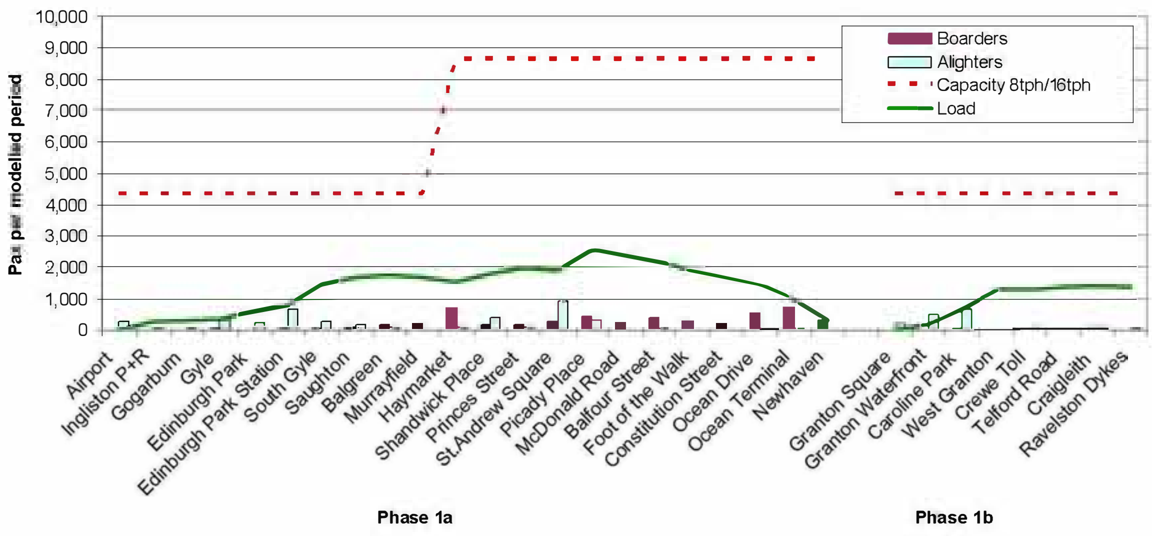


FIGURE 9.16 PHASE 1A+1B 2031 INTERPEAK WESTBOUND FLOW



Assessment against the Planning Objectives

9.19 A key principle of STAG is that a scheme is assessed against both the planning objectives established by the planning authority and the Government's five overarching objectives. Performance against planning objectives is fundamental in a Part 1 appraisal, which seeks to define the choice and rational of preferred option(s) which best meets the planning objectives. The Part 2 appraisal is essentially a more detailed exploration and appraisal against both sets of objectives, providing an updated assessment of the scheme against the planning objectives and considering in detail appraisal against the five Government objectives. This section therefore reviews the appraisal of Edinburgh Tram against the planning objectives (see Chapter 3); the Government's five objectives are considered in detail in the remainder of this chapter.

To support the local economy by improving accessibility

Improve access to the public transport network

9.20 Some of the alignment of Phase 1a is along existing public transport (bus) routes and whilst the Central case assumes some restructuring of the bus network along the route, buses will continue to run in parallel for much of its length. This will create a number of opportunities for public transport travel (and interchanges) in Edinburgh.

9.21 In addition, Phase 1b will open up new opportunities for public transport access, notably in terms of journeys from Granton and the Roseburn corridor to Haymarket and the West End.

Improved access to employment opportunities.

9.22 Edinburgh Tram will not only improve access to existing employment, it will also provide an opportunity to access new development sites planned for North Edinburgh (see Chapter 2). The wider consideration of public transport network coverage and associated accessibility is considered in later in this Chapter. It is demonstrated that Edinburgh Tram considerably improves access for a set of key employment destinations (although a few areas outside the immediate tram corridor experience slightly reduced accessibility due to changes to the bus network). This effect is significant for Phase 1a, with Phase 1a+1b delivering higher benefits than Phase 1a alone.

To promote sustainability and reduce environmental damage caused by traffic

Increase proportion of journeys made by public transport, cycling and walking

9.23 The modelling work for Edinburgh Tram has forecast increases in public transport demand. This leads to an increase in the share of demand by public transport, as set out in Table 9.7 and Table 9.8 for Phase 1a and Phase 1a+1b respectively. It should be noted that demand redistribution effects are different for the two scheme options and this can also influence the effect the two options have on mode share. The increase in the public transport share is typically around 0.5%, with the highest increase being around 0.8-0.9% in the 2031 AM Peak.

TABLE 9.7 TRAVEL DEMAND BY PUBLIC AND PRIVATE TRANSPORT (PHASE 1A)

		2011		2031	
		AM	IP	AM	IP
Reference Case	Public transport	94,993	54,707	135,845	80,648
	Private car	114,303	72,680	140,042	100,693
	PT share	45.4%	42.9%	49.2%	44.5%
Edinburgh Tram	Public transport	96,920	55,570	140,115	82,508
	Private car	114,068	72,756	139,591	101,114
	PT share	45.9%	43.3%	50.1%	44.9%
Change in public transport share		0.5%	0.4%	0.9%	0.5%

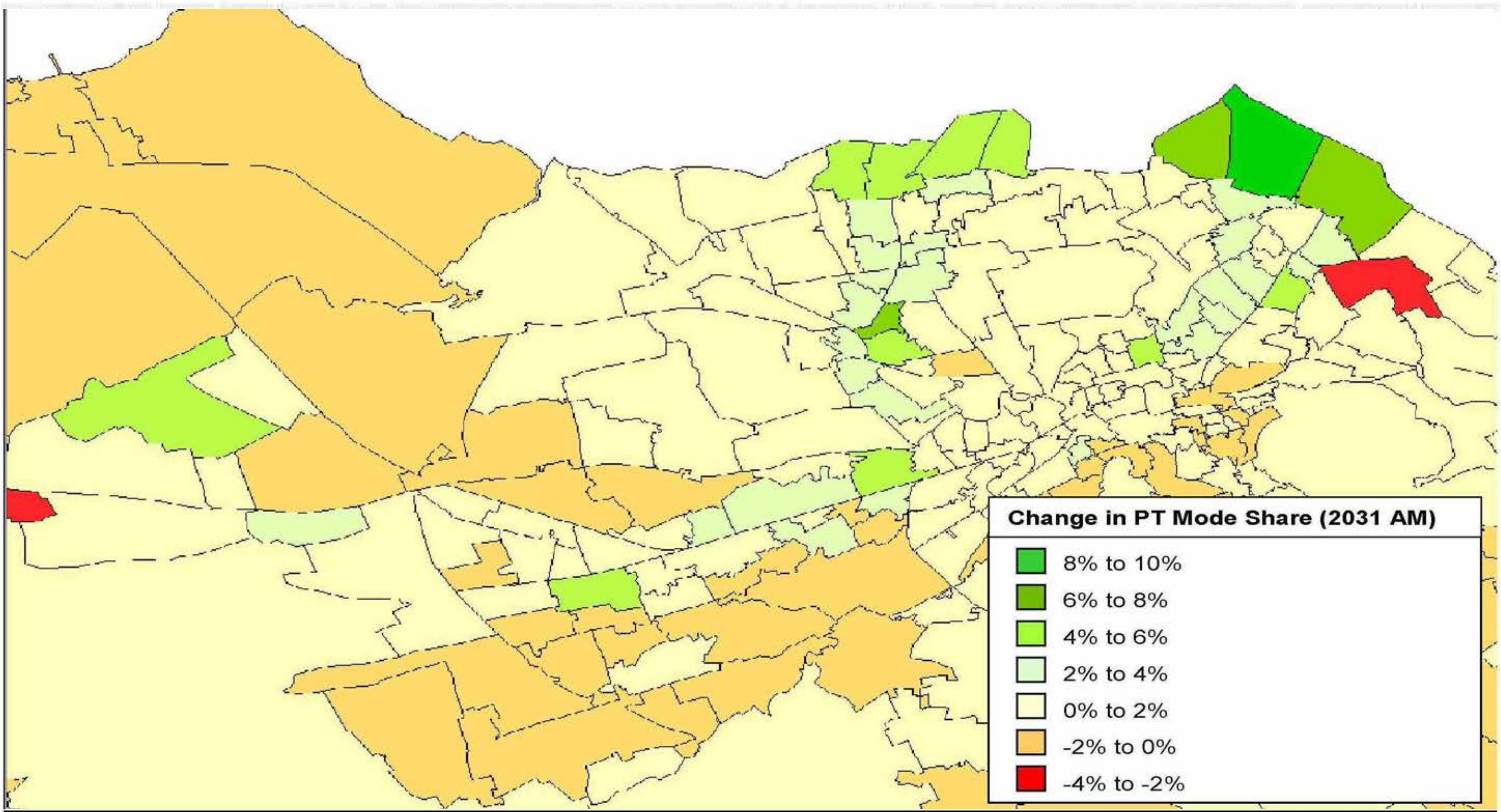
TABLE 9.8 TRAVEL DEMAND BY PUBLIC AND PRIVATE TRANSPORT (PHASE 1A+1B)

		2011		2031	
		AM	IP	AM	IP
Reference Case	Public transport	94,993	54,707	135,845	80,648
	Private car	114,303	72,680	140,042	100,693
	PT share	45.4%	42.9%	49.2%	44.5%
Edinburgh Tram	Public transport	97,183	55,642	139,989	82,754
	Private car	113,918	72,718	139,753	100,935
	PT share	46.0%	43.3%	50.0%	45.1%
Change in public transport share		0.6%	0.4%	0.8%	0.6%

9.24 The above data relates to the whole modelled area of Edinburgh and its environs, however. At a local level, in the tram corridor, the change in public transport share will be greater. The impact of the tram on mode shift is proportionately greater in areas that it will directly serve, where it is intuitive to anticipate achieving mode shift. Figure 9.17 presents the percentage change in mode share by location of trip origin for the AM peak period in 2031. It is apparent that changes in mode share from car to public transport up to 10% will be generated for trips from certain areas directly served by the tram. Areas exhibiting mode shift of greater than 5% (encompassing significant areas of development and growth which otherwise would be associated with higher levels of car travel) include:

- Leith/Newhaven
- Granton/Muirhouse
- Craigleith
- Roseburn
- Sighthill
- Edinburgh Airport

FIGURE 9.17 CHANGE IN PUBLIC TRANSPORT MODE SHARE WITH TRAM PHASE 1A+1B (2031 MORNING PEAK)



Reduce local and global emissions

9.25 A detailed analysis has been undertaken to determine the impact of Edinburgh Tram on local and global air quality; this is set out later in this Chapter. This analysis demonstrates that there is a moderate positive impact on air quality under both Phase la and Phase la+1b, with the latter have the greatest benefit.

To reduce traffic congestion

Reduce number of trips by car

9.26 Table 9.9 and Table 9.10 set out the impact of Edinburgh Tram on car demand for Phase 1a and Phase 1a+1b respectively. There are reductions during the AM peak, but the Interpeak experiences a slight increase in car travel. Note that this is considered primarily due to the increase in overall travel demand brought about by the higher development assumptions in the Edinburgh Tram scenario; it is considered that the direct impact of the tram will be to reduce the overall level of car demand.

TABLE 9.9 TRAVEL DEMAND BY PRIVATE TRANSPORT (PHASE 1A)

	2011		2031	
	AM	IP	AM	IP
Reference Case	114,303	72,680	140,042	100,693
Edinburgh Tram	114,068	72,756	139,591	101,114
Difference	-235	76	-451	421

TABLE 9.10 TRAVEL DEMAND BY PRIVATE TRANSPORT (PHASE 1A+1B)

	2011		2031	
	AM	IP	AM	IP
Reference Case	114,303	72,680	140,042	100,693
Edinburgh Tram	113,918	72,718	139,753	100,935
Difference	-385	38	-289	242

Reduce traffic volume on key routes

9.27 Table 9.11 sets out the changes in traffic flows on key roads resulting from the introduction of Edinburgh Tram. Significant reductions are expected on Constitution Street, Dalry Road, Haymarket Terrace, Leith Walk and The Mound. Some roads experience an increase in flow, such as George Street and Telford Road.

TABLE 9.11 CHANGES IN TRAFFIC FLOWS (2011 AM)

Road	Do-Minimum	1a	Change	1a+1b	Change
Abbeyhill	2,259	2,209	-50	2,205	-54
Balgreen Road	1,231	1,375	144	1,362	131
Calder Road	3,706	3,594	-112	3,597	-109
Calton Road	768	845	77	846	78
Commercial Street	2,059	2,097	38	2,103	44
Constitution Street	861	428	-433	432	-429
Crewe Road North	1,340	1,343	3	1,319	-21
Crewe Road South	1,545	1,605	60	1,587	42
Dalry Road	2,593	1,673	-920	1,626	-967
Easter Road	1,942	2,021	79	2,001	59
Eastfield Road	2,803	2,873	70	2,874	71
Ferry Road	3,744	3,905	161	3,911	167
George Street	1,232	1,553	321	1,540	308
Glasgow Road	4,831	4,879	48	4,872	41
Granton Road	1,735	1,720	-15	1,694	-41
Haymarket Terrace	3,533	2,833	-700	2,871	-662
Inverleith Row	1,865	1,940	75	1,943	78
Leith Walk	1,784	1,164	-620	1,160	-624
London Road	2,084	2,174	90	2,178	94
Market Street	826	957	131	957	131
Morrisson Street	2,539	2,751	212	2,738	199
Palmerston Place	2,121	2,236	115	2,206	85
Pilrig Street	1,645	1,428	-217	1,433	-212
Queen Street	5,449	5,327	-122	5,294	-155
Queensferry Road	2,535	2,328	-207	2,323	-212
Queensferry Street	1,325	1,496	171	1,462	137
Salamandar Street	2,679	2,507	-172	2,508	-171
South Glye Broadway	3,275	3,343	68	3,344	69
Starbank Road	2,200	2,221	21	2,214	14
Telford Road	2,892	3,181	289	3,163	271
The Mound	2,175	1,674	-501	1,668	-507
West Granton Road	2,111	2,268	157	2,272	161

9.28 The changes in traffic flow are due to a range of effects. Traffic reductions are caused by car users choosing to make their journey by public transport instead but localised increases can be caused by the displacement of traffic by the tram, for example due to reduced road capacity in the streets on which the tram will operate and an element of re-routing of traffic in areas where particular traffic movements would be altered to accommodate the tram.

9.29 As noted in paragraph 9.6 and subsequently of this report, changes in traffic flows need careful interpretation because of the larger travel market assumed in the Do Something situation. Some increases apparent in Table 9.11, such as those connected with the Granton area are due to this effect and should not necessarily be considered to have been *caused* by the tram.

9.30 It will be necessary, as the scheme develops and once it is operational, to ensure that appropriate mitigation measures are introduced and maintained to ensure that the transport network performs efficiently. Particular measures that could be introduced will vary according to the location and the range of amenities in the immediate vicinity. Examples of these measures will include:

- Appropriate signing to encourage traffic to use appropriate routes;
- Incorporation of traffic calming measures to discourage traffic from using residential streets (e.g. the streets to the east and west of Leith Walk);
- Review of parking and servicing provision on the adjacent local road network; and
- Provision of adequate parking for affected residents (e.g. at Granton Road).

9.31 In summary, whilst Edinburgh Tram removes some car demand from the highway network, at an individual street level it has only a slight beneficial impact on reducing traffic volumes on key routes. Although flow decreases appear to be largely offset by flow increases at a network level, this is due to the larger travel market assumed in the Do Something situation, which is not directly *caused* by the introduction of the tram.

To make the transport system safer and more secure:

Reduce traffic accidents.

9.32 The impact of Edinburgh Tram on the number of road traffic accidents has been estimated using model data on traffic flows by road type and the application of accident rates; the number of accidents savings by severity forecast is set out in Table 9.12. Using these figures directly from the modelled with and without-tram situations, an additional 75 accidents per annum are forecast alongside Phase 1a; alongside Phase 1a+1b a lower level of increase is forecast. The majority of these accidents are accounted for in terms of damage-only accidents.

TABLE 9.12 CHANGE IN ANNUAL NUMBER OF ACCIDENTS BY SEVERITY LEVEL

Level	1a		1a+1b	
	2011	2031	2011	2031
Damage	+70.1	+70.1	+54.1	+19.8
Slight	+4.6	+4.7	+3.6	+1.3
Serious	+0.5	+0.5	+0.4	+0.1
Fatal	+0.1	+0.1	+0.0	+0.0
Total	+75.3	+75.4	+58.2	+21.3

9.33 It should be noted that a portion of these increases are due to the larger travel market assumed in the with-tram situation and this component might not be considered as being directly *caused* by the introduction of the tram. Some adverse impact still results from redistribution and re-routing effects, however.

To promote social benefits:

Improve liveability of streets

9.34 This objective covers a whole gamut of interlinked issues, including accessibility, safety, environment and economy. In essence, it is about enhancing streets as 'civic spaces', where priority is given to people rather than cars. The current design for Edinburgh Tram is focused on delivering a transport scheme, which where possible looks to deliver benefits to the wider urban realm. The tram will provide an opportunity to implement wider enhancements to the urban realm, either explicitly planned and implemented in conjunction with the tram, or through the longer term effects of a planned framework for redevelopment and regeneration.

9.35 The regeneration effects of light rail typically take several years to become apparent and, to date, quantitative information about systems' impacts rarely has been collected. While it is difficult to demonstrate that tram schemes will themselves spark regeneration, they play a critical role in supporting it and shaping it in spatial terms. There is clear evidence of specific development projects led by light rail, such as in London Docklands, Salford Quays in Manchester and elsewhere. It is also clear that introducing light rail helps boost property values, both commercial and residential. Commercial values can experience uplifts of 100% or more, and effects on residential values can be discerned up to 1 km, or up to 20 minutes walk, from tram stops.

9.36 It is widely accepted that trams are more attractive than buses in urban areas, improving townscape features and liveability on the streets. This is valued by the wider public and not only by the users of the system.

Reduce social exclusion

9.37 Edinburgh Tram will provide a significant improvement in terms of the ability of the elderly and mobility impaired to use public transport. It will provide level boarding at stops, with the tram vehicle interior giving greater space and dedicated facilities for wheelchairs and/or prams, etc. The smooth ride and high level of comfort will make the tram system an attractive choice in comparison to other public transport modes. Such attributes will also be valued by other public transport users, albeit to a lesser degree.

9.38 The wider accessibility impacts are considered later in this Chapter, which explicitly sets out the impact of Edinburgh Tram on accessibility for those households without a car. This demonstrates that for a set of key employment destinations, there is a significant net improvement in access afforded by the scheme. Whilst some of those households benefit marginally (under 5 minutes reduction in travel time), there are substantial beneficiaries of 10 minutes or more.

Environment

9.39 The environment objective involves protecting the built and natural environments, by minimising (or where possible avoiding) the temporary and permanent impacts of transport infrastructure and operation.

9.40 The appraisal of Edinburgh Tram Line has been undertaken using the STAG 'project' level approach. This assessment is based on a reconfiguration of the results of the previous Environmental Statements (ESs) for Edinburgh Tram Lines 1 and 2, which were prepared as part of the Parliamentary Bill process.

Noise and Vibration

9.41 Airborne noise propagates through the air from the sources to receptors, while ground vibration propagates via the ground into a receptor (building). Noise and vibration arise from the actual infrastructure construction (temporary) and from the operation of the schemes (permanent).

9.42 The methods and criteria used to predict and evaluate noise and vibration impacts have been derived from relevant recognised national and international guidance.

9.43 A Code of Construction Practice[57] has been adopted; this includes restrictions on: closures of roads and footways, noise and hours of working, vibration, dust suppression and air pollution, disposal of waste and contaminated material, protection of the environment and safety. This will mitigate the impacts on noise and vibration levels during the construction process.

9.44 Similarly, a Noise and Vibration Policy has also been developed which sets out how **tie** proposes to mitigate noise from the operation of Edinburgh Tram. In essence, **tie** will undertake measures to mitigate significant noise impacts for residents and other noise sensitive receivers in the vicinity of the routes, following a tiered approach. This focuses initially on minimising the level of noise and vibration at source through appropriate vehicle standards and system design. Where levels are still considered excessive, noise barriers will then be provided, with the final option being the installation of noise insulation for residential properties.

Construction

9.45 The assessment of construction and vibration noise for Edinburgh Tram has been undertaken on a qualitative basis.

9.46 The noise levels associated with enabling works and track laying will be most typical of those to be produced on a daily basis during the construction phase. This will affect receptors along the length of the proposed alignment, whilst stop construction will only affect those located in the immediate vicinity.

9.47 In the absence of mitigation, significant impacts would be expected at receptors within approximately 40m of enabling works and approximately 15m of track laying and stop

[57] Edinburgh Tram Lines 1 and 2: Code of Construction Practice (March 2006) published by **tie**Ltd.

construction. Ground vibration may be perceptible at receptors within close proximity to the alignment construction works (within 10m buffer) but is not expected to exceed the daytime assessment criterion. Hence, whilst vibration may be perceptible in some areas, due to its temporary nature, short duration and low levels, it is not expected to give rise to adverse comment and impacts are not expected to occur. The levels of vibration expected from construction works are considered unlikely to cause cosmetic or structural damage at any properties along the route.

9.48 Only the population resident in the immediate vicinity of construction works will be affected but temporarily. These works will be undertaken using mitigation measures. Therefore, construction noise is not considered to be a significant impact.

Operation: Road Traffic Noise

9.49 Changes in traffic demand and patterns as a result of the introduction of the tram will affect the levels of road traffic noise.

9.50 The outputs from the JRC transport model have been used to estimate the effect of the tram on road traffic, comparing the situation in the Do-Minimum (i.e. without the tram in 2011, the opening year, and 2031) with the Do-Something (i.e. with the tram on the same years). The key inputs for the road traffic noise assessment are: link-by-link traffic flow, composition and speed, and population catchment within each noise contour.

9.51 The appraisal method uses the Calculation of Road Traffic Noise to predict indicative changes in source traffic noise at various distances from each road link based on changes in traffic flows, speed and composition obtained from the traffic model. The effects of road gradient, topographic screening and reflection are not considered.

9.52 Two analyses were carried out:

- Changes in the number of people annoyed by noise; and
- Changes in the number of people experiencing significant changes in noise levels.

9.53 For the first analysis, the GOMMMS noise annoyance-response relationships have been applied to the calculated noise levels to estimate the proportion of the population annoyed by different levels of noise. Annoyance-response relationships are given for noise levels above 55 dB. These percentages of people annoyed were correlated to the population within a 10 metre catchment of each link and summed across all links to give the total estimated population annoyed by noise for the whole study area.

9.54 For the second analysis, the acceptable levels for road traffic noise have been assumed at 65dB. Hence, any changes in noise levels below this threshold were disregarded. Noise contours of 3dB intervals from the minimum acceptable level, from the roadside up to 50 metres from each link, were created based on the geographical distribution of noise impacts.

9.55 Within each of these contours, the resident population was estimated using GIS analysis of 2001 census data. The total numbers of people experiencing an increase, decrease or no change in noise levels have been estimated by the summing of the population estimates for all links in the road network.

9.56 The estimated changes in the number of residents annoyed by noise within a 50m catchment are summarised in Table 9.13. These results suggest that the tram scheme would, overall, cause noise annoyance to slightly fewer people than without it in all instances (in percentage terms, these changes are marginal).

TABLE 9.13 ESTIMATED CHANGES IN THE NUMBER OF RESIDENTS ANNOYED BY NOISE

Phase	Year	Do-Minimum	Do-Something	Changes	% on Do-Min
1a	2011	37,424	37,360	-63	-0.2%
	2031	40,266	40,132	-134	-0.3%
1a+1b	2011	37,424	36,976	-448	-1.2%
	2031	40,266	39,528	-738	-1.8%

9.57 The estimated changes in the number of residents experiencing significant changes in noise levels within a 50m catchment are summarised in Table 9.14. These results suggest that more people experience reductions of at least 3dB than increases by the same amount, with a net positive impact.

TABLE 9.14 ESTIMATED NUMBER OF RESIDENTS EXPERIENCING SIGNIFICANT CHANGES IN NOISE

Phase	Year	Benefit	Disbenefit	Net
1a	2011	1501	1195	306
	2031	3725	1202	2523
1a+1b	2011	1658	1199	459
	2031	4458	1066	3392

Rail Noise

9.58 The design of the tram system will include acoustic elements and measures to reduce wheel squeal on bends. In addition, noise barriers will be needed where the tram introduces unacceptable noise levels.

9.59 Much of the tram route follows existing roads and the additional noise generated by tram movements is not expected to give rise to significant noise impacts in these areas. However, at other locations, such as along the Roseburn railway corridor, such new source of noise will be considerably detrimental.

9.60 The calculation method used was that recommended in the technical memorandum `Calculation of Railway Noise' (CoRN) 1995. The memorandum is used to determine noise from all guided transport systems where the guidance system is based on a dual running rail. The method consists of determining the reference noise level generated by an individual vehicle passage (defined as Sound Exposure Level, SEL) and by then modifying these values to take account of factors such as distance, screening and number of vehicles.

9.61 It is important to note that several features of the scheme are not typical of the type of railways for which the CRN prediction methodology was principally developed, namely: tram speeds are low, receivers are very close in some areas, and street-running track is used for the majority of the route. The source noise levels for the street running operation were based on other comparable street-running systems.

9.62 All residents within a buffer of the new tram line will be affected by the introduction of rail noise levels. The number of people likely to be annoyed by rail noise has been estimated as for road traffic noise.

9.63 Ground vibration could potentially be perceptible at receptors within approximately 20m of the alignment, but in case it is, the estimated levels are not expected to exceed the daytime assessment criterion beyond approximately 4m from the tracks. Any non-mitigated vibration will be transient and low level, and is not expected to give rise to adverse impact on people or buildings.

9.64 Table 9.15 sets out the number of residents impacted by tram noise. The number of people exposed to new rail noise as a result of the introduction of the tram has been estimated at 875 for Phase 1a and 1,198 for Phase 1a+1b.

TABLE 9.15 RESIDENTS IMPACTED BY TRAM NOISE

	Phase 1a	Phase 1a+1b
Residents directly exposed to noise	875	1,198
Residents annoyed by noise – weekday (weekend)	114 (105)	156 (144)

9.65 Table 9.15 also sets out the number of people who would be annoyed by tram noise; this considers a minimum threshold for rail noise impacts at LAeq, (0700-2300 hours) 55 dB (daytime) and the annoyance-response relationships for rail. It is relevant to note that the mitigating effect of any noise barriers at specific sensitive locations has not been taken into account in this assessment, since their size and precise location are not yet known.

9.66 The number of residents exposed to and annoyed by tram noise is modest compared to those benefiting from the tram, with daily tram demand being some 29,000 with Phase 1a in 2011, rising to 86,000 daily with Phase 1a+1b in 2031.

Air Quality – local

9.67 The key air pollutants considered for the appraisal of local air quality are Nitrogen Dioxide (NO_2) and Particulate Matter (PM_{10}) emitted from road traffic. Tram operation will have negligible impact on air quality along its route. Air quality standards for NO_2 and PM_{10} at the local level are presented in Table 9.16 below.

TABLE 9.16 AIR QUALITY STANDARDS

Pollutant		Objective	Date for Compliance
Nitrogen Dioxide (NO_2)	Annual Mean	40µg m^{-3}	31st December 2005
	99.8th %ile of Hourly Means	200µg m^{-3}	31st December 2005
Particulate Matter (PM_{10})	Annual Mean	40µg m^{-3}	31st December 2004
	90.4th %ile of Daily Means	50µg m^{-3}	31st December 2004
	Annual Mean	18µg m^{-3}	31st December 2010
	98.1%ile of Daily Means	50µg m^{-3}	31st December 2010

9.68 A spreadsheet model has been used to estimate the changes in traffic emissions of NO_2 and PM_{10} from the introduction of the tram, on a link-by-link basis. These are dependent on traffic flow, composition and speed.

9.69 The DMRB empirical method was used to estimate changes in roadside concentrations at certain distances from the road (50, 100, 150 and 200m). Background data for ambient concentrations of air pollutants for the City of Edinburgh are taken from the UK Air Quality Data and Statistics Database.

9.70 The analysis is undertaken in two ways:

- The population exposed to changes in pollutant concentrations of at least 10% within each catchment; and
- The population experiencing changes in relation to air quality standards.

9.71 Both analyses are based on the number of residents within each of the resident pollutant buffer zones experiencing increases, no change or decreases in concentrations of NO_2 and PM_{10}. Data on population are derived from GIS analysis of the 2001 postcode census data.

9.72 The population within each buffer on either side of the road link are weighted according to their distance to the roadside using weighting factors from DMRB. This accounts for the fact that traffic-related pollution decays rapidly with distance from the road.

9.73 The following scenarios are assessed: the Do-Minimum (i.e. without the tram in 2011 and 2031) with the Do-Something (i.e. with the tram on the same years).

9.74 STAG also requires an indication of the performance of a scheme in terms of the UK Air Quality Strategy.

9.75 Table 9.17 presents a weighted estimate of the number of people located within 200 metres of roads experiencing an improvement, degradation or no change in air quality. Under Phase 1a, the impact of Edinburgh Tram is broadly neutral, with comparable numbers of residents experiencing improvements in air quality as experience a worsening of air quality. For Phase 1a+1b, there is a material overall improvement.

TABLE 9.17 WEIGHTED NUMBER OF PEOPLE EXPERIENCING CHANGES IN AIR QUALITY

Phase	Year	Improvement		No change		Worsening	
		NO_2	PM_{10}	NO_2	PM_{10}	NO_2	PM_{10}
1a	2011	118,747	110,127	184,839	174,237	125,664	100,322
	2031	88,700	83,748	252,837	217,968	87,713	82,970
1a+1b	2011	141,358	126,455	175,030	164,723	112,862	93,508
	2031	120,708	108,437	243,409	212,627	65,133	63,622

9.76 The local air quality analysis set out in Table 9.17 is based on emissions from road traffic only and hence the impact of tram will not necessarily be greater on existing poor air quality areas (which exist on the Phase 1a corridor). It is quite plausible that, given the various contributors to air quality, the impact on poor air quality areas might be lower than areas with good air quality where traffic is the principal source and hence where traffic reductions have the largest proportional impact.

9.77 Table 9.18 shows the changes in population near roads which are brought into or out of compliance with PM_{10} and NO_2 air quality objectives. The introduction of the tram is predicted to increase compliance with PM_{10} and NO_2 objectives in 2011 and further in 2031.

TABLE 9.18 NUMBER OF PEOPLE SUBJECT TO CHANGES IN COMPLIANCE WITH AIR QUALITY STANDARDS

Phase	Year	Brought into Compliance with Air Quality Objectives in relation to Do-Minimum		Brought out of Compliance with Air Quality Objectives in relation to Do-Minimum	
		NO_2	PM_{10}	NO_2	PM_{10}
1a	2011	1712	0	73	0
	2031	1800	0	1164	40
1a+1b	2011	2316	0	73	0
	2031	3033	0	205	40

9.78 An indication of the relative magnitude of the exposure to pollutant emissions can be gained from the air quality index which is a product of the weighted number of people and the change in roadside air quality for each road link aggregated over the whole study area. A negative value implies an improvement in air quality and a positive value represents a deterioration; the larger the value, the more significant the impact. The air quality indices for the proposed scheme are shown in Table 9.19,, for all Phases and years, there is an improvement in air quality.

TABLE 9.19 AIR QUALITY INDICES

Phase	Year	NO_2 Index	PM_{10} Index
1a	2011	-107,954	-2,394
	2031	-161,688	-3,085
1a+1b	2011	-178,122	-3,671
	2031	-308,835	-5,587

9.79 A Code of Construction has been adopted which includes restrictions on: closures of roads and footways, noise and hours of working, vibration, dust suppression and air pollution, disposal of waste and contaminated material, protection of the environment and safety. This will mitigate any adverse impacts on local air quality arising from the construction process.

Air Quality – global

9.80 The total change in Carbon Dioxide (CO_2) emissions from road traffic and generation of electricity to power the tram is used as the indicator of greenhouse gas impacts.

9.81 The effect of the tram on CO_2 road traffic emissions is calculated using the emissions model, as described above. Emissions from tram operation are calculated from estimates of power consumption for the tram and standard factors for CO_2 emissions from UK electricity generation.

9.82 The operation of Edinburgh Tram is predicted to have an annual power consumption of 11.04 kWh/veh-km. It is assumed that this power comes from the National Grid, using an emission factor of 0.43kg of CO_2 per kWh of electricity generated. Table 9.20 presents the total changes in CO_2 emissions. The CO_2 emissions resulting from power consumption by the tram are added to the additional emissions from road traffic. Both Phase 1a and 1a+1b would increase the level of CO_2 emissions marginally, as a result of traffic re-routing and demand redistribution.

9.83 However, it must again be noted that the demand forecasting for Edinburgh Tram assumed a higher level of development in the with-tram scenario, which has inflated the reported levels of increase to overall emissions. In practice, the impact of the extra development on emissions would probably be worse if the development were instead to occur in more peripheral locations in Edinburgh or other cities where the share of travel by car would be higher than in the Granton and Leith development areas. Without the effect of the larger assumed travel market in the with-tram situation, the increases in emissions would be approximately half of those reported in Table 9.20.

TABLE 9.20 TOTAL CHANGES IN ANNUAL CARBON DIOXIDE EMISSIONS

Phase	Year	Road Traffic (tonnes/year)		Tram Operations (Power Station)	Total (tonnes/year)
		Change	% change Do-Min		
1a	2011	81,921	2.6%	6,695	88,616
	2031	153,365	2.1%	8,927	162,291
1a+1b	2011	90,147	2.8%	8,163	98,310
	2031	166,583	2.3%	10,884	177,467

Water Quality, Drainage and Flood Defence

9.84 The assessment includes surface water features along the route, the quality and sensitivity of these features, hydrogeology and groundwater resources, drainage and flooding. The impacts of construction activities and run-off from the scheme on water quality have been assessed, and mitigation proposed to minimise predicted impacts.

For Phase 1a:

9.85 There are three main watercourses in the vicinity of Edinburgh Tram Line Phase 1a that could potentially be affected by the scheme. These are;

- the River Almond;
- the Gogar Burn; and
- the Water of Leith.

9.86 The River Almond is the least affected by Phase 1a, as it flows to the north west of Edinburgh Airport, and is not crossed by the tram route. The Gogar Burn is a tributary of the River Almond and, after passing beneath the A8, it flows northward to the Airport boundary, where it flows westwards before entering a culvert near the Airport terminal building to pass beneath the runway and into the River Almond.

9.87 The Gogar Burn is known to cause flooding in areas to the south of the Airport and surrounds and an Area of Importance for Flood Control has been defined in this location. A section of the route for the scheme between the Airport and Ingliston Park and Ride stops would run close to the burn. New crossings of the Gogar Burn would be required close to the Gogarburn and Edinburgh Park stops. In addition, a number of smaller un-named water courses or ditches in the vicinity of the Area of Importance for Flood Control would be crossed. However, a study in 2003 by Edinburgh Airport Rail Link (EARL) showed that, given the mitigation plans, the tram's impact in this area would be neutral, and this was accepted in the Parliamentary Process.

9.88 The Water of Leith is crossed at Ocean Drive, to the north east of the city, as well as at Murrayfield, on the stretch towards Edinburgh Airport. Recent water quality assessments undertaken by the Scottish Environment Protection Agency (SEPA) indicate that near Ocean Drive the Water of Leith is of good quality. Overall, the Water of Leith is classified as a salmonid water of high amenity. Although existing bridges will be utilised to cross the Water of Leith in the north east, one new crossing will be required immediately west of the Murrayfield Rugby Ground. The Water of Leith is Class B (Fair) at this location and in recent times the river has caused severe flooding of the Rugby Ground and the surrounding area. The practice pitches here are also designated as Areas of Importance for Flood Control. The Murrayfield Flood Prevention Scheme will ensure that the impact of the tram here on the flood risk zone is neutral.

9.89 Stretches of the Gogar Burn have been assessed as Class B (Fair), with the stretch close to the Airport assessed as Class C (Poor) by SEPA. East of the Gogar Roundabout the route runs alongside the recently created Loch Ross, formed by widening the Gogar Burn at this point to create a water feature within Edinburgh Park. SEPA Guidelines and Best Construction Practices will be adopted and mitigation measures implemented during construction to keep the risk of surface water impacts, particularly sediment-laden runoff, to the minimum necessary for the scheme.

9.90 Considering the impact on hydrology and groundwater, much of the scheme is located within the area of a minor aquifer, which contains fractured or potentially fractured rocks. These do not have a high primary permeability or other features of varying permeability. Short sections of the scheme within the city centre are within areas with formations of rock with negligible permeability, generally regarded as containing insignificant quantities of groundwater. In locations where new drainage is required, the principles of Sustainable Urban Drainage Systems (SUDS) will be applied. SUDS measures include detention basins or wetland areas to remove pollutants in the run-off from hard surfaces prior to their discharge to adjacent watercourses. Implementation of mitigation and preventative measures, will ensure that development of the scheme will not result in any significant impacts on existing drainage systems or patterns.

9.91 Areas of contaminated ground are present along the route. Main issues included disused railway land around Baird Drive and Haymarket, as well as areas of made ground close to the Gogar Burn near Castle Gogar (a former landfill believed to have been used for demolition material).

Additional impacts for Phases 1a and 1b combined:

9.92 When including Phase 1b, the tram also crosses the Water of Leith at Coltbridge Viaduct. SEPA's water quality assessments indicate that near Coltbridge Viaduct, the Water of Leith is of poor quality. As the scheme will utilise existing bridges to cross the Water of Leith, construction of the tram is unlikely to significantly impact water quality. SEPA Guidelines and Best Construction Practices will be adopted and mitigation measures implemented during construction to keep the risk of surface water impacts, particularly sediment-laden runoff, to the minimum necessary for the scheme.

9.93 Similar to Phase 1a, impact on drainage is minimal to neutral. Within the Roseburn Railway Corridor the gradient of surrounding land varies, with the tram running on embankment and in cutting within different sections of the corridor. The existing drainage regime of the corridor consists of stormwater drains installed for the former railway and these will be utilised for the operation of the tram.

Summary

9.94 Overall the scheme, with the planned flood mitigation programmes in the problem areas of Murrayfield and Gogarburn, is expected to have a neutral impact on flooding risk. Surface water quality and drainage may suffer slight negative impacts in the short term, during construction. Best construction practices will be adopted to minimise any sediment laden or contaminated runoff during construction. Utilisation of existing drainage and installation of sustainable drainage measures where appropriate will ensure that the operation of the scheme will not result in adverse impacts to water quality.

9.95 The construction works will involve bridge construction and temporary disturbance, which would have a direct temporary impact on the channel and banks of the Water of Leith and the Gogar Burn. It would also be necessary to construct a culvert over a minor unnamed watercourse, which is a tributary of the Gogar Burn. There would also be a number of land-based activities associated with the construction works, which could potentially have an impact on surface waters in the vicinity. The Code of Construction[58] includes instructions to follow to avoid unnecessary damage.

9.96 Proposed mitigation would comprise the following:

- Construction activities would take place in accordance with all relevant legislation, codes of practice and Pollution Prevention Guidelines for protection of ground and surface water, with submission of an environmental method statement to SEPA.
- Temporary site drainage and/or treatment (e.g. settlement lagoons) would be put in place to manage site run-off and accidental spills of fuel, etc., during construction
- Identification of potential risks from possible contaminated land that would be disturbed by the proposed development.
- Temporary and permanent works would be designed to minimise disruption to water courses.
- The route drainage system would be designed to avoid pollution of watercourses and groundwater during operation though installation of interceptors, settlement tanks, etc.

9.97 The potential impacts to surface water, associated with the construction of the tram line, would be Minor and would be largely due to the temporary works associated with the construction of two new crossings of the Water of Leith and the Gogar Burn.

9.98 Assuming that adequate and well designed drainage is put in place that would collect and/or treat any contaminated run off and/or spills and that an effective management system and training is implemented to prevent inappropriate disposal or spills, potential impacts to groundwater from the proposed scheme would be Neutral.

9.99 Appropriate risk assessment of potential risks from contamination would be necessary to inform the site environmental management planning and development of appropriate mitigation measures for contaminated land risks. With these mitigation measures in place this would ensure that contact between potential contaminants and any identified receptors is minimised and the risk reduced to acceptable levels. The overall impact is assessed as being Neutral.

Geology

9.100 This section considers the impacts of the development on geology and soils and effects resulting from the presence of potentially contaminated land.

9.101 The route is underlain by glacial or raised marine deposits with areas of made ground. The underlying bedrock comprises sedimentary rocks consisting of mudstone, siltstone, sandstone and occasional thin limestones and coal seams, all of Carboniferous age. Superficial geological deposits of the area, as described by BGS, indicate that the route is principally underlain by Glacial Till (Boulder Clay).

58 Edinburgh Tram Lines 1 and 2: Code of Construction Practice (March 2006) published by **tie** Ltd.

9.102 The proposed route runs in proximity to two designated sites; a Geological Site of Special Scientific Interest (SSSI) at Calton Hill; and the Castle Rock SSSI (Edinburgh Castle). Calton Hill SSSI extends to approximately 13ha, and is designated for its geological interest as part of Arthur's Seat Volcano SSSI complex. The site is approximately 100m from the route at the top of Leith Walk. Castle Rock SSSI is close to the route at Princes Street, albeit on the far side of the main railway line west from Waverley Station. Neither should be affected by the route.

9.103 Impacts to soils along the route are likely to be generic to construction activity including erosion, disaggregation, compaction and pollution. Soil erosion as a result of development is most likely to occur in the form of water erosion where the mean annual rainfall, storm intensity and frequency are comparatively high. The removal of vegetation will contribute to erosion. Where erosion by water occurs, chemical transfer to surrounding watercourses may be an impact. Disaggregation is effectively the mixing up of soils when disturbed, both physically and chemically, and can result in problems for the re-establishment of vegetation where the chemical composition is altered. Compaction can hamper the infiltration of water resulting in increased runoff and erosion. Soil compaction can also result in difficulties for the reestablishment of vegetation in terms of root penetration and waterlogging. Pollution of soils can occur from a number of sources, in particular vehicle oils, construction materials and lead from exhausts.

9.104 Throughout the development, good practice will be adopted in order to prevent the occurrence of these potential impacts, particularly in sections of the route that are off-street. The prevention of soil erosion will involve minimising the removal of vegetation during development, and revegetation of bare areas as soon as possible. Suitable drainage systems will be put in place in order to prevent surface water build up. Some degree of disaggregation is likely to occur regardless of the mitigation measures implemented, although removal and storage of soil horizons separately can help to reduce this significantly. Using vehicles with wide tyres to spread vehicle weight, minimising the width of tracks for vehicular access, and tilling of the area will all assist in reducing compaction. Assuming that good practice measures are adopted during construction of the tram, no significant impacts on soil resources are predicted.

9.105 Any contaminated material encountered during construction will be dealt with in compliance with best practice, current legislation and statutory guidance, and no significant impacts resulting from the presence of contaminated material are predicted. The presence of contaminated land along the corridor is not expected to present any over-riding obstacle to development of the route. For areas where site investigation reveals the presence of contaminated land, a management plan will be prepared in order to comply with all relevant legislation. The plan will set out measures to avoid the remobilisation of contaminants via surface waters, groundwater and in the ambient air. Where potentially contaminated material is excavated, it will be investigated to determine the concentrations of any contaminants and to establish whether the material can be placed elsewhere on the site, and whether it should be classified as an environmental hazard by SEPA, or as special waste.

Additional impacts for Phases 1a and 1b combined:

9.106 Adding Phase 1b results in the tram running by a Regionally Important Geological Site (RIGS), at Craigleith. This site was a former quarry and was designated a RIGS in

1999 by the Edinburgh Geological Society. Craigleith Quarry was operational for over 300 years, providing much of the sandstone used in the construction of Edinburgh's New Town in the 18th and 19th Centuries. The site is now a retail park, although the RIGS designation has renewed interest in the scientific and educational value of the rock outcrops. The proposed route passes approximately 30 metres west of the rock outcrops and is separated from the RIGS site by South Groathill Avenue. The proposed tram route will consequently have no impact on the Craigleith RIGS. The proposals will not impact on the future workings of any mineral reserves.

Summary

9.107 No impacts on designated geological sites such as SSSIs and RIGS are predicted from the construction and operation of the Edinburgh Tram. In addition, no impacts on active or mineral resources are predicted. Both of these impacts have therefore been assessed as Neutral.

9.108 During construction there will be the requirement to dispose of material from within the route as required by the detailed design. It is possible that some of this waste material would come from areas that are potentially contaminated. Particular issues would include known areas of made ground such as railway embankments, former railway or industrial and the area of former landfill at Gogar.

9.109 Waste would also be generated during operation of the scheme. This would be handled and disposed of according to current Waste Management legislation. The impact from waste management issues is therefore assessed as Minor.

Biodiversity

9.110 An outline of the development proposals has been compared with the findings of the baseline survey to predict the direct impacts that may result from the scheme. In addition, likely effects on known habitats of nature conservation value in proximity to the scheme have been considered. The Landscape and Habitat Management Plan [59] (LHMP) investigates and address these issues in detail. The first publication of the document was agreed during the parliamentary process for Line 1. It is however a 'living' document, which evolves as the detailed design changes.

For Phase 1a:

9.111 The proposed route runs mainly along existing roads. These are of limited nature conservation interest, with habitats restricted to street trees and amenity grassland strips. Other habitats in the surrounding area include those associated with parkland, gardens and abandoned land. The main fresh watercourse in the area is the Water of Leith.

9.112 A number of habitats are found along the proposed route including extensive areas of low value amenity and improved grassland, tall ruderal, introduced shrub, arable land and field boundaries have been identified along the tram route. Those of note include

[59] Landscape and Habitat Management Plan, by ERM for *tie* Ltd, first published June 2005 (accessible via **tie**website http://tt.tiedinburgh.co.uk/documents.html)

woodland (broadleaf and mixed, no ancient woodland) and watercourses (the Gogar Burn and the Water of Leith).

9.113 Non-statutory designated areas along the route include Water of Leith Urban Wildlife Sit (UWS), Gogar Burn Site of Interest for Nature Conservation (SINC) and UWS. In addition, Carrick Knowe Golf Course is a Neighbourhood Nature Area (NNA).

9.114 Protected mammal species known to be present within the route study area include badgers, bats and otters. There are several Local Biodiversity Action Plan (LBAP) habitats and species within the route corridor.

9.115 Construction of the tram will result in significant temporary and permanent impacts to badger. Mitigation measures will be implemented to ensure that works undertaken in close proximity to badger setts and foraging habitat comply with the requirements of relevant legislation, in consultation with Scottish Natural Heritage (SNH) and the Scottish Executive Countryside and Natural Heritage Unit (CANHU). Appropriate mitigation measures will be implemented, in agreement with CANHU and SNH, to minimise habitat loss and disturbance to badger. This involves the creation of artificial setts and is outlined in the LHMP.

Additional impacts for Phases 1a and 1b combined:

9.116 When including Phase 1b, the stretch of the route that supports the most significant terrestrial vegetation is the Roseburn Railway Corridor. This includes woodland and grassland habitats.

9.117 Phase 1b of the route is aligned along the Roseburn Railway Corridor, an Urban Wildlife Site (UWS), for approximately 3km and will encroach into the 'Coastline' UWS along approximately 250m at Wardie Shore. The Water of Leith UWS is crossed via Coltbridge Viaduct in the Wester Coates area.

9.118 In terms of protected species in the vicinity, there are extensive signs of breeding and foraging badger along the Roseburn Railway Corridor. Additionally, pipistrelle bats (55kHz) were recorded foraging along the corridor during a September survey. No roosts were identified.

9.119 Construction of the tracks and walkway/cycleway will result in a significant impact to the Roseburn Railway Corridor UWS. The majority of vegetation will be removed along the embankments, affecting its function as a wildlife corridor. The impacts on this corridor will be limited to the minimum necessary through the implementation of mitigation measures, including the adoption of best practice measures during construction. As much vegetation will be retained as possible, consistent with safe completion of the works. No particular plant species of interest are known from the route.

Landscape

9.120 Landscape impacts are physical changes caused by a development which affect the character of the landscape and how it is experienced. They can consist of direct impacts on specific landscape features and elements or more subtle effects upon the overall pattern of elements, which together make up the local character. Where the area being discussed is predominantly built-up, it is described as 'townscape' rather than landscape.

9.121 Edinburgh is long established as one of UK's national cultural assets and is the most highly valued of Scottish townscapes. It contains one of the largest areas of Georgian architecture in Europe and almost the entire city centre is inscribed on the UNESCO register of World Heritage Sites due to its unique architectural heritage and distinctive townscape. Conservation areas cover about one third of the city and there is general agreement that its special urban qualities have to be safeguarded and protected.

For Phase 1a:

9.122 In this section the existing townscape of the area affected by the tram are divided into 'character zones' to aid description and analysis[60]. The major impacts of the tram on these various townscapes are then described, zone by zone. Mitigation proposals by **tie** are given at the end of the section.

9.123 The tramline's design proposals include the following elements relevant to the assessment of landscape impacts:

- A twin-track light rapid transit track-bed, generally at existing grade, paved in a variety of materials according to the situation;
- Stops with shelters, lighting, seating, ticketing and information;
- Tram vehicles;
- Overhead line equipment – conductor wires, supported on a combination of cables or poles;
- Substations;
- Signalling equipment and signs;
- The tram depot; and
- Alterations to various existing bridge and retaining wall structures.

9.124 A number of major road junctions will be comprehensively redesigned and existing traffic will be diverted from the tram route in a number of places. There will be some townscape impacts off-site due to changes in traffic flows but these are expected to cause no significant impacts on the townscape.

9.125 The main sources of townscape impact will be the overhead infrastructure (wires and supports referred to as overhead line equipment (OLE)) new and altered structures such as bridges, new buildings, the tram depot and substations, and the tram stops with their associated shelters, seating, etc.

9.126 The tram signalling equipment and additional traffic signalling and signage will generally have small effects but they will add clutter to the streetscape and may in sensitive locations raise the overall townscape impact above a threshold for significant impacts.

60 The methodology is based on the 'Guidelines for Landscape and Visual Assessment' (LI and IEMA, 2nd Edition, 2002) and the STAG guidelines.

9.127 The tram vehicles themselves will also have an impact in areas not currently trafficked, such as the railway corridor.

9.128 Construction activities for the tram will appear as an ordinary construction site of the sort common in urban areas, except that the sites will generally be long and linear, and will partially fill what are normally spaces within the fabric of the city. Many activities, such as the erection of the OLE supports and the equipping of the line will be of such short duration that their effect on the townscape is negligible. Several locations have been identified for use as construction compounds; these include the old bus depot site in Leith, vacant sites at Crewe toll, Craigleith, Saughton, Balgreen and Ingliston Park and Ride. These sites are all within the Limits of Land to be Acquired or Used (LLAU) as defined within the Tram Act, and will be reinstated following construction activity.

9.129 The tram will be a new element in the city, clearly visible to all and its impact will be dependent on the design of the system. There is substantial potential for mitigation through ensuring that the various new and altered elements are appropriately designed and integrated into the fabric of the city.

9.130 A Design Manual has been prepared, and this sets out the principles of urban design and detailing to be followed in the final design. This will provide specimen designs for key areas, including the whole of the World Heritage Site. Contract requirements will ensure that the final design complies with the Design Manual.

9.131 General mitigation commitments arising from the Design Manual include:

- Improvements to the pedestrian realm affected by the tram, including comprehensive wall to wall repaving of key areas;
- Careful design of the OLE to simplify the layout, balancing conductor wire and support cable sizes against support spacing so as to minimise the size of the wiring;
- Detailing and design of wire supports and their arrangement to suit the form of the street, particularly at junctions;
- Use of visually appropriate methods of OLE support, including designing a simple and elegant support column, attractive in its own right;
- Integrating the OLE supports with other vertical elements in the street (lighting and signing poles) as far as possible, and coordinating the spacing of new and existing poles, replacing existing lighting columns where appropriate;
- Simple alignment of the tram track to avoid as far as reasonably possible the need for complex OLE support structures or wiring, including straight alignments along the principal city centre streets to respect the formality of urban design of the New Town;
- Use of surfacing and kerb materials appropriate to the location, in accordance with CEC public realm guidelines;
- Coordinated and visually integrated design of tram stops, creating high quality pedestrian spaces, with the shelters, seating, signage and other equipment designed as an integrated whole, visually light and transparent.

9.132 A summary of the impacts on each townscape zone around the city centre is given in Table 9.21. The section of the route in Phase 1a which extends from Haymarket to Edinburgh Airport has been assessed in a slightly different way, and is described after

TABLE 9.21 SUMMARY OF LANDSCAPE IMPACTS (PHASE 1A)

Location	Description	Importance	Impact
Haymarket	Potentially complex OLE support. Road alterations and demolitions weaken enclosure of junction area. Tram stop will improve Haymarket Terrace.	World Heritage Site New Town Conservation Area (CA)	West of Haymarket Terrace: minor adverse to minor beneficial. East of Haymarket Terrace: major adverse. The tram stop: small area major beneficial.
West End	OLE in designed vista. Road widened into gardens.	World Heritage Site New Town CA West End CA	Major adverse.
Princes Street	OLE in designed vista and iconic tourist views. Footway widening.	World Heritage Site New Town CA	Overall major adverse, primarily arising from the OLE. Footway widening beneficial
St Andrew Sq	OLE in designed vista and iconic tourist views.	World Heritage Site New Town CA	Major adverse impact.
Queen St to Picardy Pl	OLE in designed vista. Road widened and awkward level changes.	World Heritage Site New Town CA	Major adverse impact. Particular impact on National Portrait Gallery.
Leith Walk	Road widening and loss of enclosure, but also improvement opportunity at top of Walk. OLE particularly visible in long views. Loss of street trees at north end.	World Heritage Site (part) New Town CA (part) Leith CA (part)	Overall major adverse impact.
Leith	Distinctive small-scale local character, highly sensitive to change.	Leith CA	Major adverse impact
Port of Leith	Tram a minor additional element in industrial parts, part of a much wider change elsewhere.	Leith CA (part)	Generally, minor impact, moderate in limited areas.

9.133 The section of route from Gogar roundabout to the Airport runs to the north of an Area of Great Landscape Value (AGLV) at Gogar. There is a Designed Landscape (Millburn Tower) to the south west of this stretch of corridor route, but this would be entirely unaffected by the tram proposals as there would be little intervisibility between the landscapes and the proposed tram route. The section of tram corridor from Gogar roundabout to the Airport falls within Green Belt designated land of which the local landscape character, under local plan policy is to be protected, maintained and enhanced. The tram corridor would also run adjacent to various areas of open space identified and protected under local plan policy.

9.134 Localised minor positive landscape impacts would arise particularly for the housing areas bounding Broomhouse and Stenhouse Drives due to the proposed mitigation planting along the tram corridor and the mixed woodland screen planting between the railway and tram corridors.

9.135 The area around Edinburgh Park comprises large business related developments including the modern office development set in spacious, attractive landscape grounds.

It is anticipated that only minor negative or neutral landscape impacts would occur in this area, with occasional minor positive impacts as a result of the mitigation planting. Negative landscape impacts for example would be associated with the tram line running through the landscape corridor in Edinburgh Park and the introduction of the overbridge at Hermiston Gait.

9.136 The more rural/urban fringe area between the City Bypass and the Airport generally comprises of highly sensitive and very attractive, good quality landscape. It is characterised by the rural matrix of predominantly arable farmland subtle topographic and woodland features with the traditional estate planting together with agricultural shelterbelts creating a strong and positive influence on the appearance of the landscape. The introduction of the tram would have direct landscape impacts on the historic setting of Gogar Church resulting in moderate negative impacts. Generally however, landscape character at the Airport and sections of infrastructure corridors where the mitigation planting would enhance the existing landscape framework.

9.137 To conclude, although the scheme provides opportunities for enhancing the local landscape in certain areas, several major adverse impacts can be expected at varying degrees in different locations along the route.

Additional impacts for Phases 1a and 1b combined:

9.138 Phase 1b adds further landscape zones of the 'railway corridor', Pilton, Waterfront Granton. Impact analysis for these is summarised in Table 9.22 below.

TABLE 9.22 SUMMARY OF LANDSCAPE IMPACTS (PHASE 1b)

Location	Description	Importance	Impact
Waterfront Granton	Part of a much wider change.	-	Minor to neutral impact.
Pilton	Tram will be a minor addition.	-	Minor adverse impact.
Railway Corridor	Significant vegetation removal required.	Coltbridge and Wester Coates CA (part)	Major adverse landscape impact

9.139 Overall the introduction of the tram into this wider character area, including the committed mitigation would have minor negative to neutral landscape impacts, primarily arising from the OLE and the localised removal of mature tree planting. However, at the railway corridor section, particularly at Roseburn, the negative landscape impacts increase to major adverse.

Visual Amenity

9.140 Visual impacts are changes in the composition and character of views available to people living, working and recreating in the area affected by the proposed development, changes in the visual amenity enjoyed by those who benefit from those views, and people's responses to these changes.

9.141 By definition, visual effects can only occur where the tram system is visible. Along much of the route, the tram and its infrastructure will be seen from a comparatively restricted area: from buildings facing directly onto the tram line and from streets that cross the line. The buildings that form the streets generally block views from further afield. The exceptions to this are where the tram runs through or alongside open space – most importantly along Princes Street, but also through parts of the Port of Leith.

For Phase 1a:

9.142 This section describes the extent of the area affected by Tram (Phase 1a), the sensitivity of the various receptors of visual impact, the extent of visibility of the proposals and the potential visual impacts. It also sets out the measures proposed for the mitigation of these impacts[61].

9.143 Visual impacts will be created by:

- The tram infrastructure – overhead line equipment, signals, stops and shelters;
- The tram vehicles themselves;
- The buildings associated with the tram, such as the depot and the substations; and
- Alterations to structures such as the embankments on the railway corridor.

9.144 The sensitivity of the receptors of visual impact varies according to their activity and expectations. Those for whom the view is important or where changes will be particularly noticed, such as people enjoying tourist locations or outdoor recreation activities, iconic views of the city, designed vistas in the New Town and the main outlook from residential properties are highly sensitive. People travelling through or past (on roads and railways), shoppers and people enjoying indoor recreation activities are less sensitive and those whose attention can reasonably be expected to be focussed on their work or activity, i.e. offices and other workplaces, are least sensitive.

9.145 There will be visual impacts on virtually all the properties and roads along the tram route, on public open spaces and recreational sites such as Princes Street Gardens, St Andrew Square and from important tourist viewpoints such as Princes Street and Edinburgh Castle.

9.146 Major visual impacts are caused where proposed development is clearly noticeable and affects the character or quality of view for sensitive receptors. For this reason there will be major visual impacts along much of the route because of the unavoidable visibility of much of the tram infrastructure, particularly the overhead line equipment, from houses and flats along the route and from many of the main city centre tourist locations.

9.147 A summary of the visual amenity impacts is presented in Table 9.23.

61 Consultations regarding the visual impacts of Tram Line 1 have been undertaken with CEC City Development (Planning), Historic Scotland and Edinburgh World Heritage Trust. The methodology is based on the 'Guidelines for Landscape and Visual Assessment' (LI and IEMA, 2nd Edition, 2002) and the STAG guidelines.

TABLE 9.23 VISUAL AMENITY IMPACTS (PHASE 1a)

Location and Impact	Importance	Significance of Impact
Haymarket OLE generally seen against backdrop of buildings in short views across Haymarket Terrace and junction, longer views across station car park and railway. Tops of columns seen against sky in some places.	World Heritage Site New Town Conservation Area See Cultural Heritage for listed buildings	Major to minor adverse
New Town: West End OLE generally seen against backdrop of buildings in short views across the road, longer glimpses from side streets.	World Heritage Site New Town Conservation Area West End Conservation Area See Cultural Heritage for listed buildings	Major to minor adverse
New Town: Princes Street OLE generally seen against backdrop of Castle and the Old Town in open views across gardens. Backdrop of sky from parts of north side footway. Stops interrupt views locally.	World Heritage Site New Town Conservation Area See Cultural Heritage for listed buildings	Major to minor adverse
First New Town - designed vistas from cross streets and George Street. OLE will be just discernible against a backdrop of trees.	World Heritage Site New Town Conservation Area	Neutral (to be confirmed)
Edinburgh Castle Tram discernible but not significant in panoramic views from Castle	World Heritage Site Old Town Conservation Area Listed building	Neutral
New Town: St Andrew Square OLE generally seen against backdrop of buildings and trees in short views across the road, longer glimpses from side streets.	World Heritage Site New Town Conservation Area See Cultural Heritage for listed buildings	Major to minor adverse
New Town: Queen St to Picardy Place: OLE generally seen against backdrop of buildings and trees in short views across the road, longer glimpses from side streets.	World Heritage Site New Town Conservation Area See Cultural Heritage for listed buildings	Major to minor adverse
Leith Walk OLE generally seen against backdrop of buildings and trees in short views across the road, longer glimpses from side streets.	World Heritage Site (part) New Town Conservation Area (part) Leith Conservation Area (part) See Cultural Heritage for listed buildings	Major to minor adverse
Leith OLE generally seen against backdrop of buildings and trees in short views across the road, longer glimpses from side streets.	Leith Conservation Area See Cultural Heritage for listed buildings	Major to minor adverse
Port of Leith OLE generally seen against sky backdrop in open views across dock areas, against backdrop of buildings in some areas.	Leith Conservation Area (part) See Cultural Heritage for listed buildings	Major to minor adverse

9.148 For the stretch from Haymarket to the Airport, the impacts vary. Generally, as the line gets further from the city centre, the visual envelope increases, and visual awareness of the tram corridor is more extensive.

9.149 From Haymarket west the visual envelope is contained in sections by localised planting and buildings but generally forms a relatively wide corridor contained by flats and the railway corridor to the south and open to the north extending across Carrick Knowe golf course towards Corstorphine Hill. The envelope from Carrick Knowe west remains wide although largely defined by the railway corridor to the north and by buildings to the south. Principal receptors along this section of corridor include, properties which lie adjacent to and/or have views overlooking the route corridor; employees working in offices and of the various industrial and commercial premises located adjacent to and/or with views of the route and users of the various footpaths and open spaces which either cross, run adjacent to or have views of the tram route.

9.150 From Gogar Roundabout west the visual envelope is more open and extensive. The envelope although often contained to the south by landform and woodland planting is open encompassing large areas to the north with localised built developments, occasional landform and pockets of planting restricting views. Receptors along this section include residents of the various scattered properties and pockets of concentrated development, users of the Airport and visitors to the showground, travellers using the various infrastructure corridors including the A8 and various footpaths and cycle ways which have views of the tram route.

9.151 The mitigation for the visual impacts is generally to design the tram system well, so that it fits comfortably into the scene as far as possible. Elements such as the stops and road alterations which can be designed as positive features will be treated as such, so that whilst they are visible they do not detrimentally affect the quality of the view. Elements that will by their very nature be seen as detrimental, specifically the OLE, will be designed to be as visually light as possible, cleanly and simply detailed.

9.152 A Design Manual has been prepared; this sets out the principles of design and detailing and in the construction contract will ensure that the final design complies with the Design Manual. Points in the Manual that are specifically intended to reduce the visual impact of the tram include:

- Careful design of the OLE to simplify the layout, balancing conductor wire and support cable sizes against support spacing so as to minimise the size of the wiring;
- Detailing and design of wire supports and their arrangement to suit the form of the street, particularly at junctions;
- To use visually appropriate methods of OLE support, including designing a simple and elegant support column, attractive in its own right;
- To integrate the OLE supports with other vertical elements in the street (lighting and signing poles) as far as possible, and coordinate the spacing of new and existing poles, replacing existing lighting columns where appropriate; and
- Simple alignment of the tram track to avoid as far as reasonably possible the need for complex OLE support structures or wiring.

9.153 A number of views and viewpoints are particularly important in Edinburgh because of the designed vistas in the New Town and because of the importance of tourism in the city. Examples are former are the views down Princes Street towards Calton Hill, down St David Street to the Scott Monument, down Castle Street towards the Castle, and along George Street to St Andrew Square. Examples of the latter are the views from Princes Street, looking diagonally towards the Castle and views from the Castle across the New Town.

9.154 Where possible, these views have been taken into account in the indicative design. For example, the Princes Street stop will be located so that it does not affect the view from Castle Street. The central alignment on Princes Street was partly determined by the requirement to minimise the effect on views out of the street and to allow for simple, and thus visually lighter, OLE design. The overall assessment for Visual Impact is that impacts would be minor negative although significant for localised sections of the tram corridor, but elsewhere would not be significant.

Additional impacts for Phases 1a and 1b combined:

9.155 Along the railway corridor there will be major adverse visual impacts caused by the opening up of views to a newly active line, that are currently screened by vegetation and embankments, where these are being cut back. Here, mitigation can and will be provided by screening, particularly replacing and reinforcing hedges along the site boundary. A summary of this and the other impacts along this section of the route is shown in.Table 9.24.

TABLE 9.24 VISUAL AMENITY IMPACTS (PHASE 1b)

Location and Impact	Importance	Significance of Impact
Waterfront Granton OLE generally seen against backdrop of buildings and trees in short to medium views across the new transport boulevard, longer glimpses from side streets.		Moderate to minor adverse (compared to new development without tram)
Pilton OLE generally seen against backdrop of buildings in short views across the road, longer glimpses from side streets		Moderate to minor adverse
Railway Corridor Views into railway corridor from surrounding houses substantially opened up. OLE and passing trams become visible, generally against backdrop of buildings and trees in short to medium views. Views substantially opened up at S end where embankment re-graded.	Coltbridge and Wester Coates Conservation Area (part)	Major to minor adverse

Agriculture and soils

For Phase 1a:

9.156 The section of the route which passes between the airport and Haymarket will pass through several fields which are currently used for arable or under 'set aside'. All fields are classified as Class 2 agricultural land i.e. high quality. Typically, tenant farmers hold short-term leases.

9.157 Some areas of contaminated land would be disturbed by the construction the Tram line going out the Airport (formally known as Line 2 - further detail is available on this in Chapter 7 of the Tram Line 2 Environmental Statement). The main types of potentially affected contaminated land are listed below:

- Former or existing railway land, particularly at Haymarket, Murrayfield, Baird Drive and west of Balgreen Road, and Gogar Roundabout.
- Former factory adjacent to Gogarburn Roundabout (Depot Site).
- Site of former smithy at Gogar.
- Former unlicensed landfill adjacent to the Gogar Burn.
- Made ground on eastern bank of the Gogar Burn.

9.158 The tram may have temporary and permanent impacts. These are shown in Table 9.25, along with proposed mitigation.

TABLE 9.25 IMPACTS & MITIGATION OF TRAM IMPACTS ON LAND

Temporary	Permanent
Agricultural land: Temporary agricultural impacts are related to the construction compounds being situated on fields currently being used for agricultural purposes. Proposed mitigation measures include: • Care during construction. This would require possible stripping and storage of top soils to prevent soil structure damage during construction and repair and replacement of agricultural drains. • Reinstatement of agricultural fields to enable continued farming practices. • Maintained access to agricultural fields during construction. Based on the assumption of mitigation, a **neutral** impact for the significance has been assigned for all cases.	**Agricultural land:** For all agricultural, the common permanent residual impact is the loss of agricultural farming ground required for the operation of the tram line, within Limits of Deviation (LODs). Areas of land will become unsuitable for further agricultural use because the remaining field area (between the field boundary and the track alignment) is considered too small for viable farming use. This assessment was based on discussions with the individual farmers. Proposed mitigation measures for agricultural land areas include: • Level crossings with warning lights will be built across access roads and fields to enable safe crossing of the tram line to enable continued agricultural use • Compensation has been assumed for the area of agricultural land which is no longer viable for farming use. The impact significance assessment for individual farming plots has assigned a Minor Negative Impact (because the area of land take is small in terms of the scale of the farming operations). However, because of the combined effect of land take of Class 2 agricultural land, a moderate negative Impact has been assigned overall
Contaminated Land: During construction any materials encountered that may be contaminated would be tested for potential chemical contaminants associated with known past uses of the site. In addition, all standard health and safely measures would be followed to ensure the minimum contact between site workers and members of the pubic and potential contaminants. Measures would be put in place to ensure that run-off from sites is prevented and that dust and aerosol generation is minimised. Areas of significant contaminated that may impact on construction materials would be removed or isolated to avoid contact with any sensitive materials. The residual impact has been assessed as **minor**.	**Contaminated Land:** Mitigation in terms of contaminated land would prevent and/or contain spills so that land within the scheme, particularly at depots, is not contaminated by operational activities. Design of infrastructure would take into account potentially contaminated land so that structures would be protected from aggressive ground conditions and/or gas protection measures put in place to prevent ingress/migration of landfill gas if present. Monitoring and or venting of gas may be required. It is likely, however, that the level of contamination present in each of these areas will not be significant because the areas involved are not extensive and the uses themselves are not likely to have generated large quantities of contaminated material. The impact has been assessed as minor negative.
Soils: In relation to the general management of soils throughout the route alignment, mitigation would include ensuring that soils are adequately protected and/or temporarily removed during construction works, then restored/replaced after construction works have been completed. **Neutral** impact.	

Additional impacts for Phases 1a and 1b combined:

9.159 Phase 1b does not add any additional impacts on land and soils. This section of route does not pass through any contaminated land or agricultural land of high value.

Cultural Heritage

9.160 The assessment of the impacts of the scheme on cultural heritage in and adjacent to the scheme corridor has considered impacts to;

- Scheduled Ancient Monuments (SAMs)[62]
- Listed Buildings[63] and other features of architectural or historic interest
- Conservation Areas and other important historic townscape features [64]
- Gardens and Designed landscapes[65]
- Edinburgh World Heritage Site
- Other sites and areas of archaeological significance.

For Phase 1a:

9.161 For the more urban section of Phase 1a (between St.Andrews Square and Roseburn) baseline information was collated for a corridor defined by the limits of deviation for the scheme (defined as the buffer zone for the assessment). Information was also collated on Listed Buildings with a frontage on the route or in its immediate vicinity (for example Princes Street Gardens).

9.162 Between Roseburn and Newbridge baseline information was collated for features present within 200m of proposed development locations, although to the west of Gogar Roundabout baseline information was collated on sites with statutory and non-statutory designations present within 500m of proposed scheme features.

9.163 The scheme passes through or close to a variety of historic landscapes, including:

- The Haymarket complex, which includes the Category A listed station and two listed public houses;
- Newhaven, which has been a focus for early settlement since at least the medieval period and a major centre of ship building in the 16th century. The route follows the earlier shoreline in this location;
- The medieval burgh of Leith; the 19th century dockyard (the port of Leith was developed as the mercantile equivalent of the Georgian New Town); the medieval

62 Scheduled Ancient Monuments are sites of national cultural heritage importance which are designated under the Ancient Monuments and Archaeological Areas Act 1979

63 Listed Buildings are statutorily protected buildings of special architectural or historic interest, designated under the Planning (Listed Buildings and Conservation Areas) (Scotland) Act 1997.

64 Conservation areas are designated by planning authorities under the Planning (Listed Buildings and Conservation Areas) (Scotland) Act 1997 as areas of special architectural or historic interest, the character of which it is desirable to preserve or enhance.

65 Designed landscapes are formally laid out grounds or gardens often associated with large country houses. In Scotland an Inventory of Gardens and Designed Landscapes provides a comprehensive record of more important sites.

churchyard of South Leith Parish Church;

- The ancient thoroughfare of Leith Walk;
- The site of a medieval and later village at Gogar;
- The streets and gardens of the Edinburgh New Town and World Heritage Site including Princes Street and Princes Street Gardens; and
- Street furniture along the route has also been taken into account.

9.164 The rich historic fabric of the corridor is recognised in the designation of several conservation areas along the route (e.g. Newhaven; Leith (proposed); the New Town; and the Old Town). The impacts of the scheme on the setting of these areas are covered in the assessment of Townscape (see from section 9.120 above).

9.165 Impacts have been assessed on a site-by-site basis for the route. Several sites of archaeological, cultural and historical significance have been identified as directly affected by the construction and permanent development of the scheme, lying either in the swept path or buffer zone. Of the sites of national importance in the buffer zone, there is the Scheduled Ancient Monument of Victoria Bridge in Leith Port and Gogar Mains fort.

9.166 Between St Andrew Square and Haymarket the assessment corridor runs entirely within the Edinburgh World Heritage Site, New Town Gardens Designed Landscape, and Conservation Areas (New Town / West End). There are also 140 Listed Buildings spread densely along the whole of this route section (44 Category A, 76 Category B, 18 Category C(s) and 2 non-statutory C). 29 Listed Buildings are present along the corridor between St Andrew Square and Princes Street, around St Andrew Square; 64 Listed Buildings are present along Princes Street and in East and West Princes Street Gardens; and 47 Listed Buildings are present at the West End, between Princes Street and Haymarket. These designations reflect the recognition of the New Town as a distinctive part of the Edinburgh's status as an internationally important cultural and architectural asset and townscape. St Andrew Square and Princes Street form key formal elements of the grid pattern design of the New Town, both now containing buildings of various dates. The West End forms part of an architecturally coherent extension of the New Town in the period up to 1880. No sites of purely archaeological interest have been identified between St Andrew Square and Haymarket, although Edinburgh Castle is protected as a Scheduled Ancient Monument.

9.167 A number of views and viewpoints are particularly important in Edinburgh because of the designed vistas in the New Town. Examples are the views down Princes Street towards Calton Hill, down St David Street to the Scott Monument, down Castle Street towards the Castle, and along George Street to St Andrew Square. There are also highly important views from Princes Street across Princes Street Gardens to Edinburgh Castle and the Old Town skyline, and views from the Castle across the New Town. Where possible, these views have been taken into account in the indicative design.

9.168 Powers exist under the Act to demolish the following, all of which are of local importance:

- The Caledonian Alehouse, Haymarket (Category C(S) Listed Building);
- Heart of Midlothian War Memorial, Haymarket (Category C(S) Listed Building)

– this will need to be relocated; and

- Bridge at Groathill Road South (Not listed): this is required as part of Line 1b.

9.169 The Coltbridge Viaduct is to be modified to such an extent that the impact has been defined as partial demolition. Although not listed, this bridge lies within the Coltbridge and Wester Coates Conservation Area.

9.170 For the section of route corridor between Haymarket – Gogar Roundabout, the townscape is predominantly 20th century housing and industrial developments. Here, only a scatter of cultural heritage features would be in any way potentially affected by the proposed scheme. These comprise four Listed Buildings (1 Category A, 3 Category B), in particular the Category B Jenners Depository on Balgreen Road; and three sites or areas of limited archaeological interest including the remains of a 19th century field boundary and the former site of Gogar Loch. The potential of this route section to contain currently unidentified archaeological remains is mostly low or negligible.

9.171 Between Gogar Roundabout – Edinbugh Airport, the landscape is semi-rural and considerably fragmented by major transport corridors, housing and industrial development. The more important non-scheduled archaeological sites are the site of a medieval and later village at Gogar and a WWII pillbox located on the edge of Edinburgh Airport. The potential of this route section to contain currently unidentified archaeological remains is moderate or high in areas of agricultural land. Most of the Listed Buildings potentially affected are associated with a series of former country residences set within landscaped grounds to either side of the Glasgow Road (now the A8 trunk road). These include buildings associated with Castle Gogar, Gogarburn House, and Gogar Park. Those listed structures closest to the proposed tram route are Castle Gogar Lodge and Gogar Parish Church.

9.172 The preferred mitigation strategy is to preserve in situ and in an appropriate setting all cultural heritage resources. The tram alignment has been designed to avoid all direct effects wherever possible and to minimise potential indirect effects.

9.173 The majority of sites have a suggested Level 1 mitigation response (detailed photographic record). A high proportion of these comprise historic street furniture in the buffer zone. Most are unlikely to suffer physical impact during the works, but preventive measures need to be considered to avoid damage, particularly where the features form part of Listed Buildings.

9.174 Of the sites recommended for Level 2 mitigation, a detailed standing building survey is recommended. This higher level of survey has been suggested due to risk of physical impact on these sites from engineering works.

9.175 Level 3 mitigation (watching brief) is suggested for a few sites. For example, during ground breaking works at selected locations between Murrayfield and Edinburgh Park, including Carrick Knowe golf course.

9.176 The impacts on the cultural heritage along the route range from minor to major adverse. Overall the result is moderate adverse.

Additional impacts for Phases 1a and 1b combined:

9.177 The scheme passes through or close to some additional historic landscapes, including:

- The Roseburn railway corridor, which is the line of the Granton branch of the Caledonian Railway, built in 1861 and closed in the 1980s;
- The designed landscape of Caroline Park;
- The 19th century development of Granton with high aesthetic quality townscape and minor industrial premises including the lighthouse and warehouses;

9.178 A variety of mitigation is possible as suggested with Phase 1a. Level 3 mitigation (watching brief) is recommended for part of the route believed to pass through the Caroline Park designed landscape. However, it seems likely that some of this area has been rendered archaeologically sterile by modern development.

Safety

Accidents

Change in road traffic accidents

9.179 The assessment of the changes in the number of road traffic accidents and associated casualties, as a result of the introduction of the tram, has been made quantitatively, considering the changes in traffic levels on the road network. Standard methodologies are based on accident rates and casualty rates (per vehicle-kilometres) per road type. The rates set out in the NESA manual (DMRB Volume 15) have been adopted.

9.180 A spreadsheet model has been used to estimate changes in personal injuries. It takes into account not only the casualty and accident rates by road type but also accident reduction in the future as a result of technological improvements.

9.181 The calculations have taken data from the JRC transport model on vehicle-kms travelled and the road types on which these occur. Table 9.26 shows that there is an increase in vehicle-kms on the network under both Phase 1a and Phase1a+1b. Whilst these may appear significant, they represent a change of just 0.1% in the total traffic on the network and include the assumption of a larger travel market in the with-tram situation.

TABLE 9.26 CHANGE IN VEHICLE-KMS (MILLION P.A. CHANGE DM TO DS)

Year	1a	1a+1b
2011	+14.95	+11.54
2031	+16.69	+4.71

9.182 The change in vehicle-kms is the net effect of several impacts of Edinburgh tram on traffic flows. Firstly, the direct impact of tram (highway capacity reductions on the tram corridor) will force traffic onto longer routes, increasing vehicle kms. The modelling undertaken assumed higher levels of land use and hence car trips with tram, again increasing overall vehicle kms. These two effects are mitigated by the transfer to tram of car trips, but the overall effect is still an increase in vehicle kms. Both drivers of vehicle kms increase are present in Phase 1a and Phase 1a+1b to the same degree (Phase 1b is off road and hence does not divert traffic, and both Phase 1a and Phase 1a+1b assume consistent land use changes) and hence the difference between the Phase 1a and Phase 1a+1b impacts is the increasing abstraction of car traffic to tram. Thus whilst Phase 1a and Phase 1a+1b have increased vehicle kms, Phase 1a+1b is lower since the level of car transfer is higher.

9.183 Standard accident rates are available by severity level: fatal, severe, slight and damage to property. Thus, it is possible to estimate the change in the balance of levels of severity, particularly if traffic distribution changes according to road types (e.g. deviation from one road type to another). The resultant impact on accident levels by severity level is set out in Table 9.27.

TABLE 9.27 CHANGE IN ANNUAL NUMBER OF ACCIDENTS BY SEVERITY LEVEL

Level	1a		1a+1b	
	2011	2031	2011	2031
Damage	+70.1	+70.1	+54.1	+19.8
Slight	+4.6	+4.7	+3.6	+1.3
Serious	+0.5	+0.5	+0.4	+0.1
Fatal	+0.1	+0.1	+0.0	+0.0
Total	+75.3	+75.4	+58.2	+21.3

9.184 It should be noted that a portion of these increases are due to the larger travel market assumed in the with-tram situation and this component might not be considered as being directly *caused* by the introduction of the tram. Some adverse impact still results from redistribution and re-routing effects, however.

9.185 Using standard valuations for casualties, accidents and damage to property by severity level and the accident saving estimations summarised above, the total accidents benefits as a result of changed traffic by year and in terms of a total present value benefit is set out in Table 9.28. The total present value benefit is some -£11.9 million (ie a disbenefit strictly) for Phase 1a; for Phase 1a+1b, the impact is lower at some -£5.2 million. As noted above, it must still be considered that these small adverse impacts are slightly inflated by the assumption of a larger travel market in the with-tram situation.

TABLE 9.28 MONETISED ACCIDENT SAVINGS (£000S)

	1a	1a+1b
2011 (undiscounted)	-451	-348
2031 (undiscounted)	-643	-182
Present Value over 60 years	-11,897	-5,225

Change in accidents on public transport

9.186 It is accepted that the introduction of street running trams in Edinburgh may lead to tram-vehicle and tram-pedestrian conflict and, hence, accidents. This is particularly so along the street running sections, where exposure is greatest (notably at all signalised junctions and pedestrian and bus interaction on Princes St). As part of the design process, HMRI has provided advice to both the Scottish Executive and **tie** in relation to the design and operation of Edinburgh Tram.

9.187 In 2005, there were 193 tramway incidents in the UK, 154 of which involved road vehicle collisions; no fatalities were recorded. For appraisal there is no official guidance on the estimation of public transport accidents in STAG or WebTAG. This is primarily due to the very low incidence of accidents on public transport, making the derivation of statistically significant accident rates very difficult. The STAG guidance suggests that accidents on rail-based systems are negligible and so need not be considered (except when shared running by rail and other modes is felt to be likely to increase accident rates), since the greater level of segregation offered by rail modes reduces the risk of conflicts and, hence, accidents.

9.188 Much of Edinburgh Tram will be segregated from road traffic, limiting the opportunity of traffic-related accidents. Even when not segregated from other traffic, trams have many safety advantages. They can decelerate faster than most other vehicles; indeed the main constraint on braking rate is the safety of passengers and following vehicles. The vehicles are large with a high profile and move on clearly defined predictable paths. Cab design and mirrors ensure excellent visibility for the driver. As a result there should be a lower risk of accidents than with buses. However, the risk of accidents cannot be wholly eliminated. Unfortunately directly comparable tram and bus accident statistics are not available, while the accident rates for tramways vary with the degree of segregation from other traffic and the age of the system – newer systems in general appear to have lower accident rates.

9.189 In addition to the good safety characteristics of tram, there are significant changes to the bus network, with an overall reduction in the level of bus vehicle-kms on the network.

9.190 Overall, the introduction of Edinburgh Tram will lead to a lower risk of accidents on public transport. On that basis, the impact is assumed to be slight beneficial.

Security

9.191 More vulnerable groups in society, such as women and the elderly, may be subject to greater personal security risk when travelling by public transport, especially in the hours of darkness and/or at more remote locations, and this may be a deterrent to the use of public transport. For this reason, most modern public transport facilities include attractive passenger waiting facilities with security devices (e.g. surveillance, lighting, good design) as standard.

9.192 Sections of the tram network are off-street and will allow in most instances an open and bright aspect, although there will be limited background activity levels along the segregated parts of the route. As Edinburgh Tram is advanced a careful review will be undertaken of the street environment in the vicinity of potential stops/interchanges. Lighting and street furniture will be designed to provide maximum safety and security. This may involve 'more than bright lights' but will have the objective of providing street environments that are pleasing, attractive and calming in every sense. Stops and cycle parking facilities should be located where there is, as far as possible, plenty of human activity to avoid feelings of isolation; and, for cyclists, to minimise the risk of cycle theft.

9.193 Provision of an attractive waiting facility is part of a package approach towards making stops welcoming to the individual. Location is crucial, and whilst safety in traffic terms is also important, locating stops in places where there is human activity deserves equal emphasis.

9.194 Staffing tram stops is not economically viable and the use of closed circuit television cameras is now widespread. However, there can be no single technical solution to the problems of ensuring complete passenger safety. CCTV is perceived by many as 'reactive' (that is, it may help convict an attacker but is not a great deal of help to the victim). An interchange with prominently located signs, citing the presence of discreetly positioned 'see in the dark' cameras, may however have a stronger deterrent effect. Panic buttons and PA links/help lines are possibly more reassuring for a passenger waiting alone at a remote suburban tram stop on a dark morning or night.

9.195 In summary, while all stops will be designed to high standards, the more remote ones may require mitigation facilities designed to ensure that they offer as great level of security as possible (including any street lighting or furniture to ensure safe approach to the tram stops). The tram stops have tended to be located in more accessible locations, therefore where the level of activity is greater and security higher. Although the tram stops will be unstaffed, they will be monitored by CCTV while all vehicles will provide high levels of security with the presence of inspectors.

9.196 The assessment of security for Edinburgh Tram was made qualitatively, considering the extent to which tram stops and vehicles are expected to provide, directly or indirectly, increased safety for tram travellers, according to the guidance in WebTAG 3.4.2. Table 9.29 summarises an assessment of the security impacts for each indicator, considering the changes in conditions between the existing and after implementation scenarios.

TABLE 9.29 SECURITY IMPACTS

Indicator	Impact	Assessment
Site perimeters, entrance and exits	Clear access to stops will not represent a risk to security.	Neutral
Formal surveillance	CCTV system will be in place at all stops and on all vehicles. Signage indicating the presence of CCTVs will increase the perception of security for users and staff. No staff presence at stops.	Moderate beneficial
Informal surveillance	Good proximity of tram stops to retailers and other urban activities, with positive design. Inspectors will be present in all vehicles.	Moderate beneficial
Landscaping	Design will fit in with urban form, minimising visual impact, with clear glass screens and unintrusive structures for greater visibility, maximising security.	Slight beneficial
Lighting and visibility	Light will be commensurate with securing a safe and secure environment both in vehicles and at stops.	Slight beneficial
Emergency call	It is assumed that there will be help points at all stops, which is standard feature on modern systems.	Slight beneficial

9.197 The overall impact is considered moderate beneficial.

Economy

Transport Economic Efficiency

9.198 TEE appraisal sets out the impact of the proposal on social welfare, as represented by the costs and benefits incurred by users and operators of the transport system, over a 60-year appraisal period. In essence, the analysis sets out the monetised value of changes in user travel time, charges (ie bus fares), vehicle operating costs and quality benefits, and costs and benefits accruing to private sector transport operators (capital and operating costs, revenues and any grant or subsidy payments).

9.199 Costs to the public sector are itemised separately (see paragraph 9.329 et al).

9.200 The TEE analysis for Edinburgh Tram has utilised the TUBA (Transport Users Benefit Appraisal) computer programme, developed for the DfT to undertake economic appraisal for multi-modal transport studies. TUBA undertakes a matrix-based appraisal and the respective trip, time, distance and charge matrices have been obtained from the JRC model employed in the forecasting process.

Costs

9.201 The capital costs employed within the appraisal are consistent with those presented in Chapter 7. The capital costs have been estimated by **tie** and include allowances for both risk and optimism bias. It should also be noted that £23.7m of the cost total for both scheme options is a sunk cost, and is therefore not included in the appraisal.

9.202 Similarly, the lifecycle and operating costs presented in Chapter 7 have been employed in the appraisal.

9.203 All costs have been converted to 2002 prices for the purposes of appraisal.

Economic Assumptions

9.204 The main economic assumptions used in economic appraisal are set out below:

- the opening date for the scheme is 2011;
- the scheme is assessed for the period of 60 years from opening year;
- all costs and benefits have been discounted to 2002 and are in 2002 prices;
- discount rate 3.5% is applied for the first 30 years post operation, 3% thereafter;
- for the first few years only a proportion of the benefits are included to reflect the build-up in patronage of a new scheme (75%, 85%, 92%, 97%, 99% in the five years after opening); and
- monetary valuations for the benefits consistent with current DfT guidance.

Weighting of Walk and Wait Time for Business Users

9.205 Appraisal guidance recommends that walk and weight time benefits for business users should be 'unweighted', as the time accrue to businesses rather than individuals and are therefore and valued in terms of 'actual' rather than 'perceived' time. The forecasting models developed to generate scheme demand are based on 'perceived' time, as it is this that underpins users (including business users) behavioural response.

It is difficult to separate out the walk and weight elements from this for all trips, and not possible to do this just for business users. We believe that the net effect is that the walk and wait time 'un-weighting' impact would be broadly neutral and is not distorting the result, as the walk and wait time element of journeys will be comparable in both the Do Something and Do Minimum.

Transport Demand, Revenues and Benefits

9.206 Transport demand, revenues and benefits have been forecast for two future years – 2011 and 2031. These are detailed in paragraphs 9.9 et al, and these have been run within TUBA to produce benefits over the appraisal period. Benefits between 2011 and 2031 have been interpolated using TUBA but a profile has also been added, with the effect that 39% of the growth between 2011 and 2031 is assumed to have occurred by 2011. Between 2031 onward growth assumed is at 1.5% per year until 2041 and then 1.0% per year until 2051. No further growth is assumed beyond 2051.

TEE analysis – Phase 1a

9.207 A Transport Economic Efficiency (TEE) table as included in Table 9.30. It sets out the economic results and presents the distribution of scheme benefits between business, consumers, and private sector providers.

TABLE 9.30 PHASE 1A TEE ANALYSIS

		STAG Code	Total	Public Transport	Road Users
User benefits - Consumers					
Travel time		(PV2)	£279,188	£277,963	£1,225
User Charges		(PV3)	£0	£0	£0
Vehicle Operating Costs		(PV4)	£21,828	£0	£21,828
Sub Total			£301,016	£277,963	£23,053
User benefits - Business					
Travel time		(PV2)	£123,947	£117,496	£6,451
User Charges		(PV3)	£0	£0	£0
Vehicle Operating Costs		(PV4)	£4,607	£0	£4,607
Sub Total			£128,554	£117,496	£11,058
User benefits - Total					
Travel time		PV2	£403,135	£395,459	£7,676
User Charges		PV3	£0	£0	£0
Vehicle Operating Costs		PV4	£26,435	£0	£26,435
Sub Total			£429,571	£395,459	£34,111
Private Sector Provider Impacts					
Investment (Capital) Costs		PV5	-£389,880	-£389,880	
Operating Costs:	Tram	PV6	£0	£0	
	Bus	PV6	£0	£0	
	Rail	PV6	£0		
Revenues:	Tram	PV6	£0	£0	£0
	Bus	PV7	£9,943	£9,943	
	Rail	PV7	-£54,057	-£54,057	
	Off-street Parking	PV7	£0		
Grant/ Subsidy		PV8	£389,880	£389,880	
	Developer Contribution	PV8	£0		
Sub Total			-£44,115	-£44,115	£0
Total PVB			**£385,456**		

Notes:
1. Disbenefits appear as negative
2. All values are £000s Present Value, 2002 Values and Prices

9.208 In total, the scheme delivers TEE benefits of £385m PV.

9.209 The scheme delivers £301m PV benefits to transport consumers. The majority of these benefits (£278m PV) accrue to public transport users, with the remaining £23m accounted for through time and vehicle operating cost savings to remaining car users, who benefit from a more decongested network resulting from car transfers to the tram.

9.210 The total benefit to business totals £129m PV, with £11m of these benefits to highway users and the remainder to public transport. The higher proportion of business benefits to highway users (compared to consumer benefits) reflects both the higher proportion of work trips undertaken by road (compared to public transport) and the higher value of time applied to these trips. An adjustment has also been made for airport trips only to reflect the higher proportion of business travellers for this segment.

9.211 Investment costs amount to £390m PV. The grant requirement is equivalent to the investment costs only and hence these two cancel out within this section of the TEE. There is a revenue loss to rail operators of £54m PV and a gain to private sector bus providers (non-TEL) of £9.9m PV. The latter reflects the potential for better journeys involving interchange with the tram as well as some secondary effects of the changes in TEL bus service patterns but this is a very small impact.

9.212 The total private sector provider impact is therefore equivalent to the bus and rail revenue loss impacts, totalling -£44m PV.

TEE analysis – Phase 1a+1b

9.213 The TEE Table for Scheme 1a + 1b is presented in Table 9.31.

TABLE 9.31 PHASE 1A+1B TEE ANALYSIS

		STAG Code	Total	Public Transport	Road Users
User benefits - Consumers					
Travel time		(PV2)	£501,661	£487,616	£14,046
User Charges		(PV3)	£0	£0	£0
Vehicle Operating Costs		(PV4)	£27,574	£0	£27,574
Sub Total			£529,235	£487,616	£41,619
User benefits - Business					
Travel time		(PV2)	£193,605	£169,256	£24,349
User Charges		(PV3)	£0	£0	£0
Vehicle Operating Costs		(PV4)	£6,118	£0	£6,118
Sub Total			£199,722	£169,256	£30,466
User benefits - Total					
Travel time		PV2	£695,266	£656,872	£38,394
User Charges		PV3	£0	£0	£0
Vehicle Operating Costs		PV4	£33,691	£0	£33,691
Sub Total			£728,957	£656,872	£72,085
Private Sector Provider Impacts					
Investment (Capital) Costs		PV5	-£460,335	-£460,335	
Operating Costs:	Tram	PV6	£0	£0	
	Bus	PV6	£0	£0	
	Rail	PV6	£0		
Revenues:	Tram	PV6	£0	£0	£0
	Bus	PV7	-£2,229	-£2,229	
	Rail	PV7	-£12,506	-£12,506	
	Off-street Parking	PV7	£0		
Grant/ Subsidy		PV8	£460,335	£460,335	
	Developer Contribution	PV8	£0		
Sub Total			-£14,735	-£14,735	£0
Total PVB			**£714,222**		

Notes:
1. Disbenefits appear as negative
2. All values are £000s Present Value, 2002 Values and Prices

9.214 In total, the scheme delivers TEE benefits of £714m PV. The scheme delivers £529m PV benefits to transport consumers. The majority of these benefits (£487m PV) accrue to public transport users, with the remaining £42m accounted for through time and vehicle operating cost savings to remaining car users, who benefit from a more decongested network resulting from car transfers to the tram.

9.215 The total benefit to business totals £200m PV, with £30m of these benefits to highway users and the remainder to public transport. Private Sector Provider investment costs amount to £460m PV. The grant requirement is equivalent to the investment costs only and hence these two cancel out within this section of the TEE. There is a revenue loss to private sector bus providers (non-TEL) of £2.2m PV and to rail operators of £12.5m PV. The total private sector provider impact is therefore equivalent to the bus and rail revenue loss impacts, totalling -£14.7m PV.

Economic Activity and Location Impacts (EALIs)

9.216 Employment change will be driven by a complex combination of five principal changes:

- Property related effects where the development of the tram changes the development industry's decisions about property development on sites within the tram corridor: this effect arises because the market is not wholly efficient and suffers from perceptual and other barriers which lead to perceived risks being unacceptably high. A new development especially of fixed infrastructure can alter perceptions and reduce risk levels such that development goes ahead where otherwise it would not, or where such development would be slower than would be the case with the new infrastructure.

- A land utilisation effect, which arises where the new public transport infrastructure is able to replace car travel by some residents and / or workers. By allocating less space to car parking, development can take place at a denser level than would otherwise happen.
- Cost reduction effects, which arise where businesses are able to save costs, which then result in lower output prices and hence increased sales: relatively large cost savings tend to be needed for this to generate employment growth, as smaller savings tend to accrue as increased profits where markets are not fully competitive.
- Employment related to productivity effects which will arise through denser development within the tram corridor: productivity effects increase disposable income and the expenditure of that income will drive further gains in the retail and leisure sectors in particular: this has been a very strong driver of growth in large urban economies. Productivity gains might also drive new employment which may be additional at the Scotland level.
- Distributional and social inclusion impacts

Property related effects

9.217 Property related effects can be considered where there are clearly market distortions which limit the supply of residential space available either for new workers to join a labour market that has excess demand for labour, or to provide space for businesses which have less space than required to meet the demands of customers.

9.218 CEC has provided estimates of where property development will take place and where levels of development will be changed by the tram, or where development will be accelerated by the tram. This shows that a small number of sites / locations would be affected, and at only one location, Granton Waterfront, would there be additional development. At all other sites, the effect of the tram is to bring forward development that will happen anyway. The locations for employment are shown in Table 9.32.

TABLE 9.32 PROPERTY DEVELOPMENT PROFILES (M^2 OF DEVELOPMENT)

		2011	2015	2020
With Tram				
Granton Waterfront	Commercial	65,000	130,000	130,000
	Leisure	4,400	8,800	8,800
Western Harbour, Newhaven	Commercial	20,750	31,125	41,500
Leith Docks	Office/Business	0	7,500	22,500
Edinburgh Gate	Office/Business	25,000	50,000	50,000
Newbridge North	Commercial	0	25,000	37,500
Ratho Park	Office/Business	0	3,350	3,350
Without Tram				
Granton Waterfront	Commercial	50,000	70,000	90,000
	Leisure	1,650	3,300	5,000
Western Harbour, Newhaven	Commercial	20,750	31,125	37,350
Leith Docks	Office/Business	0	6,000	19,500
Edinburgh Gate	Office/Business	12,500	25,000	37,500
Newbridge North	Commercial	0	16,500	25,000
Ratho Park	Office/Business	0	0	3,350

9.219 It should be noted that retail has been removed from this on the basis that expenditure on retail is generally treated as displacing retail spend elsewhere either in the Edinburgh travel to work area or in Scotland as a whole. This may be an unduly restrictive assumption here, as some retail spend will come from additional visitors. However, in keeping with normal economic appraisal practice we have excluded this here.

9.220 Based on the development projections an analysis was undertaken of the gross employment impacts, by first calculating the employment in each development at each of the dates shown in Table 9.32. This was based on employment to floorspace ratios. The basis of this is the work undertaken for English Partnerships. However, more recent experience suggests that the ratios identified for this work tend to be rather generous in terms of space allocated to each employee and therefore a denser level of use of floorspace has been assumed.

9.221 STAG suggests that employment should be looked at as a flow of person years of employment, with a "job" being 10 person years. Therefore a simple interpolation was undertaken between 2007 and 2011 and then for 2011 to 2015 and 2015 to 2020. This enabled the year on year gains from the tram to be calculated. It should be noted that the gain peaks in 2015, after which "without tram" development catches up with the "with tram" development scenario.

9.222 This employment stream is "gross", in that it includes some employment that will take place somewhere else in the Edinburgh travel to work area or elsewhere in Scotland in the absence of the tram. This stream therefore needs to be adjusted for this displacement. The adjustment has been made at the Scotland level only, because Edinburgh is not a regeneration area.

9.223 Lack of sites (and planning consents) makes it likely that there would be few alternative locations within the Edinburgh area, and so the issue here was whether in the absence of the tram the development would go elsewhere in Scotland. This is difficult to assess in the absence of good information on the nature of likely developments and in particular the extent to which they need to draw on the skills in the Edinburgh area generally and the extent to which the new residential developments (especially in the tram corridor) will be the origins of some or most of the skilled labour the new employment generators will require.

9.224 CEC estimates that the tram will both accelerate and intensify the level of residential development; this is shown in Table 9.33. The key impact is the acceleration in the rate of development, with an additional 5-6,000 units in place at both 2015 and 2020 with Edinburgh Tram in place, compared to the "without-tram" scenario. Post 2020, the development pipeline recovers in the "without tram" scenario, resulting in a net gain of 2,800 units with tram.

TABLE 9.33 ADDITIONAL RESIDENTIAL UNITS DUE TO THE TRAM

Location	2011	2015	2020	Planning Horizon
Granton	924	4500	3800	2800
Western Harbour	0	0	300	0
Leith Docks	0	750	1500	0
Total	924	5250	5600	2800

9.225 The timing of these gains in numbers of housing units suggests that the predicted employment gains are not highly dependent on securing this additional residential development in parallel with development of employment sites. Accordingly the levels of displacement that need to be applied are higher than would be used if there were a stronger link between the tram-intensified housing, the skill levels associated with that housing and the employment opportunities that will occur in the tram corridor. The displacement factors applied are shown in Table 9.34 alongside the present value of the employment stream from each development.

TABLE 9.34 DISPLACEMENT FACTORS FOR NEW EMPLOYMENT

Location	Development type	Displacement %	Present value of employment stream
Western Harbour, Newhaven	Commercial	75	10
Leith Docks	Office/Business	50	35
Edinburgh Gate	Office/Business	50	482
Newbridge North	Commercial	80	52
Ratho Park	Office/Business	80	14
Sub-total Line 1 A			**593**
Granton Waterfront	Commercial	80	325
	Leisure	90	14
Sub-total Line 1 B			**338**
Total 1a + 1b			**931**

9.226 The above is based on several assumptions, including the assumption that the "middle" levels of development are achieved in each location. Clearly if the tram were to have a stronger effect on developer decisions resulting in higher levels of building and use for employment purposes the gross impacts would be higher. Similarly, the levels of displacement used are relatively generous, reflecting an assumption that some development in the corridor and in the waterfront in particular will be investment that will otherwise not come to Scotland because of the limited supply of competitive locations. This may be overly optimistic in the medium term for example as Glasgow's Clyde corridor develops.

Land utilisation effect

9.227 In the above denser development on individual sites has not been factored in separately, as this appears to be captured within the CEC development projections.

Cost reduction effects

9.228 Employment effects through cost reductions are likely to be very limited. The principal savings are likely to come from the substitution of the tram for trips presently made by private car (some of which involve parking at the airport) and by taxi. Based on BAA and CAA data, there is a reasonable expectation of a total of 9m terminating passengers in the next year or so. On that basis there would be

- 781,000 UK business taxi trips to the airport (and probably broadly the same number from the airport) from the Lothians
- 1,077,000 UK business private car trips to the airport from the Lothians

9.229 At this point some broad assumptions are required:

- for taxi trips
  - 70% are to / from the city
  - 30% of these trips switch to tram

- the average saving is £12 per taxi trip
- For car trips
  - 35% are to / from the city
  - 25% of these trips switch to tram

9.230 The average saving per trip is £40: this reflects a weighted average length of trip of just under 3 days and the costs of fuel and parking at the airport.

9.231 Assuming two thirds of the total cost savings accrue to Edinburgh firms, the total saving to the region is £5m in round numbers. This is a miniscule sum compared with the GVA of the city alone, which is of the order of £7.5 billion. Therefore even with what appear to be useful levels of savings in costs, it is unlikely that such savings will result in significant impacts. A simple analysis based on estimated business sector costs and an aggregate demand response to cost savings and subsequent cost reductions would yield an estimate of just under 50 jobs arising due to cost savings.

9.232 It should be noted that this effect can be added to the property impacts only where additional space can be found to employ these additional workers – in other words, the cost savings expand the demand for labour but will also expand demand for space. If space is not available, this demand will be unmet.

Supply side effects and productivity growth

9.233 This section discusses supply side effects which are expected to be positive but limited in the short to medium term, but which are expected to become more important as congestion increases. While a UK level methodology exists for estimating GVA impacts (but not a regional or Scotland level one), the methodology for estimating employment impacts from these effects has not been developed. Therefore we have made only a qualitative assessment at this time.

9.234 In the period 1990 to 2000, GDP per capita in Scotland grew on average by 1.83% per annum, driven largely by growth in GDP per employee of 1.56% per annum with a small additional contribution from the employment rate and the participation rate, which adds additional labour resource to the economy.

9.235 Post 2000 GDP per capita in Scotland grew by only 0.92% per annum, driven mostly by growth of 0.83% per annum in the employment rate and 0.7% per annum in the participation rate with a slightly declining GDP per employee. The principal factor underlying this decline was the loss of high added value electronics activity, which effectively collapsed in 2000 – 2001 due to restructuring and movement of activities to Eastern Europe. This would have had little effect on growth in the Edinburgh city region.

9.236 This most recent lower rate of growth rests within a positive longer term trend, however. Econometric forecasting work commissioned by the Scottish Executive has also predicted strong growth over next twenty years, for the Lothians region in particular, but a reasonable degree of uncertainty must be attached to any such forecasts.

9.237 Transport can increase both the attractiveness of work by reducing cost and travel barriers, and through processes which make businesses and hence workers more productive. Long run economic growth depends largely on supply side effects which expand factor productivity and increase the amount of factors of production available within the economy. Productivity growth in the UK has typically been relatively slow compared with other G8 countries, but at least has been sustained over the last 15 years or so thanks to reducing supply side rigidities and increasing labour and product markets flexibility.

9.238 Productivity growth does not necessarily create jobs directly. If Scottish firms become more productive they may use the gains to reward labour and capital, or they may reduce employment by substituting capital for labour while increasing labour earnings. However, a proportion of additional earnings and profits are spent within the economy, and this has been a factor in driving growth of services such as retail and leisure.

9.239 Where markets function competitively and do not fail (which is the basis of the property analysis above), transport affects GVA chiefly through the supply side, by enabling businesses and people to be more productive and by enabling more people to enter the labour market.

9.240 It is evident from recent research by DfT in England that the most significant contributor to GVA impacts is agglomeration. Transport schemes reduce the generalized costs of travel between zones and therefore promote the "effective densification" of an area. For example if businesses are located over a wide area and physical links between them are poor, they will tend to operate in relative isolation. In terms of economic performance this means they will not benefit from a whole array of interactions, from the exchange of ideas and sub-contracting relationships through to sharing a pool of mobile staff and having access to universities and other business resources.

9.241 Where the transport links are improved, these interactions increase, and there is evidence which shows that there is a relationship between effective density and productivity, and hence with GVA. This relationship varies by business sector. There is also a relationship between transport generalized cost and density.

9.242 The tram is likely to make a positive contribution to increasing effective density and hence productivity and GVA. This is because it links the financial services and business services areas of Edinburgh including Edinburgh Park and the RBS headquarters with the city centre financial and business services districts. At current levels of car travel and congestion this effect will be very limited, but, over time, growth in congestion is likely to arrest growth in business productivity and the tram will offset this by enabling effective density to be sustained or grow.

9.243 In the short to medium term the agglomeration benefits appear likely to be focussed on the city centre-airport route, as the northern leg does not currently include areas with concentrations of sectors likely to be affected by increased densification through transport links.

People moving to more productive employment

9.244 Where people working in areas of low productivity can be enabled to change jobs to work in areas where productivity is higher, there is a national GVA gain. This process is especially important in higher productivity areas that are growing and have continuing under-satisfied demands for labour. Without increased labour supply, wage rates will rise, increasing costs and making businesses in such areas less competitive, thereby choking off growth.

9.245 The available evidence suggests that the effect of transport on job location is generally fairly weak and that step changes in transport cost / time / quality are required to make people change job locations.

9.246 For bus users looking at employment prospects in the tram corridor and especially the Edinburgh Park – airport area, the tram could represent a step change in overall service attributes, and this might have a small but useful effect in terms of encouraging job movement towards the high productivity employers located in this corridor. However, the majority of high skill / high income employee types (who are the ones who make the real difference in terms of national / regional GVA) presently drive to work. At present levels of congestion, people driving to work in the corridor appear not to be experiencing levels of cost and inconvenience such that people are choosing to work in less productive areas. This would limit any job move effect of the tram in the short term, but, as with agglomeration effects, growth in congestion will enhance the effect of the tram in offsetting congestion effects, which otherwise would be likely to have a small but negative effect on job locations.

Expanding the labour supply.

9.247 In addition to people who are registered as unemployed, there are people who could join or rejoin the labour force; these include people on disability benefits who would like to work, and people (especially females) who may not be registered as unemployed but who would be likely to seek work if access to jobs were improved.

9.248 Better transport links reduce the generalized cost of accessing the labour market and by enabling access to a large market improve the chances of matching skills with employer requirements – in other words the numbers searching for work can be expanded and the probability of a successful match can be increased.

9.249 However, the available evidence suggests that the elasticity of labour supply with regard to transport improvements is low. The segments of the labour market where this effect is most likely will tend to be people for whom the alternative transport mode is the bus, and for much of the corridor the tram does not represent a very large gain over the bus. It is likely therefore that the tram will have a limited but positive impact in terms of numbers of people seeking to enter the labour market.

Distributional and social inclusion impacts

9.250 The tram is expected to have limited but positive and direct social inclusion benefits, by enabling residents of parts of north Edinburgh that suffer from multiple deprivation to have better access to both existing jobs and to an expanded number and range of employment opportunities that will arise in the future.

9.251 The total increase in employment associated with all of the sites identified for development could range from 40,000 to 55,000 jobs in round numbers, including retail employment which is likely to be around 6,000 – 7,000 jobs. However, this is a gross number and does not allow for losses of retail employment elsewhere in the region. In addition, the tram makes existing employment more accessible in some locations, including Edinburgh Park, the Airport and locations such as Ratho Park and Newbridge.

9.252 However, the tram also improves accessibility for residents of other areas, and so is likely to increase competition for jobs in some locations: if these other area residents are not residents of regeneration area, and they displace residents of regeneration area, then that would be regarded as a negative impact in terms of social inclusion.

9.253 This is not an issue for jobs where skills are in short supply, where the tram will make the labour market function better and expand the labour force by enabling some additional workers to join the labour force by reducing barriers. However it is an issue for low skill types of employment where there are generally more potential workers than jobs.

9.254 In looking at social inclusion impacts the focus has been on the Granton / Pilton / Muirhouse regeneration area. Based on accessibility plots and CEC data on development, the additional development shown in Table 9.35 would become more accessible from the regeneration area.

TABLE 9.35 DEVELOPMENT AND EMPLOYMENT WITH TRAM: AREAS WHERE REGENERATION AREA RESIDENTS ENJOY BETTER ACCESS

Location	Type	Size m^2	Jobs
Edinburgh Gate	Office / business	50,000	3,250
Newbridge North	Commercial	50,000	2,500
Ratho Park	Office / business	3,350	220
Edinburgh Park	Office / business	200,000	13,000
Granton Waterfront	Commercial	130,000	6,500
	Retail	40,400	1,410
	Leisure	8,800	350
TOTAL		482,550	27,230

9.255 In principle, and over time, regeneration area residents will also be able to compete for existing employment opportunities as these turn over due to people leaving, retiring and so on.

9.256 The mix of skills that will be required will determine the limits on how many people with low or limited skills will be able to gain employment. From the 2001 Census it is noted that only 28% of the population of Granton and only 16% of those unemployed had higher level qualifications. The skills requirement across the whole corridor is difficult to predict at this time, and so it is necessary to make assumptions here. It is assumed that 15% of office, business and commercial jobs could be suitable for regeneration area residents and 35% of retail jobs. This reduces the effective number of suitable and in scope future jobs (in the with tram case) to

- 3,870 office, business and commercial jobs
- 495 retail jobs.

9.257 It should be noted that this excludes future recruitment arising from turnover of existing jobs. The social inclusion benefit of the tram is the additional number of people living in the regeneration areas who would seek and secure employment due to the tram, which will come about because

- The better accessibility afforded by the tram extends job search to more areas; and
- Would be employers are more confident about worker reliability and timekeeping due to the tram.

9.258 While the tram brings a large number of future jobs within scope in terms of better accessibility and likely skill levels, regeneration area residents will be competing with other residents for these jobs.

9.259 NOMIS data indicate that in the most likely employment categories, residents of Granton Ward have a relatively low penetration rate of employment in the surrounding Leith and North Edinburgh Parliamentary Constituency. This is shown in Table 9.36.

TABLE 9.36 GRANTON WARD RESIDENTS SHARE OF EMPLOYMENT IN LEITH AND NORTH EDINBURGH PARLIAMENTARY CONSTITUENCY EMPLOYMENT BY CATEGORY

Employment category	Granton	Parliamentary Constituency	% market share
1 Managers and senior officials	342	6,900	5.0
2 Professional	282	7,400	3.8
3 Associate professional & technical	386	10600	3.6
4 Administrative & secretarial	460	9100	5.1
5 Skilled trades	300	1400	21.4
6 Personal services	232	2700	8.6
7 Sales and customer services	311	2400	13.0
8 Process plant and machine operatives	236	800	29.5
9 Elementary occupations	478	5100	9.4
ALL	3027	46400	6.5

9.260 If similar levels of "market share" of new opportunities were to occur, 260 job opportunities would be available to be filled by regeneration area residents. This is based on employment in categories 4 and 7 above. As discussed below, further employment is likely to be generated in category 6.

9.261 It is noted, however, that there are only 262 Jobseeker's Allowance (JSA) claimants (NOMIS August 2006) and it is unlikely that all of the people in this group in the future would become employed, because of lack of skills or other factors which affect employability.

9.262 Therefore the social inclusion benefits are likely to comprise

- Regeneration area residents who are already in employment but who would find a better job because of the tram (A GVA impact rather than an employment one)

- Regeneration area residents who otherwise would be unemployment and who find employment
- Regeneration area residents who are not employed and not in receipt of JSA, but who are enabled to enter the workforce because of better accessibility.

9.263 The nature of the labour market and the way it is changing suggests that the former effect will dominate here, but both other effects could also contribute towards social inclusion impacts. In quantitative terms, the number of residents who become employed who are not currently employed is likely to be well below the potential level of 260.

9.264 A further effect which is more difficult to assess is related to the multiplier, whereby part time and possibly "hidden" (but legal) employment is created through additional expenditure by new residents in the immediate area – this could include jobs as cleaners and domestic helps, pet sitters, child minders and so on. These impacts would be less easy to track but can be important in revitalising an area by pumping in extra income which is recycled through local service providers such as shops and pubs.

9.265 Finally, these impacts are very difficult to quantify as outcomes depend on a range of unpredictable factors, including

- How Granton regeneration area residents respond to having a wider range of employment opportunities available through the tram
- The precise nature of the jobs that are generated in developing areas, the skill and other requirements and how the employers seeking staff respond to potential new recruits
- How residents of other areas, including other regeneration areas within the Edinburgh travel to work area, respond to accessibility changes.

9.266 It is noted that Granton Waterfront development, for example, is also likely to more accessible from other regeneration areas in the city, but also from other non-regeneration areas, where there are also people who would enter the labour market if transport barriers are removed. The mix between regeneration and non-regeneration area residents is important here, for only the former is normally regarded as a distributional gain.

Integration

9.267 The Scottish Executive views integration as one of its five key objectives for transport, as reflected by STAG. The 2004 Scottish Transport White Paper, Scotland's Transport Future[66], contains five objectives for transport, one of which is as follows:

"Improve integration by making journey planning and ticketing easier and working to ensure smooth connection between different forms of transport"

9.268 These objectives are also reflected in the Draft National Transport Strategy, published

[66] Scottish Transport White Paper, Scotland's Transport Future, 2004
http://www.scotland.gov.uk/library5/transport/stfwp-00.asp

by the Scottish Executive in 2006[67].

9.269 Within this chapter, this section therefore deals with the following specific issues:

- transport integration – the degree to which a proposal fits with other transport infrastructure and services;
- transport-land-use integration – the fit between the proposal and established land-use plans and land-use/transport planning guidance; and
- policy integration – the appropriateness of the proposal in light of wider policies both of central and local Government.

Transport integration

9.270 An integrated transport system must operate as a true network across all modes in order that passengers can move easily from one service to another in a comfortable environment. Integrated transport can, thus, reduce the need to travel, tackle congestion and pollution and support a strong economy, a sustainable environment and a healthy and inclusive society.

9.271 Important elements which should be considered when planning integrated transport facilities include through ticketing/joint ticketing arrangements; enhanced connections and co-ordination of services; clear, accessible and wider availability of information; improved waiting facilities; appropriate location and accessibility for the elderly and mobility impaired.

9.272 The attractiveness of the public transport system as a whole in Edinburgh can be enhanced with the implementation of Edinburgh Tram Phase 1 by:

- The existence and quality of infrastructure facilities at stops, such as seating and waiting areas with weather protection (shelter) – slight beneficial;
- Maximising bus and rail interchange with tram at key locations, with greater opportunities for interchange, greater convenience and shorter distance between boarding points, and level floor boarding for all trams. In addition, there may be opportunities for the provision of cycle racks at some stops – moderate beneficial;
- Maximising public transport interchange with car at the Park and Ride location (Ingliston) – high beneficial; and
- Real-time passenger information at all stations – moderate beneficial.

9.273 Creation of reliable interchange facilities is a fundamental part of the design process. A specific part of SDS's brief is design of reliable and effective interchange facilities. For an integrated public transport system to be fully exploited by the public, it must provide a truly "seamless" journey in which passengers can have sufficient confidence to use it as an alternative to the private car. Interchange facilities therefore form a key component of transport integration. SDS has specifically addressed the issue of interchange between bus and tram by carefully designing a number of interchange facilities along the tram line that will ensure a smooth transition between these public

[67] Scotland's National Transport Strategy: A Consultation, April 2006, http://www.scotland.gov.uk/Publications/2006/04/20084756/0

transport modes.

9.274 The potential for a lack of transport service integration, or bus competition, to impact adversely on the benefits which should result from the introduction of the trams is recognised. To this end, CEC has established Transport Edinburgh Limited ("TEL"), to take on the responsibility for coordinating the services of Lothian Buses and the tram. TEL is the single economic entity under which both the tram and Lothian Buses will operate in a fully integrated transport network.

Transport integration – Phase 1a

9.275 Phase la offers interchange with bus, rail, air and Park and Ride. This will potentially have a significant impact on patronage and opportunities for feeder services to widen the catchment for the tram.

9.276 Specifically, Phase 1a provides interchange opportunities at Edinburgh Airport, Waverley and Haymarket Rail Stations, St Andrew Square Bus Station, and interchange facilities in the city centre in general. The western part of Phase 1a would allow a principally dedicated tram route, and would likely provide a competitive combination of service quality and journey times between the Airport and Haymarket: in particular, the tram would offer greatest predictability of journey time while serving intermediate locations. This section will interchange with the Edinburgh Park Rail Station and there is potential for interchange with buses at the Gyle Shopping Centre, the A8 bus halt at Gogarburn, Ocean Terminal, and the Foot of the Walk (Leith Walk) and St.Andrew Square.

9.277 Phase 1a will provide direct access to Edinburgh Airport with a stop immediately adjacent to the terminal entrance. Phase 1a of the tram, therefore, acts as a feeder mode from the Airport to Edinburgh Park and the City Centre. A high quality and fully accessible interchange will be provided at Edinburgh Airport. The role of this interchange would be further enhanced when the proposed Edinburgh Airport Rail Link opens.

9.278 The introduction of Phase 1a will enable the integration of journeys via car and public transport through the use of Park and Ride at Ingliston. The stop which serves both the Phase 1a and the potential Newbridge branch in Phase 3 has been located to maximise the use of the Park and Ride. This will therefore offer an attractive alternative to the congested route into the City Centre.

9.279 It can be summarised that the improvements in public transport brought about by Edinburgh Tram Phase 1a are expected to meet or support most local, regional and national policy objectives, in particular those related to sustainable travel (with increased use of public transport and reduced dependence on the car), regeneration and improving access, particularly for those dependent on public transport.

9.280 It is estimated that all users of Phase 1a will benefit, to varying degrees, from the various aspects of transport integration improvements identified above, when compared to the existing level of service. The overall impact of Edinburgh Tram Phase 1a on transport integration is expected to be moderate beneficial, leading to an improvement in the accessibility of the public transport network.

Transport integration – Phase 1b

9.281 The transport interchange benefits that have been identified for Phase 1a will be enhanced further by the introduction of Phase 1b. The principal opportunity for transport interchange will be bus interchange at Crewe Toll (particularly with regards access to the Western General Hospital).

Land-use and transport integration

9.282 Overall, it can be said that Edinburgh Tram integrates well with land-use policy and proposals, as outlined below.

9.283 Recent developments in UK and Scottish Government policy have provided a clear framework for the integration of land use and transport planning with a general requirement to promote sustainability and reduce the need to travel to relevant existing or future developments.

9.284 The land-use transport integration sub-objective should consider whether:

- Any land required for the proposal is preserved for uses which are incompatible with transport (for example, protected or conservation areas);
- The proposal fits with the general policies of all authorities at all levels concerning transport and land use; and
- The proposal conflicts with any other existing or planned development.

9.285 Thus, there is a requirement for the identification of the land use policies or proposals conflicting with statutory planning documents at local, regional and national levels. This has been carried out to some extent during the STAG Part 1 process and any serious conflicts would have been identified at an earlier stage.

9.286 Edinburgh Tram Phase 1a and Phase 1b support a range of land use policy objectives at all levels. At the national level, the National Planning Framework (NPF) for Scotland[68] gives guidance on the spatial development of Scotland in the future, whilst Scottish Planning Policy: SPP 17 – Planning for Transport[69] sets out policies on land use and sustainable transport. The NPF stresses the important role of transport in planning future development, particularly sustainable modes such as the tram in Edinburgh. Integration is a key focus of SPP17, not only between land use and transport planning, but linking to economic development and environmental issues as well. One of the overarching integration objectives within SPP17 supported by the tram is:

"The maintenance and enhancement of the quality of urban life, particularly the vitality and viability of urban centres."

9.287 The tram proposal also supports the following SPP17 principles of integration (more

[68] National Planning Framework for Scotland: Guidance for the spatial development of Scotland to 2025, 2004, http://www.scotland.gov.uk/Publications/2004/04/19170/35317

[69] Scottish Planning Policy: SPP 17 – Planning for Transport, http://www.scotland.gov.uk/Publications/2005/08/16154406/44078

detailed guidance on how to achieve these are contained in the accompanying Planning Advice Note PAN 75[70]):

- reducing the need to travel;
- promoting road safety and safety on public transport;
- facilitating movement by public transport including provision of interchange facilities between modes;
- providing high quality public transport access, in order to encourage modal shift away from car use to more sustainable forms of transport, and to fully support those without access to a car; and
- providing infrastructure for real time information on public transport.

9.288 The local and regional planning policy context is set within national guidance and particularly reflects priorities for sustainability and integration.

9.289 The Transport (Scotland) Act 2005 sets out the requirement for Regional Transport Partnerships (RTP) to prepare statutory Regional Transport Strategies (RTS). The South East Scotland Regional Transport Partnership (SESTRAN) is developing a formal Regional Transport Strategy for adoption in 2007. The existing RTS was created whilst RTPs were still voluntary partnerships, and will soon be superseded. However, the Act states that the RTS must consider how transport needs to be provided, developed or improved, taking into account future needs occasioned by land use changes.

9.290 The Finalised Edinburgh and Lothians Structure Plan 2015[71] makes clear that the delivery of a tram system is essential for the successful delivery of the plan's development strategy, in particular, to encourage major new economic development outwith Edinburgh city centre where development opportunities are viewed to be limited. That strategy includes identification of core areas where major new development will take place. The Phase 1a tram proposals will directly support the core development areas of the city centre, Leith, and Edinburgh Park/South Gyle/Sighthill. Phase 1b will directly support development in the Granton area.

9.291 Similarly, the Edinburgh and the Lothians Structure Plan presents the challenge to ensure that a sustainable future can be built in West Edinburgh and the wider area using Phase 1a as a key artery of business and community activity. Key principles of this policy are as follows:

- combating social exclusion by ensuring access between disadvantaged local communities and subsequent new employment opportunities situated in or adjacent to the proposed tram corridor;
- the need to ensure access to affordable transportation networks for all parts of the local community and particularly those in disadvantaged areas, such as West

[70] Planning Advice Note: PAN 75 – Planning for transport, http://www.scotland.gov.uk/Publications/2005/08/16154453/44538

[71] Edinburgh and the Lothians Structure Plan 2015, approved June 2004, http://www.edinburgh.gov.uk/CEC/City_Development/Planning_and_Strategy/Structure_Plan/EDINBURGH_AND_THE_LOTHIANS_STRUCTURE_PLAN_2001.HTML

Edinburgh and West Lothian; and

- support for controlled development and re-use of existing buildings and vacant, derelict and brownfield sites where regeneration potential will be maximised through integration with the proposed tram line.

9.292 The West Edinburgh Planning Framework[72] has been prepared by the Scottish Executive and provides policy guidance on planning, development and growth in West Edinburgh. A key element is that adequate transport provision is essential to enable any additional development in the area.

9.293 A series of Local Plans across Edinburgh implement structure plan policy at a more detailed level. The Finalised Rural West Edinburgh Local Plan[73] identifies major new greenfield housing land sites for a total of 765 houses at Kirkliston North and Ratho Station to meet the requirements of the Structure Plan, which would likely be served by a future Phase 3 of the tram. However, the Rural West Edinburgh Local Plan does make reference to the importance of the proposed tram in supporting development in west Edinburgh as set out within the Scottish Executive's West Edinburgh Planning Framework (ibid).

9.294 Alterations to the North East Edinburgh Local Plan (1998) were adopted in 2004[74]. This Local Plan sets out CEC's policies for development and use of land in the north east of the City, and the Alteration specifically focuses on a major development opportunity in Leith Docks Western Harbour, which Phase 1a will support.

9.295 The Draft West Edinburgh Local Plan[75] (2001) focuses on the development opportunity at Granton Waterfront – Phase 1b will support a large proportion of this development.

9.296 The tram route corridor from Haymarket to the Airport integrates well with planning and transport policies by serving the Gyle Shopping Centre and avoiding further impacts on traffic congestion at Gogar Roundabout. However, the development of Green Belt land will be required at this location.

9.297 There will be some minor impacts where existing business and residential holdings will require to be compulsory purchased to accommodate the tram line.

9.298 The Roseburn – Carrick Knowe section of phase 1b will significantly impact upon residential properties on Roseburn Drive and residents along Baird Drive raised concerns regarding noise and visual impacts from the tram.

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72 West Edinburgh Planning Framework, Scottish Executive, 2003 http://www.scotland.gov.uk/Publications/2003/03/16751/19944

73 Rural West Edinburgh Local Plan, 2004, City of Edinburgh Council http://www.edinburgh.gov.uk/CEC/City_Development/Planning_and_Strategy/RWELP/index.html

74 North East Edinburgh Local Plan Alterations – January 2004, City of Edinburgh Council http://www.edinburgh.gov.uk/CEC/City_Development/Planning_and_Strategy/NEELP/neelp.html

75 Draft West Edinburgh Local Plan, City of Edinburgh Council, 2001 http://www.edinburgh.gov.uk/CEC/City_Development/Planning/Draft_West_Edinburgh_Local_Plan/west_local_plan_contents.html

9.299 In general, there is greater scope for development opportunities resulting from the routing of Edinburgh Tram Phase 1a and 1b.

9.300 The overall assessment of the land-use transport integration impacts can be considered moderate beneficial.

Policy Integration

9.301 The Transport White Paper, Scotland's Transport Future (2005), quotes economic growth, social inclusion and environmental protection as key areas of concern when planning transport, recognising that transport decisions have wide impacts upon communities.

9.302 The Policy Integration criterion examines whether the proposed scheme contributes to, and is consistent with, other Government policies and legislation beyond transport. A review of relevant national policies is included in Chapter 2 of this report.

9.303 Edinburgh Tram Phase 1a and 1b can contribute to the following wider Government policies:

- **Disability** – The design of trams and stops, fully Disability Discrimination Act (1995) compliant and with level boarding, will provide easy access to wheel chairs and push chairs, thus facilitating access not only for those with mobility impairments but also the elderly and those with young children.
- **Health** – The expected modal shift from car to public transport for journeys by local residents and others travelling to local employment and recreational facilities will provide greater opportunities for increased walking and cycling trips to reach the new tram stops. In addition, the use of trams (as opposed to cars) will reduce the adverse environmental impacts of traffic, particularly harmful local emissions, with an overall positive effect on health.
- **Rural affairs** – The scheme may potentially benefit communities in the Rural West area of Edinburgh by providing access to the tram system through the Ingliston Park and Ride in particular.
- **Social inclusion** – the scheme fits in with policies to promote social inclusion, by enabling the socially deprived (particularly those with no access to a car) access to the public transport network.

9.304 In general, Phase 1a will integrate well with major employment, leisure and transport hubs, such as the city centre, Ocean Terminal, Waverley and Haymarket Rail Station, the Gyle Shopping Centre, Edinburgh Park, the RBS and Edinburgh Airport, thus contributing to sustainability and reducing the need to travel. In addition to this Phase 1b will offer the potential to integrate with, Craigleith Retail Park, and the Western General.

9.305 With regards economic development, the Phase 1a will provide a generally positive impact for the business community, principally through improving accessibility and also potential for increased trade custom. This is particularly relevant for businesses located in Leith, the city centre, Edinburgh Park, South Gyle, and Sighthill. Phase 1b will improve the accessibility of to businesses located in the Craigleith area.

9.306 In the West of Edinburgh (Haymarket to the Airport), Phase 1a will provide additional public transport capacity. It is thus likely to have a positive impact on congestion, converting car users to public transport passengers utilising a highly efficient transport mode. The tram route will improve accessibility and social inclusion, particularly in relation to the less advantaged communities to the south of the route.

9.307 It can therefore be said that the scheme is consistent with national policies beyond transport.

Accessibility

Accessibility and Social Inclusion

9.308 The accessibility objective aims at identifying the extent to which proposals can help people access employment, education, shopping, services, health and leisure facilities and destinations (community accessibility). It is also important to analyse the distribution of impacts for particular disadvantaged groups in society (such as the unemployed, those on low-income or with no car available) and by location (comparative accessibility).

9.309 Increased accessibility levels can be measured in different ways, e.g. in terms of increased destination options within a study area, journey time reductions, changes in the number of people with walking access to the public transport network or number of people with access to certain destinations (e.g. employment). Transport models and GIS capability are usually used as mechanisms for the measurement of changes in accessibility conditions.

9.310 A measure of accessibility is relevant to establish whether an area is in particular need of assistance in the first place, and whether the scheme offers scope for appreciable gains or losses in relative terms. This can be measured by the proportion of the population with poor levels of accessibility and the extent to which the proposed scheme could alter it.

Community Accessibility

Public transport network coverage

9.311 The proposed scheme is expected to increase accessibility by public transport. Public transport network coverage is measured by the changes in the number of people with public transport access to key services and destinations (for work, education, shopping, health, leisure and other trips of local significance) within specific time bands.

9.312 This measure has been determined using results from the public transport model, which simulated the introduction of Edinburgh Tram onto the public transport network and the associated integration and optimisation of the bus network.

9.313 In terms of the key trip attractors, this was informed by the 2003/4 "Upfront Buses" project undertaken by CEC, which identified the following key local services and destinations:

- George Street / Frederick Street junction – representing the focal point of the city centre (employment, shopping, leisure and access to Waverley rail station with integration with bus and rail) in terms of overall public transport accessibility;

- Haymarket rail station (integration, interchange with bus and rail);
- Foot of Leith Walk (employment, shopping, jobcentre);
- Leith Ocean Terminal (employment);
- Granton development area (employment, residential and education, with Telford College – amalgamation of 4 campuses – and new school on waterfront site. There is also the potential for hotels and leisure activities);
- Crewe Toll/ Western General Hospital (employment, visiting relatives);
- Edinburgh Airport (employment, transport interchange);
- Gyle Centre (Shopping);
- Edinburgh Park (employment);
- Sighthill Industrial Estate (employment); and
- Napier University Sighthill Campus (education).

9.314 The changes in public transport perceived travel time have been estimated by the transport model (accounting for walk time, wait time and interchange time, according to service frequencies) from all origins to each of the destinations identified above, considering the "without" (bus only) and "with" the scheme scenarios (bus and tram). Figure 9.18 to Figure 9.28 illustrate the changes in accessibility to each of the destinations for Phase 1a; for Phase 1a+1b, the accessibility impacts are shown in Figure 9.29 to Figure 9.39. (Note that due to the zonal basis of the data and the associated representation of walk networks, the results can sometimes appear lumpy and discontinuous. In practice the transition between accessibility changes would be smoother.)

9.315 In general, accessibility is improved for travel for most zones to all the selected destinations. Some destinations show a relatively neutral impact from the tram due to the already high levels of accessibility; this applies most to the George Street location.

9.316 By definition, the reductions in accessibility occur where the bus network is reconfigured with the introduction of tram, principally routes terminating in the city centre rather than running through to Leith and beyond. For example, access to the Foot of Leith Walk is poorer from the Slateford and Kingsknowe areas due to route 25 being terminated at St.Andrews Square, rather than running through to Leith and Restalrig. Similar effects can be seen for access to Ocean Terminal.

Access to local services

9.317 This criterion captures the local accessibility benefits for walk and cycling trips. Although the tram provides increased opportunities for walking and cycling as access modes to reach the tram system (already accounted for in the policy integration with health), it has limitations to promote further non-motorised trips to access local services.

9.318 There will be some improvement in walk and cycle access where the tram runs on-street as crossing facilities and pedestrian refuges will be included in the scheme. The relatively low frequency and predictable swept paths of trams mean that pedestrians are more confident in crossing tram-only streets than streets with buses or general traffic and this would lead to some improvement in local accessibility, particularly within the city centre.

9.319 Conversely, Edinburgh Tram could cause adverse effects on non-motorised accessibility, since pedestrians and cyclists could take longer to cross the street (part of which will be taken by the tram line), particularly if the mix of road and tram traffic causes additional perceived detriment to movement. This can be particularly the case if road and tram traffic clear at different moments, since they can have different patterns, potentially delaying the complete crossing when undertaken with safety. Further aspects of relevance include the crossing:

- Of wheel and push chair users as well as of other mobility impaired, since their movement is more sensitive to physical and psychological barriers; and
- At tram stops, when their design comprises waiting/seating areas, fencing or any other facility that can represent a barrier to street crossing (although as noted above stops may introduce additional pedestrian crossings which could contribute to a safer crossing, but possibly at the expense of additional delay.)

Notwithstanding the above, the design process will seek to minimise any adverse impacts on local access through the design process.

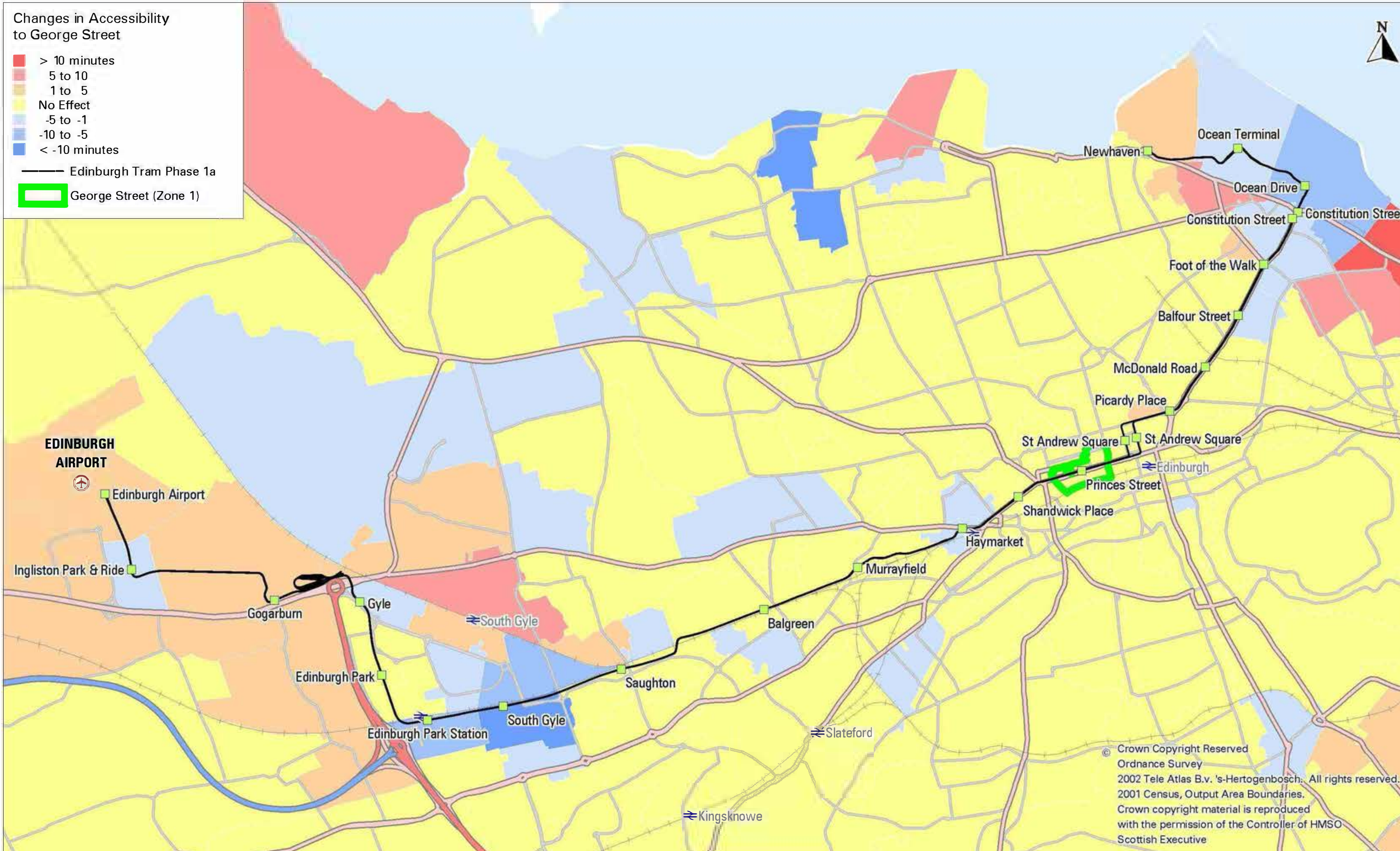
9.320 Overall the impact on local accessibility will be limited but the net effect is likely to be minor beneficial for both Phase 1a only and Phase 1a+1b.

Comparative accessibility

9.321 Some key benefits of the scheme will be realised by the socially disadvantaged. The distribution of accessibility impacts is relevant in that it identifies the extent to which the scheme benefits social groups or geographic locations most in need of access by public transport to essential activities

9.322 This analysis draws from the disaggregation of the community accessibility results (as in the previous section) by no-car ownership, with the aim to compare the accessibility benefits accrued by this group in relation to the community as a whole.

9.323 Table 9.42 summarises the results of the Phase 1a accessibility analysis for each selected location. It shows the impact on accessibility, by travel time change bands, for population, households and households without a car; the baseline data is from the 2001 Census for the City of Edinburgh, West Lothian, Midlothian and East Lothian. Negative changes indicate a reduction in travel time, with positive changes showing a disbenefit. The results for Phase 1a+1b are shown in Table 9.43.



Edinburgh Tram STAG 2 Appraisal
Figure 9.18: Change in Accessibility to George Street (Phase 1a)

steer davies gleave

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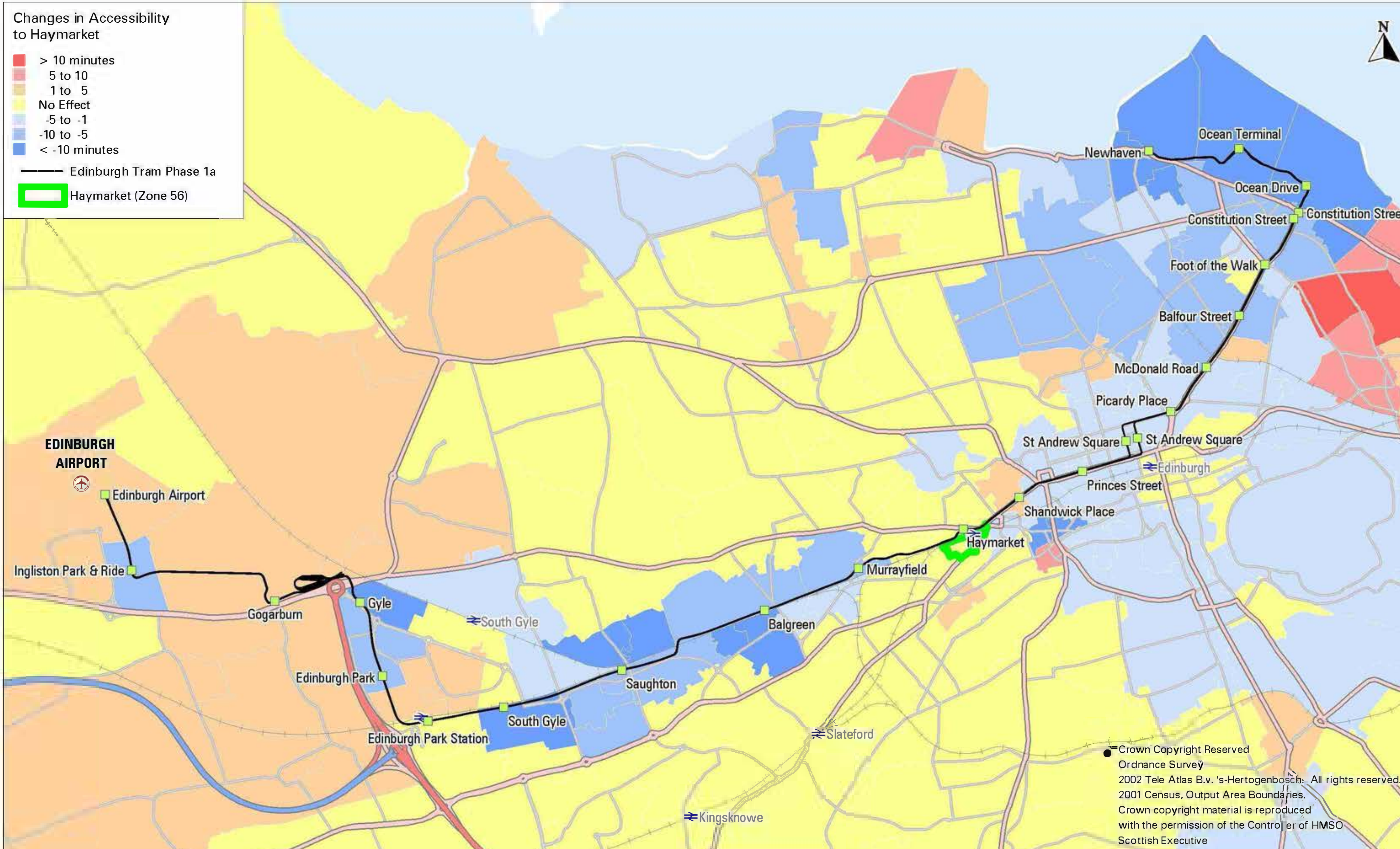

Edinburgh Tram STAG 2 Appraisal
Figure 9.19: Change in Accessibility to Haymarket (Phase 1a)

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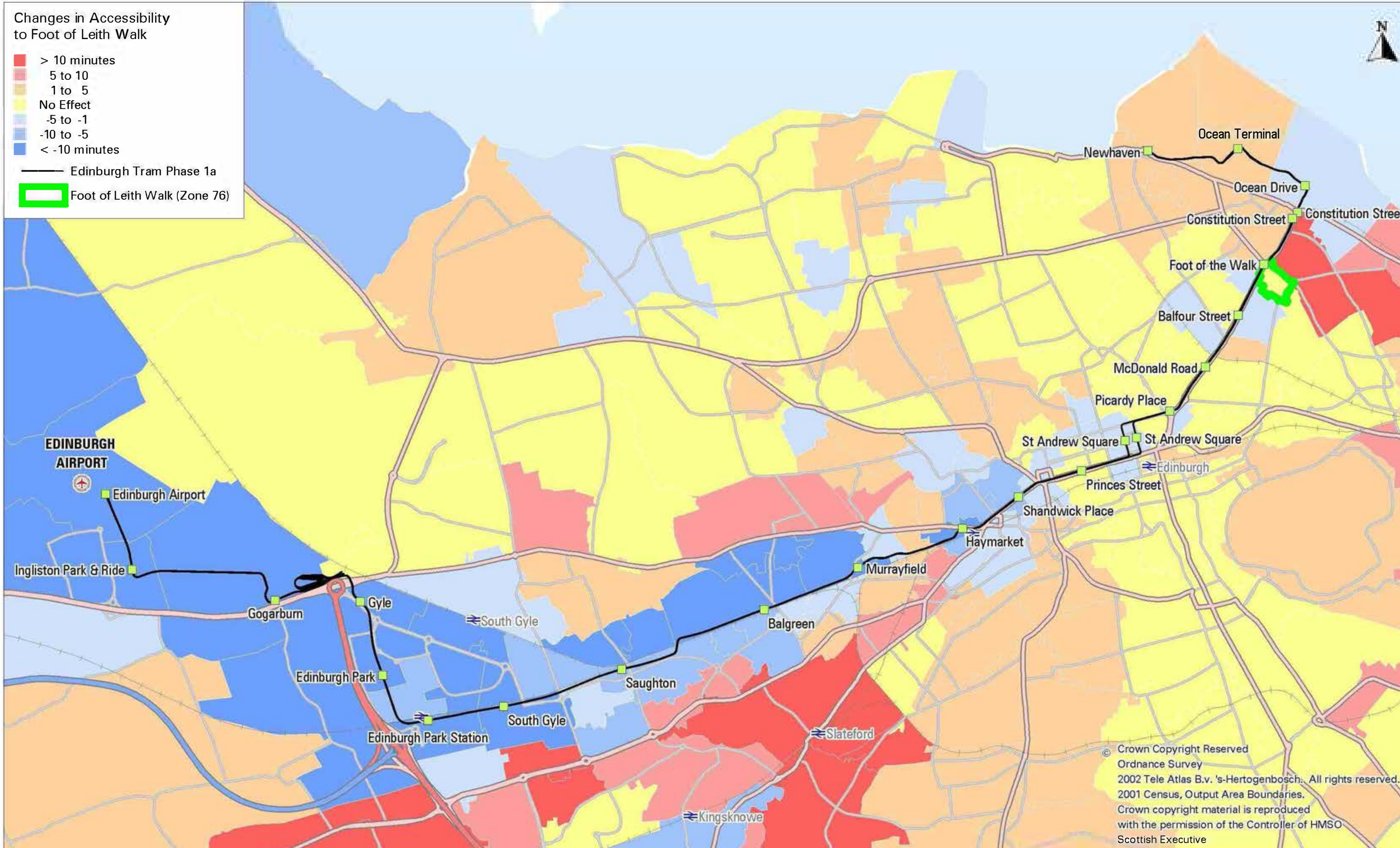

Edinburgh Tram STAG 2 Appraisal
Figure 9.20: Change in Accessibility to Foot of Leith Walk (Phase 1a)

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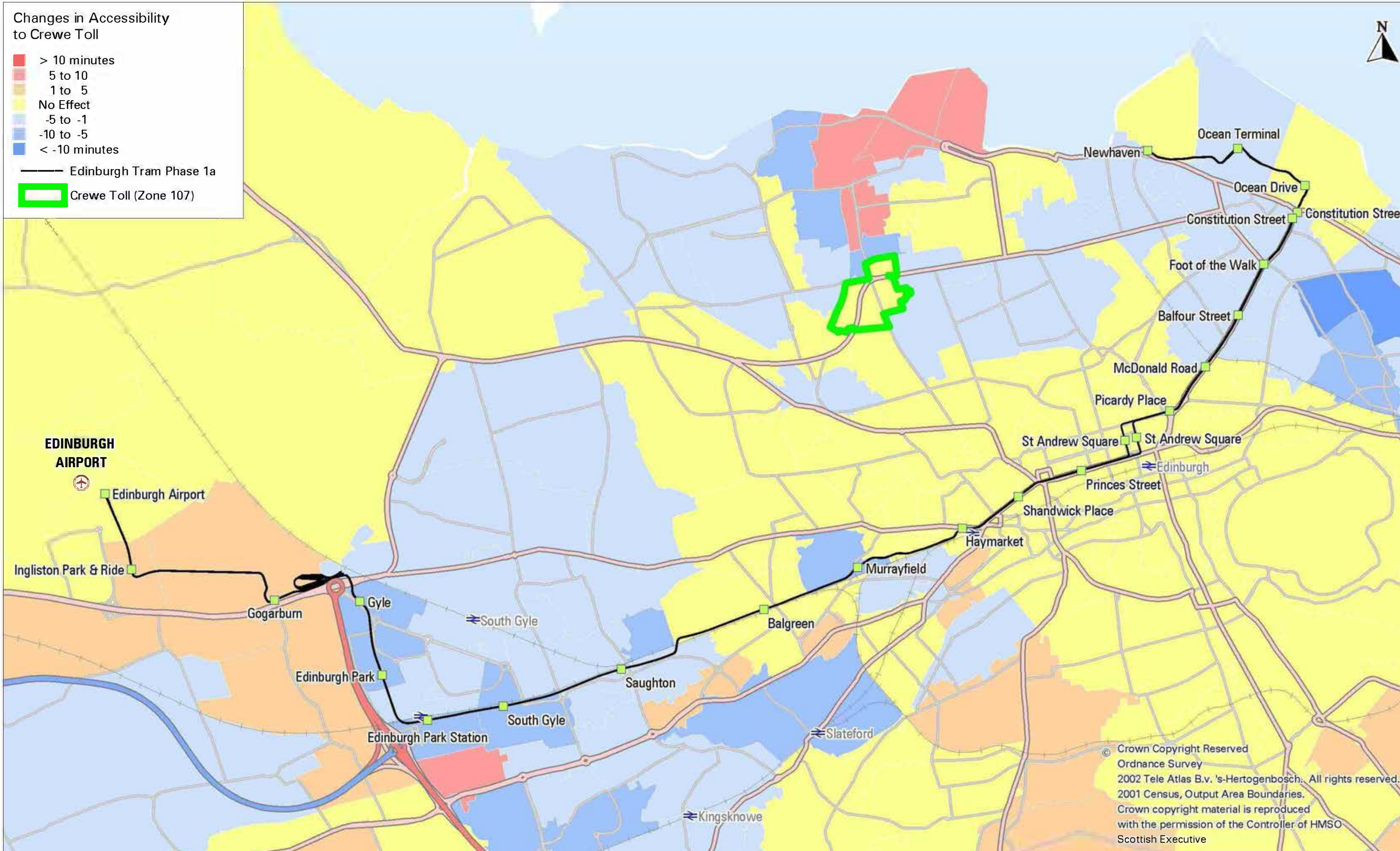

Edinburgh Tram STAG 2 Appraisal
Figure 9.21: Change in Accessibility to Crewe Toll (Phase 1a)

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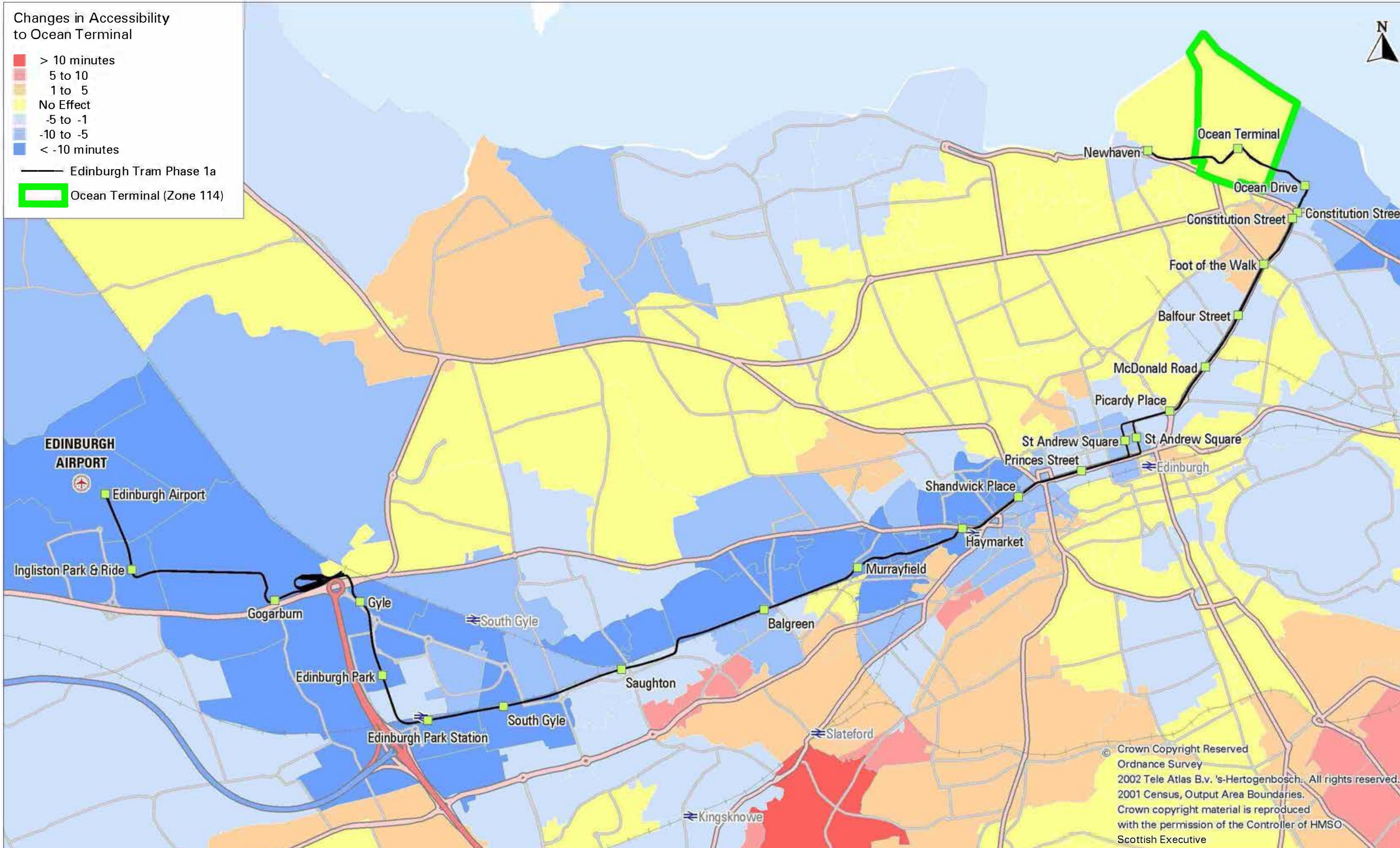

Edinburgh Tram STAG 2 Appraisal
Figure 9.22: Change in Accessibility to Ocean Terminal (Phase 1a)

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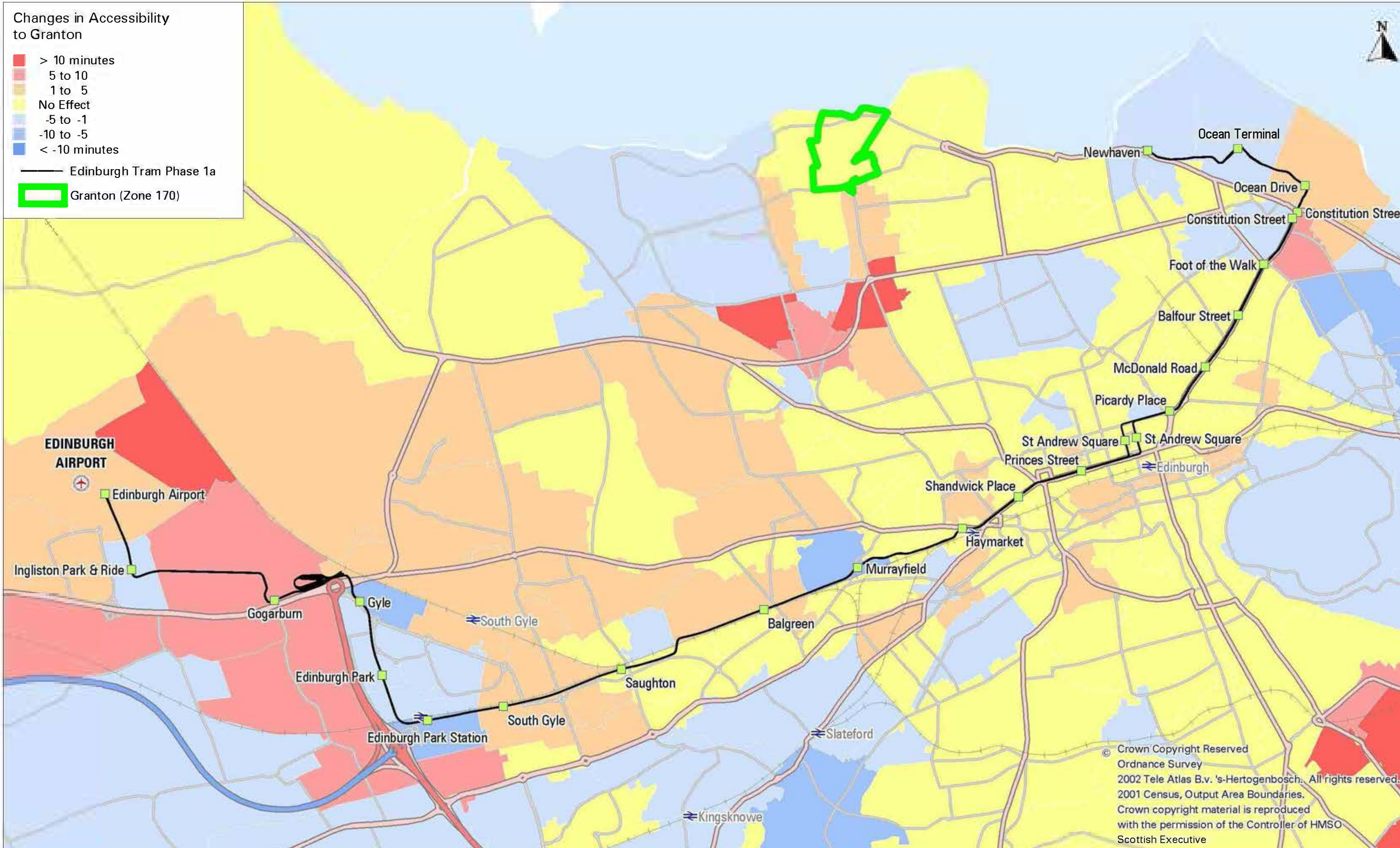

Edinburgh Tram STAG 2 Appraisal
Figure 9.23: Change in Accessibility to Granton (Phase 1a)

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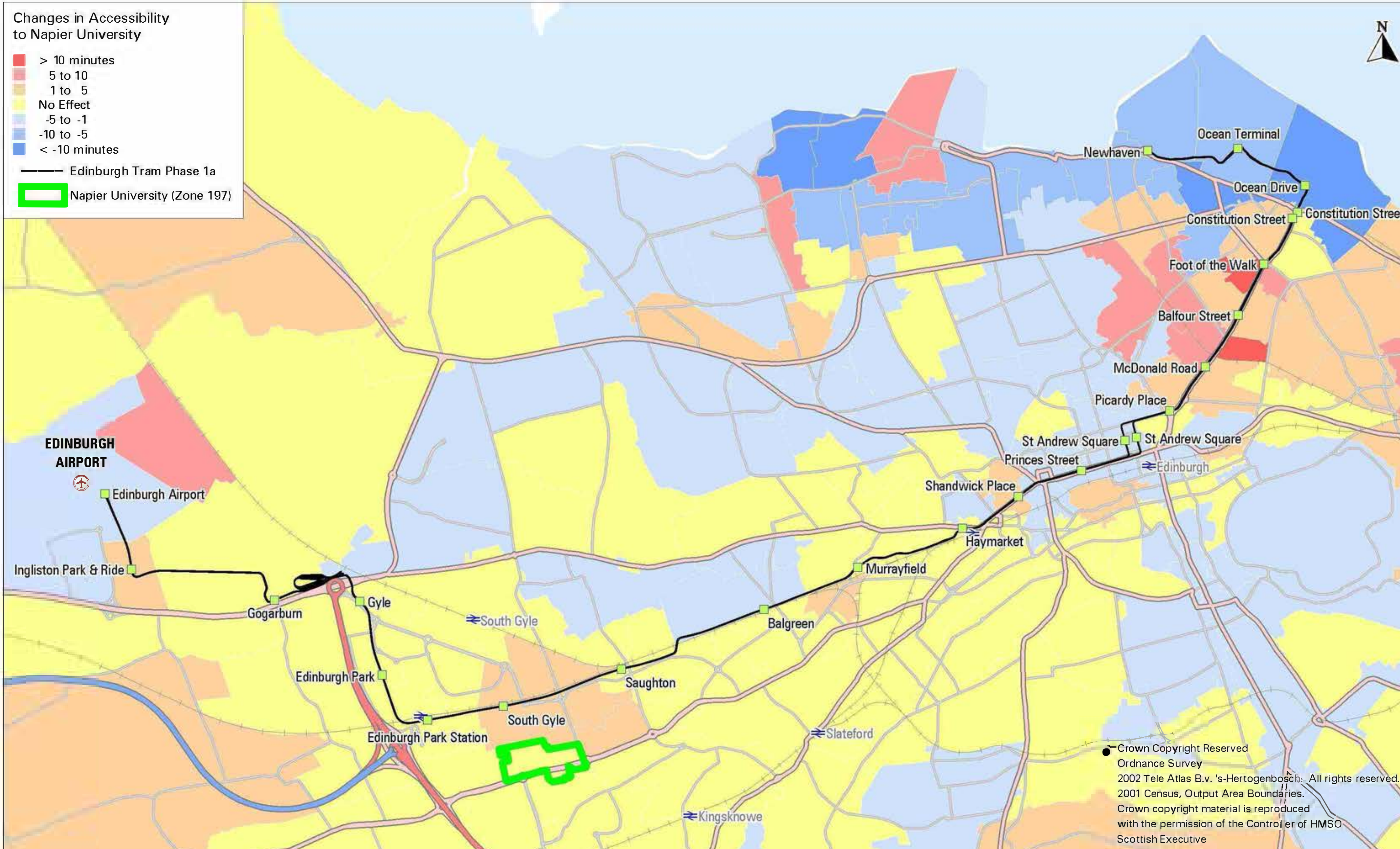

Edinburgh Tram STAG 2 Appraisal
Figure 9.24: Change in Accessibility to Napier University (Phase 1a)

steer davies gleave

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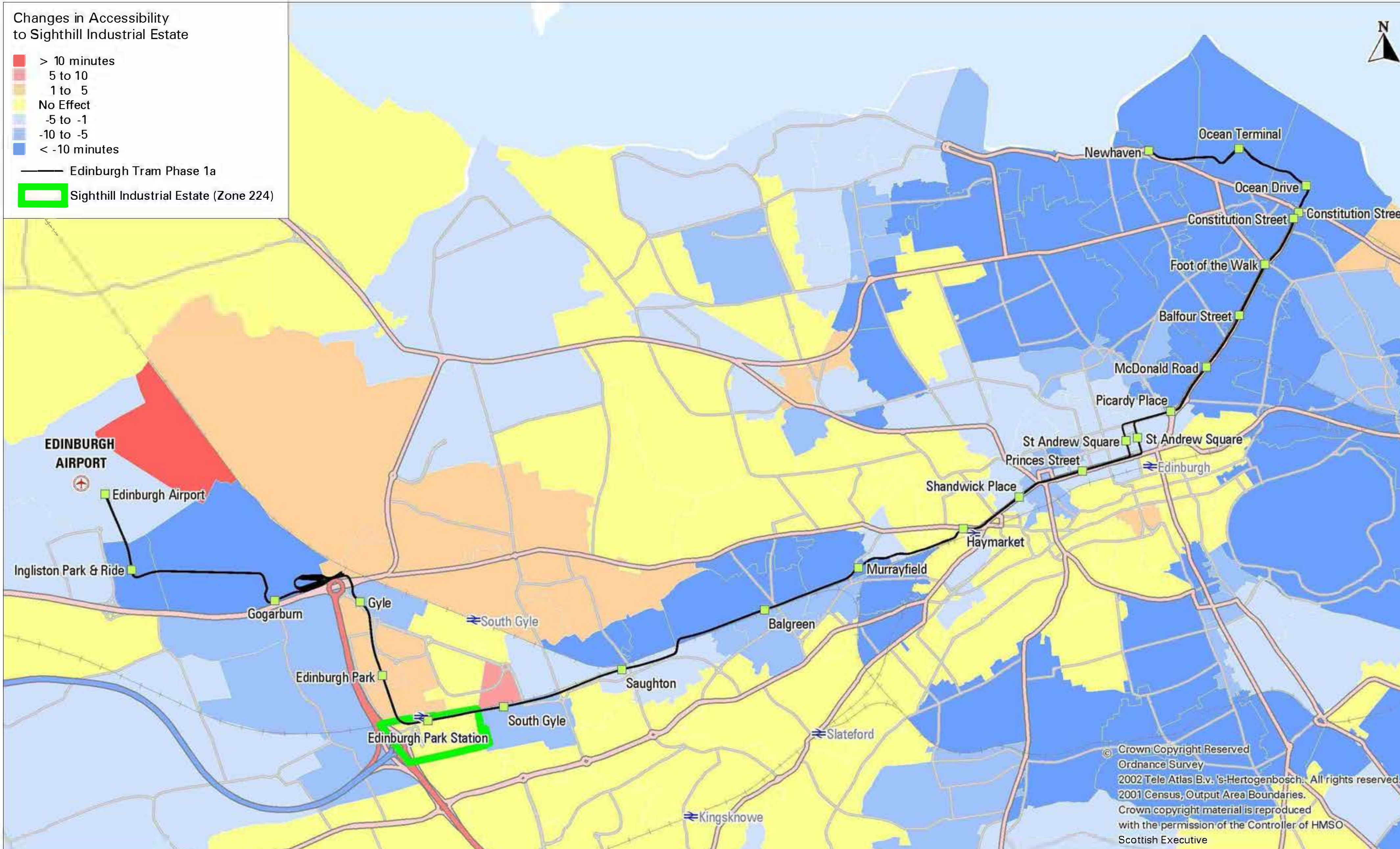

Edinburgh Tram STAG 2 Appraisal
Figure 9.25: Change in Accessibility to Sighthill Industrial Estate (Phase 1a)

steer davies gleave

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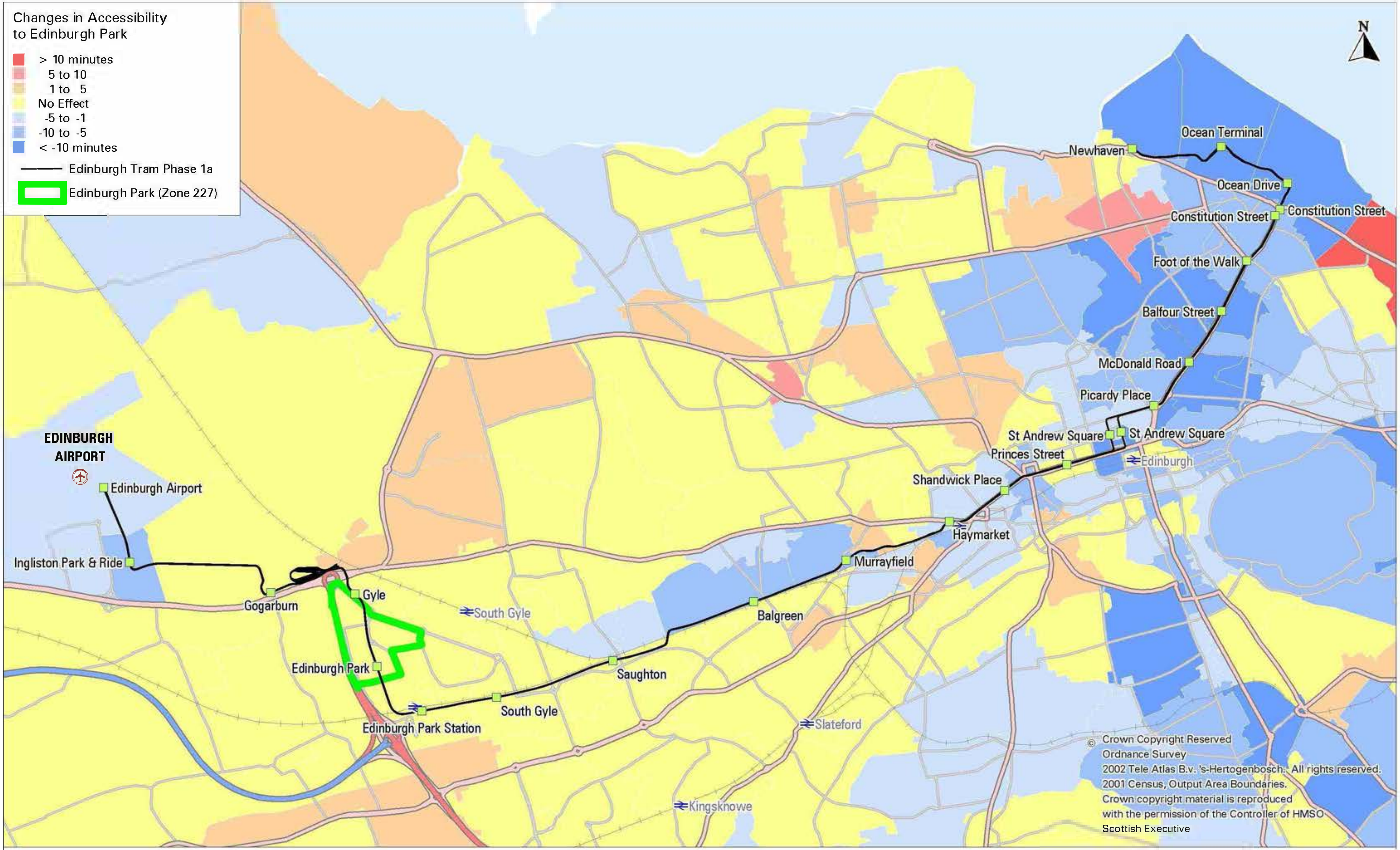

Edinburgh Tram STAG 2 Appraisal
Figure 9.26: Change in Accessibility to Edinburgh Park (Phase 1a)

steer davies gleave

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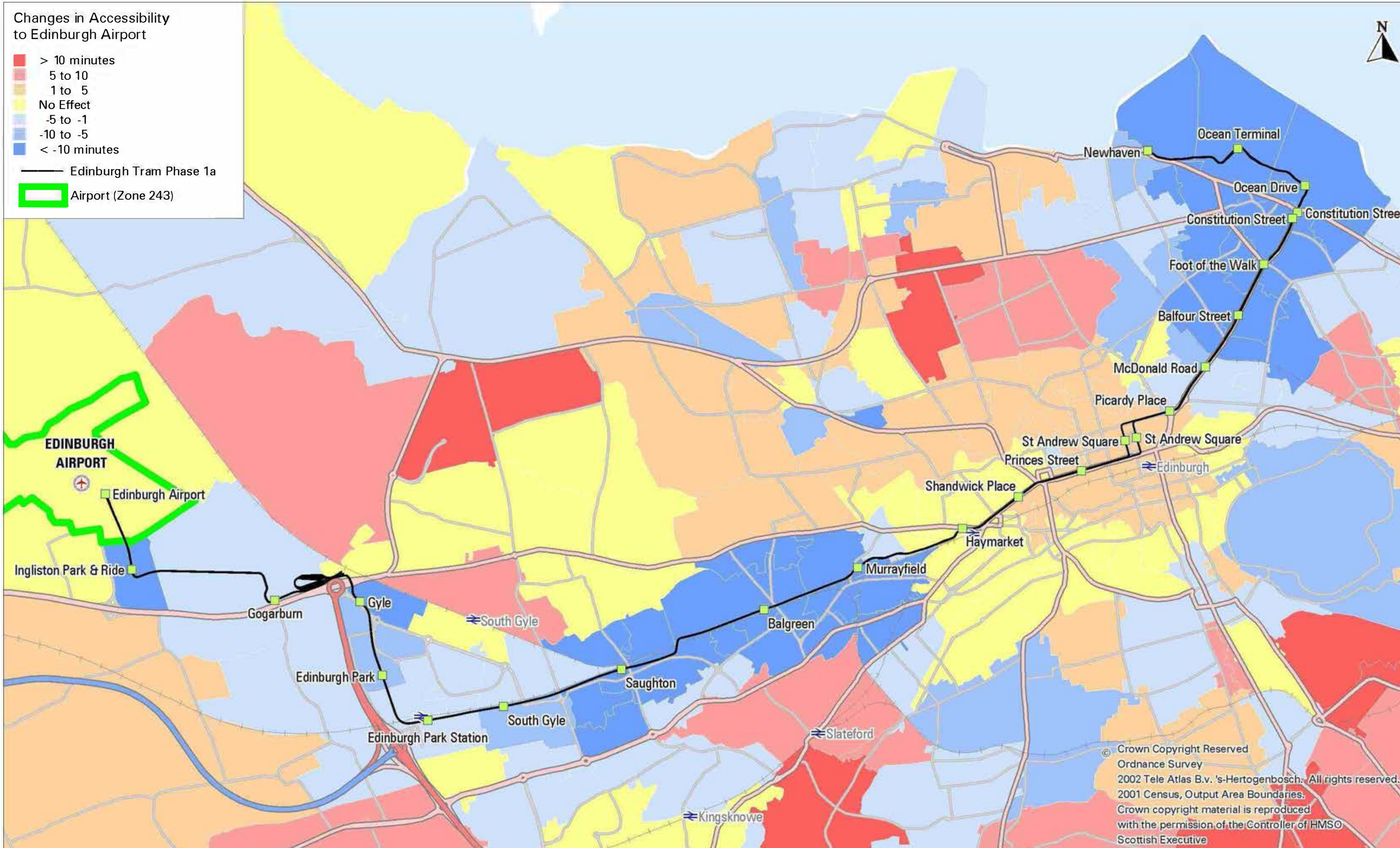

Edinburgh Tram STAG 2 Appraisal
Figure 9.28: Change in Accessibility to Edinburgh Airport (Phase 1a)

steer davies gleave

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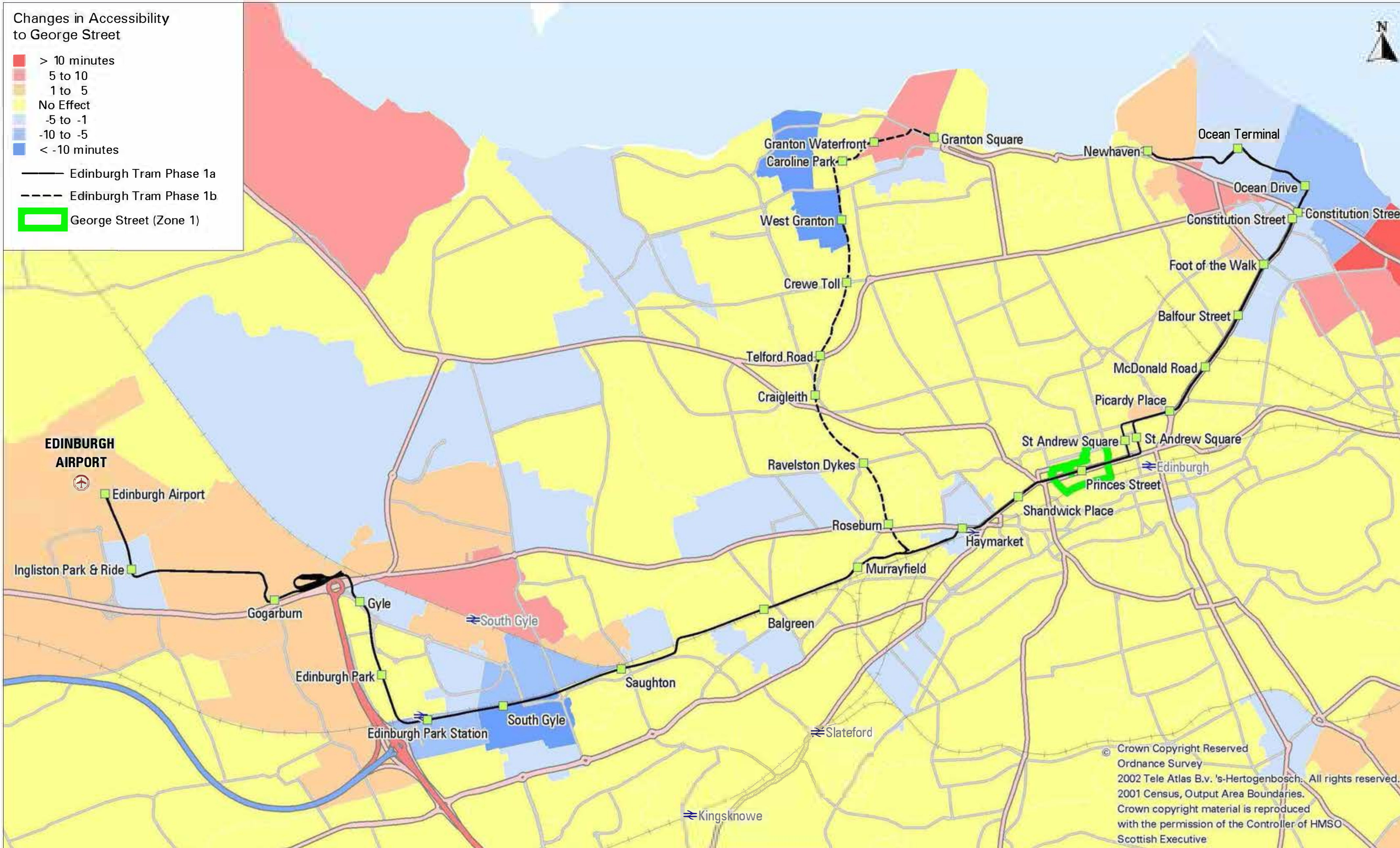

Edinburgh Tram STAG 2 Appraisal
Figure 9.29: Change in Accessibility to George Street (Phase 1a + 1b)

steer davies gleave

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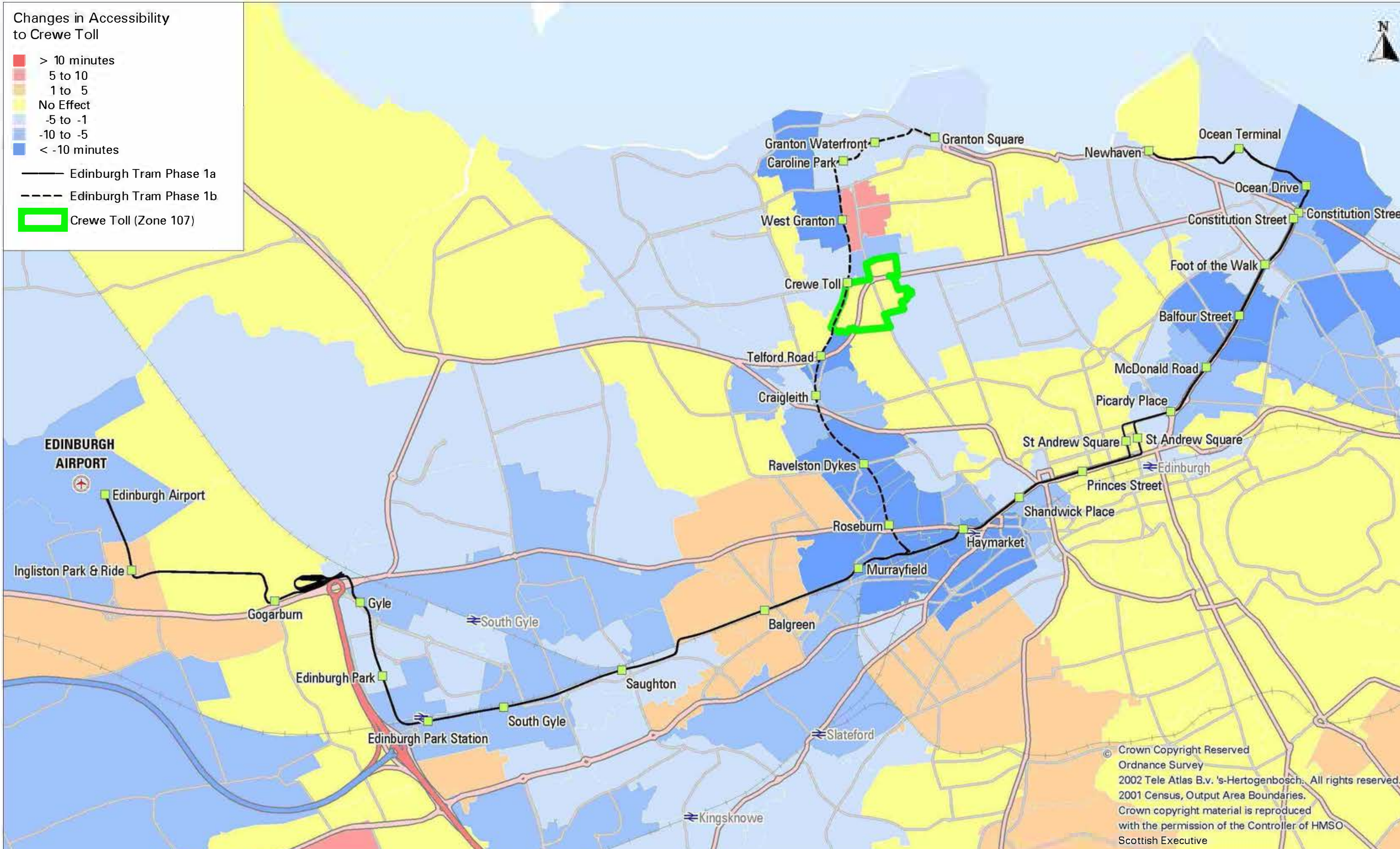

Edinburgh Tram STAG 2 Appraisal
Figure 9.32: Change in Accessibility to Crewe Toll (Phase 1a + 1b)

steer davies gleave

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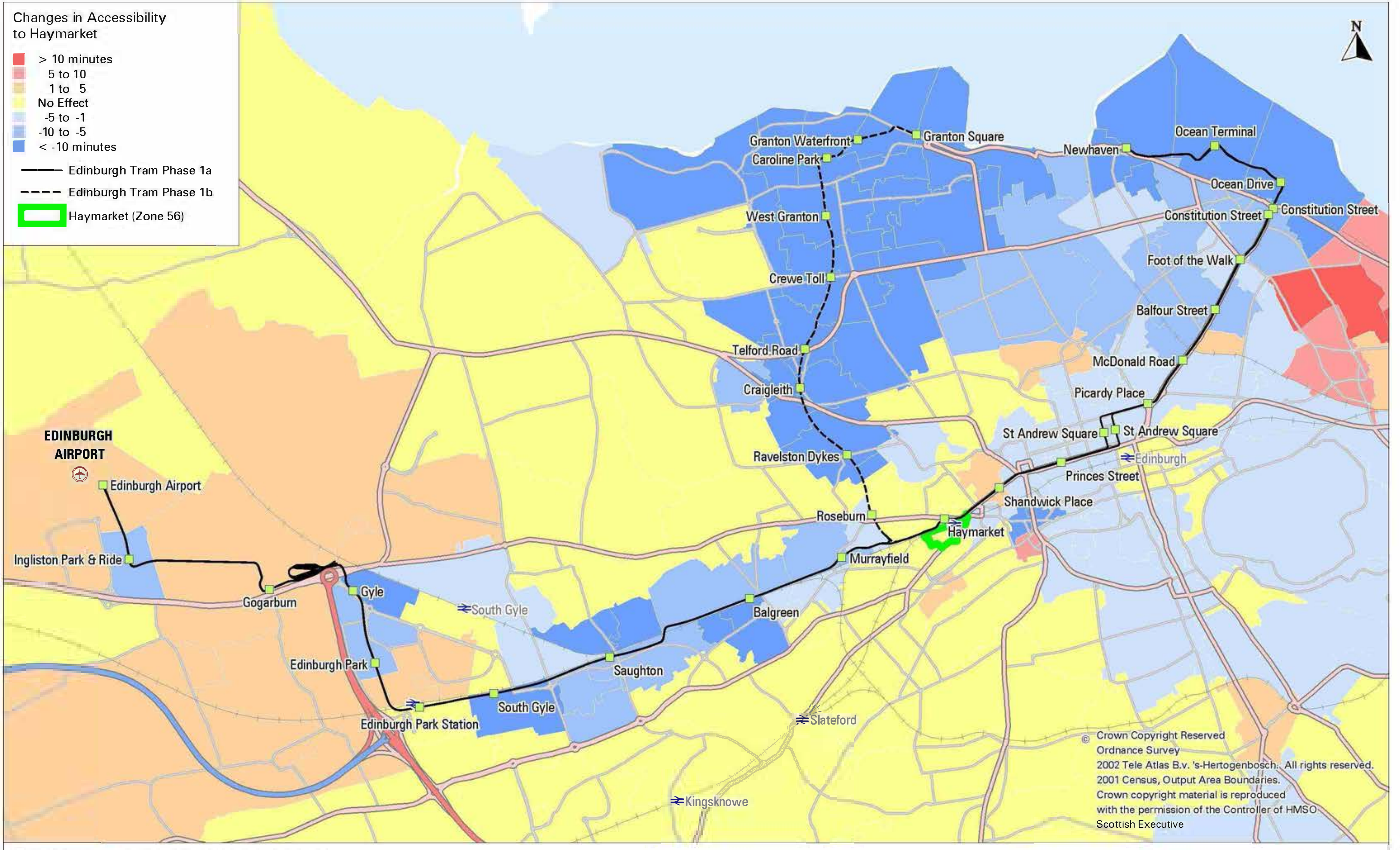

Edinburgh Tram STAG 2 Appraisal
Figure 9.30: Change in Accessibility to Haymarket (Phase 1a + 1b)

steer davies gleave

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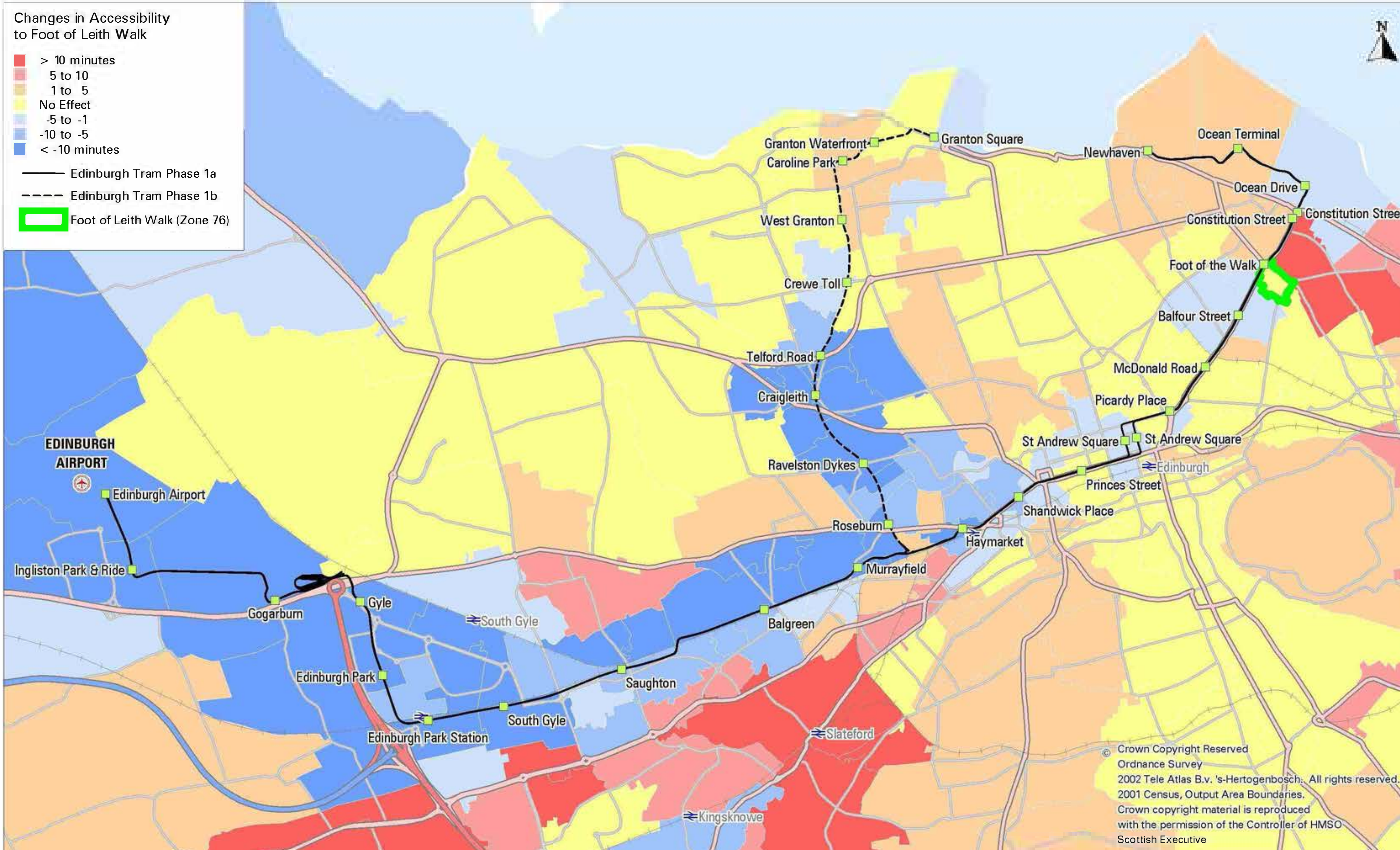

Edinburgh Tram STAG 2 Appraisal
Figure 9.31: Change in Accessibility to Foot of Leith Walk (Phase 1a + 1b)

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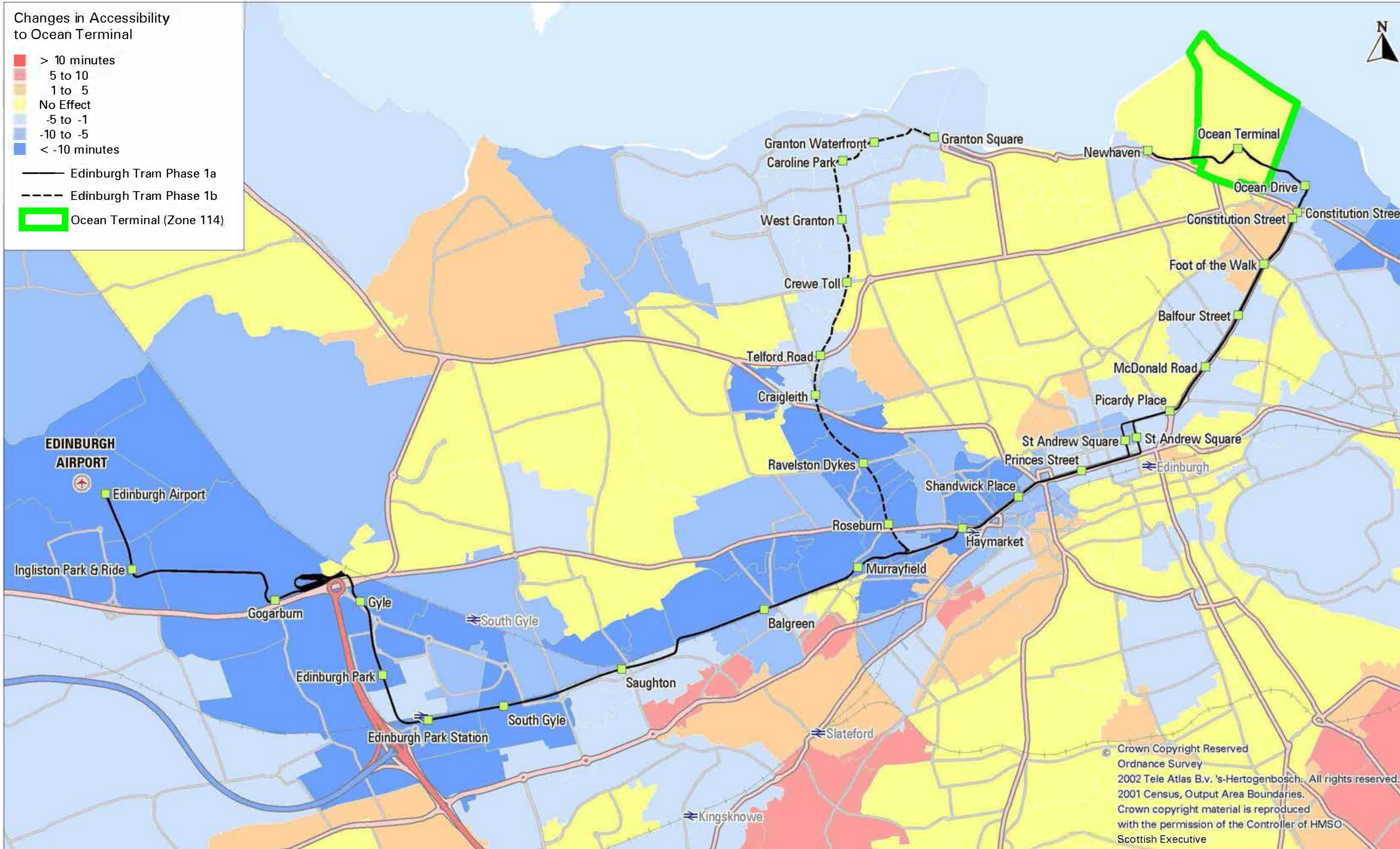

Edinburgh Tram STAG 2 Appraisal
Figure 9.33: Change in Accessibility to Ocean Terminal (Phase 1a + 1b)

steer davies gleave

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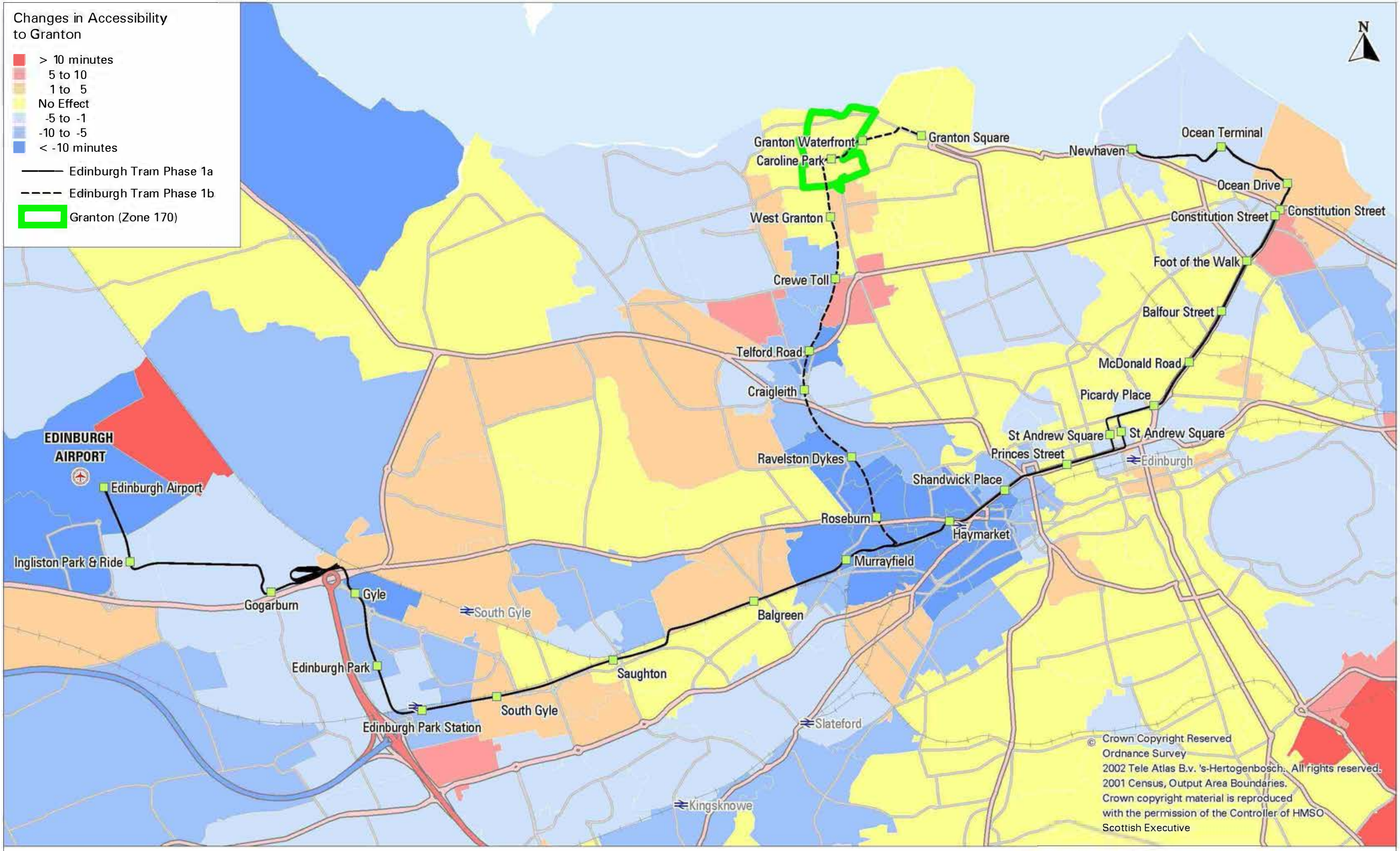

Edinburgh Tram STAG 2 Appraisal
Figure 9.34: Change in Accessibility to Granton (Phase 1a + 1b)

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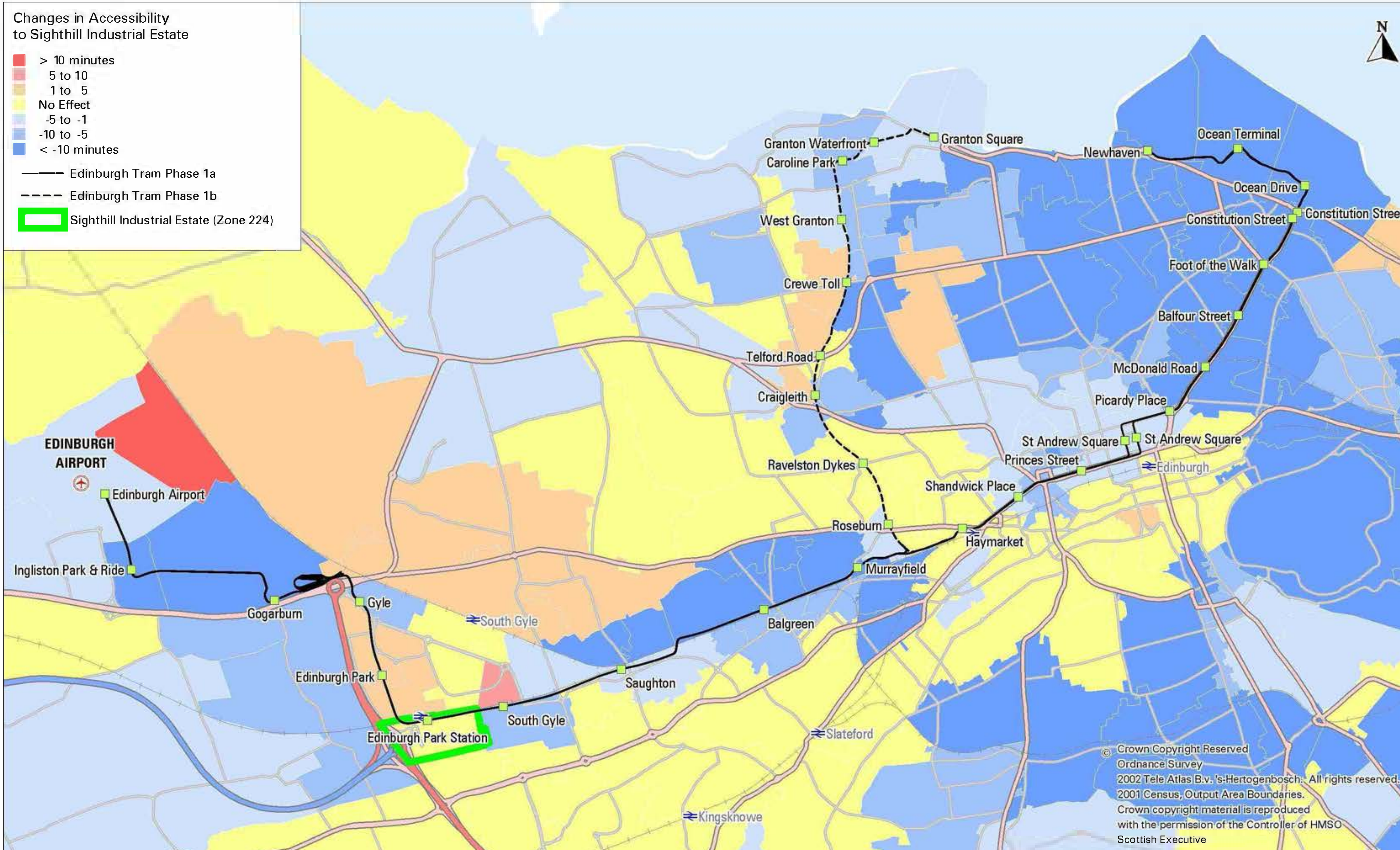

Edinburgh Tram STAG 2 Appraisal

Figure 9.36: Change in Accessibility to Sighthill Industrial Estate (Phase 1a + 1b)

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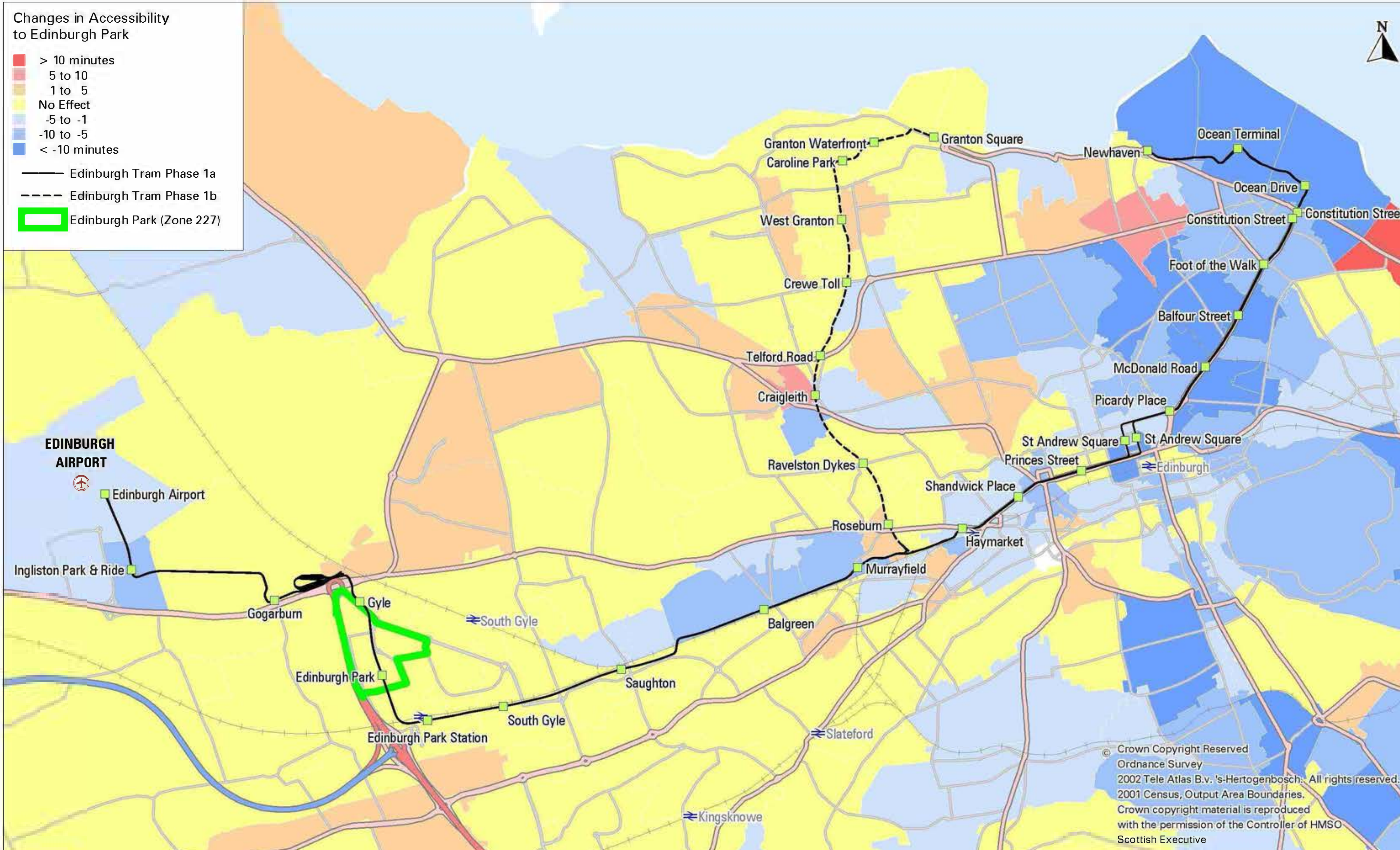

Edinburgh Tram STAG 2 Appraisal
Figure 9.37: Change in Accessibility to Edinburgh Park (Phase 1a + 1b)

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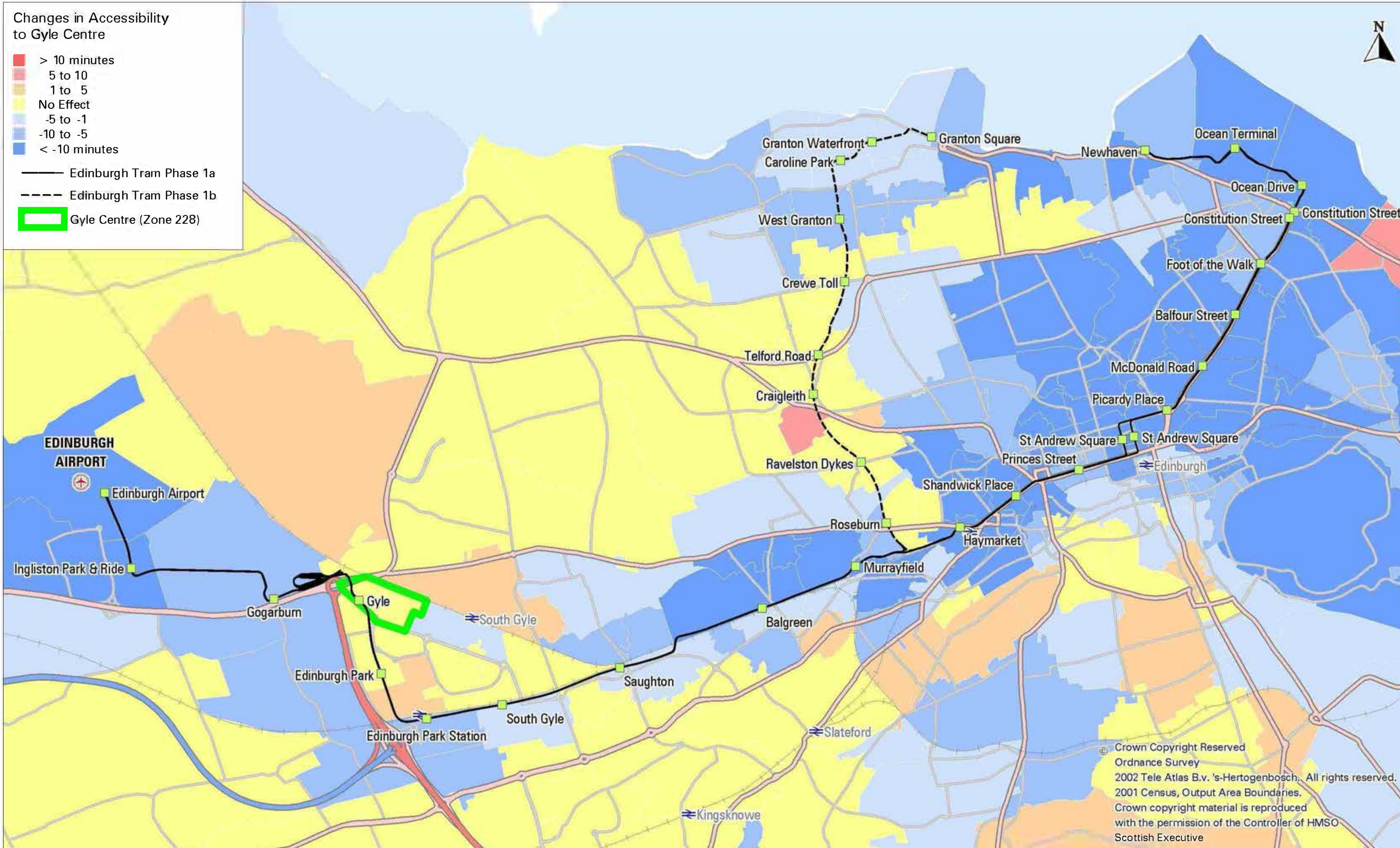

Edinburgh Tram STAG 2 Appraisal
Figure 9.38: Change in Accessibility to Gyle Centre (Phase 1a + 1b)

steer davies gleave

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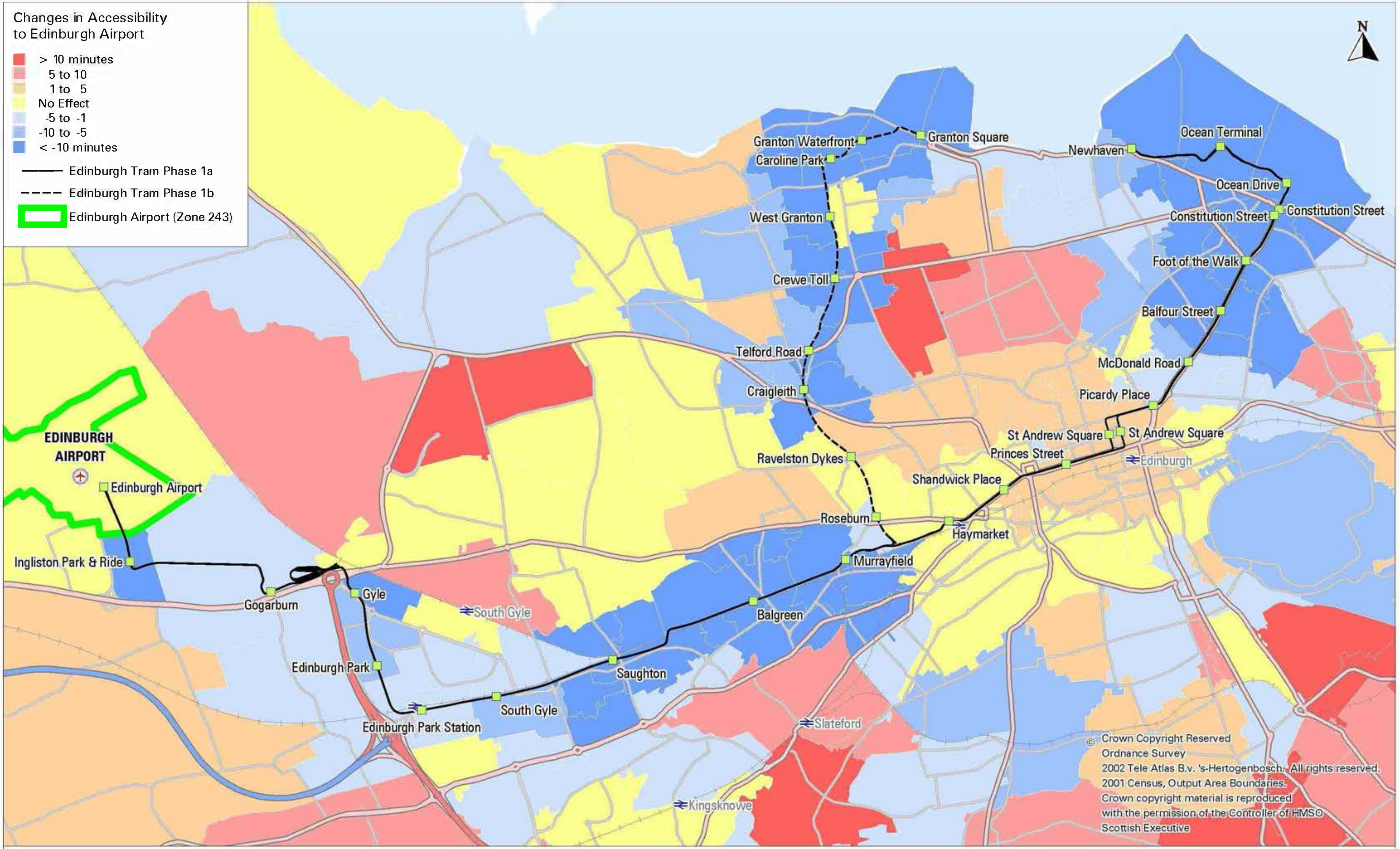

Edinburgh Tram STAG 2 Appraisal
Figure 9.39: Change in Accessibility to Edinburgh Airport (Phase 1a + 1b)

steer davies gleave

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TABLE 9.37 PHASE 1A ACCESSIBILITY IMPACTS BY POPULATION AND HOUSEHOLDS

Changes in travel time	Population	Households	Households No Car	Population	Households	Households No Car
		George St			**Haymarket**	
>10 min	235	104	42	6,483	2,945	1,143
5 to 10 min	16,853	7,645	2,917	5,057	2,572	1,491
1 to 5 min	11,090	4,923	1,245	34,153	16,148	5,917
No effect	697,444	303,969	105,655	507,522	216,220	68,450
-1 to -5 min	48,683	22,241	7,705	180,476	80,314	30,728
-5 to -10 Min	1,775	936	331	35,199	17,922	8,646
>-10 Min	2,269	863	443	9,458	4,560	1,964
Total disbenefit	*28,178*	*12,672*	*4,204*	*45,693*	*21,665*	*8,551*
Total benefit	*52,727*	*24,041*	*8,480*	*225,134*	*102,797*	*41,338*
		Foot of Leith Walk			**Crewe Toll**	
>10 min	21,465	9,071	3,456	-	-	-
5 to 10 min	41,967	19,082	7,607	29,151	12,010	3,280
1 to 5 min	202,332	90,158	31,571	47,542	19,868	6,292
No effect	226,370	101,608	39,197	435,251	190,625	64,604
-1 to -5 min	122,358	52,251	16,014	199,879	88,813	32,558
-5 to -10 Min	39,051	17,228	5,784	60,336	26,558	10,497
>-10 Min	124,806	51,284	14,710	6,189	2,808	1,108
Total disbenefit	*265,764*	*118,311*	*42,634*	*76,693*	*31,878*	*9,572*
Total benefit	*286,215*	*120,763*	*36,508*	*266,404*	*118,179*	*44,163*
		Ocean Terminal			**Granton**	
>10 min	42,528	17,071	4,568	13,332	5,949	2,909
5 to 10 min	21,967	9,495	3,299	102,214	42,857	12,047
1 to 5 min	119,678	52,623	17,737	216,135	92,960	30,034
No effect	214,140	93,372	33,339	262,877	119,239	45,820
-1 to -5 min	231,895	103,827	39,747	143,625	61,933	21,290
-5 to -10 Min	115,859	49,558	15,194	27,258	12,302	4,477
>-10 Min	32,284	14,737	4,455	12,907	5,443	1,762
Total disbenefit	*184,172*	*79,188*	*25,604*	*331,681*	*141,765*	*44,990*
Total benefit	*380,037*	*168,121*	*59,396*	*183,790*	*79,677*	*27,528*
		Napier University			**Sighthill Industrial Estate**	
>10 min	2,512	1,367	822	27	11	0
5 to 10 min	20,970	10,443	5,111	44	21	5
1 to 5 min	76,598	35,473	13,989	58,920	24,663	7,300
No effect	433,482	186,045	63,275	444,627	186,164	58,590

Changes in travel time	Population	Households	Households No Car	Population	Households	Households No Car
-1 to -5 min	164,744	72,248	24,081	106,514	47,806	16,914
-5 to -10 Min	50,840	22,378	7,025	42,783	20,482	9,206
>-10 Min	29,202	12,727	4,035	125,433	61,535	26,323
Total disbenefit	*100,081*	*47,283*	*19,922*	*58,992*	*24,695*	*7,305*
Total benefit	*244,786*	*107,354*	*35,142*	*274,730*	*129,823*	*52,443*
		Edinburgh Park			**Gyle Centre**	
>10 min	529	241	77	-	-	-
5 to 10 min	3,896	1,794	572	12,907	5,443	1,762
1 to 5 min	82,300	36,893	13,393	9,313	4,169	1,456
No effect	416,541	175,136	56,240	366,129	154,111	48,718
-1 to -5 min	171,716	76,663	26,106	137,621	58,609	20,842
-5 to -10 Min	61,128	29,515	13,014	87,185	40,260	16,460
>-10 Min	42,240	20,439	8,937	165,194	78,090	29,100
Total disbenefit	*86,724*	*38,929*	*14,042*	*22,220*	*9,612*	*3,218*
Total benefit	*275,084*	*126,618*	*48,057*	*390,000*	*176,959*	*66,403*
		Edinburgh Airport				
>10 min	99,479	41,643	12,834			
5 to 10 min	60,486	24,637	7,145			
1 to 5 min	95,856	43,655	15,727			
No effect	334,234	142,846	45,288			
-1 to -5 min	118,741	52,423	20,362			
-5 to -10 Min	27,866	12,944	5,068			
>-10 Min	41,686	22,535	11,916			
Total disbenefit	*255,821*	*109,935*	*35,705*			
Total benefit	*188,294*	*87,901*	*37,346*			
			Total impacts			
Population		Benefit	2,767,202			
		Disbenefit	1,456,017	1.90		
Households		Benefit	1,242,232			
		Disbenefit	635,934	1.95		
Households with no car		Benefit	456,802			
		Disbenefit	215,748	2.12		

TABLE 9.38 PHASE 1A+1B ACCESSIBILITY IMPACTS BY POPULATION AND HOUSEHOLDS

Changes in travel time	Population	Households	Households No Car	Population	Households	Households No Car
		George St			**Haymarket**	
>10 min	235	104	42	6,483	2,945	1,143
5 to 10 min	16,853	7,645	2,917	4,812	2,449	1,429
1 to 5 min	11,090	4,923	1,245	24,549	12,149	4,798
No effect	697,444	303,969	105,655	490,751	208,223	64,556
-1 to -5 min	48,683	22,241	7,705	179,417	80,012	30,584
-5 to -10 Min	1,775	936	331	34,147	17,553	8,301
>-10 Min	2,269	863	443	38,190	17,351	7,527
Total disbenefit	28,178	12,672	4,204	35,844	17,544	7,370
Total benefit	52,727	24,041	8,480	251,754	114,916	46,412
		Foot of Leith Walk			**Crewe Toll**	
>10 min	21,465	9,071	3,456	-	-	-
5 to 10 min	37,114	17,081	7,326	30,483	11,875	3,187
1 to 5 min	187,853	84,582	30,864	63,352	27,168	8,394
No effect	227,579	101,857	38,736	329,560	144,345	50,046
-1 to -5 min	124,829	53,319	16,770	171,135	74,857	26,557
-5 to -10 Min	41,640	17,854	5,366	92,774	41,823	15,354
>-10 Min	137,870	56,919	15,821	91,046	40,614	14,801
Total disbenefit	246,432	110,733	41,646	93,835	39,044	11,581
Total benefit	304,338	128,091	37,957	354,954	157,294	56,712
		Ocean Terminal			**Granton**	
>10 min	40,033	16,064	4,444	7,921	3,734	2,181
5 to 10 min	25,475	11,088	3,751	63,325	27,115	8,831
1 to 5 min	100,507	43,585	14,388	112,538	48,745	15,904
No effect	222,899	98,957	37,091	258,044	114,505	41,597
-1 to -5 min	235,620	104,391	38,770	125,456	56,165	21,730
-5 to -10 Min	117,728	50,361	15,327	72,574	31,612	10,042
>-10 Min	36,086	16,236	4,567	138,491	58,806	18,054
Total disbenefit	166,015	70,737	22,584	183,784	79,594	26,917
Total benefit	389,435	170,988	58,663	336,521	146,583	49,826
		Napier University			**Sighthill Industrial Estate**	
>10 min	2,512	1,367	822	27	11	0
5 to 10 min	17,266	8,621	3,836	44	21	5
1 to 5 min	77,196	35,749	14,228	61,652	25,840	7,747
No effect	432,663	185,678	63,243	443,733	185,843	58,610

Changes in travel time	Population	Households	Households No Car	Population	Households	Households No Car
-1 to -5 min	161,457	70,823	23,413	103,967	46,633	16,381
-5 to -10 Min	55,958	24,933	8,360	47,065	22,332	9,803
>-10 Min	31,296	13,511	4,436	121,859	60,001	25,791
Total disbenefit	96,974	45,737	18,887	61,724	25,872	7,753
Total benefit	248,711	109,267	36,209	272,891	128,967	51,976
		Edinburgh Park			**Gyle Centre**	
>10 min	529	241	77	-	-	-
5 to 10 min	3,896	1,794	572	13,673	5,817	1,837
1 to 5 min	82,734	37,045	13,356	40,834	17,518	5,680
No effect	415,450	174,697	56,238	330,452	138,499	43,855
-1 to -5 min	171,841	76,680	26,112	165,654	70,110	25,052
-5 to -10 Min	61,659	29,785	13,048	86,250	40,453	16,180
>-10 Min	42,240	20,439	8,937	141,485	68,284	25,734
Total disbenefit	87,158	39,080	14,005	54,507	23,335	7,517
Total benefit	275,740	126,905	48,096	393,390	178,848	66,966
		Edinburgh Airport				
>10 min	99,479	41,643	12,834			
5 to 10 min	58,153	23,569	6,588			
1 to 5 min	84,758	38,888	14,637			
No effect	338,578	144,568	45,340			
-1 to -5 min	110,216	48,548	17,516			
-5 to -10 Min	36,114	16,673	7,364			
>-10 Min	51,051	26,792	14,059			
Total disbenefit	242,389	104,100	34,059			
Total benefit	197,381	92,014	38,940			
			Total impacts			
Population		Benefit	3,077,843			
		Disbenefit	1,296,841	2.37		
Households		Benefit	1,377,914			
		Disbenefit	568,449	2.42		
Households with no car		Benefit	500,238			
		Disbenefit	196,523	2.55		

9.324 For Phase 1a, the key impacts are as follows:

- For George Street, the vast majority of population and households are unaffected, but there is a modest surplus of beneficiaries across the three segments (population, households and household without a car);
- For Haymarket, the surplus of beneficiaries is much larger , with some 180,000 net population benefiting from Edinburgh Tram;
- For the Foot of Leith Walk, the impacts are large, but broadly neutral overall, with equally large numbers benefiting and disbenefitting, although those benefiting have a high level of benefit;
- For Crewe Toll, Ocean Terminal, Napier University, Sighthill Industrial Estate, Edinburgh Park and Gyle Centre there are large net benefits across all the segments; and
- For Granton and Edinburgh Airport, there are overall disbenefits in accessibility across all three segments, although the no-car households have lower levels of disbenefit than population and all households.
- Overall, the impacts of Phase 1a is that around twice as many population and households benefit than disbenefit. The surplus is greatest for those households without a car where the ration is 2.12 to 1.

9.325 For Phase 1a+1b, the impacts are broadly consistent with Phase 1a only. The incremental changes can be summarised as follows:

- Haymarket experiences an increase in the balance of benefits, arising from the more direct access afforded to Haymarket and the West End from the railway corridor and Granton areas;
- The balance of benefits for Crewe Toll increases significantly;
- Granton changes from a net disbenefit under Phase 1a to a net benefit with the addition of Phase 1b. In general, around twice as many population and households benefit than disbenefit;
- Overall, the impacts of Phase 1a+1b is that the number of population and households benefiting is around 2½ times those who disbenefit. The excess is greatest for those households without a car where the ratio is 2.55.

9.326 Overall, the impact is considered slight beneficial for Phase 1a and moderate beneficial for Phase 1a+1b.

Cost to Government

9.327 This section sets out the net cost of Edinburgh Tram from the public sectors point of view and enables comparison with the transport economic efficiency presented earlier in this Chapter and the wider non-monetised benefits presented in the rest of the appraisal.

Phase 1a

9.328 The Cost to Government analysis is set out in Table 9.39.

TABLE 9.39 PHASE 1A COST TO GOVERNMENT

Cost to Public Sector				
	STAG Code	**Total**	**Public Transport**	**Road Users**
Local Government				
Public Sector Investment Costs	PV9	£0		
Public Sector Operating & Maintenance Costs	PV10	-£120,008	-£120,008	
Grant/ subsidy payments	PV11	£0		
(Developer Contribution)		£0		
Revenues	PV12	£219,817	£219,817	
Taxation impacts	PV13	£0		
Central Government				
Public Sector Investment Costs	PV9	£0		
Public Sector Operating & Maintenance Costs	PV10	£0		
Grant/ subsidy payments	PV11	-£389,880	-£389,880	
(Developer Contribution)		£0		
Revenues	PV12	£0		
Taxation impacts	PV13	-£49,486	-£30,733	-£18,753
Total PVC to Government		**£339,557**	costs appear as negative	

Monetised Summary		
Present Value of Transport Benefits (PV1-8)		
Accidents, PV1	-£11,897	
Transport Economic Efficiency	£385,456	
Total PVB (PV1-PV8)	£373,559	
Present Value of Cost to Government (PV9-13)	£339,557	
Net Present Value	£34,002	
Benefit-Cost to Government Ratio	1.10	

9.329 Total net revenues to TEL are £219m PV, which includes both new revenue to tram of £568m PV and a revenue loss to bus £349m PV. TEL net operating, maintenance and renewal costs are -£120m PV, with tram costing £428m PV partially offset by bus operating cost savings of £308m PV. This shows that the overall operational financial for TEL is positive, and that the trams revenues would also more than cover its operating costs.

9.330 The £390m grant / subsidy requirement is equivalent to the investment costs of the scheme. Whilst this is shown as coming entirely from Central Government, in practice some funding will come from both Local Government and some level of private sector contribution; the exact funding mix is being developed. The impact of the private sector contribution is not expected to be material to the Benefit-Cost to Government Ratio, although any impact will be positive in this case.

9.331 In addition to the this grant funding requirement from the Executive, an additional net £49m is incurred as a loss to the Treasury through loss in taxation revenues due to a combination of a net increase in public transport fares expenditure (which is not liable for VAT) and a net loss in fuel expenditure (with an associated loss in fuel duty).

Phase 1a+1b Cost to Government

9.332 The Cost to Government analysis is set out in Table 9.40.

TABLE 9.40 PHASE 1A + 1B COST TO GOVERNMENT

Cost to Public Sector

	STAG Code	Total	Public Transport	Road Users
Local Government				
Public Sector Investment Costs	PV9	£0		
Public Sector Operating & Maintenance Costs	PV10	-£154,291	-£154,291	
Grant/ subsidy payments	PV11	£0		
(Developer Contribution)		£0		
Revenues	PV12	£241,647	£241,647	
Taxation impacts	PV13	£0		
Central Government				
Public Sector Investment Costs	PV9	£0		
Public Sector Operating & Maintenance Costs	PV10	£0		
Grant/ subsidy payments	PV11	-£460,335	-£460,335	
(Developer Contribution)		£0		
Revenues	PV12	£0		
Taxation impacts	PV13	-£63,097	-£39,146	-£23,951
Total PVC to Government		**-£436,077**	costs appear as negative	

Monetised Summary		
Present Value of Transport Benefits (PV1-8)		
Accidents, PV1	-£5,225	
Transport Economic Efficiency	£714,222	
Total PVB (PV1-PV8)	£708,997	
Present Value of Cost to Government (PV9-13)	£436,077	
Net Present Value	£272,920	
Benefit-Cost to Government Ratio	1.63	

9.333 Total net revenues to TEL are £241m PV, which includes both new revenue to tram of £720m PV and a revenue loss to bus £479m PV. TEL net operating, maintenance and renewal costs are -£154m PV, with tram costing £480m PV partially offset by bus operating cost savings of £326m PV. This shows that the overall operational financial for TEL is positive, and that the trams revenues would also more than cover its operating costs.

9.334 The £460m grant/ subsidy requirement is equivalent to investment costs of the scheme. In addition to the grant funding requirement from the Executive, an additional net £63m is incurred as a loss to the Treasury.

Economic Appraisal Summary

9.335 Table 9.41 summarises the key results of the economic appraisal for both Scheme 1a only and Scheme 1a + 1b.

TABLE 9.41 SUMMARY ECONOMIC APPRAISAL RESULTS OVER 60 YEARS

	Scheme 1a only - Economic impacts (£m PV, 2002 prices)	Scheme 1a + 1b - Economic impacts (£m PV, 2002 prices)
User Benefits (consumer)	301	529
User benefits (business)	129	200
Private sector provider impacts	-44	-15
Present Value of Scheme Benefits	385	714
Accident benefits	-12	-5
Present Value of Scheme Benefits incl. Accidents	374	709
Present Value of Scheme Costs	340	436
Net Present Value	34	273
Benefit : Cost Ratio	1.10	1.63

9.336 The economic case for Edinburgh Tram demonstrates that both the 1a and 1a + 1b options provides positive NPVs and therefore would provide overall value for money.

9.337 The 1a scheme would deliver a net present value of £34m and a BCR of 1.10 : 1, representing value for money in economic terms. The 1a + 1b scheme would therefore deliver a net present value of £273m and a BCR of 1.63 : 1, representing good value for money in economic terms.

9.338 The 1a scheme would deliver 56% of the 1a + 1b scheme benefits, but would incur costs equivalent to 78% of the 1a + 1b scheme.

9.339 A comparison of the 1a appraisal with that of 1a + 1b enables the incremental benefit of the 1b scheme component to be identified. The incremental case for 1b is very strong, with 1b delivering an additional 90% of scheme benefits (£335m) over 1a but at an incremental cost £97m PV, a 28% addition. The incremental NPV of the 1b scheme is £239m with a BCR of 3.48 : 1.

9.340 This sensitivity therefore demonstrates that the 1a scheme would deliver an inferior, but still positive, economic return than the Central Case, but that the case for the 1b scheme is very strong and helps underpin the robustness of the scheme as a whole.

STAG2 Appraisal Summary Tables

9.341 Table 9.42 and Table 9.43 provide a STAG Part 2 appraisal summary of Edinburgh Tram Phase 1a and Phase 1a+1b respectively.

TABLE 9.42 EDINBURGH TRAM PHASE 1A STAG PART 2 APPRAISAL

<table>
<tr><td colspan="4">Proposal Details</td></tr>
<tr><td colspan="2">Name and address of authority or organisation promoting the proposal</td><td colspan="2">tie (City of Edinburgh Council)</td></tr>
<tr><td>Proposal Name:</td><td>Edinburgh Tram</td><td>Name of Planner:</td><td></td></tr>
<tr><td>Proposal Description:</td><td>Introduction of a tram route serving the Leith development area, the two main railway stations, the city centre, Edinburgh Park and Edinburgh Airport</td><td>Total Public Sector Funding Requirement:</td><td>Capital costs/grant (undiscounted) £495m (2006 prices)
Annual revenue support: £0
PVC to Govt.: £340m</td></tr>
<tr><td>Funding Sought From:</td><td>Transport Scotland</td><td>Amount of Application:</td><td></td></tr>
<tr><td colspan="4">Background Information</td></tr>
<tr><td>Geographic Context:</td><td colspan="3">The proposal will directly serve the corridor from Leith via the City Centre to Edinburgh Airport, including the communities of Newhaven, Leith, Pilrig, Dalry, Saughton, Broomhouse and Edinburgh Park. The route will serve a mixture of commercial, residential and airport related land uses, and the major regeneration areas within Leith. The route will be largely segregated and, through careful design, minimise interaction with the built environment.</td></tr>
<tr><td>Social Context:</td><td colspan="3">There are a number of (former) Social Inclusion Partnerships along the tram corridor, including geographical-focused initiatives operating in Broomhouse as well as thematic initiatives operating in Sighthill and Stenhouse. The 2004 based Indices of Deprivation indicate that some deprived wards lie within or adjoining the tram route. Car ownership along much of the route is less than 50% of households.</td></tr>
<tr><td>Economic Context:</td><td colspan="3">The economic performance of the tram corridor is influenced by the economic dynamics of the City of Edinburgh and its wider conurbation, and in particular Central and West Edinburgh. Edinburgh is the seat of administrative power for Scotland with the presence of the Scottish Parliament. The City and its city-region is also at the heart of the country's financial, business, legal, medical/healthcare and insurance markets, and therefore remains very strong in these key industries and sectors. The scheme will serve the commercial core of the city-centre, the major growth area at Edinburgh Park, Gyle Shopping Centre, the RBoS HQ and Edinburgh airport, and the major regeneration areas at Leith.</td></tr>
<tr><td colspan="4">Planning objectives:</td></tr>
<tr><td colspan="2">Objective:</td><td colspan="2">Performance against planning objective</td></tr>
<tr><td colspan="2">To support the local economy by improving accessibility:
• Improved access to the public transport network; and
• Improved access to employment opportunities.
To promote sustainability and reduce environmental damage caused by traffic:
• Increasing proportion of journeys made by public transport, cycling and walking; and
• Reducing local and global emissions.
To reduce traffic congestion:
• Reducing number of trips by car; and
• Reducing traffic volume on key routes.
To make the transport system safer and more secure:
• Reducing traffic accidents.
To promote social benefits:
• Improving liveability of streets, maximising their role</td><td colspan="2">Edinburgh Tram will improve accessibility to employment opportunities, education, shopping and leisure destinations, contributing to improve the local economy. In particular, the tram will serve the regeneration area of Leith and Western Harbour.
The scheme will contribute to sustainable travel (zero emissions produced at source by the tram, reduced noise and urban realm improvements) and provide enhanced opportunity for transfer from car to public transport.
The tram system will provide a safe and secure means for travel
The tram will provide social benefits in terms of enhanced liveability on streets and accessibility to mobility impaired and deprived segments of the population.</td></tr>
</table>

as the focal point of local communities; and • Reducing social exclusion, by improving the ability of people with low incomes, no access to car, the elderly or those with mobility impairments to use the transport system.			
Rationale for Selection or Rejection of Proposal:	Lines 1 and 2 were developed within the STAG framework and demonstrated the best fit with planning objectives and the overarching five governmental objectives relating to Environment, Safety, Economy, Integration and Accessibility. The current proposal, comprising elements of Lines 1 and 2, reflects current affordability constraints and the need to maximise the benefits from Edinburgh Tram within this constraint.		
Implementability Appraisal			
Technical:	The proposed alignment is technically feasible, employing tried and tested tram technology. Urban design issues are acceptable and the tram system is integrated with the local bus network.		
Operational:	Run times are minimised through good alignment design and integration with the highway network.		
Financial:	Capital funding is sought from Transport Scotland with a contribution from City of Edinburgh Council, On-going operating cost to be covered by farebox revenue.		
Public:	Extensive consultation took place in 2003, with high levels of support shown for tram in Edinburgh. Legal powers to construct the tram have been obtained through the Parliamentary Private Bill process, which weighed the overall merits of the scheme with specific objections. Mitigation strategies and policies have been developed to minimise the adverse impacts and hence acceptability of the tram.		
Environment			
Mitigation Options included: (Costs & Benefits)	Various documents have been developed (the Design Manual, Code of Construction Practice and the Noise and Vibration Policy) which set out how any potential adverse impacts of the tram will be mitigated.		
Sub-objective	Qualitative Information	Quantitative Information	Significance of Impact
Noise and vibration	Construction noise is not considered to be a significant impact, since it will be temporary and mitigated. Less people are annoyed by road noise with than without the scheme. More people experience a significant reduction in road noise than a significant increase. Major detrimental where there is currently no other source of noise.	63 people are less annoyed by noise with than without the scheme in 2011 (0.2%), raising to 134 in 2031 (0.3%). 306 more people benefited from a significant reduction in road noise in 2011 than disbenefited (2523 in 2031). 875 people directly exposed to rail noise, of which 114 are annoyed.	Slight beneficial (road traffic noise) Moderate adverse (rail traffic noise)
Air Quality – Overall	The impact is broadly neutral, with comparable numbers of residents experiencing improvements and worsening in air quality.		Neutral
CO_2 – Global	Additional emissions due to additional vehicle-km.	Additional 88,616 tonnes/year in 2011 and 162,291 in 2031.	Neutral

PM_{10} – Local		People affected in 2011: Improvement: 110,127. No change: 174,237. Worsening: 100,322. People affected in 2031: Improvement: 83,748. No change: 217,968. Worsening: 82,970. Only 4 people were brought out of compliance with air quality objectives in 2031	Neutral
NO_2 – Local		People affected in 2011: Improvement: 118,747. No change: 184,839. Worsening: 125,664. People affected in 2031: Improvement: 88,700. No change: 252,837. Worsening: 87,713. 1712 people were brought into compliance with air quality objectives in 2011 (in contrast to 73 out of compliance), while in 2031 the figures raised to 1800 (into compliance) and 1164 (out of compliance).	Neutral
Water Quality, Drainage and Flood Defence	Water Quality may be affected by run-off from construction sites, and during the operation of the route. Where overbridging or culverting is required at the Water of Leith and Gogar Burn plus minor tributaries, there may also be water quality impacts. Groundwater may be affected by penetration of contaminated run-off to aquifers. Comprehensive mitigation programmes render impact on areas at risk of flooding neutral.	Water courses likely to be affected & quality (SEPA classification); Gogar Burn (fair to poor) Water of Leith (good to fair)	Water Quality: Minor negative Groundwater: Neutral Flood Defence: Neutral
Geology	No impacts on designated geological sites. Mineral reserves will not be affected. Waste management issues relating to disposal of potentially contaminated waste during construction and operation may occur.	Designated Geological Sites: SSSIs: Calton Hill (13ha) Castle Rock (Edinburgh Castle) RIGs: No RIGs	Geological Sites: Neutral Mineral Reserves: Neutral Waste Management: Minor negative
Biodiversity	Several areas of habitat will be lost including		Slight adverse

	sections of the wildlife corridor adjacent to the main Glasgow/Edinburgh railway line. The Gogar Burn Site of Interest for Nature Conservation (SINC) and Water of Leith Urban Wildlife Site (UWS) will be affected by the construction of bridges. Badgers at Gogar area in particular will be affected during construction and operation.		
Visual Amenity	Varying range of visual impacts all along the route. The World Heritage Site would be directly impacted by the proposals, as well as wider landscapes including sections of the open Greenbelt landscape. Design of tram system will need to fit to scene. Positive impacts would occur over localised areas due to the proposed mitigation by associated planting.	World Heritage Site and Conservation Areas	Minor adverse. (However, major negative impacts would occur for views from No. 4 Ingliston Rd, Princes St and St Andrew Sq.)
Agriculture and Soils	Agriculture - There would be a Minor Negative impact for individual farming plots, because the area of land take is small in terms of the scale of the farming operations. Contaminated Land - Areas of contaminated land may be disturbed by the construction of the tram.	Agriculture :The extent of agricultural land take will be quantified in the Book of Reference as part of the parliamentary bill submission. Contaminated land (2 sites possibly affected): Disused railway land around Baird Drive and Haymarket, Former landfill believed to have been used for demolition material close to Gogar Burn & Castle Gogar	Agriculture: Neutral to Moderate Negative Contaminated Land: Minor to Negative Soils: Neutral
Cultural Heritage	The tram will pass through the World Heritage Site of the City Centre. Additionally, to make way for the tram, three sites have been identified to be demolished or relocated, including two Listed Buildings.	World Heritage Site: Edinburgh City Centre Listed Buildings to be demolished: The Caledonian Alehouse The Heart of Midlothian War Memorial (at Haymarket)	Moderate negative
Landscape	The World Heritage Site would be directly impacted by the proposals. The proposals would also	World Heritage Site and Conservation Areas	Major Negative (However minor negative for the occasional localised

	impact on the character of sensitive townscape areas and wider landscapes including sections of the open Greenbelt landscape. Some positive impacts would occur over localised areas due to the proposed mitigation by associated planting.		character areas)
Safety			
Sub-objective	**Item**	**Qualitative Information**	**Quantitative Information**
Accidents	Change in Annual Personal Injury Accidents	Standard rates and methodology from NESA	Change in annual accidents: +75.3 in 2011 and +75.4 in 2031
	Change in Balance of Severity	Split by damage only, slight, serious and fatal	Annual changes (2011): damage only 70.1, slight 4.6, serious 0.5, fatal 0.1
	Total Discounted Savings		-£11.9m (PV)
Security		CCTV system at all stops and on vehicles. Positive design and access integrated with urban form. High use of inspectors on vehicles. Lighting and help points at all stops.	Moderate beneficial
Economy (Transport Economic Efficiency)			
Sub-objective	**Item**	**Qualitative Information**	**Quantitative Information (£000's)**
User Benefits	Travel Time	Significant public transport journey time savings: Leith Docks – Haymarket 10+ minutes, tram corridor west of Haymarket to Leith Docks improved by 10+ minutes, access time to Edinburgh Park/Gyle improved by 10+ minutes for much of eastern Edinburgh	£403,135 (PV)
	User Charges		£0
	Vehicle Operating Costs		£26,435 (PV)
	Quality / Reliability Benefits	The higher quality afforded by Edinburgh Tram compared to the alternative public transport modes has been encapsulated in the demand modelling and appraisal through the use of differential in-vehicle time factors.	Included in travel time benefits

Private Sector Operator Impacts	Investment Costs	Scheme capital cost	-£389,880 (PV)
	Operating & Maintenance Costs		£0
	Revenues	Change in revenue to rail operators and non-TEL bus operations	-£44,115 (PV)
	Grant / Subsidy payments	Grant for capital costs	£389,880 (PV)
Economy (Economic Activity and Location Impacts)			
Sub-objective	**Item**	**Qualitative Information**	**Quantitative Information**
Economic Activity and Location Impacts	Local Economic Impacts	The commercial and residential property markets will benefit from the tram, leading to additional employment in the retail, office, commercial and leisure sectors. North Edinburgh (Western Harbour - Newhaven and Leith Docks) will benefit as will Edinburgh Gate, Newbridge North and Ratho Park. Small additional employment due to cost savings (eg taxi/parking costs): central/north Edinburgh.	1,450 local additional jobs (present value) assuming that displacement takes place outside of Edinburgh TTWA.
	National Economic Impacts	A proportion of the local employment generated will be retained at the national level. Potential for further national impacts through additional labour supply, people moving to more productive jobs and agglomeration effects (not quantified).	640 additional jobs (present value) at the Scotland level, allowing for displacement .
	Distributional Impacts		
Integration			
Sub-objective	**Item**	**Qualitative Information**	**Quantitative Information**
Transport Interchanges	Services & Ticketing	Phase 1A will enhance the opportunity for through ticketing/joint ticketing arrangements.	Slight beneficial
	Infrastructure & Information	Scheme will enhance existing transport interchange facilities and also provide new transport interchange opportunities. Information provision at the interchange facilities will be of the highest quality and	Moderate beneficial

		will include real time information provision.	
Land-use Transport Integration		Scheme integrates well with national, regional, and local land-use policy and development proposals.	Moderate beneficial
Policy Integration		The scheme is consistent with national policies beyond transport.	Slight beneficial
Accessibility &Social Inclusion			
Sub-objective	**Item**	**Qualitative Information**	**Quantitative Information**
Community Accessibility	Public Transport Network Coverage	Accessibility is significantly improved for travel from most zones to all the selected destinations, with the exception of travel from the south-west of Edinburgh to Leith.	
	Access to Other Local Services	The tram provides increased opportunities for walking and cycling as access modes, but it has limitations to promote further non-motorised trips to access local services.	
Comparative Accessibility	Distribution / Spatial Impacts by Social Group	Significant accessibility benefits can be realised across all population groups.	In general, around twice as many benefit from the scheme as disbenefit, with the ratio being highest for non-car owning households.
	Distribution / Spatial Impacts by Area	For George Street, mostly neutral impact but there is a modest surplus of beneficiaries across the three segments For Haymarket, 180,000 net population benefiting from Edinburgh Tram For the Foot of Leith Walk, the impacts are large, but broadly neutral overall, with equally large numbers benefiting and disbenefitting For Crewe Toll, Ocean Terminal, Napier University, Sighthill Industrial Estate, Edinburgh Park and Gyle Centre there are large net benefits across all the segments For Granton and Edinburgh	No. of households without a car that benefit (disbenefit) George St: 8,480 (4,204) Haymarket: 41,338 (8,551) Foot of Leith Walk: 36,508 (42,634) Crewe Toll: 44,163 (9,572) Ocean Terminal: 59,396 (25,604) Granton: 27,528 (44,990) Napier University: 35,142 (19,922) Sighthill Industrial Estate: 52,443 (7,305) Edinburgh Park: 48,057 (14,042) Gyle Centre: 66,403

		Airport, there are overall disbenefits in accessibility	(3,218) Edinburgh Airport: 37,346 (35,705)
Strategic Environmental Assessment (SEA)			
Summary of SEA outcome where appropriate	Not applicable		
Cost to Public Sector			
Item	**Qualitative information**		**Quantitative Information (£000's)**
Public Sector Investment Costs			£0
Public Sector Operating & Maintenance Costs	Net change in TEL operating and maintenance costs		-£120,008 (PV)
Grant / Subsidy Payments	Grant to the private sector to cover the capital cost		-£389,880 (PV)
Revenues	Revenue to TEL for tram and bus operations		£219,817 (PV)
Taxation Impacts	Reduction in tax receipts arising from		-£49,486 (PV)
Monetised Summary			
Present Values of Transport Benefits			£373,559
Present Value of Cost to Government			£339,557
Net Present Value			£34,002
Benefit-Cost to Government Ratio			1.10

TABLE 9.43 EDINBURGH TRAM PHASE 1A+1B STAG PART 2 APPRAISAL

Proposal Details			
Name and address of authority or organisation promoting the proposal		**tie** (City of Edinburgh Council)	
Proposal Name:	Edinburgh Tram	Name of Planner:	
Proposal Description:	Introduction of a tram route serving the Leith development area, the two main railway stations, the city centre, Edinburgh Park and Edinburgh Airport	Total Public Sector Funding Requirement:	Capital costs/grant (undiscounted): £580m Annual revenue support: £0 PVC to Govt.: £436
Funding Sought From:	Transport Scotland	Amount of Application:	
Background Information			
Geographic Context:	The proposal will directly serve the corridor from Leith via the City Centre to Edinburgh Airport, including the communities of Newhaven, Leith, Pilrig, Dalry, Saughton, Broomhouse and Edinburgh Park. It will also serve the Roseburn corridor and Granton. The route will serve a mixture of commercial, residential and airport related land uses, and the major regeneration and development areas within Leith and Granton. The route will be largely segregated and, through careful design, minimise interaction with the built environment.		
Social Context:	There are a number of (former) Social Inclusion Partnerships along the tram corridor, including geographical-focused initiatives operating in North Edinburgh and Broomhouse as well as thematic initiatives operating in Sighthill and Stenhouse. The 2004 based Indices of Deprivation indicate that some deprived wards lie within or adjoining the tram route. Car ownership along much of the route is less than 50% of households.		
Economic Context:	The economic performance of the tram corridor is influenced by the economic dynamics of the City of Edinburgh and its wider conurbation, and in particular Central and West Edinburgh. Edinburgh is the seat of administrative power for Scotland with the presence of the Scottish Parliament. The City and its city-region is also at the heart of the country's financial, business, legal, medical/healthcare and insurance markets, and therefore remains very strong in these key industries and sectors. The scheme will serve the commercial core of the city-centre, the major growth area at Edinburgh Park, Gyle Shopping Centre, the RBoS HQ and Edinburgh airport, and the major regeneration and development areas at Leith and Granton.		
Planning objectives:			
Objective:		Performance against planning objective	
To support the local economy by improving accessibility: • Improved access to the public transport network; and • Improved access to employment opportunities. To promote sustainability and reduce environmental damage caused by traffic: • Increasing proportion of journeys made by public transport, cycling and walking; and • Reducing local and global emissions. To reduce traffic congestion: • Reducing number of trips by car; and • Reducing traffic volume on key routes. To make the transport system safer and more secure: • Reducing traffic accidents.		Edinburgh Tram will improve accessibility to employment opportunities, education, shopping and leisure destinations, contributing to improve the local economy. In particular, the tram will serve the regeneration area of Granton, Leith and Western Harbour. The scheme will contribute to sustainable travel (zero emissions produced at source by the tram, reduced noise and urban realm improvements) and provide enhanced opportunity for transfer from car to public transport. The tram system will provide a safe and secure means for travel The tram will provide social benefits in terms of enhanced liveability on streets and accessibility to mobility impaired and deprived segments of the	

To promote social benefits: • Improving liveability of streets, maximising their role as the focal point of local communities; and • Reducing social exclusion, by improving the ability of people with low incomes, no access to car, the elderly or those with mobility impairments to use the transport system.		population.	
Rationale for Selection or Rejection of Proposal:	Lines 1 and 2 were developed within the STAG framework and demonstrated the best fit with planning objectives and the overarching five governmental objectives relating to Environment, Safety, Economy, Integration and Accessibility. The current proposal, comprising elements of Lines 1 and 2, reflects current affordability constraints and the need to maximise the benefits from Edinburgh Tram within this constraint.		
Implementability Appraisal			
Technical:	The proposed alignment is technically feasible, employing tried and tested tram technology. Urban design issues are acceptable and the tram system is integrated with the local bus network.		
Operational:	Run times are minimised through good alignment design and integration with the highway network.		
Financial:	Capital funding is sought from Transport Scotland with a contribution from City of Edinburgh Council. On-going operating cost to be covered by farebox revenue.		
Public:	Extensive consultation took place in 2003, with high levels of support shown for tram in Edinburgh. Legal powers to construct the tram have been obtained through the Parliamentary Private Bill process, which weighed the overall merits of the scheme with specific objections. Mitigation strategies and policies have been developed to minimise the adverse impacts and hence acceptability of the tram.		
Environment			
Mitigation Options included: (Costs & Benefits)	Various documents have been developed (the Design Manual, Code of Construction Practice and the Noise and Vibration Policy) which set out how any potential adverse impacts of the tram will be mitigated.		
Sub-objective	Qualitative Information	Quantitative Information	Significance of Impact
Noise and vibration	Construction noise is not considered to be a significant impact, since it will be temporary and mitigated. Less people are annoyed by road noise with than without the scheme. More people experience a significant reduction in road noise than a significant increase. Major detrimental where there is currently no other source of noise, such as the Roseburn corridor.	448 people are less annoyed by noise with than without the scheme in 2011 (1.2%), raising to 738 in 2031 (1.8%). 459 more people benefited from a significant reduction in road noise in 2011 than disbenefited (3392 in 2031). 1198 people directly exposed to rail noise, of which 156 are annoyed.	Slight beneficial (road traffic noise) Moderate adverse (rail traffic noise)
Air Quality – Overall	Higher numbers of residents experiencing improvements than worsening in air quality.		Slight beneficial
CO_2 – Global	Additional emissions due to additional vehicle-km.	Additional 98,310 tonnes/year in 2011 and	Neutral

		177,467 in 2031.	
PM_{10} – Local		People affected in 2011: Improvement: 126,455. No change: 164723. Worsening: 93,508. People affected in 2031: Improvement: 108,437. No change: 212,627. Worsening: 63,622. Only 4 people were brought out of compliance with air quality objectives in 2031	Slight beneficial
NO_2 – Local		People affected in 2011: Improvement: 141,358. No change: 175,030. Worsening: 112,862. People affected in 2031: Improvement: 120,708. No change: 243,409. Worsening: 65,133. 2316 people were brought into compliance with air quality objectives in 2011 (in contrast to 73 out of compliance), while in 2031 the figures raised to 3033 (into compliance) and 205 (out of compliance).	Slight beneficial
Water Quality, Drainage and Flood Defence	Water Quality may be affected by run-off from construction sites, and during the operation of the route. Where overbridging or culverting is required at the Water of Leith and Gogar Burn plus minor tributaries, there may also be water quality impacts. Groundwater may be affected by penetration of contaminated run-off to aquifers. Comprehensive mitigation programmes render impact on areas at risk of flooding neutral.	Water courses likely to be affected & quality (SEPA classification); Gogar Burn (fair to poor) Water of Leith (good to poor)	Water Quality: Minor negative Groundwater: Neutral Flood Defence: Neutral
Geology	No impacts on designated geological sites. Mineral reserves will not be affected. Waste management issues relating to disposal of potentially contaminated waste during construction and operation may occur.	Designated Geological Sites: SSSIs: Calton Hill (13ha) Castle Rock (Edinburgh Castle) RIGs: Craigleith Quarry	Geological Sites: Neutral Mineral Reserves: Neutral Waste Management: Minor negative

Biodiversity	Several areas of habitat will be lost including sections of the wildlife corridor adjacent to the main Glasgow/Edinburgh railway line. Roseburn Railway Corridor, which contains significant woodland & grassland habitats, will suffer significant impacts. Protected badger species will also be affected at this site and at Gogar Burn.	Affected sites: Gogar Burn Site of Interest for Nature Conservation (SINC) Water of Leith Urban Wildlife Site (UWS) Roseburn Railway Urban Wildlife Corridor Protected species potentially affected: Badgers, pipistrelle bats.	Moderate adverse
Visual Amenity	Varying range of visual impacts all along the route. The World Heritage Site would be directly impacted by the proposals, as well as wider landscapes including sections of the open Greenbelt landscape. Design of tram system will need to fit to scene. Views into railway corridor from surrounding houses substantially opened up. Positive impacts would occur over localised areas due to the proposed mitigation by associated planting.	World Heritage Site and Conservation Areas (i.e. Coltbridge and Wester Coates Conservation Area - part)	Minor adverse. (Major negative impacts would occur for views from No. 4 Ingliston Rd, Princes St and St Andrew Square. Also along the railway corridor at Roseburn, although mitigation is planned.)
Agriculture and Soils	Agriculture - There would be a Minor Negative impact for individual farming plots, because the area of land take is small in terms of the scale of the farming operations. However, land segregation would result from Tram Line 2 alignment and this is a Moderate Negative impact because of the combined effect of Class 2 Agricultural land take. Contaminated Land - Areas of contaminated land may be disturbed by the construction of the tram.	Agriculture :The extent of agricultural land take will be quantified in the Book of Reference as part of the parliamentary bill submission. Contaminated land (2 sites possibly affected): Disused railway land around Roseburn, Baird Drive and Haymarket, Former landfill believed to have been used for demolition material close to Gogar Burn & Castle Gogar	Agriculture: Neutral to Moderate Negative Contaminated Land: Minor to Negative Soils: Neutral
Cultural Heritage	The tram will pass through the World Heritage Site of the City Centre. Additionally, to make way for the tram, three sites have been identified to be demolished or relocated, including two Listed	World Heritage Site: Edinburgh City Centre Listed Buildings to be demolished: The Caledonian Alehouse The Heart of Midlothian War Memorial (at	Moderate Negative

	Buildings.	Haymarket)	
Landscape	The World Heritage Site would be directly impacted by the proposals. The proposals would also impact on the character of sensitive townscape areas and wider landscapes including sections of the open Greenbelt landscape. Significant vegetation removal along the railway corridor. Some positive impacts would occur over localised areas due to the proposed mitigation by associated planting.	World Heritage Site and Conservation Areas (Coltbridge and Wester Coates Conservation Area – part.) Caroline Park – designated Landscape	Major Negative (However minor negative for the occasional localised character areas)
Safety			
Sub-objective	**Item**	**Qualitative Information**	**Quantitative Information**
Accidents	Change in Annual Personal Injury Accidents	Standard rates and methodology from NESA	Change in annual accidents: +58.2 in 2011 and +21.3 in 2031
	Change in Balance of Severity	Split by damage only, slight, serious and fatal	Annual changes (2011): damage only 54.1, slight 3.6, serious 0.4, fatal 0.0
	Total Discounted Savings		-£5.2m (PV)
Security		CCTV system at all stops and on vehicles. Positive design and access integrated with urban form. High use of inspectors on vehicles. Lighting and help points at all stops.	Moderate beneficial
Economy (Transport Economic Efficiency)			
Sub-objective	**Item**	**Qualitative Information**	**Quantitative Information**
User Benefits	Travel Time	Significant public transport journey time savings: Leith Docks and Granton to Haymarket 10+ minutes, tram corridor west of Haymarket to Leith Docks improved by 10+ minutes, access time to Edinburgh Park/Gyle improved by 10+ minutes for much of eastern Edinburgh	£695,266 (PV)
	User Charges		£0
	Vehicle Operating Costs		£33,691 (PV)
	Quality / Reliability Benefits	The higher quality afforded	Included in travel time

		by Edinburgh Tram compared to the alternative public transport modes has been encapsulated in the demand modelling and appraisal through the use of differential in-vehicle time factors.	benefits
Private Sector Operator Impacts	Investment Costs	Scheme capital cost	£460,335 (PV)
	Operating & Maintenance Costs		£0
	Revenues	Change in revenue to rail operators and non-TEL bus operations	-£14,735 (PV)
	Grant / Subsidy payments	Grant for capital costs	£460,335 (PV)
Economy (Economic Activity and Location Impacts)			
Sub-objective	**Item**	**Qualitative Information**	**Quantitative Information**
Economic Activity and Location Impacts	Local Economic Impacts	The commercial and residential property markets will benefit from the tram, leading to additional employment in the retail, office, commercial and leisure sectors. North Edinburgh (Granton Waterfront, Western Harbour - Newhaven and Leith Docks) will benefit as will Edinburgh Gate, Newbridge North and Ratho Park. Small additional employment due to cost savings (eg taxi/parking costs): central/north Edinburgh.	3,200 local additional jobs (present value) assuming that displacement takes place outside of Edinburgh TTWA.
	National Economic Impacts	A proportion of the local employment generated will be retained at the national level. Potential for further national impacts through additional labour supply, people moving to more productive jobs and agglomeration effects (not quantified).	980 additional jobs (present value) at the Scotland level, allowing for displacement.
	Distributional Impacts	North Edinburgh regeneration area residents would have access to a broader range of jobs. Some would move from unemployment to employment; some who are already in employment may find a better job	Better access to 27,000 additional jobs for North Edinburgh regeneration area residents.

		because of the tram (A GVA impact rather than an employment one); and, others who are not employed and not in receipt of JSA, but who are enabled to enter the workforce because of better accessibility.	
Integration			
Sub-objective	**Item**	**Qualitative Information**	**Quantitative Information**
Transport Interchanges	Services & Ticketing	Scheme will enhance the opportunity for through ticketing/joint ticketing arrangements.	Slight beneficial
	Infrastructure & Information	Scheme will enhance existing transport interchange facilities and also provide new transport interchange opportunities – Phase 1b will enhance interchange opportunities at Crewe Toll (particularly with regards access to the Western General Hospital). Information provision at the interchange facilities will be of the highest quality and will include real time information provision.	Moderate beneficial
Land-use Transport Integration		Scheme integrates well with national, regional, and local land-use policy and development proposals. In particular Phase 1B will help enhance the integration of the development in the Granton area.	Large beneficial
Policy Integration		Scheme is consistent with national policies beyond transport.	Slight beneficial
Accessibility &Social Inclusion			
Sub-objective	**Item**	**Qualitative Information**	**Quantitative Information**
Community Accessibility	Public Transport Network Coverage	Accessibility is significantly improved for travel from most zones to all the selected destinations, with the exception of travel from the south-west of Edinburgh to Leith.	
	Access to Other Local Services	The tram provides increased opportunities for	

		walking and cycling as access modes, but it has limitations to promote further non-motorised trips to access local services.	
Comparative Accessibility	Distribution / Spatial Impacts by Social Group		
	Distribution / Spatial Impacts by Area	For George Street, mostly neutral impact but there is a modest surplus of beneficiaries across the three segments For Haymarket, 216,000 net population benefiting from Edinburgh Tram For the Foot of Leith Walk, the impacts are large, but broadly neutral overall, with equally large numbers benefiting and disbenefitting For Crewe Toll, Granton, Ocean Terminal, Napier University, Sighthill Industrial Estate, Edinburgh Park and Gyle Centre there are large net benefits across all the segments For Edinburgh Airport, there are marginal disbenefits in accessibility, although no-car households have a small benefit.	No. of households without a car that benefit (disbenefit) George St: 8,480 (4,204) Haymarket: 46,412 (7,370) Foot of Leith Walk: 37,957 (41,646) Crewe Toll: 56,712 (11,581) Ocean Terminal: 58,663 (22,584) Granton: 49,826 (26,917) Napier University: 36,209 (18,887) Sighthill Industrial Estate: 51,976 (7,753) Edinburgh Park: 48,096 (14,005) Gyle Centre: 66,966 (7,517) Edinburgh Airport: 38,940 (34,059)
Strategic Environmental Assessment (SEA)			
Summary of SEA outcome where appropriate	Not applicable		
Cost to Public Sector			
Item	**Qualitative information**		**Quantitative Information**
Public Sector Investment Costs			£0
Public Sector Operating & Maintenance Costs	Net change in TEL operating and maintenance costs		-£154,291 (PV)
Grant / Subsidy Payments	Grant to the private sector to cover the capital cost		-£460,335 (PV)
Revenues	Revenue to TEL for tram and bus operations		£241,647 (PV)
Taxation Impacts	Reduction in tax receipts arising from		-£63,097 (PV)
Monetised Summary			
Present Values of Transport Benefits			£708,997
Present Value of Cost to			£436,077

Government	
Net Present Value	£272,920
Benefit-Cost to Government Ratio	1.63

10. RISK AND UNCERTAINTY

In scheme development and appraisal, there is always likely to be some difference between what is expected and what eventually happens, due to the inherent risks and uncertainties that exist. The main aim of taking account of such risks is to ensure the on-going deliverability of the project and to obtain the best estimate of costs and benefits.

tie has implemented a rigorous approach to risk management across all elements affecting the delivery of Edinburgh Tram. This is set out in this Chapter as follows:

- The general risk management process;
- Derivation of costs and revenues;
- Optimism bias;
- Current risk status;
- Economic case sensitivity analysis; and
- On-going risk management process.

Introduction

10.1 One of the critical success factors for the Edinburgh Tram Network (ETN) project is the identification and management of the risks and opportunities inherent in a project of this nature. The aim is to successfully manage all risks to and opportunities for the project thus ensuring that a supported and fully functioning operational service is delivered within budget and on time. Key drivers are as follows:

- integrate risk awareness and management, and not risk aversion, into the project culture;
- decrease risk exposure to acceptable levels;
- capitalise on opportunities;
- transfer ownership of risks to the party best able to manage them; and
- provide clear and useful information to managers and assurance to stakeholders.

10.2 In order to manage risk in a structured manner, **tie**'s Risk Manager oversees and co-ordinates risk across a number of transport initiatives including ETN. Additionally, **tie** has appointed a full time Project Risk Adviser to apply a framework of risk analysis and evaluation to assist in decision making.

10.3 The project has also made allowance for Optimism Bias as required by HM Treasury's "The Green Book". A risk in itself, OB is the systematic tendency for appraisers to be over-optimistic and evidence from other projects worldwide, as well as tram projects in the UK, shows that it has been a major issue.

Risk Management Process

Early Strategic Appraisal

10.4 During 2002, **tie** and CEC gave early consideration to the overall strategic risks associated with the introduction of a tram network in Edinburgh. Previous experience with the proposed City of Edinburgh Rapid Transit (CERT) suggested that a major risk was that associated with the integration of public transport services following introduction of the trams.

10.5 CEC commissioned a report by Turner & Townsend to review the development of the Edinburgh Tram Line 1 and the appropriateness of potential procurement routes, funding sources, best practice in scheme delivery and issues and pitfalls on other schemes. Papers were written as a means of briefing both CEC Elected Members and Officers on the nature of strategic risks related to the proposed tram system and other Integrated Transport Initiative (ITI) proposals. Identified risks were recorded as a preliminary risk matrix used as a basis for discussion at a workshop involving CEC Officers, the **tie** Board and several key advisors during January 2003. The matrix and discussion upon it assisted **tie** in the formulation of an overall Risk Management Plan.

Phase Specific Activities

10.6 During early work on the tram, all advisers, appointed by **tie** to provide services, were required within their appointment briefs to advise **tie** on risks associated with their particular element of work. This was generally line specific and risk registers were compiled for each line.

10.7 **tie** recognised the economies of scale to be brought to the project by considering it as a phased network. Therefore, a single risk register has been compiled with detailed information on the likelihood and potential impact of each identified risk. However, in order to allow for analysis of different phases of the project, risk impacts have been allocated to each phase where applicable.

tie Risk Management Plan

10.8 Throughout the development of the tram and other ITI proposals, **tie** has initiated and continued to develop a plan for the management of risk. The principal components are:

- appointment of experienced advisers covering legal, financial, technical, operational, environmental, transport modelling, PR and communications, project management and implementation issues;
- engagement of Partnerships UK for specialist procurement advice;
- consultation with relevant authorities, such as the Office for Fair Trading and Scottish Executive, to obtain advice on competition issues and on the funding and development of similar schemes;
- involvement of an Operator at an early stage in scheme development;
- early involvement of engineering design and utility contractors through the SDS and MUDFA contracts respectively;
- periodic briefing and updating of CEC and Transport Scotland to advise progress and development of risk management process;
- benchmarking with other schemes;
- constitution of a multi-disciplinary Risk Management Working Group to facilitate preparation of a consolidated risk register and to monitor the management of risk;
- appointment of a full time Risk Manager to oversee and co-ordinate the complete risk process for all transport initiatives by **tie**;

- appointment of a full time Project Risk Adviser to undertake project specific risk management tasks on behalf of **tie**; and
- implementation of a multiple user/register risk management system – Active Risk Manager – which will enable the Risk Manager and Risk Owners to monitor risk progress on a “live” basis.

Technical Feasibility and Risks

10.9 The proposed alignment and options are feasible, based on a number of key assumptions:

- the design is based upon vehicle parameters (as described in Section 7). No new or untried technology is proposed, but new traction technologies will be reassessed prior to implementation;
- adequate tram priority is achieved in order that run times can be maintained as required. Agreement with CEC will be reached on junction and traffic management designs. The practical and feasible alignment and junction designs demonstrate that the required level of tram priority can be achieved. The designs have varied during development in order to optimise runtime.
- the tram is prioritised over the wide area model effects.
- acceptability of urban design issues. This has been addressed through the development of a detailed design manual in conjunction with CEC Planning.
- integration with other modes of transport, in particular bus. The design provides for maximum tram-bus integration and mitigates potential adverse impacts on bus. A degree of modal transfer is assumed. The risk of changes in bus routes, competition and predatory bus pricing is significant and has proved to be problematic on other schemes. This has been largely mitigated through the creation of Transport Edinburgh Limited who will operate an integrated tram and bus network as a single economic entity and through detailed design development aimed at tram-bus integration.

Consultation

10.10 In order to reduce strategic risk, **tie** has taken steps to consult with key organisations such as Transport Scotland, CEC and bus operators in the Edinburgh area.

10.11 To gain and maintain overall knowledge of the progress of scheme development, Transport Scotland has an observer on the board of **tie**. Additionally there were a number of consultations with stakeholders. **tie** also created the Modelling and Revenue Stakeholder Group (MRSG), comprising representatives from **tie**, the JRC consultants, CEC, Transport Scotland and Transdev to peer review the demand and revenue forecasting process.

10.12 CEC provides a number of **tie** Board Members and is thus directly involved in the decision-making process related to tram scheme development. At the technical level, there has also been regular and close involvement, with Council Officers engaged in some of the Topic Working Groups established by **tie**, notably the Planning and Environment Working Groups. These have been involved in detailed with development of the Design Manual and with the evolution of streetscape designs in critical areas of the city, with the aim of ensuring that the scheme meets CEC’s aspirations for the tram network.

10.13 Recognising the importance of a properly integrated public transport network to the viability of the tram scheme, **tie** has been in discussion with major bus operators in the Edinburgh region. In addition to regular liaison at Executive Officer level through a sub-committee to the Board covering Business Planning, Integration and Commercial Issues, there have been specific discussions supported by the tram operator, Transdev Edinburgh Trams Ltd, under the Development Partnering and Operating Franchise (DPOF) process (see Section 10.18).

10.14 Additionally, **tie** have been undertaking various public consultation exercises (see Chapter 6) throughout the development and design process and this has produced information that has been fed back into the design and risk register where applicable.

10.15 **tie** also recognises that Funders are exposed to strategic risk which the project cannot control. This includes exposure to fluctuations in inflation rates, changes of law and external events impacting on works. In order to aid Funder understanding of potential strategic risks that may affect out-turn cost, **tie** and their advisers have taken part in meetings between CEC and Transport Scotland convened with a view to reach agreement over the funding of such risk.

Risk Transfer Through Procurement

10.16 Optimal risk transfer dictates that risk is allocated to the party best able to manage that risk. This in turn requires the terms of any contract to be negotiated in order to achieve the optimal risk spread amongst the participants in the project.

10.17 Through the procurement process, **tie** has sought to enhance the delivery of the ETN by combining best practice with lessons learned from other related projects in the UK and abroad. The outcome of this work led to the shaping of the procurement route with a balanced approach to risk transfer, and active treatment of specific areas that have proven problematic in other projects. **tie** established a Procurement Working Group, comprising representatives from legal, financial and technical advisers, at the end of 2002. Issues covered included mode integration, legal and financial and the major strategic risks anticipated by the group were:

- integration of the trams network with other transport modes;
- delivery of the tram network within an affordable and certain capital cost;
- delivery within an acceptable timescale; and
- minimisation of the impact of tram costs on the finances of CEC.

10.18 The Working Group recognised that one key weakness of typical tram scheme procurement was that tram schemes were being constructed and implemented with minimal reference to the operations and long term sustainability of the system. **tie**'s belief is that this can be solved by involving the intended operator in the initial and development phases of the procurement of the main infrastructure contractor. To this end the early appointment of an operator as an additional specialist adviser was considered advantageous and a Development Partnering and Operating Franchise Agreement (DPOFA) was established with Transdev in May 2004.

10.19 Another key strand of the procurement strategy was the early involvement of the design contractor. This allowed **tie** to advance design work for sensitive sections of the tram route, thereby reducing the planning and estimating risks to which bidders for the infrastructure contract are exposed. The Systems Design Services (SDS) contract was awarded to Parsons Brinckerhoff in September 2005.

10.20 A significant benefit arising from having undertaken early design work is that **tie** is able to procure the necessary utility diversions prior to commencement of the system construction. This provides very significant construction programme benefits and therefore cost benefits, due to reduced risk exposure of the infrastructure provider, creating the best opportunity to minimise disruption and maximise construction productivity. The Multi Utilities Diversion Framework Agreement (MUDFA) was awarded to Alfred McAlpine Infrastructure Services in October 2006.

10.21 The separation of the day-to-day operation of the tram network from the initial construction of the tram system is a further characteristic or consequence of early operator involvement. It allows those parties responsible for providing vehicles and infrastructure to concentrate on their respective strengths.

10.22 The 'Enhanced' Conventional Procurement Strategy that was developed, addresses both the issues experienced on other light rail procurements in the UK and the specific circumstances affecting Edinburgh. The resultant structure is a series of contracts which, managed as a group, will transfer risk effectively to the private sector, advance the scheme as quickly as possible and deliver strong value for money solution to **tie**, CEC and Transport Scotland.

10.23 **tie** does however, recognise the benefits delivered by a consortium structure which would normally be achieved through a single integrated procurement process and aims to retain as many of these benefits as possible by re-aggregating the structure within the infrastructure contract (Infraco). It is intended to achieve this by novating the design (SDS) and vehicle supply and maintenance contracts (Tramco) to the infrastructure contract.

10.24 **tie** and CEC will retain certain risks either where they are the best party to own them or where retention commercially offers value for money. For example, it has been commercially attractive for **tie** to retain the land acquisition role and consequently ownership of the risks associated with this.

10.25 As part of the process of co-ordination and integration of buses and tram, a Joint Revenue Committee (JRC) was established with the objective of the development, testing and commissioning of a modelling suite to test the viability of the Tram Business Case and ongoing revenue forecasting for TEL. The JRC contract was awarded to a joint team of Steer Davies Gleave and Sir Colin Buchanan & Partners and the modelling suite became available for use in August 2006.

10.26 To support **tie** in the facilitation of design and project management and allow for continuity post novation of SDS to the infrastructure contract, a Technical Support Services (TSS) provider has been contracted. These resources will also be critical for testing, quality, safety and environmental management.

Derivation of Costs and Cost Benchmarking

10.27 The technical teams engaged to advise upon the estimation of costs have extensive experience in the development of tram schemes in the UK and abroad and are thus cognisant of the likely factors and risks that will impact upon out-turn costs. Details of the derivation of costs and project revenues for the scheme can be found elsewhere in this report.

Capital Costs Base Data

10.28 Initial capital cost estimates were prepared using a combination of benchmarking, previous experience and engineering judgement to define the works elements and to obtain and refine implementation costs.

10.29 With the procuring of the SDS Provider in September 2005, base cost estimation has developed in parallel with the design. **tie**'s technical advisers, TSS, have provided assurance on estimates produced by SDS and a further cost study is being conducted by Cyril Sweett in order to provide an independent check on costs.

10.30 A key benefit in developing the tram system as a network, is that gained by economies of scale.

Operating Costs Base Data

10.31 Operating costs have been built up from detailed estimates of likely staffing levels, power requirements, maintenance costs and other related costs such as insurance and policing (see Chapter 7 for further details). These in turn are based upon an assumed operation service pattern and frequency.

10.32 The DPOF process has informed the benchmarking exercise and operating assumptions made taking into account advice from Transdev.

Scheme Cost Benchmarking

10.33 **tie** has undertaken a comparison with other operational tram schemes within the UK to assess the values adopted for the Edinburgh Tram Network projections. These were reported fully in the Outline Business Case. The principal points of note are summarised as follows:

- project-wide construction cost over-runs have been up to 25% of award construction cost. **tie** will manage this risk through the integration of the construction and maintenance contract. Current optimism bias for cost is at 6%;
- completed projects have typically overrun by three to six months with minimal promoter downside risk due to contractual structures used. Current optimism bias for time suggests a value of 2% which represents an additional 1 month on a 39 month construction programme;
- **tie** has the benefit of learning from the experience of other promoters in respect of time delays and costs escalation. This is influencing choice of procurement method and funding options;
- based upon current practice and expectation, most promoters would seek a two-contract structure separating infrastructure and operations, as proposed by **tie**;
- cost escalations in utilities diversion budgets have been recognised by **tie** and the early involvement of MUDFA in the design process should further mitigate this;
- the potential advantage to be gained from full co-operation of bus and tram operators has not always been forthcoming on other projects. **tie** has progressed the DPOFA with Transdev to facilitate this with TEL, with support from JRC;

and

- **tie** continues to liaise with other promoters to obtain maximum benefit from their experiences.

Demand and Revenue Benchmarking

10.34 As part of the process to ensure robust and credible demand and revenue forecasts for Edinburgh Tram, comparable data for other UK systems have been compiled (using DfT statistics) and a benchmarking exercise undertaken. The results are set out in Table 10.1. Demand for Edinburgh Tram is that forecast for 2011; data is presented for both the ramp-up forecast and the 'full' forecast, excluding any ramp-up effects. The latter provides a more meaningful comparison with existing systems, all of which, with the possible exception of Nottingham, have reached maturity.

10.35 Looking at revenue per trip, Edinburgh Tram is at the low end of the range, with only Nottingham having a lower average fare. In demand terms, the boardings per stop for Edinburgh Tram equal or exceed any of the existing systems. A similar story exists for the boardings per route-km, where Edinburgh Tram is exceeded only by Croydon. For passenger-kms by route-km, Edinburgh Tram is comparable to Croydon, with Manchester exceeding both systems by a wide margin. In summary, the demand forecasts for Edinburgh Tram are at the upper end of the range compared to existing systems; however, this is not to a degree that is considered unreasonable, given the high public transport usage in Edinburgh, coupled with the relatively dense urban fabric. Overall, it confirms the credibility of the forecasts for Edinburgh Tram.

TABLE 10.1 DEMAND AND REVENUE BENCHMARKING

System	Year	No. of Stops	Length (km)	Annual Boardings (2005/6)	Annual Pax kms	Revenue / trip (04/05)	Boardings / stop	Boardings / route km	Pax km per route km
Manchester Metrolink	1992	37	39	19.9	206	£1.12	0.54	0.51	5.28
Sheffield Supertram	1994	48	29	13.1	44	£0.87	0.27	0.45	1.52
Midland Metro	1999	23	20	5.1	54	£1.08	0.22	0.26	2.70
Croydon Tramlink	2000	39	28	22.5	117	£0.82	0.58	0.80	4.18
Nottingham NET	2004	23	15	9.8	42	£0.69	0.43	0.65	2.80
Edinburgh	2011								
	1a	22	18	10.6	62	£0.74	0.48	0.59	3.44
	1a+1b	31	24	13.2	73	£0.74	0.43	0.55	3.04
	1a (excluding ramp up)	22	18	14.1	82	£0.74	0.64	0.79	4.56
	1a+1b (excluding ramp up)	31	24	17.6	98	£0.74	0.57	0.73	4.08

Risk Allowance

Process

10.36 Significant effort has been placed in the management of risk to the Edinburgh Tram Network. However, it is recognised that there will be a need for risk allowances set aside to deliver the scheme. These allowances to be set aside are split between those necessary for the Delivery Agent (**tie**) and those necessary for the Principal Funder (Transport Scotland). The terminology used for these risk allowances are recognised to comprise those emerging from Specified Contingencies and Optimism Bias, respectively.

10.37 These are estimated using two recognised industry techniques of Quantitative Risk Analysis (Monte Carlo simulation) and HM Treasury guidelines (as documented in Mott MacDonald's study on behalf of HM Treasury). Separate estimation is adopted due to two fundamentally different approaches being used, namely a 'bottom up' (QRA) and 'top down' (OB) estimations. This also avoids the risk of potential double counting of necessary contingencies.

10.38 **tie** has been consistent in the approach to the estimation of potential outturn costs and applied allowances to base cost estimates and sought specified contingencies for the delivery of scheme within the potential OB allowance to provide a degree of certainty to estimates.

10.39 The QRA techniques employed allow a statistical assessment to be carried that allows stakeholders to choose the level of confidence necessary for delivery, This is exemplified where on 'individual' schemes funders may seek a higher degree of confidence compared with a lesser level of certainty on each project where it fits within a portfolio approach. This degree of confidence (probability) is illustrated in Table 10.2.

TABLE 10.2 CONFIDENCE PROBABILITIES

0-30%	30-70%	70-100%
Low Confidence	Reasonable Confidence	High Confidence

10.40 Prior to the advent of OB, it has been practice that projects are delivered with the schemes funded to a 50% confidence level (e.g. 50 out of 100 projects will be delivered within this allowance) and funders maintaining a reserve to 90% very high confidence level.

10.41 **tie** has conducted an updated QRA exercise following completion of capital cost estimates.

10.42 Optimism Bias on capital cost estimates reduce with management effort in mitigation of documented principal contributing risk areas related to procurement, the Project, the Client, the environment and external influences.

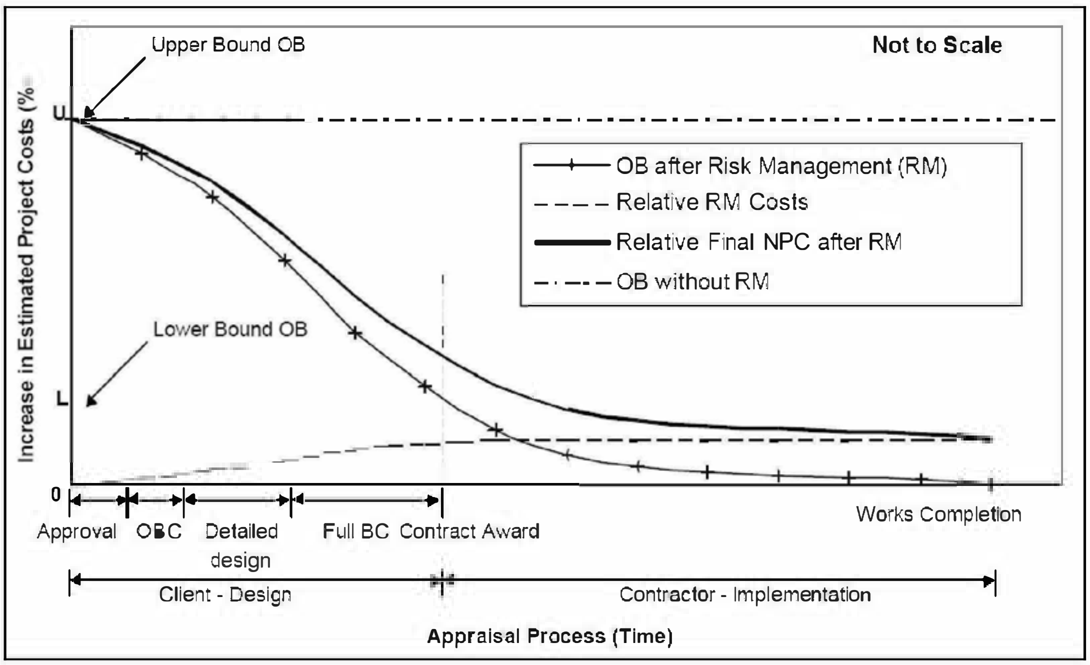
10.43 The Mott MacDonald study that forms the extant guidance recommended by the Scottish Executive confirmed the need for OB allowances across all types of projects at Outline Business Case. The study determined 'upper bound' and 'lower bound' OB values that represent starting values and the levels to aim for in projects with effective risk management by the time of contract award, respectively. The study also recognised that lower bound values can be reduced below suggested values. Our scheme has been classified as a 'standard civil engineering' project with upper bound starting value increase to base estimates of 44% and reported lower bound value of 3%.

10.44 It should be recognised that these values are based upon quantitative data review of the following key differences:

- Capital expenditure as planned at Outline Business Case and Contract Award
- Actual capital expenditure

10.45 As discussed above, the reduction in optimism bias is due to concerted project and risk management effort, and is best shown diagrammatically in Figure 10.1 (extract from Mott MacDonald study) with the lower bound value representing the optimism bias level to expect with effective risk management by the time of Contract Award. Mott MacDonald concluded that with effective risk management the level of optimism bias could reduce to 3%. However, the project's enhanced procurement strategy, which was specifically developed with the consideration of risk, means that it is expected that optimism bias will be near to 0% at Contract Award and will come within the 90% confidence level for risk.

FIGURE 10.1 OPTIMISM BIAS



10.46 At the Outline Business Case, **tie** estimated a reduction in OB to 24% , which includes specified risk allowances of c10%. This reduction was partly due to the extensive development work undertaken during the gestation period of preparing and delivering the scheme through the Private Bill process.

10.47 In conjunction with Parsons Brinckerhoff, our System Design Services Provider, **tie** has placed significant effort in preliminary design and scheme functional specification development that clarify stakeholders' requirements. In addition, **tie**'s procurement strategy has included for early operator involvement that has helped to mollify potential project delivery risks.

10.48 However, the Mott MacDonald study showed conclusively that the single most important contributing factor to optimism bias was the inadequacy of the initial business case. There has therefore been an industry need for significant improved effort in developing the business case, identifying and, obtaining confirmation of the requirements, analysing risks when evaluating options. **tie**'s Outline Business Case has addressed project risk areas with the assessment of risk allowances for the total cost of managing residual risks. **tie** has carried out a review of project estimates accounting for the major changes to scope to confirm that project estimates are still relevant.

Current Risk Status

Risk Identification

10.49 **tie** and its advisers have identified project risks through workshops, strategic reviews, experience of other UK tram schemes and recording of risks throughout the development process. To aid the identification process, methodologies and checklists contained in the following guidance were used:-

- The Institution of Civil Engineers and the Faculty and Institute of Actuaries (2002 Revised) RAMP Risk Analysis and Management for Projects, Thomas Telford, UK.
- Mott MacDonald (July 2002) Review of Large Public Procurement in the UK, Report prepared for HM Treasury.
- Association for Project Management (2004) PRAM Project Risk Analysis and Management Guide, APM Publishing, UK.

10.50 New risks are identified through subject specific workshops and as part of the general project processes. These are analysed for duplication or overlap with risks already identified within the project risk register and added or discarded accordingly. Through the analysis process, and as the project progresses, the nature and magnitude of risks changes and the register is adjusted as required.

Risk Matrix

10.51 A consolidated risk register has been prepared for the tram network. For each risk identified, the register shows:-

- the stage of the scheme development at which the risk might materialise;
- the underlying nature of the risk (procedural, specification, external influence

etc);

- elements impacted by the risk (capital expenditure, operating expenditure, revenue, programme, quality);
- likelihood of realisation;
- magnitude of impact;
- treatment strategy;
- responsibility for treatment;
- mitigation factor achieved;
- status of risk; and
- dates for action.

10.52 In order to identify impact area, the risks have been categorised in order to identify the risk level within each of the following contractual areas of the project and to ensure risks are reviewed and treated for each area of the project.

- Project Management;
- Design;
- Land & Property;
- Utilities Diversions (MUDFA);
- TRAM Vehicles (Tramco);
- Infrastructure (Infraco); and
- Other Third Party Works.

10.53 **tie**, their advisers and service providers have identified risks. These risks have been categorised into the following groups in accordance with HM Treasury guidance:

- Procurement;
- Project specific;
- Client specific;
- Environment; and
- External influences.

10.54 Each of the project risks has been assessed against the following principal impacts:

- Capital costs;
- Operating costs;
- Revenue;
- Programme; and
- Quality.

10.55 Of these areas, capital costs and works duration (programme) have been shown to lie within Optimism Bias considerations. Two strategies have been adopted to quantify the impact of risk, in accordance with HM Treasury Green Book guidance. The first has been to calculate Optimism Bias to be applied to capital costs and works duration. The second has been to appraise the risks associated with operating costs and revenue through sensitivity analysis.

10.56 The significance of each risk is classified by means of an impact-probability matrix and this allows risk action to be prioritised. This matrix is shown in Table 10.3.

TABLE 10.3 RISK SIGNIFICANCE MATRIX

Impact \ Probability				1	2	3	4	5
				0-5% (Remote)	6-30% (Unusual)	31-70% (Possible)	71-90% (Probable)	91-100% (Expected)
Level	Impact	Capex £/ Opex/Rev £pa	Programme (Weeks)					
1	Insignificant	0-25k	0-1	1	2	3	4	5
2	Minor	25-100k	1-2	2	4	6	8	10
3	Moderate	100-500k	2-4	3	6	9	12	15
4	Significant	500k-1m	4-12	4	8	12	16	20
5	Major	>1m	>12	5	10	15	20	25

10.57 Table 10.4 shows the ranges of risk significance that have been adopted.

TABLE 10.4 SIGNIFICANCE OF RISK

Significance	Range	Colour
Low Risk	1 - 6	
Medium Risk	7 - 15	
High Risk	16 - 25	

Key Risks

10.58 **tie** has developed clear and active processes to prevent and mitigate project risks in accordance with industry best practice. Through this management, a number of risks have been identified.

10.59 A number of lessons have also been learnt from the previous UK tram schemes. The following key risks that occurred on other UK tram schemes have been recognised and duly mitigated through **tie**'s procurement strategy, consultations and design and cost assumptions:

- Revenue – reduction in tram capacity, negative PR, bus competition (fares and coverage) and overestimated revenues;
- Capital Costs – underestimated costs due to utility diversions, compliance with planning, traffic management and bid costs;
- Approvability – planning issues and negative PR; and
- Operating Costs – lack of tram priority and reduced operational performance.

10.60 Utilising the ranking process identified above, the principal risks arising from this exercise can be summarised as follows:

- Funding availability is less than **tie** requires to proceed – a key element of the Business Case is to demonstrate the requirement for a minimum amount of funding to enable the project to proceed;
- Passenger numbers are lower than forecast – **tie** and their JRC technical advisers have established a credible transport model and reviewed the factors affecting revenue, assumptions and sensitivities. Further comfort has been gained through the early involvement of Transdev;
- Delay and cost increases due to CEC Planning requirements – **tie** have significantly mitigated this risk through the development of the Design Manual and proposals to account for World Heritage Site status. Additionally, there is ongoing liaison with CEC Planning during design development in order that approvals requirements can be incorporated into the design;
- Capital costs, associated with land purchase, contractor's area and compensation, Network Rail, unforeseen ground conditions, vehicle costs, CEC/**tie** instructed changes and utility diversion costs exceed current forecasts, breach the contingency level included within the Model. This should be mitigated through the level of work undertaken to date by the technical advisers and designers (with preliminary design complete and detailed design underway), and will also be accounted for by the inclusion of Optimism Bias within financial reporting; and
- Operating costs exceed current projections due to lack of priority to the tram at junctions. Transdev have been involved in identifying cost issues and it is recognised that this has been influenced by specification issues, such as staffing levels.

10.61 The risks listed above represent those considered as most serious to the success of the project more or less on an ongoing basis. **tie** will use the risk treatment summary as a means to undertake this process through regular reviews and updates of the risk documentation and proactive management of risks.

Treatment of Contingency

10.62 Traditionally, it is customary to include a certain element of contingency within base cost estimates as an allowance against possible increases in capital costs. However, reporting methods for this do not always allow transparency of contingency allocation. Therefore, **tie** has required estimators to exclude contingency from base costs.

10.63 In order to gain the required transparency, contingency has been treated as risk with specific quantities applied against identified risks. Each risk has a likelihood of occurrence and minimum, most likely and maximum cost impacts noted. This allows a full Quantitative Risk Analysis (QRA) to be undertaken using Monte Carlo simulation – a probabilistic analysis, which combines the impact range and likelihood of all the risks to estimate confidence in possible outcomes.

10.64 The level of risk allowance calculated and included in the updated estimate represents 16% of the underlying base cost estimates. This is considered to be a prudent allowance to allow for cost uncertainty at this stage of the project and reflects the evolution of design and the increasing level of certainty and confidence in the costs of Phase 1 as procurement has progressed through 2006.

10.65 **tie** has continued to comply with the HM Treasury recommendations for the estimation of potential Optimism Bias and has determined, in consultation with Transport Scotland, that no allowances for Optimism Bias are required in addition to the 16% risk allowance above the base costs. **tie** will continue to analyse, quantify and mitigate risks during the period through to final negotiation and award of the Tramco and Infraco contracts and during construction, with the objective of reducing or eliminating the impact of quantified risks and thereby the element of the allowance for risk that crystallises into actual costs.

10.66 It should be noted that the costs and allowance for risk upon which this STAG appraisal is based were at an appropriate 'freeze point' in their development. Further work has since been done on costs, resulting in marginal changes, the results of which are reflected in tie's Financial Business Plan. It is understood that this further work has led to the reduction in allowance for risk from 16% to 12%. The net differences have a relatively marginal impact on the economic appraisal but changes subsequent to this appraisal document are to be reported in a technical note.

Sensitivity Analysis

Sensitivity Tests

10.67 We have undertaken a range of sensitivity tests to understand the robustness of the appraisal. These are:

- In-vehicle time / mode constant sensitivity
- No change to bus network
- Lower interchange penalty
- Impact of EARL

10.68 A summary of the sensitivity test results is presented in Table 10.5. Each sensitivity is then discussed.

TABLE 10.5 SENSITIVITY TESTS (FOR 1A+1B CASE)

Economic impacts (£m PV, 2002 prices)	Central Case	Mode Constant	DM Bus	Interchange Penalty	Exclusion of EARL
PT User Benefits	657	514	744	707	669
Highway User benefits	72	5	87	59	328
Private sector provider impacts	-15	-8	-9	-14	6
Accident benefits	-5	0	1	0	-24
Present Value of Scheme Benefits	709	501	823	752	980
Present Value of Scheme Costs	436	453	755	433	424
Net Present Value (£ m)	273	47	68	319	556
Benefit : Cost Ratio	1.63	1.10	1.09	1.74	2.31

Mode Constant Test / In-Vehicle Time

10.69 The central case includes an in-vehicle time weight for tram of 0.77, reflecting the higher quality and perception that tram has over bus.

10.70 A sensitivity test has been undertaken with a weight of 0.86, which gauges the sensitivity of the appraisal case to the assumed 'quality' benefit that tram would deliver. The 0.86 weighting was based on an interpretation of the stated preference results which reflected the impact of those respondents who stated a clear objection to the concept of the Edinburgh Tram and hence would be biased against it.

10.71 The sensitivity test shows the overall scheme benefits decline from £709m PV to £501m PV, while costs to the public sector increase slightly to £453m due to a lower public transport revenues than in the Central Case.

10.72 The NPV under this scenario reduces to £47m and the BCR falls to 1.10 : 1. This sensitivity shows that the case for the tram is sensitive to the improved 'quality' associated with tram, but also that, even under this pessimistic scenario the overall economic case remains positive.

10.73 This scenario also represents a proxy for an increase tram journey time of around 12% (the ratio of 0.86 to 0.77). Again, this suggests that the economic case would remain positive if tram journey times were to increase by 12%, but that the case is sensitive to the delivery of attractive tram journey times.

Do Minimum Bus Network Scenario

10.74 This test examines the economic case for the scheme assuming that the Do Minimum bus network remains in place.

10.75 The key impact of this scenario is that scheme costs increase significantly by £319m to £755m as the bus operating and renewal cost savings that accrue in the central case are eliminated. By contrast, overall scheme benefits only increase from £709m to £823m PV, an increase of £114m.

10.76 The net effect is that the overall NPV falls to £68m and the BCR falls to 1.09 : 1. The implication of this is that the benefits 'lost' from removing parallel bus services and rationalisation are significantly out-weighed by the operating cost savings this would bring, thereby delivering a much more efficient transport system.

10.77 The result provides a strong validation of the assumed bus network configurations, which would deliver significant cost savings while not impacting too greatly on passengers.

Interchange Test

10.78 The forecasting for Edinburgh Tram includes an interchange 'penalty' of 12.5 minutes, which is at the higher end of typical interchange penalty value range. The effect of this is to penalise those who have a 'forced' interchange, particularly at Leith Walk.

10.79 A sensitivity has been undertaken assuming a lower interchange penalty of 8 minutes, applied in both the Do Minimum and the Do Something. The effect of a lower interchange penalty is to improve the scheme benefits from £709m to £752m, and the overall NPV by a similar amount. The BCR would increase to 1.74 : 1.

10.80 The sensitivity test shows that the case is not particularly sensitive to this assumption but that with a more 'typical' interchange value employed the economic case for the scheme would improve.

Exclusion of EARL

10.81 EARL is assumed to be in the Reference Case for appraisal purposes. Should it be excluded, this would have a material impact on the case for Edinburgh Tram, given that both serve Edinburgh Airport.

10.82 Overall tram benefits would be £980m if EARL is not included, compared to £709m. Consequently the NPV would approximately double and the BCR would increase to 2.31 : 1.

Ongoing Risk Management Process

10.83 Ultimately responsibility for risk is taken by the **tie** Board, with responsibility delegated to the Project Director. He has appointed advisors covering technical, legal and financial issues, together with **tie**'s appointed Risk Manager. He is responsible for executing or overseeing actions necessary to treat risk on the tram scheme.

11. MONITORING AND EVALUATION

STAG guidance requires that a new project be subject to planned evaluation and monitoring, in addition to regular revalidation of the project throughout its development.

STAG defines Monitoring as "*an on-going process of watching over the performance of a project identifying problems as these arise and taking appropriate action*", while Evaluation is used for "*specific, post-implementation events, designed to assess the project performance against established objectives and to provide in-depth diagnosis of successes as well as deficiencies*". Therefore, by gathering and interpreting information, monitoring and evaluation will demonstrate how the project performs against its objectives, identify any deficiencies and allow adjustments to be made.

Soon after implementation, the performance of the project should be assessed against the specified objectives – the process evaluation. Recognising that certain projects, including public transport projects, require time before the full benefits can be realised, a further evaluation – the outcome evaluation – is required some time after implementation.

In addition, regular monitoring of the project is essential against specified Key Performance Indicators (KPIs) to assess the ongoing effectiveness of the scheme.

This chapter describes the measures put in place by **tie** to meet the requirements of the STAG guidance with respect to evaluation and monitoring.

Introduction

11.1 There are five phases of the project which require consideration during the monitoring and evaluation process, namely:

- Scheme development;
- Infrastructure procurement;
- Construction;
- Testing and commissioning; and
- Operations.

11.2 The STAG requirements for monitoring and evaluation are principally associated with the operational phase, following scheme implementation. However, it is also necessary to assess and re-appraise the project during phases prior to implementation. Actions to be undertaken by **tie** during scheme development, procurement and construction to assess impacts on programme, costs and potential revenues are also described below.

Objectives

11.3 The objectives for this scheme are described in Chapter 3 of this report. The specific project objectives are derived from a range of national, regional and local objectives reflecting transport and more diverse government and local authority strategies.

Project Objectives

11.4 Project objectives have been set out as a more measurable and specific account of the planning objectives (as described in Chapter 3), and can be seen as scheme performance indicators:

- Local economy and accessibility:
  - Increased number of people with access to the public transport network; and
  - Increased number of people with access to employment opportunities at Granton, Leith, Muirhouse, Pilton and Newhaven.
- Sustainability and environment:
  - Increased share of travel on public transport and non-motorised modes; and
  - Reduced global emissions and control local air quality in order to comply with air quality standards.
- Traffic congestion:
  - Reduced number of trips made by car; and
  - Reduced road traffic volume (veh-km) on key urban routes.
- Safety:
  - Reduce the number of road traffic accidents and casualties in Edinburgh.
- Social benefits:
  - Improve liveability of streets; and
  - Improve access to transport system by people with low incomes, no access to car, the elderly or mobility impairments.

Project Stage Influences

11.5 All development work undertaken to date has been done with the above objectives in mind. The choice of alignment and development of the design and specification has been directed towards meeting or aiding these objectives. The following are amongst the factors taken into account during scheme development to date:

- The introduction of the tram will improve travel mode choice for Edinburgh, providing a fast, clean and efficient service as an attractive alternative to the private car which should help reduction of congestion both on public transport and in general traffic;
- Design proposals have considered the interface between trams, buses and other transport modes, with the objective of favouring public transport, thereby encouraging an increase in the use of public transport and reducing the need for car travel;
- In turn, it is anticipated that the reduction will lead to improvements in road traffic accidents and in some environmental criteria such as air quality;
- The proposals to accommodate the tram on Princes Street have also been developed with the intention of improving the pedestrian environment in this well-used area of the city;
- A Design Manual has been developed for the tram and its immediate environment;
- Route options considered have been chosen to serve population centres in socially disadvantaged areas, thereby increasing access for low income groups; and
- Specifications for infrastructure and equipment are being developed to cater for

the mobility impaired.

11.6 During future scheme development, the scheme objectives will continue to be under review and re-appraisal where appropriate. The following can be cited as examples:

- Operating patterns will be reviewed in conjunction with Transdev (the Operator appointed through the Development, Partnering and Operating Franchise – DPOF – Agreement) to establish the optimum service pattern and frequencies;
- The Service Integration Plan will be finalised through TEL to encourage optimum use of public transport;
- Junction operation will be reviewed with TEL and CEC to optimise priorities for public transport modes and minimise congestion;
- Operating plans will be developed with Transdev covering all aspects of operational safety;
- Specifications for infrastructure and equipment will be developed in conjunction with Transdev to obtain benefits with respect to safety, passenger security, system accessibility, etc all leading to improved public perception and system attractiveness; and
- Proposals will be agreed with CEC and TEL for future fares policies.

Base Case

11.7 STAG guidance recognises the problems associated with establishing a valid Base Case against which the performance of the scheme may be judged. In the case of the tram scheme, there is an additional difficulty introduced by the length of the lead time prior to implementation of tram operations, which is unlikely to be before 2010.

11.8 Under these circumstances it is premature to be prescriptive in terms of the establishment of the collection and organisation of the data that will provide the Base Case. It is anticipated that this will be developed and agreed by **tie** with CEC and Transport Scotland for execution during the period immediately prior to initial operation on any part of the tram network. In the case of environmental base data, it will also be necessary to consult with other heritage and conservation bodies to ensure that any changes in the environment since production of the Environmental Statement can be accommodated.

11.9 It is likely that the baseline data will include but will not necessarily be limited to:

- Data on noise, water quality, air quality, ecology, tree surveys and the like;
- Passenger usage on public transport, particularly buses and heavy rail services upon which patronage may be affected by the introduction of the tram;
- Junction performance, queue lengths, etc at critical locations;
- Mode choice survey; and
- Safety records.

11.10 It will be important to establish through discussions with other organisations (e.g. CEC, train and bus operators) what information is available as part of their regular data gathering functions at that time, to avoid incurring additional cost and to limit the collection of new information to that which is strictly necessary to establish performance against scheme objectives.

11.11 It is also noted that it may be necessary to obtain some base line data prior to start of construction to be certain that construction activities do not adversely impact the validity of any changes measured.

Project Development, Procurement and Construction

Project Validation

11.12 There is currently around 4 years required for final scheme development, approval and construction. It is possible that circumstances may change within that time, which could affect the assumptions made regarding the scheme. For example, CEC and/or **tie** will likely be implementing various transport projects during that period and it will be necessary to keep under review the tram objectives, taking into account any changes in the underlying transport situation resulting from these and other measures.

11.13 Future changes in planning and transportation strategies as proposed or implemented by CEC will also result in a re-assessment of the tram proposals. Such changes might influence phasing of the network, detailed design or planned service pattern and frequency, which will be assessed by **tie** and its advisors.

Cost and Revenue Review

Early Operator Involvement

11.14 A key strand of the Procurement Strategy was the decision to select the operator for the system in advance of completing the Parliamentary process which is a pre-requisite to the letting of contracts for the fabric of the system. The principal reasons for introducing early involvement of the operator were that it allows **tie** to use the operator's knowledge and experience during the Parliamentary process, business case development, planning, design, and commissioning phases, to ensure that the system will be capable of being operated effectively, facilitates input from an experienced tram operator on issues such as fares and ticketing policy and facilitates planning of the integration of the tram into the combined TEL network of trams and buses, taking account of other operators. Following a competitive tendering process, Transdev were duly appointed as operators under the Development Partnering and Operating Franchise Agreement (DPOFA) in May 2004.

11.15 DPOFA also recognises that there may be subsequent changes to infrastructure and/or operating plans which could lead to changes in agreed costs and revenues, both before and after the start of operations. The DPOFA Agreement includes a mechanism for adjustment of target costs and incentivises the Operator to achieve these targets through a pain/gain sharing formula during operations.

Joint Revenue Committee

11.16 As part of the process of coordination and integration of buses and tram, a Joint Revenue Committee (JRC) was established with the objective of the development, testing and successful commissioning of a Modelling Suite to support the viability of the Tram Business Case and ongoing revenue forecasting for TEL.

11.17 A Modelling Revenue Stakeholder Group ("MRSG") has been established to assist JRC to define the parameters and inputs which allows them to deliver the scope of services under their contract. The members of this group will be required to source any information which their organisation has and which is required to inform the model building process to ensure it is robust. This group will report back to their respective organisations on progress and ultimately on the output from the modelling.

Early Designer Involvement

11.18 Another key strand of the Procurement strategy was the early involvement of the design contractor. The System Design Services (SDS) contract was awarded in September 2005 to Parsons Brinkerhoff. This contract allows **tie** to advance design work for sensitive sections of the tram route, thereby reducing the planning and estimating risks to which bidders for the infrastructure contract are exposed. It also facilitates the opportunity to procure advanced works on utility diversions and identify at an earlier stage the land requirements and traffic regulation requirements, both temporary and permanent, of the identified network scope.

Advanced works

11.19 A significant benefit arising from having undertaken early design work is that **tie** is able to procure the necessary utility diversions prior to commencement of the system construction. This provides very significant construction programme benefits and therefore cost benefits, due to reduced risk exposure of the infrastructure provider, creating the best opportunity to minimise disruption and maximise construction productivity.

Summary

11.20 Given the above, operating costs and revenues will be under continual review throughout the project development and operating phases.

11.21 In addition, **tie** will be able to continually review costs associated with infrastructure and equipment during the development, procurement, construction and commissioning phases to confirm the ongoing validity of estimates and underlying assumptions.

Programme Monitoring

11.22 **tie** will lead a project management team comprising various advisors throughout scheme development and construction. In addition to monitoring changes in capital and operating costs and revenues, the same team will also regularly review progress against the assumed project programme, thereby evaluating any potential for changes in project costs and associated risks.

Operations

Process Evaluation

11.23 Evaluations are specific post-implementation events designed to identify whether:

- A project has performed as intended (or under or beyond expectations);
- Established objectives have been achieved (fully or partially, and the reasons for any failures); and
- The project continues to represent value for money (also considering actual cost

budget).

11.24 The Process Evaluation is conducted straight after the implementation. It will draw lessons for on-going implementation and for the design, management and implementation of future projects.

11.25 For the reasons given above with respect to Base Case data, it is not possible at this stage to be specific about the nature of the process evaluation. It seems likely at this stage that there will be a need to provide data which will measure changes in the baseline parameters mentioned above such as various environmental parameters, public transport passenger counts, mode choice surveys and junction performance. Particularly in the case of the last of these, it would be prudent to ensure that junction performance is optimised to benefit the public transport modes without excessive inconvenience to general traffic. The introduction of additional minor traffic control measures to assist this process might be desirable and a process evaluation soon after implementation would provide information to justify any such action.

11.26 Evaluation can be conducted straight after the implementation and/or after the full benefits can be capitalised. It will draw lessons for on-going implementation and for the design, management and implementation of future projects. The proposed evaluation performance indicators related to project implementation are summarised in Table 11.1

TABLE 11.1 EVALUATION PERFORMANCE INDICATORS

Objective	Performance indicator/measure	Performance target	Source of indicator	Monitoring method and frequency
Costs	Proportion of actual costs over budget	X% of budget exceedance	Project costs	Budget and cost comparison – after implementation
	Proportion of budget allocated to the CEC which was actually spent within timescale	X% budget spent by completion	Project costs by time	Project costs by time – after implementation
Views	The extent to which (stakeholder, public) consultation influenced outcomes	Significant number of views taken into account	Consultation process	Qualitative examination of consultation, by group
	Stakeholder's views on how well the project was designed and implemented	Overall positive views	Stakeholder interviews	Qualitative survey results by group – after implementation
Transport	The extent to which public transport model results reflect reality	Travel time Patronage N. bus services withdrawn or modified	PT model, TIMS, bus operator timetable and after surveys	Comparison between modelled and actual – after implementation and again one year later
	The extent to which road model results reflect reality	Traffic diversion Congestion Delays	Highway model and traffic surveys	Comparison between modelled and actual – after implementation and again one year later
Local economy	Actual impact on economic activity	Employment Commerce Tourism	Before and after surveys	Comparison between before and one year after implementation, by location and activity

Outcome Evaluation

11.27 It is recognised that the full potential of a new transport mode will only be realised some time (perhaps 2 to 3 years) after its introduction. It is for this reason that the DPOFA contract proposes a review and possible revision of Target Costs after such a period. The outcome evaluation will probably be undertaken as part of the process to be followed prior to agreeing any change of the targets and will be based on similar data to that collected for the baseline survey and process evaluation mentioned above.

Monitoring

11.28 A monitoring programme will need to be developed within the development and implementation stages of the project, in order to ensure the gathering of relevant information on performance indicators. The monitoring programme will measure the progress towards meeting the objectives through an assessment against target indicators, in particular whether the project is providing Best Value.

11.29 The payment mechanism within the DPOFA contract for the tram project includes four discrete elements related to payment during the Operations phase:

- Operating costs and profit element;
- Performance regime;
- Pain/gain share mechanism; and
- Vision achievement bonus.

11.30 The evaluation of payments due will require a degree of monitoring to be undertaken as a regular function of operations. The pain/gain share payment will be dependent upon the financial performance of the tram and will offer the Operator and **tie** the opportunity to share in savings on operating costs below the agreed Target Operating Cost.

11.31 In addition, a significant proportion of payment is linked to the Performance Regime and the Vision Achievement Bonus. The Performance Regime is the day-to-day mechanism through which **tie** will monitor and incentivise the Operator to deliver a high quality and attractive tram scheme which will satisfy the primary scheme objectives, by increasing public transport use and reducing car use. Deductions will be applied to payments in the event of unsatisfactory performance against 7 Key Performance Indicators.

11.32 The KPIs against which the service will be measured are:

- Timetable Adherence – measuring performance against scheduled service intervals;
- First and last tram – punctuality of first and last services (included within Timetable Adherence but weighted as 5 times a regular departure);
- Cleanliness of tram interiors and stops fulfilment of maintenance obligations;
- Security – to gauge personal security, equipment and incident responses;
- Information and signage – currency and coverage of service information;
- Revenue generation and protection – availability of ticket sales points and minimisation of fare evasion; and

- Customer satisfaction – to indicate a measure of good performance in public perception.

11.33 These KPIs have been selected as being the aspects of service most likely to influence the attractiveness of the system to users, which in turn will assist achievement of the objectives set down for the tram.

11.34 The Vision Achievement Bonus is also payable dependent upon a consistent performance against these KPIs over time, promoting continued high quality service.

11.35 It is recognised that monitoring of these KPIs will not address all the expectations of the STAG guidance in assessing the performance against the scheme objectives and additional monitoring will be required for this purpose. It is proposed that the details of such performance indicators be developed in conjunction with interested parties closer to the date of service introduction. Nonetheless, a set of performance indicators have been set out earlier in this chapter based on the project objectives.

11.36 A monitoring survey framework is proposed, which will encompass the collection, analysis and interpretation of data generated by:

- Traffic count surveys (e.g. cordon and screen line, but first checking the availability of any on-going traffic surveys by CEC or any national data sources);
- Data collection from Ticketing Information Management System (TIMS);
- Air quality monitoring equipment (first verify whether any air quality monitoring is already in place);
- Safety records from the Police; and
- Household and employee monitoring survey (first verify whether employee and school travel plans already exist).

11.37 The KPIs and monitoring programme are summarised in Table 11.2.

TABLE 11.2 MONITORING PERFORMANCE INDICATORS

Objective	Performance indicator	Definition of indicator	Performance target	Source of indicator/target	Monitoring method and frequency
Accessibility	Access to transport network	Number of people (non-car available in particular) within 400 metres walk distance from a public transport stop/service Public transport use	X% by 2015 (5 years after opening) X million per year by 2015	Population distribution, car availability (from Census/ Scottish Registry Office), PT routes TIMS	Yearly population and distribution updates by ward Continuous monitoring of bus and tram ticketing
	Access to employment opportunities	Number of people with access to employment in Granton, Leith, Muirhouse, Pilton and Newhaven	X% employees at key locations being able to access jobs by public transport by 2015	Population distribution, car availability, PT routes. Employee survey	Annual population and distribution. Annual survey with employees from key employment locations.
Sustainability and Environment	Use of sustainable transport modes	Increased modal share on public transport, cycle and walk.	X% increase on PT by 2015 Y% reduction on cars by 2015	Household survey	Citywide household survey every 5 years
	Air quality - pollutant concentrations	Various pollutant concentration targets	Meet NAQS targets for all pollutants	UK National Air Quality Strategy (NAQS)	Changes in air quality with monitoring equipment, allowing for seasonal variations
	Global emissions	Reduction in CO_2 emissions	X% reduction in CO_2 emissions.	Emission modelling	Modelling of before and after emissions.
Traffic Congestion	Car trips	Reduction in car trips	X% reduction in car trips	Traffic monitoring, household survey	Traffic monitoring programme. Citywide household survey every 5 years
	Traffic volumes - key routes	Average AM/PM, daily, weekly, monthly and annual traffic volumes on urban key routes (veh-km) Growth in car traffic	Road Traffic Reduction Act (RTRA) local targets Car traffic growth not to exceed X% in 2015	Road Traffic Reduction Act UK Government's 1st Report	Permanent/temporary site automatic/manual traffic count programme
Safety	Road traffic accidents and casualties	Total number of people killed or injured in road traffic accidents in Edinburgh	X % reduction by 2015	Tomorrow's roads: safer for everyone (UK Road Safety Strategy)	Road traffic accident database. Annual records from local Police and local authorities
Social Benefits	Liveability of streets	Number of people using the streets for leisure	% increase in street activities	On-street surveys	Annual survey
	Access by deprived and impaired	Number of deprived / impaired people using the system	% of users that are deprived or impaired	On-board surveys	Annual survey

11.38 Before the monitoring programme is agreed upon, consideration must be given to the actual availability of the data, practicalities from collecting new data, its format, whether it will properly reflect the indicators proposed and cost from obtaining it. Indicators and targets should be subject to regular reviews to ensure that they continue to properly reflect the performance of the project against its objectives, throughout the monitoring period.

11.39 Emphasis has been placed in the DPOFA contract on the need for electronic data gathering to be employed as the preferred method wherever possible. This will also apply to data gathered outside the DPOFA contract for monitoring purposes.

Conclusion

11.40 The paragraphs above demonstrate that **tie** has been, is and will continue to take steps to validate and evaluate the scheme (both before and after implementation) and to monitor its performance in the operational phase.

11.41 The project objectives are set out together with actions to be taken during the various phases from scheme development throughout operations. A key factor in this process is the appointment of the Operator using the DPOF procedure, the creation of the JRC and the early designer appointment. These actions alone will contribute significantly to minimisation of risk and regular review of the project.

12. GLOSSARY OF TERMS

A

Air quality. A measure of the levels of pollutants in the air. Poor air quality is a term which refers to air containing high levels of pollutants i.e., levels which approach or exceed recommended guideline and limit concentrations.

A-weighting. Environmental noise levels are usually expressed using a variation of the decibel scale which gives less weight to low frequencies and very high frequencies. This system was originally devised to correspond to the reduced sensitivity of the hearing mechanism to these frequencies when noise levels are low (i.e. relatively quiet). It has since been found to be a suitable scale regardless of the intensity of the noise. A-weighted noise levels are indicated by the abbreviation LA.

Ambient air quality. Air pollutant concentrations which occur in the open air, away from the immediate influence of local pollution sources, such as industrial processes or roads (otherwise known as the background air quality).

Aquifer. A deposit or rock layer containing water and allowing water to pass through it and which may be exploited as a water source.

B

Bedrock. Solid rock underlying soils.

Benzene (C_6H_6). Benzene is a pollutant which is a liquid at normal ambient temperatures, but is also present in the atmosphere at very low concentrations. The most important source of benzene in the atmosphere is the motor vehicle, but cigarette smoking, wood burning and industry also contribute.

Biodiversity. A term summarising the phrase 'biological diversity' and encompassing the whole range of variation in living organisms: genetic variation, species variation and ecosystem variation.

Borehole. A hole drilled into the ground, usually for the purposes of geological investigation.

Boulder clay. Deposit of unsorted sediment laid down beneath glacial ice or by retreat of glacier.

C

Carbon Dioxide (CO_2). Primary greenhouse gas.

Carbon Monoxide (CO). Carbon monoxide is a colourless, odourless gas which is formed upon incomplete combustion of fuels and is produced by vehicles.

CEC. City of Edinburgh Council.

Community journeys. Journeys by pedestrians, cyclists and equestrians, and journeys by car, where these are for local domestic or leisure purposes.

Community severance. The separation of residents from facilities and services they use within their community or in other locations, caused by new transport infrastructure or changes in traffic.

Conservation area. Planning authorities have a duty to determine areas of special architectural or historic interest, the character or appearance of which it is desirable to preserve or enhance. Such areas should be designated as conservation Areas under the Planning (Listed Buildings and Conservation Areas) (Scotland) Act 1997.

CRTN. Calculation of Road Traffic Noise.

CRN. Calculation of Railway Noise.

Culvert. A covered channel or pipe for carrying a watercourse beneath a road or railway.

D

dB (decibel). The unit of sound pressure level expressed as 20 times the logarithm of the ratio between the pressure of the sound field and the reference pressure (0.00002 N/m2).

Deciduous. Term describing a tree or shrub that retains its leaves for one growing season only, dropping them before the following winter.

Dispersion. The way in which a pollutant spreads from its point of emission and becomes diluted in the atmosphere.

DMRB. Design Manual for Roads and Bridges.

DPOFA. Development Partnering & Operating Franchise

E

EALI. Economic Activity and Location Impacts

Emission. A material discharged into the atmosphere by a process e.g., engine combustion, where pollutants are emitted via the vehicle's exhaust.

Environmental barriers. Physical structures erected alongside (or some distance from) the transport alignment to mitigate the effects of rail or road traffic noise and/or visual intrusion.

F

Facade noise level. Refers to a sound pressure level determined at a point close to an acoustically reflective surface (in addition to the ground). Typically a distance of 1 metre is used.

Fauna. A collective term for animals.

Fill. Manmade deposits of waste or overburden.

Flora. A collective term for plants.

G

GOMMMS. Guidance on the Methodology for Multi-modal Studies.

Groundwater. Water occurring within the saturation zone (ie below the water table) of an aquifer.

H

Habitat. Living place of an organism or community, characterised by its physical or biological properties.

HGV. Heavy Goods Vehicle.

Historic Scotland. An executive agency within the Scottish Executive, responsible for administering the laws concerning protection and management of ancient monuments and historic buildings.

Hydrology. The science dealing with water on land, or under the earth's surface, its properties, geographical distribution etc.

I

IMD. Index of Multiple Deprivation

Improved. When applied to meadows and pastures implies that they have been so affected by heavy grazing, drainage, or the application of herbicides, inorganic fertilisers, slurry or high doses of manure that they have lost many of the species typical of an unimproved sward.

Invertebrate. Animals without a backbone, including snails, worms and insects.

J

JRC. Joint Revenue Committee

L

LAeq. This is the equivalent steady sound level in dB(A) containing the same acoustic energy as the actual fluctuating sound level over the given period.

Landfill. The engineered deposit of waste into or onto land in such a way that pollution or harm to the environment is minimised or prevented and, through restoration, to provide land which may be used for another purpose.

LB. Lothian Buses

Listed buildings. Statutorily protected buildings of "special architectural or historic interest". Under the Planning (Listed Buildings and Conservation Areas) (Scotland) Act 1997 the Scottish Ministers are empowered to compile lists of such buildings which are ranked according to their quality as Category A, B or C(S).

LRT. Light Rail Transit

LTS. Local Transport Strategy

M

Mitigation. In the context of this report, mitigation is the provision of measures to remedy or reduce adverse environmental impacts.

MUDFA. Multi Utilities Diversion Framework Agreement

N

NATA. New Approach to Appraisal.

Native. A species which is considered to have reached Britain since the last Ice Age without the aid of man. Some non-native species have been found in Britain for hundreds of years eg rabbit (Oryctolagus cuniculus).

NEAR. North Edinburgh Area Renewal.

Nitrogen Dioxide (NO2). A brown, toxic gas found in the air, which is formed from nitric oxide (NO) which is produced by vehicle engines.

Noise bund. See environmental barrier.

NPPG. National Planning Policy Guideline.

O

OLE. Overhead Line Equipment.

Opening year. The projected date of scheme opening, which is projected to be 2009 for this assessment of the proposals.

Oxides of Nitrogen (NOx). The collective term used to refer to nitric oxide (NO) and nitrogen dioxide (NO2).

P

Particulate Matter (PM). Particulate matter is a term used to describe the solid particles which are present in the atmosphere, including organic and inorganic substances, present as both liquids and solids. Particles may be coarse, eg dust from roads, or fine, such as aerosols.

Peak hour. The busiest morning (AM peak) and evening (PM peak) hourly period in terms of vehicle flows. For this scheme, the "peak hours" are a representative hour within a longer peak period.

PPG. Planning Policy Guideline.

Population. All the individuals of one species in a given area.

R

Receptor. In terms of the assessment of the operational impacts of this scheme, a receptor is defined as a residential or commercial property which may be influenced by emissions from the tram or changed traffic flows. For the purposes of the assessment of construction impacts, a receptor is defined as a residential or commercial property, land under cultivation for production of horticultural produce (vegetables, fruit, flowers), areas designated by local, national, international bodies as of nature conservation interest, other sites, features or land uses where dust deposition can be demonstrated to harm receptors or the beneficial use or value of resources.

RPG. Regional Planning Guidance.

Runoff. Water which moves downslope over the surface of the earth either in a channel (channel runoff) or across the soil (surface runoff).

S

Scheduled ancient monument (SAM). Under the Ancient Monuments and Archaeological Areas Act 1979 the Secretary of State has a duty to compile and maintain a schedule of monuments of national importance called scheduled ancient monuments. These monuments represent the most important network of known archaeological features.

Scheme. The "scheme" is a shorthand term for the tram infrastructure proposals which have been assessed in the report.

Scheme Design. This reflects the geometrical and engineering characteristics of the tramline and its associated infrastructure proposed as well as the environmental mitigation proposals.

Scrub. Vegetation dominated by shrubs usually less than 5m tall, occasionally with a few scattered trees.

SDS. System Design Services

Semi-improved. When applied to grassland implies a transitionary category which show signs of modification due to intensive grazing, application of artificial fertilisers, slurry, herbicides or drainage and as a result the grassland is less diverse and natural than unimproved grasslands.

SEPA. Scottish Environment Protection Agency.

SER. Stop Equipment Room.

SESTRAN. South East Scotland Transport Partnership

Site of Special Scientific Interest (SSSI). A site statutorily notified by Scottish Natural Heritage as being of national importance for nature conservation.

SNH. Scottish Natural Heritage

STAG. Scottish Transport Appraisal Guidance.

Subsoil. The less well structured and less biologically active layer below top soil which acts as a reserve of nutrients and water for plant growth in the top soil.

Surface Water. Any uncontaminated waters which drain off the surface of the ground can be made to drain or be pumped from an area of ground by the actions of a Contractor.

T

TEE. Transport Economic Efficiency.

Temporary Works. All temporary works of every kind required in or about the construction, completion and maintenance of the Works.

Transport Edinburgh Limited. Single economic entity within which Edinburgh Tram and Lothian Buses will operate.

V

Viaduct. Bridge comprising a series of spans with supporting piers for carrying a road over a valley, railway, road etc.

W

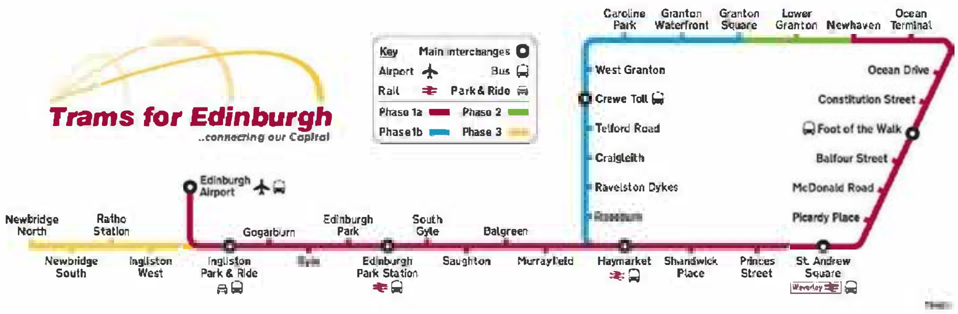
WEL. Waterfront Edinburgh Limited.

Wildlife corridor. A strip of habitat, for example, a hedgerow, trackside verge or watercourse, which connects other patches of habitat and is used by wildlife as a means of moving between isolated areas of habitat.

13. EXECUTVE SUMMARY

13.1 This STAG2 report represents a comprehensive assessment of the appraisal case to construct and operate phases 1a and 1b of the Edinburgh Tram network. Figure S1 below shows the full planned network. Given that Phase 1 comprises two sections 1a (Newhaven to Edinburgh Airport) and 1b (Newhaven to Granton via the Roseburn corridor), a STAG2 appraisal has been undertaken for the core route (1a) alone and for Phase 1 in its entirety (1a+1b).

FIGURE 13.1 EDINBURGH TRAM NETWORK PHASING



13.2 The proposed phased implementation was assessed by Transport Edinburgh Limited (TEL) following the successful acquisition of powers to construct the project, recognising current affordability constraints

13.3 The route choice and phasing has been guided by the need to address the socio-economic, environmental and transport problems and opportunities and, in line with STAG guidance, to meet the Transport Planning Objectives for the proposal.

13.4 Analysis of the current socio-economic characteristics of Edinburgh revealed that the recent strength of the regional economy, with corresponding increase in population and jobs, is set to continue in future. Opportunities for growth exist in particular along Edinburgh's waterfront at Leith, Newhaven and Granton.

13.5 The lively economy is likely to result in both considerable inward migration and an associated increase in commuting. As a result the capacity and range of Edinburgh's public transport system will be required to increase to encourage growth and development opportunities to be met sustainably.

13.6 Mapping of the levels of economic deprivation, employment levels and levels of educational attainment show a considerable variance across the city. A number of trends are evident which make it possible to identify a range of pockets and corridors of deprivation. Areas of Granton and Pilton to the north, and a zone around Leith Walk, as well as around Saughton and Balgreen in the west are identified as areas where socio economic status is considerably less affluent than surrounding areas. Employment, income levels and car ownership tend to be comparatively low in these areas which result in a notably higher index of multiple deprivation.

13.7 Direct connection to the city centre and other employment areas which would be facilitated by the proposals would undoubtedly improve the situation for these areas. Despite the high levels of car ownership at the city wide level, similar pockets of low car ownership exist, broadly correlated to areas of high population density. The proposals would offer an attractive service to those areas which include Granton, Newhaven, Leith and Leith Walk, as well as Haymarket and Gorgie near the city centre and Saughton and Balgreen in the west.

13.8 Assessment of the environmental aspects of the proposal show that it would make a positive contribution towards objectives of reducing emissions and improving air quality in the Air Quality Management Area (AQMA) set up by City of Edinburgh Council (CEC). The proposal passes through the heart of the city centre would specifically contribute to these issues in the AQMA. Its contribution to mode shift would enable further progress towards objectives set in the Air Quality (Scotland) Amendment Regulations 2002 and to national objectives to reduce emissions of greenhouse gases. CEC have identified air quality issues in the western corridor of the city leading to the airport area, with a particular focus on Corstophine Road, St Johns Road and Drumbrae Roundabout, monitoring of this is being carried out with a view to determining it a second AQMA. The proposal would pass directly through this corridor, as a result contributing to air quality improvements in the area.

13.9 The public transport infrastructure in Edinburgh is currently reliant upon buses – primarily operated by Lothian Buses and First Edinburgh. Implementation of a wide range of bus priority measures has improved the bus service but the bus services remain vulnerable to the effects of increasing congestion across the city. In this regard the proposals would enhance the public transport 'offer' of the city, making contributions to mode shift and air quality objectives in the process.

13.10 Development of planning objectives is fundamental to development and appraisal of transport proposals. Planning objectives were developed taking cognisance of the Scottish Executive's national objectives and to incorporate the relevant policies in local planning documents. They were based significantly on the opportunities, problems and constraints in the waterfront – city centre – airport corridor.

13.11 The planning and policy context at national, regional and local levels was used as the basis to develop the following Transport Planning Objectives:

- To support the local economy by improving accessibility;
- To promote sustainability and reduce environmental damage caused by traffic;
- To reduce traffic congestion;
- To make the transport system safer and more secure; and
- To promote social benefits.

13.12 Scheme development and acquisition of parliamentary powers was undertaken in parallel for the northern loop route (formerly Line 1: Granton, Roseburn corridor, city centre, Leith) and the former line 2 between St Andrews Square and Newbridge/Edinburgh Airport. Each route went through a detailed route and option development process, including full STAG2 appraisals.

13.13 Extensive consultation was undertaken during the development of Lines 1 and 2. This continued through the Parliamentary process, notably the management of and negotiation with objectors to the Bill. A separate strand during this time and subsequently has been the creation of Community Liaison Groups to inform further development of the scheme. A Business Liaison Group has been set up for traders on Leith Walk and Constitution Street.

13.14 The proposed service pattern for Phase 1 is as follows:

13.15 **2011** opening date 6 trams per hour Edinburgh Airport to Newhaven via Princes Street (Phase 1a), combined with 6 trams per hour Granton to Newhaven via the Roseburn corridor and Princes Street: combined 5 minute frequency between Haymarket and Newhaven (Phase 1b), rising to:

13.16 **2031** 8 trams per hour on each leg: combined frequency of a tram every 3 ¾ minutes.

13.17 Total out-turn capital costs for phase 1 are **£580m** including a 16% allowance for risk and optimism bias. **£495m** of this cost would be attributable to phase 1a if built alone. Operating and maintenance costs for phase 1 are expected to be **£15.8m** in 2012, although after allowing for advertising income and savings in bus operating costs, net costs are **£4.5m**. For phase 1a alone, the equivalent figures are **£14.4m** (gross) and **£3.1m** (net).

TABLE 13.1 TRAM CAPITAL COST EXPENDITURE PHASE 1A AND 1B

Item	Cost (£m)
Scheme 1a + 1b Costs	
Out-turn costs, assuming 6% construction price inflation	499
Of which	
Risk and optimism bias component	81
% risk and OB	16%
Total – out-turn – Scheme 1a + 1b Costs	**580**
Total – out-turn – Scheme 1a only	**495**

Note: These were the capital costs at the point of a 'freeze' in their development. Further work has since been done on costs, resulting in marginal changes, the results of which are reflected in tie's Financial Business Plan. The differences have a relatively marginal impact on the economic appraisal, the results of which are available in a technical note.

13.18 Extensive work has been undertaken to build new demand forecasting models to predict use of the tram and the impact upon use of other transport: bus, rail and car. Annual demand for phase 1a is predicted to be **10.6m** tram passengers in 2011 (**13.2m** for 1a+1b) (assuming that 75% of modelled demand occurs in the first year), rising to **24.3m** in 2031 (**31.6m** for 1a+1b). This growth is predicated on substantial growth in the total travel market, as well as additional predicted commercial and housing development as a result of the scheme. Table 13.2 and Table 13.3 below summarise demand.

TABLE 13.2 EDINBURGH TRAM PHASE 1A DEMAND (TRIPS PER 2-HR PERIOD)

	2011		2031	
	AM	IP	AM	IP
Eastbound	2,689	2,005	3,967	4,331
Westbound	4,041	1,696	11,876	3,956
Total	6,730	3,701	15,843	8,287
Annual (m)	10.61		24.32	

TABLE 13.3 EDINBURGH TRAM PHASE 1A+1B DEMAND (TRIPS PER 2-HR PERIOD)

	2011		2031	
	AM	IP	AM	IP
Eastbound	3,664	2,607	6,839	6,276
Westbound	4,433	2,154	12,485	5,911
Total	8,098	4,761	19,324	12,187
Annual (m)	13.18		31.62	

13.19 Abstraction from (TEL and non-TEL) buses is predicted to be **8m** annually in 2011(**10.3m** for 1a + 1b), rising to **16.7m** by 2031 (**23.6m** for 1a +1b)**.** About **17%** of tram patronage is attracted as new public transport patronage in 2011, rising to **20%** in 2031. The expected reduction in person car trips would be **2m** in 2011 (**2.3m** for 1a +1b) rising to **6m** by 2031 (**6.4m** for 1a +1b).

13.20 Tram revenue is projected to be **£7.4m** in 2011**(£9.4m** for 1a +1b), rising to **£21.1m** in 2031(**£27.9m** for 1a +1b).

13.21 For appraisal purposes, the tram project has been appraised against a 'reference case' alternative rather than a conventional 'do minimum'. This is to sensibly reflect the traffic management and bus policies that it would be necessary to introduce to cater for travel demand growth, should the tram scheme not be implemented. This includes, for example, the closing of Shandwick Place to through traffic (private cars) both with and without the tram.

13.22 Table 13.4 summarises the transport cost:benefit impacts.

TABLE 13.4 SUMMARY APPRAISAL RESULTS OVER 60 YEARS

	Scheme 1a only - Economic impacts (£m PV, 2002 prices)	Scheme 1a + 1b - Economic impacts (£m PV, 2002 prices)
User Benefits (consumer)	301	529
User benefits (business)	129	200
Private sector provider impacts	-44	-15
Present Value of Scheme Benefits	385	714
Accident benefits	-12	-5
Present Value of Scheme Benefits incl. Accidents	374	709
Present Value of Scheme Costs	340	436
Net Present Value (£ m)	34	273
Benefit : Cost Ratio	1.10	1.63

13.23 There is a healthy NPV of **+£273m** and **£1.63** of benefits for each £1 of costs, for the full phase 1 scheme, indicating a scheme that offers good value for money in transport economic efficiency terms. The economic case for phase 1a alone is still worthwhile **+£34m NPV.** However, its value for money is much more marginal at **£1.10** for each £1 of expenditure.

13.24 Total transport benefits are weighted heavily in favour of those to public transport users. The case is not reliant on benefits to highway users although these are conservative, reflecting increase in development and traffic growth within the study area between ‘without’ and ‘with’ tram travel markets: this leads to a small increase in accidents also.

13.25 The key **Economic Activity and Locational Impacts** are projected to be:

- **Employment development**: In 2011, more than 40,000 sq.m of employment development is anticipated as a result of the tram. This rises to more than 114,000 sq.m by 2015 but drops back to an additional 96,000 sq.m by 2020 as the development pipeline recovers in the “without tram" scenario. Post 2020, the development pipeline recovers further, resulting in a net gain of 34,000 sq.m with tram.
- **Residential development**: More than 900 additional residential units are anticipated to come forward as a result of the tram (1a +1b) in 2011, rising to 5,250 by 2015 and 5,600 by 2020. The majority of these would be in Granton and therefore reliant on phase 1b. Post 2020, the development pipeline recovers, resulting in a net gain of 2,800 units with tram.
- **Employment generation**: More than 930 jobs, in present value terms, are expected to be generated or brought forward by the development impact of the tram, after allowing for displacement of jobs elsewhere in Scotland. 590 of these can be attributed to phase 1a alone.

13.26 There is also evidence that residents of the regeneration area of Granton will have improved access to more and better jobs and this will lead to greater inclusion within the labour market: this again is dependent on Phase 1b.

13.27 The key **Environmental** impacts are:

- Improvement in air quality, traffic noise and C02 emissions resulting from the transfer of car trips to public transport
- Cultural Heritage (Moderate Negative impact) relating to alignment through World Heritage Site and demolition/relocation of listed buildings
- Landscape (Major Negative impact) relating to World Heritage Site impacts, impact on open Greenbelt landscape and significant vegetation removal along railway corridors

13.28 Mitigation of environmental impacts would be maximised through sensitive design and construction practices.

13.29 In relation to the **Safety** objective, a very small increase in highway accidents is projected, reflecting an increase in the size of the travel market and vehicle kms in the "with-tram" scenario. Personal security will improve (moderate beneficial assessment) reflecting tram design elements (CCTV and help points at all stops and vehicles) and designed access arrangements aimed at enhancing security. The planned high use of inspectors on vehicles will assist this objective.

13.30 There are two key aspects to the **Integration** objective. The tram scheme will enhance the opportunity to make journeys on the Public Transport network through bus-tram service integration plans and ticketing arrangements, reflecting specifically designed stops and interchange facilities for effective integration with the bus and rail networks, most notably at:

- Edinburgh Airport
- Waverley, Haymarket and Edinburgh Park rail stations
- St Andrews Bus Station and the bus hubs at Ocean Terminal, Gyle Shopping Centre and Crewe Toll
- Expanded Park & Ride at Ingliston and potentially other locations

13.31 In relation to land-use policy and proposal integration, the scheme integrates positively with land-use policies and proposals as detailed in:

- National Policy – National Planning Framework (NPF) and Scottish Planning Policy (SPP17)
- Regional Policy – Developing SESTRANS Regional Transport Strategy and Edinburgh and Lothians Structure Plan 2015
- Local Policy – Edinburgh Local Plans and associated development proposals, most notably Leith Docks Western Harbour development, Granton Waterfront and Haymarket-Airport including Edinburgh Park/Gyle.

13.32 In relation to **Accessibility,** the tram scheme improves accessibility to identified key trip attractions/destinations from a substantial portion of Edinburgh e.g:

- George Street / Frederick Street junction – representing the focal point of the city centre (employment, shopping, leisure and access to Waverley rail station with integration with bus and rail) in terms of overall public transport accessibility;

- Haymarket rail station (integration, interchange with bus and rail)
- Leith Ocean Terminal (employment)
- Edinburgh Airport (employment, transport interchange)
- Gyle Centre / Edinburgh Park (Shopping / Employment).

13.33 Level boarding on all tram vehicles will enhance accessibility for the mobility impaired.

13.34 The formal Appraisal Summary Tables are included within Chapter 9 of the main report.

13.35 The **Revenue and Risk Analysis** indicates that:

- Healthy tram patronage and revenue can be generated and a positive TEL net revenue situation can be maintained
- Key revenue risks centre on development/planning growth, economic outlook and performance and public perception
- Some key levers are available to help mitigate risks on TEL revenue, most notably fares strategy, tram design and service integration refinements.

13.36 In **Conclusion,** a "reference case" Economic Appraisal suggests that the 1A+1B scheme offers good economic value for money with a **BCR of 1.6:1**

13.37 Scenario and sensitivity testing suggests that:

- 1A alone is a significantly poorer performing scheme but achieves BCR parity
- Planned economic/development growth being achieved is central to maximising benefits and patronage
- Tram design will need to deliver on quality/runtime if benefits are to be realised

13.38 EALI analysis indicates that **net** wider economic impacts will accrue from the tram scheme having taken account of economic impacts that might accrue in any case and displacement of these benefits from elsewhere in Scotland.

APPENDIX A

LINE 1 APPRAISAL SUMMARY TABLES

Table 4.2 Summary of OBC Appraisal Results

Proposal details			
Proposal name	Waterfront Light Rail Loop	**Promoter name**	Waterfront Edinburgh Limited in association with 14 other organisations in both public and private sectors along the preferred route.
Proposal description	A light rail service creating high-speed reliable public transport links between the Granton regeneration area, central Edinburgh and central Leith and multiple intermediate points.	**Estimated costs** • **Capital (undiscounted)** • **Annual**	Estimated costs • £191 million • £5.4 million
Funding sought from	Not applicable	**Amount of application (if applicable)**	Not applicable
Proposal background			
Planning objectives	This appraisal is based on the fact that the City of Edinburgh has approved the masterplan for the Waterfront regeneration area. Hence, the planning context is the question of identifying the best transport structure to support the achievement of the masterplan in keeping with the transport priorities for the City as a whole. The planning objectives which have informed the process leading to this appraisal are the six aims set out in the Local Transport Strategy 2004-2007 for Edinburgh[9]: • to improve safety for all road and transport users; • to reduce the environmental impacts of travel; • to support the local economy; • to promote better health and fitness; • to enhance social inclusion; • to maximise the role of streets as the focal point of local communities, where people can meet, shop and, in appropriate circumstances, children can play. Supported by the principal aim of the Waterfront Granton Master Plan[10]: • To create a place which involves and benefits the existing communities of Granton and which attracts investment in a full range of employment uses, housing opportunities, leisure, cultural and community development. (*The Vision*, Waterfront Masterplan, page 1)		
Performance against planning	A scheme very similar to this one ("North Edinburgh Light Rail") was appraised as part of a study carried out for SESTRAN to develop a strategy for travel to and within Edinburgh[11]. The appraisal was carried out against a set of criteria extremely close in spirit and content to the LTS aims cited above. Of 80 schemes (across the Edinburgh area) considered, it performed fourth best. It was the strongest contender amongst those schemes facilitating accessibility for		

9 City of Edinburgh Council Local Transport Strategy 2004-2007 2001-2004, p15

10 Three volumes, published by City of Edinburgh Council, Scottish Enterprise Edinburgh and Lothian, Scottish Homes, December 2000 (Llewelyn-Davies et al)

11 Appraisal of Strategies for Travel to and within Edinburgh, WS Atkins, September 2000

objectives	the Granton site as well as Leith and Newhaven. In effect, the technology favoured (light rapid transit) has a further strength given that the best performing measure from the 80 is also a light rapid transit scheme (Edinburgh Light Rapid Transit). Given the above and the fact that the pool against which the option was compared was so large, it is fair to say that the favoured scheme is a strong contender when considered against the planning objectives set out above.
Alternatives to proposal considered	This study has considered alternative technologies and routes for a rapid transit in North Edinburgh. A review of available technologies indicated that either light rail or kerb guided bus were possible candidates: other technologies were discounted. A large number of route options were considered before three routes were identified as suitable for detailed consideration. These were: • Scenario 1 – Granton to Haymarket via the Roseburn link. • Scenario 2 – Granton to St Andrew's Square, via Haymarket, Prince's Street and Waverley. • The Northern Loop – a loop link Granton to St Andrew's Square as per option 2 before continuing to Leith via Leith Walk and then along the waterfront to Granton Square. In the earlier SESTRAN study, alternative means of facilitating good links to the Waterfront/Granton development considered were[12]: • North Suburban Rail Link • North Edinburgh CERT • Upgrades to bus services (frequencies and start/finish times) and priorities (lanes, selective vehicle detection) • Improvements to cycle access and parking These options are not mutually exclusive (cycle accessibility improvements are probably compatible with a light rapid transit scheme); for the purposes of this exercise, however, each of these are considered as the principal element of a strategy to provide Granton, Leith and Newhaven with good links.
Comment on performance of alternatives	Demand forecasting and financial appraisal undertaken as part of this study showed that for light rail: • Scenario 1 – operating costs are not covered by revenue streams; • Scenario 2 – operating costs are covered by revenue streams, but the case was marginal. The financial case for the scheme is highly dependent upon the outturn development at Granton and elsewhere in North Edinburgh The Loop had a strong financial case, which is strengthened by additional demand from developments planned for Granton, Leith and elsewhere. Despite other benefits from light rail options 1 and 2, the financial analysis indicated that only the Loop should be taken forward. Guided bus options were also considered for the three routes. The analysis showed that the financial case was not strong. While covering operating costs from revenue, the system was unlikely to be attractive to private sector operators as the potential return was low. Moreover, an implementability issue was identified, associated with the institutional problems of establishing a concession. Engineering investigation showed other than along the Roseburn link and around Leith port, the guided bus would actually be operating on-street in the Greenways with other buses: it would not offer a step change improvement for much of its route. Light rail was identified as bringing much greater benefits and was therefore the preferred technology. Similar findings were found from earlier work. The appraisal exercise undertaken for SESTRAN produced the following rankings for the schemes mentioned above: **Scheme** **Rank** • North Suburban Rail Link 49

12 The density of development proposed for the site is such that predominantly car-based access would be unworkable (regardless of its relative acceptability in wider policy terms). The set of alternatives from which the favoured option has been drawn therefore reflects the assumption that "good links" implies good public transport access.

	• North Edinburgh CERT 11 • Upgrades to bus services 18, 40 46, etc[13] • Improvements to cycle access and parking 13 North Edinburgh CERT, the favoured option's nearest equivalent amongst the alternative schemes, visibly does not perform as well. This reflects a poorer showing under the headings of accessibility and integration. The various bus improvements could be seen as the obvious "low cost" option for access to Waterfront/Granton. The relatively poorer ranking of its components indicates that it would do less well in meeting the key aims set by Edinburgh. The North Suburban Rail Link would not serve Waterfront/Granton directly as it would terminate in Leith so its value must be judged in the context of the requirement for bus feeders to make it a viable transport connection for the site. Given that it performs poorly in relative terms even without this consideration, it can be seen to be a very weak competitor. The performance of cycle options suggests that, whilst it is not credible as a stand-alone strategy, it might significantly enhance the overall transport picture in combination with a major scheme.
Rationale for selection of proposal	The light rail loop option: • Has a strong financial case; • Brings economic benefits to a wide area; • Goes towards meeting the planning objectives of the Edinburgh LTS; and • Will help contribute to the regeneration of Leith and Granton waterfronts. The other two light rail options examined are not considered financially viable. Guided bus alternatives have a poor financial case, have difficulties associated with their implementation and bring benefits which are at a much smaller scale to those that light rail will achieve. This study's findings are supported by the earlier SESTRANs work, which concluded that light rail is the best technology for meeting the planning objectives set out for Edinburgh.
Spatial and social information	
Area context: general	The Loop serves a large area within Edinburgh, salient within which is the Waterfront/Granton regeneration area (described below). Central Edinburgh is an increasingly vibrant business and leisure/tourism centre for which congestion charging is being taken forward by the City Council. Leith, until recently itself an area of significant deprivation, has seen considerable improvement of late but still has some regeneration needs of its own.
Economic performance	Parts of Edinburgh are enjoying considerable prosperity and can be expected to continue to do so. Meanwhile, areas within the City suffer significant deprivation: Granton, Pilton and Muirhouse make up the North Edinburgh Social Inclusion Partnership Area and have demonstrable economic deprivation. Recent regeneration in Leith has improved the situation there, but there are still significant areas of economic need there too. Granton Waterfront has been independently identified as a regeneration area.
Deprivation/ social exclusion	North Edinburgh has larger household sizes than Edinburgh on average though 24% of households in Granton are single-parent households. Owner occupied homes represent only 12% of the dwellings. Access to a car is relatively low: 66% across NEAR (North Edinburgh Renewal Area). 62% of a sample surveyed in West Granton had left school without qualifications. The fulfilment of the Waterfront/Granton Masterplan is expected to have considerable positive effects on the economic and social situations of local people.
Planning and	Edinburgh is for the most part highly urbanised with large sections of prized built heritage. There are significant conservation areas across Edinburgh (the

13 The bus improvements were separated into a number of service and infrastructure initiatives

environment	centre being a World Heritage Site) which the further design of this scheme will clearly have to respect. The planned alignment on the Roseburn railway bed is protected and is currently used as a cycle path and de facto linear park. Granton Waterfront is an area designated for redevelopment and is subject to a Masterplan which has been adopted by the City Council.
Spatial level of appraisal	Impacts on the whole of Edinburgh are considered as the primary level of appraisal. In addition, the particular issue of access to and from Waterfront / Granton is considered separately – here the regeneration area is the sector of concern. The *net* wider economic impacts are analysed at a Scotland level.
Implementability appraisal	
Transport land-use integration	This statement is based on the examination of: • Major Issues Paper (preparation for replacement of the Lothian Structure Plan 1994) • West Edinburgh Local Plan (consultation draft as at 27/3/01) The favoured scheme is in keeping with the principles voiced in the Major Issues Report. It describes a "development direction" within Edinburgh along the lines of a "compact city" and speaks of the scope for further development intensification in two locations in particular, one of these being Waterfront. The possible benefits of reusing brown-field land and providing job opportunities for local people are contrasted with the danger of town cramming. The draft Local Plan actively embraces the Masterplan for Granton Waterfront and states that "the regeneration of this area is a priority objective of the Council"[14]. The draft local plan also contains no obvious conflict with the scheme. Its underlying objectives are those set out in *Changing Edinburgh for the Better*[15]: There are four themes to the objectives in the Local Plan. They are: • Sustainable Development • Regeneration and Equality • Quality • Diversity and Identity The first two are of most relevance to the Waterfront project. They include the objective to reduce car dependency and the need to travel, and to promote more sustainable travel choices: the greater use of public transport, walking and cycling. In addition, with regard to regeneration and equality, the objectives include opening up opportunity and developing stable and balanced communities in identified priority areas. In the Transport chapter, the following is said: "the Council also considers that a … high quality, public transport link should be provided to access the Granton Waterfront area, to enable this to achieve its full economic and employment potential" (8.25). These objectives are also presented in the chapter: • To facilitate development and activity in locations which promote accessibility, minimise car use and the need to travel and favour more sustainable means of transport – walking, cycling and public transport. • To minimise the incentive to use the car, particularly in areas where the direct adverse impacts of this are most severe. • To minimise the transport and parking impacts of new developments on neighbouring areas/people and the environment. • To ensure that development takes account of user and community safety, having regard in particular to vulnerable groups such as children and cyclists. The scheme will clearly contribute directly to the achievement of the first two of these and it, in combination with the realisation of the Masterplan, will contribute to the achievement of the third and fourth.

14 Executive Summary
15 City of Edinburgh Council, March 2000

Policy integration	The development of a light rail loop in North Edinburgh fits well with the policy direction outlined in the Government's 1998 White Paper. It also fits well with regional transport policy as established by SESTRANS. The scheme is fully in accord with the Edinburgh Local Transport Strategy 2004-2007. At a local level, the scheme will contribute to the achievement of the strategy of the Social Inclusion Partnership (SIP) of NEAR in the following key ways: • By providing excellent transport links to new job opportunities in the Waterfront area and in central Edinburgh, the scheme will open up significant potential for the residents of the area; • The scheme will link residents to the substantial amenities planned for the Waterfront as well as those already existing in Edinburgh at large. When looked at in combination with the Waterfront Masterplan for land-use, the principles of community involvement and strategic planning inherent in the latter are clearly in keeping with the SIP's strategy. The preferred scheme will support and complement the Waterfront Masterplan.
Distribution impacts	The accessibility impacts of this scheme will be felt particularly strongly amongst the poorer communities served by the stops Drylaw, South Pilton, West Pilton and Caroline Park amongst whom car availability is generally low. Relatively large numbers of these people are unemployed. The expectation is that a substantial number of the jobs created at the Waterfront site will be in-scope for this community given its skills levels but a clearer picture of the likely numbers will become apparent on further analysis.
Technical feasibility	A technology review has demonstrated that the preferred light rail solution is both proven, with many applications worldwide and is feasible for the options put forward. The review showed that the only feasible alternative technology in this context was kerb guided bus, an option that has been ruled out for reasons other than technological feasibility.
Operational feasibility	The issues are: • Maintaining patronage – lack of flexibility with light rail; need to develop alignment, at considerable cost, if patronage changes. • Choice of vehicle – if vehicle becomes outdated, obsolete, or servicing arrangements are not maintained by manufacturer then the system's fleet could be at risk. Risk typically occurs where technology choice is bespoke and from one manufacturer only. Generally, light rail is flexible enough to mitigate this risk due to the extensive vehicle market.
Technical risks	• Operation of a light rail system through the city centre, specifically Prince's Street, St Andrew Square and Leith Walk, which will need reconfiguration to produce an efficient LRT operation without unduly affecting other transport proposals such as CEC's 'Managing Traffic in Central Edinburgh'. Finding agreement with interested parties for these areas, particularly Princes Street, which is a World Heritage Site. • Depending on chosen alignment there is potential for additional costs associated with immunisation of Network rail signalling cables at Haymarket, depending on the proximity of the nearest LRT & heavy rail running rails. These costs cannot easily be quantified for the Outline Business Case (OBC) as this requires detailed alignment design before definitive consultations can be had with Network rail; these consultations will be incorporated in the next phase of design development. • Fitting the alignment within Starbank Road knowing that current parking provision would be removed and parking outlawed, especially in light of the distance from residences to alternative parking sites. • Influence upon 'Greenways' and conflict with existing bus operations. • Impact of service diversions – accurate cost estimates not possible for OBC. • Impact upon ESW Stormwater Outfall facility at Trinity Crescent and its associated operations – precise details unknown for OBC.
Other risks	• Danger that the necessary political will to drive implementation of requisite priorities will not come about. • Possibility that the Waterfront/Granton Masterplan fails to deliver all that is promised of it and expected patronage and social benefits do not materialise. • Demand fails to transfer elsewhere on the route for other reasons (e.g. change of travel patterns, changes in wider transport policy).

Affordability	It is expected that the capital costs of this project will be met from a number of sources, including some form of developer contributions and grant-funding from the Public Transport Fund. A condition of the scheme's more detailed design is a robust case for the capital costs to be covered from established sources supported by a properly argued explanation of the capital cost estimates.	
Financial sustainability	One key reason for the selection of the Loop alignment for rapid transit is the strong indication that revenue will cover operating costs. Forecasting and appraisal work to date indicates that the preferred option will not require ongoing revenue funding.	
Public acceptability	Preliminary consultation has been carried out with a range of representative bodies (such as the NEAR Group, the Pilton Partnership, the Greater Pilton Community Alliance) in North Edinburgh to gauge the attitude of stakeholders to the proposed scheme. The response to date has been almost wholly positive.	
Objective	**Assessment**	**Supporting information**
Transport: what are the transport impacts of the proposal	Those transferring to the system from bus and car are forecast to enjoy significant benefits in terms of travel time savings, quality improvements and gains in travel time reliability. There will in addition be decongestion benefits for continuing users of the road network.	Patronage has been forecast on the basis of current and projected demand and forecasts of development related demand. The network used was drawn from the established model for transport in Central Scotland (CSTM3) which includes a detailed representation of the highway and public transport networks in Edinburgh. A mode choice model was developed that explicitly allowed the consideration of attributes of alternative modes. An initial cost benefit analysis demonstrated that the preferred option has an economic NPV of £275m, a Benefit Cost Ratio of 2.65:1 and an Internal rate of Return of 10.1%
The local economy: what will be the impacts in terms of employment	Preliminary analysis suggests that were the scheme not built, developments at Waterfront Granton might be delayed and may come about at a smaller scale. A "mid-case" projection of impact indicates that 6,700 additional new jobs will arise as a result of the scheme in the regeneration area. Between 500 and 1,000 of these new jobs would result from displacement and would therefore be additional at the Scotland level.	These numbers are provisional and the fuller ramifications of the scheme in distributional terms will only be understood once the type and scale of development has been more closely analysed.

Environment : what will be the impacts on the environment	The principal environmental impact of this scheme will lie in its effect on the built heritage of Edinburgh and, in particular, the section of Princes Street that is a World Heritage Site. Overhead power supply is likely to bring visual intrusion which may excite resistance but its careful management could mitigate the degree of perceived damage. The aggregate noise and vibration impacts will depend on associated bus operations but the scheme can be expected to have at worst a neutral impact and at best a positive effect. The effect on air quality is expected to be positive because of decongestion effects on general traffic and the likely reduction in bus numbers and their associated pollution. Efficiencies in power production will lead to an overall reduction in greenhouse gas emission. Impacts on water quality, drainage and flood defence is likely to be negligible. There will be an impact along the Roseburn corridor, which is used as a cycleway and footpath.	An environmental scooping study was undertaken to support the Part 1 environmental assessment.
Safety: what will be the effects of the proposal on road and pedestrian safety	Accident savings are expected from the general reduction of traffic, but there is a danger that these are partially offset by accidents involving pedestrians and light rail vehicles given their novelty in Edinburgh. The groups benefiting most from the gains will be pedestrians and cyclists. There may also be gains in sense of personal security if, as envisaged, the scheme results in a more bustling, continental street atmosphere. In general, greater reliability will support the feeling of security and bring larger passenger flows, increasing the comfort of passengers, particularly women and the elderly.	
Accessibility : what will be the impacts on accessibility	Given low car ownership in certain key areas served by the scheme, change in base accessibility can be expected to be for the better particularly as the Loop alignment will provide good links between points in Edinburgh which are poorly connected by public transport at present. Severance benefits can be expected as the scheme creates a strong connection between the Waterfront area and points surrounding it. It should be possible to cross the alignment at any point along its length provided sufficient care is taken.	The change of severance impact relates to walk trips, the majority of which would not normally take place at present given the state of the regeneration site, but which can be expected in light of the jobs, housing and amenities which are to be located there.
Transport integration: what will be the impacts in integrating transport modes and services	The scheme will bring good links with mainline rail at Haymarket and Waverley. If buses continue to hub at St Andrew Sq. and with the forthcoming new coach station at that location, there will clearly be considerable interchange opportunities at this site for trips within and outside Edinburgh. In all these cases, the "turn up and go" frequencies of the scheme will mean that travellers will not need to worry about scheduling of interchanging services. The expectation is that bicycles will not be accommodated on the vehicles but the provision of good parking facilities at stops will ensure strong perceived links between the two modes on the part of users. The nature of ticketing remains to be established but this too could aid the integration of transport options within the SESTRAN region.	

Table 7.38 Appraisal Summary Table for Preferred Route: Part 2

Proposal Details			
Name and address of authority promoting the proposal		City of Edinburgh Council	
Proposal name	Edinburgh Tram Line 1	*Name of planner*	
Proposal description	Introduction of a tram line circular route serving Edinburgh city centre, the two main rail stations and the regeneration areas of Granton and Leith.	*Capital Costs/Grant* *Revenue Support* *PV Costs*	£274.15m (capital cost) £6.29m/year (operating cost)
Funding sought from	Scottish Executive	*Amount of application*	N/A
Proposal Background			
Geographic context	Edinburgh is the capital of Scotland, a World Heritage city, spread over 100 square miles in area, built upon a jumble of hills and valleys.		
Social context	High population density in areas covered by the route. 39.5% of households in Edinburgh do not have a car (2001 Census), and the route will serve much of the areas of low car ownership. The north east part of Edinburgh (served by the route) is the most deprived and of lowest income levels. Unemployment is at a 25-year low. The tram services will enable non-car owners and the socially excluded increased access to the public transport network.		
Economic context	Edinburgh's regional economy is expected to be the fastest growing economy of any major UK city over the next five years, with correspondent growth in population and jobs.		
Planning Objectives			
Planning objectives	*Performance against planning objectives*		
▪ Improve accessibility ▪ Promote sustainability ▪ Reduce congestion ▪ Improve safety and security ▪ Social benefits	▪ Line 1 will improve accessibility to employment opportunities, education, shopping and leisure destinations, contributing to improve the local economy. ▪ The scheme will contribute to sustainable travel (zero emissions produced by trams in urban areas, reduced noise, townscape benefits) and less congestion (more public transport trips and less car trips). ▪ The tram system will provide a safe and secure means for travel as well as a safe local environment. ▪ The tram will provide social benefits in terms of enhanced liveability on streets and accessibility to mobility impaired and deprived segment of the population.		
Rationale for selection of proposal	George Street and Princes Street options have comparable capital costs. Run times are slower on George Street, there are fewer opportunities for transport integration and accessibility and greater environmental and heritage impacts. Therefore, Princes Street is the preferred option. Telford Road option is more costly, slower and environmentally adverse than the railway solum, and would impact significantly highway operations, while the former railway solum is completely segregated; hence chosen.		
Implementability Appraisal			
Technical	The proposed alignment is technically feasible, as no untried technology is used, run times are maintained, urban design issues are acceptable and it is integrated with buses.		
Operational	Journey times can be minimised to maximise the attractiveness of the service and minimise operating costs and rolling stock resources. The line capacity is 640 seated and 1,840 total passengers per hour (pph) in each direction.		
Financial	The costs will be met from a number of sources, including developer contributions and grant-funding from Public Transport Fund. Revenue will broadly cover operating costs.		
Public acceptability	The results of the consultation show that there is broad support for trams, despite concerns with the impact on properties in proximity to the route, the requirement for CPOs in certain areas, disruption caused by construction, environmental impact, destruction of local wildlife and the impact of the tram on local traffic and parking.		
Environment			
Mitigation options included (cost/benefit)	Noise barriers have been assumed to be installed along some sections of the Roseburn Railway Corridor to reduce noise impacts at adjacent properties.		
Sub-objective	**Qualitative information**	**Quantitative information**	**Significance of impact**
Noise and vibration	Impact of noise from tram operations on receptors adjacent to the proposed tram route	• Roseburn rail corridor: Residential properties adversely affected by	• Significant (major) negative impact of tram noise on receptors

		tram operations. • Remaining sections of tram route: no significant impact.	along Roseburn corridor. These reduce to slight after mitigation.
	Residential receptors either side of the roads where traffic flow changes have been predicted	• 2011: Do minimum to with scheme: No change in population annoyed • 2026: Do minimum to with scheme: No change in population annoyed	• Neutral-slight negative impact on remaining route sections. • Neutral
Local air quality — PM_{10} and NO_2	In 2011 there will be an increase in properties near roads with improved air quality compared to the do minimum and more properties will benefit from roadside improvements than from degradations in roadside air quality, for both pollutants. In 2026 a greater number of households will be near roads with worse PM_{10} concentrations than better (due to predicted increased congestion in 2026), but with improved or unchanged NO_2 compared with the do minimum.	• 70,200 households with increase in PM_{10} in 2011 (134,500 in 2026) • 174,000 households with decrease in PM_{10} in 2001 (112,050 in 2026) • 3,400 households with no change in PM_{10} in 2011 (1,000 in 2026)	Moderate positive (2011) Neutral (2026)
		• 77,950 households with increase in NO_2 in 2011 (139,550 in 2026) • 177,250 households with decrease in NO_2 in 2011 (119,100 in 2026) • 26,200 households with no change in NO_2 in 2011 (22,750 in 2026)	Moderate positive (2011) Minor positive (2026)
Global emissions — CO_2	There will be a small reduction in CO_2 emissions in the long term	• No net change in CO_2 emissions in 2011. Net reduction of 10,000 tonnes in 2026	Minor positive
Water quality, drainage and flood defence	• Potential short-term increase in sediment-laden runoff during construction due to earthworks (slight adverse but mitigation measures will reduce potential). • Existing drainage will be utilised, but where new one is required the principles of SUDS will apply (slight adverse but mitigation will prevent impact). • The scheme is not located in high-risk flood areas and is not expected to increase flood risk (neutral). • Existing groundwater and hydrogeological resources will not be impacted (neutral).	• The scheme crosses the Water of Leith twice. • Works to the seawall at Starbank Road run adjacent to the Firth of Forth for 250m. Potential for impacts on water quality during construction.	Neutral
Geology	• The route will pass south of the designated Firth of Forth Geological SSSI. No significant impacts are predicted. • The route will pass 30m west of the RIGS site at Craigleith Quarry, now a retail park. The rock outcrops will not be impacted upon.	• 1 SSSI • 1RIGS	Neutral

Biodiversity	• The Firth of Forth is designated as SPA/Ramsar Site and SSSI, for supporting populations of European importance: Moderate adverse.	250m of the Firth of Forth will be affected in construction of the walk/cycleway over the sea wall, extending out by 3m (≅ 0.1ha in total).	• Moderate adverse
	• The Roseburn Corridor is designated as an Urban Wildlife Site for its function as a wildlife corridor: Large adverse.	Significant amount of vegetation lost from ≅ 3km of Roseburn Corridor between Roseburn Terrace and Telford Rd.	• Major adverse
	• Badger and bats have been recorded from the Roseburn Railway Corridor: Moderate adverse.	Badgers and habitats directly affected by works within Roseburn Railway Corridor.	• Major adverse
		Bats affected by reduction in foraging habitat along Roseburn Railway Corridor.	• Slight adverse
Landscape / Townscape	Townscape improvements at specific locations but major adverse impacts, primarily from OLE, in many sensitive areas. Significant vegetation removal and tree loss along the Roseburn corridor	World Heritage Site and Conservation Areas	Major adverse
Visual amenity	Varying range of visual impacts (mainly OLE) all along the route. Most significant in the New Town where iconic views are affected, open areas and Roseburn Railway corridor where views are opened up. Screening can mitigate in Railway corridor, but elsewhere design of tram system will need to fit to scene.	World Heritage Site and Conservation Areas	Major adverse
Agriculture and soils	No agricultural land affected. Soils addressed above under '*Geology, Soils and Contaminated Land*'.		Neutral
Cultural heritage	• One listed building, the Caledonian Ale House (Category C(S)) at Haymarket is likely to require demolition. Mod adverse.	86 sites of potential significance in the swept path or buffer zone will be directly affected: • 16 sites of national importance; • 20 sites of regional importance; • 27 sites of local importance; • 23 sites of little or no importance. In addition, the setting of a further 230 listed buildings will be affected	Moderate adverse
	• The war memorial/clock at Haymarket (Category C(S)) may require relocation. Slight adverse		
	• The settings of groups of listed buildings will be affected (see Townscape).		

Safety

Sub-objective	**Item**	**Qualitative information statement**	**Quantitative information**
Accidents	Change in annual personal injury accidents	Standard rates and methodology from NESA	Change in annual accidents: -7.6 in 2011 and +51 in 2026, for all severity levels

	Change in balance of severity	Rates by severity level: fatal, severe, slight and damage.	Annual changes (2026): Damage = 45.4; Slight = 4.8; Serious = 0.6; Fatal = 0.1
	Total discounted savings	PV 30 years	PV £4.8m
Security		CCTV system at all stops and vehicles. Good proximity of tram stops to retailers and other urban activities. Positive design. Conductors present in all vehicles. Lighting and help points at all stops.	Moderate beneficial
Economy			
Sub-objective	**Item**	**Qualitative information**	**Quantitative information**
User Benefits	Travel Time	Public transport journey time savings: Roseburn Corridor / Pilton to Ocean Terminal / Leith 10+ min; access times to Granton development area improved by 10+ minutes from most of Edinburgh; access time to Haymarket from Granton and Leith improved by 5+ min.	£232,045m (PV)
	User Charges	Public transport fares	-£9,462m (PV)
	Vehicle Operating Costs		£5,579m (PV)
	Quality / Reliability Benefits	The higher quality afforded by Line 1 compared to the alternative public transport modes has been encapsulated in the demand modelling and appraisal through the use of differential in-vehicle time factors.	
Private Sector Operator Impacts	Investment Costs	Scheme's capital cost	-£213,542m (PV)
	Operating and Maintenance Costs	Operating cost = £6.29m pa. Bus operating costs savings = £2.2m pa.	-£77,144m (PV)
	Revenues	Reduction of bus revenue = £40,278m (PV). Rail revenue increase = £25,514m (PV).	-£14,764m (PV)
	Grant/Subsidy payments	Total grant for capital and operating costs = £321,827m (PV). Potential developer contribution of £9,563m (PV)	£312,264m (PV)
Economic activity and location impacts	Local Economic Impacts	• 5% of opportunities for low / no skill activities, some of which could be filled by residents of north Edinburgh regeneration areas. • Additional jobs at the regeneration area level.	• 35 – 100 jobs. • 0 – 10 jobs.
	National Economic Impacts	• No net additional employment is claimed at the Scotland level. • Half of extra jobs in the health sector are additional, which would not be filled without tram.	• No impacts. • 0 – 10 jobs.
	Distributional Impacts	• Not all jobs coming to North Edinburgh will be additional, as some will be relocations from other areas. Displacement assumed at 50%	• 35 – 100 jobs.
Integration			
Sub-objective	**Item**	**Qualitative information**	**Quantitative information**

Transport interchanges	Services & ticketing	Integrated transport services and ticketing contribute to more “seamless” journeys across the public transport network.	All users benefited – moderate beneficial
	Infrastructure & information	Infrastructure facilities at tram stops, grater opportunities for bus and rail interchange with the tram at key locations, real-time information at all tram and bus stops.	All users benefited – moderate beneficial
Land-use transport integration	Transport assessment	The scheme is expected to meet or support most local, regional and national policy objectives, in particular related to regeneration, improving access and sustainable travel.	Moderate beneficial
Policy integration	Fit with key policies	The scheme is consistent with national policies beyond transport (disability, health and social exclusion).	Slight beneficial
Accessibility & Social Inclusion			
Sub-objective	**Item**	**Qualitative information**	**Quantitative information**
Community accessibility	Public transport network coverage	Accessibility is significantly increased for travel from most zones to all the selected destinations (apart from travel from the south-west of Edinburgh to the north-east).	
	Access to other local services	The tram provides increased opportunities for walking and cycling as access modes, but it has limitations to promote further non-motorised trips to access local services.	
Comparative accessibility	Distribution / Spatial impacts by social group	Significant accessibility benefits can be realised, also for households without a car.	Some 4 times as many households with no car benefit than disbenefit as a result of the scheme.
	Distribution / Spatial impacts by area	• George Street: vast majority unaffected. Twice as many disbenefit than benefit; • Haymarket: vast majority unaffected. No accessibility disbenefits; • Leith Ocean Terminal and Foot of Leith Walk: many times more people/households benefit than disbenefit; • Granton and Crewe Toll: majority benefit significantly (i.e. reduction of 10+ minutes in journey times).	N° of households without a car benefit (disbenefit): • George St: 6,366 (12,604); • Haymarket: 17,337 (0); • Leith Ocean Terminal: 93,728 (53,176); • Foot of Leith Walk: 68,547 (39,127); • Granton: 161,998 (9,856); • Crewe Toll: 124,023 (9,286).
Cost to Public Sector			
Item	**Qualitative information**		**Quantitative information**
Public Sector Investment Costs			
Public Sector Operating & Maintenance Costs			

Grant/Subsidy Payments	Grant to the private sector to cover the capital (£213,542 PV) and operating costs (£108,285 PV) of Line 1 = £321,827m (PV). Potential developer contribution of £9,563m (PV).	£312,264m (PV)
Revenues	Revenue from operation of Line 1 Revenue from car parking	£116,241m (PV) £25,835m (PV)
Taxation Impacts	Reduction in tax receipts arising from reduced travel and congestion on the highway network reducing fuel and other vehicle related taxes. Increased use of public transport (non-taxed) will reduce tax take from former consumption.	£25,326m (PV)

Monetised Summary	
Present Value of Transport Benefits	£235,879
Present Value of Cost to Government	-£195,513
Net Present Value	£40,366
Benefit-Cost to Government Ratio	1.21

APPENDIX B

LINE 2 APPRAISAL SUMMARY TABLES

Table 2.6 Appraisal Summary Table – Performance Against STAG Objectives – Scheme Option: West Edinburgh

Scheme Description: A radial tram route from the city centre, initially parallel to the main railway line to Edinburgh Park then adjacent to the A8 from Gogar to Edinburgh Airport and Newbridge, with opportunities for Park and Ride and accessibility to development at Edinburgh Park and along the A8 corridor.

Objective	Qualitative impacts	Assessment Summary	Supporting information
Transport Impact	What transport problems will be addressed, how successful is the scheme option at achieving this.	+2	Relieving congestion that may be a barrier to development on a major radial corridor, providing access to key employment sites and supporting growth at Edinburgh Airport.
Environmental Impact:	How will the option contribute towards reducing harmful emissions and promoting better air quality, particularly in response to the impacts of transport on the environment.		
Local Air Quality		+2	Mode switch from car to tram could significantly reduce the environmental impacts of traffic in the corridor and at key locations. Improved public transport mode share for trips to Edinburgh Park, Gyle and Edinburgh Airport will also have localised impacts.
Built Environment Resources		-1	Route parallels the existing railway from Haymarket to Edinburgh Park with no impact on existing train operations. City centre issues common with North Edinburgh would apply.
Natural Environmental Resources		0	No significant impact on the natural environment, water quality, drainage and flood defences.
Safety	How will the option enhance safety for different types of road user, are there any impacts on personal safety/security.		
Accidents		+1	Mode shift from car and reduction in vehicle kilometres will reduce traffic related accidents.
Security		+1	Improved security for public transport from major developments such as Edinburgh Park and the RBOS site at Gogarburn.
Economy:	What will be the effect on traffic volumes, journey times and reliability for different modes of transport, will there be a significant de-congestion effect.		
Journey Times		+2	Significant journey time benefits to and from important locations such as Edinburgh Airport, Edinburgh Park and The Gyle
Reliability		+2	Segregated alignment should provide much better reliability. De-congestion will benefit all road users including bus passengers.
Economic Activity:	How might the option contribute to attracting new employment opportunities and stimulating development, particularly if accessible to areas of high unemployment.		
Regeneration		+2	Supports the West Edinburgh Planning Framework (WEPF) for development along the A8 and to secure expansion of existing sites while mitigating against the impacts of extra traffic. Supports Edinburgh Airport expansion and Surface Access Strategy.
Wider Economic Impacts		+2	Promotes employment opportunities outside of Edinburgh city centre where land values are higher and infrastructure constraints apply.

Objective	Qualitative impacts	Assessment Summary	Supporting information
Accessibility:	How does the option affect accessibility for transport users including access to jobs, education and health facilities, and does it contribute to promoting social inclusion.		
Social Inclusion		+2	Increased access to jobs and facilities outside Edinburgh city centre and improved public transport provision for communities in West Edinburgh, such as Bramhall.
Access to the Transport System		+1	Increased reliability along this important corridor will improve access to other parts of the transport system.
Transport Integration:	How will the option promote or enhance integration of transport modes, including interchange.		
Integration		+1	Fully integrated with land use planning and transport provision in the A8 corridor and consistent with the WEPF.
Transport Interchange		+2	Interchange opportunities with rail at Edinburgh Park, Haymarket and Waverley, with bus at suburban and central interchange points and serves Edinburgh Airport. Opportunities for Park and Ride close to the regional motorway network.
Policy Integration:	How well does the option fit with wider policies at a local, regional or national level, including its integration with or contribution to land use policy.		
Land Use Policy		+1	Supportive of WEPF and the projected increase in population in West Lothian and Fife that would commute to Edinburgh. Park and Ride would be in green belt.
Financial Sustainability:	Can the option meet its on-going operating costs and how likely is the option to attract any additional funding that may be necessary	+2	Opportunity for developer contributions to capital costs. Cost of alignment can be partly offset through use of WEBS. Cost of spur to Hermiston prohibitive due to crossing of Edinburgh Bypass, Union Canal and A71. Revenues are likely to cover operating costs.
Technical Feasibility:	How straightforward is it to implement the option, does this prejudice the costs or technical options available for other proposals.	+1	CAA stipulations will impact on available alignments but this only affects route choice.
Operational Feasibility:	Are there any factors that may adversely affect the ability to operate the option over its projected life without significant additional costs.	+1	No operational impacts identified.

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<table>
<tr><th colspan="4">Proposal Details</th></tr>
<tr><td colspan="2">Name and address of authority or organisation promoting the proposal: (Also provide name of any subsidiary organisations also involved in promoting the proposal)</td><td colspan="2">City of Edinburgh Council, PO Box 12470, 1 Cockburn Street, Edinburgh EH1 1ZF
Transport Initiatives Edinburgh, 91 Hanover Street, Edinburgh EH2 1DJ</td></tr>
<tr><td>Proposal Name:</td><td>Edinburgh Tram Line Two, West Edinburgh - Preferred Route Alignment</td><td>Name of Planner:</td><td>Alex Macaulay / Geoff Duke</td></tr>
<tr><td rowspan="3">Proposal Description:</td><td rowspan="3">The preferred route alignment operates from St Andrew Square via Haymarket and Edinburgh Park to Edinburgh Airport. A spur line will extend to Newbridge.</td><td rowspan="3">Estimated Total Public Sector Funding Requirement:</td><td>£336.3 M (@2003 incl. 31% Optimism Bias)</td></tr>
<tr><td>£0</td></tr>
<tr><td>- £198.935 M</td></tr>
<tr><td>Funding Sought From: (if applicable)</td><td>Scottish Executive</td><td>Amount of Application:</td><td>£336.3 M (@2003 incl. 31% Optimism Bias)</td></tr>
<tr><th colspan="4">Background Information</th></tr>
<tr><td>Geographic Context:</td><td colspan="3">The proposal will directly serve the corridor from Edinburgh city-centre to western Edinburgh including the communities of Dalry, Saughton, Broomhouse, Edinburgh Park, Gogar, Ingliston and Newbridge. The route will serve a mixture of commercial, residential and airport related land uses. The route will be predominately segregated and will minimise interaction with the built environment and will provide the opportunity to enhance the landscape adjacent to the Edinburgh – Glasgow rail line. The western section of the route will be within green belt. The west of Edinburgh currently suffers from growing congestion.</td></tr>
<tr><td>Social Context:</td><td colspan="3">There are a number of designated 'social inclusion partnerships' in the appraisal area, including geographical-focused initiatives operating in Broomhouse as well as more thematic initiatives operating in Sighthill and Stenhouse. The Scottish Indices of Deprivation 2003 indicate that some deprived wards lie within or adjoining the proposed route. West Edinburgh has a higher proportion of car ownership (72%) and availability rates per household than Edinburgh (60%) and Scotland (66%) averages.</td></tr>
<tr><td>Economic Context:</td><td colspan="3">The economic performance of the proposal area is influenced by the economic dynamics of the City of Edinburgh and its wider conurbation, and in particular Central and West Edinburgh. Edinburgh is the seat of administrative power for Scotland with the presence of the Scottish Parliament. The City and its city-region is also at the heart of the country's financial, business, legal, medical/healthcare and insurance markets, and therefore remains very strong in these key industries and sectors. The scheme will serve the commercial core of the city-centre, the major growth area at Edinburgh Park, Gyle Shopping Centre, the RBoS HQ and Edinburgh airport.</td></tr>
</table>

Planning Objectives	
Objective:	**Performance against planning objective:**
• To improve accessibility. • To reduce pollution and environmental damage caused by traffic. • To reduce traffic congestion. • To make the transport system safer and more secure for both users and non-users.	• The preferred alignment will provide an efficient, accessible, safe and affordable public transport network to the West of Edinburgh. • Traffic congestion and environmental impacts will be reduced due to fewer private vehicles on the road network at peak periods. • Accessibility will be increased along the corridor, in particular to employment opportunities including the Gyle, Edinburgh Park and RBoS. • The preferred alignment will improve accessibility to the West of Edinburgh thereby supporting development and regeneration in the corridor catchment area. • The tram system will provide a safe and secure means of travel.
Rationale for Selection or Rejection of Proposal:	Overall the preferred route alignment best satisfies the planning objectives and the Scottish Executive's five objectives relating to Environment; Accessibility; Safety; Integration; and Economy. The proposal will enhance the current level of public transport service, provide a safe and secure means of travel, assist in reducing traffic levels at peak periods and provide improved accessibility along the western corridor.

Implementability Appraisal	
Technical:	The preferred route corridor has been designed in detail and will involve a number of major structures. The proposed alignment is technically feasible. The tram technology is tried and tested. Detailed alignments ensure that good operational speeds can be maintained.
Operational:	Journey times can be minimised to maximise the attractiveness of the service and minimise operating costs and rolling stock resources. Interface with other public transport operators and likely competition is potentially a risk to successful operation. The proposed depot site (at Gogar Roundabout) occupies a central position on the tram mainline and allows phased implementation. The depot site has no major impact on the surrounding area (for example, no nearby residences to be affected by noise).
Financial:	Capital costs will be provided by the Scottish Executive. On-going operating cost will be covered by revenue generated by the Tram Scheme. Patronage modelling has shown that there is sufficient demand potential for the scheme.
Public:	The options taken forward to form the preferred route corridor have all achieved public acceptability. The corridor offers a fast link between the city centre and Edinburgh Airport that has minimal impact on the existing road network, whilst offering a clear improvement in public transport provision. Results of the consultation show that there is broad support for trams in Edinburgh (84%) and broad support for Edinburgh Tram Line Two (86%).

Environment			
Mitigation Options Included: (Costs & Benefits)	A number of mitigation measures have been implemented along the route. A comprehensive description of mitigation measures is provided within the Environmental Statement.		
Sub-objective	**Qualitative Information**	**Quantitative Information**	**Significance of Impact**
Noise and Vibration	Generally, changes in traffic flows will have a neutral impact on noise levels. Acoustic barriers would be required at Balbirnie Place, Baird Drive, Hillwood Rise and Station Road at Ratho Station to reduce noise impacts from the tram.	Following the STAG methodology an additional 3 people would be annoyed by traffic and 4 people by tram noise. An additional 76 people would experience an increase in noise from the tram of more than 3 dB(A).	Construction impacts would be major negative in some locations but short term. Operational impacts would be moderate negative at one location but otherwise minor negative.
Air Quality - Overall	The scheme was predicted to be beneficial due to an overall reduction in traffic flows during peak periods.	Properties with Improved Air Quality 2011: 175,893; 2026: 165,425 Properties with Degraded Air Quality 2011: 101,315; 2026: 105,842	Operational impacts would be moderate positive.
CO_2 - Global	CO_2 emissions for the scheme were lower than the Do-Minimum for both 2011 and 2026.	2011: -8339 tonnes of CO_2 2026: -24912 tonnes of CO_2	Moderate Positive
PM_{10} - Local	Overall, the exposure to PM_{10} concentrations is predicted to reduce.	PM_{10} Index 2011: -11,334 2026: -17,780	Moderate Positive
NO_2 - Local	Overall, the exposure to NO_2 concentrations is predicted to reduce.	NO_2 Index 2011: -47,669 2026: -39,193	Moderate Positive

Water Quality, Drainage and Flood Defence	Water Quality may be affected by run-off from construction sites and during operation of the route. Where over-bridging or culverting is required at the Water of Leith and Gogar Burn plus minor tributaries, there may also be water quality impacts. Groundwater may be affected by penetration of contaminated run-off to aquifers. Flood Defence may be compromised at the Gogar Burn Area of Importance for Flood Defence.	None	Water Quality – Minor Negative Groundwater – Neutral Flood Defence – Minor to Moderate Negative Impact
Geology	No geological SSSIs or RIGS will be affected by the development. Mineral reserves will not be affected. Waste management issues relating to disposal of potentially contaminated waste during construction and operation may occur.	None	Geological sites – Neutral Impact Mineral Reserves – Neutral Impact Waste Management – Minor Negative Impact
Biodiversity	Several areas of habitat will be lost including sections of the wildlife corridor adjacent to the main Glasgow/Edinburgh railway line. The Gogar Burn Site of Interest for Nature Conservation (SINC) and Water of Leith Urban Wildlife Site (UWS) will be affected by the construction of bridges. Badgers at Gogar area in particular will be affected during construction and operation.		Habitats – Minor to Moderate negative impact Wildlife Corridors – Minor negative impact Badgers – Moderate negative impact
Visual Amenity	Various significant and negative visual impacts would result for receptors where the tram proposals, specifically the OHLE, poles, new and altered structures would fundamentally change views / visual amenity and impinge on iconic vistas and long views.		Visual impacts would be moderate negative for receptors in localised sections of the tram corridor. The only major negative impacts would occur for views from No. 4 Ingliston Rd, Princes St and St Andrew Sq.

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Agriculture and Soils	Agriculture - There would be a Minor Negative impact for individual farming plots, because the area of land take is small in terms of the scale of the farming operations. However, land segregation would result from Tram Line 2 alignment and this is a Moderate Negative impact because of the combined effect of Class 2 Agricultural land take. Contaminated Land - Areas of contaminated land may be disturbed by the construction of Line 2.	Agriculture - The extent of agricultural land take will be quantified in the Book of Reference as part of the parliamentary bill submission. In addition, areas of agricultural land will be lost due to Tram Line 2 alignment as the remaining field area is too small for viable farming use (as discussed in AG2: Permanent Impacts).	Agriculture – Neutral to Moderate Negative Contaminated Land – Minor Negative
Cultural Heritage	Between Queen St and Haymarket visual effects would occur on the setting of the World Heritage Site, New Town Gardens Designed Landscape, New Town and West End Conservation Areas, and Listed Buildings. Potential direct effects may occur on a range of Listed Buildings and other features of architectural interest. Between Haymarket and Newbridge direct effects may occur on the Scheduled Ancient Monument at Huly Hill, Newbridge and other sites and areas of archaeological significance. Visual effects would occur on a range of Listed Buildings, and a minor direct effect would occur on the Jenners Depository.	1 World Heritage Site, 1 Inventory status Designed Landscape, 2 Conservation Areas, 140 Listed Buildings. Parts of 18 Listed Buildings may be directly affected. Three unlisted railings may be affected. 1 Scheduled Ancient Monument and up to 11 sites or areas of archaeological significance and 1 Listed Building would be directly affected. 22 Listed Buildings would be indirectly affected.	Queen Street – Haymarket: major negative Haymarket – Gogar Roundabout: minor negative Gogar Roundabout – Newbridge: moderate negative
Landscape	The World Heritage Site would be directly impacted by the proposals. The proposals would also impact on the character of sensitive townscape areas and wider landscapes including sections of the open Greenbelt landscape. Positive impacts would occur over localised areas due to the proposed mitigation by associated planting.		Landscape impacts would be major negative and significant for the townscapes associated with the World Heritage Site and moderate negative for occasional localised character areas.

Safety			
Sub-objective	**Item**	**Qualitative Information**	**Quantitative Information**
Accidents	Change in Annual Personal Injury Accidents	Standard rates and methodology from NESA applied to calculate changes in highway accidents. A reduction in peak hour car trips is off set by an increase in off peak car trips due to the impact of regeneration.	+0.99M extra car trips per annum in 2026. +104 highway casualty accidents over 30 years operation.
	Change in Balance of Severity	The generation of extra trips leads to an increase of accidents. The increase in fatal accidents is negligible, i.e. is less than can be reliably estimated, but the growth in damage accidents is large.	Reduction in 2026 accidents (i.e. negative indicates the situation is worse): Damage: –107 Slight: –5 Serious: –1 Fatal: 0
	Total Discounted Savings	While the shift from car to public transport reduces car vehicle miles, the rerouting of traffic due to reduced highway capacity in the city centre, increases journey lengths. Overall vehicle kilometres are reduced in the early years but increase as highway demand grows, leading to an overall increase in highway accidents.	-£ 2.906 M
Security		The proposals include additional lighting and CCTV at all stops. Positive design. Conductors present in all vehicles. Help points at all stops. The tramline will be mostly segregated and hence may in some locations be remote from human activity.	

Economy (Transport Economic Efficiency)			
Sub-objective	**Item**	**Qualitative Information**	**Quantitative Information**
User Benefits	Travel Time	The proposal will provide rapid transit between the city centre, Edinburgh Park, the airport and Newbridge. The majority of the route will be segregated from general traffic. It is estimated that in 2011, there will be a saving on AM peak car journey from the Edinburgh Park to Princes St of 0.5 minutes.	£242.517 M
	User Charges	The change in user charges are dominated by PT fares. There is a negligible increase in car and highway user charges, due to a rerouting over the Forth Bridge.	-£ 26.735 M
	Vehicle Operating Costs	Vehicle Operating costs increase due to the increase in off peak car journeys.	-£ 14.209 M
	Quality / Reliability Benefits	The majority of the route will be segregated from general traffic. Signal priority will be provided to tram along the route. However, it has to be recognised that PT alternatives to tram include the Airlink express bus and WEBS. Most of the alternative bus services benefit from Greenways and the WEBS service will have a dedicated guideway for part of its route.	

Private Sector Operator Impacts	Investment Costs		£ 0.000 M
	Operating & Maintenance Costs	Existing PT services remain unchanged.	£ 0.000 M
	Revenues	Change in bus and rail revenue = £86.528 M Change in Forth Bridge Revenue = -£0.485 M Change in off street parking revenue = £3.088	£ 89.130 M
	Grant/Subsidy payments		£ 0.000 M

Economy (Economic Activity and Location Impacts)			
Sub-objective	**Item**	**Qualitative Information**	**Quantitative Information**
Economic Activity and Location Impacts	Local Economic Impacts	The greatest employment impact will be in Edinburgh City. The greatest impact in gross added value will be achieved within the key sectors of finance and business, public administration and distribution and catering.	Total employment is projected to increase by 440 jobs during the period 2009 to 2025, 410 jobs of which will be in Edinburgh. Notional employment gains in total by 2025: Finance and business (61) Construction (14), Public administration (12), Other services (8).
	National Economic Impacts	There will be small employment gains in selected parts of Lothian. West Lothian will experience a very minimal decline in overall employment. Similarly the largest proportion of growth in gross added value will occur at the Lothian level. The level of notional employment by industry/sector in Lothian shows that the greatest gains will occur within finance and business, construction, public administration and other services. The greatest impact in gross added value will be achieved within the key sectors of finance and business, public administration and distribution and catering.	Total employment is projected to increase by 440 jobs during the period 2009 to 2025, 30 jobs of which will be outwith Edinburgh. Total gross added value of £22m in Lothian. This comprises £8m added value each in finance and business, and public administration, with a further £6m added value in distribution and catering.
	Distributional Impacts	The Edinburgh and Lothian region is currently benefiting from continuing buoyancy in the economy and property market. There are likely to be some benefits gained in a number of local regeneration areas, which suffer from varying aspects of social exclusion and deprivation, e.g. Sighthill, Stenhouse. The tram line is likely to have positive impacts, particularly as it will increase accessibility to employment opportunities and the wider labour market. In employment terms, the potential growth in services and construction may provide opportunities for higher employment, especially in female working population and those wishing part-time employment.	The 410 jobs increase in Edinburgh by 2025, will provide job opportunities for many local communities. Employment for example in construction and other services will provide the greatest job prospects for many.

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Integration			
Sub-objective	**Item**	**Qualitative Information**	**Quantitative Information**
Transport Interchanges	Services & Ticketing	Integrated transport services and ticketing contribute to more "seamless" journeys across the public transport network. The proposals provide the opportunity for interchange at the city centre, Haymarket, Edinburgh Park, the Gyle, the Airport and at Park and Ride sites in West Edinburgh.	Minor - Moderate positive impact
	Infrastructure & Information	Infrastructure facilities at stations, greater opportunities for bus and rail interchange with the tram at key locations, real-time information at all stations.	Minor – Moderate positive impact
Land-use Transport Integration		Interfacing with the Airport, Edinburgh Park, Haymarket station and the city-centre the proposal integrates well with existing and planned land uses and public transport. In addition, there is improved linkage between West Edinburgh and the whole city. The proposals are consistent with local and national planning policies.	Moderate positive impact
Policy Integration		The proposal fits with general transport and health policies promoting public transport whilst reducing the need for private car use, and enhancing the environment. The corridor provides a link between the city centre and the Airport. Planned development of Edinburgh Park is well served by the proposal.	Minor positive impact

Accessibility & Social Inclusion			
Sub-objective	**Item**	**Qualitative Information**	**Quantitative Information**
Community Accessibility	Public Transport Network Coverage	The proposal complements existing public transport by serving a catchment with limited existing bus services. By running with a dedicated route, the tram service will have efficient and reliable run times. The proposal will enhance access to employment and services in the city centre and West Edinburgh.	Minor - moderate positive impact
	Access to Other Local Services	Severance generally limited due to segregation of the tram line. Localised severance occurs where the tram line crosses existing walk / cycle routes, however appropriate mitigation measures will be implemented.	Neutral / Minor negative impact
Comparative Accessibility	Distribution/Spatial Impacts by Social Group	The proposal has limited impact on social exclusion.	Neutral - minor positive impact
	Distribution/Spatial Impacts by Area	Improved access to employment and services in the city centre and West Edinburgh area.	Minor positive impact

Cost to Public Sector		
Item	**Qualitative information**	**Quantitative information**
Public Sector Investment Costs	Undiscounted costs, 2003 prices: Design: -£10.753M; Preliminaries & Project costs: -£47.523M; Construction: -£224.806M; and Land (privately owned): -£33.029M	-£204.954 M
Public Sector Operating & Maintenance Costs		-£ 97.219 M
Grant/Subsidy Payments	£4.8M of the land required is owned by the public sector.	-£ 3.273 M
Revenues	The mains source of revenue is tram, however, an increase in city centre car parking revenues is predicted, due to the generation of off peak highway trips, due to improved transport accessibility and an element of long term parkers being replaced by multiple short term parking.	£109.459 M
Taxation impacts	Indirect taxation impacts consist of -£22.085 M from PT and £11.921 M from highway.	-£ 10.164 M

Monetised Summary	
Present Value of Transport Benefits	£287.798 M
Present Value of Cost to Government	-£206.151 M
Net Present Value	£ 81.647 M
Benefit-Cost to Government Ratio	1.40

APPENDIX C

EXTRACT FROM DRAFT CEC LOCAL TRANSPORT STRATEGY ON BUS PRIORITIES

C1.1 One of the main obstacles to provision of a high quality bus service is congestion. Congestion affects reliability and journey times become longer, reducing the attractiveness of bus travel. The Council has now implemented bus priority measures designed to improve bus journey times on most of the main radial routes and within the city centre. Further bus priorities and better quality infrastructure are being put in place on routes serving key centres of economic growth in 2006. New traffic control systems funded in 2006 will also assist bus reliability.

C1.2 As a result of better traffic management, such measures have improved car as well as bus journey times in some corridors. Cyclists and pedestrians are also catered for in implementing bus priority schemes to ensure effective integration.

C1.3 A comprehensive review of the existing bus lane network is now proposed to ensure that the network is appropriate, understood and enforced. In addition, the review will examine the integration of the bus lane network with trams. The review will be undertaken with key stakeholders, including bus operators, Police and other interests.

C1.4 The proposed objectives are to:

- Ensure existing bus lane detail and layout are still appropriate to meet objectives;
- Develop a simplified regime in regard to hours of operation;
- Develop improved bus lane markings and signs;
- Examine decriminalisation of Greenways enforcement;
- Examine introducing decriminalised bus lane camera enforcement; and
- Plan for the integration of bus lanes with the tram network.

PT18

The Council will review the current bus lane network and its operation to ensure it is effective, legible and enforced; and will examine opportunities and priorities for its further development.

C1.5 At the same time, bus use is increasing, and new development in and around the city will increase demand further. It will be essential to maintain and improve bus service quality and reliability if targets for sustainable travel are to be met. This will require continuing development and enhancement of bus priority in and around the city over the long term covering corridors both with and without existing priority schemes. Measures such as bus only streets, bus lanes on trunk roads around the edge of the city such as the city bypass and M8, and advanced traffic control systems focused on bus reliability may need to be considered in the future.

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Appendix IV Communications and Stakeholder Strategy

Trams for Edinburgh
..connecting our Capital

Edinburgh Tram Project
Communications and Stakeholder Strategy

September 2007

DRAFT 4

Contents

	Page
1. Introduction	1
2. Strategic goal	2
3. Core project messages	4
4. Communications and stakeholder delivery objectives	6
5. Key communication channels	8
6. Stakeholder segmentation	10
7. Communication collateral	12
8. Review and evaluation	13
9. Milestones	14

Appendices:

Appendix A	Branding and marketing	15
Appendix B	Special interest groups	16
Appendix C	Potential issues	17

This document is derived from the tram project work plan, which is a working document updated on a regular basis.

1. Introduction

In June 2007 the Scottish Parliament gave approval for the first phase of the Edinburgh Tram Project (ETP) to proceed. Work has now begun to divert utilities away from the tram route and construction of the infrastructure will commence in early 2008.

Now that work has commenced on site, **tie** Limited (**tie**) aims to introduce a robust communications strategy in line with its policy of stakeholder consultation. This paper will outline a strong delivery programme for **tie** and its key partners.

The project has an agreed budget of £545 million and is to be funded by Transport Scotland (TS) and the City of Edinburgh Council (CEC). **tie** is the delivery agent for the project, CEC is the promoter and Transport Edinburgh Limited (TEL) has been created to manage Edinburgh's integrated bus and tram network.

The ETP involves building a tram system in Edinburgh. The first two phases are for a line from Edinburgh Airport to Newhaven (1b) and a line connecting Haymarket to Granton (1b).

The objectives of the project are to:

- Deliver the ETP on time;
- Deliver the ETP within the agreed budget;
- Construct the network with the least disruption possible;
- Keep Edinburgh informed and involved with the progress through each phase of the project; and
- Operate a profitable and successful integrated transport network through TEL.

NB: This Communications and Stakeholder Strategy supports the above objectives and is underpinned by the Stakeholder and Communications Project Management Plan.

2. Strategic goal of the Edinburgh Tram Project

The strategic goal of **tie** and its partners is:

> ***"To successfully deliver, by 2011, a world class tram system in Edinburgh, the Capital of Scotland; safely - together - with commitment, professionalism and expertise."***

The essence of the Communications and Stakeholder Relations Strategy is to deliver three key goals:

- Raise awareness of the Tram Project across a wide audience
- Maximise involvement and success
- Gain commitment and engage

There is a requirement on **tie** to develop a communications and stakeholder relations strategy for the Trams for Edinburgh project.

This has been built around some 'first principles' which include:

- **Communicating a vision of the goal and a set of values:** as the project delivery goes through a step by step process there will be a requirement for the team to:
    - Be proactive;
    - Consult and listen;
    - Learn;
    - Be accurate; and
    - Ensure no surprises; and
- **Evidence and analysis:** gain an understanding of the current situation and existing perceptions based on a realistic evaluation so as to develop a strategy which informs, consults and develops wider engagement of all key stakeholders;
- **Stakeholder relations:** develop an understanding of peoples' views, concerns and perspectives and a plan for how they should be involved in the development of the project as it progresses through each phase of delivery; and
- **Delivery capability:** ensure that the communications and stakeholder relations functions are fit for purpose and have the available resource mix of skills and capability to successfully deliver the Communications and Stakeholder Relations Strategy.

In order for the Communications and Stakeholder Relations team to contribute to the successful delivery of the strategic goal and reflecting functional stakeholder analysis the following key work streams have been identified:

Strategic goal continued

Work stream	Function
Co-ordination of community relationships	An analysis of the consequential impact of the design of the tram route,MUDFA and Infraco construction phases on the public. Implement a programme including a set of measures to inform, address and where possible mitigate this impact.
Co-ordination of Business Relationships	An analysis of the consequential impact of the design of the tram route, MUDFA and Infraco construction phases on the business community. Implement a programme including a set of measures to inform, address and where possible mitigate this impact.
Core Project Stakeholders	Intrinsic to delivering a successful tram project is the ongoing relationship and protocols with key stakeholders. At present these include CEC TS, TEL and Lothian Buses (LB). Due to the nature of this Strategy, engagement with these core stakeholders will involve a changing audience determined by each phase of the project as it progresses.
Co-ordination of Project Communication	As the Tram Project will be in the public spotlight for a significant time the effectiveness of this element of the strategy will be vital. This will inevitably involve embracing new and continuing relationships with key project delivery partners that contribute to the wider success of the project. Requirements will vary as the project progresses.
Co-ordination of Media and External Relations	It is intended that this will be all-embracing and will include a commitment to influence, persuade and change perceptions, attitudes and values through all the external channels; print, broadcast and electronic that will report on, be interested in, and need to know about, the Tram Project.
CEC	As enshrined in the governance arrangements agreed between **tie** and the CEC it is important that we give high regard and emphasis to the communication relationship between ourselves and that of CEC and the overall consequences of the policy of the Tram Project. It is our intention to foster a partnership relationship with a 'One Team – Many Skills, All Valued' approach.

3. Core Tram Project messages

Area	Core Message
The Tram Project	• Project funded by TS and CEC; • Agreed budget of £545 million; • **tie** delivering project and CEC promoting; • Building of tram route in phases; - Phase 1a Edinburgh Airport to Leith; and - Phase 1b Haymarket to Granton (potential); • World class tram system in Edinburgh, successfully delivered by **2011** on time and within budget; and • Complete integration with LB, managed by TEL.
The Tram Project programme	• Multi-Utility diversion work commenced in July 2007. Unique contract diverting all utilities at once; • Infraco and Tramco contracts awarded in Jan 08; • Infraco works start in February 2008; and • Commissioning 2010.
The Public	• Edinburgh will remain 'Open for Business' throughout construction; • The construction process will be manage to minimise disruption where possible; • Dedicated tram helpers, community and business liaison officers on the street; and • Dedicated helpline, website, newsletters, DVD and presentations.
The Social Benefits	• Social inclusion for local communities with better transport links for those living in the Waterfront and west of Edinburgh areas; • Access to shopping areas, jobs, tourist and leisure activities and other public transport; • Improvement to the urban environment; • Trams and tram stops will be DDA compliant for those with mobility problems ; • Permanent public transport solution; and • Trams have been shown to increase property prices in areas where they have been introduced.

Core messages continued

Area	Core Message
The Economic Benefits	• For every £1 invested, £1.77 will be generated for Phase 1a; • A world class tram system will show Edinburgh is modern, well-connected and forward thinking. This will help to attract inward investment and jobs, improve Edinburgh's image and assist regeneration; • More jobs will be created through construction and permanent jobs will result once operational; and • Small Business Opportunities.
The Benefits to Customers	• Trams are reliable and provide a smooth comfortable ride; • Trams and can carry many passengers – at least 230, plus luggage space; • Improved accessibility through level boarding and a range of facilities for mobility, vision and hearing-impaired passengers; • Trams and LB will be a fully integrated transport network, which will include through ticketing, integrated fares and joint branding; and • Connectivity to other transport networks.
The Society and Environmental Benefits	• Trams are electrically powered, therefore, they produce no on-street emissions. This will improve Edinburgh's air quality; • Trams attract more people out of their cars than any other form of public transport, reducing emissions and congestion; • A tram design manual has been produced to ensure that the tram works well with the existing landscape of the city and maintain its heritage; and • Trams are generally quieter than other vehicles.

4. Communications and stakeholder delivery objectives

In support of the Tram Project, the development of key objectives is a requirement of the overall strategy. Successful delivery of the strategy needs a clear understanding of our:

- Communication channels;
- Customers; and
- Stakeholders.

(For further clarification on the above see sections 5 and 6.)

The following set of principles will form the framework for the delivery of our Communications and Stakeholder Relations Strategy:

- **Lead the way** – exploit opportunities to repeat the key messages, identify and promote examples of success;
- **Consult and listen** – develop implementation of the project by using continuous and innovative stakeholder consultation at all levels;
- **Learn and Act** – evaluate and evolve our Communications and Stakeholder Strategy;
- **Be accurate –** misunderstandings should be addressed with urgency – accurate line identified, disseminated and promoted; and
- **Ensure no surprises –** create a 'no surprises' culture where information is shared across the development of the Tram Project.

Work stream	Objectives
Community and Business	• Facilitate communication to ensure local businesses and residents and other affected parties are kept fully informed of the nature and timing of the works.
Project Stakeholders	• Commit to a one-message approach, owned by all key partners and stakeholders; • Generate support and endorsement as required from key audiences: local residents and businesses; commuters; political; media; travelling public; community; special interest groups and visitors to Edinburgh; and • Encourage a joined-up working approach between **tie**, CEC, LB and TEL.

Delivery objectives continued

Work stream	Objectives
Project Communication	• Implement a robust public information campaign during construction, throughout the following key stages: utilities diversion; final business case approval; contracts awarded for Tramco and Infraco; tram branding; final tram route design; tram commissioning and driver training; new tram timetable and tram operation by TEL; and • Ensure all **tie** and CEC management and operational staff are kept up to date and are fully briefed as appropriate.
Media and External Relations	• Generate positive media coverage for the tram project, **tie**, CEC and TEL, focusing on benefits for the travelling public and wider economy; • Harness political and public support and media commentary; and • Demonstrate competence and efficiency of delivery agent, promoter and funders.

5. Key communication channels

The tram project framework for delivery includes all core stakeholders and, therefore, a coherent set of key messages needs be presented by all partners involved in the delivery. These will:

- Involve partnership working;
- Promote value, efficiency, delivery and success; and
- Deliver CECs strategy for the Tram Project.

These key messages will be delivered through the communication channels below:

Work stream	Communication channels
Community	• **Customer Helpline** – The ETP has a dedicated tram Helpline where all public enquiries are directed in the first instance; • **Customer Interaction Cycle** – To ensure that local residents and businesses are fully informed of upcoming works in their area. The successful delivery of the Tram Project will also inform the general development of the public into future positive customers of the integrated tram and bus network; • **Newsletters** – Construction newsletters are distributed to residents along the route and quarterly project newsletters are distributed to a wider audience, including local residents and businesses, MSPs, Councillors. Articles also appear in CEC's Outlook publication, which is distributed to all residents in Edinburgh; • **Community meetings** – Local residents and businesses along the route are visited on a weekly basis. Other meetings include: design consultation, frontager and wider community meetings; and • **Schools Programme** – A programme will be introduced, in conjunction with the local authorities, to visit all local schools along the tram route. This will include providing updates on the project, safety briefings and joint initiatives.

Communication channels continued

Work stream	Communication channels
Business	• **Newsletters** – construction newsletters are distributed to businesses along the route and quarterly project newsletters are distributed to a wider audience, including local residents and businesses, MSPs, Councillors. Articles also appear in CEC's Outlook publication, which is distributed to all residents in Edinburgh; • **Business meetings** - regular meetings and visits take place with key business stakeholders along the route. Workshops also take place to discuss the 'Open for Business' package; and • **Conferences, business lunches and breakfasts** – key project staff will attend appropriate conferences and business events in order to brief business influencers on the project and build on key relationships.
Project Stakeholders	• **Regular presentations and workshops** take place with consultees and interested third parties to ensure two-way communication is ongoing. These will include political and media briefings. Key stakeholders can be identified in Section 6; and • **Conferences, business lunches and breakfasts** – key project staff will attend appropriate conferences and business events in order to brief business influencers on the project and build on key relationships.
Project Communications	• **Internal newsletters and briefings -** project staff will be kept fully informed on the progress of the project through internal newsletters, team briefings, email bulletins and staff events; and • **Trams for Edinburgh website** – this will carry updated information on current and planned works, background information on the project, newsletters, event details and contact information.
Media and External Relations	• **Ongoing proactive and reactive engagement with media** including in-depth briefings on elements of the project of public interest. Other channels include: one to one briefings; exclusives; press releases; interviews with key spokespeople and site visits; and • There will also be intensive activity around key milestones.

6. Stakeholder segmentation

In creating widespread awareness and understanding of the Project, there are key stakeholders who are important drivers for the successful delivery of the Tram Project: internal; political; media; community, including businesses and local residents; and special interest groups.

These stakeholders are identified through the three key principles to our stakeholder engagement:

- **Principle One: Materiality** – we are required to know our stakeholders and their material concerns.
- **Principle Two: Completeness** – we understand stakeholder concerns: views, needs, expectations and perceptions.
- **Principle Three: Responsiveness** – we respond coherently to stakeholders and their material concerns.

To support this engagement, we have established a master database of named contacts based on the target audiences outlined below. These include:

Work stream	Stakeholder segmentation
Community and Business	• Local businesses; • Local residents; • Community Councils along the route and beyond; • Bus travellers; • Commuters; • Cyclists; • Air passengers; • Train passengers; • Car Drivers; • Organised groups of the business community; and • Other organised community groups.
Project Stakeholders	• Scottish Government / TS; • CEC; • CEC councillors and officials; • Members of the Scottish Parliament Scottish Government Ministers; • Members of Parliament; • TEL; and • LB.

Stakeholder segmentation continued

Work Stream	Stakeholder segmentation
Project Communications	• **tie**, CEC and AMIS communications teams; • **tie** and CEC spokesperson / s; • LB marketing team; • **tie** staff; and • Contractors.
Media and External Relations	• Broadcast; • National; • Scottish national; • Scottish regional; • Edinburgh local; and • Trade.

7. Communication collateral

Effective communication is vital to us delivering our message and this will vary depending on prevailing circumstances, stakeholder issues, whether or not the communication is formal (consultative, requiring agreement, etc) or informal.

Below is a range of communication and media methodologies which will be used directly or indirectly to support the successful delivery of the project.

Work Stream	Collateral
Community and Business	• Contact database; • Bespoke presentations for briefings; • Exhibition and banner stands; • Construction Newsletters – local community; • Tramtime newsletter – wider community; • Fact Sheets and Concertinas; • Tram DVD; • Tram branding; • Tram models and simulations; and • Leaflets.
Project Stakeholders	• FAQs; • One to one briefings with partners and key stakeholders; and • Bespoke presentations for Cllr and MSP briefings.
Project Communication	• Q&As; • Key Messages / statements; • Key programme dates; and • Working action plan.
Media and External Relations	• Artist's impressions; • Stock photography; • Tram models and simulations; • Tram branding; • Tram DVD; • Programme maps with key dates; • Facts Sheets; • Q&As; • Key Messages / statements; and • Key programme dates.

8. Review and Evaluation

Regular reviews will be undertaken to evaluate the success of the communications strategy. The following methodologies will be carried out to achieve sound qualitative and quantitative results.

Work stream	Measure	Method
Community and Business	i. Local residents and businesses' perceptions; ii. Telephone helpline; iii. Response to all queries and complaints by email, telephone and written correspondence; and iv. Satisfaction with external newsletters.	i. Feedback forms available at events and one to one visits; ii. Analysis of calls to helpline – negative and positive comparison; iii. Analysis of response rate and number of complaints. Information is maintained on the stakeholder database from which reports can be produced; and iv. Feedback mechanism within each newsletter.
Project Stakeholders	i. Stakeholders feeling informed.	i. Consultation – surveys of key groups.
Project Communication	i. Trams for Edinburgh and **tie** websites; ii. Satisfaction with internal newsletters; and iii. Public understanding of Edinburgh Trams brand and integration with buses.	i. Analysis of hits and comment to gauge public perception; ii. Feedback mechanism within each internal newsletter; and iii. Public Opinion survey.
Media and External Relations	i. Positive coverage in the media.	i. Media Monitoring - keeping abreast of news on the Edinburgh Tram project, **tie**, TEL, contractors, suppliers and the industry as a whole. This will track public perception, balance and factual content of articles and enable us to respond accordingly.

9. Milestones

Communications and stakeholder relations activity is driven by key programme milestones which inform the successful status and progress of the project.

These key milestones will result in high level communication and stakeholder engagement.

July 2007	MUDFA commenced
September 2007	Tramco preferred bidder announced
October 2007	Infraco preferred bidder announced
October 2007	Final Business Case to CEC
January 2008	Tramco Contract awarded
January 2008	Infraco Contract awarded
January 2008	Contracts signed (Tramco and Infraco)
February 2008	Infraco work commences
2010	Commissioning commences
Quarter 1 2011	Passenger trams start running

To be confirmed:
TRO process
Final tram design

Appendix A

Branding and marketing

In order for tram and bus integration to succeed as one transport network, the family colours of LB and other key themes will be incorporated. A key element of the tram branding is that it will connect successfully with LB to create a positive, integrated image.

Effective communications and marketing of the new brand will have significant influence over the public's perception of the integrated tram and bus network. A positive image will assist in increasing patronage by targeting groups who do not currently use public transport and by opening up more transport options.

Discussions are already underway with design consultants to develop a brand and livery for when Edinburgh Trams are operational. This will be agreed by all key stakeholders. The agreed name and design will be built into the Tramco contract and this will be launched in advance of commissioning in 2010. Until then the 'Trams for Edinburgh' brand, livery and colour scheme will apply.

Appendix B

Special interest groups

Sector	Special interest groups
Transport	• LB; • Transform Scotland; • Transport 2000; • Scottish Association for Public Transport; • Capital Rail Action Group; • Sestrans; • Passenger Focus; • Spokes; • Scottish Taxi Federation; and • Freight Association.
Tourism and Business	• Edinburgh Chamber of Commerce; • Federation of Small Businesses; • Scottish Enterprise Edinburgh and Lothian; • CBI Scotland; • Scottish Tourism Forum; • Visit Scotland; • SCDI; and • Edinburgh City Centre Management.
Mobility	• Mobility and Access Committee for Scotland; • Disabled Persons Transport Advisory Committee; • Royal National Institute for the Blind; • Royal National Institute for the Deaf; • Help the Aged Scotland; • Age Concern Scotland; and • Capability Scotland.
Environment	• Friends of the Earth Scotland; • SEPA; • Sustainable Scotland Network; • Lothian & Edinburgh Environmental Partnership; • Scottish Environment Link; and • Scottish Natural Heritage.
Heritage	• Historic Scotland; • Cockburn Association; and • Edinburgh World Heritage Trust.

Appendix C

Stakeholder and Communications potential issues

There are a few potential issues of which **tie** and its partners should be aware. Broadly, these concern the following:

Work Stream	Potential issues
Community	• Impact on other transport during construction; • Disgruntled commuters – car and bus; • Complaints about construction work noise / dust / vibration / worker's conduct; • Public criticism; • Project delays; and • Project over budget.
Business	• Temporary loss of trade for business along on the tram route; • Business community opposition; • Impact on businesses through delays to commuters and business travellers; • Loss of development opportunities; • Lack of advance information regarding traffic diversions; • Complaints about construction work noise / dust / vibration / worker's conduct; and • Project delays.
Project Stakeholders	• Political opposition; • Lack of political support; • Lack of partner support; and • Political indecision.
Project Communication	• Lack of two-way communication with internal staff / partners could compromise the successful delivery of the project; and • Construction incident / employee injury / member of public injured.
Media and External Relations	• Negative media campaign regarding community and business issues; • Inaccurate stories; and • Construction incident / employee injury / member of public injured.

EDINBURGH TRAM JRC

Revenue and Risk

Report

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Contents

Page

1.	**INTRODUCTION**	**1**
	Background	1
2.	**APPROACH TO FORECASTING REVENUE AND RISK**	**3**
	Overview	3
	Overview of Forecasting Tools	4
3.	**PLANNING CASE FORECASTS**	**7**
	Planning Case Definition (Key Assumptions)	7
	Other Technical Forecasting Assumptions	9
	Financial & Economic Assumptions	10
	Planning Case Patronage & Revenue Forecasts	12
4.	**SCENARIO-BASED ANALYSIS**	**21**
	Key Areas of Uncertainty Affecting Tram and Overall TEL Revenue	21
	Key Areas of Uncertainty Affecting Revenue Uplift with Tram	28
	Lower Attractiveness of Tram to Users	28
	Bus Operator Competition	29
5.	**MONTE CARLO ANALYSIS**	**31**
	Introduction	31
	Results	31
6.	**'INFORMED CHOICES'**	**41**
	Selection of Scheme Infrastructure	41
	Co-existence with Edinburgh Airport Rail Link (EARL)	42
	Approach to Revenue Protection	44
	Standard of Interchange Provision	44
	Tram Operational Runtimes	46
	Alternative Bus Service Integration Plans	48
	Alternative Service Patterns	48
	Other TEL business planning	49
	Possible Future Park and Ride Schemes	49
	Road User Charging	50
7.	**CONCLUSIONS**	**51**

FIGURES

Figure 3.1 Planning Case Tram Revenue Profile 15

Figure 3.2 Planning Case TEL Bus Revenue Impact Profile 16

Figure 3.3 Planning Case TEL PT Fares Revenue Impact Profile 17

Figure 3.4 Abolute TEL Public Transport Revenue Projections (2005 Prices) 19

Figure 3.5 Absolute TEL Public Transport Fares Revenue Projection (Nominal wth 3% per annum RPI growth) 20

Figure 5.1 Impact of Tram on: Tram and Change in TEL Bus Revenue Confidence Bands 33

Figure 5.2 Impact of Tram on: Tram and Change in TEL Bus Revenue Confidence Bands 34

Figure 5.3 Impact of Tram on: TEL Revenue with Tram 35

Figure 5.4 Tornado Chart of Risk Significance in 2011 39

Figure 5.5 Tornado Chart of Risk Significance in 2031 40

TABLES

Table 3.1 Planning Case Ramp-Up Assumptions

Table 3.2 Planning Case All-Operator Patronage (Boardings)

Table 3.3 Planning Case Revenue (2005 Prices)

Table 3.4 Planning Case Net TEL PT Fares Revenue Impact (2005 Prices)

Table 3.5 Projections of Absolute TEL Patronage & Revenue

Table 4.1 High Planning: Net TEL Fares Revenue Impact (2005 Prices)

Table 4.2 Absolute TEL Revenue: High Planning Growth (2005 Prices)

Table 4.3 Low Planning: Net TEL Fares Revenue Impact (2005 Prices)

Table 4.4 Absolute TEL Revenue: Low Planning Growth (2005 Prices)

Table 4.5 Absolute TEL Revenue: Low Economic Growth (2005 Prices)

Table 4.6 Low Attractiveness: Net TEL Revenue Impact (2005 Prices)

Table 4.7 Bus Competition: Net TEL Revenue Impact (2005 Prices)

Table 5.1 Revenue Impact Confidence Bands

Table 6.1 Option 1A Only Revenue (2005 Prices)

Table 6.2 Option 1A Only: Net TEL Revenue Impact (2005 Prices)

Table 6.3 1A+1B Without EARL: Revenue (2005 Prices)

Table 6.4 1A+1B Without EARL: Net TEL Revenue Impact (2005 Prices)

Table 6.5 Revenue Protection: Net TEL Revenue Impact (2005 Prices)

Table 6.6 Efficient Interchange: Net TEL Revenue Impact (2005 Prices)

Table 6.7 Quality Interchange: Net TEL Revenue Impact (2005 Prices)

Table 6.8 Longer Tram Runtime: Net TEL Revenue Impact (2005 Prices)

Table 6.9 Runtime Upside: Net TEL Revenue Impact (2005 Prices)

APPENDICES

A REVENUE RISK REGISTER

B CALCULATION OF ANNUALISATION FACTORS

C OPTION 1A + 1B TRAM PATRONAGE HISTOGRAMS

1. INTRODUCTION

Background

1.1 Steer Davies Gleave in conjunction with Colin Buchanan was commissioned by tie in September 2005 to form the Edinburgh Tram Joint Revenue Committee. Following the development of revenue forecasting models, the main function of the commission is to undertake forecasts of revenue and revenue risk for the proposed Edinburgh Tram and for other public transport in connection with the introduction of the tram. This would inform tie/TEL's business planning and management of revenue through the design implementation and operation of the tram.

1.2 Since the original commission, the scope of work has been expanded also to include Transport Economic Efficiency appraisal as part of an updated full STAG appraisal. The revenue forecasting has been undertaken in parallel with, and as a component of, the appraisal work.

1.3 Revenue forecasts for the tram scheme are produced using forecasting tools that require a range of assumptions to be made regarding future economic conditions, patterns of land-use and development, and the characteristics of the transport network as a whole - including levels of service, performance and the cost to users. The STAG appraisal employs a set of assumptions, described here as the 'Planning Case', for which revenue forecasts have also been prepared. These assumptions have been put forward by the client and the promoting group as an appropriate planning scenario.

1.4 Revenue forecasts are affected by the assumptions in the Planning scenario, but also by the quality and scope of the forecasting tools employed. For the purposes of ongoing business planning it is appropriate to seek to understand how revenue forecasts are affected by changes in planning assumptions – what the main factors are and how sensitive the forecasts are to those changes. Some of the assumptions are outside the scope of the promoting group and others are under their control in either the short or long term. In either case, there is inevitably uncertainty over what future circumstances or policy decisions will be, as well as how future revenues would be affected.

1.5 The objective of this report and the analysis behind it is to provide an understanding of the revenue implications of the Planning Case and the risks and uncertainties within it. The effects of changes to specific assumptions are illustrated through forecasts of alternative scenarios, while the possible range of outcomes is explored by a probability based analysis of a range of scenarios. The effects of future decisions that can be made by the promoting group are considered in particular.

1.6 Many of the risks and uncertainties considered have been identified in conjunction with the client stakeholder group and many of the ranges of uncertainty (in terms of impacts and probability) used are reflective of views expressed at the Modelling and Revenue Stakeholders Group (MRSG), although, in some cases, the ranges of uncertainty considered here are wider than those expressed at the MRSG.

1.7 The JRC has not produced the forecasts of the underlying economic, planning, land-use and development drivers of travel demand, nor of future policies towards these factors or transport supply in the future – rather these have been an input from the appropriate stakeholders.

2. APPROACH TO FORECASTING REVENUE AND RISK

Overview

2.1 Any forecast of a transport service's revenue is based on a range of assumptions relating to unknowns, particularly those relating to the future. For example, for a tram scheme one must make assumptions about the future economy, changes in land-use, transport policy, the performance of the planned tram and bus network and its attractiveness to users.

2.2 The resulting forecasts will be dependent on the assumptions made. In order to support decision making therefore, the full implications of the assumptions made should be explored, in order to identify the critical success factors and ways to mitigate potential shortfall.

2.3 Risks have been identified in conjunction with the Modelling and Revenue Stakeholders Group (MRSG) and the MRSG also assisted with quantifying these risks. The JRC has also taken its own view as to the range of uncertainty in some areas.

2.4 The informative analysis then undertaken, and presented in this report takes three broad forms:

- Scenario analysis;
- Monte Carlo Risk analysis; and
- Informed choice analysis.

2.5 These are introduced in more detail below.

Risk Identification & Assessment

2.6 A wide range of revenue risks have been identified and quantified in conjunction with the MRSG stakeholders group. Three workshop sessions were used for this purpose. In the first, risks were 'brainstormed' by stakeholders' representatives.

2.7 Once these were collated, a second session was used to review, group and categorise them. During this second session it was also considered which forecasting assumption relates to each identified risk and how the risks would be represented for the purposes of a risk assessment.

2.8 The third session considered the range of uncertainty perceived by stakeholders in respect of the driving assumption for each risk. This has largely been reflected in the ranges used for the Monte Carlo analysis but in some cases wider, or more conservative ranges have been employed, based on the professional judgement of the JRC.

2.9 The full revenue risk register (as distinct from the JRC's contribution to the project risk register) is provided as Appendix A to this report. The most significant of the risks identified in this register are directly addressed within this report. The majority are either covered by scenario analysis or incorporated into the Monte Carlo analysis.

Uncertain Scenario Analysis

2.10 Scenario analysis seeks to examine how the revenue might respond to alternative assumptions for unknowns that are out of the control of the scheme promoter. Various "what if?" questions are addressed and worst case scenarios are considered. This analysis is based directly on the outcome of forecasting model sensitivity tests.

2.11 All the scenarios consider deviation from the central case in respect of just one issue at a time and the other assumptions are kept constant.

Monte Carlo Risk Analysis

2.12 Monte Carlo analysis takes a probabilistic approach to consider the chances of revenue falling within certain boundaries. This type of analysis is necessarily anchored on specific assumptions with regards to some of the starker or discrete uncertainties. It is also inappropriate to address with this type of analysis uncertainty over which the promoter has significant influence. Hence, any given Monte Carlo analysis rests itself within assumed scenarios.

2.13 For this initial revenue risk report, only an outline Monte Carlo analysis has been undertaken. But this area of analysis will be developed in future revisions of this report for the ongoing management of revenue through the design, construction and initial operational.

Informed Decisions

2.14 Several of the risks identified represent areas of uncertainty over which the promoting group has at least some degree of control (for example scheme performance). These have been reported as issues which the scheme promoter should consider either:

- To maximise the chances of achieving the Planning Case forecasts; or
- To manage revenue up towards the planned level in the event of a shortfall.

Overview of Forecasting Tools

2.15 The forecasting of revenue for Edinburgh Tram has been undertaken primarily using the JRC 'High Level Model', a 4-stage model incorporating the following elements and implemented primarily using the VISUM software package:

- Trip generation from fixed trip-end planning data and trip rates.
- A trip distribution model
- A PT/Car mode choice model using a logit formulation;
- Public transport and highway network assignment models.

2.16 In addition, a spreadsheet based model has been used to estimate the patronage from the Ingliston Park and Ride site.

2.17 Revenue calculations have been undertaken externally to the VISUM model using semi-automated database and spreadsheet applications.

2.18 Further detail of these models is provided in separate model specification and calibration reports.

2.19 The models produce forecasts for three modelled periods within a typical weekday and these are then factored up to annual demand and revenue using an "annualisation" process. The modelled periods are a morning peak (07:00 to 09:00), an inter-peak (10:00 to 12:00) and an evening peak (16:00 to 18:00). Details of the annualisation process are provided in Appendix B.

2.20 Annualised forecasts are produced for two future years, 2011 (as the planned opening year of the Tram) and 2031. The forecasts for intervening years are derived by interpolation. For the reference case described in Chapter 3, the interpolation process assumes that 39% of the growth (2011 to 2031) occurs by 2016, in line with the profile observed in the data underlying the Reference Case planning scenario. Between 2031 and 2041, an assumed average annual growth rate is assumed to extend the forecasts. The figure used for the Reference Case is specified in Chapter 3.

Limitations of Forecasting Capability

2.21 With the need to submit the Tram business case to Transport Scotland by November 2006, a relatively short period of time was available in which to undertake the necessary forecasting work. A preliminary economic assessment in September highlighted inconsistencies in the previously agreed specification for the 'Do Minimum' situation, against which the scheme was being appraised. Prior to the final STAG 2 appraisal, a challenging process of questioning and re-establishing the baseline assumptions in consultation with Stakeholders was therefore necessary. This further reduced the time available for further forecasting work.

2.22 In practice a full range of necessary forecasting tests has been undertaken but some limitations to this forecasting work must be noted, specifically:

- Although an evening peak period model has been developed, it has only been possible to make use of the morning peak (07:00 to 09:00) and inter-peak (10:00 to 12:00) period models for forecasting work in the available timescales. The main implication of this is that the annualised revenue forecasts are asymmetrical and not yet able to represent a balance picture of patronage flow.
- An independent 'due diligence' review of the modelling work has been undertaken, from which a summary report is available. Ideally it would have been possible to make model refinements in response to recommendations of this audit process (as well as some other potential refinements identified internally by the JRC) prior to undertaking the final forecasting work for the business case submission. In practice, this has not been possible and such refinements will now form part of future ongoing work.
- Since the preliminary economic assessment, some network modelling refinements have been made in the forecasting years only and not in the calibrated 2005 base year model. This will be addressed for further work but represents a risk to the current forecasts, adding uncertainty in particular to projections of total absolute TEL revenue growth, which it has not been possible to explore.

3. PLANNING CASE FORECASTS

Planning Case Definition (Key Assumptions)

3.1 The Planning Case forecasts are those undertaken for the Transport Economic Efficiency (TEE) analysis undertaken for the STAG appraisal. They are based on a set of assumptions that were developed in conjunction with tie as a scenario for which they and the local authorities would like to plan.

Scheme Specification

3.2 The key assumptions underpinning the Planning Case forecasts in respect of the scheme specification are as follows:

- Infrastructure Options 1A and 1B
- Two tram services:
  - Airport ⇔ Ocean Terminal; and
  - Granton Square ⇔ Newhaven.
- Service frequencies per direction per service:
  - 6 trams per hour in 2011; and
  - 8 trams per hour in 2031; with
  - an implied gradual ramping up of service due to uncertainty around the date of transition.
- Tram journey times:
  - As estimated by the Parsons Brinckerhoff Stage 3 Runtime Simulation Report of August 2006.
  - Assumption of zero traffic delay to trams (reflecting SDS traffic engineers' expectation that a very minimal delay is likely to be possible - less than 1 cumulative minute along the full tram route).
- Tram fare level at parity with TEL bus fares as part of an integrated through-ticketing system

3.3 The perceived attractiveness of the tram to users other than relative journey times and fares (i.e. reliability, quality of ride, information provision etc.) is represented by a parameter derived from Stated Preference research. This is discussed below in the section on "Other Technical Forecasting Assumptions"

Background Forecasting Assumptions

Transport Supply

3.4 Bus service integration patterns for both with and without tram in both 2011 and 2031 have been supplied by TEL for use in forecasting. The 'with-tram' services are as per the "Service Integration Plan v3". 'Without-tram' assumptions were also provided concurrently. These assumptions are detailed in the STAG appraisal report.

3.5 In summary, these include significant increases in bus service provision on Leith Walk by 2031 without the tram and a reduction from that higher base with the introduction of the tram. Many of the additional buses serve the Leith Docks development area and many of them run through to areas such as Edinburgh Park and Gyle where significant attraction development is planned. With the tram, bus service levels are significantly reduced on Leith Walk, with some of the curtailed services at the Leith end joined to form orbital feeder services rather than radial services. Passengers on some existing routes from areas such as Leith Links and Lochend are thus forced to interchange with tram at the foot of Leith Walk.

3.6 Because of these significant changes to bus service level and without accommodating network enhancements, significant uncertainty would exist as to the journey time performance, reliability and operability of buses in the future. It is the stated policy of CEC, however, that public transport should be supported through the provision of priorities to deliver journey time improvements to bus, and that the policy of maintaining public transport journey time and reliability will continue into the future.

3.7 Bus services are therefore assumed not to deteriorate in either speed or reliability into the future for the Planning Reference Case. This is assumed to be the case for both the with- and without-tram scenarios and will have reduced the net patronage uplift expected with the introduction of the tram.

3.8 In order to account for the accommodation of increased bus provision at current performance levels in the without-tram situation, impacts on car traffic are also assumed, which are similar to those required for the introduction of the tram. This would have reduced slightly further the net patronage uplift expected with the introduction of the tram.

3.9 The following rail schemes have been assumed to have been implemented:

- Edinburgh Airport Rail Link (EARL);
- Airdrie-Bathgate Line;
- Stirling – Alloa – Kincardine Line;
- Glasgow Airport Rail Link (GARL); and
- Borders Rail Link.

3.10 No committed highway schemes have been incorporated within the direct catchment area of the tram.

Planning and Growth

3.11 Growth as far as 2021 is based on a planning scenario established in conjunction with City of Edinburgh council planners, based on their best professional judgement. Detailed data was provided in 5-year intervals to 2021. Phasing assumptions for development take-up were superimposed for key developments where these were thought likely not to be fully taken up by their planned dates. The planning data was combined with fixed, recently observed trip rates to produce travel demand growth.

3.12 Factors for travel demand growth were incorporated from the government TEMPRO database for areas outside of the City of Edinburgh.

3.13 Travel demand growth beyond 2021 has been assumed to be a uniform 2% per annum in the City of Edinburgh and surrounding regions. This growth rate assumption was porposed by stakeholders (and agreed at the stakeholders group meeting on Friday 8th September 2006) as an appropriate planning scenario for the Tram. It is similar in overall scale to the % per annum growth indicated for the City of Edinburgh by the planning scenario prior to 2021.

3.14 Beyond 2031, the growth rate was stepped down to 1.5% per annum.

Other Technical Forecasting Assumptions

3.15 The stated preference survey work was used to determine an appropriate weight on in-tram vehicle time (relative to time spent on buses) to reflect the user preference for trams. Users are expected to have a preference for trams over buses because of less directly measurable perceptions such as interior comfort, ride quality, reliability, visibility and permanence of route, as well as less tangible factors. Although in some modelling work this parameter can be implemented as a *modal constant,* the research indicated that in this case it should be implemented as a weight on in-vehicle time.

3.16 The results of the surveys, taken at face value, suggest that a weight of 0.81 (for non-concessionary and 1.0 for concessionary users) should be used. However, because the stated preference research was undertaken well in advance of the tram's implementation and because adverse media coverage of the proposals had been prevalent in the run up to the work, it is thought that the direct results are unlikely to be reflective of perceptions of the tram once introduced.

3.17 A screening question had been asked as part of the surveys about general attitude to the tram proposals. If those responding that tram is either a "bad" or "very bad" idea are temporarily excluded from the analysis of results, an average (for all public transport users) in-vehicle weight of 0.77 is suggested. This parameter (0.77) has been used for the Planning Case forecasts in the expectation that, once the tram is introduced, tendency to use the tram will be based on personal utility rather than any form of prejudice (however reasoned). The obvious uncertainty around this interpretation of the stated preference work must be noted.

3.18 The stated preference survey results also suggested that Edinburgh public transport users perceive the need to interchange as equivalent to 12.5 minutes of in-vehicle time. This is in addition to any additional walk or weight time. This figure is within established ranges and has been incorporated into the forecasting.

3.19 Other parameters have been determined from the stated preference work and also incorporated into the forecasting model. Specifically, these are perceived weights placed on time spent walking and waiting, as well as perceived values of time. These figures are detailed in the reports on stated preference research and model development, issued separately.

3.20 For the Planning Case, assumptions as to ramp-up of early year demand are as shown in Table 3.1:

TABLE 3.1 PLANNING CASE RAMP-UP ASSUMPTIONS

Year	Ramp-up Assumption
2011	75%
2012	85%
2013	92%
2014	97%
2015	99%
2016	100%

Financial & Economic Assumptions

3.21 TEL have stated that their expected 2006 fares yield would be 74.2p per boarding (in 2006 prices), this base yield has been incorporated into the forecast. TEL has also stated a policy of +1% per annum real growth in this yield (above retail price index) as their central planning assumption. This has been incorporated for the Planning Reference Case as reported in this document.

3.22 It should be noted that the revenue forecasts presented in this report reflect some more sophisticated assumptions than were practical for undertaking an internally consistent Transport Economic Efficiency (TEE) analysis for the updated STAG 2 Appraisal. Specifically, while the analysis presented in this report assumes that the network-wide average yield per boarding would be controlled to growth of +1% per annum, the work for the TEE appraisal assumes that fares in general would grow at +1% per annum and an assumed overall average yield per trip was the basis of the revenue calculations (with separate yields for airport and non-airport trips). It is not unusual for revenue to be calculated on a slightly different basis for the purposes of financial planning and economic appraisal and it has been confirmed that any discrepancy between the two is not material to the economic case.

3.23 A further point to note is the treatment in this report of the differential between network-wide yield and the average yield for travel to and from the airport. Without the tram, it is planned that the average yield would be controlled to grow at +1% per annum by setting fares for the range of ticket types available. The revenue uplift with the introduction of the tram has also been calculated, for presentation here, using this same average yield. This is the basis of financial planning for the tram but is actually explicitly conservative because the proportion of the patronage uplift associated with airport traffic (at higher average yield) is greater than the proportion of overall TEL patronage associated with airport traffic. In consequence, with constant fares, revenue for airport traffic would be realised at the higher yield and not the average yield.

3.24 For the planning case, it was assumed that the long-term elasticity of public transport demand to moderate and universal real growth in public transport fares would be zero. That is to say, that the balance of real growth in public transport fares, costs of motoring and users' value of time will be such that the overall car / public transport mode-share would be unaffected by such changes.

3.25 These assumptions are critical and the uncertainty around them is to be tested. They are, however, notionally consistent with an expectation that moderate real growth in public transport fares would be driven by similar factors to those driving the cost of motoring and that the balance would therefore be unaffected. Furthermore, any growth in value of time would mitigate the impact on mode share of any differential growth of fares and motoring costs.

3.26 In the case where growth in public transport fares is planned to be significantly in excess of any expected growth in the cost of motoring, this balance would clearly be upset with a consequent loss of patronage and therefore mitigated revenue growth. The potential for competition from private bus operators would also become heightened in such a scenario. Any sudden uplift in public transport fares would have to be considered similarly.

3.27 It has also been assumed that fully integrated through-ticketing would also be introduced within TEL bus services and between tram and TEL bus services. This precludes the introduction of any fare premium for tram over bus services.

3.28 In the central case, scenario-based and informed-choice analyses, it is assumed that 3% of potential revenue is lost due to fraud (fare evasion) or due to circumstances where either passengers are unable to purchase tickets or the operator is unable to collect all fares.

3.29 Finally, the Planning Case forecasts also assume that tram patronage will be unconstrained by capacity. By 2031, the forecasts suggest that this assumption should be questioned. It would therefore be appropriate to consider either adjustments of service patterns in the peak periods better to address peak demand, or planning for the cost of providing some additional services by 2031 to address heavily loaded times and locations.

Planning Case Patronage & Revenue Forecasts

Net Impacts of Introducing Tram (2011 and 2031 Forecast Years)

3.30 The forecasts of patronage impacts associated with the Planning Case are shown in Table 3.2, broken down into key geographical movements. These show tram patronage (boardings) and the impact on TEL bus patronage (boardings). It should be noted that more than one boarding will be counted for multi-leg trips, including where both modes of transport are used.

TABLE 3.2 PLANNING CASE ALL-OPERATOR PATRONAGE (BOARDINGS)

1,000 boardings per year	2011*		2031	
Movement***	Tram Patronage	Δ TEL Bus Patronage	Tram Patronage	Δ TEL Bus Patronage
Airport ⇔ System	370	-97	1,224	-204
Ingliston ⇔ System	835	-516	1,150	-727
Option 1B Catchment ⇔ System	2,188	-1,257	6,223	-3,037
Option 1A East Catchment ⇔ System	5,865	-5,106	14,294	-10,944
Outer Opt. 1A West Catchment ⇔ System	2,699	-1,916	7,904	-5,346
Inner Opt. 1A West Catchment ⇔ System	1,688	-1,410	3,022	-2,661
City Centre Catchment ⇔ System	6,150	-5,127	12,409	-10,187
Non-Catchment ⇔ System	3,297	-2,077	9,024	-6,240
Non-Catchment ⇔ Non-Catchment	48	418	87	-294
Total ⇔ System	13,243	-9,373	32,225	-23,087

* Reflecting an assumption of 75% 'ramp-up' in 2011 towards full potential patronage by 2016.

***Note that the total is not the sum of the above segment values which are not mutually exclusive.

3.31 In respect of tram patronage, the following observations can be made:

i. The tram would have relatively low patronage and carry a small proportion of total airport surface access demand, reflecting that the tram journey time to the airport is not particularly competitive relative to other modes. The market in the tram corridor is also a small proportion of total airport demand.

ii. Most of the large patronage segments relate to areas exhibiting significant planning-driven growth, leading to growth in either trip production or attraction (Granton, Leith and Edinburgh Park / Gyle). This is also reflected in increases between 2011 and 2031.

iii. Travel to and from the City centre remains an important market segment, reflecting continued buoyancy of the centre as a trip attractor.

iv. The tram offers new or improved journey opportunities to/from areas which it does not directly serve because of connections with rail and other bus services.

3.32 It is notable that a significant proportion of tram patronage is balanced by a loss in

TEL bus patronage. Because only TEL revenues are shown here, it is not possible to see what proportion of patronage is 'new to public transport', which is actually forecast to be 17% in 2011, growing to 20% by 2031 in the Planning Reference Case.

3.33 Tram patronage is presented in Appendix C as histograms of boarding and alighting numbers by stop. It is shown separately for each direction of travel, for each modelled period (morning peak and inter-peak) and for each forecast year (2011 and 2031). These demonstrate that the service patterns are reasonably matched to the forecast patterns of demand. They do, however, indicate that patronage is expected slightly to exceed design capacity (not crush capacity) by 2031, for a short stretch of the Option 1A route west of Haymarket in the morning peak period. The Planning Reference Case demand and revenue forecasts have not been constrained in this respect.

3.34 Table 3.3 shows the impact on TEL revenue. The reported revenue figures are directly related to the patronage (boardings) figures by the yield per boarding, because this is the metric to be used for controlling growth in overall fare levels. This leads to two notable effects in the reporting of revenue, however:

i. The control over average yield per boarding is also assumed to encompass the airport premium fares. For transparency of reporting, these are also therefore reported at the average yield level, rather than at their premium level.

ii. Where an increase in the number of multi-leg trips is forecast, the increase in revenue reported continues to reflect the control of fares growth on the basis of yield per-boarding. It does not therefore reflect the additional fares that would be collected directly from those passengers making multi-leg trips, which would constitute a smaller revenue.

TABLE 3.3 PLANNING CASE REVENUE (2005 PRICES)

£1,000 per year	2011*		2031	
Movement	Tram Revenue	Δ TEL Bus Revenue	Tram Revenue	Δ TEL Bus Revenue
Airport ⇔ System**	£272	-£73	£1,097	-£188
Ingliston ⇔ System	£614	-£390	£1,031	-£671
Option 1B Catchment ⇔ System	£1,607	-£952	£5,577	-£2,806
Option 1A East Catchment ⇔ System	£4,308	-£3,866	£12,809	-£10,110
Outer Opt. 1A West Catchment ⇔ System	£1,982	-£1,450	£7,083	-£4,939
Inner Opt. 1A West Catchment ⇔ System	£1,240	-£1,068	£2,708	-£2,458
City Centre Catchment ⇔ System	£4,516	-£3,882	£11,120	-£9,411
Non-Catchment ⇔ System	£2,421	-£1,573	£8,087	-£5,765
Non-Catchment ⇔ Non-Catchment	£35	£317	£78	-£272
Total ⇔ System	£9,726	-£7,097	£28,877	-£21,329

* Reflecting an assumption of 75% 'ramp-up' in 2011 towards full potential patronage by 2016.

** Revenue calculated using the average system-wide yield and not airport premium. (Necessary to ensure yield growth policy enforced)

3.35 Table 3.4 shows the Planning Case forecast of net impact on overall TEL public transport fares revenue.

TABLE 3.4 PLANNING CASE NET TEL PT FARES REVENUE IMPACT (2005 PRICES)

Movement £1,000 per year	2011*	2031
Airport ⇔ System	£199	£909
Ingliston ⇔ System	£223	£360
Option 1B Catchment ⇔ System	£655	£2,770
Option 1A East Catchment ⇔ System	£442	£2,699
Outer Opt. 1A West Catchment ⇔ System	£532	£2,144
Inner Opt. 1A West Catchment ⇔ System	£172	£250
City Centre Catchment ⇔ System	£634	£1,709
Non-Catchment ⇔ System	£849	£2,322
Non-Catchment ⇔ Non-Catchment	£352	-£194
Total ⇔ System	£2,629	£7,548

* Reflecting an assumption of 75% 'ramp-up' in 2011 towards full potential patronage by 2016.

** Revenue calculated using the average system-wide yield and not airport premium. (Necessary to ensure yield growth policy enforced)

Net TEL Revenue Profiles

3.36 Tables 3.2 to 3.4 showed forecasts for 2011 and 2031, broken down by geographical segment. Figures 3.1 to 3.3 then show the profile between and beyond these Planning Case forecast years, for tram revenue, the change to TEL bus revenue and the overall change to TEL public transport fares revenue expected with the introduction of tram.

3.37 Each of the two charts shows these Planning Case forecasts both in a fixed 2005 price base and, for illustrative purposes, in nominal terms with the assumption of 3% per annum growth in Retail Price Index (RPI).

FIGURE 3.1 PLANNING CASE TRAM REVENUE PROFILE

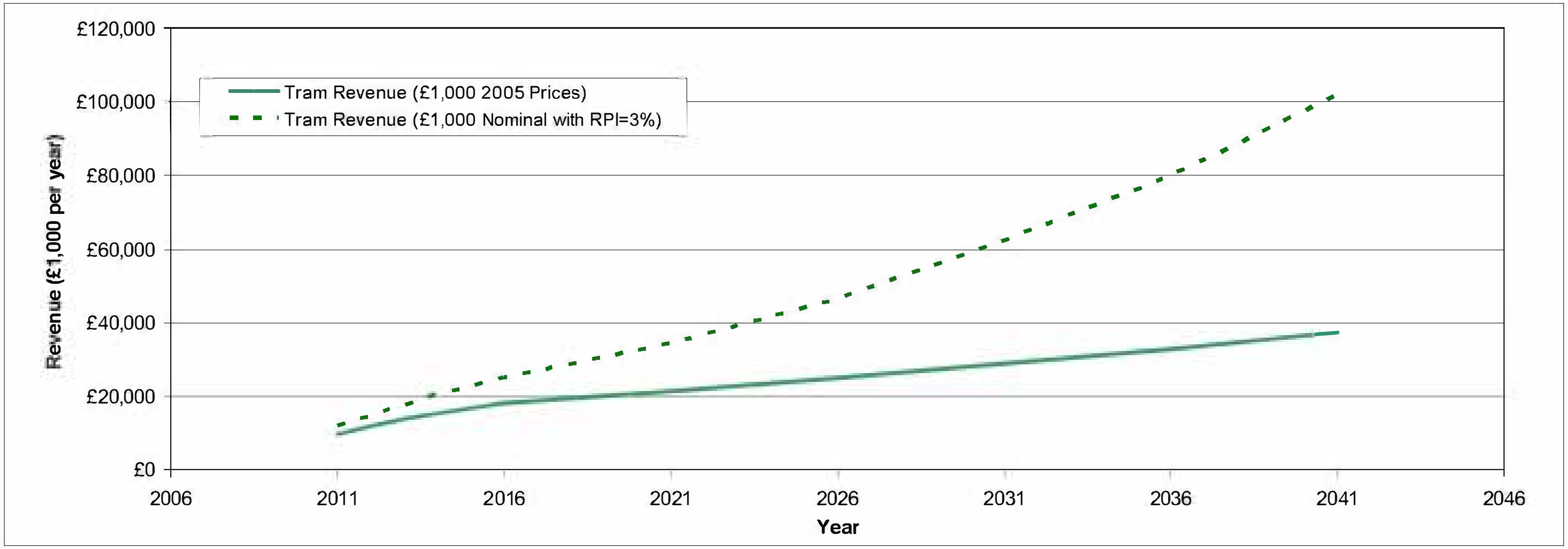


FIGURE 3.2 PLANNING CASE TEL BUS REVENUE IMPACT PROFILE

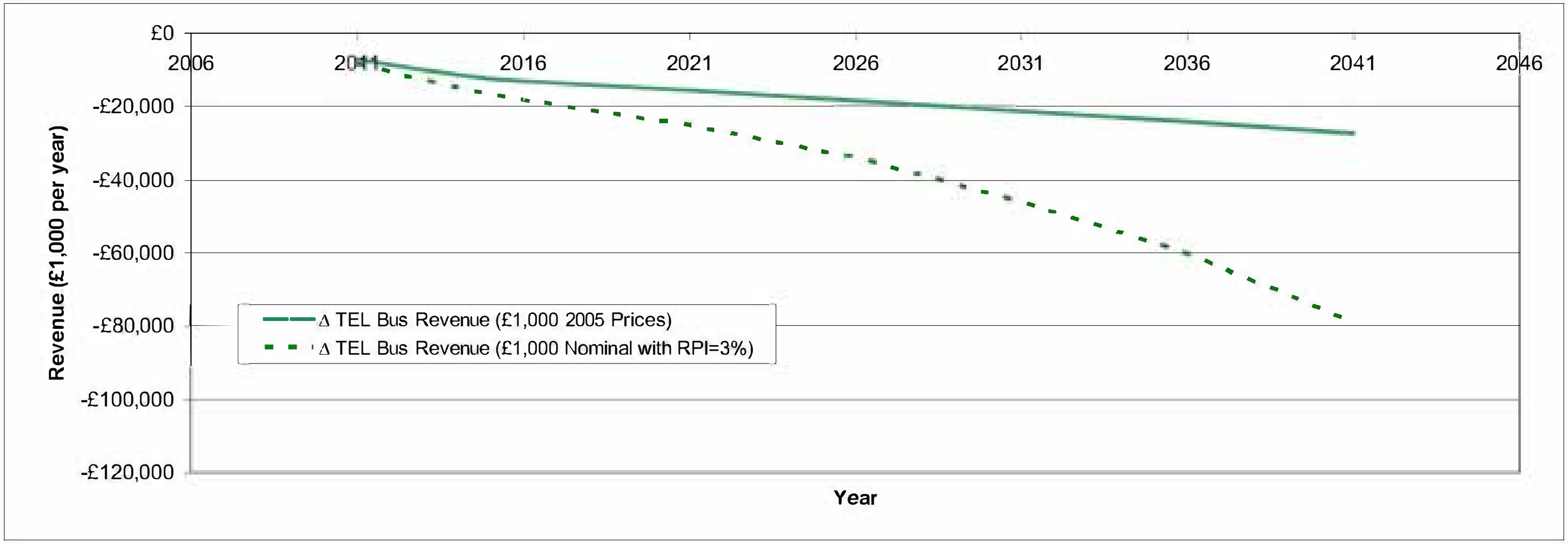
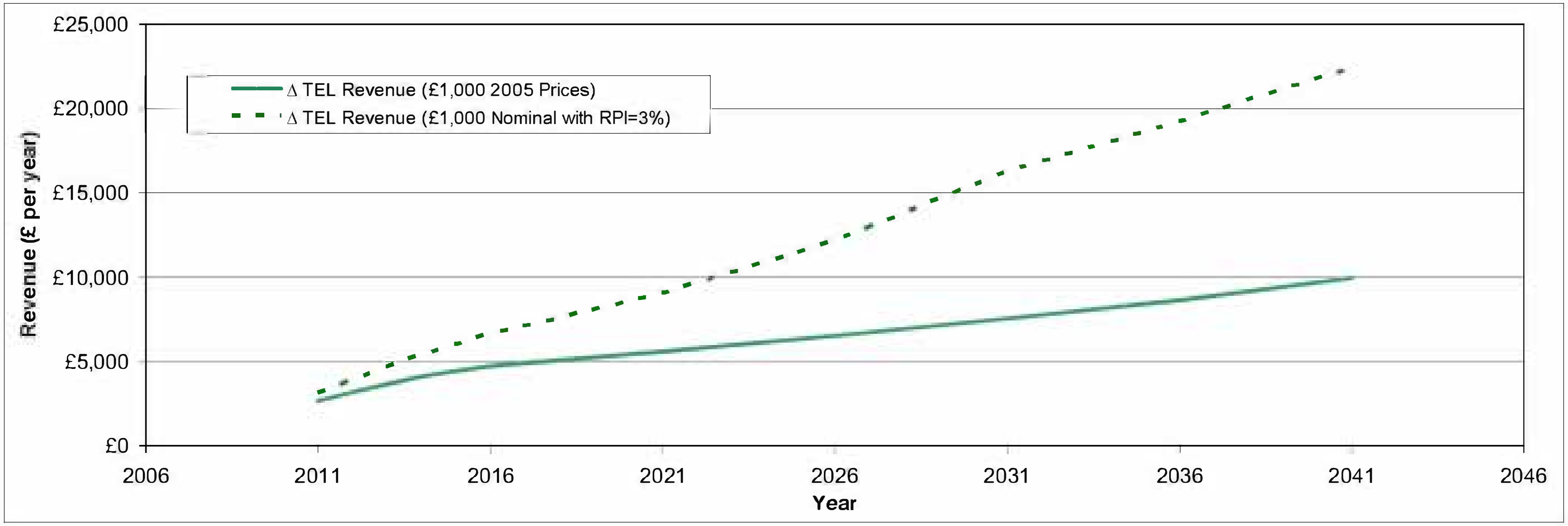


FIGURE 3.3 PLANNING CASE TEL PT FARES REVENUE IMPACT PROFILE



Projections of TEL Absolute Revenue

3.38 As noted in the discussion of forecasting tools in Section 2 of this report, the constrained timescales available for forecasting following a protracted process of specifying the Planning Case, means that the future year models have had to be refined without revisiting the calibrated 2005 base year. This represents a particular additional risk to projections of absolute TEL public transport revenue, which it has not been possible to explore at this stage. This issue will be addressed in ongoing work and for future revisions of this Revenue and Risk Report. The projections here rest firmly on the assumptions noted in Section 2, as well as those critical assumptions underpinning the promoters' Planning Case.

3.39 Table 3.5 shows a projection of absolute TEL public transport fares revenue (excluding supported bus service revenues) for the two forecast years and a key year of 2016. The projections are shown in both fixed 2005 prices and, for illustration, in nominal terms with the assumption of +3% per annum Retail Price Index growth.

TABLE 3.5 PROJECTIONS OF ABSOLUTE TEL PATRONAGE & REVENUE

1,000 per year	2005	2011	2016	2031
Patronage (Boardings)				
TEL Bus Without Tram	102,217	119,599	137,358	165,135
TEL With Tram	102,217	123,469	144,069	174,272
2005 Prices				
Without Tram	£68,170	£90,553	£109,304	£152,560
With Tram**	£68,170	£93,182	£114,087	£160,108
Difference	n/a	£2,629	£4,783	£7,548
Nominal Prices*				
Without Tram	£68,170	£108,125	£151,302	£329,009
With Tram**	£68,170	£111,264	£157,923	£345,288
Difference	£n/a	£3,139	£6,621	£16,279

* For illustration with assumption of Retail Price Index (RPI) growth of +3% per annum.

** Note that yields will be affected by an assumption of 3% loss due to tram fare non-payment.

3.40 Full projections are shown in Figures 3.4 and 3.5

FIGURE 3.4 ABOLUTE TEL PUBLIC TRANSPORT REVENUE PROJECTIONS (2005 PRICES)

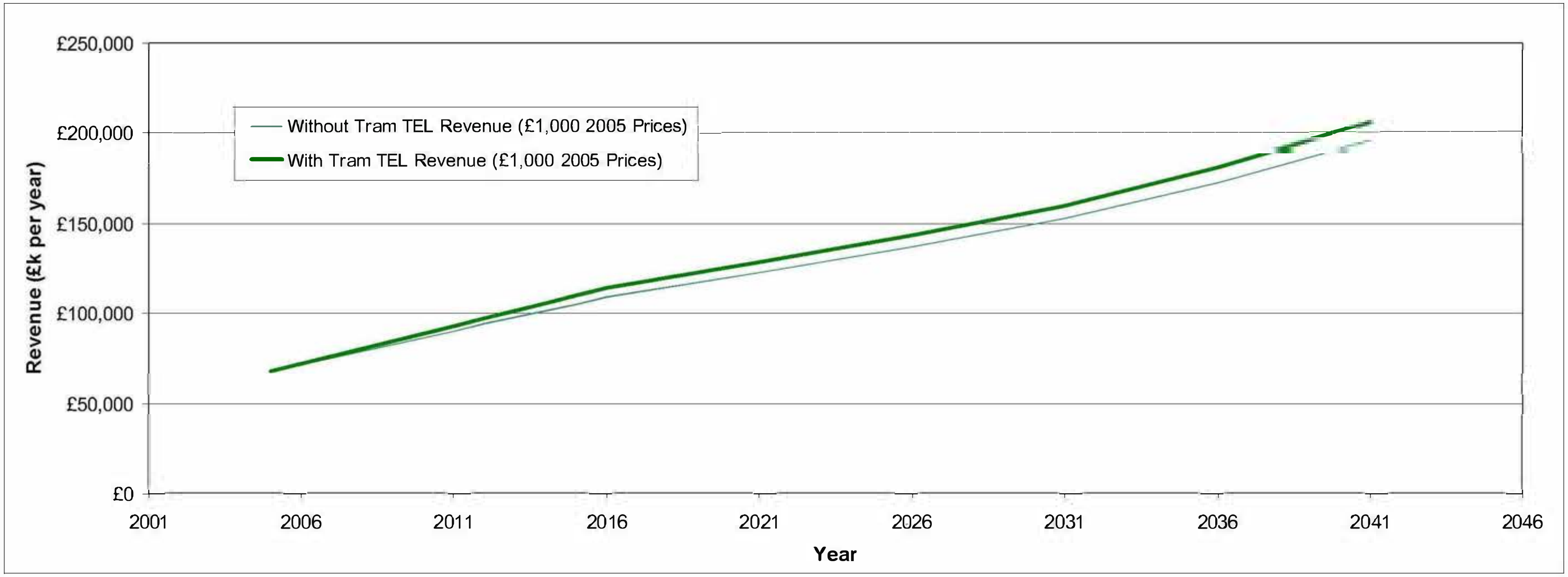
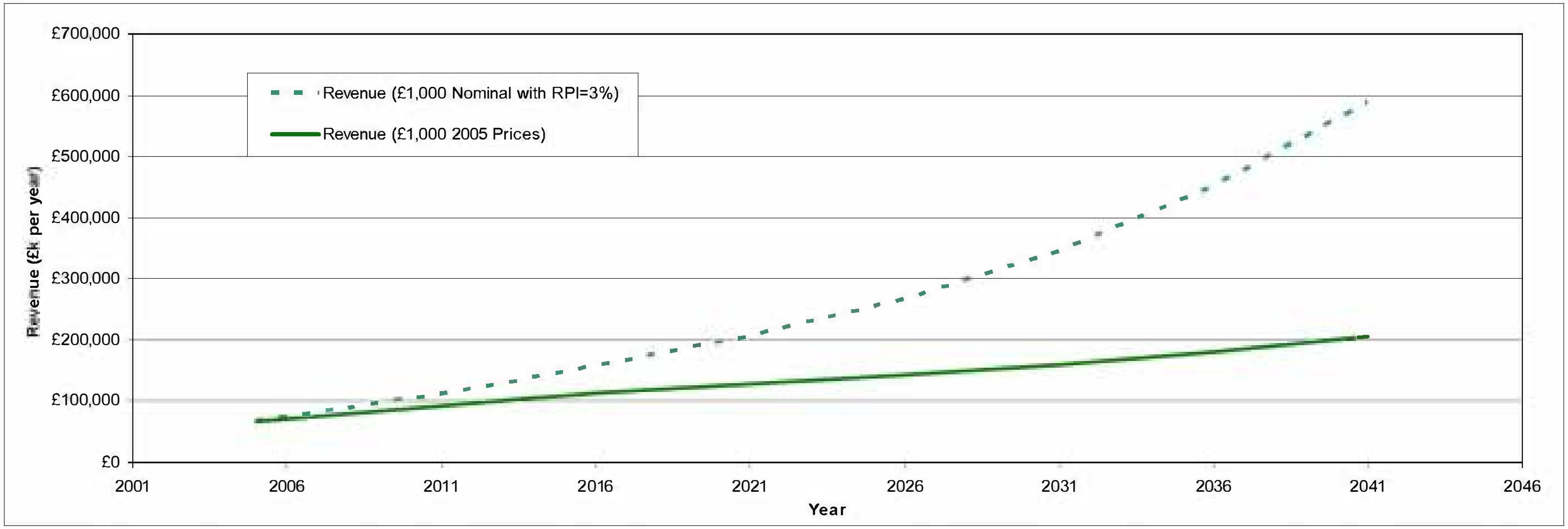


FIGURE 3.5 ABSOLUTE TEL PUBLIC TRANSPORT FARES REVENUE PROJECTION (NOMINAL WTH 3% PER ANNUM RPI GROWTH)



4. SCENARIO-BASED ANALYSIS

Key Areas of Uncertainty Affecting Tram and Overall TEL Revenue

Alternative Planning & Growth Scenarios

4.1 Two alternative development planning scenarios to the Planning Case have been developed – an upside and a downside. Although the actual outcome relative to these possible scenarios could be influenced by TEL/tie in conjunction with City of Edinburgh Council as the promoting group, they could not be guaranteed. These have therefore been presented as scenarios rather than as informed choices. An economic downturn scenario has also been presented, better to consider the potential for real economic downturn within longer term growth.

'Higher Planning Growth' Scenario

4.2 An upside 'Higher Planning Growth' scenario has been developed, looking at a speculative absolute maximum development-driven growth scenario, established in conjunction with the MRSG stakeholders group.

4.3 This scenario included the following differences from the Planning Reference Case:

- *With tram*:
  - 2 additional developments by 2031 (not 2011) at Ingliston located opposite the RBS site and each equivalent in size to the RBS site.
  - Granton and Leith development assumptions closer to the *planned* phasing rather than likely take-up phasing.
- *Without tram as 'with tram' except*:
  - Differences against with-tram scenario proportional to those in Central Case; and
  - Granton at 25% Planning Case without-tram growth.

TABLE 4.1 HIGH PLANNING: NET TEL FARES REVENUE IMPACT (2005 PRICES)

£1,000 per year	2011*		2031	
Movement	Planning Case	Planning Upside	Planning Case	Planning Upside
Airport ⇔ System	£199	£206	£909	£981
Ingliston ⇔ System	£223	£223	£360	£360
Option 1B Catchment ⇔ System	£655	£2,697	£2,770	£9,972
Option 1A East Catchment ⇔ System	£442	£672	£2,699	£3,614
Outer Opt. 1A West Catchment ⇔ System	£532	£627	£2,144	£3,123
Inner Opt. 1A West Catchment ⇔ System	£172	£251	£250	£646
City Centre Catchment ⇔ System	£634	£798	£1,709	£2,173
Non-Catchment ⇔ System	£849	£2,321	£2,322	£7,732
Non-Catchment ⇔ Non-Catchment	£352	£300	-£194	-£90
TOTAL	£2,629	£5,359	£7,548	£18,076

* Reflecting an assumption of 75% 'ramp-up' in 2011 towards full potential patronage by 2016.

** Revenue calculated using the average system-wide yield and not airport premium. (Necessary to ensure yield growth policy enforced)

4.4 Table 4.1 shows that the impact of the upside planning scenario on the revenue is forecast to be extremely significant in terms of the revenue uplift expected with the introduction of the tram. This is attributable to two issues connected with trip generation assumptions and trip distribution:

- Revenue generated for the tram by additional trip-attracting development (employment at Ingliston) being satisfied by people living outside the tram catchment but nevertheless using the tram as part of their journey. For example people travelling from the South East Wedge development area, who would otherwise travel to work by car, or people from outside of the City interchanging from rail to the tram at Gyle, Haymarket or the Airport;
- The assumption in this scenario that the Granton development would be highly dependent on the tram, leading to a strong revenue uplift for both tram *and* bus with the tram's introduction.

4.5 In respect of the latter issue, it is important to note the implication that this aspect of the scenario represents an upside only for the net impact on TEL revenue of the introduction of tram. It indicates the opportunity represented by the inclusion of the Option 1B infrastructure but is balanced by the risk that the development at Granton might not happen even with the tram. This risk is reflected in the "Lower Planning Growth" scenario discussed later in this section.

4.6 In terms of absolute TEL revenue, the Higher Planning Scenario forecasts are shown below in Table 4.2

TABLE 4.2 ABSOLUTE TEL REVENUE: HIGH PLANNING GROWTH (2005 PRICES)

£1,000 per year	2005	2011	2016	2031
Planning Case				
Without Tram	£68,170	£90,553	£109,304	£152,560
With Tram	£68,170	£93,182	£114,087	£160,108
Difference	n/a	£2,629	£4,783	£7,548
Higher Planning				
Without Tram	£68,170	£90,470	£109,647	£153,739
With Tram	£68,170	£95,828	£120,299	£171,815
Difference	n/a	£5,359	£10,653	£18,076

4.7 It should be noted that the bus services assumed for this scenario are the same as those assumed for the Planning Case. In practice, additional services might be required, which would have a cost associated with them.

4.8 In addition, it should be noted that the 2031 tram patronage in the Planning Reference Case is already forecasts to be reaching design capacity at some times and locations and that to accommodate the additional patronage forecast for this Higher Planning Growth scenario would almost certainly require additional services with their associated cost.

'Lower' Planning Growth Scenario

4.9 Similarly a downside planning growth scenario was considered, also in conjunction with the MRSG. This scenario, however, is not thought by the JRC to represent a reasonable estimate of the full potential for a growth downside because it still presumes a reasonably healthy economic climate driving underlying growth.

4.10 The 'Lower Planning Growth' scenario included the following changes from the central case:

- *With tram*
  - Granton growth 25% of that in central case;
  - Leith growth phasing delayed by 5 years;
  - Edinburgh Park growth phasing delayed by 5 years;
  - No City Centre growth except schemes already being developed for specific purposes;
  - General 5-year slippage in all other ambient growth;
  - Growth assumptions outside Edinburgh halved; and
  - Growth 2021-2031 set at 1%per annum instead of 2% per annum.
- *Without tram:*
  - As Downside Do-something (i.e. no development is influenced by the tram)

4.11 The forecasts of tram and net bus revenue resulting in the downside planning growth scenario are presented in Table 4.3 below.

TABLE 4.3 LOW PLANNING: NET TEL FARES REVENUE IMPACT (2005 PRICES)

£1,000 per year	2011*		2031	
Movement	Planning Case	Planning Downside	Planning Case	Planning Downside
Airport ⇔ System	£199	£194	£909	£851
Ingliston ⇔ System	£223	£223	£360	£359
Option 1B Catchment ⇔ System	£655	£378	£2,770	£897
Option 1A East Catchment ⇔ System	£442	£408	£2,699	£1,105
Outer Opt. 1A West Catchment ⇔ System	£532	£470	£2,144	£1,049
Inner Opt. 1A West Catchment ⇔ System	£172	£156	£250	£100
City Centre Catchment ⇔ System	£634	£538	£1,709	£740
Non-Catchment ⇔ System	£849	£676	£2,322	£1,220
Non-Catchment ⇔ Non-Catchment	£352	£340	-£194	-£266
TOTAL	£2,629	£2,199	£7,548	£3,504

* Reflecting an assumption of 75% 'ramp-up' in 2011 towards full potential patronage by 2016.

** Revenue calculated using the average system-wide yield and not airport premium. (Necessary to ensure yield growth policy enforced)

4.12 It should be noted that the bus services assumed for this scenario are the same as those assumed for the Planning Case. In practice, it would be likely that a reduced bus service would be offered both with and without tram but that the difference between them would be proportionately similar. In this way, the impact on overall profitability would be mitigated.

4.13 In terms of absolute TEL revenue, the Lower Planning Scenario forecasts are shown below in Table 4.4

TABLE 4.4 ABSOLUTE TEL REVENUE: LOW PLANNING GROWTH (2005 PRICES)

£1,000 per year	2005	2011	2016	2031
Planning Case				
Without Tram	£68,170	£90,553	£109,304	£152,560
With Tram	£68,170	£93,182	£114,087	£160,108
Difference	n/a	£2,629	£4,783	£7,548
Downside Planning				
Without Tram	£68,170	£87,932	£102,020	£135,879
With Tram	£68,170	£90,132	£105,078	£139,384
Difference	n/a	£2,199	£3,057	£3,504

4.14 It can be seen that, not only is the uplift in revenue expected with the introduction of the tram at very significant risk from the possibility of reduced planning growth, but also the overall level of TEL revenue, all of which is exposed to the risk of planning development shortfall. While nearly half of the £7.5m million uplift in revenue planned to be generated by the tram by 2031 could be lost in this Lower Planning Scenario, the reduction in overall revenue that TEL might expect is around £21m per year, relative to the Planning Reference Case.

4.15 It should also be noted that the uplift in revenue generated by the tram for the Option 1B route in 2031 would be reduced by nearly 60% from the reference case. This reflects the assumption of 'stalled' development at Granton in this scenario and the dependence of patronage in this area on development growth.

Low Economic Growth Scenario

4.16 While the Lower Planning Growth Scenario represents a significant shortfall in development take-up relative to the Planning Case, it probably does not reflect the full potential for growth shortfall should a general economic downturn be concurrent with the planning shortfall. Further scenarios are presented based on the assumption that long-term background patronage growth will be either 50% or 25% of that expected in the Lower Planning Growth Scenario.

4.17 This is an illustration of the potential impact of an economic downturn. At this stage, the uncertainty around the revenue uplift resulting from the introduction of the tram is expected to be of most concern. As the forecasting of revenue and risk progresses throughout design and construction, however, the importance of longer term growth is expected to become increasingly important and the approach to considering the economic drivers of upsides and downsides can be developed further.

4.18 Although this is intended to illustrate the possibility of a less positive economic outlook, it is expected that the initial interest in the revenue forecasts will be in the early years. Projections of revenue further into the future can be considered more thoroughly in future versions of the Revenue and Risk Report.

4.19 In terms of absolute TEL revenue, the Lower Planning Scenario forecasts are shown below in Table 4.5

4.20 It should be noted that the bus services assumed for this scenario are the same as those assumed for the Planning Case. In practice, it would likely that a reduced bus service would be offered both with and without tram but that the difference between them would be proportionately similar.

TABLE 4.5 ABSOLUTE TEL REVENUE: LOW ECONOMIC GROWTH (2005 PRICES)

£1,000 per year	2005	2011	2016	2031
Planning Case				
Without Tram	£68,170	£90,553	£109,304	£152,560
With Tram	£68,170	£93,182	£114,087	£160,108
Difference	n/a	£2,629	£4,783	£7,548
Economic Downside (50% of "Low Planning" Growth				
Without Tram	£68,170	£83,979	£93,207	£117,189
With Tram	£68,170	£86,018	£95,919	£120,123
Difference	n/a	£2,039	£2,712	£2,935
Economic Downside (25% "Low Planning" Growth				
Without Tram	£68,170	£80,692	£87,280	£105,818
With Tram	£68,170	£82,651	£89,820	£108,468
Difference	n/a	£1,960	£2,540	£2,650

4.21 It can be seen from these economic down-turn scenarios that both the overall planned TEL revenue and the uplift in revenue expected with the introduction of the tram are at significant risk to the prevailing economic climate. The implication of such a shortfall in growth are naturally much more significant further into the future.

Elasticity of Patronage to Real Fares Growth

4.22 For the Planning Reference Case forecasts, it has been assumed for financial planning purposes that the collective net impact of real fares growth (at RPI+1%), growth in the cost of motoring and value of time growth would be such that mode shares are unaffected. This assumption was made for financial planning because of significant uncertainty of the expected level of growth in both values of time and motoring costs but would seem to be intuitively consistent with the strong economic growth assumed in the Planning Reference Case.

4.23 The assumption would affect both the overall TEL revenue and the uplift in revenue to be expected with the introduction of tram.

4.24 Scenarios have not been developed around this area of uncertainty but it has been incorporated into the Monte Carlo revenue analysis.

Key Areas of Uncertainty Affecting Revenue Uplift with Tram

4.25 The following scenarios have been considered to explore areas of uncertainty that would impact on Tram revenue and the uplift in overall revenue to be expected with the introduction of tram. These issues would not, however, impact on the remainder of TEL revenue.

Lower Attractiveness of Tram to Users

4.26 A weight of 0.77 on tram in-vehicle time has been used in the Planning Case to represent the greater attractiveness to users of trams relative to buses. The derivation of this Planning Case assumption is discussed in Chapter 3 of this report. The parameter was taken from stated preference survey results but the results were screened to exclude respondents stating a prejudice against the tram. This was done on the basis that such prejudice that exists currently would be unlikely to affect a user's propensity to travel by tram for a particular journey once the tram is in place. A value of around 0.81 or greater would have otherwise been derived.

4.27 In addition, the stated preference technique itself reveals a statistical level of uncertainty and a notional lower bound value of 0.86 is suggested.

4.28 Using the weight of 0.86 on tram in-vehicle time rather than 0.77 results in reduced tram revenue abstraction from bus and a net reduction in the uplift to TEL public transport revenue, as shown in Table 4.6.

TABLE 4.6 LOW ATTRACTIVENESS: NET TEL REVENUE IMPACT (2005 PRICES)

£1,000 per year	2011*		2031	
Movement	Planning Case	Low Tram Attraction	Planning Case	Low Tram Attraction
Airport ⇔ System	£199	£169	£909	£795
Ingliston ⇔ System	£223	£225	£360	£362
Option 1B Catchment ⇔ System	£655	£604	£2,770	£2,604
Option 1A East Catchment ⇔ System	£442	£340	£2,699	£2,350
Outer Opt. 1A West Catchment ⇔ System	£532	£429	£2,144	£1,759
Inner Opt. 1A West Catchment ⇔ System	£172	£147	£250	£195
City Centre Catchment ⇔ System	£634	£540	£1,709	£1,431
Non-Catchment ⇔ System	£849	£734	£2,322	£1,962
Non-Catchment ⇔ Non-Catchment	£352	£346	-£194	-£213
TOTAL	£2,629	£2,307	£7,548	£6,498

* Reflecting an assumption of 75% 'ramp-up' in 2011 towards full potential patronage by 2016.

** Revenue calculated using the average system-wide yield and not airport premium. (Necessary to ensure yield growth policy enforced)

4.29 It is clear that this issue is important, with the expected 2031 revenue uplift reducing from £7.5m to £6.5m, with the 1A West catchment being most affected, both proportionately and in terms of the absolute value of unrealised revenue.

Bus Operator Competition

4.30 The possibility for bus operator competition has been identified as a potential threat to tram and overall TEL revenue. Unfortunately, the form that competition might take is not at all clear. An extreme illustration of the risk to tram and TEL revenue from other-operator competition (with respect to service provision rather than fare) was made by assuming that the without-tram bus services would be retained with the introduction of the tram. The outcome for this forecast scenario is shown in Table 4.7

TABLE 4.7 BUS COMPETITION: NET TEL REVENUE IMPACT (2005 PRICES)

£1,000 per year	2011*		2031	
Movement	Planning Case	Bus Comp.	Planning Case	Bus Comp.
Airport ⇔ System	£199	£200	£909	£787
Ingliston ⇔ System	£223	£181	£360	£208
Option 1B Catchment ⇔ System	£655	£644	£2,770	£2,516
Option 1A East Catchment ⇔ System	£442	-£441	£2,699	£1,139
Outer Opt. 1A West Catchment ⇔ System	£532	£528	£2,144	£1,850
Inner Opt. 1A West Catchment ⇔ System	£172	£60	£250	£35
City Centre Catchment ⇔ System	£634	£35	£1,709	£359
Non-Catchment ⇔ System	£849	£462	£2,322	£933
Non-Catchment ⇔ Non-Catchment	£352	£327	-£194	-£235
TOTAL	£2,629	£1,392	£7,548	£4,144

* Reflecting an assumption of 75% 'ramp-up' in 2011 towards full potential patronage by 2016.

** Revenue calculated using the average system-wide yield and not airport premium. (Necessary to ensure yield growth policy enforced)

4.31 Because the changes to the bus service most affect travel to the city centre up Leith Walk, the most significant impact on the revenue uplift is on the Option 1A East route, mostly to the City Centre. A significant shortfall is also indicated for the Non-Catchment to System segment as well, which represents the potential for competition where bus services off the route of the tram have been affected by the bus service integration plans in the absence of a good tram journey – for example in Lochend and Leith Links.

4.32 This scenario was also examined in terms of Transport Economic Efficiency in the STAG appraisal work and it was demonstrated that the operating costs of these retained services would be overwhelmingly greater than the likely revenue they would generate. It therefore seems unlikely that another operator would put up competition of this form and severity. The extremity of this scenario is therefore thought to be highly unlikely, and the development of well-balanced bus/tram service integration plans would appear to limit the scope for effective competition to a very significant degree.

5. MONTE CARLO ANALYSIS

Introduction

5.1 An initial Monte Carlo simulation has been developed to investigate the range of uncertainty around the target "Planning Reference Case" forecasts of patronage and revenue. The simulation reflects the majority of risks identified in the revenue risk register and their implementation within the simulation, which is summarised in Appendix A. These cover both external risks and uncertainty inherent to the modelling and forecasting.

Results

5.2 Figures 5.1 to 5.3 show the range of uncertainty around the revenue forecasts using probabilistic forecasts with different confidence levels. For example, the 5% confidence level tram revenue is one against which the chances of shortfall are estimated at 5%. For buses, the 5% confidence level represents the revenue impact against which the chances of a greater abstraction are estimated at 5%.

5.3 These charts appear to show that the Reference Case revenue forecasts are upsides in that there is a greater probability of shortfall than of them being exceeded. This is due to the use of a strong development driven growth profile in the Planning Reference Case and it is important to remember that there is more chance of a downside against such a scenario than of a implausibly high level of growth. The analysis presented also retains the presumption of a long-term positive economic climate (as discussed in the planning scenario section of Chapter 4). The economy is currently strong and there genuinely is an expectation that this, and associated development planning growth will continue but this is by no means guaranteed.

5.4 It also should be noted, however, that the confidence bands presented do not allow for any responsive action to any given outcome and is not able to capture much of the potential actively to manage revenue upwards by one mechanism in the event of a shortfall caused by another.

FIGURE 5.1 IMPACT OF TRAM ON: TRAM AND CHANGE IN TEL BUS REVENUE CONFIDENCE BANDS

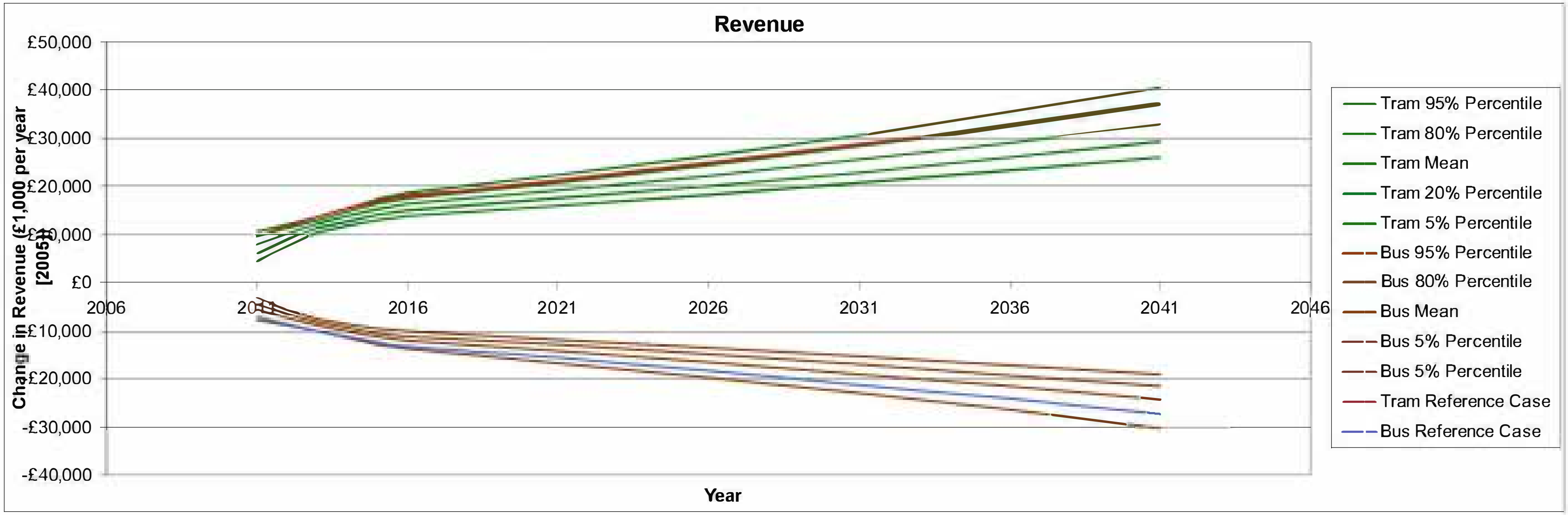


FIGURE 5.2 IMPACT OF TRAM ON: TRAM AND CHANGE IN TEL BUS REVENUE CONFIDENCE BANDS

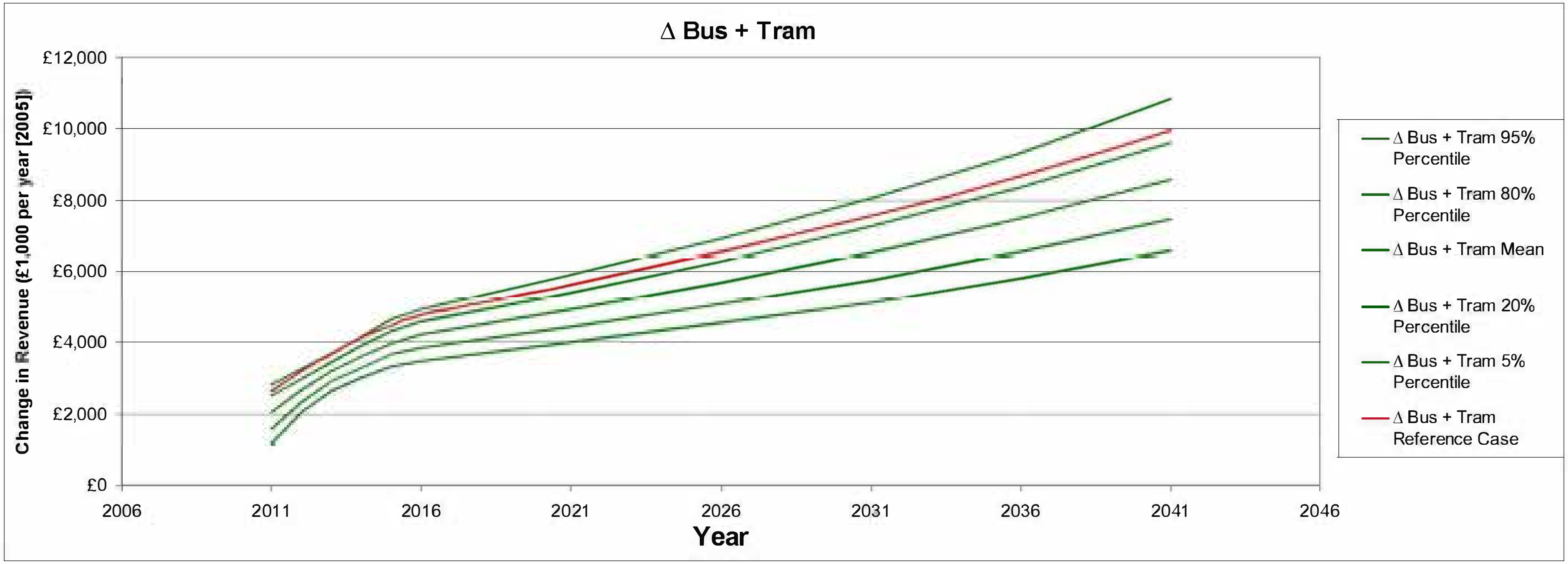
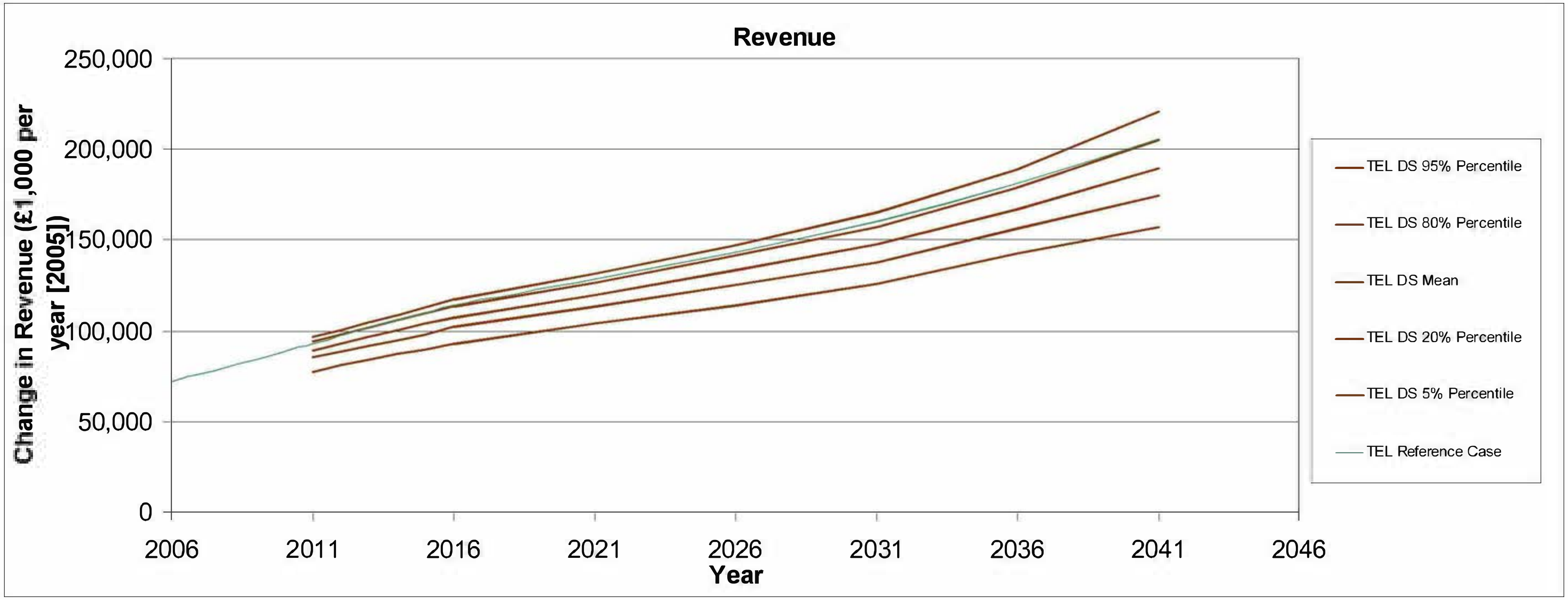


FIGURE 5.3 IMPACT OF TRAM ON: TEL REVENUE WITH TRAM



5.5 The underlying data is presented in Table 5.1:

TABLE 5.1 REVENUE IMPACT CONFIDENCE BANDS

£1,000 per year	2011	2016	2031	2041
TRAM				
Tram 95% Percentile	£10,536	£18,595	£30,692	£40,520
Tram 80% Percentile	£9,479	£17,544	£28,386	£36,904
Tram Mean	£7,781	£16,287	£25,559	£33,043
Tram 20% Percentile	£6,064	£15,024	£22,830	£29,252
Tram 5% Percentile	£4,414	£13,795	£20,683	£25,955
ΔBUS				
Bus 95% Percentile	-£3,208	-£10,130	-£15,310	-£19,136
Bus 80% Percentile	-£4,448	-£11,124	-£16,978	-£21,489
Bus Mean	-£5,720	-£12,056	-£19,036	-£24,452
Bus 20% Percentile	-£6,972	-£13,012	-£21,179	-£27,434
Bus 5% Percentile	-£7,793	-£13,829	-£23,011	-£30,326
Tram + ΔBUS				
Bus 95% Percentile	£2,838	£4,958	£8,044	£10,835
Bus 80% Percentile	£2,518	£4,610	£7,288	£9,614
Bus Mean	£2,061	£4,231	£6,523	£8,591
Bus 20% Percentile	£1,590	£3,861	£5,765	£7,464
Bus 5% Percentile	£1,169	£3,496	£5,123	£6,600

5.6 Figures 5.4 and 5.5 are tornado charts showing which risks are most significant in within the full range of uncertainty for the tram revenue forecasts in 2011 and 2031. It can be seen that for the first year, uncertainty about the ramp-up profile is most dominant, while for later years the planning growth assumptions and short-term revenue impact events become highly significant.

FIGURE 5.4 TORNADO CHART OF RISK SIGNIFICANCE IN 2011

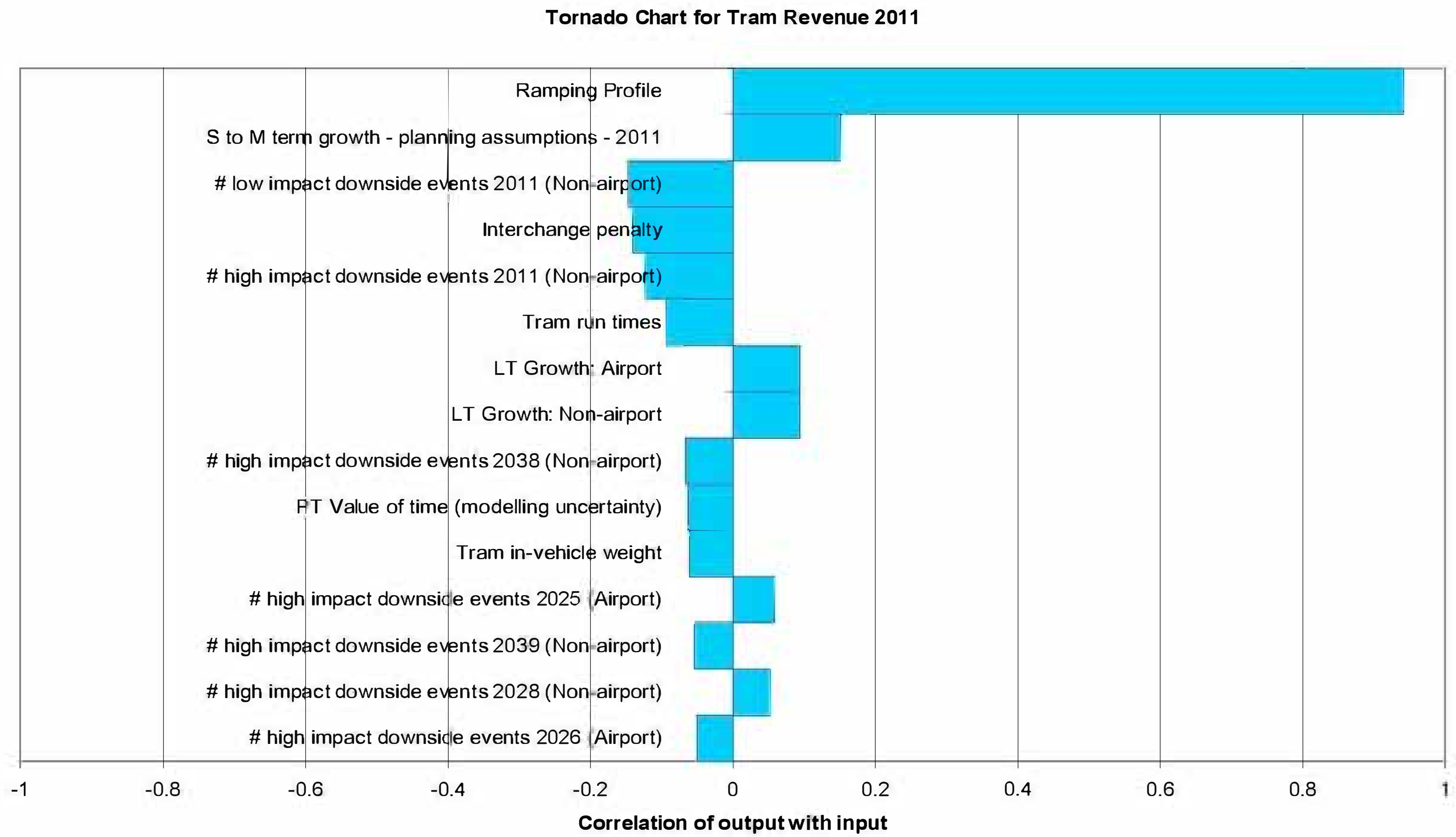
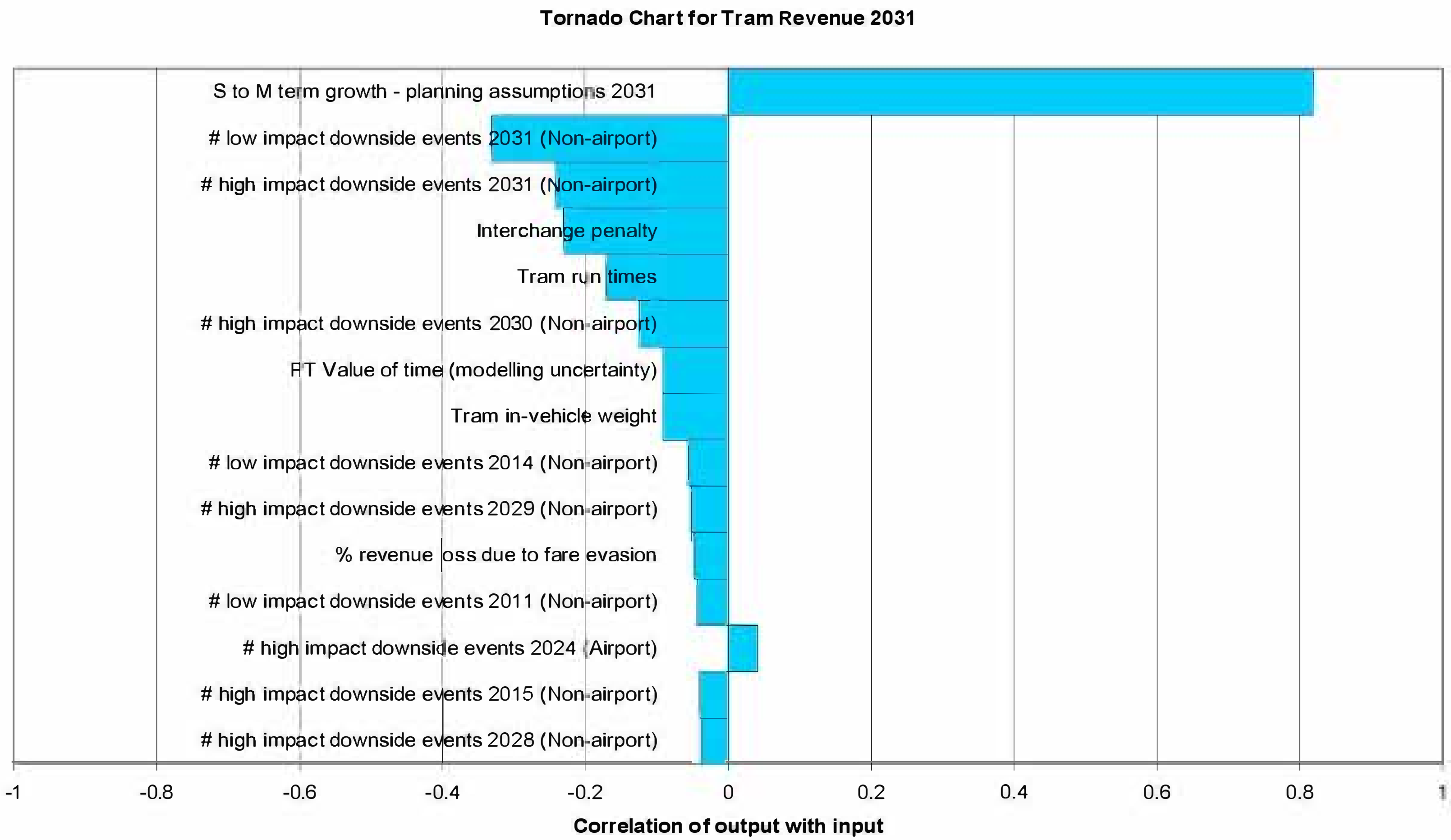


FIGURE 5.5 TORNADO CHART OF RISK SIGNIFICANCE IN 2031



6. 'INFORMED CHOICES'

6.1 The uncertainty around forecast tram and TEL revenues is in part because decisions on scheme specification are yet to be finalised and because tie/TEL and local authorities will take planning and policy decisions in the future.

6.2 Some key areas where such decisions can affect revenues are set out below.

Selection of Scheme Infrastructure

Infrastructure Option 1a Only

6.3 The implications of implementing only the Option 1A infrastructure have been explored in terms of Transport Economic Efficiency Appraisal and are presented here in terms of the revenue uplift to be expected with its introduction. Table 6.1 shows the forecasts of tram revenue and bus revenue abstraction for Option 1A only.

TABLE 6.1 OPTION 1A ONLY REVENUE (2005 PRICES)

£1,000 per year	2011*		2031	
Movement	Tram Revenue	Δ TEL Bus Revenue	Tram Revenue	Δ TEL Bus Revenue
Airport ⇔ System	£266	-£58	£1,022	-£113
Ingliston ⇔ System	£611	-£390	£1,031	-£672
Option 1B Catchment ⇔ System	£157	£172	£671	£1,140
Option 1A East Catchment ⇔ System	£4,162	-£3,765	£12,503	-£9,885
Outer Opt. 1A West Catchment ⇔ System	£1,923	-£1,384	£6,295	-£4,316
Inner Opt. 1A West Catchment ⇔ System	£1,132	-£978	£2,354	-£2,169
City Centre Catchment ⇔ System	£3,790	-£3,339	£9,179	-£7,839
Non-Catchment ⇔ System	£1,746	-£903	£5,202	-£2,617
Non-Catchment ⇔ Non-Catchment	£27	£307	£66	£83
TOTAL	£7,793	-£5,467	£21,795	-£14,461

* Reflecting an assumption of 75% 'ramp-up' in 2011 towards full potential patronage by 2016.

** Revenue calculated using the average system-wide yield and not airport premium. (Necessary to ensure yield growth policy enforced)

6.4 Table 6.2 shows the forecast of net impact on overall TEL public transport fares revenue for the Option 1A only tram scheme. The TEL revenue uplift of £7.5m expected for the full Option 1A+1B infrastructure in the 2031 Planning Reference Case is forecast to reduce by only £0.2m with the exclusion of Option 1B. A small amount of tram revenue is still generated by travel from what was the 1B catchment and an additional £1.1m of bus patronage per annum is forecast to be induced to this area by the introduction of tram.

TABLE 6.2 OPTION 1A ONLY: NET TEL REVENUE IMPACT (2005 PRICES)

£1,000 per year	2011*		2031	
Movement	Planning Case	Option 1A Only	Planning Case	Option 1A Only
Airport ⇔ System	£199	£207	£909	£909
Ingliston ⇔ System	£223	£222	£360	£359
Option 1B Catchment ⇔ System	£655	£329	£2,770	£1,811
Option 1A East Catchment ⇔ System	£442	£397	£2,699	£2,618
Outer Opt. 1A West Catchment ⇔ System	£532	£539	£2,144	£1,979
Inner Opt. 1A West Catchment ⇔ System	£172	£154	£250	£185
City Centre Catchment ⇔ System	£634	£451	£1,709	£1,340
Non-Catchment ⇔ System	£849	£844	£2,322	£2,585
Non-Catchment ⇔ Non-Catchment	£352	£333	-£194	£149
TOTAL	£2,629	£2,326	£7,548	£7,335

* Reflecting an assumption of 75% 'ramp-up' in 2011 towards full potential patronage by 2016.

** Revenue calculated using the average system-wide yield and not airport premium. (Necessary to ensure yield growth policy enforced)

Co-existence with Edinburgh Airport Rail Link (EARL)

6.5 On the instruction of Transport Scotland, the Planning Reference Case revenue forecasts, around which this assessment of revenue uncertainty is being undertaken, are based on a scenario in which EARL is also present from the outset.

6.6 Because the process of securing statutory powers for EARL is still underway, however, and funding has not yet been confirmed, it is important to consider the implications for the revenue performance of the Tram were EARL not to be implemented.

6.7 Table 6.3 shows the Tram revenue and reduction in TEL bus revenue forecast with the introduction of Tram without EARL having been implemented. Table 6.4 shows the resulting net uplift to TEL revenue expected with the introduction of tram.

6.8 It can be seen that £10.1m of revenue is forecast for the Tram in 2011 compared to £9.7m with EARL also implemented; an increase of £0.4m. But the net uplift to total TEL revenue in 2011 is actually lower without EARL because much of the patronage that is forecast to be abstracted from EARL would otherwise already be travelling on TEL bus services.

TABLE 6.3 1A+1B WITHOUT EARL: REVENUE (2005 PRICES)

£1,000 per year	2011*		2031	
Movement	Tram Revenue	Δ TEL Bus Revenue	Tram Revenue	Δ TEL Bus Revenue
Airport ⇔ System	£515	-£342	£1,960	-£928
Ingliston ⇔ System	£614	-£391	£1,031	-£670
Option 1B Catchment ⇔ System	£1,618	-£957	£5,664	-£2,831
Option 1A East Catchment ⇔ System	£4,330	-£3,961	£12,865	-£10,355
Outer Opt. 1A West Catchment ⇔ System	£1,987	-£1,458	£7,141	-£4,927
Inner Opt. 1A West Catchment ⇔ System	£1,254	-£1,111	£2,746	-£2,541
City Centre Catchment ⇔ System	£4,690	-£3,996	£11,700	-£9,762
Non-Catchment ⇔ System	£2,547	-£1,696	£8,592	-£5,955
Non-Catchment ⇔ Non-Catchment	£39	£313	£135	-£336
TOTAL	£10,090	-£7,492	£30,281	-£22,297

* Reflecting an assumption of 75% 'ramp-up' in 2011 towards full potential patronage by 2016.

** Revenue calculated using the average system-wide yield and not airport premium. (Necessary to ensure yield growth policy enforced)

TABLE 6.4 1A+1B WITHOUT EARL: NET TEL REVENUE IMPACT (2005 PRICES)

£1,000 per year	2011*		2031	
Movement	Planning Case	Without EARL	Planning Case	Without EARL
Airport ⇔ System	£199	£172	£909	£1,032
Ingliston ⇔ System	£223	£223	£360	£361
Option 1B Catchment ⇔ System	£655	£662	£2,770	£2,833
Option 1A East Catchment ⇔ System	£442	£369	£2,699	£2,509
Outer Opt. 1A West Catchment ⇔ System	£532	£529	£2,144	£2,214
Inner Opt. 1A West Catchment ⇔ System	£172	£143	£250	£205
City Centre Catchment ⇔ System	£634	£693	£1,709	£1,939
Non-Catchment ⇔ System	£849	£851	£2,322	£2,637
Non-Catchment ⇔ Non-Catchment	£352	£352	-£194	-£200
TOTAL	£2,629	£2,598	£7,548	£7,983

* Reflecting an assumption of 75% 'ramp-up' in 2011 towards full potential patronage by 2016.

** Revenue calculated using the average system-wide yield and not airport premium. (Necessary to ensure yield growth policy enforced)

Approach to Revenue Protection

6.9 The currently preferred approach to revenue protection being considered (and incorporated into the Planning Reference Case) is to have ticket inspectors on every tram. Thus the Reference Case assumption for revenue loss due to fraud, inability to purchase tickets, or inability to collect fares is assumed to be just 3%. All assumptions regarding revenue loss have been provided by TEL.

6.10 An alternative scenario of revenue protection has also been considered, with pairs of ticket inspectors aiming to target every fourth tram. The revenue lost under this type of regime is assumed to be 9%. Applying this level of loss only to tram revenue has a proportionately larger impact on the expected TEL *net* revenue uplift with the introduction of tram. This is shown in Table 6.5.

6.11 Whether the more stringent revenue protection regime is cost-effective will naturally depend on its costs of operation but the proportionate difference in revenue uplift with the introduction of the tram appears to be significant.

6.12 In practice, revenue protection activity is likely to evolve during the operation of the tram, guided by problems of fare evasion as they occur, the resources available to be deployed, the structure and level of fares and the means of ticket issue and validation.

TABLE 6.5 REVENUE PROTECTION: NET TEL REVENUE IMPACT (2005 PRICES)

£1,000 per year	2011*		2031	
Movement	Planning Case	Alternate RP Regime	Planning Case	Alternate RP Regime
Airport ⇔ System	£199	£141	£909	£911
Ingliston ⇔ System	£223	£185	£360	£297
Option 1B Catchment ⇔ System	£655	£561	£2,770	£2,483
Option 1A East Catchment ⇔ System	£442	£101	£2,699	£1,714
Outer Opt. 1A West Catchment ⇔ System	£532	£406	£2,144	£1,773
Inner Opt. 1A West Catchment ⇔ System	£172	£65	£250	£35
City Centre Catchment ⇔ System	£634	£403	£1,709	£1,215
Non-Catchment ⇔ System	£849	£694	£2,322	£2,105
Non-Catchment ⇔ Non-Catchment	£352	£349	-£194	-£209
TOTAL	£2,629	£1,974	£7,548	£6,110

Standard of Interchange Provision

6.13 Because of the complicated bus service integration plans that have been developed, the deterrent to travel of needing to interchange between services is thought to be an important issue. The potential to improve the revenue performance of TEL by improving interchange needs to be understood.

6.14 Two tests have been undertaken to explore the issues:

- An assumption of zero walk time for interchange at St Andrews Square and the foot of Leith Walk.

- A reduction of the modelled interchange penalty from 12.5 to 8 minutes.

Efficiency of Interchange

6.15 The potential revenue impact of improving the efficiency of interchange has been explored by assuming zero walk time for interchange at the foot of Leith Walk and at St Andrews square. The results of this test are presented in Table 6.6 in terms of the revenue uplift expected with the introduction of the tram.

TABLE 6.6 EFFICIENT INTERCHANGE: NET TEL REVENUE IMPACT (2005 PRICES)

£1,000 per year	2011*		2031	
Movement	Planning Case	Efficient Interchange	Planning Case	Efficient Interchange
Airport ⇔ System	£199	£228	£909	£985
Ingliston ⇔ System	£223	£219	£360	££360
Option 1B Catchment ⇔ System	£655	£710	£2,770	£2,872
Option 1A East Catchment ⇔ System	£442	£640	£2,699	£3,242
Outer Opt. 1A West Catchment ⇔ System	£532	£572	£2,144	£2,290
Inner Opt. 1A West Catchment ⇔ System	£172	£203	£250	£302
City Centre Catchment ⇔ System	£634	£884	£1,709	£2,474
Non-Catchment ⇔ System	£849	£1,163	£2,322	£3,164
Non-Catchment ⇔ Non-Catchment	£352	£360	-£194	-£106
TOTAL	£2,629	£3,252	£7,548	£9,321

* Reflecting an assumption of 75% 'ramp-up' in 2011 towards full potential patronage by 2016.

** Revenue calculated using the average system-wide yield and not airport premium. (Necessary to ensure yield growth policy enforced)

6.16 It can be seen from Table 6.6 that, were this level of efficiency to be achieved at these two locations, the potential for an increased revenue uplift could be as much as £1.8m per year by 2031. This increase naturally relates to increased revenues between the City Centre and both the 1A east catchment and areas off the tram catchment travelling via the foot of Leith Walk, particularly where interchange is forced by the curtailment of bus services as part of the bus service integration plans.

Quality of Interchange

6.17 This test addresses the interchange penalty of 12.5 minutes assumed for the forecasting model. This parameter represents public transport users' aversion to interchange over and above any deterred of additional walk and weight time. The value of 12.5 minutes derived from the stated preference research is itself subject to a degree of uncertainty in terms of statistical confidence in the result and this has been incorporated into the Monte Carlo analysis. However, this value, where attributable to any interchange resulting from the tram/bus service integration plans could be influenced by the quality of that interchange. A test has therefore been undertaken with a penalty of 8 minutes instead of 12.5 minutes and this is shown in Table 6.7. 8 minutes is reasonably reflective of the bottom end of the range when comparing figures derived from previous research elsewhere.

TABLE 6.7 QUALITY INTERCHANGE: NET TEL REVENUE IMPACT (2005 PRICES)

£1,000 per year	2011*		2031	
Movement	Planning Case	Quality Interchange	Planning Case	Quality Interchange
Airport ⇔ System	£199	£200	£909	£923
Ingliston ⇔ System	£223	£193	£360	£331
Option 1B Catchment ⇔ System	£655	£653	£2,770	£2,790
Option 1A East Catchment ⇔ System	£442	£342	£2,699	£2,472
Outer Opt. 1A West Catchment ⇔ System	£532	£578	£2,144	£2,100
Inner Opt. 1A West Catchment ⇔ System	£172	£137	£250	£188
City Centre Catchment ⇔ System	£634	£474	£1,709	£1,327
Non-Catchment ⇔ System	£849	£912	£2,322	£2,554
Non-Catchment ⇔ Non-Catchment	£352	£387	-£194	-£280
TOTAL	£2,629	£2,588	£7,548	£7,340

* Reflecting an assumption of 75% 'ramp-up' in 2011 towards full potential patronage by 2016.

** Revenue calculated using the average system-wide yield and not airport premium. (Necessary to ensure yield growth policy enforced)

6.18 In the case of the Non-Catchment ⇔ System segment, the reduction in interchange penalty results in a greater revenue uplift with the introduction of the tram because it increases the modelled propensity for passengers to interchange with the tram.. Overall, however, the uplift is expected to be around £210k lower in 2031. This is a symptom of the way in which this test has necessarily been undertaken: It is not possible to specify a different interchange penalty at different locations because it is a universal modelling parameter and it must therefore be implemented in both the with and without tram scenarios. It therefore has the effect of reducing the general aversion to bus travel (where it could involve an interchange) against which the tram is compared, resulting in a relatively reduced advantage provided to users by the introduction of tram.

Tram Operational Runtimes

Runtime downside

6.19 The tram runtimes used for the Planning Reference Case are based on the Parsons Brinckerhoff (PB) Stage 3 Runtime Simulation Report of August 2006. These account for no traffic delay to the tram where it interacts with the highway. Analysis undertaken by SDS traffic engineers appears to show that very minimal delay (less than 1 cumulative minute along the full route) is likely to be possible but this will remain an area of future risk even once the tram is operational.

6.20 The latest work being undertaken by PB indicates that this level of priority could indeed be delivered to the tram and that the Stage 3 runtimes could practically be achieved, in 2011 with, at worst, less than a minute added to the tram runtimes from end to end. However this achievement of runtimes alongside interaction with the traffic is clearly at risk, particularly in years further into the future. It is therefore necessary to explore the likely impact of lengthened runtimes.

6.21 A scenario of 12% lengthening of runtimes (about equivalent to an additional 5 minutes from Granton Square to Newhaven) has been established and the forecasting results for this are shown in Table 6.8

TABLE 6.8 LONGER TRAM RUNTIME: NET TEL REVENUE IMPACT (2005 PRICES)

£1,000 per year	2011*		2031	
Movement	Planning Case	Run Times +12%	Planning Case	Run Times +12%
Airport ⇔ System	£199	£169	£909	£795
Ingliston ⇔ System	£223	£225	£360	£362
Option 1B Catchment ⇔ System	£655	£604	£2,770	£2,604
Option 1A East Catchment ⇔ System	£442	£340	£2,699	£2,350
Outer Opt. 1A West Catchment ⇔ System	£532	£429	£2,144	£1,759
Inner Opt. 1A West Catchment ⇔ System	£172	£147	£250	£195
City Centre Catchment ⇔ System	£634	£540	£1,709	£1,431
Non-Catchment ⇔ System	£849	£734	£2,322	£1,962
Non-Catchment ⇔ Non-Catchment	£352	£346	-£194	-£213
TOTAL	£2,629	£2,307	£7,548	£6,498

* Reflecting an assumption of 75% 'ramp-up' in 2011 towards full potential patronage by 2016.

** Revenue calculated using the average system-wide yield and not airport premium. (Necessary to ensure yield growth policy enforced)

6.22 A reduction of about £0.3m is forecast to the 2011 expected revenue uplift from introducing the tram. The largest reductions in revenue uplift are the eastern and outer western stretches of the Option 1A route. This therefore represents s significant risk to the revenue uplift. It has only been explored here in terms of a uniform shortfall on average tram speeds but the facility exists to consider the revenue impact once any locations have been identified that are particularly at risk.

6.23 It will be very important through detailed design that runtimes competitive with bus and car are maintained and that an absolute minimum of traffic delay is allowed to be incurred.

Runtime upside

6.24 If it remains the expectation that no traffic delay will impact on runtimes then there could be a possibility of improved runtimes as a result of detailed design optimisation.

6.25 Table 6.9 shows the impact of a hypothetical uniform improvement of runtimes by 10%. This leads to an increase in the 2031 revenue uplift from £7.5m to £8.4m. At the present time, however, it is anticipated that the only improvement to runtimes through detailed design work is a potential 0.5 to 1 minute saving on the Option 1A west route.

TABLE 6.9 RUNTIME UPSIDE: NET TEL REVENUE IMPACT (2005 PRICES)

	2011*		2031	
Movement	Planning Case	Run Times -10%	Planning Case	Run Times -10%
Airport ⇔ System	199	224	909	1,004
Ingliston ⇔ System	223	222	360	358
Option 1B Catchment ⇔ System	655	701	2,770	2,913
Option 1A East Catchment ⇔ System	442	529	2,699	2,989
Outer Opt. 1A West Catchment ⇔ System	532	620	2,144	2,461
Inner Opt. 1A West Catchment ⇔ System	172	193	250	295
City Centre Catchment ⇔ System	634	718	1,709	1,948
Non-Catchment ⇔ System	849	948	2,322	2,633
Non-Catchment ⇔ Non-Catchment	352	357	-194	-179
TOTAL	2,629	2,909	7,548	8,437

* Reflecting an assumption of 75% 'ramp-up' in 2011 towards full potential patronage by 2016.

** Revenue calculated using the average system-wide yield and not airport premium. (Necessary to ensure yield growth policy enforced)

Alternative Bus Service Integration Plans

6.26 A considerable degree of attention has been given to the specification of bus service plans for use in future year forecasting in both with and without tram scenarios. TEL and the JRC have worked closely together to ensure that the service patterns represent a reasonable balance of economic and financial performance, with future year service levels designed to match Planning Reference Case demand and with-tram integration plans designed to limit the need for bus-tram interchange on well patronised routes without resulting in over provision.

6.27 While the potential for optimising these services has been expended at this stage, there will be further possibility to improve these service patterns closer to the opening date of the tram and during its operation. Matching service levels to actual outturn patterns of demand will naturally be an important consideration in managing TEL profitability.

Alternative Service Patterns

Granton ⇔ Edinburgh Park / Airport Services

6.28 The currently proposed service pattern (as assumed for the forecasts) does not incorporate direct services between the Option 1B route and the western part of the 1A route (to the west of Haymarket). A poor journey time comparison therefore exists between tram and buses for journeys from Granton to Gyle / Edinburgh Park, with the result that virtually no patronage is captured for such movements. An option does exist, however, to construct a North to West cord at the Roseburn junction, which would enable services to be run between Granton and Edinburgh Park / Airport. The revenue potential for such services could be investigated as part of future work.

Express Services

6.29 Service key locations – some running through intermediate stops on outer stretches and some running through intermediate stops on inner stretch.

6.30 These could improve run-times for high-demand stops to the detriment of frequency at lower-demand stops. Attitudes and perception of tram to users of skipped stops would also be affected.

Other TEL business planning

6.31 Considering the downside scenarios that were presented in Chapter 4 of this report, it is notable that the scenarios affecting overall TEL revenue inevitability had the biggest potential to damage TEL profitability.

6.32 It should be noted, however, that while TEL is clearly exposed to the risks associated with its whole revenue stream, it is also in control of all of the levers usually available to transport operators with respect to their profitability. These would cover the ability to manage both cost (including by better matching service levels to demand) and yield.

6.33 No illustrations of such management interventions are provided here, however, as they are part of the usual management processes of a transport operator.

Possible Future Park and Ride Schemes

Hermiston Park and Ride Site

6.34 It has been identified that a possible future park and ride site at Hermiston would contribute to overall TEL revenue and profitability. It has not yet been possible to undertake forecasts for such a scenario and the likely impact of such a scheme would be highly dependent on:

- The overall market size for park and ride;
- The degree of abstraction expected to Hermiston from the Ingliston park and ride site.

6.35 The degree to which a Hermiston park and ride site would abstract revenue from tram is uncertain and how much this would affect overall TEL revenue would also depend on the size of the overall market. Profitability would depend not only on the market size and abstraction from existing services but also on the capital and operating costs of the new site / services.

Expansion of Ingliston Site

6.36 It is expected that with the introduction of the tram, the Ingliston site would quickly reach its planned capacity. Expansion of the site would therefore boost revenues for a potentially small capital cost and very little additional operating cost. The revenue potential of such an expansion would depend on growth in the overall size of the park and ride market and further work will be required to establish this clearly. Initial observations, however, have indicated that the market is unlikely to be large enough to require significant expansion in the short term. There could be gain from incremental expansion following the introduction of the tram, which could be an effective tool in maximising revenue growth.

Road User Charging

6.37 Although an Edinburgh City Centre congestion charge scheme has been rejected by referendum, the possibility of road user charging in various forms may well return to the agenda in the future and its implementation would inevitably promote the use of sustainable public transport modes, improving the revenue-generating capacity and hence the profitability of TEL.

7. CONCLUSIONS

Planning Reference Case Forecasts (Target Revenue)

7.1 Forecasts have been produced for a Planning Reference Case, reflecting a range of detailed assumptions about the proposed scheme and the scenario of future year travel demand for which it is being planned. The Reference Case reflects what is felt by City of Edinburgh Council and the promoting group in general to be a realistic scenario of development planning driven growth.

7.2 For the full scheme Options 1A+1B, the Reference Case forecasts indicate strong underlying TEL revenue growth with a significant uplift following the introduction of the tram.

Alternative Infrastructure Option (Option 1A Only)

7.3 For the 1A only infrastructure (excluding the route from Haymarket to Granton Square) only about 20% lower patronage and just 12% lower uplift in revenue is forecast for 2011. A greater proportion of the expected revenue for the Option 1B route to Granton is dependent on development driven growth than that forecast for Option 1A.

Risk and Uncertainty

7.4 The Planning Reference Case is based on a range of assumptions, many of which are subject to significant uncertainty. Tangible risks exist both to future TEL revenue and to the uplift in revenue expected with the introduction of the tram. Other uncertainty also results from the forecasting method in itself and the detailed assumptions contained within it.

7.5 Scenario-based analysis of tangible risks has evaluated several key risks to the revenue uplift expected with the introduction of tram, including

- the potential revenue impact of planned run times not being achieved; and
- a reduced perception of tram quality by users.

7.6 Collectively, these and other risks to the revenue uplift are significant and will need to be managed.

7.7 More significant, however, is the uncertainty around future year overall TEL revenue. This is related chiefly to the risk of the Planning Reference Case growth scenario not being realised. While the planning scenario is thought to be realistic on the presumption of a positive economic outlook, there would still be a greater chance of shortfall than of it being exceeded. In addition, the presumption of a long-term positive economic climate is also at risk.

7.8 These risks to overall TEL revenue appear to represent greater risks to TEL profitability than the risks specifically to the revenue uplift expected with the introduction of the tram.

Choices and Opportunities

7.9 Some of the risks to shortfall in the revenue uplift expected with the introduction of tram can be effectively managed through design, construction and into operation. Tram run times and the quality of the system (in terms of facility, comfort and reliability) are most notable in this respect.

7.10 The biggest risk to TEL profitability is the overall exposure to uncertainty around future growth in the Edinburgh travel market. However, subject to political constraints, TEL is in the usual position of a transport operator to manage costs and yields and match service provision to actual demand. These are therefore the strongest 'levers' available for the management of a shortfall in net TEL revenue, either with or without a tram.

7.11 Various other possibilities exist, under influence of the local authorities, which could also provide an uplift to expected tram and overall TEL revenue, including the expansion of park and ride sites and the potential for road user changing schemes in the longer term.

Summary

7.12 In summary, the target tram revenue being planned for by tie is subject to a range of risks, some of which can, and need, to be managed between now and operation.

7.13 The target revenue also rests on a central assumption of a long-term positive economic climate and realisation of the currently expected planning scenario. In the event of a deviation from these assumptions, TEL would have most of the usual actions available to a transport operator to manage their business in response, but some segments of tram revenue would be more susceptible than others to such an outcome.

APPENDIX A

REVENUE RISK REGISTER

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RISK AREA	ISSUES CONSIDERED	Affects Patronage (Yes, Inversely, No)	Risk Modelling Method (HLM or Off-line)	Risk, Scenario, or Choice	Measure & Method	Mitigation Measures*
GROWTH						
Short to medium term growth	Phasing of growth within planning horizon and subsequent overall growth up to 2031	Y	H	R	Extreme upside and downside scenarios developed as alternatives to central case scenario. Resulting change in forecasts used as max & min variance from central case.	n/a
Long term growth - not including airport	Long term growth due to ambient growth/changes in population	Y	O	R	Post 2031 average annual % growth rate assumed in RRM. Max & Min fto be defined.	n/a
Long term growth - airport market	Long term growth due to ambient growth/changes in travel patterns/environmental constraints etc.	Y	O	R	Post 2031 average annual % growth rate assumed in RRM. Max & Min fto be defined.	n/a
Temporary impact on growth - not including airport	Short term impact of economic downside events such as terrorism, industrial action.	Y	O	R	Two event types defined: high impact (duration 'tails off' over period of approx. 5 years). Typical %pax/rev loss defined for each. Frequency of occurrence defined for each. Poisson distribution to model number of occurrences of event.	n/a
Temporary impact on growth - airport	Short term economic downside events such as terrorism, airline bankruptcy.	Y	O	R	Two event types defined: high impact (duration 'tails off' over period of approx. 5 years). Typical %pax/rev loss defined for each. Frequency of occurrence defined for each. Poisson distribution to model number of occurrences of event.	n/a
Patronage ramp-up	awareness of tram and response	Y	O	R	Max and min percentage shortfall in 1st, 2nd, 3rd, & 4th years defined. Percentile sampled and number drawn from triangular distribution for each year. Matching ramp down period in bus patronage and revenue introduced.	Effective marketing.
Geographical pattern of growth	Medium term decentralisation (e.g failure of city centre retail, changing working practices, response to congestion	Y	H	S	Incorporated within short to medium term growth risk.	n/a (Some policy input)
FARES AND COST						
TEL controlled PT fares	E.g In response to tram operating costs	I	H	R	Central case asssumption is that TEL PT fares grow at 1% greater than Retail Price Index and that cost of motoring increases such that the differential between car and PT stays constant. Risk applied to this *differential* by assuming that fares policy is maintained but cost of motoring grows at between 1% more or 1% less than PT fares. Applied using modelled elasticity to TEL PT fare level.	n/a (Some policy input)
Rail fares	Change to rail fares in real terms	Y	H	R	Not currently assumed.	n/a
Cost of motoring	Fuel, taxation and maintenance costs of car	Y	H	R	See 'TEL controlled PT fares' above.	n/a
Parking costs	Changes in charges for parking	Y	H	C	A policy issue therefore not included in QRA but can explore different levels of real growth to parking charges using elasticity to car/PT mode constant.	Policy
Parking availability	Changes in parking availability	Y	none	C	Not straightforward to model. Could be tackled through changes to parking costs (increased prices due to lowered supply). Policy issue.	Policy
Congestion charging	Congestion charging as a public sector decision	Y	H	C	Different congestion charging mechanisms can be modelled in HLM but treated in RRM as a choice because it is a policy issue.	Policy
Yield calculations uncertainty	Uncertainty surrounding yield calculations	N	O	R	Treated as a policy issue. Assumption made that TEL adopts yield management approach to fares strategy. Risk to differential in price between PT and motoring considered in 'TEL controlled PT fares' above.	n/a
Assumed yield composition	Lower proportion of concession pass holder use than predicted	N	O	R	Treated as a policy issue. Assumption made that TEL adopts yield management approach to fares strategy. Risk to differential in price between PT and motoring considered in 'TEL controlled PT fares' above.	Measures to improve attractiveness of tram to concessionary users.
COMPETITIVE RESPONSE						
Bus competition (other operators)	Changes in service levels, routes and fares	Y	H	S	Only possible to model impact of different service patterns. Modelled as scenario in which the do minimum bus services are maintained in the 'do something' scenario.	Quality bus contracts?
Taxi and private hire competition - to airport	Changes in taxi fares	Y	O	R	Taxi market size established and max possible % increase in Taxi market from aggressive fare competition defined.	Local authority control on minimum taxi fares?
EARL as a competing route	Considers whether or not EARL is competitive and the extent of its market share if it is competitive	Y	H	C	Modelled as a scenario and then treated as a policy choice.	Policy
Expanded Park and Ride competitive to the tram	Increases to capacity or emergent P&R proposals competitive to tram scheme	Y	H	C	Impact of new P&R sites elsewhere could be modelled in HLM as a scenario and then treated as a policy choice. Impact of capacity changes at P&R sites aleswhere not straightforward to model sensibly.	Policy & planning decisions
NON-PAYMENT						
Fare evasion/inability to pay - general	General fare evasion, mass civil disobedience, ticket forgery, crowding prevents payment, fare collection cannot deal with demand	N	O	R	Defined as a % loss of revenue on all routes. Max & min % loss also defined	Choice of revenue protection regime
Fare evasion/inability to pay - airport	Avoidance of airport premium	N	O	R	Not currently considered as separate from general market. Additional % loss of revenue could be defined for airport market.	Choice of revenue protection measures
Revenue protection	Inspections regime: inspectors on every tram? Teams of Revenue Protection Inspectors checking 25% of trams?	N	O	C	Choice: alternative assumptions on above depending on regime chosen	Choice of revenue protection regime

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RISK AREA	ISSUES CONSIDERED	Affects Patronage (Yes, Inversely, No)	Risk Modelling Method (HLM or Off-line)	Risk, Scenario, or Choice	Measure & Method	Mitigation Measures*
INTERCHANGE PROVISION / QUALITY						
Expanded Park and Ride complementary to the tram	Increases to capacity or emergent P&R proposals complementary to tram scheme	Y	H	C	Additional P&R sites could be modelled in HLM as alternative scenarios then treated as policy/decision. Capacity increases less straightforward to model usefully.	Policy & planning decisions
Perception of improved interchange quality	Method of representing any planned "premium" quality of interchange facilities for tram is subject to some uncertainty.	Y	H	R	Max and min value of interchange penalty defined by modellors to reflect uncertainty of assumption. This is then combined with statistical uncertainty around interchange penalty from Stated Preference work and applied using elasticity to interchange penalty.	n/a
Variation in as-built interchange from preliminary design.	interchange design subsequent to preliminary design approval, changes	Y	H	S	Scenario modelled in HLM incorporating 'efficient' interchanges at Foot of Leith Walk and St Andrew's Square (walk time fixed to zero).	Manage detailed design to clear terms of reference and specification.
TRAM PERFORMANCE & QUALITY						
Perception of personal security	late-night travel	Y	H	C	General uncertainty around tram IVTweight parameter defined to incorporate perception of personal security, perception of reliability of run times/punctuality.	Consider measures to improve personal security beyond those typical for tram schemes and those presented in Stated Preference surveys.
Reliability on run times / punctuality	Enforcement of segregation and bus / tram priority, impact of excessive and unmanageable vandalism	Y	H	R	See 'perception of personal security' above.	Enforcement of segregation. Procurement of technology (specification and financial incentives/penalties)
Run times / priorities achieved	Accuracy of run-time modelling	Y	H	R	+/- % Error on run-time modelling assessed by SDS/JRC modellers. Applied as a max & min adjustment through modelled elasticity to tram IVT weight.	n/a
Run times / priorities achieved	Out-turn of technology, design changes subsequent to preliminary design.	Y	H	R	Incorporated in uncertainty on accuracy of run-time modelling.	Management of design process to target run-time. Technology performance ensured through procurement (specification & financial incentives / penalties)
SERVICE PROVISION AND CAPACITY						
Delayed start		Y	O	S	Can be modelled as a scenario by applying modelled impact of tram on net TEL revenue to later years absolute TEL revenue. Not currently assessed.	Accelerated construction? Phased opening?
Closure of route sections for 'events' e.g. Princes Street		Y	O	-	Central case closures assumptions incorporated in annualisation factors. Uncertainty not assessed.	n/a
Capacity restraint / super peak may put people off		Y	O	-	No capacity restraint currently assumed.	n/a
MODELLING UNCERTAINTY						
Value of time (PT users)	Values of time (derived from Stated Preference surveys) used to trade-off monetary costs against components of journey time in modelling.	Y	H	R	Stated preference work yields measure of statistical confidence in this parameter. Applied in conjunction with modelled elasticity to PT fares.	n/a
Tram in-vehicle time weight	Tram IVT weight represents an inherent preference for tram unexplained by journey times or costs.	Y	H	R	See 'perception of personal security' above. Stated preference work yields measure of statistical confidence in these parameters. Applied in conjunction with modelled elasticity to this parameter.	n/a
Interchange penalty	Perception of technology difference	Y	H	R	Stated preference work yields measure of statistical confidence. Applied in conjunction with modelled elasticity to this parameter.	n/a
Annualisation of modelled periods	Calculation of annualisation factor from available source data	Y	O	R	Not currently assessed.	n/a

* To be further developed

Definitions:

Affects Patronage?: "Yes" means patronage influenced in same direction as revenue. "No" means patronage not affected. "Inversely" means patronage influenced in oppostive direction to revenue.

Risk Modelling Method: "HLM" means can be represented in High Level Model. This could be achieved directly or by determining an implied elasticity to a given parameter and making a calculation using this. "Off line" means either that the risk will be represented through off line calculations in the RRM or applies to calculations undertaken in that context anyway.

Risk, Scenario or Choice: "Risks" will be incorporated into the Quantified Risk Assessment. "Scenarios" are areas of uncertainty that will be investigated as deterministic alternatives (e.g. because they are complex sets of assumptions such as development planning) "Choices" relate to areas of supposed uncertainty that will be resolved by policy or design decisions and should therefore also be investigated in a deterministic fashion.

APPENDIX B

CALCULATION OF ANNUALISATION FACTORS

B1. ANNUALISATION CALCULATIONS

Introduction

B1.1 Public transport annualisation calculations are required to produce factors to apply to forecasts from modelled time periods that inflate these values to yearly totals. These are required in order to provide an estimate of, for example, the annual revenue and user-benefits that can be expected to result from a particular level of forecast demand.

B1.2 This note details the process used in calculating annualisation factors for application to the public transport outputs of the High-Level Model (HLM), which has been constructed to provide demand and revenue forecasts to inform the development of the Edinburgh Tram scheme.

B1.3 This version of the note is intended to present the initial annualisation calculations for information and discussion. The annualisation process can be refined through the course of preliminary business case development, subject to the availability of supporting data.

Calculation process

B1.4 The calculations described below have been conducted on ETM data supplied by Lothian Buses. In general, the calculations seek to reasonably reflect the demand in the period of interest as a proportion of demand in the periods modelled. As such this process is independent of HLM outputs.

Modelled Periods

B1.5 The HLM produces forecasts for a weekday in September in three time periods:

- AM peak – 0700 to 0859
- Interpeak – 1000 to 1159
- PM peak – 1600 to 1759

Data assembly

B1.6 There were three broad types of data supplied.

B1.7 At an annual level:

- Annual patronage from 7 November 2004 to 5 November 2005 for 'tram equivalent' services[1], service 100 ('Airlink' service), and for all other services.

[1] Services 1, 7, 10, 11, 12, 13, 14, 16, 21, 22, 24, 25, 32, 34, 35, 37, 38, 41, 42 and 49. The 'Airlink' service was also considered 'tram equivalent'.

B1.8 At a daily level:

- Total patronage on weekdays 14-18 November 2005 for 'tram equivalent' services, service 100 ('Airlink' service), and for all other services.
- Total patronage on Saturday 19 November 2005 for 'tram equivalent' services, service 100 ('Airlink' service), and for all other services.
- Total patronage on Sunday 13 November 2005 for 'tram equivalent' services, service 100 ('Airlink' service), and for all other services.

B1.9 At an intraday level:

- Patronage split by 2-hour time bands (from 0400-0559 to 2200-2359) on weekdays 14-18 November 2005 for 'tram equivalent' services, service 100 ('Airlink' service).
- Patronage for weekdays 19-23 and 26-30 June 2006 for service 22[2] split by disaggregate time bands defined below
- Patronage for Saturday 24 June 2006 for service 22 split by disaggregate time bands defined below.
- Patronage for Sundays 18 and 25 June 2006 for service 22 split by disaggregate time bands defined below.

2 Service 22 was expected to be the most typical of demand patterns likely to be seen on the tram route and bus routes affected by the introduction of the tram.

B1.10 Disaggregate time bands were: 04:00-05:59, 06:00-06:59, 07:00-07:29, 07:30-07:59, 08:00-08:29, 08:30-08:59, 09:00-09:29, 09:30-09:59, 10:00-10:59, 11:00-11:59, 12:00-13:59, 14:00-14:59, 15:00-15:59, 16:00-16:29, 16:30-16:59, 17:00-17:29, 17:30-17:59, 18:00-18:59, 19:00-19:59, 20:00-23:59.

B1.11 The most disaggregate data was not used directly but used to infer the intra-day proportional split, which was then used to apportion the less aggregate data to the same level of temporal detail. In the case of weekday patronage this meant splitting the data segmented by 2-hour time bands; in the case of Saturday and Sunday patronage this entailed splitting the whole day demand for those days.

B1.12 The outcome of this process was intra-day demand profiles for weekdays, Saturdays and Sundays.

B1.13 In all cases, the data used for calculations was restricted to those services deemed to be relevant to the tram route.

Inflating from modelled period to daily demand

B1.14 The first stage in the annualisation calculation process is to calculate the daily demand that occurs within the period to be forecasted, as a proportion of the daily demand that occurs within each of the periods modelled. The basic process for calculating factors to produce daily totals follows the equation below for each period (AM, PM, and interpeak) and for weekdays, Saturdays and Sundays:

$$\mathrm{Ann}\left(\text{model period} \rightarrow \text{day}\right) = \frac{\text{observed demand in forecast period}}{\text{observed demand in modelled period}}$$

B1.15 The forecast periods associated with each modelled period have been defined by reasoned judgement, based on the profile of patronage throughout the day. The periods assigned to the peak and interpeak periods are shown in figures 1.1 to 1.3. These graphs have been created by pro-rating each time period to one hour and assuming a constant hourly rate throughout periods which have not been disaggregated to a half-hourly level.

Results

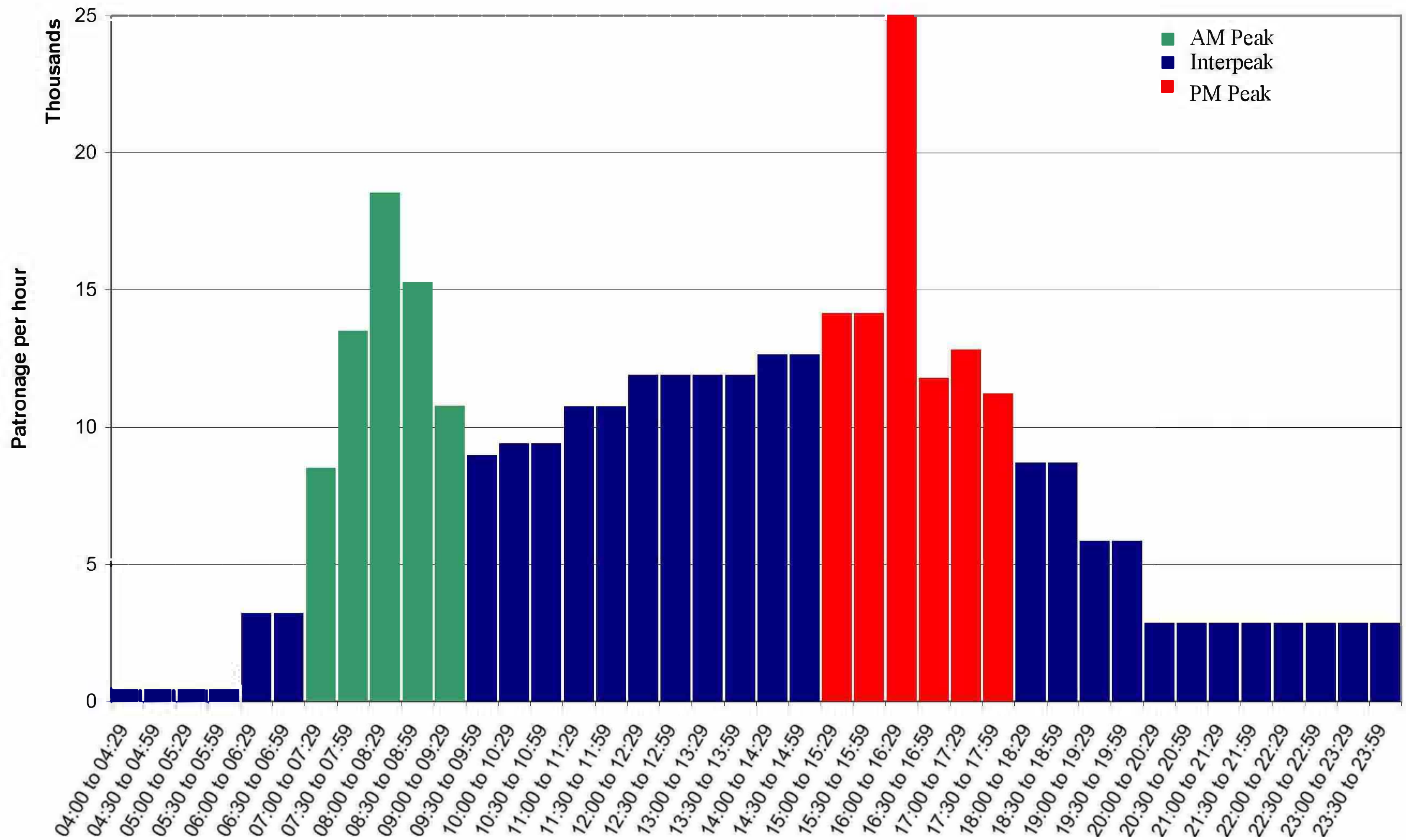
B1.16 The resultant factors for inflating from modelled periods to whole day forecast periods were:\

TABLE B1.1 FACTORS TO INFLATE MODELLED PERIODS TO DAILY TOTALS

	Single weekday	Saturdays	Sundays
AM Peak	1.354	0.000	0.000
PM Peak	1.465	0.000	0.000
Inter-peak	4.305	6.574	3.239

B1.17 It should be noted that, because the factors are collectively controlled to daily totals, the overall forecasts of patronage and revenue will be relatively insensitive to the assumed association of forecast periods with different modelled periods. However the forecasts of economic user benefits will be more sensitive to the definition of forecast periods.

FIGURE B1.1 WEEKDAY DEMAND PROFILE



\ FIGURE B1.2 SATURDAY DEMAND PROFILE

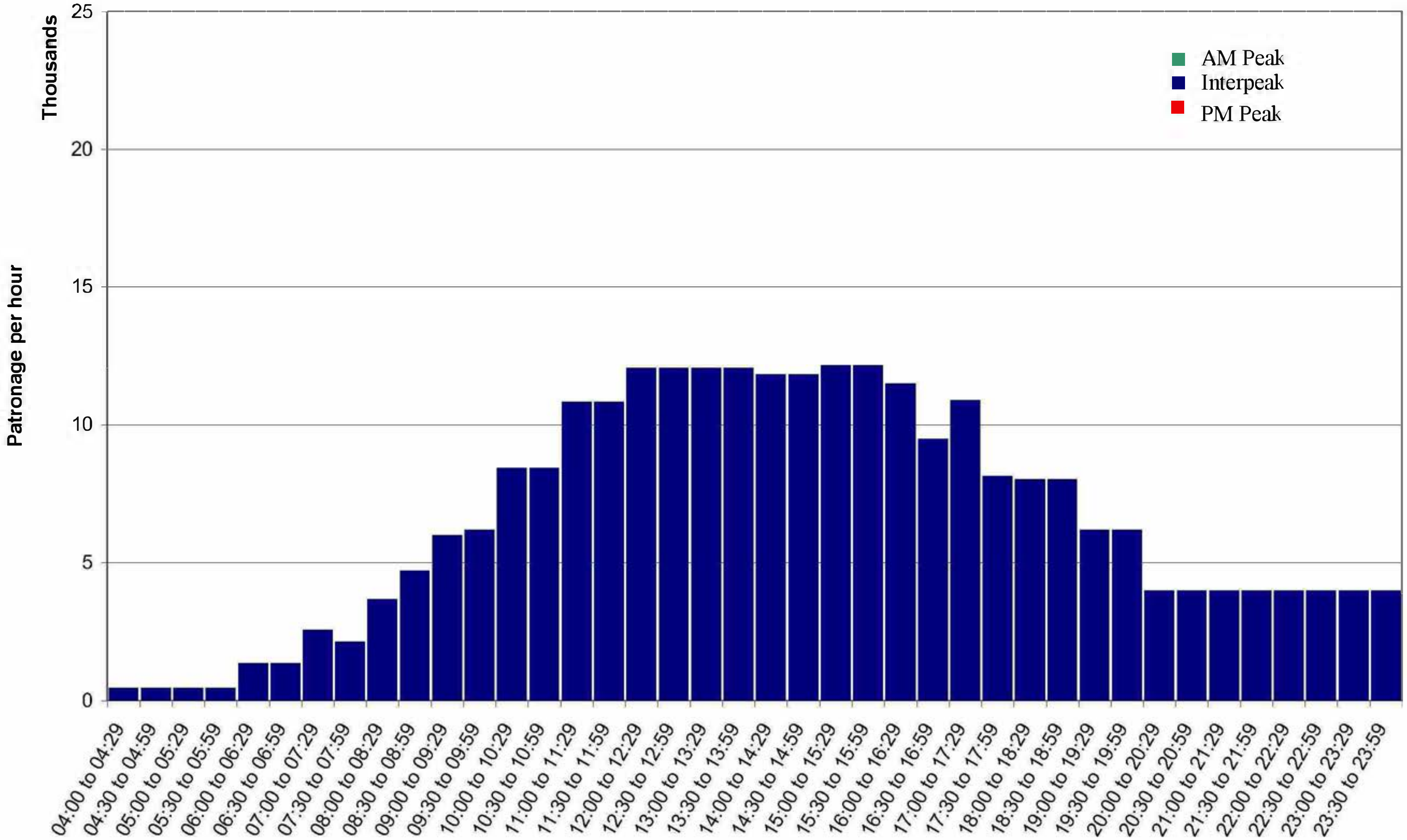
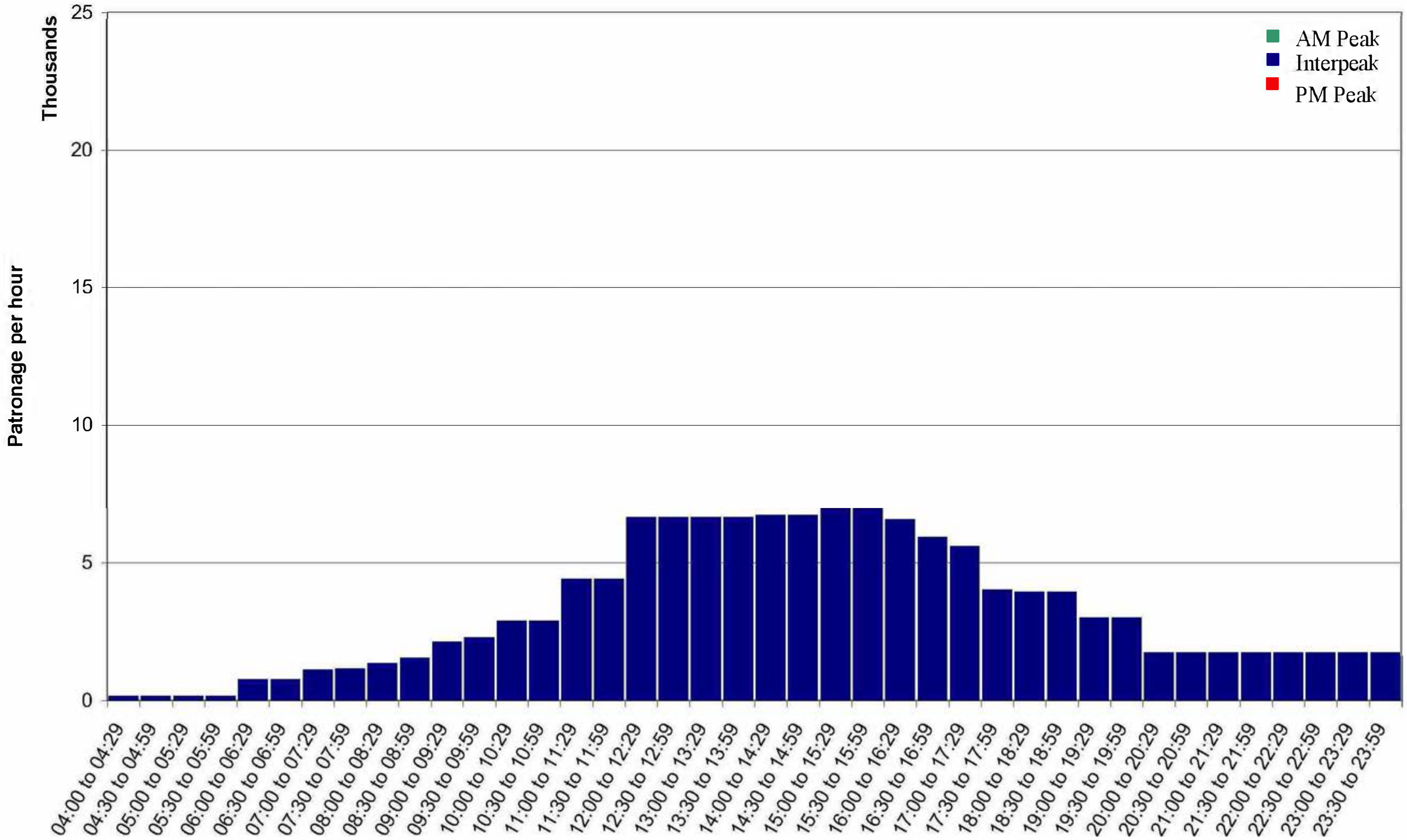


FIGURE B1.3 SUNDAY DEMAND PROFILE



Inflating from weekly demand to yearly demand

B1.18 The data described above for total annual patronage, total aggregate weekday patronage, total patronage on a typical Saturday and a typical Sunday was used to estimate the proportion of yearly demand that falls within a typical week in November, i.e.:

$$\mathrm{Ann}(\text{week} \rightarrow \text{year}) = \frac{\text{observed demand in typical week}}{\text{observed demand in typical year}}$$

B1.19 The resultant factor was 49.29[3].

Producing overall annualisation factors

B1.20 The 'week to year' factor was applied to each of the previously calculated 'period to day' factors. In the case of the weekday factors the simplifying assumption was made that there are 5 identical weekdays in a week. The equation used was thus, for each period:

$$\mathrm{Ann}(\text{day} \rightarrow \text{year}) = [5 \times \mathrm{Ann}(\text{weekday} \rightarrow \text{week}) + \mathrm{Ann}(\text{Saturday} \rightarrow \text{week}) + \mathrm{Ann}(\text{Sunday} \rightarrow \text{week})] \times \mathrm{Ann}(\text{week} \rightarrow \text{year})$$

B1.21 The above calculation does not yet take account of bank-holidays but since the process is controlled to an annual total the forecasts of patronage and revenue should be insensitive to this simplification. It is intended that this will be refined, however, in particular for the annualisation of economic user benefits.

B1.22 The resultant annualisation factors are as follows:

TABLE B1.2 ANNUALISATION FACTORS

Period	Annual Weekdays	Annual Saturday	Annual Sunday	Total Annual
Morning Peak	333.6	0.0	0.0	333.6
Evening Peak	361.1	0.0	0.0	361.1
Inter-peak	1061.0	324.0	159.6	1544.7

[3] Further work will need to be undertaken to investigate the possibility of atypical events occurring over the course of the year for which the annual data was available. For example, industrial action will have depressed this figure, resulting in a factor that is too low.

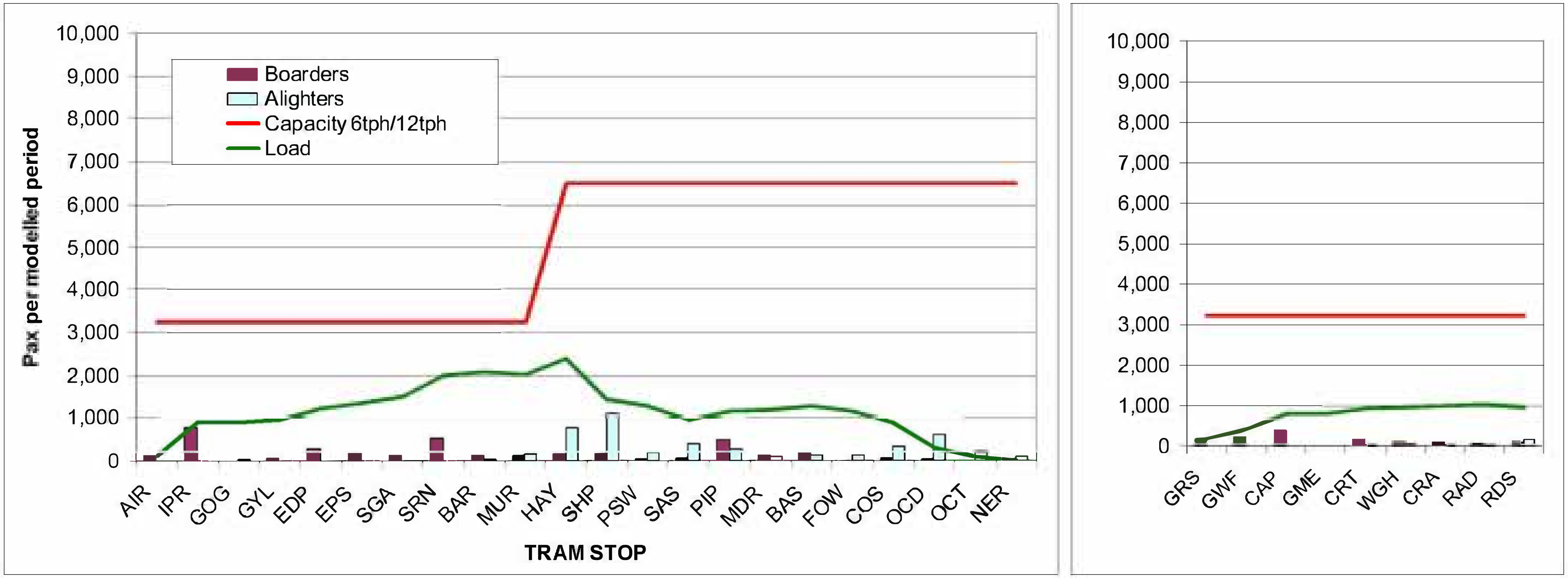
B1.23 For the purpose of annualising forecasts from the Morning Peak and Inter-Peak models in the absence of the Evening Peak model, the following factors were determined by a consistent method:

- Morning Peak: 727
- Inter-Peak: 1545

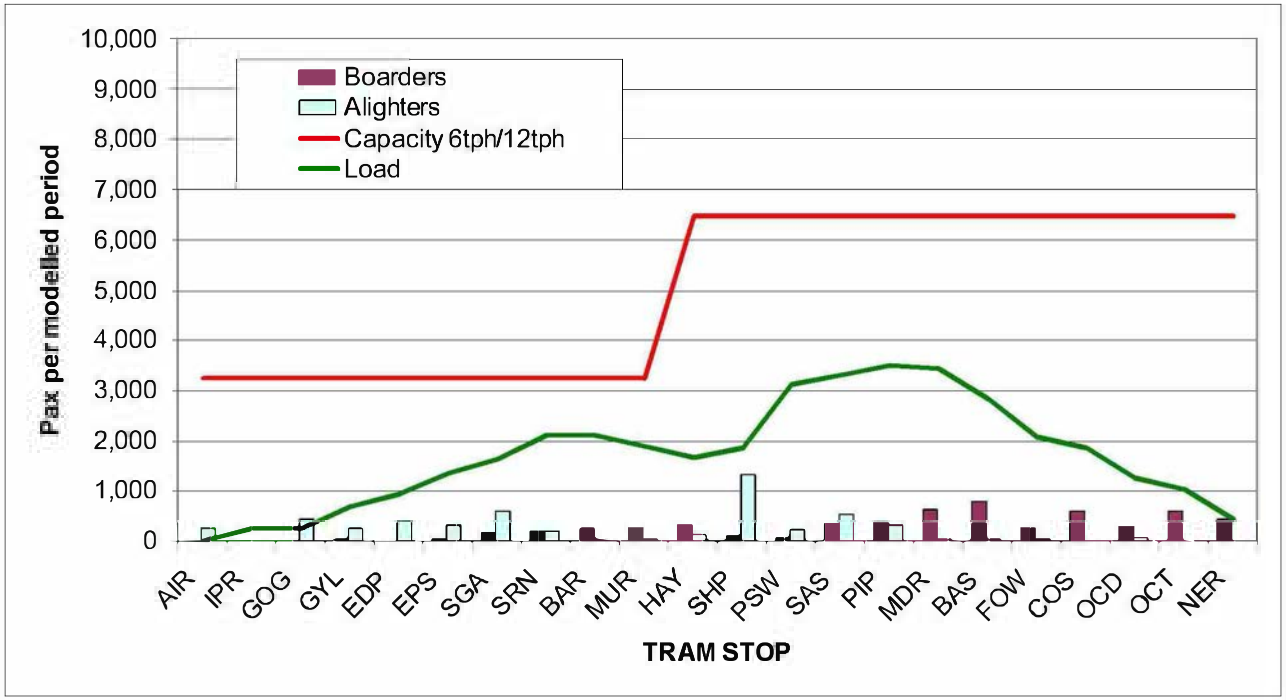
APPENDIX C

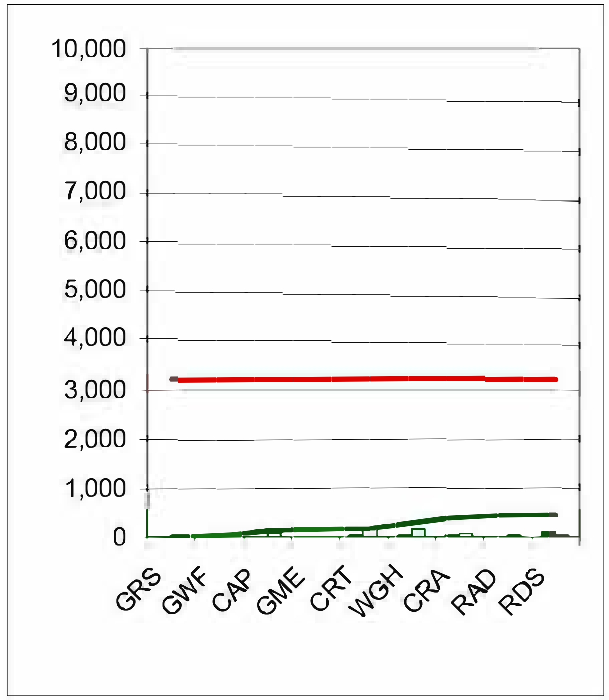
OPTION 1A + 1B TRAM PATRONAGE HISTOGRAMS

APPENDIX: FIGURE C1.1 TRAM BOARDING, ALIGHTING AND PATRONAGE: 2011 MORNING PEAK EASTBOUND

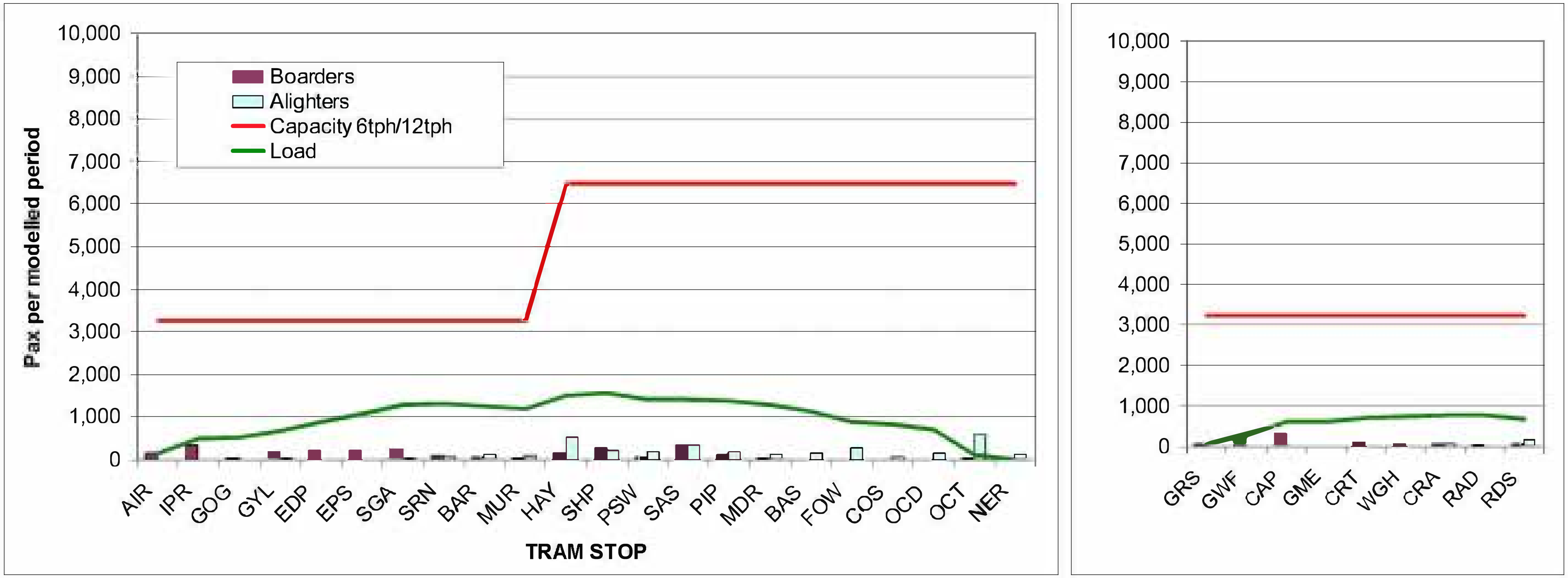


APPENDIX: FIGURE C1.2 TRAM BOARDING, ALIGHTING AND PATRONAGE: 2011 MORNING PEAK WESTBOUND

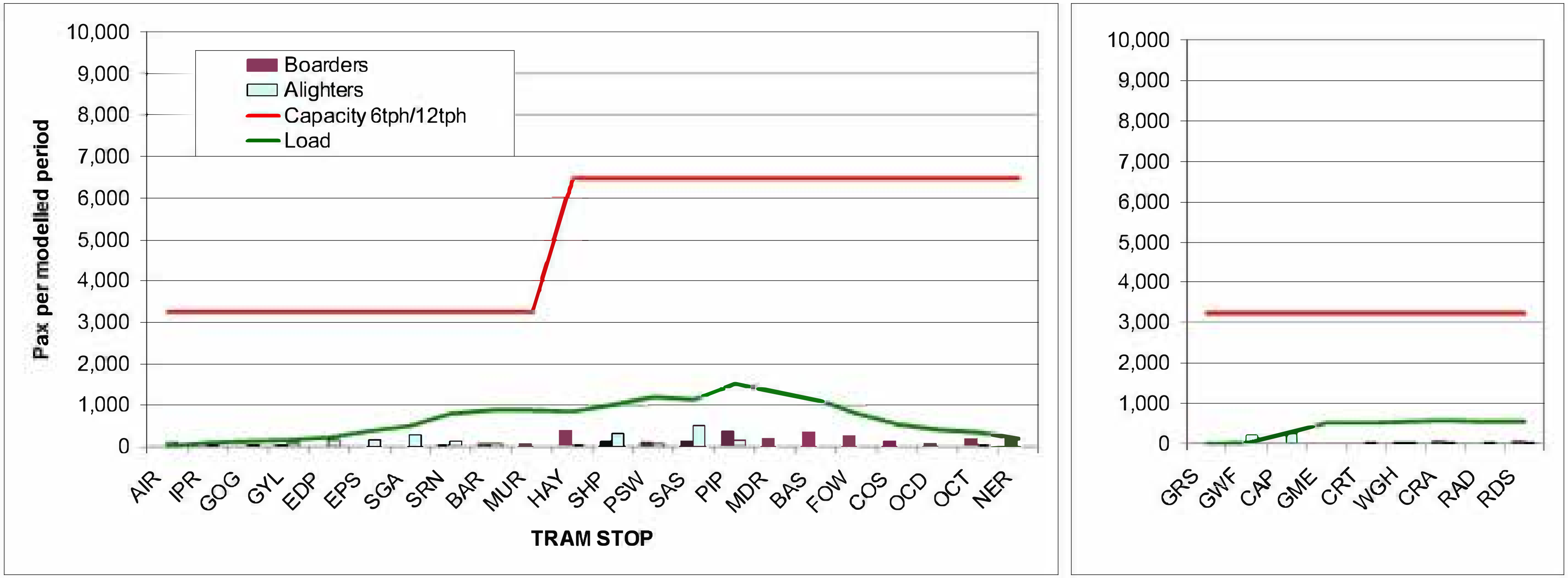




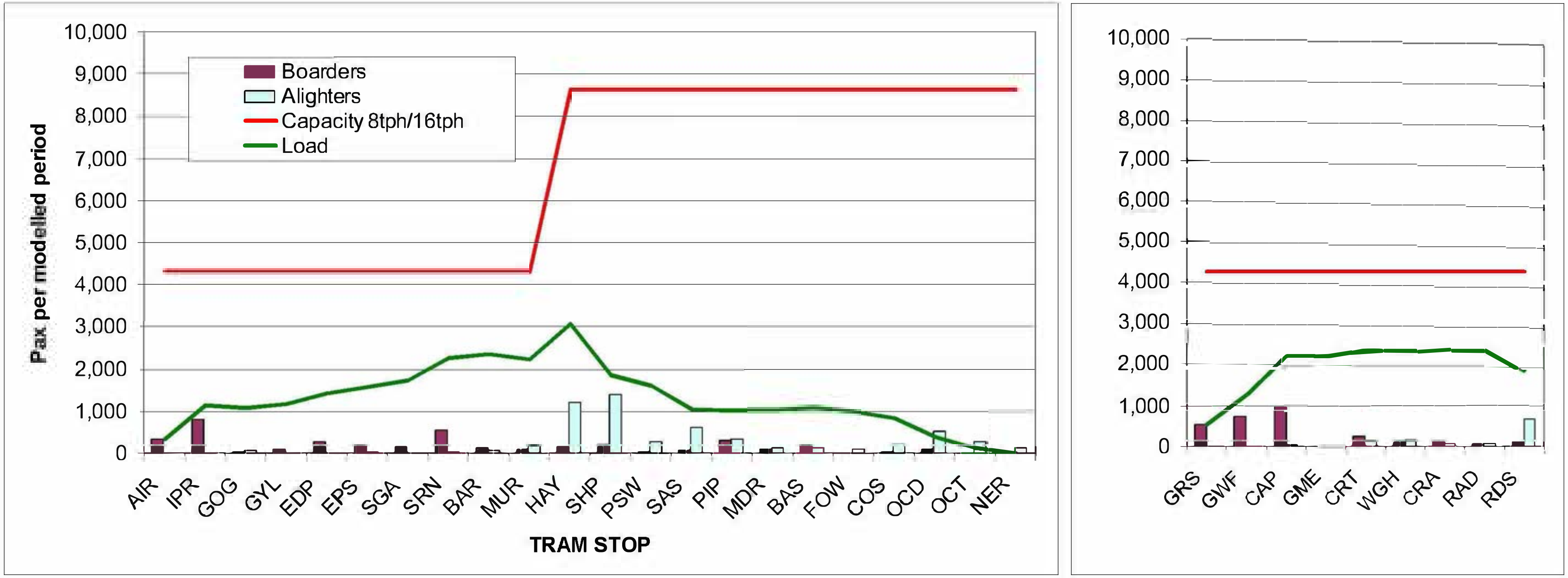
APPENDIX: FIGURE C1.3 TRAM BOARDING, ALIGHTING AND PATRONAGE: 2011 INTER-PEAK EASTBOUND



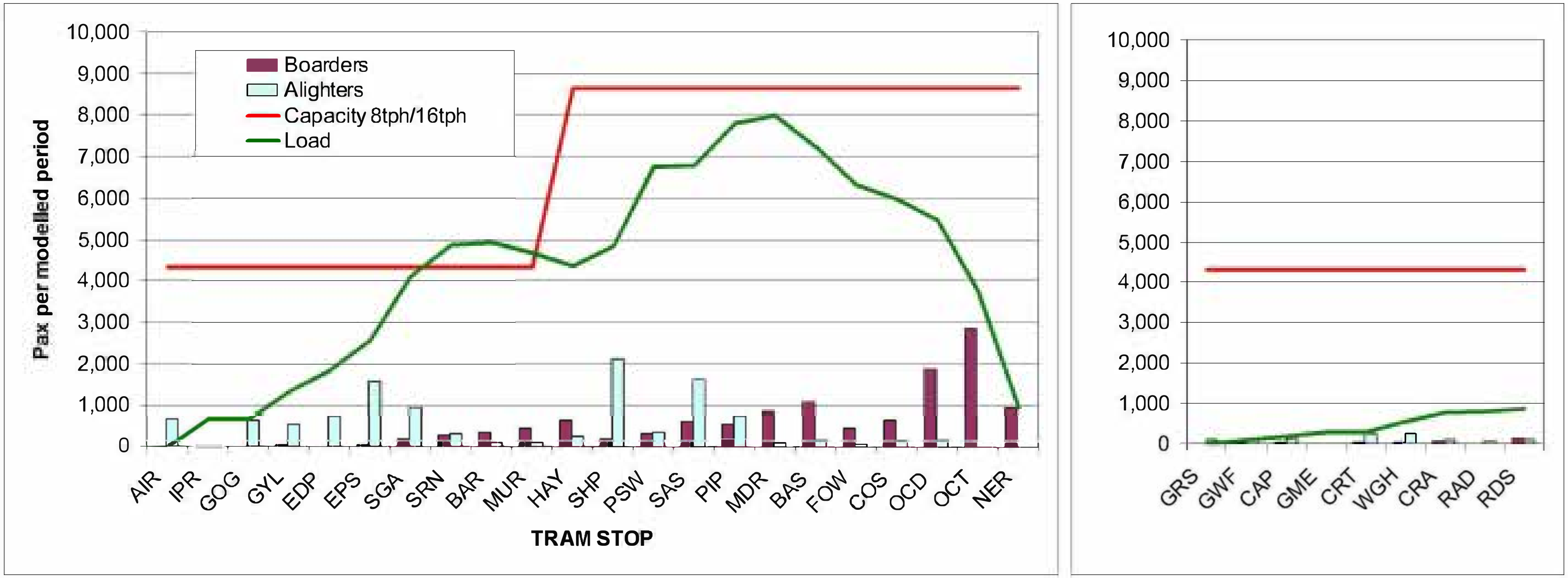
APPENDIX: FIGURE C1.4 TRAM BOARDING, ALIGHTING AND PATRONAGE: 2011 INTER-PEAK WESTBOUND



APPENDIX: FIGURE C1.5 TRAM BOARDING, ALIGHTING AND PATRONAGE: 2031 MORNING PEAK EASTBOUND

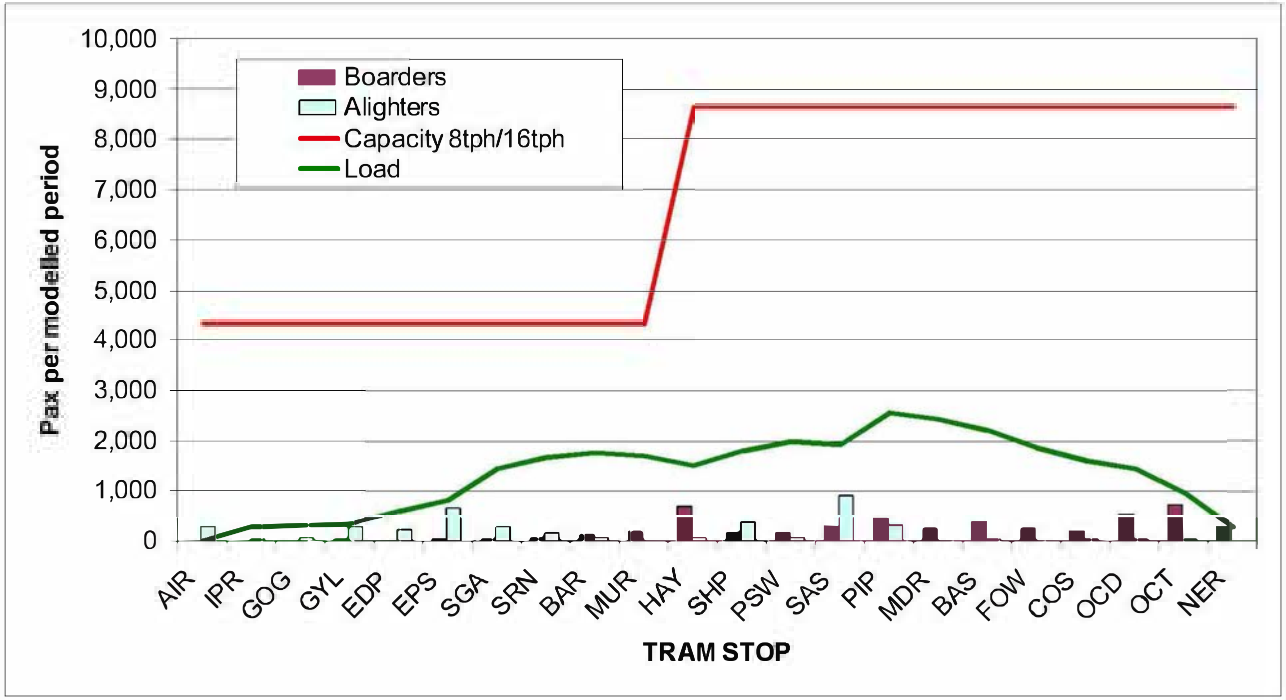


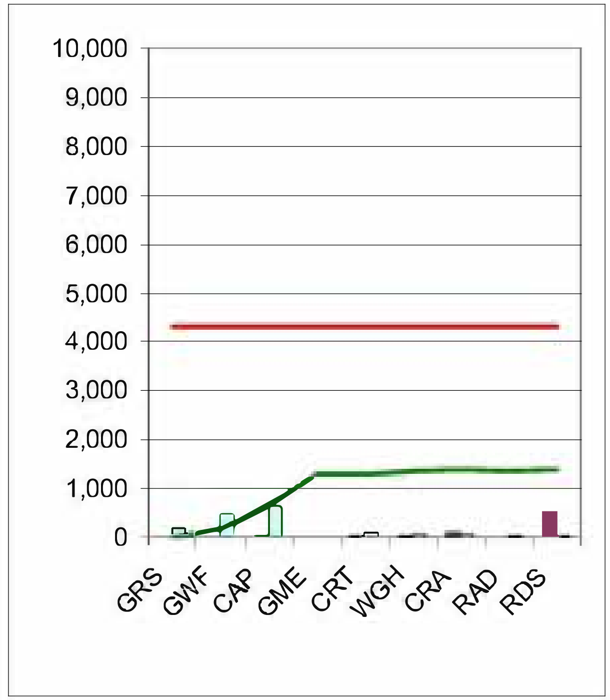
APPENDIX: FIGURE 1.6 TRAM BOARDING, ALIGHTING AND PATRONAGE 2031: MORNING PEAK WESTBOUND



APPENDIX: FIGURE 1.7 TRAM BOARDING, ALIGHTING AND PATRONAGE 2031: INTER-PEAK EASTBOUND

APPENDIX: FIGURE C1.8 TRAM BOARDING, ALIGHTING AND PATRONAGE: 2031 INTER-PEAK WESTBOUND





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