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**EDINBURGH TRAM NETWORK**

# STAG Appraisal: Line One

**10 September 2004**

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# Edinburgh Tram Network
# Line 1 (Northern Loop)

## STAG Appraisal
**September 2004**

**Report No. 203011/100/H**

**10 September 2004**

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## Disclaimer Notice

The contents of this report have been produced for **tie** for submission to the Scottish Executive and the City of Edinburgh Council. It should only be used in association with the development of the Edinburgh Tram Line 1 project for **tie**.

The projections of demand and revenue contained within this document represent the authors' current best estimates. While they are not precise forecasts, they do represent a reasonable expectation for the future, based on the most credible information available as of the date of this report.

The estimates contained within this document do however rely on assumptions and judgements which are influenced by external circumstances that can change quickly and could in certain circumstances affect the results.

It has also been necessary to base much of this analysis on data collected by third parties. This has been independently checked whenever possible. However **tie** and their advisors do not guarantee the accuracy of any third party data.

# Summary

## Introduction

The City of Edinburgh Council is examining ways of providing the city with the transport infrastructure necessary to promote and support a growing local economy and create a healthy, safe and sustainable environment. This is a key component of the strategy of public transport investment in Edinburgh, part of a £1.5 billion New Transport Initiative that the CEC is working in co-operation with other local authorities in South East Scotland to deliver.

In 2001, Waterfront Edinburgh Limited (WEL) commissioned a preliminary technical and economic Feasibility Study of a rapid transit system in north Edinburgh, led by a Steering Group involving the City Council. One of the objectives of this system was to provide a link between the city centre and the proposals for the Waterfront redevelopment planned at Granton.

This Feasibility Study concluded that a northern loop tram system would maximize a number of positive benefits for the area including economic regeneration and improved accessibility. The Feasibility Study and, critically, an associated preliminary appraisal, was submitted to and accepted by the Scottish Executive, and funding of £6.5m was subsequently made available for the development of the Line 1 project to full appraisal and Bill submission.

The alignment of the Line 1 route is proposed to connect the city centre with Leith, Newhaven and Granton, passing through the Waterfront development area and then along the line of the former Roseburn Railway to Haymarket.

This report sets out the justification and appraisal of Line 1 of Edinburgh tram network, the Northern Loop, linking the City Centre with Granton, Newhaven and Leith, passing through the Waterfront development area and then along the line of the former Roseburn Railway to Haymarket. This line is expected to provide a number of positive benefits for the area, including economic regeneration and improved accessibility.

## Planning Objectives

The Council has a well developed transport vision with clear strategic objectives enabling projects to be categorised as part of particular strategies. This is beneficial in taking forward the projects through the STAG appraisal process. However, a further explicit process is needed for developing an option appraisal which addresses the requirements of a STAG appraisal. This process underlies the rationale for the project, by testing outcomes against objectives, assessing likely costs and value for money, and considering deliverability and fundability.

The Council has stated its vision for transport within the Local Transport Strategy 2004-2007 (LTS) as follows:

> *Edinburgh aspires to be a city with a transport system that is accessible to all and serves all. Edinburgh's transport system should contribute to better health, safety and quality of life, with particular consideration for vulnerable people such as children, and elderly and disabled people: it should be a true Citizen's Network. The transport system should support a strong, sustainable local economy.*

*The Council will seek to maximise people's ability to meet their day-to-day needs within short distances that can easily be undertaken without the need to use a car. The city should develop and grow in a form that reduces the need to travel longer distances, especially by car. Choice should be available for all journeys within the city.*

A number of aims are stated in the City of Edinburgh Council's Local Transport Strategy 2004-2007:

- 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 reduce social exclusion; and
- To maximise the role of streets as the focal point of local communities.

In the context of the OBC, the LTS aims were utilised as objectives. However, STAG2 comprises a more refined appraisal process and enables the appraisal of more detailed impacts, requiring higher-level planning objectives to be developed. For the purposes of STAG2 appraisal, more focused specific planning objectives were developed for the scheme, under broad categories:

- To support the local economy by improving accessibility:
  - Improve access to public transport network; and
  - Improve access to employment opportunities.
- To promote sustainability and reduce environmental damage caused by traffic:
  - Increase proportion of journeys made by public transport, cycling and walking; and
  - Reduce local and global emissions (improving air quality and reducing contribution to greenhouse gases).
- To reduce traffic congestion:
  - Reduce number of trips by car; and
  - Reduce traffic volume on key routes.
- To make the transport system safer and more secure:
  - Reduce traffic accidents and casualties.
- To promote social benefits:
  - Improve liveability of streets, maximising their role as the focal point of local communities; and
  - Reduce social exclusion, by improving the ability of people with low incomes, no access to car, the elderly or mobility impairments to use the transport system.

## Problems and Opportunities in North Edinburgh

North Edinburgh has demonstrable social deprivation and in economic terms, performs below average when compared with the rest of the City. Unemployment is higher than the City average while skills and qualifications are below average. There is a high dependency on public transport, yet poor accessibility is highlighted as one of the key obstacles to residents gaining employment opportunities.

Studies examining the North Edinburgh public transport network have highlighted its apparent incoherence and the degree to which congestion affects journey times, punctuality and regularity. Previous studies have already highlighted the potential of new and improved bus links. Connections to potential employment opportunities in Leith and the West of Edinburgh are inadequate, creating social exclusion problems. This has been identified in the North Edinburgh Public Transport Strategy and such a theme has recurred in several other studies on transport in the north Edinburgh area. Line 1 will not only improve existing connections with the north of the city but also create much needed links with the west.

The Waterfront Masterplan is predicated on the provision of high quality public transport. Studies that have preceded this one have already highlighted that additional capacity will be required to that available at present and, moreover, as well as additional capacity the development related public transport element will only occur if there is a step-change in the quality of public transport.

North Edinburgh's road network already experiences peak hour congestion and has a significant rat-running problem. Without a step-change shift to public transport, general economic and local regeneration is forecast to place increasing pressure on the road network.

## Option Generation, Sifting and Development

The Outline Business Case investigated whether a feasible scheme existed which met the objectives of the study Steering Group and the Local Transport Strategy 2004-2007. The study considered a range of issues, including:

- Technology options – bus based systems, guided bus and rail based rapid transit;
- Alignment and route options – Granton – Haymarket, Granton – St. Andrews Square, the full Northern Loop; and
- Potential demand and revenue – demand and revenue forecasts were made for each of the three route options and for guided bus and light rail transit technologies.

The appraisal and sifting of the options was made in the context of technical, operational, patronage, cost and integration issues and in the ability of the options to satisfy the planning objectives. In general, the full loop option was considered to have the highest potential to solving the local problems, take advantage of the opportunities and address the planning objectives.

This process resulted in the Preferred Option being the full Northern Loop using LRT technology. A preliminary appraisal was produced for this scheme within the Outline Business Case (OBC) and was accepted by CEC and the Scottish Executive, from whom funding was made available to further develop the scheme. The PT network was explored further in the "Edinburgh LRT Masterplan Study" commissioned by the Council and undertaken by Arup. The study confirmed that the Northern Loop should receive the highest priority followed by the Western and South-Eastern Lines.

This option development process was revisited in the current study, which broadly confirmed the Preferred Option, subject to potential alignment variants at George Street and Telford Road. Whilst there were strong technical preferences, these options were taken forward to public consultation in order to ensure robust and inclusive decision-making.

## Consultation

The consultation process has informed major stakeholders and the residents of Edinburgh about the proposals to introduce trams to Edinburgh, and it has provided the opportunity to comment in a variety of ways.

The results of the consultation show that there is broad support in Edinburgh for the tram. The considerable level of support is, however, punctuated by a range of concerns. The main concerns are in relation to the impact trams will have on properties in close proximity to the route and the requirement for CPOs in certain areas. Other concerns related to the disruption caused by the construction of the tram infrastructure, the environmental impact (particularly to local wildlife) and the impact of the tram on local traffic and parking.

The consultation process resulted in Princes Street being chosen over George Street and the former railway solum being chosen over Telford Road, completing the selection of the preferred route.

## Scheme Description

### *Route*

The preferred route will proceed on-street from Princes Street, along Shandwick Place to Haymarket. Going off-street at Haymarket, the alignment will parallel the heavy rail line, before turning north onto the disused railway solum (Roseburn corridor). Line 1 will remain on this corridor to Crewe Toll, whereupon it will run alongside the Western Access Road and enter the Granton redevelopment site. Passing through this site, the alignment will turn east and travel along Lower Granton Road and Starbank Road and enter the Forth Ports development area. Passing Ocean Terminal and the Scottish Executive, the alignment will return to the city centre via Constitution Street, Leith Walk and St. Andrews Square. The route comprises:

- 15.5 km of Double Track infrastructure (single track at St Andrews Square);
- 58% off street; and
- 22 proposed stop locations. (See also sections 7.2.1 & 7.2.2)

Wherever possible a segregated alignment has been proposed (where the tram operates on dedicated tramway or tramroad) such that the system can maintain speed and frequency and reliability of service without interference to and from other traffic. The alignment is effectively double track, clockwise and anti-clockwise running, throughout its length, with the exception of the one way loop at St. Andrews Square (approximately 520m long).

### *Tram Specification*

It is assumed that the trams will be semi-low floor or total low floor vehicles. This implies a floor height of between 300 and 400mm. This type of vehicle has been adopted in order to ensure that the alignment characteristics will cater for most currently available rolling stock.

### *Construction*

The construction of Line 1 is programmed to commence in mid 2006 with an estimated construction period of 36 months.

One of the early activities required for construction is the diversion of Public Utilities from beneath the tramway. This is generally undertaken either as an advanced works contract or as part of the main works contract. Generally the inclusion of this phase within the main contract can provide a reduction

in overall programme due to the ability to coordinate efficiently within the main contract. The construction period is based upon the utilities diversions being undertaken entirely as part of the main contract. However, to meet the programme the PU diversion policy, including agreed diversionary works, would require to be established prior to construction activites commence.

***Capital Costs***

Capital costs are estimated at £274.15m, including optimism bias, set at a base point of Quarter 2, 2003. Costs have been derived from a comprehensive database compiled from analyses of costs for the infrastructure works of completed and proposed LRT schemes throughout the UK, currently advised prices from vehicle manufacturers and preliminary diversionary works estimates obtained from utilities companies. The resulting estimates take account of the prevailing factors influencing this particular scheme including location, relative complexity, environment and anticipated programme.

***Operations***

The single overarching objective from the operational viewpoint is to minimise journey times, so as to maximise the attractiveness of the service and minimise operating costs and rolling stock resources. The key is to achieve free flow wherever possible so that the running speed is the maximum safe speed for any particular type of environment.

The model forecasts a total time of 40.5 minutes around the loop, excluding any layover time allowance, equivalent to an average journey speed of 23.3 km/h. The frequency will be 8 trams per hour (i.e. a headway of 7½ minutes).

## STAG2 Appraisal

***Option Sifting***

A restricted STAG2 appraisal was undertaken, focusing on the key objectives in order to determine the best performing route option (to be carried forward as an integral part of a full loop) between:

- George Street / Princes Street; and
- Telford Road / former railway solum.

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. Telford Road option is more costly and slower than the railway solum, and would impact significantly on highway operations, while the former railway solum is completely segregated. Biodiversity impacts on Telford Road are recorded as neutral whilst there is a small adverse affect on the former railway solum. Given the merits of the respective options, Princes Street and the former railway solum are the preferred alternative options and have been carried forward for inclusion in the appraisal of the full loop.

***Assessment Against the Planning Objectives***

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. An appraisal of the scheme against the planning objectives and problems in North Edinburgh has been undertaken. Across all the objectives, Line 1 is considered to have a positive impact, notably on the level of public transport and car demand and the associated mode share and the consequent impacts on the environment. Notwithstanding some adverse impacts arising from the bus network changes, Line 1

has a positive impact on accessibility which will support the local economy and reduce social exclusion. The key findings were that Line 1 has considerable potential to:

- Contribute to improve the local economy (greater potential for regeneration);
- Facilitate access to employment opportunities (more attractive, integrated, comfortable, efficient and reliable public transport alternative);
- Reduce the adverse impacts of transport on the environment (zero exhaust emissions produced by the trams in urban areas, reduced noise levels, townscape benefits);
- Reduce traffic and congestion (greatest potential as an alternative to the private car, with decongestion benefits); and
- Reduce social exclusion (providing widely accessible, particularly to the new areas of employment and social deprivation in north and west areas of Edinburgh, and affordable transport connections for all).

***Scheme Appraisal***

The appraisal has followed STAG, which appraises the scheme against both the planning objectives set and the Governments five national objectives for transport:

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

***Environment***

Noise and Vibration

The majority 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. Where the tram alignment runs along the disused Roseburn to Crewe Toll rail corridor, noise barriers will be required and, provided an appropriate design can be developed, for most locations they will mitigate significant impacts that would otherwise occur. Some slight residual impacts may be unavoidable.

On the road network traffic changes resulting from the tram's operation will give rise to noise increases in some areas and noise decreases in others, but most changes will be small. Overall the effect of the scheme is predicted to be neutral on the road network with slight negative impacts along the Roseburn to Crewe Toll rail corridor after mitigation in the form of noise barriers has been taken into account.

Air Quality

The proposed Edinburgh Tram Line 1 is predicted to have a moderate positive impact on air quality in the City of Edinburgh in 2011. 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.

There is no net change in $CO_2$ emissions in 2011 as a result of the tram. In 2026, there is a net predicted decrease in $CO_2$ emissions of 10 kilo-tonnes.

Water Quality, Drainage and Flood Defence

Overall the scheme is expected to have a minor negative impact on surface water quality and drainage 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 mitigation measures where appropriate will ensure that the operation of the scheme will not result in adverse impacts to drainage.

Construction and operation of the scheme will not increase the flood risks along the alignment. The contractor will consult with SEPA and CEC during detailed design to ensure that all requirements and guidelines will be adhered to. There are limited existing groundwater resources along the route and the construction and operation of the scheme is not predicted to impact on these.

Geology

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, for example along the Roseburn Railway Corridor, will also contribute to erosion. 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 not on-street. Assuming that good practice measures are adopted during construction of the tram, no significant impacts on geological resources are predicted. Land take associated with the development of Edinburgh Tram Line 1 will not involve loss of any agricultural land.

Any contaminated material encountered during construction will be dealt with in compliance with best practice, current legislation and statutory guidance.

Biodiversity

Mitigation measures will be implemented to reduce impacts to the minimum necessary for the safe completion of the works. Opportunities will be sought in the design of the new structures to provide additional roosting opportunities for the species using this area and to mimic the existing habitat along the sea wall.

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 to this corridor will be limited to the minimum necessary through the implementation of mitigation measures, including the adoption of best practice measures during construction.

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 will comply with the requirements of relevant legislation. Bats are known to forage along the Roseburn corridor and the loss of a significant amount of vegetation will reduce their foraging habitat availability. Prior to construction, all bridges and other built structures and mature and dead trees to be affected will be checked again for roosting bats and appropriate mitigation measures agreed with SNH and implemented if bats are found.

Landscape

Although the scheme provides opportunities for enhancing the local landscape in certain areas, other adverse impacts can be expected at varying degrees in different locations of the route. The key landscape impacts for each area affected by the scheme are:

- Haymarket – Potentially complex OLE support. Road alterations and demolitions weaken enclosure of junction area. Tram stop will improve Haymarket Terrace;
- West End – OLE in designed vista. Road widened into gardens;
- Princes Street – OLE in designed vista and iconic tourist views. Footway widening;
- St Andrew Sq – OLE in designed vista and iconic tourist views;
- Queen St to Picardy Pl – OLE in designed vista. Road widened and awkward level changes;
- 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;
- Leith – Distinctive small-scale local character, highly sensitive to change;
- Port of Leith – Tram a minor additional element in industrial parts, part of a much wider change elsewhere;
- Newhaven to Granton – OLE will partially enclose open sea-front sections. New footpath at Starbank beneficial;
- Waterfront Granton – Part of a much wider change;
- Pilton – Tram will be a minor addition; and
- Railway Corridor – Significant vegetation removal required.

Visual Amenity

The sensitivity of the receptors of visual impact varies according to their activity and expectations. 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 the Roseburn cycle route, and from important tourist viewpoints such as Princes Street and Edinburgh Castle.

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.

Agriculture and Soils

There are no agricultural issues associated with the proposal.

Cultural Heritage

The vast majority of sites impacted upon by the implementation of Line 1 in terms of cultural heritage have a suggested Level 1 mitigation response (detailed photographic record). A high proportion of such sites comprise historic street furniture in the buffer zone, most of which are unlikely to suffer physical impact during the works, but preventive measures are required to avoid damage, particularly where the features form part of Listed Buildings.

Thirteen sites are recommended for Level 2 mitigation (detailed standing building survey). This higher level of survey has been suggested due to the physical impact on such sites expected as a result of engineering works. This includes the "B" listed bridge over Glasgow Road at Roseburn.

Level 3 mitigation (watching brief) is suggested for five sites. This includes the 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. The other four sites are areas of archaeological potential.

The two sites recommended for Level 4 mitigation (Detailed standing building survey and salvage) are both at Haymarket. The C(S) Listed Caledonian Ale House is likely to require demolition. The C(S) Listed Heart of Midlothian War Memorial may require relocation, unless through design this can be avoided.

***Safety***

Accidents

A reduction in private vehicle traffic has promoted an annual saving in the number of accidents in the road network at –7.6 (an increase) in 2011 and 51 (a decease) in 2026, considering all severity levels. The majority of accidents are accounted for in terms of damage to property. The number of fatalities saved from the implementation of the scheme would be negligible.

The total savings as a result of reduced traffic on the road network has been calculated at approximately -£80,000 per year for 2011, and £0.7 million per year for 2026. Feeding these valuations through cash flow calculations into the accident framework, which discounts the annual valuations to a present value, the NPV of these savings represent £4.8 million (NPV), considering the project life-time.

Security

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

***Economy***

Transport Economic Efficiency (TEE)

The TEE analysis has been undertaken in compliance with the requirements of both Guidance on the Methodology for Multi-Modal Studies (GOMMMS) and STAG. The DfT Transport Users Benefit Appraisal (TUBA) software has been employed, using model output from the LUTI modelling framework employed in the study.

The scheme costs within the TEE (2003 Q2 prices) are as follows:

- Construction cost of £274.15 million (including optimism bias at 25%). This includes construction and vehicle capital costs, land and project supervision and design costs. This cost was spread over the years 2006 – 2009 inclusive based on the cost profile provided within the cost estimate;
- Private developer contribution of £11.6 million (PV);

- Annual Line 1 operating cost of £6.3 million; and
- Lifecycle costs of £44.6 million, allocated over years when particular costs were predicted.

The table below presents the TEE analysis for the Line 1 Central Case scheme. Issues to note include:

- Total PT benefits of £116.5m;
- Total highway benefits of £111.6m;
- A negative impact on bus operations, with a revenue reduction of £40.3m exceeding the operating cost reduction of £31.1m by some £9.2m;
- A small reduction in off-street parking revenues; and
- An overall present value of benefits of £231.1m.

| | | STAG Code | Total | Public Transport | Road Users | |
|---|---|---|---|---|---|---|
| | | | | | Cars | Freight |
| **User benefits - Consumers** | | | | | | |
| Travel time | | (PV2) | £184,329 | £116,749 | £67,580 | |
| User Charges | | (PV3) | -£9,166 | -£9,166 | £0 | |
| Vehicle Operating Costs | | (PV4) | £3,105 | £0 | £3,105 | |
| Sub Total | | | £178,268 | £107,582 | £70,685 | |
| **User benefits - Business** | | | | | | |
| Travel time | | (PV2) | £47,717 | £9,244 | £21,294 | £17,179 |
| User Charges | | (PV3) | -£296 | -£296 | £0 | £0 |
| Vehicle Operating Costs | | (PV4) | £2,474 | £0 | £756 | £1,717 |
| Sub Total | | | £49,894 | £8,948 | £22,050 | £18,896 |
| **User benefits - Total** | | | | | | |
| Travel time | | PV2 | £232,045 | £125,993 | £88,874 | £17,179 |
| User Charges | | PV3 | -£9,462 | -£9,462 | £0 | £0 |
| Vehicle Operating Costs | | PV4 | £5,579 | £0 | £3,861 | £1,717 |
| Sub Total | | | £228,162 | £116,531 | £92,735 | £18,896 |
| **Private Sector Provider Impacts** | | | | | | |
| Investment (Capital) Costs | | PV5 | -£213,542 | -£213,542 | | |
| Operating Costs: | Line 1 | PV6 | -£108,285 | -£108,285 | | |
| | Bus | PV6 | £31,141 | £31,141 | | |
| | Rail | PV6 | £0 | | | |
| Revenues: | Line 1 | PV6 | £0 | | | |
| | Bus | PV7 | -£40,278 | -£40,278 | | |
| | Rail | PV7 | £25,514 | £25,514 | | |
| | Off-street Parking | PV7 | -£3,895 | | -£3,895 | |
| Grant/ Subsidy | | PV8 | £321,827 | £321,827 | | |
| | Developer Contribution | PV8 | -£9,563 | -£9,563 | | |
| Sub Total | | | £2,918 | £6,814 | -£3,895 | £0 |
| **Total PVB** | | | **£231,080** | | | |

**Notes:**
1. Disbenefits appear as negative
2. All values are £000s Present Value, 1998 Values and Prices

## Economic Activity and Location Impacts

The aim of Economic Activity and Location Impact (EALI) analysis is to quantify the impacts of a proposed scheme on the economy at a local or regional level and at the level of Scotland as a whole.

The appraisal is undertaken in terms of employment and where possible income. The analysis is intended to identify how different locations may be impacted upon and to capture net additional economic impacts at different spatial levels. These impacts are not however additional to those captured in the standard cost benefit analysis approach; rather, they express these impacts using an alternative unit of account.

*Property related impacts*

The tram will comprise a strategic transport link to and from the Waterfront regeneration area. This is essential for the successful implementation of:

- A sustainable community comprising high density units, as well as housing for key workers and social housing;
- New educational institution: students will be dependent on public transport for access to their education;
- New employment uses in the regeneration area: residents from outside the regeneration area will have better access to these sites; and
- Access to potential tourism and leisure event venues.

Developments have been planned on the assumption that the tram will be implemented in 2009. While some developments are either constructed or under construction now, it is likely that any changes in the plan to implement the tram will impact on the fulfilment of all proposed developments in the longer term. It will also impact on the development of major event developments that might otherwise not be located in Edinburgh, such as the proposed casino development currently under consideration.

Planned developments where employment impacts could be claimed at the Scotland level are still very much tentative proposals and any impacts cannot be claimed at this stage. At the regeneration level, the tram will provide a strategic transport link – the benefits at the level of the regeneration areas depend upon how residents of these areas are enabled to access the jobs in the North Edinburgh sites. Based on the proximity and travel to work characteristics of people living in the regeneration areas, it is reasonable to expect that a proportion of total new jobs will be taken up by these residents as a result of better accessibility and that this will amount to between 70 and 200 jobs. Some allowance needs to be made for displacement, which is assumed to be around 50%. Accordingly the net impact ranges from 35 to 100 jobs at the regeneration area level.

*Business impacts*

The surveys results indicated that the tram is expected to be of very limited benefit to businesses, except in terms of providing better access to labour, primarily in the retail, financial services and health sectors. However, it is difficult to argue that location is the reason for being unable to fill vacancies. Within the health sector, vacancies currently hard to fill could be filled by having better access to the regeneration areas in North Edinburgh. This could result in filling around 20 vacancies per annum, of which half might be additional at the regeneration area level and half at the Scotland level, which represents those jobs which would not be filled without the tram.

*Social inclusion impacts*

The new developments will attract a significant number of service sector based businesses, which will result in a large number of low skilled jobs being created. It is likely that these jobs may be filled by residents living in deprived areas in North Edinburgh. The tram will be pivotal in providing public transport access to these jobs for these individuals.

***Integration***

Transport Integration

Co-ordinated and integrated transport services with convenient, simplified (and possibly through) ticketing can contribute to more "seamless" journeys across the public transport network. Travel cards, season tickets, concession passes and probably the integrated "The One" ticket system will be available for purchase at other locations. Real time passenger information at bus stops will contribute to an integrated public transport system.

The attractiveness of the public transport system as a whole in Edinburgh can be enhanced with the implementation of Line 1 by the existence and quality of infrastructure facilities at tram stops, maximising bus and rail interchange with the tram and real-time passenger information at all tram and bus stops.

Land-Use Transport Integration

Improvements in public transport brought about by Line 1 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 (especially for those dependent on public transport).

Policy Integration

Edinburgh Line 1 can contribute to the following wider Government policies:

- Disability – The design of trams and stops, fully DDA (1995) compliant and with level boarding, will provide easy access to wheel (and push) chairs, facilitating thus the access not only for the mobility impaired but also the elderly and mothers with babies;
- 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 does not reach rural areas and therefore it can do very little to contribute to improve rural affairs or retaining rural communities; and
- Social exclusion – 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.

***Accessibility and Social Inclusion***

Community Accessibility

Community accessibility has been measured to key local services and destinations:

- George Street / Frederick Street junction – representing the city centre (employment, shopping, leisure and access to Waverley rail station with integration with bus and rail);
- 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); and
- Crewe Toll / Western General Hospital (employment, visiting relatives).

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). Seven time bands have been determined and the changes in the number of people with access to the selected locations within these time bands have been estimated.

Accessibility is significantly increased for travel from most zones to all the selected destinations. The most notable exception is for travel from the south-west of Edinburgh to destinations in the north-east, since these trips can currently be made by a single bus journey. With the introduction of the tram, these direct services are assumed to be withdrawn and an interchange will be required at or near Haymarket Station, making the journey longer in terms of total travel time (wait and interchange time), but probably more pleasant and comfortable on the tram section. A similar effect takes place also in parts of the south-east for travel to most of the selected destinations.

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

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. The analysis has been carried out for the locations where the local population depends most on public transport provision, that is, where there is no car availability.

The results vary considerably according to the destination under consideration. Overall, significant accessibility benefits can be realised by the introduction of Line 1 in Edinburgh, also for households without a car. Some 4 times as many households with no car benefit than disbenefit as a result of the scheme. It is important to bear in mind that any disbenefit in the accessibility analysis is a result of the changes in bus routes, when the tram is in place. Many journeys are likely to require one (or one additional) interchange, and this tends to increase the total travel time. However, the tram section of the journey will gain in quality, reliability, speed and comfort, which could become acceptable trade-offs for travellers. The accessibility impacts per selected location are:

- 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; and
- Granton and Crewe Toll: majority benefit significantly (i.e. reduction of more than 10 minutes in journey times).

***Cost to Government***

The cost to government sets out the net cost of a proposal from the public sector's point of view, which can then be compared with the overall benefits of the scheme covering all five of the main objectives (environment, safety, economy, integration and accessibility). The economic impact of Line 1 is presented in the table below, which summarises the monetised benefits of the scheme in

terms of safety and economy and then compares this with the cost to government. The overall Present Value of Cost to Government is £195.5m, of which the principal component is the grant payment for the construction of Line 1. The overall PVB, including accidents, is some £235.9m. These combine to produce a BCR of 1.21 and an NPV of £40.4m. On this basis, the scheme represents good value for money. Sensitivities around this Central Case demonstrate the robustness of the case for Line 1; coupled with the benefits to the non-monetary objectives, a strong case for Line 1 has been made.

| | STAG Code | Total | Public Transport | Cars | Road Users Freight |
|---|---|---|---|---|---|
| **Local Government** | | | | | |
| Public Sector Investment Costs | PV9 | £0 | | | |
| Public Sector Operating & Maintenance Costs | PV10 | £0 | | | |
| Grant/ subsidy payments | PV11 | -£108,285 | -£108,285 | | |
| (Developer Contribution) | | £0 | | | |
| Revenues | PV12 | £142,076 | £116,241 | £25,835 | |
| Taxation impacts | PV13 | £0 | | | |
| **Central Government** | | | | | |
| Public Sector Investment Costs | PV9 | £0 | | | |
| Public Sector Operating & Maintenance Costs | PV10 | £0 | | | |
| Grant/ subsidy payments | PV11 | -£213,542 | -£213,542 | | |
| (Developer Contribution) | | £9,563 | £9,563 | | |
| Revenues | PV12 | £0 | | | |
| Taxation impacts | PV13 | -£25,326 | -£17,087 | -£7,862 | -£377 |
| **Total PVC to Government** | | **-£195,513** | costs appear as negative | | |

| **Monetised Summary** | |
|---|---|
| Present Value of Transport Benefits (PV1-8) | |
| Accidents, PV1 | £4,799 |
| Transport Economic Efficiency | £231,080 |
| Total PVB (PV1-PV8) | £235,879 |
| Present Value of Cost to Government (PV9-13) | -£195,513 |
| Net Present Value | £40,366 |
| Benefit-Cost to Government Ratio | 1.21 |

### *Appraisal Summary Table*

The table presented below summarises the appraisal of the various impacts under STAG2 for the preferred route.

| **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*<br>*Revenue Support*<br>*PV Costs* | £274.15m (capital cost)<br>£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<br>▪ Promote sustainability<br>▪ Reduce congestion<br>▪ Improve safety and security<br>▪ Social benefits | ▪ Line 1 will improve accessibility to employment opportunities, education, shopping and leisure destinations, contributing to improve the local economy.<br>▪ 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).<br>▪ The tram system will provide a safe and secure means for travel as well as a safe local environment.<br>▪ 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 tram operations.<br>• Remaining sections of tram route: no significant impact. | • Significant (major) negative impact of tram noise on receptors 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<br>• 2026: Do minimum to with scheme: No change in population annoyed | • Neutral-slight negative impact on remaining route sections.<br>• 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)<br>• 174,000 households with decrease in $PM_{10}$ in 2001 (112,050 in 2026)<br>• 3,400 households with no change in $PM_{10}$ in 2011 (1,000 in 2026) | Moderate positive (2011)<br>Neutral (2026) |
| | | • 77,950 households with increase in $NO_2$ in 2011 (139,550 in 2026)<br>• 177,250 households with decrease in $NO_2$ in 2011 (119,100 in 2026)<br>• 26,200 households with no change in $NO_2$ in 2011 (22,750 in 2026) | Moderate positive (2011)<br>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).<br>• Existing drainage will be utilised, but where new one is required the principles of SUDS will apply (slight adverse but mitigation will prevent impact).<br>• The scheme is not located in high-risk flood areas and is not expected to increase flood risk (neutral).<br>• Existing groundwater and hydrogeological resources will not be impacted (neutral). | • The scheme crosses the Water of Leith twice.<br>• 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.<br>• 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<br>• 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:<br>• 16 sites of national importance;<br>• 20 sites of regional importance;<br>• 27 sites of local importance;<br>• 23 sites of little or no importance.<br>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 | Moderate beneficial |

| | | | |
|---|---|---|---|
| | | activities. Positive design. Conductors present in all vehicles. Lighting and help points at all stops. | |
| **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.<br>• Additional jobs at the regeneration area level. | • 35 – 100 jobs.<br>• 0 – 10 jobs. |
| | National Economic Impacts | • No net additional employment is claimed at the Scotland level.<br>• Half of extra jobs in the health sector are additional, which would not be filled without tram. | • No impacts.<br>• 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;<br>• Haymarket: vast majority unaffected. No accessibility disbenefits;<br>• Leith Ocean Terminal and Foot of Leith Walk: many times more people/households benefit than disbenefit;<br>• Granton and Crewe Toll: majority benefit significantly (i.e. reduction of 10+ minutes in journey times). | N° of households without a car benefit (disbenefit):<br>• George St: 6,366 (12,604);<br>• Haymarket: 17,337 (0);<br>• Leith Ocean Terminal: 93,728 (53,176);<br>• Foot of Leith Walk: 68,547 (39,127);<br>• Granton: 161,998 (9,856);<br>• 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).<br>Potential developer contribution of £9,563m (PV). | | £312,264m (PV) |
| Revenues | Revenue from operation of Line 1<br>Revenue from car parking | | £116,241m (PV)<br>£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 |

## Sensitivity and Risk Analysis

One of the critical success factors for the Tram Line project is the identification and mitigation of the risks inherent in a project of this nature. In order to manage risk in a structured manner, **tie** has appointed a full-time Risk Manager to develop and apply a framework of risk analysis and evaluation to assist in decision-making, and identified the following prime objectives:

- Mitigate all identified risks to a 'medium' significance or less;
- Pass all identified risks to the best parties capable of managing the risk;
- A culture of risk awareness (not risk averse) and management be created;
- Delivery within budget and on time;
- Provide a fully functioning operational service; and
- Obtain support from all key stakeholders.

***Risk Management Process***

Throughout the development of the tram and other ITI proposals, **tie** has initiated and continued to develop a plan for management of risk.

The proposed alignment and options have been found to be feasible, based upon a number of key assumptions (and consequent risks, associated with these assumptions):

- The design is based upon vehicle parameters. No new or innovative, untried technology is proposed, but new traction technologies will be reassessed prior to implementation;
- The run times can be maintained – this depends on achieving adequate tram priority;
- Acceptability of urban design issues – this is being addressed through the development of a detailed design manual, prior to implementation of the scheme;
- Integration with bus – the design provides opportunity for bus integration and mitigates potential adverse impacts on bus. The risk of changes in bus routes, competition and predatory bus pricing is significant and has proved to be problematic on other schemes.

In order to reduce strategic risk, **tie** has taken steps to consult with key organisations such as Scottish Executive, City of Edinburgh Council (CEC) and bus operators in the Edinburgh area.

**tie** established a Procurement Working Group, comprising representatives from legal, financial and technical advisors, in order to address these issues with respect to Edinburgh. The major strategic risks anticipated by the group were:

- Integration of the tram 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.

The group considered a range of potential procurement methods to evaluate the performance of these methods in mitigation of the identified risks, concluding that the early appointment of an Operator as an additional specialist advisor to **tie** would be advantageous.

A sub-group was appointed by **tie** comprising legal, technical and financial advisors augmented by Partnerships UK to prepare 'Invitation to Negotiate' documentation. This has evolved into an agreement for the Development Partnering and Operating Franchise (DPOF).

***Derivation of Costs and Revenues***

The technical teams engaged to advise upon the estimation of costs have extensive experience in the development of tram schemes in the United Kingdom and abroad and are thus cognisant of the likely factors and risks that will impact upon outturn costs.

Cost estimates have been prepared using a combination of benchmarking, previous experience and engineering judgement to define the works elements and to obtain and refine implementation costs. 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.

Line 1 boardings are comparable to existing systems, though in terms of passengers per route kilometre, Line 1 by 2026 will exceed all existing systems. Data on passenger kilometres shows a similar story. The revenue per passenger is in the centre of the range for existing systems, whilst the revenue per tram km is near the upper end of the range.

**tie** has undertaken a comparison with other operational tram schemes within the United Kingdom to assess the values adopted for the Edinburgh tram projections. The principal points of note are:

- Project-wide construction cost overruns have been up to 25% of award construction cost. **tie** will manage this risk by structuring and integrated construction and (potentially) maintenance contract. Current optimism bias value is at 25%;
- Completed projects have typically overrun by three to six months with minimal Promoter downside risk due to contractual structures used. Current optimism bias suggests a value of 14%, which represents an additional 5 months on a 36 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 expectations, 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**;
- The potential advantage to be gained from full cooperation of bus and tram operators has not always been forthcoming on other projects. **tie** has progressed the DPOF process to facilitate this; and
- **tie** continues to liase with other Promoters to obtain maximum benefit from their experiences.

***Optimism Bias***

**tie** and its advisers have considered the implications of the new Green Book Guidance as issued by the Treasury and have discussed the application of this guidance to the Line One project with PUK and the Scottish Executive. The Optimism Bias process as required by Scottish Executive for all major public transport schemes is being followed.

Optimism Bias provides a methodology to determine what level of additional cost and programme delay should be applied to a project given its particular stage of development. Standard factors are given dependent upon the nature of the project based on analysis of previous schemes. No Optimism Bias adjustments exist at present to cover operating costs, lifecycle costs or revenue.

Optimism Bias does not appear to account for the rigorous capital costing methodology employed by **tie**'s technical advisors, that is, determining the cost from the out-turn costs of a number of recent tram schemes. It is, therefore, considered that the capital costs (net of contingency) include for a portion of Optimism Bias. It has not been possible to quantify this portion and therefore it may be considered that the Capital Cost Optimism Bias is conservative.

***Current Risk Status***

**tie** and its advisors have identified project risks through workshops, strategic reviews, experience of other UK tram schemes and recording of risks throughout the development process. These risks have been recorded on a register which has been further developed from checklists contained in published industry guidance.

A consolidated risk register has been prepared for the tram network. In order to review timing, the risks have been categorised in order to identify the risk level of each stage of the project and to ensure risks are reviewed and mitigated for each stage.

Of all areas, capital costs, operating costs and works duration (programme) have been shown to lie within Optimism Bias considerations. Strategies have been adopted to quantify the impact of risk. **tie** has developed clear and active processes to prevent and mitigate project risks in accordance with industry best practice. **tie** has also ensured that clear and tangible evidence has been observed prior to reducing the Optimism Bias.

Given the level of development the project has reached, together with the amount of mitigation that has been carried out across the range of risk areas identified by Optimism Bias, it is considered appropriate to use lower factors of 25% for Capital Cost Optimism Bias and 14% Works Duration Optimism Bias.

***Sensitivity Analysis***

A number of sensitivities have been tested to simulate a number of the key project risks. These sensitivities are designed to test the overall economic and financial robustness of the project, and to give an indication of the impact of key project risks on the financial structure proposed:

- Demand and Costs – The overall economic case for Line 1 will be impacted upon by capital and operating cost increases and by demand falling lower than forecast. To illustrate this, the 'switching value' of the capital cost, operating cost and scale of demand have been established where the NPV would fall to zero.
- Unchanged Bus Network – The integration of bus and tram services is critical to successful operation. Line 1 Central Case assumes that there is limited bus network restructuring, but a scenario was tested assuming an unchanged network. The analysis shows that Line 1 would add significant public transport supply, but this dilutes the available revenue to the various public transport operators. Therefore, from a financial

viewpoint, i.e. the business case, this option performs noticeably worse, but from an economic viewpoint, it performs better with a BCR of 1.57.

- Mode Constant – The Central Case assumes a modal preference of 0.8 in-vehicle weighting. A test has been undertaken assuming a value of 0.9. This reduces the level of demand and benefits accruing to Line 1, reducing the BCR to 1.07.
- Tram Frequency – The current central case assumes a frequency of 8tph; however, by 2026 demand is forecast to be near or at the capacity of this frequency. On this basis, a test has been undertaken assuming 10tph, increasing the operating cost. The impact is positive on Line 1 demand and benefits, but the operating ratio of the tram is marginally worse, where the increase in revenue is insufficient to offset the increased capital and operating costs. The BCR is unchanged at 1.21, where the benefits of the frequency increase is offset by the additional operating cost.
- Tram run time – The Central case run time is some 40.5 minutes, assuming a reasonable level of priority at junctions. But, as it is possible that this is not achieved, run times of 43.0 minutes have been developed. There would be an increase in operating cost, with a larger fleet requirement, and the BCR would lower to 1.09.
- Work Split – The Central Case appraisal assumed a local work split based on Edinburgh household survey data. Using default TUBA work splits increases the PVB by some 6.3%, and the BCR to 1.28.
- Worst Credible Scenario – The results for the worst credible scenario with respect to the financial case for Line 1 indicates that the operating ratio would be substantially eroded. Bus operations would be similarly affected. This scenario produces a BCR of 1.26.

## 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.

Soon after implementation, the performance of the project should be assessed against the specified objectives – the process evaluation. Recognising that certain 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.

Project objectives have been set out as a more measurable and specific account of the planning objectives, and can be seen as scheme performance indicators. During future scheme development, the scheme objectives will continue to be under review and re-appraisal where appropriate.

There is a 5-6 year period required for scheme development, approval and construction. It is possible that circumstances may change within that time, which could affect the assumptions made regarding the scheme. Future changes in planning and transportation strategies as proposed or implemented by CEC will also result in a re-assessment of the tram proposals.

**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.

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).

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.

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 DPOF contract proposes a review and possible revision of Target Costs and Revenues 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.

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.

**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.

# 1 Introduction

## 1.1 Background

### 1.1.1 Edinburgh Tram

The City of Edinburgh Council (CEC) is examining ways of providing the city with the transport infrastructure necessary to promote and support a growing local economy and create a healthy, safe and sustainable environment. This is part of a £1.5 billion New Transport Initiative that the CEC is working in co-operation with other local authorities in South East Scotland to deliver.

As a key component of the strategy of public transport investment in Edinburgh, the council is proposing to develop a network of modern light rapid transit rail systems, or trams. The tram system is being developed in stages and will focus on the major city transport corridors including links to Park and Ride sites.

CEC has established a company, called Transport Initiatives Edinburgh (**tie**), which is responsible for the delivery of a number of major public transport schemes in the next 10 to 15 years, including the proposed tram network. At this time, **tie** is developing and promoting three tramlines, with further lines and extensions envisaged in the longer-term. This three-line network comprises the following:

- Line 1, the Northern Loop, linking the City Centre with Granton and Leith;
- Line 2, west from the City Centre to serve Edinburgh Park and the Airport, with Park and Ride at its western extremities; and
- Line 3, connecting the City Centre with the south-east area of Edinburgh.

Each line is being developed and approvals sought independently, with a separate, but parallel, network study providing the overarching framework for the development of trams in Edinburgh. On this basis, separate STAG (Scottish Transport Appraisal Guidance) appraisals and Parliamentary Bills will be submitted for each line.

Whilst a network of trams is being developed, each line is being promoted independently and as such this report relates to the impacts of Line 1 alone. A sister appraisal report will be submitted contemporaneously for Line 2. A full STAG for Line 3 is envisaged during 2004.

### 1.1.2 Line 1: Northern Loop

In 2001, Waterfront Edinburgh Limited (WEL) commissioned a preliminary technical and economic Feasibility Study[1] of a rapid transit system in north Edinburgh, led by a Steering Group involving the City Council. One of the objectives of the system was to provide a link between the city centre and the proposals for the Waterfront redevelopment planned at Granton.

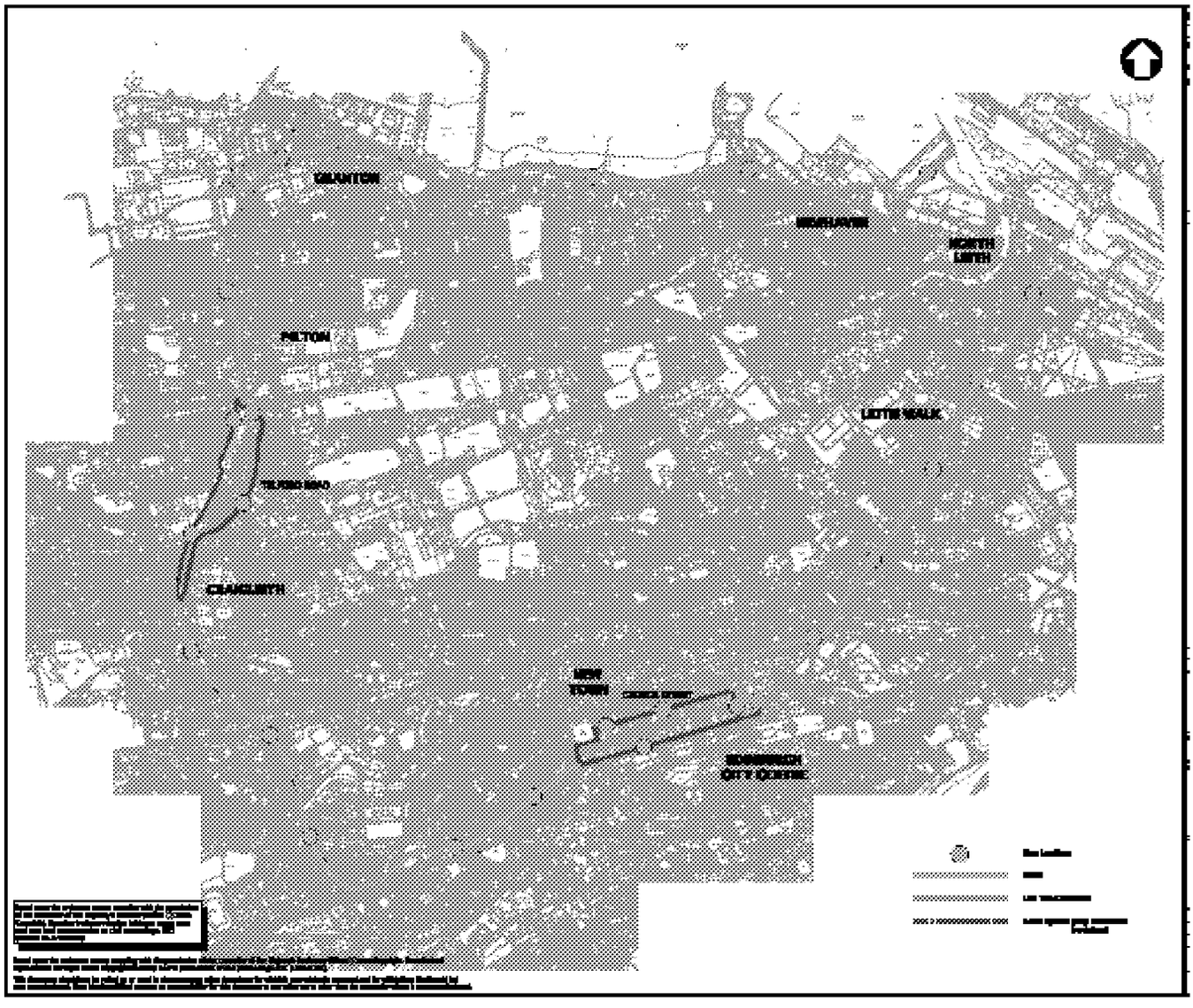
This Feasibility Study concluded that a northern loop tram system would maximize a number of positive benefits for the area including economic regeneration and improved accessibility. The Feasibility Study and, critically, an associated preliminary appraisal, was submitted to and accepted by

[1] Feasibility Study for a North Edinburgh Rapid Transit Solution, July 2001, Andersen, Steer Davies Gleave and Mott MacDonald.

the Scottish Executive, and funding of £6.5m was subsequently made available for the development of the Line 1 project to full appraisal and Bill submission.

The alignment of the Line 1 route, illustrated in Figure 1.1, is proposed to connect the city centre with Leith, Newhaven and Granton, passing through the Waterfront development area and then along the line of the former Roseburn Railway to Haymarket.

**Figure 1.1 Route Alternatives**




## 1.2 The STAG Appraisal Process

Scottish Transport Appraisal Guidance (STAG) is the official appraisal framework to aid transport planners and decision-makers in the development of transport policies, plans, programmes and projects in Scotland.

STAG has two parts:

- STAG1: initial appraisal and broad assessment of impacts, designed to decide whether a proposal should proceed, subject to meeting the planning objectives and fitting with relevant policies; and
- STAG2: detailed appraisal against the scheme and Government's objectives.

For the purposes of the Edinburgh Tram projects, STAG1 appraisal was effectively undertaken in the scope of the feasibility study, and reported within the Outline Business Case (OBC). A formal STAG1 has not been undertaken since STAG had not been published at the time (the full guidance was only issued in September 2003) and the OBC fulfilled the role and objectives of STAG1 – which has been accepted by the Scottish Executive. The OBC concluded that the Light Rail Transit (LRT) system on the Northern Loop is the preferred option and offers greatest benefits. In addition, the scheme was considered to fit with the Local Transport Strategy 2004-2007 and Steering Group objectives (more details in Chapter 4).

This report focuses on STAG2 appraisal (full details in Chapter 7), taking full cognisance of the recent release of the STAG guidance update (Scottish Executive[2], 2003).

A consistent basis for the technical development, modelling and appraisal of Edinburgh Tram has been developed and agreed between the respective Line 1 and 2 technical teams. Furthermore, on the section of common running between Haymarket and St. Andrews Square, the appraisal has been undertaken by the Line 1 team and adopted by Line 2.

## 1.3 Objective and Structure of this Report

This report sets out the STAG appraisal for Edinburgh Tram Line 1, building on the appraisal considerations in the OBC (as reported in the Feasibility Study report) and developing a full STAG2 appraisal.

This report describes the various processes, issues and results from the STAG appraisal for the Edinburgh Tram Line 1 scheme. This is set out in the following chapters:

- Planning objectives (Chapter 2);
- Problems and opportunities in North Edinburgh (Chapter 3);
- Option generation, sifting and development (Chapter 4);
- Consultation (Chapter 5);
- Scheme description (Chapter 6);
- STAG2 appraisal (Chapter 7);
- Sensitivity and risk analysis (Chapter 8);
- Monitoring and evaluation (Chapter 9); and
- Conclusions (Chapter 10).

For practical reasons, the report is accompanied by a separately bound volume containing a set of Appendices, which provide a more detailed treatise of some of the issues under consideration.

[2] http://www.scotland.gov.uk/library5/transport/stag-00.asp

# 2 Planning Objectives

The aim of this chapter is to develop the planning objectives to drive the appraisal stage, based on the requirements of STAG and on the planning policy framework.

## 2.1 STAG Requirements

STAG appraisal is not simply completion of the Appraisal Summary Tables but is a holistic process that begins from issues and objectives and traces the development of project proposals from objectives and is developed through a process of option appraisal. There is therefore a requirement to provide a rationale for the selection of particular project proposals, and that rationale must be traceable back to the issues to be addressed and the planning objectives determined by the promoter of the project.

In summary, the STAG appraisal process requires that proposals are tested against three sets of objectives:

- The planning objectives established by the planner (planning strategy);
- The Government's five objectives (environment, safety, economy, integration and accessibility); and
- Any other relevant external objectives relating to transport, land use or wider policies (local, regional and national policy framework).

STAG suggests that, when setting objectives in complex situations, there should be layers or levels of objectives, with strategic and operational level objectives and possibly intermediate objectives below but linked to the strategic level aims. While strategic level objectives are concerned with final (policy) outcomes, the lower levels of objectives can relate to outputs from particular strategies and / or to the inputs used.

The City of Edinburgh Council has clear strategic objectives enabling projects to be categorised as part of particular strategies. This is beneficial in taking forward the projects through the STAG appraisal process. However, a further explicit process is needed for developing an option appraisal which addresses the requirements of a STAG appraisal. This process underlies the rationale for the project, by testing outcomes against objectives, assessing likely costs and value for money, and considering deliverability and fundability.

In order to develop the required rationale and to provide a STAG driven basis for categorisation of projects, the following section sets out the transport vision and from it develops planning objectives suitable for a STAG appraisal.

## 2.2 Planning and Policy Framework

This section examines the planning and policy framework for Edinburgh in relation to transport, in the national, regional and city contexts.

### 2.2.1 National Context

The national policy framework for transport is set out in the White Paper, *Travel Choices for Scotland* (TSO, 1998), and more specifically in relation to planning and transport, in the Planning Advice Note

57 *Transport and Planning*, and in the National Planning Policy Guideline 17 (NPPG17) (Steer Davies Gleave, 2001).

The White Paper states the development of a sustainable transport system can contribute to meeting economic, environmental and social inclusion goals, but in doing so a number of issues need to be addressed:

- Rising traffic levels, but there is a recognition that simply providing more roads is not a viable solution to congestion problems;
- Key blockages on the trunk road network that have negative economic impacts;
- Traffic related local air pollution; and
- The need for the transport network to counter social exclusion.

Within NPPG17, land use planning is stated as an important tool in:

- Reducing the need for travel by relating land use to transport facilities;
- Enabling access to local facilities by walking and cycling;
- Encouraging public transport access to developments; and
- Supporting essential motorised travel.

As stressed in NPPG17, the general hierarchy of priorities for individual travel accessibility to development should be walking, cycling, public transport and then private cars. NPPG17 suggests that access to jobs and facilities across the wider urban area should be a prime consideration. Accessibility of new developments is an important issue, and one that has historically been difficult to measure definitively.

In order to support the development of its integrated transport policy, the Government has established five appraisal objectives in STAG, which are used when authorities and agencies develop and appraise new transport proposals. Thus, planning objectives are required to satisfy the five overarching national objectives for transport:

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

### 2.2.2 Regional Context

The City of Edinburgh Council forms part of SESTRAN, the South East Scotland Transport Partnership. Transport between the city and the wider region is an important issue, as the high value property market increasingly pushes commuters out to the surrounding areas. The Transport Partnership has adopted a number of overall policy principles:

- Reduce dependence on the private car and minimise he need for travel especially by car for regional journeys within South East Scotland;
- Maximise public transport provision and achieve public transport integration and inter-modality;

- Promote and develop travel awareness and information, encourage walking/cycling, promote better health and fitness and encourage the use of public transport;
- Improve safety for all road and transport users;
- Reduce the environmental impacts of travel;
- Enhance community life and social inclusion, and
- Encourage the use of the most economic, effective, environmentally friendly and efficient modes for freight transport.

### 2.2.3 Local Context

The City of Edinburgh Council has a well developed vision for transport over the next 20 years. It recognises the importance of transport for the economy of the City while at the same time seeking a major change in the way transport needs are met in order to achieve central objectives relating to the sustainability of the City and its environment, safety in using transport and the need to promote greater social inclusion.

*Local planning*

The statutory development plan for Edinburgh is comprised of the Lothian Structure Plan (1994) and the local plans. The City of Edinburgh Council, West Lothian, Midlothian and East Lothian Councils are currently working together to prepare a new Structure Plan, and have published a major issues paper for consultation. The key issues that have been identified are housing pressures, jobs and the economy, transport and commuting. Within Edinburgh itself, the Granton Waterfront area is identified as having potential for brownfield residential development, as well as land for office and business space, provided transport and other infrastructure is adequate. In this context, the Waterfront Granton Masterplan[3] aims to create a place which involves and benefits the existing communities of northern Edinburgh and which attracts employment, housing and other opportunities.

*Local Transport Strategy 2004-2007*

The Local Transport Strategy 2004-2007[4] (LTS) produced by the City of Edinburgh Council (CEC) sets the key framework for the City's transport strategy over the next years. CEC has stated its vision for transport within the LTS as follows:

> *Edinburgh aspires to be a city with a transport system that is accessible to all and serves all. Edinburgh's transport system should contribute to better health, safety and quality of life, particularly for children, and elderly and disabled people. The transport system should support a strong, sustainable local economy.*
>
> *The Council will seek to maximise people's ability to meet their day-to-day needs within short distances that can easily be undertaken without the need to use a car. The city should develop and grow in a form that reduces the need to travel longer distances, especially by car. Choice should be available for all journeys within the city.*

[3] City of Edinburgh Council, Scottish Enterprise Edinburgh and Lothian, Scottish Homes, December 2000, Llewelyn-Davies et al.
[4] Local Transport Strategy 2004-2007; The City of Edinburgh Council.

A number of policy aims and objectives derive from this vision, which address specific issues and trends, including modal and spatial dimensions of the overall transport plan. There are also further policy aspirations that need to be taken into account. The City of Edinburgh Council has also considered specific schemes, programmes and projects[5] that can be implemented to achieve its transport vision, of which Edinburgh Tram is a principal component, and wider policy goals.

The Council has concerns over car use and car ownership in Edinburgh, both of which are growing. The growth in car use is a consequence of rising ownership levels and of changing land-use patterns: more out-of-town destinations, the decline of older industries in central parts of the city, as well as changes in expectations for personal mobility. In particular, traffic levels outside the city centre and in off-peak hours have grown, compared to stabilised levels at peak periods into the city centre. Controlling congestion is, thus, considered crucial to maintain the effectiveness of Edinburgh's transport system, so that the focus is on:

- Ensuring that attractive alternatives to the car are available for the widest possible range of journeys; and
- Putting in place measures to tackle congestion at times and in places where it is a problem.

Walking and public transport still make up significant proportions of travel, while rail remains important for medium-long distance travel. Lack of access to facilities and services are significant contributors to high levels of social exclusion. Particularly vulnerable are the elderly, disabled as well as those with low incomes, children, women and parents with young children. To reduce social exclusion, the Council has identified good public transport, less traffic and lower speeds, better land use planning and transport integration, and accessible services as required.

The Council views congestion as affecting the economy in the city centre, but it is also seen to be affecting the outskirts of the city. The LTS stresses that all major centres of activity need to be accessible by public transport, foot and cycle. Future major travel generating development should be steered to areas that are well served by public transport, and local centres need to be supported by planning policies.

A number of aims are stated in the City of Edinburgh Council's Local Transport Strategy 2004-2007, as follows:

- 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; and
- To reduce social exclusion.

To help meet their aims, the Council has adopted a number of objectives and targets for their transport strategy:

- To reduce congestion on all modes of transport;
- To increase the proportion of journeys made on foot, by cycle by powered two wheelers (PTW) and by public transport;
- To reduce the need to travel, especially by car;

[5] For convenience, these will all be referred to as projects, but it is recognised that this includes activities which involve more than and / or last longer than individual projects.

- To reduce the adverse impacts of travel, including road accidents and environmental damage;
- To maximise the community role of streets, as places where people can meet, shop, and in appropriate circumstances, children can play;
- To improve the ability of people with low incomes or mobility impairments to use the transport system; and
- To ensure that the road, footway and cycle network are of a standard suitable for safe and comfortable movement.

For a transport proposal to be successfully promoted in the City, it must be shown to contribute to meeting these objectives. The aims of the LTS clearly echo the transport vision and to a degree represent a re-statement of the key themes of the vision, and as such represent the high level strategic aims which City of Edinburgh Council wishes to achieve in the future. However, these combine some impacts relating to how transport performs (e.g. safety and environmental impacts) which are qualitatively different from those relating to how the transport scheme being appraised can contribute towards these and other wider aims (especially economic development, fitness and social inclusion). Accordingly, these are not directly usable as planning objectives for the scheme.

## 2.3 Developing Planning Objectives

In the context of the OBC, where a preliminary appraisal was undertaken, the LTS aims were utilised, leading to the overall appraisal under the five key Government objectives (environment, economy, safety, integration and accessibility). Since STAG2 comprises a more refined appraisal process and enable the appraisal of more detailed impacts, higher-level planning objectives were developed. These also needed to meet the STAG requirements and be consistent with the planning objectives set out in the OBC, as well as with the transport vision for Edinburgh, the LTS and with wider (regional and national) policy objectives for transport and beyond.

Thus, for the purposes of STAG2 appraisal, more comprehensive and specific planning objectives were developed for the scheme, under broad categories, as outlined below:

- **To support the local economy by improving accessibility** – To achieve an integrated, efficient, accessible and quality public transport system that promotes economic growth to the local community, improving its performance and competitiveness. This is fundamental to achieving both the social inclusion and economic development elements of the transport vision, through:
  - Improve access to public transport network; and
  - Improve access to employment opportunities.
- **To promote sustainability and reduce environmental damage caused by traffic** – To encourage more sustainable travel and comply with the targets set by the Air Quality Amendment Regulations. This is fundamental to achieving the environmental, sustainability, health & fitness and traffic aspirations:
  - Increase proportion of journeys made by public transport, cycling and walking; and
  - Reduce local and global emissions (improving air quality and reducing contribution to Greenhouse gases).
- **To reduce traffic congestion** – To enable cars to be used efficiently, reducing congestion and delays on key routes. This is fundamental to the achievement of economic development and environmental aims of the vision:

- Reduce number of trips by car; and
- Reduce traffic volume on key routes.

- **To make the transport system safer and more secure** – To aim at less deaths by road traffic accident, by reducing vehicle volumes, speeds and making roads safer for both users and non-users. This is fundamental to the achievement of the safety elements of the vision:
  - Reduce traffic accidents.
- **To promote social benefits** – To take the new system as an opportunity to promote social and community benefits, which are fundamental to the respective elements of the vision:
  - Improve liveability of streets, maximising their role as the focal point of local communities; and
  - Reduce social exclusion, by improving the ability of people with low incomes, no access to car, the elderly or mobility impairments to use the transport system.

These planning objectives can help to identify both where projects and programmes re-enforce each other in achieving a range of objectives, as well as where there may be trade-offs. For example, there will be projects which contribute positively towards accessibility objectives but which could be potentially negative against some environmental objectives.

# 3 Problems and Opportunities in North Edinburgh

The purpose of this chapter is to set out the key problems and opportunities in North Edinburgh. The main areas considered relate to:

- Socio-economic characteristics;
- Environment; and
- Transport.

The following sections deal with each in turn. The last section sets out the potential opportunities that exist for a transport scheme.

## 3.1 Socio-Economic Characteristics

Despite the current worldwide economic slowdown, the strength of Edinburgh's regional economy, with correspondent growth in population and jobs, is expected to continue (Transport Initiatives Edinburgh, 2002). Recent research suggested that Edinburgh will have the fastest growing economy of any major UK city over the next five years (European Regional Prospects, 2001). Economic growth is closely related to future labour supply and population growth, with a buoyant economy likely to result in both a high level of inward migration and a growth in commuting.

The following sections revise the socio-economic context for:

- Population;
- Car ownership;
- Employment;
- Income;
- Deprivation; and
- Education.

### 3.1.1 Population

The General Register Office (Scotland) estimates that Edinburgh's population will grow from 453,000 to 465,000 between 2001 and 2011 (The City of Edinburgh Council City Development Department). Figure 3.1 illustrates the variation in population density levels within the study area at Output Area level from the 2001 Census. High densities are found in the north of the New Town, along Leith Walk and into Leith, through to Newhaven and across the north west of Edinburgh, covering the areas of Granton, Pilton and Muirhouse. The City Centre, by its very nature has a low density. The areas of Granton and Leith Docks, whilst currently having low population levels and density, are the subject of major development plans. These anticipate up to 15,000 household units, some 30,000 residents, split approximately 60% at Granton and 40% at Leith.

Mott MacDonald

**Figure 3.1 Population Density**




GILLESPIES McLEAN HAZEL ERM Babtie steer davies gleave

### 3.1.2 Car Ownership

At the end of the 1990s, Edinburgh experienced one of the fastest rates of growth in car ownership in Europe – the number of cars per 1000 population rose by 162% between 1971 and 1997. Comparing the results from the 1991 and 2001 census, the number of cars per 1000 population rose by nearly 20% in that period. However, 39.5% of households in Edinburgh do not own a car (according to the 2001 Census).

Figure 3.2 shows the distribution of non-car owning households for the study area (based on 2001 Census). The areas of low car ownership are broadly correlated to population density, which correspond to much of the study area. In part this reflects the compact nature of much of the City, which allied with the comprehensive bus system, makes car ownership less attractive than is the case elsewhere. However, it is also related to income and deprivation and this is covered below.

### 3.1.3 Employment

Unemployment is at a 25-year low and is expected to decline only slightly from its present level. A growing workforce, combined with increasing productivity, could lead to a 36% increase in economic output over the next decade. In turn, growing output would support substantial growth in real income and spending, with all the consequent effects on demand for services, such as shops, leisure, health, education and, particularly, travel (The City of Edinburgh Council City Development Department).

Figure 3.3 illustrates unemployment levels (from the 2001 Census) and their distribution. The key concentrations of unemployment are in pockets of Leith and, more widespread, in areas of Granton, Pilton and Muirhouse.

### 3.1.4 Income

Figure 3.4 shows the distribution of income in the study area at the ward level (2001 Census). As could be excepted, the areas of lower income are correlated with areas of low car ownership and high unemployment, namely the areas of Leith and the Granton, Pilton and Muirhouse areas of north east Edinburgh.

### 3.1.5 Deprivation

The area covered by the Waterfront regeneration initiative and surrounding neighbourhoods, notably the Granton, Pilton and Muirhouse areas, has a history of social deprivation and exclusion and this is shown in Figure 3.5, which illustrates the deprivation level for wards in Edinburgh, based on the Index of Multiple Deprivation (IMD) per ward. In north Edinburgh, this north-eastern section is one of the most deprived areas.

### 3.1.6 Education

Figure 3.6 illustrates the level of education in the study area. As with the other indicators shown above, the areas of Granton, Pilton and Muirhouse show poor levels of educational achievement amongst its populace, with Leith also performing poorly compared to the average.

**Figure 3.2 Households with No Car Available**

Mott MacDonald

**Figure 3.3 Percentage of Unemployment**

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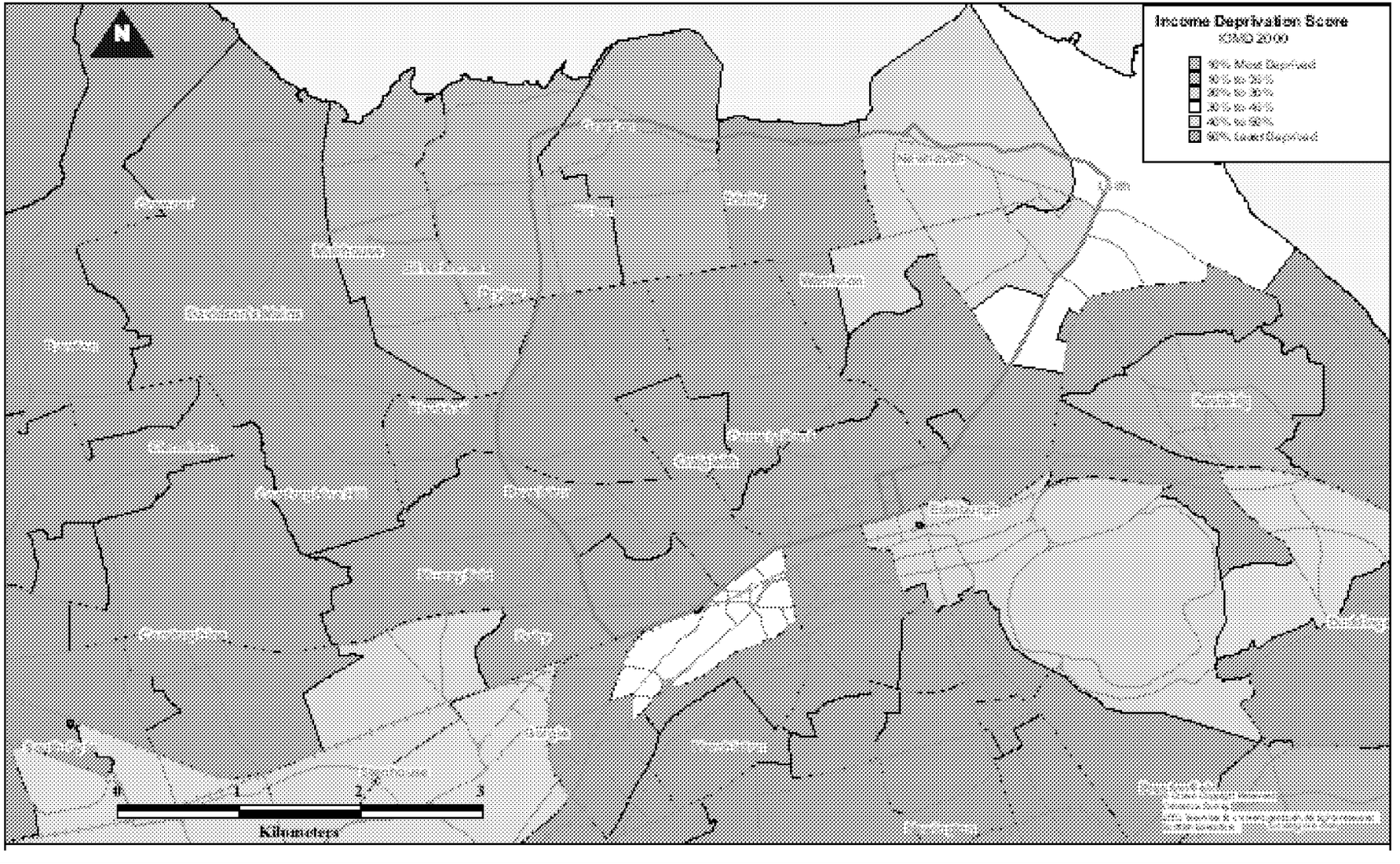
Mott MacDonald

## Figure 3.4 Income Levels



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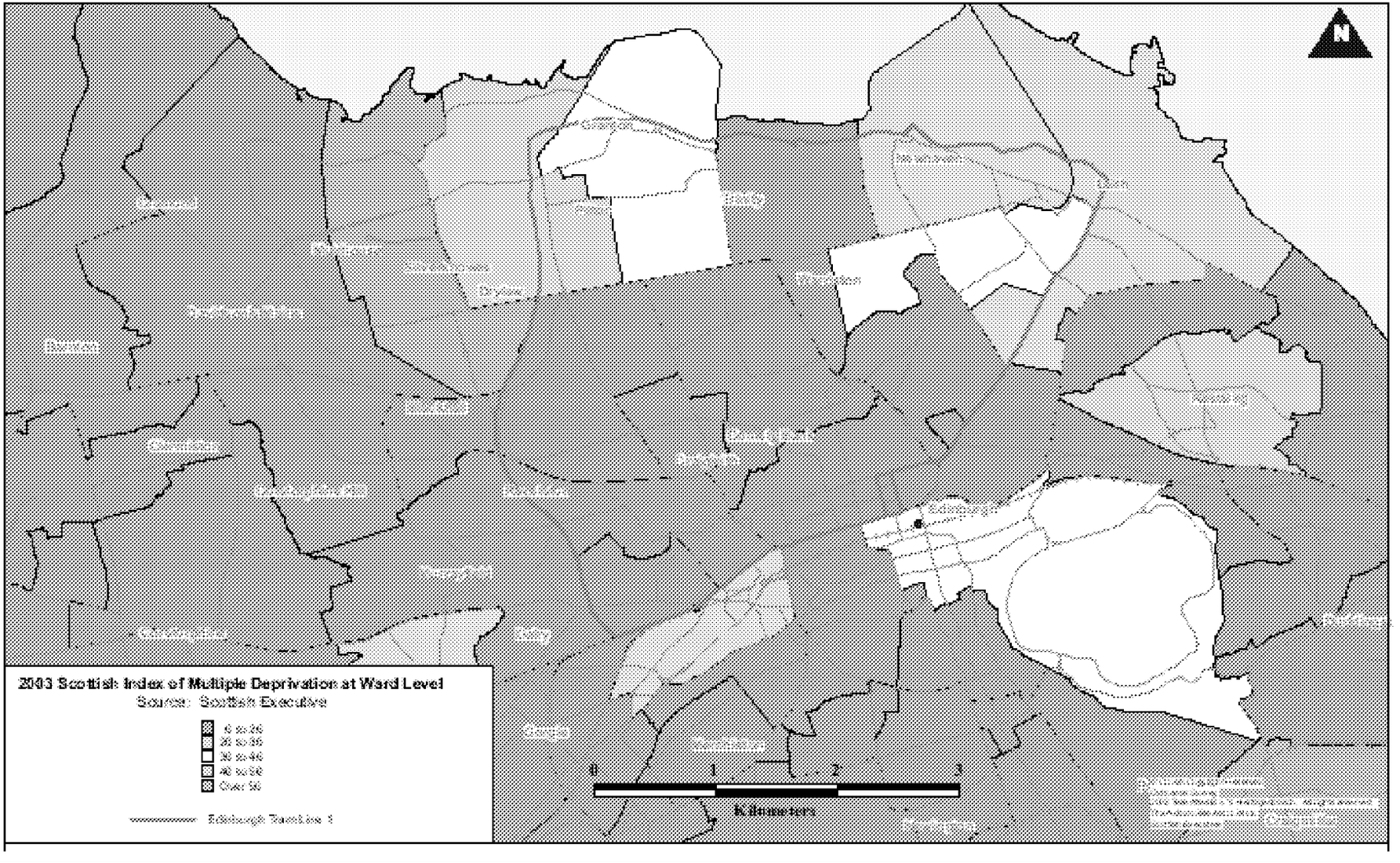
Mott MacDonald

**Figure 3.5 Index of Multiple Deprivation**



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Mott MacDonald

**Figure 3.6 Education Levels**




GILLESPIES McLEAN HAZELL ERM Babtie steer davies gleave

### 3.1.7 Socio-Economic Characteristics in North Edinburgh

The areas covered by the Waterfront regeneration, the surrounding neighbourhoods and North Edinburgh as a whole have a history of social deprivation and exclusion. The North Edinburgh area has been the subject of a policy initiative, which seeks to address social derivation issues. As such, there is a rich stream of data that illustrates the area's social deprivation compared with the rest of the City and Edinburgh. However, whilst the available research is quoted extensively below, it is important to note that social needs are not limited to the neighbourhoods covered by the data. Social deprivation spreads across much of the north of the City, including Leith, where notwithstanding recent regeneration social issues remain. The situation in the North Edinburgh Area Renewal (NEAR) area is typical of many parts of the north of the city.

The redevelopment of the Waterfront area is intended to contribute to the regeneration of Granton and the surrounding areas. Granton, and its neighbouring areas of West Pilton, Muirhouse, Drylaw and Royston/Wardieburn suffer from significant levels of social deprivation. A 1999 study by Halcrow (Halcrow, 1999) produced an updated Economic and Social Profile of the NEAR area, covering these five areas.

The study highlighted some general social and economic characteristics of the NEAR area:

- North Edinburgh has larger household sizes than the city and national averages. There are also high proportions large households with children, and elderly households in the area;
- The area had a younger population than Edinburgh as whole;
- 53% of respondents in the NEAR area rented housing from the local authority. Owner-occupied levels were low, at 28% of households in the area. The Halcrow report noted the difficulties in developing a private housing market in the area, with market values of properties low. The proportion of respondents with housing from the Housing Association and Co-operative Sector is double the proportion in Edinburgh as a whole (at 11%, compared to 5% in Edinburgh). This reflects the growing significance of this sector in housing in the area;
- Access to a car varied amongst the areas surveyed. Overall, 66% did not have access to a car. This compares to 46% of Edinburgh residents with no access to a car, and 35% in Scotland overall. Therefore, the North Edinburgh area has significant proportions of people with no access to private vehicular transport;
- Across Scotland, 12% of households do not have a bank or Building Society account. In the NEAR area, this proportion was 23%, suggesting a high level of exclusion with regard to financial services;
- Overall 22% had a net income of less than £300 per month, with females faring worse than males – 29% of women in lowest income bracket, compared to 13% of men;
- The levels of qualifications in North Edinburgh were poor compared to the national average. Those with no qualifications were double the national average. In the NEAR area, 46% left school with no qualifications. Overall, only 22% had undertaken post school education.

In relation to employment, the following figures show the nature of employment patterns and modes of travel in the area:

- In the NEAR area 42% of adults in surveyed households were employed full-time, 12% part-time, with 22% unemployed and 13% retired. Unemployment figures for Edinburgh for 1997 suggested 4.5% unemployed in the city overall;
- The proportion of respondents employed part-time is lower than the Edinburgh average. Overall, differences between genders reflect wider trends, with 51% of males in full-time employment, compared to only 26% of females. More females are unemployed than males. However, females working part-time is much more significant at 16% compared to 2% of male respondents;
- Compared to Edinburgh as a whole, the NEAR area has a low proportion of adults working in managerial, administrator and professional sectors. The majority of respondents were employed in the service and skilled trade sectors, with some variations across neighbourhoods;
- There are significant levels of long-term unemployment: 80% of the unemployed respondents had been so for longer than a year, higher than the official statistics of 24% (explained by unregistered unemployed in this survey) and 48% had been unemployed for longer than 5 years. Long-term unemployment was particularly prevalent in older age groups, especially between 45-54 years old;
- Overall in the NEAR area, most respondents worked in the City Centre (29%), followed closely by the NEAR area (28%);
- When asked about mode of travel to work, overall the largest single proportion (36%) travelled by bus, followed by 31% travelling by their own car and 14% walking. Although this is considered a high modal share in favour of the bus in relation to the Scottish average, this proportion reduces significantly when looking at areas with lower levels of accessibility. For instance, the largest proportion of West Granton respondents travel to work by car (38%) with bus at 26%, walking at 15% and cycling at 11% (compared to an overall average of 4%);
- When asked about barriers to their ideal job, 21% stated access, the second highest obstacle after lack of experience. Access is likely to be a greater barrier to the new development and employment areas in the north of Edinburgh, where deficiencies to the current bus network are most evident;
- As a consequence of the research into modes of travel to work, the study concluded that employment patterns were shown to reflect public transport links. It also suggested that work patterns will continue to be affected by accessibility by bus and foot. The main growth areas were viewed to be service sector employment, in the City Centre and at The Gyle and Edinburgh Park. The report stressed that better public transport links to the latter two locations in particular were required to enable access to opportunities, with relatively good public transport access currently to the City Centre.

A study carried out by Oscar Faber (Oscar Faber, 2000) examining public transport option in North Edinburgh, reinforced Halcrow's findings. It stressed these communities' reliance on public transport and the inadequacy of current connections to areas of employment in Leith and the west of the city.

The recent studies that have examined the socio-economic characteristics have identified that the North Edinburgh area – defined as Muirhouse, West Pilton, West Granton, Royston/Wardieburn and Drylaw – is characterised by social deprivation and economic need. While there is an acceptance that improved transport provision will not address all of the needs of the area, there is also a recognition that in concert with other initiatives promoting housing, employment and urban regeneration, it can make a contribution to improving the well being of the North City. It is also important to note that while the available studies have concentrated on a sub-area of North Edinburgh, the socio-economic

deprivation is not limited to the area covered by the NEAR study. Needs spread further afield, including into Leith where, notwithstanding the regeneration that has occurred there, areas of social deprivation remain.

## 3.2 Environment

### 3.2.1 Aims and Objectives

The overarching planning objectives for the study have been set out and discussed in Chapter 2 of this report. Environmental objectives are expressed within these aims and objectives, and are clearly established by the Government's environmental objective as one of the five key objectives for transport.

These objectives are supported by policies and aspirations at the regional and local level in statutory documents such as structure and local plans and the Local Transport Strategy 2004-2007, which have an environmental theme. The statutory development plan for the area through which the scheme passes comprises the Edinburgh and Lothian Structure Plan and several local plans. The core strategy of these documents is to facilitate more sustainable patterns of land use and development, which include protection and enhancement of the natural and built environment.

The Local Transport Strategy 2004-2007 (LTS) includes a key aim which is to reduce the environmental impacts of travel, and a number of the LTS's objectives support this aim:

- To make it easier to live without the car, or use the car less;
- To reduce the need to travel, especially by car;
- To increase the proportion of journeys made on foot, by cycle by powered two wheelers (PTW) and by public transport;
- To reduce the adverse impacts of travel, including road accidents and environmental damage; and
- To maximise the community role of streets, as places where people can meet, shop, and in appropriate circumstances, children can play.

To ensure that the road, footway and cycle network are of a standard suitable for safe and comfortable movement

The LTS contains targets for air pollution and noise pollution from traffic which will be used to help monitor progress in achieving objectives.

The City Plan for Edinburgh[6] sets out broad aims for the city's environmental policy:

- The promotion of sustainable practices in every sphere;
- The creation of practical alternatives to the private car together with improved accessibility and road safety, enhanced air and water quality, reduced energy use and waste, and an increase in the proportion of 'brownfield' to 'greenfield' land being developed; and
- The maintenance and improvement of the urban environment.

[6] The City of Edinburgh Council (1999) City Plan for Edinburgh.

The City Plan for Edinburgh identifies a number of environmental issues which were raised as part of the process followed by the Lord Provost's Commission on Sustainable Development. A number of the findings of this process have relevance to the environmental context of the city centre and study area for the Edinburgh Tram, including:

- A recognised need to reduce energy consumption and meet internationally agreed targets for carbon dioxide emissions;
- Increasing concern about air quality – particularly nitrogen dioxide levels and particulate emissions;
- Water quality along the Forth Estuary and other waterways is poor and waste water treatment and surface water management needs to be significantly improved; and
- Increased low density, greenfield development around the periphery of Edinburgh, which leads to increasing travel distances and hence unsustainable patterns of activity.

The Commission also identified transportation problems as one of the highest profile issues in Edinburgh at present. Accessibility is a key factor governing future investment decisions by the business sector. The reconciliation between increasing car use with the need to improve accessibility, reduce energy use and improve air quality represents a major challenge.

### 3.2.2 Existing and Potential Environmental Problems

The relevant baseline environmental conditions for each of the environmental sub objectives is summarised in Chapter 7.3 of this report (with additional and supporting information presented in Appendix B). This section on existing and potential problems therefore focuses on particular issues of significance for the environment in the vicinity of the proposed Edinburgh Tram's study area.

In relation to the environmental sub-objectives set out in STAG, the key environmental sub-objective which can be identified as a problem is city centre air quality. This has been specifically identified, since air quality can be related to quantitative standards (air quality objectives) such that exceedences of these standards (or predicted future exceedences) can constitute environmental 'problems'. Air quality is also an issue which receives public and media attention (it is therefore also a 'perceived problem'), particularly in terms of health implications, and one which is very clearly related to issues of city centre traffic growth and congestion in Edinburgh.

As a requirement of Part IV of the Environment Act 1995 local authorities have been required to complete a review and assessment of air quality to determine whether the air quality objectives are likely to be met, and where necessary designate Air Quality Management Areas (AQMAs). The review and assessment of air quality report[7] for Edinburgh recommended that a single AQMA be declared which centres on the New Town and links directly to the other locations in order that an integrated action plan can be prepared.

Edinburgh City Centre has been declared an AQMA on the basis that the nitrogen dioxide objectives for the annual and hourly mean are likely to be exceeded in 2005. Studies in Edinburgh have shown that 88% of nitrogen oxides come from road transport with the remaining 12% coming from domestic heating and Edinburgh International Airport[8].

[7] City of Edinburgh (2001) Stage 3 Review and Assessment of Air Quality. http://www.edinburgh.gov.uk/airquality
[8] Summary Air Quality Action Plan from the Edinburgh City Council Website. http://www.edinburgh.gov.uk/airquality

Road traffic clearly makes the principal contribution to air pollutant emissions in Edinburgh, and the measures included in the proposed Edinburgh City Council Action Plan for the AQMA are directly related to the cause of the problem. These are:

- Reducing the amount of traffic; and
- Easing traffic congestion.

These objectives are clearly relevant to the overall planning objectives for the proposed scheme, which are addressed in detail in Chapter 2 of this report.

Problems relating to other environmental sub-objectives are less straightforward to identify through comparison of existing conditions with objectives and standards. For example, whilst periodic flooding in parts of the Water of Leith is known to be a problem in Edinburgh, the locations where the proposed tram route crosses the watercourse are not flood prone, and the tram has been designed to use existing bridges in these locations (see Section 7.3.3).

The significance of the World Heritage designation of the city centre and its importance as a valued townscape is also a key factor in the environmental appraisal. This is therefore reflected in the appraisal against the appraisal sub-objectives relating to landscape/townscape, visual amenity and cultural heritage. Similarly, the significance of the Roseburn Railway Corridor for urban wildlife and open space/recreation, and of the foreshore at Granton for coastal ecology, is factored into the sub-objectives for biodiversity and landscape/townscape.

### 3.2.3 Environmental Issues and Constraints

No specific environmental uncertainties or constraints have been identified in the STAG appraisal of Edinburgh Tram proposals. However, the extent to which the tram scheme can contribute to reduce environmental adversities (i.e. air pollution) is constrained by other factors such as complementary measures to encourage use of public transport and reduce the demand for road traffic. These measures are part of the City of Edinburgh Council's New Transport Initiative, however in the context of this STAG appraisal of the proposed scheme, they have not been incorporated into the transport assumptions which underpin the predicted traffic flows (and therefore air quality effects) for the operation of the tram.

## 3.3 Transport

### 3.3.1 Public Transport

*Current bus provision*

Within Edinburgh (City of Edinburgh Council), public transport carries more than 100 million passenger journeys per year. The City is served by over 200 local bus services using over 800 buses which call at 2,000 stops. There are 7 railway stations within the City area, and the rail network is important for medium and long distance travel to the city centre. According to the 2001 Census, nearly 28% of all trips to work made in Edinburgh were by bus. Since Edinburgh has one of the highest rates of bus use per person in Britain, public transport is therefore crucial in maintaining the accessibility and economy of the city centre.

Current bus services in North Edinburgh are operated mostly by Lothian Buses, with some run by First Edinburgh in the Silverknowes area. Existing services run predominantly radial through the city centre on a strong grid pattern. As many services cross the city centre, there are problems of

congestion affecting journey times and reliability. In order to try and mitigate the effect this has on bus journey times, bus priority measures have been implemented throughout the city, adding to the existing Greenways strategy. Leith Walk is the principal bus corridor to the north, with seven frequent routes serving the City Centre to Leith section. There are a further four routes on Inverleith Row and three routes on Crewe Road South. All routes operate at high frequencies, with most routes running at 4bph or 6bph. Low floor buses are being introduced on many routes as the fleet is renewed.

Greenways are improving bus travel, especially to and from the city centre, the Gyle area and the airport. An innovative bus priority scheme has been installed on the A90, following a Scottish Office Challenge funding award. Further bus priority projects are under development in the north Edinburgh area as part of the Access to Economic Growth Areas project. Funding is in place for the implementation of this work. The precise design of these projects has not been finalised and consequently it is not yet possible to calculate the scale of benefit that they will provide to bus users.

While this forms an integral part of public transport in Edinburgh there is no measurable net effect on the tram scheme benefits at present. However it is contended that the effects on tram patronage will be within the sensitivity test range.

*Shortfalls with existing provision*

Between 1991 and 2001, the percentage of trips to work by bus in Edinburgh fell from 33.2% to 27.9% (2001 Census). Over the previous two decades, commuting by bus in Edinburgh fell by 39% (City Plan for Edinburgh, 1999). A separate report (Feasibility Study, 2001) claims that bus usage in Edinburgh had the greatest decline registered by the European Local Transport Information Services (ELTIS), with a partial explanation given to the high fares. The growth areas at the Gyle, North Edinburgh and Kinnaird Park are inadequately served from many directions, with journeys by bus to these areas often requiring interchange.

Another study carried out by Oscar Faber (2000) into a public transport strategy for North Edinburgh reviewed existing services and recommended a strategy, with particular reference to the two main developments in the area, Leith and Granton Waterfronts. Amongst the findings of the report was the apparent incoherence of current public transport services in the area. As many services cross the City Centre, there are problems of congestion affecting routes and regularity, as well as the network constraints in the City Centre, which affect services.

It was reported that concerns over the capacity of the current road network were expressed by Lothian Buses, who indicated that there were particular pinch points in the central area through which services ran to and from the North of Edinburgh. It was argued that these points impair their ability to deliver effective service provision to the area in question. These areas are:

- Lothian Road/Prince's Street/Charlotte Square;
- Picardy Place and London Road/Leith Walk roundabouts; and
- George IV Bridge/The Mound/Lawnmarket.

Other areas along the routes were identified as causing problems for the running of service, mainly by lack of capacity and on-street parking.

In the same study, representatives of the Public Transport section of the City of Edinburgh Council commented on the lack of clarity of bus services in the area, with ad-hoc provision being made by operators for new developers, and expressed the general view that the North of Edinburgh is the only part of the city to suffer from a lack of high quality service. The comment was also made that the current road network in North Edinburgh hindered the development of a high quality bus service.

The study mapped accessibility to a set of defined strategic destinations (categorised under travel, education, employment, retail, leisure and health) from four local centres in North Edinburgh, namely Granton, Muirhouse, Newhaven and Leith. The mapping exercise clearly showed the lack of direct services to destinations in the West of the city, notably Haymarket, Gyle, Edinburgh Park, Sighthill and Hermiston Gait, as well as the Airport. This limited accessibility to the west is a recurring theme in several studies carried out on transport in the North Edinburgh area, and has implications for access to employment and social inclusion.

The report on the North Edinburgh public transport strategy recommended new and improved public transport services to and from North Edinburgh, as well as within, in the short to medium term. The strategic links (which should be aligned with the development areas) forming the core of the strategy were identified as the "Roseburn Link", utilising the Southern Access Road and the former railway solum via Haymarket, and from Newhaven and Leith to the City Centre.

In a review of the North Edinburgh Public Transport Strategy, Colin Buchanan and Partners suggested that new direct public transport services from Granton to the Gyle, Edinburgh Park and the airport should be considered, as the strategy produced by Oscar Faber appeared to focus mainly on improved links to and from the City Centre, and on east-west corridors. The same review emphasised certain issues in connection with the North Edinburgh Public Transport Strategy, such as the need to meet an incremental build-up of demand for public transport as a result of the development in North Edinburgh, by phasing additional capacity. The review agreed that a segregated public transport corridor would be required in the long-term.

### 3.3.2 Private Transport

*Highway network*

The principal routes into the city centre comprise the A8 Corstorphine Road and A90 Queensferry Road from the west and the A900 Leith Walk from the east. The principal east – west route is the A902 Ferry Road. The A903 and A901 provide access to the Forth shoreline area; the latter also provides an alternative east – west route serving Leith Docks. A new Southern Approach Road, constructed on the alignment of the former railway solum to Granton Harbour, was recently completed to serve the Granton development area. In general, the roads in the area are predominantly single carriageways with frontage development.

*Car demand and congestion*

Combined with frequent junctions and access points, travel speeds are typical of such dense urban areas, with low speeds and congestion during the peaks. During the 1980's and 1990's, commuting into Edinburgh by car rose by 53%, with traffic volumes increasing, for instance by 52% on the A8 at Gogar and by 31% at Barnton in the ten years to 1995 (City Plan for Edinburgh, 1999). However, peak hour traffic into the City Centre has remained static in recent years. In essence, traffic growth has occurred both spatially and temporally where there has been the available capacity to do so and reflects the impacts of capacity limitations and restrictions on growth in car use to the city centre and increasing car ownership and economic dispersal outwith the centre.

Between Leith Walk and Queensferry Road, the crossings of the Water of Leigh act as pinch points to north-south traffic. North-south traffic has to cross or use in part a number of heavily trafficked east-west routes. The area experiences significant rat running, with many alternative routes along roads often unsuitable for heavy volumes of traffic.

Forecast trends in traffic and congestion point to an overall growth in traffic levels by 20% over the 20 years 2001 – 2021, while time lost in traffic due to congestion almost doubles. All areas of the city are expected to suffer from worsened traffic congestion (Transport Initiatives Edinburgh, 2002). Of this

growth, the largest impacts will be concentrated on those areas of highest growth, and consequently the highest congestion increases are expected to be on the strategic routes serving the areas of major economic activity around the city: West Edinburgh, the Waterfront, the South East Wedge and the city centre. Such increases in congestion will have commensurate effects on bus journey time and reliability.

## 3.4 Opportunities

In addition to addressing the socio-economic, environmental and transport problems of Edinburgh (in particular in the Northern area), as described in the previous sections, a rapid transit scheme through North Edinburgh can also contribute to the fulfilment of the opportunities that exist.

The biggest opportunity is the redevelopment of the Granton and Leith dock areas. Whilst substantial development has already taken place, notably at Leith, the overall aspirations for these areas are very considerable, as set out in Table 3.1.

**Table 3.1 Waterfront Planning Aspirations**

| Floorspace type | Granton | Leith |
|---|---|---|
| Residential | 8,900 units | 5,700 units |
| Office | 217,000 $m^2$ | 222,000 $m^2$ |
| Retail | 18,000 $m^2$ | 92,000 $m^2$ (including Ocean Terminal) |

Comprehensive urban and economic regeneration is expected to arise together with this level of development. Although this development will take some time to complete (possibly a decade or more), there is a unique opportunity to integrate it with the development and implementation of new transport links to the City Centre and beyond. This will support the redevelopment and, more importantly from a transport viewpoint, help influence the transport and wider 'lifestyle' choices of the residents, employers and employees from the outset.

# 4 Option Generation, Sifting and Development

## 4.1 Development Process

The current framework for the development and implementation of transport schemes is founded on two complementary elements: the definition of objectives for the transport system (at local, regional and national levels, as described in Chapter 2), and an associated analysis of transport problems and opportunities (as described in Chapter 3). A key aim of this approach is to develop the scheme most suited to addressing the problems and opportunities and satisfying the objectives set for the transport system, rather than develop a scheme looking for a problem. On this basis, it is important to set out the process through which the proposed scheme was developed to demonstrate that this approach has been adhered to.

The purpose of this chapter therefore is to trace the development of the preferred scheme presented in this STAG appraisal – in effect an audit trail of the scheme development. In broad terms, the key stages in the development of the scheme can be defined as:

- Initial feasibility study, leading to the Outline Business Case, with recommendations on the development of a preferred alignment using tram technology;
- Review of the initial feasibility study and confirmation of the preferred route and sub-options;
- Further option development and sifting; and
- Confirmation of the options to be carried forward to consultation and STAG2.

## 4.2 Feasibility Study

As previously stated, the 'Northern Loop' (or Line 1), was originally conceived through the feasibility study undertaken for Waterfront Edinburgh Limited, which was led by a Steering Group that involved the City Council. This study was charged with the task of considering the feasibility of a rapid transit scheme linking the Waterfront development sites in North Edinburgh (at Granton and Leith) with the City Centre. The objectives of the study were:

- To establish the economics of a comprehensive public transport solution connecting the Waterfront project site with the City Centre, considering all practicable modes of transport and combinations of modes;
- To recommend an appropriate procurement route; and
- To develop and outline business case supporting the recommendations

The study and report were developed in accordance with The Scottish Executive Guidance for Public Transport Fund bids and the draft STAG. In that context, the study:

- Reviewed the transport and land use policies, aims and objectives for Edinburgh and the wider environs;
- Set out existing problems in North Edinburgh;
- Developed a set of options to address the objectives and problems and undertook outline appraisal of each;

- Consulted with stakeholders (including CEC, local community groups and businesses);
- Define a Preferred option, with more detailed appraisal; and
- Considered the financial, procurement and risk transfer options.

### 4.2.1 Option Development and Sifting

The feasibility study and the Outline Business Case (OBC) considered a range of issues, including:

- Technology options;
- Alignment and route options;
- Demand and revenue forecasting; and
- Option appraisal and sifting to derive a Preferred Option.

*Technology options*

A range of technologies were considered, from bus based systems (including 'quality bus' and guided bus), rail based systems, and through to more specialist guideway systems (such as monorail or cable based systems). A two-stage process was adopted to determine the best option. Firstly, a broadly qualitative assessment on the strengths, weaknesses, opportunities and threats (SWOT analysis) of each technology was undertaken, followed by a more detailed analysis taking cognisance of the local topography, scheme development and general 'implementability' of the options.

The first stage assessment narrowed the options set down to a core of guided bus (with several guidance system options) and light rail. It demonstrated that a 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. However, while covering operating costs from revenue, the guided bus 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.

*Alignment and route options*

Adopting the option set of technologies defined previously, the next stage was to consider the alignment options available to serve the north Edinburgh area from the City Centre. The development of the study led to the identification of three route scenarios (which can be viewed in Figure 1.1), namely:

- Scenario 1 – Granton to Haymarket;
- Scenario 2 – Granton to St. Andrews Square via Haymarket; and
- Scenario 3 – The Northern Loop (Line 1).

Within this framework, the process of route development considered the technical, operational, patronage, financial and other issues associated with the implementation of a rapid transit system in an urban area in order to define possible alignments. This process derived a total of 24 route sections, which in various combinations satisfied the scheme objectives of serving north Edinburgh. These sections were appraised at a qualitative level, notably at a technical level, leading to a sub-set of

options for further consideration. In essence they combined to form a single loop, running south from Granton on the former railway solum to Haymarket, on street along Shandwick Place, Princes Street, St. Andrews Square, Leith Walk and into Leith Docks and then returning to Granton via Newhaven and Lower Granton Road. This alignment was then considered further in terms of the three route scenarios noted above.

*Demand and revenue forecasting*

To inform the option development process, a demand and revenue model was developed. This was based on a cordoned version of the CSTM3 PT assignment model with the addition of bespoke mode split and demand forecasting tools. Demand was split into background and Waterfront development related demand. Background demand was based on the 2006 CSTM3 Do-Minimum forecast, whilst development related demand was based on the application of trip rates and a mode split model to the development aspirations of the Waterfront companies for the years 2006, 2011 and 2016. Table 4.1 summarises the annual patronage for the three route options, considering guided bus and light rail technologies, considering the development related demand in 2011.

**Table 4.1 Results of Demand Forecast**

| Route | Technology | Annual Demand (2011) |
|---|---|---|
| 1 – Granton to Haymarket | Guided bus | 1.47m |
| | Light rail | 2.28m |
| 2 – Granton to St. Andrews Sq. | Guided bus | 3.31m |
| | Light rail | 5.45m |
| 3 – Northern Loop | Guided bus | 9.33m |
| | Light rail | 20.04m |

Source: Waterfront Transit: Modelling Report (2001); Appendix 6 of the Feasibility Study Appendices Report.

It can be seen that the Northern Loop (Line 1) has by far the largest patronage, in comparison to the other route options, and that the light rail option consistently attracts more travellers in comparison with the guided bus. The other two light rail options examined are not considered to be financially viable. Guided bus alternatives also have a poor financial case and bring benefits which are at a much smaller scale to those that light rail can achieve.

### 4.2.2 Appraisal

The appraisal of the three route scenarios was then made within the context of technical, operational, patronage, cost and integration issues. This process resulted in the Preferred Option being the full Northern loop using LRT technology, generating revenue streams attractive to potential operators. In addition, the Preferred Option was considered to address the key planning objectives and to have the highest potential to contribute to resolve some of the local transport and economic problems.

A preliminary STAG appraisal of the Preferred Route was presented as part of the OBC. (Note that the draft STAG guidance was issued in July 2001, contemporaneously with the OBC. The appraisal contained within the OBC was therefore undertaken in accordance with STAG; however, strictly speaking it is not a STAG1 appraisal). This is summarised in Table 4.2 (note that the structure and layout follows the draft STAG guidance and may differ from the full guidance issued in September 2003). The key outcomes were:

- The Light Rail Transit (LRT) system on the Northern Loop offers greatest benefits;

- The preliminary economic indicators were:
  - Net present value at £275 million;
  - Benefit:Cost ratio at 2.6:1; and
  - Internal rate of return at 10.1%.
- The scheme was considered to fit with the Local Transport Strategy 2004-2007 and Steering Group objectives:
  - Transport objectives: travel time and ride quality benefits for travellers transferring from car and bus, as well as decongestion benefits for remaining road users;
  - Local economy: developments at Granton are partially dependent on the implementation of the scheme and some 6,700 new jobs are estimated to arise as a result of the scheme in the regeneration area; and
  - Environment: key issues include potential negative impacts on built heritage of Princes Street, visual intrusion form overhead power supply, reduction in emissions and disruption to pedestrians and cyclists along the Roseburn corridor.

Following completion of the OBC, the City of Edinburgh Council concluded that the Northern Loop (Line 1) should progress in line with their Local Transport Strategy 2004-2007. The OBC, containing a preliminary STAG appraisal, was submitted to and accepted by the Scottish Executive and funding subsequently made available for the project development to STAG2.

## 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**<br>• **Capital (undiscounted)**<br>• **Annual** | Estimated costs<br>• £191 million<br>• £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]:<br>• to improve safety for all road and transport users;<br>• to reduce the environmental impacts of travel;<br>• to support the local economy;<br>• to promote better health and fitness;<br>• to enhance social inclusion;<br>• 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.<br>Supported by the principal aim of the Waterfront Granton Master Plan[10]:<br>• 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).<br>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:<br>• Scenario 1 – Granton to Haymarket via the Roseburn link.<br>• Scenario 2 – Granton to St Andrew's Square, via Haymarket, Prince's Street and Waverley.<br>• 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.<br>In the earlier SESTRAN study, alternative means of facilitating good links to the Waterfront/Granton development considered were[12]:<br>• North Suburban Rail Link<br>• North Edinburgh CERT<br>• Upgrades to bus services (frequencies and start/finish times) and priorities (lanes, selective vehicle detection)<br>• Improvements to cycle access and parking<br>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:<br>• Scenario 1 – operating costs are not covered by revenue streams;<br>• 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<br>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:<br>**Scheme** **Rank**<br>• 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<br>• Upgrades to bus services 18, 40 46, etc[13]<br>• Improvements to cycle access and parking 13<br>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.<br>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.<br>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.<br>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:<br>• Has a strong financial case;<br>• Brings economic benefits to a wide area;<br>• Goes towards meeting the planning objectives of the Edinburgh LTS; and<br>• Will help contribute to the regeneration of Leith and Granton waterfronts.<br>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:<br>• Major Issues Paper (preparation for replacement of the Lothian Structure Plan 1994)<br>• West Edinburgh Local Plan (consultation draft as at 27/3/01)<br>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.<br>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:<br>• Sustainable Development<br>• Regeneration and Equality<br>• Quality<br>• Diversity and Identity<br>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.<br>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:<br>• 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.<br>• To minimise the incentive to use the car, particularly in areas where the direct adverse impacts of this are most severe.<br>• To minimise the transport and parking impacts of new developments on neighbouring areas/people and the environment.<br>• To ensure that development takes account of user and community safety, having regard in particular to vulnerable groups such as children and cyclists.<br>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

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| 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.<br>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:<br>• 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;<br>• The scheme will link residents to the substantial amenities planned for the Waterfront as well as those already existing in Edinburgh at large.<br>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:<br>• Maintaining patronage – lack of flexibility with light rail; need to develop alignment, at considerable cost, if patronage changes.<br>• 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.<br>• 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.<br>• 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.<br>• Influence upon 'Greenways' and conflict with existing bus operations.<br>• Impact of service diversions – accurate cost estimates not possible for OBC.<br>• 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.<br>• Possibility that the Waterfront/Granton Masterplan fails to deliver all that is promised of it and expected patronage and social benefits do not materialise.<br>• Demand fails to transfer elsewhere on the route for other reasons (e.g. change of travel patterns, changes in wider transport policy). |

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| 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.<br><br>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.<br>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.<br>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. |

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| 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.<br>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.<br>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.<br>Impacts on water quality, drainage and flood defence is likely to be negligible.<br>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.<br>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.<br>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.<br>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.<br>The nature of ticketing remains to be established but this too could aid the integration of transport options within the SESTRAN region. | |

## 4.3 Review of OBC and Confirmation of Preferred Options

The initial exercise of the project development was to review the OBC, to confirm the selection of the Preferred Route and to define the options available within this route. This was undertaken in a staged process:

- Review and sifting of all the possible route links;
- Aggregate the sifted links into coherent and sensible complete routes for further development and appraisal; and
- Identify a preferred route with any possible options.

### 4.3.1 Sifting of Route Links

For the sifting of route links, a process akin to that employed in the OBC was initiated. All possible links were identified, including all those identified at OBC. New links added to that from those considered at OBC included Easter Road, Leith Street and Telford Road. For the purposes of sifting, a more formal approach was employed to that in the OBC. This process drew from the preliminary appraisal in the OBC and considered the links under four criteria:

- Technical implementability;
- Economy;
- Transport; and
- Environment.

These criteria differ from (but are consistent with) the planning objectives in that they are broader, include the issue of implementability and do not take account of safety and social aspects (which are less tangible and offer less opportunity for comparisons between options to be made).

Under each of these four criteria, a qualitative assessment was made of each link and a score attached (between –3 for large adverse impact to +3 for large beneficial impact). Using weightings, these scores were then aggregated for each link to give a total score used to rank the links.

### 4.3.2 Route Options

The next stage was to aggregate the best performing links into sensible sequences to establish route options for testing. This process was undertaken to identify those options sufficiently different to be distinguishable in the demand model and in wider appraisal terms and which differed on one particular section of the route so that the effect of each route variation could be isolated. The options therefore developed for further appraisal were as follows:

- Option 1: OBC route;
- Option 2: Crewe Road;
- Option 3: Easter Road; and
- Option 4: Junction Street.

These four options were appraised using a simplified version of the STAG2 appraisal table which retained the key elements of the appraisal, namely appraisal against the planning objectives and the

government five objectives (using a sub-set of sub-objectives commensurate with the level of appraisal and available information). This appraisal process was supported by running the demand model developed at OBC for the options.

Following the completion of the ASTs, analysis was undertaken to determine the Preferred Option, based on a comparison of scores by sub-objective. This demonstrated the best performing option was Option 1, with Option 3: Easter Road performing slightly worse. Options 2 and 4 performed demonstrably worse.

### 4.3.3 Preferred Route and Options

The process described above reconfirmed the OBC route as the best performing option for a Northern Loop LRT system. However, this was based on a broad analysis of the route options available, rather than a detailed assessment of all possible variants within the routes; in effect, the potential corridor had been identified and appraised rather than the detailed alignment at every section. On that basis, a number of variants were identified within the Preferred Route where the development of the Loop was not sufficiently advanced to demonstrate a clear preference. These were as follows:

- **Haymarket** – where the exact route from the street running section to the former railway solum was not determined, in part because of issues surrounding frontage servicing, traffic and heavy rail interfaces;
- **George Street / Princes Street** – where public realm and consultative issues were felt to be paramount;
- **Former railway solum / Telford Road** – where the proximity of the alignments counted against a robust case for either in patronage terms and where a key issue is the possible accessibility benefit in running close to the Western General Hospital; and
- **Easter Road** – as an alternative to Leith Walk and where the work to date did not yield any clear argument.

## 4.4 Further Option Development and Sifting

The next stage of scheme development focused on further development of the Preferred Route and variants therein. Whilst technical development and consultation with stakeholders was progressed on the George Street/Princes Street and former railway solum/Telford Road variants, the final choice was left open until the end of the public consultation period to accommodate and take cognisance of the feedback from the public.

Following further technical development of the Easter Road and Leith Walk variants, the former was discounted at an early stage on engineering grounds. The technical development at Haymarket has continued, but is focused on determining a feasible alignment through this area, rather than the route choices per se.

## 4.5 Option for Consultation and STAG2 Appraisal

Given the above, the option taken forward for public consultation and STAG2 appraisal was the light rail technology option along the Preferred Route (the Northern Loop), with variants at George Street/Princes Street and former railway solum/Telford Road.

# 5 Consultation

## 5.1 Objectives and Process

Extensive consultation has been undertaken in respect of the Edinburgh Tram network. **tie** has appointed a specialist advisor, Weber Shandwick, to develop and implement an overall strategy for public relations and communications, including for example, the organisation, monitoring and reporting of a major public consultation exercise carried out covering both Lines 1 and 2. In addition, there has been wide-ranging consultation with the client group (**tie** and CEC) and with major stakeholders affected by one or both Lines. The consultations sought the views and comments on several route options presented by the advisors. This Chapter provides an overview of the consultation process and summarises the principal findings.

STAG sets out the requirements and the benefits of participation and consultation as well as providing details on scope and methods for this work. The strategy for participation and consultation should have the following attributes:

- Be open so that those taking part understand the process and can see how their views are being taken into account;
- Start as early as possible in the planning exercise and continue throughout to maximise ownership;
- Involve stakeholders both in the identification of problems and the development of solutions; and
- Provide feedback to contributors wherever possible.

The main objectives of the consultations were to inform stakeholders about the proposals, and to allow stakeholders to express their views on the proposals and therefore contribute to the assessment and preparation of final route designs. The consultation process also aimed to raise awareness, interest and understanding of the proposals amongst stakeholders, and build support where possible. In addition, the consultation process enabled any misconceptions and negative perceptions amongst stakeholders and the wider public to be addressed.

An early demarcation was drawn between public consultation and other consultation. The 'other' consultation became generally known as 'stakeholder' consultation and a simple definition of a 'stakeholder' is a person or organisation that has an interest in the project proposals other than as a member of the public.

The stakeholder consultation undertaken for Line 1 by the consultant team involved a variety of methods and actions. In the first instance the team collectively reviewed the range of stakeholders and placed them into the following broad categories:

- Statutory;
- Council;
- Environmental;
- Heritage;
- Transport;
- Community;

- Business;
- Public Utility;
- Emergency Services;
- Disability; and
- A further category of 'technical' consultees was identified though this is strictly not a stakeholder category.

Several of the consultants within the team were allocated categories of stakeholder with whom they consulted. This was generally arranged taking account of the consultant's discipline and role in the team. A full list of these consultees is provided in Appendix D1. The consultations commenced in September 2002.

The consultations were undertaken by letter, telephone or meetings and often by a combination of these. They were followed up by notes of meetings and issues brought to the consultant team. The basis for discussion at a consultation meeting was a Technical Briefing Note. The Technical Briefing Note, revision D, is provided at Appendix D2. From May 2003 onwards the tramtime leaflet prepared for public consultation superseded the Technical Briefing Note.

As noted above, the consultation strategy is to provide feedback to consultees where possible. This was achieved in a number of ways. When questions were asked at the public exhibitions these were answered directly by the professional advisers present at the time. For some stakeholder consultees, several meetings were held to clarify issues, exchange views and report back changes to the scheme to accommodate concerns. Consultation with other groups began with meetings and a dialogue is expected to continue as the project progresses. Specific questions raised through correspondence and web-site enquiries have been answered in like fashion.

Many consultees expressed views but did not raise issues requiring a response.

## 5.2 Public Consultation

### 5.2.1 Methodology

A number of methods were used to raise awareness of the consultation and to involve the stakeholders and the wider public in the process, and these are summarised below:

- Media launch – Media representatives were briefed at an official consultation launch;
- Leaflets – A leaflet was produced containing information on the proposals and the timetable for exhibitions and public meetings. The leaflet also included route maps and a self-completion questionnaire;
- Website – A dedicated website was set up and this included background information and the questionnaire, in addition to downloadable maps and documents and hyperlinks to other sites of interest. The website was promoted through the media;
- Freefone number – This was advertised in the local press, and was available to those who wished to request a consultation leaflet or further information on proposals and / or the consultation process;
- Consultation with Political Representatives and Community Organisations – MPs, MSPs and community council representatives were sent leaflets and a letter from **tie**'s

Chief Executive. These parties were invited to one of two events to discuss the proposals, and **tie** made representations or presentations at community council meetings, which were also open to the general public;

- Exhibitions – A static exhibition was erected in the City Centre from 21 May 2003 to 25 June 2003 and was manned by staff from Weber Shandwick, Mott MacDonald and Faber Maunsell. In addition, a number of touring exhibitions were arranged at venues adjacent to the proposed tram route, and were also manned by staff from Weber Shandwick, Mott MacDonald and Faber Maunsell. The exhibitions provided detailed information on the proposals and an opportunity for the public to make comments. Comment books were available at all exhibitions and leaflets were distributed; and
- Public meetings – Public meetings were held at venues along the route. All public meetings and exhibitions were advertised in a prominent position (page 3) in the Evening News during the first week of the consultation. Radio advertising supported the public meetings, and additional publicity was achieved via press coverage at the consultation launch. Members of the public could respond to the consultation in the following ways:
  - Returning the pre-paid response slip from the leaflet or filling in the on-line response form;
  - Writing to the Freepost address or by e-mail;
  - Calling a Free-phone number; and
  - Attending an exhibition or public meeting.

### 5.2.2 Coverage and Response

The level of coverage and response rate to each stage of the consultation is described below.

- 107,000 leaflets were mailed directly to households and businesses in the vicinity of the tram;
- 9,100 leaflets were distributed to libraries, supermarkets, shopping centres and public buildings;
- 5,000 leaflets were distributed via exhibitions and public meetings;
- 450 leaflets were mailed directly to individuals on request;
- All businesses in the city centre, other major businesses, and third party groups were sent a leaflet, and additional leaflets were sent to city centre businesses on request;
- 676 people in total attended the public meetings (seven meetings); and a total of 67 people attended the wider stakeholder meetings;
- The website was the most popular means of information access, gaining between 30,000-50,000 hits per week;
- The overall number of responses received prior to the end of the consultation was 3,023. There were 74 duplications leaving the number of responses as 2,949. These were distributed as follows:
  - 1,929 of responses were received via the leaflet questionnaire;
  - 481 responses were received through the online response form on the website; and

- The remaining 539 were received by letter, email, phone, comment book, comment cards, and at exhibitions.

### 5.2.3 Main Findings

Overall, 84% support the concept of the tram in Edinburgh.

The public consultation has disseminated information on the tram proposals in a comprehensive manner. Responses to this process have provided useful and important feedback. They have:

- Identified route option preferences on Lines 1 and 2;
- Gained public majority support for proposed stop locations;
- Enabled views, opinions and concerns to be expressed and recorded on a wide range of issues such as:
  - Property concerns, proximity and noise;
  - Disruption;
  - Wildlife;
  - Visual intrusion; and
  - Impacts on traffic and parking.

These are addressed in more detail in the PR consultant's reports and in this report where appropriate.

## 5.3 Stakeholder Consultation

A database of stakeholder organisations was compiled by Weber Shandwick. These stakeholder organisations were sent leaflets with a covering letter from **tie**'s Chief Executive inviting comments, and key organisations were invited to one of two meetings.

For Line 1, this part of the consultation was subdivided into groups of consultees to be dealt with by different members of the Line1 team according to their discipline. The broad groupings are described below with explanation as to the nature of the consultation.

### 5.3.1 Client Group

The Client Group is the City of Edinburgh Council (CEC) Transport and Planning divisions and **tie**.

CEC established **tie** as a separate entity from the council charged with responsibility for delivery of Integrated Transport Initiative (ITI). **tie** is responsible for the implementation of council's policies and delivery of projects, however CEC still maintains responsibility for development of policy.

Regular meetings and communications with the client group have been undertaken. Meetings have included Steering Group consultations and monthly progress meetings with **tie**. Further meetings with CEC Transport and Planning divisions and the Scottish Executive on an 'as required' basis have been held.

### 5.3.2 Business

The business consultees included several large individual employers, such as BAE Systems and State Street at Crewe Toll and business organisations, such as the Edinburgh and Leith Chambers of Commerce, the Federation of Small Businesses and Princes Street and George Street Associations.

The Western General Hospital and Telford College were also included under the broad umbrella of businesses in as much as they have large numbers of employees as well as students and visitors.

### 5.3.3 Council and Communities

Some initial contact was made by telephone and letter to Councillors and Community Councils prior to the public consultation. However, it was agreed that these should properly fall within the public consultation and they were not pursued as stakeholders.

### 5.3.4 Environment

The environmental consultation has been a major exercise and a significant part of the overall consultation programme. This is necessary to inform the environmental appraisal for STAG2 and the Environmental Impact Assessment (EIA) in conformity with STAG and EIA guidance.

Consultation with statutory and non-statutory organisations is an important part of the environmental appraisal process. Environmental consultation followed a number of stages as follows:

- Initial letters to key environmental consultees briefly setting out the proposals for Line 1, and seeking both information on environmental conditions and an early response from each consultee on the key impacts and issues for the assessment;
- The response to the initial consultation was used to feed into an Environmental Scoping Report which set out in more detail an initial environmental appraisal of the tram scheme; and
- The Environmental Scoping Report was then issued to all environmental consultees with a letter requesting more detailed comment on the environment impacts of the scheme.

The organisations consulted during the environmental appraisal process are listed in Appendix D1.

The project team then held further discussions and meetings with several of the above consultees in order to understand their views, discuss assessment methods, identify all the key environmental and development issues, obtain baseline information on the area and help evolve mitigation measures.

In addition, due to the importance of Edinburgh city centre for townscape and heritage (as recognised through its World Heritage status), a working group was convened with a number of consultees to specifically discuss aspects of design of the tram. This group includes representatives from **tie** and its advisors, the City of Edinburgh Council, Historic Scotland, and the Edinburgh World Heritage Trust. Consultation with these organisations identified a number of key issues for the appraisal which are summarised in Section 5.4 below.

Environmental issues were also raised during the programme of public consultation, through both the feedback forms provided by the public and through questions raised at public meetings and presentations. These issues generally were similar to those within the scope of the environmental

appraisal, but reinforced the need for consideration of effects of the tram on communities and natural habitats in particular.

### 5.3.5 Statutory

The statutory bodies consulted are recorded in Appendix D1. They include the City of Edinburgh Council, the Scottish Executive and several National Bodies.

### 5.3.6 Transport

This heading is used to gather a range of interested parties related to transport. These include over-arching groups such as The Freight Transport Association and The Road Haulage Association but also include local interests such as bus and taxi operators.

Regular meetings have been held with Network Rail throughout development of the project.

### 5.3.7 Public Utilities and Technical Consultees

As well as consulting the Public Utilities about plant which could be affected by the tram line construction and operation, there are other technical consultees who have provided input to the design process. An important group in this context is the 'Traffic Interface Group' which incorporates CEC representatives from Transport Planning, Network Services and Strategic Services. This group has regular meetings with the Line 1 team to consider proposed on-street designs for implementing the tram, particularly at road junctions.

The Line 1 team has also had regular contact with the Line 2 team to discuss methodology and exchange information.

### 5.3.8 Other Groups

There are a small number of other consultees that do not fall within the categories already described. These include: Heritage, Disability and Emergency Services.

## 5.4 Key Issues Raised

### 5.4.1 Public Consultation

Two main types of issues were raised: those related to the route and other concerns. Public opinion on route options was sought for two parts of the Line 1 route. These were:

- Princes Street/George Street – Princes Street was supported by 66% of respondents. Responses highlighted that Princes Street offered the best balance between accessibility for the public, visual impact and commercial gain for city centre businesses and tourist attractions. Concerns were expressed about the environmental and heritage impact if George Street and Charlotte Square were to be used.
- Telford Road/Former railway solum – Responses from the public within the zone of influence of the route options favoured the former railway solum along the Roseburn

corridor. When taking into account all parties, the picture switched in favour of Telford Road, particularly because of the cycle groups, who are concerned that there may be an adverse effect on the cycleway if the former railway solum was used for the tram route. Notwithstanding, there was strong support for the former railway solum as a means of segregating trams from traffic and lessening congestion in the Telford Road area.

With regard to proposed stops on Line 1, 83% of the respondents considered them to be well placed and convenient, whereas, 17% considered them to be too few in number and not well placed.

Lower Granton Road attracted comment, in particular, concern about existing traffic problems and the plan for road realignment. A desire was expressed to relocate the tram from this section.

Trinity Crescent and Starbank Road also emerged as sections causing concern about width of carriageway, conflict with traffic and loss of parking.

On Leith Walk and Constitution Street concerns were expressed about impact of the tram on bus services and about traffic management generally.

The use of the Roseburn to Crewe Toll railway corridor was noted as impacting on wildlife, conflicting with cycling, having safety risks (of cyclists beside trams), impacting on adjoining housing.

Expressions of support came forward for Granton Road/Ferry Road/Great Junction Street/Trinity Railway corridor to Lindsay Road as an alternative to the proposed route. Some of these arose in conjunction with the opposition to the use of West Granton Road and Starbank Road.

Other matters raised and recorded by respondents to the public consultation were proximity to properties, disruption, design and visual impact, the use of alternative formats, congestion, environment, cycling, noise and safety. Numerically these other topics gave rise to far fewer comments than the specific route option issues.

### 5.4.2 Stakeholder Consultation

*Environmental consultation*

Table 5.1 summarises the key issues raised during the environmental consultation.

**Table 5.1 Summary of Issues from Environmental Consultation**

| Environment Sub-Objective | Issues Raised through Consultation |
|---|---|
| Noise and Vibration | Variation in noise levels during the day depending on road traffic flows; noise from depot sites to be considered. |
| Air Quality | Air Quality Management Area (AQMA) designated in city centre due to predicted future exceedences of nitrogen dioxide levels. |
| Water Quality, Drainage & Flood Defence | Water of Leith designated as salmonid water of high amenity; measures needed to contain contaminated run-off during construction and operation; Sustainable Urban Drainage Systems (SUDS) measures should be considered. |
| Geology | Presence of geological SSSI at Wardie Shaw |
| Biodiversity | Appropriate assessment of potential works to seawall at Trinity Crescent required by SNH due to impacts on Firth of Forth SSSI/SPA; Roseburn corridor an important habitat for animals including protected species and scheme impacts are significant (and |

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| | habitat compensation is important). |
| Landscape and Visual Amenity | Sensitivity of World Heritage Site, Conservation Areas and other monuments to townscape and visual changes; impacts on key views throughout the city to be considered. |
| Agriculture and Soils | Potentially contaminated areas of land identified along the route corridor; no agricultural issues raised. |
| Cultural Heritage | Greater archaeological sensitivity in the coastal and Forth port areas; important archaeological areas east of Constitution Street. |

*Transport consultation*

With regard to transport-related consultees, the following issues arose:

- There is a need to ensure that tram operation will not adversely affect servicing and deliveries to businesses;
- Bus operators have been consulted about alignment issues and subsequently about participation in tram operation. The latter will be dealt with in the appointment of an operator;
- Taxi operator representatives did not see the tram as a threat to their business. However, they did express concern about traffic disruption during construction and the prospect of poor road surfaces at that time;
- The west side of the loop, Roseburn to Granton will provide a welcome new public transport link which is not available at present; and
- Network Rail generally approve of the principle of the Tram Lines. However, the interchange facility created by development opportunities at Haymarket Station was a specific concern that will need to be addressed. Discussions with NR are ongoing.

*Other consultation*

The preceding comments all arose from discussions in which general support was expressed for the tram proposals. Other notable comments follow that are not related to any specific group of consultees:

- Several consultees asked that integrated tickets should be available for bus and tram travel;
- Tickets should be made available through shops;
- The tram is beneficial for the operation of the new Telford College campus;
- Stop locations require fine tuning;
- There is a risk of dividing old and new Leith;
- Land take at Haymarket should be reduced;
- Timespan to implement. It should be as soon as possible;
- Design compatibility required with proposed developments;
- Urban design particularly in the city centre;
- City archaeology will maintain a watching brief;
- Alignment, safety and vehicle access all under scrutiny by the emergency services;

- Whether the proposals will integrate with the CETM proposals; and
- Information will be required on construction and operation to inform further response.

### 5.4.3 Overall

The consultation process has informed major stakeholders and the residents of Edinburgh about the proposals to introduce trams to Edinburgh, and it has provided the opportunity to comment in a variety of ways.

The results of the consultation show that there is broad support in Edinburgh for the tram. The considerable level of support is, however, punctuated by a range of concerns. The main concerns are in relation to the impact trams will have on properties in close proximity to the route and the requirement for CPOs in certain areas. Other concerns related to the disruption caused by the construction of the tram infrastructure, the environmental impact and destruction of local wildlife, and the impact of the tram on local traffic and parking.

The consultation is in conformity with the strategy outlined in STAG and noted here in Section 5.1.

The consultation process resulted in Princes Street being chosen over George Street and the former railway solum being chosen over Telford Road, completing the selection of the preferred route.

# 6 Scheme Description

## 6.1 Route

### 6.1.1 Background

The proposed route (shown blue) and options (shown red) are detailed in Figure 1.1. In summary, the preferred route comprises:

- 15.5 km of Double Track infrastructure (single track at St Andrews Square);
- 58% off street; and
- 22 proposed stop locations. (See also sections 7.2.1 & 7.2.2)

### 6.1.2 Extent of Segregation and Shared Running

Wherever possible a segregated alignment has been proposed (where the tram operates on dedicated tramway or tramroad) such that the system can maintain speed and frequency and reliability of service without interference to and from other traffic.

The proposed Edinburgh Tram Line 1 is approximately 15.5 km long in both directions of which 58% is off street segregated (9.0 km) and 42% (6.5 km) is on street running. Of the on street running section 23% (1.5 km) is segregated, 35% (2.3 km) is joint running and 42% (2.7 km) is public transport corridor (tram/bus lanes). Therefore, of the 15.5 km route a total of 68% (10.5 km) is entirely segregated from traffic, 15% (2.3 km) is joint running and 17% (2.7 km) is public transport corridor

The alignment is effectively double track, clockwise and anti-clockwise running, throughout its length, with the exception of the one way loop at St. Andrews Square (approximately 520m long).

### 6.1.3 Junction Re-prioritisation

To maintain the level of service throughout on-street sections, it is proposed that associated junctions are remodelled with revised signal priority applied where appropriate (with the agreement of the City of Edinburgh Council), including (but not limited to) the following key junctions:

*Granton – Haymarket Section*

- West Granton / Southern Approach Road
- Southern Approach Road / Ferry Road
- Haymarket Yards / Haymarket Terrace
- Haymarket Terrace / Dalry Road/ Morrison Street / West Maitland Street / Grosvenor Street

*Haymarket – York Place*

- West Maitland Street / Palmerston Place / Torphichen Street
- Shandwick Place / Rutland Street / Lothian Road

- Princes Street / South Charlotte Street
- Princes Street / The Mound / Hanover Street
- North St. David's Street / Queen Street / York Place / North St. Andrew's Street
- St. Andrew's Square North
- St. Andrew's Square South
- South St. David's Street / Princes Street / South St. Andrew's Street
- Picardy Place / Broughton Street / York Place / Leith Street / Leith Walk

*Leith Walk – Granton Section*

- Leith Walk / London Road / Elm Row
- Leith Walk / Duke Street / Great Junction Street / Constitution Street
- Constitution Street / Bernard Street / Baltic Street
- Newhaven Place / Pier Road / Lindsay Road
- Pier Place / Starbank Road / Craighall Road
- Trinity Crescent / Lower Granton Road
- West Harbour Road / West Granton Road

Further re-signalling and new signalling is proposed at other locations around the route, to promote road safety and the requirements of Her Majesty's Railway Inspectorate.

### 6.1.4 Route Alignment Parameters

The proposed route takes account of the following design parameters and constraints:

- Topography – based upon the updated OS 1:1250 mapping provided as at October 2003 and topographical survey work undertaken specifically for the scheme during Autumn 2003;
- Vehicle parameters – the ability of the proposed light rail vehicle to negotiate the alignment, based upon parameters given in Section 6.2; and
- Proposed new developments – the alignment takes account of proposed planned development and wherever possible is aligned to integrate with detailed planning proposals.

### 6.1.5 Route Description

The scheme is described, as follows, commencing in the City Centre and following an anti-clockwise direction around the loop:

*City centre*

The city centre is an essential component of the loop, since this section is by far the largest trip generator for the scheme. The service on this section provides convenient, on street access to shops and businesses and integration with bus and rail (at Waverley station).

Within the city centre, two option alignments are considered: one via Princes Street and the other via Charlotte Square and George street.

For the Princes Street option the route passes from Shandwick Place through the World Heritage Site on Princes Street. Overall the introduction of the tram to Princes Street, including the committed mitigation, will have a negative townscape effect, primarily arising from the OLE (overhead line equipment) and the tram stop. The site, Edinburgh's principal street and a formally laid out part of the World Heritage site, has a very high public profile. Its designation and location makes it highly sensitive to change, although it can be argued that the degree of change wrought on the street in post-war developments is such that it is now only moderately sensitive. However, this section of the route will be afforded specific attention with respect to its townscape design.

The tram will run on-street from Rutland Place centrally onto and in a straight line along Princes Street, as far as South St David Street for eastbound trams and South St Andrew for westbound trams. A stop is proposed just east of the junction with Castle Street.

Between Lothian Road and South Charlotte Street the there are three lanes in either direction, occupying the entire current road width to accommodate vehicle flows in this busy junction.

The main part of Princes Street will have a layout broadly similar to the existing but with reduced road space. It will consist of a dual carriageway as at present but the centre strip will be increased to approximately 1.6m width. There will be one continuous lane of mixed tram and bus traffic and a discontinuous second lane in each direction. The discontinuous second lane accommodates bus stopping and limited amounts of bus running, allows for the tram stop, reduced length pedestrian crossings and increased pedestrian circulation space at key points, all as outlined below.

At the junction with South Charlotte Street the north footway is widened for a length of approximately 20 metres. At Castle Street both the north and south footways are widened over a length of approximately 100m including the Princes Street tram stop. At the mound the north side footway is widened over approximately 50m west and 20 m east of the junction and the south footway over approximately 100m east of the junction, including the current pedestrian pinch-point at the steps to the Royal Scottish Academy. At South St David Street the north side footway is widened over approximately 60m in front of Jenners and the Mount Royal Hotel.

Between Princes Street and Queen Street the tram will run on-street with single-track alignments. The northbound trams will run up South St David Street in a straight line along the edge of the square and down North St David Street, turning east on to Queen Street. Southbound trams will turn off York Place and follow the equivalent route on North and South St Andrew Street.

Stops are proposed on South St David and South St Andrew Streets, between St Andrew Square and Meuse Lane.

For the Charlotte Square and George Street option, the key features of the route, lie in three main areas: St Andrew Square, George Street and Charlotte Square.

In St. Andrew square, a city bound tram (west bound) follows the line of the preferred alignment along York Place before turning onto North St Andrew Street. This section of the alignment would require the removal of parking/servicing, the cutting back of the steps on the south kerb line, the modification of the junctions at North St Andrew Street and Broughton Street along with the junction to accommodate the right turning traffic into the St James Centre car park and the Bus station. Once in the square the alignment runs on the east face before deviating from the preferred alignment to run along the south face of the square, where a stop will be located, and then runs onto George Street via the west face of the square. Within St Andrew Square there is a requirement to modify all the

junctions to accommodate the tram along with a loss of parking on both the east and west faces. A tram leaving the city (east bound) would exit George Street and join the preferred alignment which runs north onto North St David Street then head east on Queen Street (kerb running on the north). This leg requires the modification of two signalised junctions and the removal of parking along Queen Street. With this option along both Queen Street and York Place there will be four dedicated traffic lanes.

On George Street, the alignment was developed to maintain a straight segregated alignment centrally on George Street adjacent to a single traffic lane kerbside in both directions. This option requires the removal of the on street parking and servicing from Hanover Street to Castle Street both kerbside and centrally, although limited parking would remain kerbside from Hanover Street east and Castle Street west. The three main junctions along George Street all operate as roundabouts at present with incorporated zebra crossings, however, there would be a requirement to signalise these junctions and incorporate pedestrian crossings. It is anticipated that the level of priority at these junctions will be tram, pedestrian then road traffic. At present there is no designated cycleway along George Street although it is part of the National Cycle Network and under this option there would be no allocated cycleway along George Street.

The stop location is staggered either side of the Fredrick Street junction with central island platforms.

In Charlotte Square the alignment is the result of early consultations and is principally designed to minimise visual impact on the Square. The route runs from the end of George Street south round Charlotte Square onto the southern face where it is expected that the tram will run with the traffic. The alignment then turns south into Hope Street where it runs with traffic through to Rutland Place. The alignment then runs across Rutland Place to Shandwick Place then heads west to the West End Stop location. This option will have serious impacts on the traffic operations in the Square. There could also be a requirement to run general traffic around the northern face of Charlotte Square and reopen the northern end of Glenfinlas Street to general traffic, however, further work is required to develop the traffic operations and model the flows. There would not be a requirement to remove any of the on-street parking currently provided within Charlotte Square for this option, although the taxi rank currently at the southern end of Hope Street would require to be relocated further north.

North of St Andrew square, the northbound tram will run on-street single-track on Queen Street and both north and southbound trams will run twin-track along the centre of York Place.

In order to accommodate the heavy vehicular flows along York Place and Queen Street, two general traffic lanes are maintained in each direction. The result is a requirement to widen York Place slightly. It is recognised that this arrangement changes with the proposed introduction of CETM which will alleviate this impact.

*Leith Walk to Constitution Street*

Whilst the extent of tram boarding along this section is relatively low for the loop, it forms an essential link for ridership between the City Centre and key locations and areas of new development in Leith and Newhaven.

The junctions at the top of Leith Walk will be entirely reorganised. The roundabouts at Picardy Place and London Road will both be replaced by T-junctions and a stop introduced in the reorganised junction at Picardy Place. The tram will then run the full length of Leith Walk along the centre of the road, with stops at MacDonald Road, Balfour Street and the Foot of the Walk. The tramline will be shared with bus throughout this length, offering a high degree of priority of movement through junctions to both tram and bus. Buses will leave the shared centre-running alignment to stop at a number of locations along Leith Walk approximately in line with existing bus stop provision (subject to limited rationalisation).

The tram lines will run on-street out of the centre of York Place into Picardy Place, swinging slightly south to allow two lanes of general traffic along Picardy Place on the line of the current access lane. Through the new junction and tram stop at Picardy Place there will be a short section of fully segregated running. Down Leith Walk the tracks will generally follow the alignment of the street, along the centre of the road, deviating occasionally to allow for right turn lanes.

Tram stops are proposed at Picardy Place, MacDonald Road, Balfour Street and the Foot of Leith Walk. All these stops are currently envisaged as island stops, located centrally between tram lanes, with Picardy Place linked to a large pedestrian traffic island. Stops located at Picardy Place and, more significantly, at the Foot of the Walk are also located to provide potential for integration with possible bus services.

*Constitution Street to Ocean Terminal & Chancelot Mill*

Moving north from Leith Walk, Line 1 will run on-street, sharing road space with all other traffic through Leith from the Foot of Leith Walk along Constitution Street to the dock gates at Constitution Place, with a staggered stop in the old town centre between Queen Charlotte and Bernard Streets. This would take the form of a north bound stop (Kerbside) immediately to the south of Maritime Lane and a south bound stop close to the south side of the junction with Bernard Street. Both stops would be designed to appear as well-detailed slightly raised areas of footpath. Apart from the area of the stop and minor junction alterations at Bernard Street, the alterations to the streetscape will be minimal.

Tram Line 1 will run through the Port of Leith from Constitution Street through an area of new development (by Cala Homes) off-street on the north side line of a realigned section Ocean Drive to a realigned newly signalised junction with Tower Place. A stop is proposed to the west of the junction between Constitution Street and Ocean Drive to serve this area including the new development. The tram road will continue west following the alignment of the existing, privately owned, section of Ocean Drive to Ocean Terminal. A stop at Ocean Terminal is proposed providing access for passengers within this area of extensive redevelopment (including the new Skyliner and Ocean Point Developments). From there the route will proceed along the dock road past the entrance to Chancelot Mill and then ramp up to join Lindsay Road at Anchorfield.

The tram depot will be located just inside the port area, on the east side of the route, immediately north of the dock gates on Constitution Street. There will be two stops, one at Ocean Terminal and one on Ocean Drive, between Constitution Street and Tower Place.

From Ocean Terminal to Lindsay Road the tram will run on-street for a short section (to avoid the sewage pumping station) then segregated parallel to the street. A new ramp structure, approximately on the line of the existing pedestrian ramp, will provide access from the dock road to Lindsay Road. This will cut the end off a lightly used piece of public open space but allows the opportunity to reinstate the area to a higher quality and provide better public access.

*Newhaven to Wardie Bay*

The tram will run from Newhaven to Granton along the waterfront – Lindsay Road, Pier Place, Starbank Road, Trinity Crescent and Lower Granton Road. Stops are proposed at Newhaven, adjacent Great Michael Square, and at the east end of Lower Granton Road.

From the top of the ramp at Anchorfield to the junction at Newhaven Place, the tram will run on-street in segregated on the north (dock) side of the road. Detailed alterations to the road alignment will be required along much of the length and new traffic islands will be introduced

From Newhaven Place to Trinity Road it will run on-street, entirely integrated with other traffic.

At Newhaven Place and at the junction between Craighall Road and Starbank Road, the junctions will be reorganised, within the existing road area, and signalised.

The junction at the foot of Trinity Road will be realigned, taking up some of the existing open space but providing a layout that is more visually logical as well as functional.

Starbank Road is particularly narrow with restricted pavement widths. Frontages access and informal parking will be impacted upon by the tram alignment and this in turn could have an impact on the operations of the timetable. A new 3 metre wide combined footway and cyclepath is proposed on the seaward side of the existing sea wall to mitigate this. However, environmental issues associated with the site's protected status and impacts on natural habitats will have to be carefully examined (see Section 7.2.1). This will be the subject of more detailed discussion with the Council Planners to promote a sympathetic solution.

Where the tram runs on-street, the track-bed will be finished in bitumen macadam with granite chips rolled in, to integrate it visually with the existing road.

Realignment of kerblines will be undertaken over much of this length. Some islands and tie-ins will be constructed with concrete kerbs where necessary to match the existing to ensure visual integration.

The route between Trinity Crescent towards Granton Square will be segregated, on street. The arrangement will be one of segregated running to the north of a revised alignment for Lower Granton Road. The revised arrangement offers better provision for parking by residents and improvement in noise and vibration levels caused by traffic, which currently runs close to residential properties. This alignment also addresses the issues associated with right turns and the aspects of loading points for buses. The tram road alignment to the north also provides the opportunity to use grass track and therefore improve the aspects of urban space being provided.

The alterations to the road between Anchorfield and Trinity Road will generally have an effect on the townscape of low magnitude. The alterations at the Trinity Road junction and along Lower Granton Road will have an effect of medium magnitude.

Stops, currently envisaged as a pair of kerbside stops opposite each other, are proposed at Newhaven, adjacent Great Michael Square, and at the east end of Lower Granton Road.

*Granton to Ferry Road*

The tram runs 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. The area is currently undergoing comprehensive redevelopment and the tram alignment through the area has been determined primarily through the development master-planning process. A stop is envisaged at Granton Square and two others at key locations within the new development.

From Granton Square to the junction with the main development spine road just west of the lighthouse on West Harbour road, the tram will run on a segregated alignment along the north side of the road. The stop envisaged 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.

Through much of the main development area, the tram will form part of a transport boulevard, with a short section of roadside segregated track along the northern extension of West Granton Access.

The design for this area will be developed in conjunction with the masterplanners 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.

The extent of 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.

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 envisaged approximately mid-way.

The construction of the tram will involve the loss of the broad grass verge to the new road and some areas of semi-decorative shrub planting, and the opening up of the temporary infill under part of the span of the bridge carrying West Pilton Place across the road.

To reduce the effect on what is currently a fairly bleak townscape it is envisaged that the track-bed will be in-filled with grass and that, wherever the room is available, a hedge will be planted immediately in front of the existing and any new barrier fencing.

The stop is currently envisaged as an island stop, with the northbound track diverging into an additional area of land to the rear of 4 to 6 Pilton Place. The stop would take the form of an extended traffic island designed to appear as a well-detailed slightly raised area of pavement. Pedestrian access to West Pilton is envisaged to be via a new road as part of a new housing development.

*Ferry Road to Haymarket*

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 to the City Centre. Much of this section makes use of the former railway corridor, providing a rapid, segregated section of route, which has very little impact upon and from other modes of transport. Unsurprisingly, this section of the route offers the fastest journeys and consistently carries the highest passenger loading for the scheme, particularly during the a.m. peak.

The tram will follow the former railway solum from Ferry Road to the point where it meets the existing heavy rail just west of Haymarket. Stops are envisaged at Ferry Road, Telford Road, Craigleith and Ravelston Dykes.

Close to Crewe Toll there are two options: one option continues along the former railway alignment with stops located at Craigleith (just north of Queensferry Road), Crewe Toll (south of Ferry Road) and West Granton (north of West Granton Road).

The other option leaves the former rail corridor at the Craigleith stop and runs along South Groathill Avenue, Groathill Avenue and Telford Road. A stop is located at the Western General Hospital. The route leaves Telford Road just south of Crewe Toll where it swings west through the Fire Training Centre car park to rejoin the former railway at Ferry Road. From here it continues along the former railway to the West Granton stop.

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 the Coltbridge viaduct. This will be the subject of more detailed design considerations and approval in order to promote a sympathetic solution within this conservation area.

At both ends of the corridor, the existing railway corridor is on embankment some five metres above the surrounding land. Significant regrading will be required to ramp the tram line up to and down from this level over a length of about 150 metres.

The former railway solum was converted to a cycleway and footpath in the 1980s and is now a well used and popular recreational resource. 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.

The tram and the replacement cycleway and footpath will be constructed on the line of the old track-bed, with a fence and, where space is available, a hedge separating them. 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.

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 cycle-track of 3 metres. In parts of the existing cutting and embankments retaining structures will be required to allow for widening.

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 narrow cycleway and footpath.

The safety clearances required for the 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 cycleway and footpath will be surfaced in a fine grade black-top as existing, while the tram track, except at crossings, is envisaged as grasscrete or "grasstrack"

Stops are envisaged at Ferry Road, Telford Road, Craigleith and Ravelston Dykes.

The stops at Telford Road, Craigleith and Ravelston Dykes are entirely within the railway corridor and will be designed as well-detailed low platform height suburban railway halts, with the shelters, seating, signage and other equipment designed as an integrated whole. Level difference between these stops and the adjacent roads and footways will be dealt with by the incorporation of ramps and steps with commensurate lighting and security measures.

*Haymarket to Princes Street*

This section of the route offers the opportunity for major multi-modal interchange between Tram, rail, bus and taxi and represents a significant service demand for the tram.

The tram enters the Haymarket area parallel to the existing heavy railway to the south of Balbirnie Place, where a strip of existing screen planting will be replaced by twin tram tracks, opening up further an area where spaces are currently weakly defined by the built form. A possible substation site has been identified in an unobtrusive location at the rear of the yard to the warehouse at 15 Devon Place.

East of Balbirnie Place, the tram will turn north, away from the heavy rail, passing between the new office developments of Haymarket Yards and the rear of the warehouses on Devon Place and the rear of the offices and tenements of Haymarket Terrace and emerging onto the top section of Haymarket Yards alongside Rosebery House. The tram track will replace some areas of car parking and small areas of landscaping and larger areas of derelict land.

At the top of Haymarket Yards, the tram lines will turn east, at street level, onto a viaduct structure to be built up over the current station car park and run parallel to Haymarket Terrace, where a tram stop

is proposed. They will then move onto to the street in a reverse curve at the end of Haymarket Terrace at the location of the current Caledonian Ale House, requiring the demolition of this B listed building. The line will cross the Haymarket junction following the curve of Haymarket Terrace into Clifton Terrace and continuing straight along West Maitland Street towards the West End.

To accommodate the tram running in a segregated lane, the junction at Haymarket will be reorganised. The junction design as frozen for the purposes of this assessment includes the widening of Morrison Street by 3 to 6 metres, flaring out between Morrison Link and Dalry Road.

The tram will run straight through the West End, on road from West Maitland Street to Shandwick Place, with a stop proposed between Coates and Atholl Crescents. This would take the form of an extended island designed as a well-detailed slightly raised area of pavement. To the west of the stop a crossover is proposed to offer turnback facility for east bound vehicles during closure for events in the City centre.

To accommodate the two lanes of traffic that have to pass the island stop in either direction (a tram lane and a general traffic lane) the footways along the front of the garden areas will have to be set back, giving the opportunity to redesigning the edges of the gardens along Shandwick Place.

The design as currently envisaged entails the reconstruction and making good of the edges of the gardens generally matching the existing design, but set back by up to 2m to accommodate the island stop. The trees will need to be replaced by semi-mature specimen trees of a minimum 30cm girth aligned to suit the revised design, which itself will respect the formality of alignment of the New Town. The area will be subject to further liaison and design consideration with the City planners in order to promote the best use of the space.

Traffic movements are proposed to be controlled by new traffic signals at the east end of Coates and Atholl Crescents. Subject to the detailed design alignment, a realignment of the kerbs may be required at Rutland Place.

## 6.2 Vehicle Technology

A range of vehicle types and systems were examined at feasibility stage (see Appendix C9). The selection of a tram system for the Edinburgh Loop was agreed in principle based upon the economics of the scheme, which showed that the level and type of passenger service required was more suited to this type of mass transit system. Trams also satisfied a number of other criteria including environmental aspects, speed, safety, reliability and quality. Such qualities are believed to have been found to provide a more attractive form of public transport than other forms (to the extent that they are able to attract passengers away from their cars), and providing accessibility for all members of the community including the Mobility Impaired. These aspects are clearly in line with the Objectives of the City of Edinburgh Council.

A variety of types and characteristics of tram vehicles are available as detailed below. The selection of a preferred vehicle has not been made, as yet, and vehicle parameters (established for the purposes of design) have been adopted such that the selection is not unduly restricted during the procurement stages of the scheme.

There are three main categories of LRVs/trams currently available which are based upon the height of the tram floor relative to the running surface: *High Floor, Partial Low Floor and Low Floor*. These descriptions also reflect the evolution of tram design, although none of these categories are obsolete and each has its own relative merits which are set out below. All three of these types can be further classified as single or articulated. The articulated vehicles can be single-, double-, triple- or multiple-

articulated. Both single and articulated trams can be operated as single units or assembled into pairs or trains according to the required capacity and stop facilities.

### 6.2.1 High Floor Trams

High floor trams are mainly suited for use in segregated corridors, in sub-urban areas, on disused heavy rail lines or on lines used commonly by trains and trams, where high speed is required. They require high boarding platforms, typically 850-1000mm and therefore on lines not already equipped with high platforms the civils works required to accommodate these trams are usually more expensive than trams with lower floors.

The advantages of these vehicles come from their simple construction, high riding quality, speed (90-120km/h is attainable), easy equipment inspections, easy passenger accessibility and low purchasing costs.

If it is necessary to provide step wells for boarding the tram from low level tram stops this results in poor accessibility for mobility impaired travellers. These factors mean that high floor trams are not generally suited to the urban environment where high platforms cause physical obstacle and strong visual impact.

### 6.2.2 Partial Low Floor Trams

These trams offer high and low floor sections with the principal aim of improving accessibility, especially for mobility impaired travellers. They are mainly suited for use in urban and sub-urban areas where high speed is also required. They provide a good riding quality and can attain speeds of up to 80-100 km/h. The low floor sections usually make up approximately 50-70% of the floor area and are generally at the doors. Internal access to high floor sections of the tram must be negotiated by steps.

### 6.2.3 Continuous Low Floor Trams

These are the most modern of available trams and provide the most accessible passenger vehicles, facilitating kerb boarding for users of all levels of mobility and age. These trams are mainly suited for use in urban environments where low visual impact is required. These vehicles offer fewer limitations on operations and can be easily customised internally to accommodate special requirements, for example, cycles and wheel chairs. Some are capable of negotiating very tight curves (radii 18m). On straight segregated track they can operate at speeds of 70-80km/h.

The disadvantage of low floor trams is that the on-board auxiliary equipment must be accommodated on the body roof. At present they are more expensive than the partly low floor types.

### 6.2.4 General LRV Specification

Currently no particular light rail vehicle (LRV) or tram has been chosen for use on the Edinburgh system. However, it is understood that **tie** is seeking to implement a high quality low floor system. The following, therefore, sets out to provide a guide on the range of vehicle characteristics currently available on the market and to define an outline vehicle specification to be adopted for design. It is the intention that within the specification the interior ergonomics are optimised.

Table 6.1 provides indicative performance parameters for a typical modern tram.

**Table 6.1 Indicative Tram Performance Parameters**

| Characteristic | Typical Street Running LRV | Comments |
|---|---|---|
| Overall length | 22m – 35m (up to 48m modular) | Envelope of vehicle lengths available |
| Vehicle width | 2.30m – 2.65m | Envelope of vehicle widths available |
| Vehicle height | 3.20m – 3.40m | Envelope of vehicle heights available |
| Floor height (above top of rail) | 300mm – 350mm (low floor) up to 915 mm | Envelope of vehicle floor heights available |
| Track gauge | 1435mm | Standard track gauge |
| Doorway width | 1,200mm – 1,300mm | Envelope of vehicle Doorway widths available |
| Seating capacity (including tip ups) | 65 – 80 | Envelope of seating capacities available |
| Passenger capacity (4/m²) normal load | 100 – 230 | Envelope of passenger capacities available (normal load) |
| Passenger capacity (6/m²) max service load | 200 – 320 | Envelope of passenger capacities available (max service load) |
| Line voltage | 750V d.c. | Standard Line voltage |
| Maximum speed | 70km/h – 100km/h | Envelope of maximum speeds available |
| Absolute minimum horizontal radius | 18m | Absolute minimum horizontal radius available. |
| Usual minimum horizontal radius | 25m | Usual minimum horizontal radius available. |
| Minimum vertical radius | 400m – 500m | Envelope of minimum vertical radii available |
| Expandable vehicle (modular) | Yes | Most tram vehicles considered are expandable |
| Multiple unit operation | Yes | All tram vehicles considered are capable of multiple unit operation |
| Single-ended* or double-ended | Either type | For Edinburgh double-ended more practical, although single-ended possible. |
| Maximum gradient | 6% – 10% | Envelope of maximum gradients available |
| Maximum acceleration rate (crush load on straight & level track) | 1.00m/s² – 1.30m/s² | Envelope of maximum acceleration rates available |
| Maximum service braking rate | 1.00m/s² – 1.30m/s² | Envelope of maximum service braking rates available |
| Maximum emergency braking rate | 2.50m/s² – 3.00m/s² (note: HMRI requirement is 3.00m/s²) | Envelope of maximum emergency braking rates available |
| Design life (body structure) | 30 years | Design life of all vehicles considered |
| Braking systems | Mechanical, electrical, electro-magnetic (track) | Braking systems employed by the vehicles considered. |

Note: * Normal operation unidirectional, in emergency can be operated in reverse.

## 6.3 Tram Design Specification

### 6.3.1 Characteristics of Tram Systems

*Vehicle characteristics*

A number of tram vehicles have been considered in compiling the following assumptions, including the Ansaldo Transporti, Firema T68, the Alstom Citadis tram and the Adtranz Incentro tram vehicle. A further review of other possible tram vehicle types has been undertaken in summary to confirm the validity of the following assumptions.

It has been assumed that geometric design will comply fully with the requirements of Railway Safety Principles and Guidance 1996 published by HMSO.

It is assumed for the purposes of STAG2 alignment development that the trams will be semi-low floor or total low floor vehicles. This implies a floor height of between 300 and 400mm. This type of vehicle has been adopted in order to ensure that the alignment characteristics will cater for *most* currently available rolling stock. It should be noted, however, that as trams are frequently variations on a basic vehicle derivative, no guarantee could be given in relation to the ability to accommodate any particular vehicle in the future.

The key characteristics of a typical street running light rail vehicle are illustrated in Table 6.2.

**Table 6.2 Characteristics of a Typical Street Running Light Rail Vehicle**

| Indicator | Characteristic |
|---|---|
| Overall length | 40m inclusive |
| Vehicle width | 2.65m |
| Vehicle height, excluding pantograph | 3.365m (from top of rail to roof) |
| Floor height (above top of rail) | 350mm |
| Track gauge | 1435mm |
| Doorway width | 1200 – 1300 mm |
| Seating capacity (including tip ups) | 65 – 80 |
| Passenger capacity (4/m²) normal load | 100 – 230 |
| Passenger capacity (6/m²) max service load | 200 – 320 |
| Line voltage | 750V d.c. |
| Maximum operating speed | 80km/h |
| Maximum design speed | 85km/h |
| Absolute minimum horizontal radius | 25m |
| Desirable minimum horizontal radius | 30m |
| Minimum vertical radius (sag or hog) | 500m |
| Desirable vertical radius (sag or hog) | 1000m |
| Expandable vehicle (modular) | Yes |
| Multiple unit operation | Only in case of breakdown and emergency (see note) |
| Bi-directional | Yes |

| | |
|---|---|
| Maximum gradient | 6.5% |
| Maximum acceleration rate (crush load on straight & level track) | 1.00m/s² – 1.30m/s² |
| Maximum service braking rate | 1.10m/s² – 1.30m/s² |
| Minimum emergency braking rate | 3.0m/s² |
| Operational acceleration and braking rate | 0.9m/s² (for use in run time and operational assessments) |
| Design life (body structure) | 30 years |

**Note:** It is presently assumed that vehicles will not require to be coupled together during normal operation. This assumes that single units will be capable of providing the required capacity to meet patronage demands during the design life of the system. Early confirmation of the likely patronage demand and hence this assumption is required.

*Traction system specifications*

Approximately 97% of the 400, or so, tram systems operating currently throughout the world are powered by electricity supplied via overhead wires. The environmental impact of such wires within the Edinburgh streetscape is significant, particularly within the New Town, World Heritage Site. Whilst the use of overhead wires (OLE) is proposed, for Edinburgh for a number of reasons (not least the proven technology of OLE) a review of alternative traction systems has been undertaken and will merit further review prior to implementation (see Appendix C10).

### 6.3.2 Tram Infrastructure

*Rails, trackslab and surfacing*

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 are fixed within the trackslab using a no-shrink medium. The trackslab may also be designed for specific circumstances to mitigate ground borne vibrations and noise. Off-street the rails may be fixed within trackslab, "grasstrack" (usually a "lawned" type slab or unit construction) or traditional ballast and sleeper type arrangement. Current details for line 1 do not include ballast type track due the impact of its appearance and the risk of misuse of ballast material by members of the public.

Outwith the street environment unpaved surfacing can be provided such as ballast or grass track. The extent of ballast that is proposed for Line 1 is currently confined to the depot. Within the streets hard surfacing is proposed. To ensure that the design quality is commensurate with a City of Edinburgh's standing, a Design Manual has been developed. The Design Manual addresses, amongst other things, the Principles of Design for Surfacing and states:

> *"The tramway surfacing will be influenced by its environment/context. The final palette of materials selected must be capable of satisfying equally aesthetic and technical requirements. As part of the Partnership Working Framework, where agreement has been reached with CEC [City of Edinburgh Council], certain areas of streetscape may be subject to additional funding initiatives to enhance the environment.*
>
> *Where appropriate, preference will be given to natural materials, especially in historic areas.*
>
> *The extent of the area to be resurfaced will be influenced by technical conditions of each location and the prerequisite to provide a seamless fit with the surrounding streetscape*

*context. The overarching objective is to ensure that all the available space is used positively to improve and extend the public realm."*

The extent of surfacing works following this approach has been costed 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;
- The full width of the carriageway should be resurfaced were the tram construction and ancillary works (including service diversions) disturbs the existing;
- Surface finishes to reflect the location and design manual within the swept path, opportunities outside the swept path to provide betterment and/or upgrade finishes to existing to be considered;
- 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*

Where 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 Trams route and it is necessary that the layout features and finishes of the pavements and roads along the route should also, whenever possible, take into account use by cyclists.

*Parking bays*

Parking bays will be provided, where possible, as described in the 1:500 scale drawings (to be included in the Figures Supplement) along the Edinburgh Trams route for the purposes of loading, residential parking, drop off points, taxi ranks and bus stops, when appropriate.

*Trackside equipment*

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.

Trackside equipment may be divided into various categories:

- Power supply sub-stations, overhead line equipment, trackside isolators and return circuits for OLE;
- Stop equipment rooms;
- Communications and signalling, including telephones and emergency call buttons;
- Track controls;
- Signage;
- Lighting;

- Fare collection mechanisms;
- Closed circuit television systems (security) and PA;
- Shelters and seating;
- Cycle facilities; and
- Rubbish collection/disposal (cleansing).

*Substations*

A number of new substations will be built along the route to accommodate the infrastructure's power supply.

Sub-station sites will be spaced along the route as dictated by the needs to supply power to the system. Nine sub-stations will be required along the route at approximately 2km spacing. In addition, a switch-room is required to be located in the vicinity of each sub-station. Each proposed sub-station location has been identified on the 1:500 drawings for Line 1 (to be included in the Figures Supplement).

The size of the sub-station has been estimated, at this stage, from first principles by Mott MacDonald based on experience of other system requirements. Power simulation and liaison with the local electricity supply company will be required to develop the proposals further.

*Stop equipment rooms*

Each stop will be provided with a Stop Equipment Room (SER), this can be in the form of a cabinet or multiple of and this will house the majority of the control equipment such as communication and signalling equipment. Where possible this could also be co-located with a sub-station. A number of options, particularly in the city centre, are possible.

Typically these equipment rooms are smaller building units, similar to substations, approximately 3x3m in plan area. The alternative to these buildings is to have the control boxes situated within the vicinity of the stop, but in the open. Such control boxes are generally metal units with a 1-2m frontage, up to 1m depth and 1.5m high.

*Communications and signalling*

Small control cabinets will be required close to all signals (including telephones and emergency call buttons) for power supply controls. SERs 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.

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

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*

Points and 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 is also sited near to the points and is housed in a locked pole; this could be combined with the isolator or even supplied to each vehicle.

Where points (switches) are provided, at the delta junction or for turnbacks along the route, point controls can generally be housed in the stop equipment room, if a SER is not sited near a switch a

small housing will be required, this can also contain the emergency point handle. The point motor is to be located in a pit within the road.

*Signage*

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*

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

*Fare collection equipment*

It is currently the policy of **tie** and CEC to use conductors for fare collection in addition to two ticket vending machines at all stops. The level of redundancy will be subject to review.

Equipment at or near stops and at all road crossings will be needed to facilitate traffic controls, this will include poles and signs, a small supply pillar or control box which will enable the supply to be isolated.

*Closed circuit television systems (security) and PA*

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

The cameras will have a point, tilt and zoom facility and will be interface to the emergency call button, such that camera will turn to the location of the call button. All controls will be contained within the stop equipment room.

A public address system and emergency call buttons can be attached to other poles such as street lighting columns.

*Shelters and seating*

The type and style of shelters and seating will be determined from the design guide. Their location may vary from stop to stop.

*Cycle facilities*

Demand for cycle provision on trams depends on the terrain, access to adjacent attractive cycling areas and the general numbers of cyclists in the area. In Edinburgh much of the route of Tramline One follows or integrates with existing cycle routes, for example the former railway corridor between Haymarket and Granton. The cycle routes appear popular and suggest that a large local cycling population may exist. Consequently, allowing cyclists to use Tramline 1 will provide added value to the existing cycle facilities. Moreover, access from the Line One loop into the suburbs by cycle could increase patronage.

There are a variety of reasons why cyclist provision on trams will attract patronage. Provision for cyclists on trams is useful for longer routes or where the terrain is difficult, offering the possibility of breaking the journey, providing alternatives to other modes of travel. Many cyclists travelling on more secluded lines outside normal hours, also prefer to cycle at either end of their trip to offer them added security.

Much of the demand to integrate the tram with cyclists may be satisfied in alternative ways. The provision of secure cycle storage at tram stops would accommodate travellers who only require to

cycle at one end of their journey and would remove the need to take bicycles on the tram. Similarly, provision of cycle hire facilities at selected tram stops (most probably major transport interchanges such as Waverley or Haymarket) also increases the systems flexibility; such schemes are common in European cities and are particularly attractive option for tourists wishing to use public transport but explore areas beyond the network.

Cycle facilities – Vehicles

In terms of the statutory position on this issue, it is our understanding that HMRI have no objection to the inclusion of cycles on trams but consider the decision to be one for the operator. It remains the responsibility of the operator to demonstrate to the Inspectorate that the cycle facilities can be implemented safely.

Allowing bicycles on trams may cause inconvenience to other passengers. Cycles can block accesses and be wet, dirty and oily. Loading cycles onto the tram has the potential to increase dwell times at stops and therefore overall journey times. This will be dependent upon actual numbers of bicycles on individual trams and in particular the number during peak periods. However, experience from other European systems suggests that actual numbers may not be large and careful design can accommodate cycles safely and efficiently.

Provision for cyclists on trams also restricts the type of tram that can be sensibly used. Ideally, cyclists require level access into trams with wide gangways and vestibules. It should be noted that level access does not mean the sole use of a low floor vehicle. DDA requirements ensure that both high and low floor varieties will in the future have boarding points suitable for the mobility impaired (which would include cyclists if they are specifically permitted to utilise the system). In many ways, partial low floor vehicles are likely to be more restrictive on cycle provision inside the vehicle as the interior layout is often restricted by the changing floor level. The width of the tram is likely to be towards the wider range of vehicles (i.e. 2650mm) to allow sufficient movement of the cycle within the vehicle. Trams typically have more doors and designated areas adjacent to them for e.g. a common low floor section for pushchairs and wheelchairs including tip up seats to give more spatial flexibility. It is these areas which would be expanded and designed to accommodate cycles, preferably with a means of securing the bicycles so as to reduce the conflict with other users.

It is of course beneficial to ensure that the tram design has sufficient flexibility to allow future conversion to accommodate bicycles, if their provision is not specifically included during initial procurement.

Where systems employ conductors, there would be a clear advantage in the ways which cycles could be managed. Regulations or Bye-Laws permitting cycle use must be clear, covering for example, permitted times of use, fares, placing and securing of cycles, the hierarchy of user priorities and where cyclists must give way to the mobility impaired (i.e. disabled and families). The penalties for misuse of the system must also be clear and enforceable.

One frequently raised concern regards the impact cycle inclusion has on safety during emergency stops since modern trams have powerful braking systems. The solution will be in the interior design of the vehicles, with the use of specified cycle bays next to entrances with provision for restraint. Alternatively, cycles could be restricted to certain sections of the vehicle and cyclists required staying with their bicycle for the journey to ensure they remain secure. As outlined above, the cycle proposals will require the approval of the HMRI.

Cycle facilities – Platforms

There are a number of design issues relating to platforms as well as the trams themselves. Cyclists have the potential to cause nuisance on platforms and around stops. The design will discourage riding of bikes onto or through the facilities. Again, this requires clear guidance, markings, signs and penalties for misuse. Where vehicles will restrict access to particular tram doors, this will need to be indicated in a similar manner to disabled access.

Cycle facilities – Control of Demand

Various tools can be used to either help control the demand or to manage cycle accommodation. The hours of use can be restricted to off peak hours, or routes can be restricted to counter the direction of peak flow of passenger traffic. Allowing bicycles on the tram is also a means of generating additional revenue during off-peak hours. The payment method and its level can be used to control the numbers of cycles on the tram. For example, some systems require cyclists to purchase travel permits in advance of using the tram. This indicates to the operator the likely demand allowing him to plan and manage operations. Monitoring the numbers of cycles, time of use, compliance with regulations, relative numbers of cyclists to wheelchairs, prams and pushchairs provides particularly useful information regarding the necessity and development of control procedures.

*Rubbish collection/disposal (cleansing)*

Refuse collection at stops will be determined from the design guidance. A number of these will be placed on or near a platform.

Signage at the platform will be fairly standard, if real time information systems are to be used; the control for this will again be in the SER.

*Overhead Line Equipment (OLE)*

It is a major objective of the design guide to minimise the number of poles/columns used. In urban areas OLE can be supported from fixings attached to existing structures, removing the need for new support poles. Where this is not possible or desirable, then combined OLE and street lighting should be considered.

Supply will be taken from the sub-stations in underground ducts to the OLE system when it will be fed through the poles via isolators at 750v dc to the feed cable. Return currents via the wheels and track is then fed back via a collection mat to the sub-station. All equipment is insulated and earthed to prevent touch potential building up. A stray current mat may be required below the rails for monitoring or capturing stray currents, these are located below the running rails.

All parallel feeder cables and control cables will route through underground ducts parallel to the running lines. The ducts will have draw pits at regular intervals.

*Poles*

Consideration will be given to the use of lighting column reflecting the local environment to support OLE. The form and appearance of the combined lighting and OLE pole should cater for the additional loading applied by the OLE. Where dedicated OLE poles are used then the OLE pole should be of the same design as the adapted lighting column. These issues will be reflected in the design manual for the streetscape, as with the requirement for centre supports for the OLE, which may necessitate separate lighting columns depending on the road layout.

*Building fixings*

Wherever possible the overhead line will be registered from building pull off fixings to minimise the visual impact on the cityscape. In residential and areas in the city centre where building fixings are not feasible or desirable combined OLE and lighting poles are the preferred solution.

### 6.3.3 Depot

The proposed depot site is at Leith. The location and layout is described on drawing 203011/EDIN/0556.

The facilities required to service a fleet size of 14 LRVs are likely to include the following:

- Maintenance shed (90m × 30m single storey portal frame building c/w overhead travelling crane);
- Integral floor access pits & inspection platforms;
- Integral control & communication centre;
- Wheel lathe;
- Automated vehicle washing facility;
- Other associated M & E equipment (including substation);
- Stabling trackwork & inspection platforms (for 14no. LRVs, preferably more for expansion);
- Materials storage & laydown area (vehicle delivery & removal needs careful consideration); and
- Road access & parking.

## 6.4 Construction

The construction of Line 1 is programmed to commence in mid 2006 with an estimated construction period (excluding Optimism Bias) of 36 months.

One of the early activities required for construction is the diversion of Public Utilities from beneath the tramline. This has, historically been undertaken, either as an advanced works contract or as part of the main works contract. Generally the inclusion of this phase within the main contract provides a reduction in programme due to the ability to coordinate efficiently within the main contract. However, the disadvantages of this approach may impact, particularly on the main contract in the form of increased programme risk and further consideration should be given to the implementation of "long lead" or high risk Utility diversions (pertaining, in particular to key "golden assets") as part of an advanced works contract. The 36-month construction period is based upon the utilities diversions being undertaken entirely as part of the main contract.

The construction of Line 1 will potentially impact upon the environment and steps are required to mitigate the impact of works.

A number of possible works sites have been identified and will be included in the Draft Bill application for powers to temporarily use the site for construction purposes. These sites are addressed within the Environmental section.

Bearing the above in mind, the general sequence of track construction following diversion of the services within each area will be as follows:

1. Site clearance.
2. Demolition if required.
3. Removal of hard landscaping, etc if required.
4. General excavation.
5. Installation of drainage, ducts and stray current protection beneath track formation.

6. Lay granular capping material if required.
7. Lay sub base/blinding.
8. Fix reinforcement.
9. Lay first stage concrete.
10. Install rails and complete stray current protection.
11. Complete drainage/ducting above first stage concrete.
12. Lay second stage concrete around rails.
13. Construct stops where required.
14. Install main cabling.
15. Complete highway/accommodation works and final surfacing where possible.
16. Install OLE supports.
17. Complete final surfacing.
18. Install OLE wiring and complete cabling.
19. Energise and commission.

Further details of construction aspects are contained in Appendix C11.

## 6.5 Capital Cost

### 6.5.1 Construction

Capital cost estimates for Line 1 have been compiled from criteria generated by the project team appointed to undertake the Technical, Operational and Environmental Commission and, in particular, the following documentation:

- Route Corridor Plans prepared by Mott MacDonald with supplementary annotations by Babtie and Gillespies;
- Utilities Diversionary Works estimates sourced by Babtie;
- Townscape design/treatment category schedules prepared by Gillespies; and
- Structures Reports and Proposal Sketches prepared by Mott MacDonald.

The costings are presented in Table 6.3, set at a base point of Quarter2 2003. Costs have been derived from a comprehensive database compiled from analyses of costs for the infrastructure works of completed and proposed LRT schemes throughout the UK, currently advised prices from vehicle manufacturers and preliminary diversionary works estimates obtained from utilities companies. The resulting estimates take account of the prevailing factors influencing this particular scheme including location, relative complexity, environment and anticipated programme. Optimism Bias, at a rate of

25%, is also included. This rate has been generated through applying the guidance notes on Optimism Bias.

**Table 6.3 Interim Capital Cost Estimate Summary**

| Element | Sub-Element | Estimated Costs (£) | Element Cost (£) |
|---|---|---|---|
| Civils | Clearance | 1,705,000 | |
| | Bulk Earthworks | 2,525,000 | |
| | Structures | 4,415,000 | |
| | AHW/Acc.Works | 20,690,000 | |
| | Prelims (Prop.) | 5,870,000 | |
| | Design (Prop.) | 2,113,000 | 37,318,000 |
| Electrical | Power Supply | 7,592,000 | |
| | OLE | 6,523,000 | |
| | Sigs & Comms | 10,628,000 | |
| | Prelims (Prop.) | 4,950,000 | |
| | Design (Prop.) | 1,782,000 | 31,475,000 |
| Stops | Platforms & Equip. | 6,203,000 | |
| | Prelims (Prop.) | 1,240,000 | |
| | Design (Prop.) | 446,000 | 7,889,000 |
| Depot | OM&C Facility | 10,255,000 | |
| | Prelims (Prop.) | 2,055,000 | |
| | Design (Prop.) | 740,000 | 13,050,000 |
| Track | Trackwork, formation, drainage, ducting | 33,220,000 | |
| | Prelims (Prop.) | 6,645,000 | |
| | Design (Prop.) | 2,393,000 | 42,258,000 |
| Land Purchases | Land/Property acquisition & compensations | 23,330,000 | 23,330,000 |
| Other: | | | |
| Utilities Diversions | Diversionary Works | 30,000,000 | |
| | Design & Co-ordination | 1,800,000 | 31,800,000 |
| Vehicles | Purchase (14 no units) | 21,700,000 | 21,700,000 |
| Project Costs | Promoters & consultants, Pre-Ops, insurances | 10,500,000 | 10,500,000 |
| **Sub-total** | | | **219,320,000** |
| Optimism Bias | 25% | 54,830,000 | 54,830,000 |
| **Total** | | | **274,150,000** |

All estimated costs exclude VAT and relate to gross capital expenditure prior to commencement of operation of the system with no offset allowances in respect of revenue, contributions or concession values.

The coverage of the capital cost estimates for the various elements of the scheme can be briefly summarised as follows:

- ***Clearance*** – Removal of all obstructions, above natural ground level, necessary for construction of the permanent works excluding demolition of existing buildings and structures;

- ***Bulk Earthworks*** – Major re-profiling works, essentially through the former Haymarket to Granton railway corridor, including allowance for disposal of contaminated material;
- ***Structures*** – Construction of new and modifications to existing structures including associated earthworks and temporary works;
- ***Associated Highway and Accommodation Works*** – All modifications to the existing highways, drainage and streetscape, adjacent to the swept path including urban traffic control soft landscaping and any accommodation works required to 3rd party properties necessary as a result of the introduction of the tram infrastructure;
- ***Power Supply*** – Construction of buildings and installation of plant and equipment for substations; incoming 11kv supply; power distribution cabling; traction SCADA system; stray current control; electro-magnetic immunisation;
- ***OLE*** – Installation of support poles, building mountings, catenary wires and contact wires;
- ***Signalling and Communications*** – Installation of tram signals, automatic vehicle detection and recognition system and all communications, monitoring and security systems;
- ***Stops*** – Construction of platforms and access ramps; installation of platform furniture and equipment; platform surface water drainage; LV power supplies; ticket vending machines;
- ***Trackwork*** – Laying of encapsulated rails on reinforced concrete trackslab, sub-bases and capping layers; installation of points sets at turnouts and crossovers; nominal excavation to formation and disposal; track drainage; bonding of mash reinforcement as stray current mat; trackside ducting; layover facility; swept path infill finishes and delineator kerbs;
- ***Depot*** – Construction of a self-contained, fully equipped facility for the tram system operation and control together with full maintenance and stabling capability for Line 1;
- ***Contractor's Preliminaries*** – All obligations contributing to the construction contractor's on-costs and comprising: site accommodation and establishment; supervision and general contract management staff; traffic management and safety measures; temporary works; insurances; other incidental items not included in elemental costings;
- ***Design and Co-ordination*** – Contractor's design costs for the system infrastructure works; co-ordination of utilities diversionary works and 3rd party accommodation works; liaison with 3rd parties and local authorities;
- ***Land & Property*** – Acquisition costs for all land and property required to accommodate the proposed route alignment together with associated compensation costs;
- ***Utilities Diversions*** – Diversions and/or protection of utilities companies' apparatus necessary to avoid any disruption to the tram services by future repair and maintenance works;
- ***Vehicles*** – Procurement of a fleet of 14 nr nominal 40m, bi-directional, low floor trams with on-board passenger information system, CCTV and driver communication facility; and
- ***Project Costs*** – Project implementation comprising: promoter's internal costs and external advisors' fees; pre-operational costs incurred during the commissioning phase; promoter controlled insurances.

The capital costs of the system will be met from a number of sources, including grant-funding from the Public Transport Fund and private sector financial contributions, since the scheme is beneficial to the operation of a number of businesses, developers and enterprises. Revenue will cover operating costs.

### 6.5.2 Life Cycle

Life-cycle costings have been estimated essentially from the capital cost data. The estimated costs relate to replacements and renewals necessary over a 30-year operational period and exclude running costs and routine maintenance costs. The areas covered are:

- Track and highway;
- Stops;
- Power supply;
- Signals and telecommunications;
- Passenger communications;
- Ticketing;
- Vehicles;
- Depot; and
- Other buildings.

The total cost for these is estimated at £44,624,636.

## 6.6 Operations

This section covers the operational aspects of the system as they affect the feasibility and appraisal of the scheme. The issues covered here are:

- Run times;
- Operating patterns;
- Service planning; and
- Operating and maintenance costs.

A more detailed discussion (including further aspects such as: provision of turnback facilities, revenue system, depot) appears in Appendix C.

### 6.6.1 Run Times

The single overarching objective from the operational viewpoint is to minimise journey times, so as to maximise the attractiveness of the service and minimise operating costs and rolling stock resources. This requires attention to:

- Vehicle performance;
- Maximum running speed between stops;

- Stop dwell times; and
- Traffic signal delays.

Vehicle performance is not generally a major issue as the limiting factor on acceleration and braking is normally passenger comfort. Running speed between stops is important but provided the tram can operate free of obstruction by other traffic, the actual speed limit is not critical when there are frequent stops. In general tram speeds are governed by the speed limit on the adjacent highway, although a higher limit may be possible where the route is fully segregated. The key is to achieve free flow wherever possible so that the running speed is the maximum safe speed for any particular type of environment.

The system requirements for an effective scheme can therefore be defined as follows:

- Segregation from traffic wherever possible – and certainly wherever congestion is likely;
- Maximum priority at junctions;
- Efficient boarding and alighting arrangements (for all people including those with mobility impairments); and
- A high standard horizontal alignment to minimise local speed restrictions and lateral acceleration – hence short radius curves should be used sparingly.

To these can be added further elements required to maximise the attractiveness of the system to passengers, including:

- High quality vehicles and traction control systems to minimise jerk rates;
- Frequent and regular 'turn up and go' service at all times; and
- Good quality pedestrian access to stops.

Estimates of run times for Line 1 have been prepared using the Steer Davies Gleave run time model, which is described in Appendix C. This calculates times from the following key inputs:

- Vehicle performance – acceleration and deceleration rates;
- Link characteristics – distances, curvature, maximum speed; and
- Delay characteristics – stop dwell times, junction delays.

The model forecasts a total time of **40.5 minutes** around the loop, excluding any layover time allowance, equivalent to an average journey speed of 23.3 km/h. The times between individual stops are also shown in Appendix C.

### 6.6.2 Operating Patterns

The configuration of Line 1 as a continuous loop poses special issues for service planning and operations because there are no 'natural' termini. Determining the service pattern is therefore more complex than with a simple end-to-end route. The appraisal has been based on continuous loop running in both directions with a layover at a single 'terminus' en route. Under this option, there would be self-contained clockwise and anticlockwise services, and each tram would pause for a short time at the layover point before continuing in the same direction. It has been assumed that the full service frequency is provided throughout the loop, i.e. there are no short workings.

Some layover time is normally provided in any tram or other public transport service to allow for drivers changing ends (if reversing), resetting of controls and destination displays, entering trip data, recovery from minor delays, etc. For a loop service with a journey time of around 40 minutes, a layover of 4-5 minutes per circuit is an appropriate assumption. This figure is similar to those found on other LRT systems with a mixture of segregated and on-street operation. In practice the total cycle time (the sum of the loop run time and the layover) must be a multiple of the headway. The layover time is therefore also influenced by the actual values of the run time and headway, and is therefore generally adjusted to 'take up the slack' when planning the timetable. This may limit flexibility, especially at times when wider headways are being operated.

Facilities for turning back trams at intermediate points are also required, to provide for scheduled short workings, to allow services to be maintained over part of the route during disruption affecting a local area (planned or otherwise) and to allow a failed vehicle to be returned to the depot by the shortest practical route. Typically, these facilities will consist of a simple (normally trailing[16]) crossover, operated from the control centre, which is sufficient for occasional use during disruption.

### 6.6.3 Service Planning

The maximum passenger flows from the preliminary demand forecasts have been summarised in Table 6.4, which sets out the maximum hourly flows on the western and eastern sectors (sides) of the loop for the Feasibility Study Route (Option 1).

Table 6.4 also shows line capacity figures, based on a service of 8 trams per hour (i.e. a headway of 7½ minutes). The design of the vehicle has not been finalised at this stage but is likely to be about 32-40m in length[17], with a capacity of about 80 passengers seated and up to 230 passengers in total (based on standing at 4 per $m^2$)[18]. These passenger capacities would give a line capacity of 1,840 total places per hour (pph) in each direction, of which 640 would be seated places.

It should be noted that these figures are average hourly flows, and do not take account of a 'peak within the peak'. Short term loadings, in terms of their equivalent hourly flows, could therefore be expected to be rather higher than indicated, and it is therefore desirable to allow some 'headroom' between hourly flow and capacity.

[16] A trailing crossover is one arranged so that vehicles have to reverse to cross to the other track – i.e. in normal operation they pass through the turnouts in the trailing direction.

[17] Preliminary track layout design has, however, made allowances for vehicles up to 40m in length.

[18] See section 6.3.

**Table 6.4 Passenger Flows - Maximum by Sector**

| Forecast Year | Time Period | Western Sector (City Centre to Lower Granton Road via Crewe Toll) | | Eastern Sector (City Centre to Lower Granton Road via Leith Walk) | |
|---|---|---|---|---|---|
| | | Clockwise (pass/h) | Anticlockwise (pass/h) | Clockwise (pass/h) | Anticlockwise (pass/h) |
| 2011 | AM Peak | 844 | 1,414 | 912 | 483 |
| | Interpeak | 368 | 498 | 498 | 294 |
| | PM Peak | 1,247 | 750 | 954 | 641 |
| 2026 | AM Peak | 1,126 | **2,422** | 1,620 | 755 |
| | Interpeak | 505 | **673** | 585 | 349 |
| | PM Peak | **1,989** | 1,106 | 1,653 | 872 |
| Line capacity (total) | | 1,840 each direction (at 4 standing passengers per $m^2$) | | | |
| Line capacity (seated) | | 640 each direction | | | |

Notes: For the peak periods, the figures shown in **bold** are in excess of total capacity (at 4 standing per $m^2$)
In the interpeak period, the figure shown in **bold** is the only one in excess of seated capacity

These figures show that in the **peak** hours, the flows in the year 2011 on both the eastern and western sides of the loop are well within the total capacity of 1,840 pph.

In 2026, however, flows exceed this capacity in two cases. First, on the eastern sector the evening peak clockwise flow of 1,989 pph exceeds capacity by about 8%. This would mean that the standing density would be more than 4 per $m^2$, but by only a small amount. The demand forecasts indicate flows exceeding capacity over the section from the City Centre as far as Craigleith, but beyond Haymarket the excess would be only 2-3%, which not significant.

Secondly, the morning peak anticlockwise flow on the western sector, at 2,422 pph, would be in excess of the 1,840 figure by more than 30% and would be equivalent to a standing density approaching 6 per $m^2$. Higher standing densities are undesirable on the grounds of both passenger comfort and stop dwell times, and would therefore require mitigation. Ideally, the service would be increased to about 10 trams per hour, which would bring the standing density back close to 4 per square metre. This could be accomplished by 'fine-tuning' the timetable to provide a higher frequency over the affected section only, thus minimising the additional resources, though sufficient capacity to meet the clockwise demand on the eastern sector would need to be maintained.

It is possible that such fine-tuning could be achieved without any additional vehicles in the fleet, by a mixture of short workings and a slight reduction in the service in the clockwise direction. However, the forecast year 2026 is a considerable way into the future and it is possible that other general changes will have take place by then, such as the acquisition of additional trams. The excess of demand over capacity in 2026 on one section of route is not, therefore, considered to be a significant issue at this stage.

With the exception of the section discussed above, flows are below capacity by a sufficient margin to allow for some short term peaking of demand within the peak hour without breaching the standard of 4 passengers per square metre.

In the **interpeak,** flows are within the seated capacity provided by a service of 8 trams per hour, with one minor exception. This is the flow of 673 on the western sector, anticlockwise, in 2026. However, even here the excess is only about 5% and is maintained for only a short distance.

Thus, in the interpeak a seat would be available to any passenger who wanted one, bearing in mind that a proportion of passengers typically choose to stand even when seats are available. Whilst it would be operationally possible to reduce the service level in the inter-peak and thus increase load factors, this would result in some passengers being required to stand. Furthermore, sensitivity tests show that this would not reduce operating costs by a significant amount compared with the proposed 'flat' frequency profile across the day. The flat profile is consistent with existing UK systems, which in most cases operate at the same frequency all day. (The main exceptions are Nottingham, which runs at 8 tph in the inter-peak and 10 tph in the peaks, and Manchester, which operates at an enhanced frequency in the AM peak only).

Outside the main weekday time periods (peak and interpeak), lower frequencies will be required to meet the expected lower levels of demand. As an initial assumption for service planning and appraisal purposes, the profile shown in Table 6.5 is proposed. To a large extent these frequencies will be flexible in response to actual demand during different time periods, so that (for example) on Fridays and Saturdays the evening service could be increased in frequency and last trams scheduled later. Although there would be some effect on the maintenance regime, the net effect on the appraisal case of variations in service level and demand/revenue at off-peak times would be marginal.

**Table 6.5 Service Operating Periods and Frequency Profile**

| Day | Period | From | | To | Frequency (trams per hour) |
|---|---|---|---|---|---|
| Monday-Friday | early morning | 05:00 | - | 07:00 | 4 |
| | AM peak | 07:00 | - | 09:30 | 8 |
| | Inter-peak | 09:30 | - | 16:30 | 8 |
| | PM peak | 16:30 | - | 19:00 | 8 |
| | evening | 19:00 | - | 24:00 | 4 |
| Saturday | early | 05:00 | - | 09:00 | 4 |
| | shopping hours | 09:00 | - | 18:00 | 8 |
| | evening | 18:00 | - | 24:00 | 4 |
| Sunday | early | 08:00 | - | 10:00 | 4 |
| | daytime | 10:00 | - | 18:00 | 4 |
| | evening | 18:00 | - | 24:00 | 4 |

### 6.6.4 Operating and Maintenance Costs

*Staffing*

It is assumed that the system is operated by a company set up for the purpose; in practice the actual form will depend on the structure of the successful concession company or consortium. For the purposes of estimating operating costs it has been assumed to be a stand-alone company structure containing all functions in-house, although out-sourcing of some activities is very likely.

The staffing structure of an operating company can be divided into:

- Management staff performing central functions such as financial control, accounts, personnel, marketing, etc.;

- Operations staff, consisting of drivers, conductors, controllers, supervisors, revenue system and control staff and instructors; and
- Maintenance staff, covering vehicles, track, Overhead Line Equipment (OLE), stops, ticketing and other equipment, signalling and communications.

Staff numbers in some cases (notably drivers and conductors) can be estimated directly from operational statistics; in other cases they can be estimated from track mileage, fleet size etc. Some central management and support staff numbers can only be defined directly by comparison with experience elsewhere.

It is estimated that a total of 184 staff will be required to operate Line 1 as a free-standing operation, made up as follows:

- Management, finance and administration staff: 14
- Operations staff: 121, including:
  - *40 drivers*
  - *40 conductors*
- Maintenance staff: 49
- Total: 184

*Operating cost model*

Operating and maintenance costs have been estimated using the Light Rapid Transit Operating Cost Model developed by Steer Davies Gleave, which builds up the total annual cost of operating the system from a number of variables or characteristics. These can be separated into a number of main categories:

- System characteristics – operating days per annum, hours of operation, etc.;
- Route characteristics – route lengths, journey time, peak and off-peak frequencies, number of stops, etc.;
- Vehicle characteristics – method of propulsion, weight;
- The management/staffing structure of an operating company (as set out above); and
- Shift lengths, holiday entitlements, expected sick days, number of staff required on duty etc. to determine the number of operational staff required.

Also in the model are a series of cost rates and assumptions relating these system descriptors to annual costs, including:

- Salary levels by grade;
- Energy costs per vehicle kilometre and centrally;
- Vehicle maintenance costs fixed and per vehicle kilometre;
- Fixed equipment maintenance costs per route/track kilometre;
- Revenue collection costs;
- Insurance;
- Overheads; and

- Policing.

The model reflects the relationships between the assumptions and input variables and resulting cost estimates in different ways. Some, particularly operations costs, vary directly with the size of the system (defined by service pattern, route length, number of stops, etc.), whereas others, such as certain management and administration costs, will be fixed within a range of alternatives under consideration. Other costs, such as maintenance costs, are semi-variable, where costs include a fixed element and increase with system size but less than proportionally. Overheads are added as a proportion of total costs. Insurance and policing are based on experience elsewhere on a route-km basis. Operator profits are specifically excluded, on the basis that for most UK tram schemes, where a PFI style procurement is typically employed, the revenue risk is taken by the concessionaire and hence the level of profit is given by the difference between revenues and operating costs.

*Operating cost estimates*

Table 6.6 shows a summary of the operating cost estimate together with some operating statistics output from the model: the overall net operating cost estimate is £5.82m per annum.

**Table 6.6 Operating Cost Estimates and Statistics**

| Component | Sub-component | Operating Costs (£m pa) |
|---|---|---|
| **Staff** | | **3.96** |
| *of which* | *Drivers* | *0.81* |
| | *Conductors* | *0.63* |
| | *Other operations staff* | *0.97* |
| | *Management and administration staff* | *0.48* |
| | *Maintenance and engineering staff* | *1.07* |
| **Power** | | **0.28** |
| **Maintenance materials** | | **0.66** |
| **Insurance** | | **0.27** |
| **Policing** | | **0.20** |
| **Overheads** | | **0.27** |
| **Rates** | | **0.19** |
| **Total Operating Cost** | | **5.82** |
| **Operating statistics:** | | |
| **Annual vehicle kilometres (million)** | **1.30** | |
| **Operating cost per vehicle km** | **£4.47** | |
| **Annual vehicle hours** | **61,100** | |
| **Operating cost per vehicle hour** | **£95** | |

*DPOF Operating cost estimate*

An operating cost estimate for Line 1 has been independently developed by the operator appointed under the DPOF agreement (see section 8.2.7). This estimate, of **£6.287m per annum**, includes operator profit in the total cost estimate, whilst the estimate presented above is net and excludes profit.

Given the commercial sensitivity of the profit level sought by the operator, it is not possible to explicitly state what the operator profit margin would be. However, assuming a reasonable mark up on the estimate, the operator estimate is broadly consistent with the STAG estimate above.

At the current time, the envisaged procurement route for Line 1 is for **tie** and its partners to assume the revenue risk, with the operation of the system being undertaken by a private operator and a fee paid to them by **tie**. On this basis, the operating cost derived by the operator is employed within this STAG appraisal.

## 6.7 Bus Network

### 6.7.1 General

As part of the definition and appraisal of Line 1, it is necessary to consider the effect on bus provision in the corridors served by the tram and, to a lesser extent, in parallel corridors. The reasons for this are that:

- Frequencies on the bus network are virtually certain to change in response to the introduction of trams, if for no other reason than abstraction of passengers;
- Some reorganisation of routes is also likely to match bus service provision to new patterns of demand; and
- A reduction of bus services, even though it cannot be guaranteed in a deregulated environment, has significant benefits in terms of the environment and the operation of congested corridors.

**tie** and the City council are undertaking an exercise to involve an operator at an early stage with a Development, Partnering Operating Franchise (DPOF), a key element of which will be the establishment of an integrated bus service.

This section therefore sets out a set of potential bus network changes, focusing on a partial restructuring of routes currently serving demand between the City Centre and the Leith, Newhaven, Granton and Crewe Toll areas to set a notional Central Case. The development of these changes takes cognisance of the relative economic and financial impact on the case for Line 1. The best economic case (Cost to Government) will be produced where the bus services are left unchanged; however, this will produce the weakest financial case for both Line 1 and bus. In essence, Line 1 would add significant public transport supply (albeit with some increase in public transport demand due to transfer from car) diluting the available revenue to the various public transport operators. Removal of bus services will improve the financial case for both bus and Line 1, since the reduction in bus operating costs would compensate for the reduction in bus revenue and the demand and revenue for Line 1 would increase as bus passengers seek alternative routes. However, the removal of bus routes will impact on those passengers remaining on the bus network, reducing the economic benefit of Line 1.

The work underlying this was carried out before a series of route and timetable changes was announced by Lothian Buses, to take place on 20 July 2003. However, the effects of these changes have been factored into the results and there are no significant changes to the conclusions.

It is recognised that bus networks change constantly, and that the route structure in north Edinburgh will have altered, perhaps significantly, by the time Line 1 is introduced. However, it is necessary to take a 'snapshot' view of the network in order to provide the basis for assessment.

The final configuration of an integrated bus/tram public service will be developed by the City Council and **tie** as part of the DPOF process with the appointed tram operator and existing bus operators at an early stage of the project. It is recognised that this is an area of project risk and how this is being managed is set out in Chapter 8.

### 6.7.2 Existing Services

Bus services have been grouped into six 'corridors' for the purposes of analysis:

A: Leith Walk

AB: Easter Road (coded because it is parallel to A)

AC: other routes linking the City Centre and Leith

B: Crewe Road

C: Inverleith Road

D: Orbital routes

Table 6.7 shows the existing services in these corridors (from 20 July 2003). All quoted frequencies are for Monday to Saturday daytime. Not all services run the full length of the corridor (for example route 11 only traverses about half of Leith Walk before turning along Pilrig Street). However, the routes shown above have been selected on the basis that they serve at least some demands that would be served by Tram Line 1. Other routes, which cross the corridor or travel along them for only short distances, have been omitted.

**Table 6.7 Bus Services in Line 1 Corridor**

| Corridor | | Route | Headway (minutes) | Change on 20 July 2003 (if significant effect on corridors) |
|---|---|---|---|---|
| A | Leith Walk | 7 | 10 | |
| A | Leith Walk | 10 | 10 | |
| A | Leith Walk | 11 | 10 | |
| A | Leith Walk | 12 | 10 | |
| A | Leith Walk | 14 | 15 | |
| A | Leith Walk | 16 | 10 | Daytime service increased from every 15 to every 10 minutes |
| A | Leith Walk | 22 | 10 | |
| A | Leith Walk | 25 | 10 | |
| A | Leith Walk | 49 | 20 | |
| AB | Easter Road | 1 | 15 | Split into 2 routes (both every 15 minutes):<br>1: Clermiston-City Centre-Easter Road-Ocean Terminal<br>21: Gyle-Clermiston-Crewe Toll-Duke Street (effectively an orbital) |
| AB | Easter Road | 35 | 20 | |
| AC | parallel to Leith Walk (via Lochend) | 34 | 15 | Daytime service increased from every 20 to every 15 minutes |
| AC | parallel to Leith Walk (via Broughton Road) | 36 | 30 | |
| B | Crewe Road | 19 | 15 | |
| B | Crewe Road | 42 | 20 | Replaced previous service 28 at same frequency |
| B | Crewe Road | 29 | 10 | |
| B | Crewe Road | 37/ 37A | 10 | |
| B | Crewe Road | First 129 | 15 | |
| C | Inverleith Road | 8 | 15 | |
| C | Inverleith Road | 17 | 15 | |
| C | Inverleith Road | 23 | 10 | |
| C | Inverleith Road | 27 | 10 | |
| D | Orbital via Granton and Leith | 32/ 32A | 20 | |
| D | Orbital via Crewe Rd | 38 | 20 | |

### 6.7.3 Potential Bus Changes

The potential changes to the bus network, set out in Table 6.8, have been developed on the basis that:

- A notional reduction in frequency is justified where the tram is in direct competition with bus services; the closer the tram is to the bus corridor, the larger the reduction, since more existing bus demand will be attracted to the tram.

- This applies between major centres even where buses and trams follow different routes, for example between the City Centre and Granton,

  BUT

- Frequency reductions should be avoided as far as possible for routes where there is no tram alternative;

  AND

- Existing linkages provided by buses should be preserved as far as possible if the tram does not provide an alternative.

Table 6.8 shows the changes proposed for the purposes of the Central Case

**Table 6.8 Bus Service Changes in Line 1 Corridor**

| Corridor | | Route | Proposed change |
|---|---|---|---|
| A | Leith Walk | 7 | Divert via Commercial Street and Henderson Street to replace 22 |
| A | Leith Walk | 10 | Withdraw between Newhaven and city centre |
| A | Leith Walk | 14 | Divert via Easter Road and Royal Mile to replace 35 |
| A | Leith Walk | 16 | Withdraw between Silverknowes and city centre |
| A | Leith Walk | 22 | Withdraw between Ocean Terminal and city centre |
| AB | Easter Road | 35 | Withdraw between Ocean Terminal and city centre |
| B | Crewe Road | 19 | Withdraw between Granton and city centre |
| B | Crewe Road | 42 | Withdraw between Silverknowes and city centre |
| B | Crewe Road | 29 | Divert half of service as 29A via Telford Road and Groathill Road North to replace 42 at same frequency |
| C | Inverleith Road | 8 | Divert to Caroline Park (extended 17 provides new service to Muirhouse) |
| C | Inverleith Road | 17 | Extend from Granton to Silverknowes to replace 16 on this section |
| C | Inverleith Road | 27 | Extend some journeys to serve Silverknowes Prom loop to replace 42; reduce to 3 bph between Silverknowes and city centre (extended 17 provides service to Muirhouse and Silverknowes) |
| D | Orbital via Crewe Road | 38 | Divert to Granton to replace part of 19 (particularly the link between Granton and Western General Hospital) |

The aggregate impact on the corridors of these changes is Table 6.9. This shows the change in buses per hour (bph) per direction and places per hour (pph) per direction, assuming 70 places per bus.

**Table 6.9 Bus Supply Changes**

| Corridor | | Existing | | Proposed | | Change | | % change |
|---|---|---|---|---|---|---|---|---|
| | | bph | pph | bph | pph | bph | pph | bph & pph |
| A | Leith Walk | 49 | 3,430 | 27 | 1,890 | -22 | -1,540 | -45% |
| AB | Easter Road | 7 | 490 | 8 | 560 | +1 | +70 | +14% |
| AC | parallel to Leith Walk | 6 | 420 | 6 | 420 | 0 | 0 | 0% |
| B | Crewe Road | 23 | 1,610 | 16 | 1,120 | -7 | -490 | -30% |
| C | Inverleith Road | 20 | 1,400 | 17 | 1,190 | -3 | -210 | -15% |
| D | Orbital | 6 | 420 | 6 | 420 | 0 | 0 | 0% |
| **Total** | | **111** | **7,770** | **80** | **5,600** | **-31** | **-2,170** | **-28%** |

The notional reduction in capacity of around 2,200 places per hour will be broadly offset by the capacity supplied by tram Line 1. At 8 trams per hour, this will be approximately 2,000 passengers per hour per direction on each side of the loop (4,000 per hour in total between the City Centre and Granton/Leith). On Leith Walk, the proportional reduction is greater because the tram exactly parallels the bus, but even here the reduction of 1,540 places per hour is offset by 2,000 per hour by tram.

### 6.7.4 Resource implications

An estimate of the savings that would accrue from these service changes has been produced by identifying the number of vehicle hours and vehicle kilometres represented by the changes to each route, and aggregating the results for all routes over a full year, making allowance for lower levels of service during early mornings, evenings and Sundays.

The results suggest a saving of about 1.37 million vehicle kilometres and 89,000 vehicle hours per year. At a cost of £25 per hour, this represents an annual saving of around £2.2 million.

The net change in vehicle requirement would be 15 vehicles in service, representing a reduction in the required Lothian Buses fleet of about 18 vehicles. In proportion to the total normal bus fleet of around 550 vehicles[19], this is a very small reduction of about 3%.

It would be possible to re-deploy the displaced vehicles on other services, either by increasing frequencies or introducing new routes. Unless directly related to the tram scheme, this would be a matter for the bus operator. Some additional revenue could be generated as a result, but the net effect cannot be estimated. It is more likely that such new services could be unprofitable and therefore require revenue support (otherwise they would already be provided commercially).

Re-deploying the displaced vehicles on feeder services to the tram would be another possibility, but it is difficult to identify where there would be a market for such services in connection with Line 1, given the loop configuration, the lack of catchment areas to the north and the relatively short distances from the City Centre. Again, it is likely that such services would require revenue support. Subjectively, Lines 2 and 3 would probably offer better opportunities for bus feeders in view of their more radial nature and more extensive hinterland.

[19] An approximate figure, excluding coaches and open top buses.

### 6.7.5 Bus Speeds

The demand modelling process used in the development of Line 1 utilises an interface between the highway model and public transport model, which transfers highway speeds to the latter to derive bus speeds. Allowance is made for the slower running speeds of buses compared to general traffic and for the existence of bus lanes.

During the development of Line 1, this process led to modelled delays to the bus network arising from highway network changes to accommodate Line 1. In practice, it was felt that these delays were excessive and would be mitigated during the detailed design process and/or explicit bus priority measures implemented. On this basis, it was decided to assume that bus speeds across the network remained unchanged between the Reference Case and Line 1 scenario (although bus speeds were modelled changing between the forecast years of 2011 and 2026).

This modelling assumption may underestimate the impact of Line 1 on bus operations, thus overestimating the benefits of Line 1. However, this assumption also removes the benefits of improved bus operations arising from a less congested highway network following car transfer to Line 1. On balance, it is felt that the impact is broadly neutral.

# 7 STAG2 Appraisal

## 7.1 Option Sifting

Before undertaking a comprehensive STAG2 appraisal of the options for Line 1, it was evident that the decision between the remaining route alignment options should be driven by a limited number of key objectives within the STAG process. On this basis, we elected to undertake a restricted STAG2 appraisal, focusing on these key objectives, to ascertain whether there was a clear preference at each option location. Should this prove to be the case, the best performing option will be carried forward as an integral part of a full loop, potentially resulting in a single Preferred Route.

On this basis, this section sets out the appraisal of the route options, namely:

- George Street / Princes Street; and
- Telford Road / former railway solum.

The appraisals only cover the route sections where the options exist, not the loop in its entirety.

### 7.1.1 George Street / Princes Street

Detailed scheme development and analysis of the two options has been undertaken and this is set out in an option study report (Mott MacDonald et al, 2003). Tables 7.1 and 7.2 set out the resultant ASTs for the George Street and Princes Street options respectively. It is important to note that the ASTs have not been fully completed; rather they have been used to demonstrate the key drivers and impacts to inform the choice between the two options.

Considering the technical aspects of the scheme, both options have comparable capital costs, with George Street some £0.8m more expensive. However, this excludes the cost of PU diversions and this will be likely to increase the cost of George Street compared to Princes Street. The run times are slower on George Street, but this option is expected to have less impact on highway operations.

At consultation, the public expressed a clear preference for Princes Street, with its balance of providing accessibility whilst minimising the visual impact, noting the environmental and heritage impact of the George Street option.

The appraisal of environmental impacts indicates that there are likely to be adverse impacts from both options but that those of the George Street option will be greater. The George Street option is expected to lead to greater noise impacts, as a result of the quieter evening and night-time environment compared to Princes Street. Both options will have large adverse effects on visual amenity and the city centre townscape but the impact is considered to be greater on George Street. The enclosed layout, designed vistas and high architectural quality of George Street, combined with the human scale of the buildings, means that the tram is likely to more dominant than in Princes Street. Charlotte Square, with its intact architecture and generally smaller scale, is particularly sensitive. Although the adverse impact on the townscape will still be large, Princes Street is judged to be less sensitive because of its more variable architectural quality and because it is already a major public transport corridor; the tram will only re-enforce this aspect of its character.

The impacts on safety and economy are judged to be comparable, with no clear advantage to either option. The softer effects on patronage, such as system visibility, use of a natural transport corridor, safety and security and tourism tend to favour Princes Street.

The Princes Street option has advantages to transport integration, since this road is the principal bus route through the City Centre. On a similar basis, the Princes Street route is likely to provide better accessibility benefits; it is the main retail area with surveyed pedestrian flows three times that of George Street and enjoys a strong relationship with both the Old and New towns.

Given the merits of the respective options set out above, Princes Street is the preferred option and this option has been carried forward for inclusion in the appraisal of the full loop.

### 7.1.2 Telford Road / Former Railway Solum

Detailed scheme development and analysis of the two options has been undertaken and this is set out in an option study report (Mott MacDonald et al, 2003). Tables 7.3 and 7.4 set out the resultant ASTs for the Telford Road and former railway solum options respectively. As stated previously, the ASTs have not been fully completed; rather they have been used to demonstrate the key drivers and impacts to inform the choice between the two options.

Considering the technical aspects of the scheme, the Telford Road option is materially more costly than the railway solum, the respective costs being £15.4m and £6.4m. However, this excludes the cost of PU diversions, which will further increase the cost of the Telford Road option. The tram run times are slower on Telford Road, with an impact on highway operations, compared to the former railway solum which is completely segregated.

Environmentally, the Telford Road option would produce greater noise and vibration and air quality impacts, whilst the former railway solum option would lead to some re-balancing of biodiversity. Safety and security impacts are marginal and comparable in both cases. The economy impacts favour the former railway solum, which maximises through patronage due to the superior run times, with no highway impacts. Integration benefits are marginally in favour to the Telford Road option, since this allows better transport integration. Accessibility to the Western General Hospital is maximised by the Telford Road option; the former railway solum option gives rise to an additional 300m walk access (4-5 minute walk time).

Given the merits of the respective options set out above, the former railway solum is the preferred option and this option has been carried forward for inclusion in the appraisal of the full loop.

### 7.1.3 Preferred Route

On the basis of the option sifting set out above, a single Preferred route alignment has now been identified and this is the subject of detailed appraisal set out below.

## Table 7.1 George Street: Restricted STAG2 Appraisal Summary Table

| **Proposal Details** | | | |
|---|---|---|---|
| *Name and address of authority promoting the proposal* | | | |
| *Proposal name* | | *Name of planner* | |
| *Proposal description* | | *Capital Costs/Grant*<br>*Revenue Support*<br>*PV Costs* | £m<br>£m/year |
| *Funding sought from* | N/A | *Amount of application* | N/A |
| **Proposal Background** | | | |
| *Geographic context* | | | |
| *Social context* | | | |
| *Economic context* | | | |
| **Planning Objectives** | | | |
| *Planning objectives* | *Performance against planning objectives* | | |
| • To improve accessibility<br>• To reduce pollution<br>• To reduce congestion<br>• To make the transport system safer and more secure | | | |
| *Rationale for selection of proposal* | | | |
| **Implementability Appraisal** | | | |
| *Technical* | George Street has a high level of PU apparatus, resulting in high cost and extended construction period. | | |
| *Operational* | Run time of 420 seconds between the Picardy Place and Shandwick Place stops. Some road closures throughout year will necessitate alternative operational plan. | | |
| *Financial* | Estimated capital cost overall of £16.1m, excluding PUs | | |
| *Public* | Public consultation highlighted concerns about the environmental and heritage impact of running on George Street and Charlotte Square. | | |
| **Environment** | | | |
| *Mitigation options included (costs and benefits)* | | | |
| **Sub-objective** | **Qualitative information** | **Quantitative information** | **Significance of impact** |
| Noise and vibration | Tram will not adversely impact upon already high daytime ambient noise level. However, during evening and night (post 7:00pm) operating periods, tram will become dominant noise source. Tight radii at either end of George Street will likely lead to some wheel squeal. | | Moderate adverse |
| Air quality — overall | | | |
| Air quality $CO_2$ — global | | | |
| $PM_{10}$ – local | | | |
| $NO_2$ – local | | | |
| Water quality, drainage and flood defence | No significant impacts | | |
| Geology | No significant impacts | | |
| Biodiversity | No significant impacts | | |
| Visual amenity | Large impact due to scale of vehicle related impact. OLE wires and poles have an impact on primary view along street. | | Large adverse |

| | | | |
|---|---|---|---|
| Landscape / Townscape | OLE very detrimental. George Street is the prime street in the urban design hierarchy of the New Town and thus the most sensitive. | World Heritage Site;Conservation Area | Large adverse |
| Agriculture and soils | No significant impacts | | |
| Cultural heritage | Connection to building facades possible, but listed building consents may not be forthcoming. Strong objection from Historic Scotland to route through Charlotte Square. | | |

**Safety**

| Sub-objective | Item | Qualitative information statement | Quantitative information |
|---|---|---|---|
| Accidents | Change in annual personal injury accidents | Reduced pedestrian conflict due to change to pelican from zebra crossings at three junctions. | |
| | Change in balance of severity | | |
| | Total discounted savings | | |
| Security | | Security improvements to those transferring from bus. Low pedestrian activity outside business hours potentially increases risk. | Small positive |

**Economy**

| Sub-objective | Item | Qualitative information | Quantitative information |
|---|---|---|---|
| User Benefits | Travel Time | Long run time reduces benefits to through trips. Good penetration of commercial and business centre of Edinburgh. Poor integration with bus network reduces potential benefits. | Early testing indicated annual patronage of 10.32m p.a. (assuming railway corridor alignment at the Telford Road option) |
| | User Charges | | |
| | Vehicle Operating Costs | | |
| | Quality / Reliability Benefits | | |
| Private Sector Operator Impacts | Investment Costs | | |
| | Operating & Maintenance Costs | | |
| | Revenues | | |
| | Grant/Subsidy payments | | |
| Economic activity and location impacts | Local Economic Impacts | | |
| | National Economic Impacts | | |
| | Distributional Impacts | | |

**Integration**

| Sub-objective | Item | Qualitative information | Quantitative information |
|---|---|---|---|
| Transport interchanges | Services & ticketing | Poor integration with bus network. | |
| | Infrastructure & information | | |
| Land-use transport integration | Transport assessment | No significant impacts | |
| Policy integration | Fit with key policies | No significant impacts | |

**Accessibility & Social Inclusion**

| Sub-objective | Item | Qualitative information | Quantitative information |
|---|---|---|---|
| Community accessibility | Public transport network coverage | | |
| | Access to other local services | | |
| Comparative accessibility | Distribution / Spatial impacts by social group | | |
| | Distribution / Spatial impacts by area | | |

**Cost to Public Sector**

| Item | Qualitative information | Quantitative information |
|---|---|---|
| Public Sector Investment Costs | | |
| Public Sector Operating & Maintenance Costs | | |
| Grant/Subsidy Payments | | |
| Revenues | | |
| Taxation Impacts | | |
| **Monetised Summary** | | |
| Present Value of Transport Benefits | | |
| Present Value of Cost to Government | | |
| Net Present Value | | |
| Benefit-Cost to Government Ratio | | |

### Table 7.2 Princes Street: Restricted STAG2 Appraisal Summary Table

| **Proposal Details** | | | |
|---|---|---|---|
| *Name and address of authority promoting the proposal* | | | |
| *Proposal name* | | *Name of planner* | |
| *Proposal description* | | *Capital Costs/Grant*<br>*Revenue Support*<br>*PV Costs* | £m<br>£m/year |
| *Funding sought from* | N/A | *Amount of application* | N/A |
| **Proposal Background** | | | |
| *Geographic context* | | | |
| *Social context* | | | |
| *Economic context* | | | |
| **Planning Objectives** | | | |
| *Planning objectives* | *Performance against planning objectives* | | |
| • To improve accessibility<br>• To reduce pollution<br>• To reduce congestion<br>• To make the transport system safer and more secure | | | |
| *Rationale for selection of proposal* | | | |
| **Implementability Appraisal** | | | |
| *Technical* | A moderate level of PU apparatus necessitating diversions will incur capital cost and associated construction disruption. | | |
| *Operational* | Run time of 364 seconds between the Picardy Place and Shandwick Place stops. A number of road closures throughout year will necessitate alternative operational plan. | | |
| *Financial* | Estimated capital cost overall of £15.3m, excluding PUs. | | |
| *Public* | Princes Street was supported by 66% of public consultation respondents. Princes Street offered the best balance between accessibility for the public, visual impact and commercial gain for city centre businesses and tourist attractions. | | |
| **Environment** | | | |
| *Mitigation options included (costs and benefits)* | | | |
| **Sub-objective** | **Qualitative information** | **Quantitative information** | **Significance of impact** |
| Noise and vibration | Tram will not adversely impact upon already high daytime ambient noise level. However, during late evening and night (post 11:00pm) operating periods, tram will become dominant noise source. | | Small adverse |

| | | | |
|---|---|---|---|
| Air quality — overall | | | |
| Air quality $CO_2$ — global | | | |
| $PM_{10}$ – local | | | |
| $NO_2$ – local | | | |
| Water quality, drainage and flood defence | No significant impacts | | |
| Geology | No significant impacts | | |
| Biodiversity | No significant impacts | | |
| Visual amenity | Impacts on views to Castle across OLE and down street along OLE | | Large adverse |
| Landscape / Townscape | OLE detrimental (but on balance less so than in George Street) | World Heritage Site and Conservation Area | Large adverse |
| Agriculture and soils | No significant impacts | | |
| Cultural heritage | | | |

**Safety**

| **Sub-objective** | **Item** | **Qualitative information statement** | **Quantitative information** |
|---|---|---|---|
| Accidents | Change in annual personal injury accidents | Improvement in pedestrian safety arising from installation of pedestrian crossings and fixed track route for tram. | |
| | Change in balance of severity | | |
| | Total discounted savings | | |
| Security | | Security improvements to those transferring from bus. High pedestrian volumes promotes safer environment. | Small positive |

**Economy**

| **Sub-objective** | **Item** | **Qualitative information** | **Quantitative information** |
|---|---|---|---|
| User Benefits | Travel Time | Good penetration of commercial and business centre of Edinburgh. Good interchange with bus network and softer factors (tourism, safety and security) maximise patronage benefits. | Early testing indicated annual patronage of 10.5m p.a. (assuming railway corridor alignment at the Telford Rd option) |
| | User Charges | | |
| | Vehicle Operating Costs | | |
| | Quality / Reliability Benefits | | |
| Private Sector Operator Impacts | Investment Costs | | |
| | Operating & Maintenance Costs | | |
| | Revenues | | |
| | Grant/Subsidy payments | | |
| Economic activity and location impacts | Local Economic Impacts | | |
| | National Economic Impacts | | |
| | Distributional Impacts | | |

**Integration**

| **Sub-objective** | **Item** | **Qualitative information** | **Quantitative information** |
|---|---|---|---|
| Transport interchanges | Services & ticketing | Good integration with bus network. | |
| | Infrastructure & information | | |
| Land-use transport integration | Transport assessment | No significant impacts | |

| | | | |
|---|---|---|---|
| Policy integration | Fit with key policies | Provision of Line 1 consistent with historic and existing polices for transport and land use planning | |
| **Accessibility & Social Inclusion** | | | |
| **Sub-objective** | **Item** | **Qualitative information** | **Quantitative information** |
| Community accessibility | Public transport network coverage | | |
| | Access to other local services | | |
| Comparative accessibility | Distribution / Spatial impacts by social group | | |
| | Distribution / Spatial impacts by area | | |
| **Cost to Public Sector** | | | |
| **Item** | | **Qualitative information** | **Quantitative information** |
| Public Sector Investment Costs | | | |
| Public Sector Operating & Maintenance Costs | | | |
| Grant/Subsidy Payments | | | |
| Revenues | | | |
| Taxation Impacts | | | |
| **Monetised Summary** | | | |
| Present Value of Transport Benefits | | | |
| Present Value of Cost to Government | | | |
| Net Present Value | | | |
| Benefit-Cost to Government Ratio | | | |

**Table 7.3 Telford Road: Restricted STAG2 Appraisal Summary Table**

| | | | |
|---|---|---|---|
| **Proposal Details** | | | |
| *Name and address of authority promoting the proposal* | | | |
| *Proposal name* | | *Name of planner* | |
| *Proposal description* | | *Capital Costs/Grant*<br>*Revenue Support*<br>*PV Costs* | £m<br>£m/year |
| *Funding sought from* | | *Amount of application* | N/A |
| **Proposal Background** | | | |
| *Geographic context* | | | |
| *Social context* | | | |
| *Economic context* | | | |
| **Planning Objectives** | | | |
| *Planning objectives* | *Performance against planning objectives* | | |
| • To improve accessibility<br>• To reduce pollution<br>• To reduce congestion<br>• To make the transport system safer and more secure | | | |
| *Rationale for selection of proposal* | | | |
| **Implementability Appraisal** | | | |
| *Technical* | Route length 2.54km, 47% segregated (Craigleith to Caroline Park). Landtake required, notably at northern end to access Western Approach Road. Significant traffic interface issues, requiring new and revised signalisation and loss of parking. Significant earthworks and PU diversions required | | |
| *Operational* | Run time 5.9mins (Craigleith to Caroline Park), excluding junction delays. | | |
| *Financial* | Capital cost £15.4m | | |
| *Public* | Public consultation responses showed Telford Road as the favoured route. However, some of the weighting is the result of a number of petitions and actions by cycle groups. Concern about safety | | |

| | |
|---|---|
| | and/or loss of cycleway along former railway solum. |

**Environment**

*Mitigation options included (costs and benefits)*

| Sub-objective | Qualitative information | Quantitative information | Significance of impact |
|---|---|---|---|
| Noise and vibration | Tram will not adversely impact upon already high daytime ambient noise level. However, during evening and night (post 7:00pm) operating periods, tram will become dominant noise source. Tight radii at access onto Telford Road will likely lead to some wheel squeal. | | Small adverse |
| Air quality — overall | Traffic impacts arising from street running may adversely affect air quality. | | Small adverse |
| Air quality $CO_2$ — global | | | |
| $PM_{10}$ – local | | | |
| $NO_2$ – local | | | |
| Water quality, drainage and flood defence | No significant impacts | | Neutral |
| Geology | Contaminated ground likely to be present at Fire Training Ground and disused petrol station on alignment. These require remedial work before construction. | | Small positive |
| Biodiversity | No significant impacts | | Neutral |
| Visual amenity | Some visual impacts to properties on Telford Road and Groathill Avenue. | | Moderate adverse |
| Landscape / Townscape | Potential impacts on Telford Road and Groathill Avenue. | | Moderate adverse |
| Agriculture and soils | No significant impacts | | Neutral |
| Cultural heritage | No significant impacts | | Neutral |

**Safety**

| Sub-objective | Item | Qualitative information | Quantitative information |
|---|---|---|---|
| Accidents | Change in annual personal injury accidents | On-street mixed running may marginally increase risk of highway related accidents. | |
| | Change in balance of severity | | |
| | Total discounted savings | | |
| Security | | Security improvements to those transferring from bus. On-street stop location provides visibility and presence of tram stop, with positive impact on personal security and incidence of crime. | |

**Economy**

| Sub-objective | Item | Qualitative information | Quantitative information |
|---|---|---|---|
| User Benefits | Travel Time | Extended run times reduces level of through patronage. Local patronage maximised through visible presence and | Early testing indicated annual patronage of 10.32m p.a. (assuming Princes Street option in the City Centre) |
| | User Charges | | |
| | Vehicle Operating Costs | | |

| | | | |
|---|---|---|---|
| | Quality / Reliability Benefits | direct access.<br>On-street alignment reduces highway capacity, with negative impact on non-user benefits. | |
| Private Sector Operator Impacts | Investment Costs | | |
| | Operating & Maintenance Costs | | |
| | Revenues | | |
| | Grant/Subsidy payments | | |
| Economic activity and location impacts | Local Economic Impacts | No significant impacts | |
| | National Economic Impacts | | |
| | Distributional Impacts | | |
| **Integration** | | | |
| **Sub-objective** | **Item** | **Qualitative information** | **Quantitative information** |
| Transport interchanges | Services & ticketing | Good integration with bus network. | |
| | Infrastructure & information | | |
| Land-use transport integration | Transport assessment | | |
| Policy integration | Fit with key policies | | |
| **Accessibility & Social Inclusion** | | | |
| **Sub-objective** | **Item** | **Qualitative information** | **Quantitative information** |
| Community accessibility | Public transport network coverage | Provides good access to the Drylaw and Craigleith areas of north west Edinburgh. | |
| | Access to other local services | Provides good access (50m from stop) to the Western General Hospital (rear entrance). | |
| Comparative accessibility | Distribution / Spatial impacts by social group | | |
| | Distribution / Spatial impacts by area | | |
| **Cost to Public Sector** | | | |
| **Item** | | **Qualitative information** | **Quantitative information** |
| Public Sector Investment Costs | | | |
| Public Sector Operating & Maintenance Costs | | | |
| Grant/Subsidy Payments | | | |
| Revenues | | | |
| Taxation Impacts | | | |
| **Monetised Summary** | | | |
| Present Value of Transport Benefits | | | |
| Present Value of Cost to Government | | | |
| Net Present Value | | | |
| Benefit-Cost to Government Ratio | | | |

## Table 7.4 Former Railway Solum: Restricted STAG2 Appraisal Summary Table

| **Proposal Details** | | | |
|---|---|---|---|
| *Name and address of authority promoting the proposal* | | | |
| *Proposal name* | | *Name of planner* | |
| *Proposal description* | | *Capital Costs/Grant*<br>*Revenue Support*<br>*PV Costs* | <br>£m<br>£m/year |
| *Funding sought from* | | *Amount of application* | N/A |

| **Proposal Background** | |
|---|---|
| *Geographic context* | |
| *Social context* | |
| *Economic context* | |

| **Planning Objectives** | |
|---|---|
| *Planning objectives* | *Performance against planning objectives* |
| • To improve accessibility<br>• To reduce pollution<br>• To reduce congestion<br>• To make the transport system safer and more secure | |
| *Rationale for selection of proposal* | |

| **Implementability Appraisal** | |
|---|---|
| *Technical* | Route length 2.40km, 100% segregated (Craigleith to Ferry Road stop). Negligible PU apparatus. |
| *Operational* | Run time 4.9mins (Craigleith to Caroline Park), with no traffic interfaces. |
| *Financial* | Capital cost £6.4m |
| *Public* | The public consultation showed strong support for the railway corridor as a means of segregating trams from traffic and lessening congestion in the Telford Road area. |

| **Environment** | | | |
|---|---|---|---|
| *Mitigation options included (costs and benefits)* | | | |
| **Sub-objective** | **Qualitative information** | **Quantitative information** | **Significance of impact** |
| Noise and vibration | Potential noise impacts from tram operations to properties adjacent to alignment, where present ambient noise levels are low. Noise impacts may be significant at night. A wide corridor of land is available between Telford Road and Ferry Road and it may be possible to incorporate noise barriers or similar measures into any peripheral corridor landscaping / planting providing some noise mitigation for adjacent residential properties. | | Moderate adverse |
| Air quality — overall | No significant impacts | | Neutral |
| Air quality $CO_2$ — global | | | |
| $PM_{10}$ – local | | | |
| $NO_2$ – local | | | |
| Water quality, drainage and flood defence | No significant impacts | | Neutral |
| Geology | No significant impacts | | Neutral |
| Biodiversity | Loss of small areas of habitat (designated Urban Wildlife Site). Badgers are known to reside on the railway corridor and therefore mitigation measures may be required. | | Small adverse |

| | | | |
|---|---|---|---|
| Visual amenity | Some visual impact on rear of Groathill Road properties | | Small adverse |
| Landscape / Townscape | Significant vegetation clearance required | | large adverse |
| Agriculture and soils | No significant impacts | | Neutral |
| Cultural heritage | No significant impacts | | Neutral |
| **Safety** | | | |
| **Sub-objective** | **Item** | **Qualitative information statement** | **Quantitative information** |
| Accidents | Change in annual personal injury accidents | No impact on highway accident levels. | |
| | Change in balance of severity | | |
| | Total discounted savings | | |
| Security | | Security improvements to those transferring from bus. | Small positive |
| **Economy** | | | |
| **Sub-objective** | **Item** | **Qualitative information** | **Quantitative information** |
| User Benefits | Travel Time | Able to maintain high running speeds, maximising level of through patronage. Segregated alignment has no direct impact on highway network operation. | Early testing indicated annual patronage of 10.51m p.a. (assuming Princes Street option in the City Centre) |
| | User Charges | | |
| | Vehicle Operating Costs | | |
| | Quality / Reliability Benefits | | |
| Private Sector Operator Impacts | Investment Costs | | |
| | Operating & Maintenance Costs | | |
| | Revenues | | |
| | Grant/Subsidy payments | | |
| Economic activity and location impacts | Local Economic Impacts | No significant impacts | |
| | National Economic Impacts | | |
| | Distributional Impacts | | |
| **Integration** | | | |
| **Sub-objective** | **Item** | **Qualitative information** | **Quantitative information** |
| Transport interchanges | Services & ticketing | Effective signage and marketing will ensure good integration with bus network from the Groathill Road North stop. | |
| | Infrastructure & information | | |
| Land-use transport integration | Transport assessment | | |
| Policy integration | Fit with key policies | | |
| **Accessibility & Social Inclusion** | | | |
| **Sub-objective** | **Item** | **Qualitative information** | **Quantitative information** |
| Community accessibility | Public transport network coverage | Provides good access to the Drylaw and Craigleith areas of north-west Edinburgh. | |
| | Access to other local services | Provides reasonable access (350m from stop) to the Western General Hospital (rear entrance). | |
| Comparative accessibility | Distribution / Spatial impacts by social group | | |
| | Distribution / Spatial impacts by area. | | |
| **Cost to Public Sector** | | | |

| Item | Qualitative information | Quantitative information |
|---|---|---|
| Public Sector Investment Costs | | |
| Public Sector Operating & Maintenance Costs | | |
| Grant/Subsidy Payments | | |
| Revenues | | |
| Taxation Impacts | | |
| **Monetised Summary** | | |
| Present Value of Transport Benefits | | |
| Present Value of Cost to Government | | |
| Net Present Value | | |
| Benefit-Cost to Government Ratio | | |

## 7.2 Line 1

### 7.2.1 Central Case Definition

This section provides a summary of the transport impacts from the implementation of the Central Case (Line 1 option), which has been modelled with basis on the following assumptions:

- Line 1 with 8tph and a run time of 40.5 minutes (with a 4.5 minute layover assumed at Lower Granton Road, giving 45 minutes in total);
- 23 stops, corresponding to those presented at public consultation, but with two stops on Princes Street (see section 7.2.2 below);
- Fares parity with buses;
- Bus network changes as set out in Section 6.7; and
- Unchanged bus speeds between the Reference Case and Line 1 (see Section 6.7.5).

Sensitivities around this Central Case have been carried out and are presented in Section 8.6.

### 7.2.2 Princes Street

Full consultation has been undertaken during the development of the scheme to ensure all relevant parties and stakeholders views and principles have been taken into account during the design of the scheme. Within the timescale of this STAG appraisal process there have been several material revisions to the scheme design along Princes Street.

The current design, which is reflected in the qualitative appraisal throughout this STAG2, assumes the removal of westbound traffic on Princes Street and a central public transport lane provided in both directions, with tram and bus sharing this lane. A second discontinuous lane is provided in both directions to accommodate bus stopping and limited amounts of bus running. At key points, where the second lane is discontinued, widened pavements are provided to provide tram stops, reduced length pedestrian crossings and improved pedestrian circulation space.

Earlier designs retained the westbound traffic, with segregated tram running on central lanes and a bus lane in each direction, making five lanes in total. The roadway width was greater than that currently occupied and resulted in the loss of a narrow strip of Princes Street Gardens to accommodate it. Whilst robust from a transport viewpoint, the townscape impact and the wider aspirations for Princes Street precluded this option. Due to the long lead times and complexity of the transport modelling, the assessment and quantitative analysis of the route (noise and air quality, transport economic efficiency

and accessibility) is based on the earlier five lane solution. The local transport effects along Princes Street have been subsequently reviewed on the basis of the revised configuration using a detailed micro-simulation model (VISSIM) to ensure that the tram and bus run times are not penalised. As part of the revised configuration the two stops on Princes Street were rationalised into one more centrally located stop revising the total number of stops to 22. From this work it can be concluded that the net impact of the design changes on the operational performance of the scheme will be negligible.

CETM was approved after the current tram appraisal had begun and therefore was not specified within the original scope of the work specified for this stage. Its impact on the current design of appropriate integrated layouts is under high-level review. No detailed consideration of CETM is taken into account within the current reports.

### 7.2.3 Transport Impacts

This section sets out the demand for Line 1 and the associated impacts on other public transport demand and on the highway network. The information presented here is based on the outputs from a comprehensive computer based transport modelling process; demand forecasts and other outputs from the transport model are used in calculating the economic benefits from the options (e.g. travel time savings), as well as some environmental (e.g. highway pollutant emissions) and safety impacts (e.g. number of accidents). Appendix A details the transport model used.

Demand forecasts for Line 1 were previously undertaken at OBC (see Section 4.2.1); the forecasts presented here are based on the latest modelling analysis using a more comprehensive and robust modelling tool. It is considered that use of the current modelling tool would broadly replicate the results presented in the OBC in relative terms, but with lower demand levels across the options. In that context, the conclusions of the OBC remain robust.

The impact on overall travel demand[20] is presented in Table 7.5. The increase in public transport trips is significant, reaching nearly 4,000 in the 2026 AM Peak hour; the reduction in car travel is less marked, but significant nevertheless.

**Table 7.5 Hourly Travel Demand (Person Trips) by Public and Private Transport**

| | | 2011 | | | 2026 | | |
|---|---|---|---|---|---|---|---|
| | | AM | IP | PM | AM | IP | PM |
| Reference Case | Public transport | 45,595 | 27,484 | 42,030 | 48,555 | 28,501 | 46,174 |
| | Private car/LGV | 172,293 | 130,079 | 201,140 | 218,546 | 160,317 | 252,245 |
| Line 1 | Public transport | 46,980 | 28,442 | 43,406 | 52,484 | 30,769 | 49,007 |
| | Private car/LGV | 171,696 | 130,060 | 200,723 | 216,472 | 160,430 | 250,329 |
| Differences | Public transport | 1,385 | 958 | 1,376 | 3,929 | 2,268 | 2,833 |
| | Private car/LGV | -598 | -19 | -417 | -2,074 | 113 | -1,916 |

Table 7.6 presents the Line 1 aggregate demand by modelled period (morning peak, inter-peak and afternoon peak) and year (2011 and 2026). Broadly, the demand is comparable by direction, with the clockwise direction being materially higher in the PM peak. Annual demand is forecast at some

[20] Throughout the modelled area of Edinburgh and its environs.

9.44m in 2011[21], growing strongly to reach 13.69m by 2026. This growth is largely as a result of increasing traffic congestion making the tram increasingly attractive. The estimated revenue is £6.59m and £9.62m, respectively, giving average fare yields of around 70pence/trip. This is in line with expectations, given the current fare scales, ticket mix and ticket fraud assumptions.

**Table 7.6 Hourly Line 1 Demand**

| | 2011 | | | 2026 | | |
|---|---|---|---|---|---|---|
| | AM | IP | PM | AM | IP | PM |
| Clockwise | 2,010 | 1,208 | 2,131 | 3,175 | 1,485 | 3,376 |
| Anti-clockwise | 2,040 | 1,063 | 1,727 | 3,231 | 1,349 | 2,395 |
| Total | 4,050 | 2,271 | 3,858 | 6,406 | 2,834 | 5,771 |
| Annual demand | | 9.44m | | | 13.69m | |
| Annual revenue (£m, 2003 prices) | | £6.59m | | | £9.62m | |

A significant proportion of this demand is trips new to public transport; this is illustrated in Table 7.7. These new public transport trips include trips transferring from car and generated trips (trips that were not made at all previously or additional trips arising from increases in trip frequency). In 2011, some 16%-20% of Line 1 demand will be new public transport passengers; this will increase up to 28% in 2026. These estimates compare well with observed data from existing light rail systems, which typically have around 20% of demand being former car users.

**Table 7.7 Hourly Line 1 Demand from New PT Trips**

| | 2011 | | | 2026 | | |
|---|---|---|---|---|---|---|
| | AM | IP | PM | AM | IP | PM |
| Central Case Demand | 4,050 | 2,271 | 3,858 | 6,406 | 2,834 | 5,771 |
| of which new PT demand | 794 | 364 | 708 | 1,793 | 659 | 1,178 |
| % of Central Case | 20 | 16 | 18 | 28 | 23 | 20 |

The impact on public transport demand is significant, as demonstrated in Table 7.8, in terms of the number of boardings by mode, presented by modelled hour (morning peak, inter-peak and afternoon peak) and year. The impact in 2011 reduces bus demand by some 2,400 boardings in the peaks and around 1,200 in the inter-peak. By 2026, the impact is less marked, due to the growth in the overall public transport market due to Line 1. This point is also reflected in the analysis of new PT demand presented in Table 7.7.

[21] This compares to some 20m previously estimated in the Waterford Transit Modelling Report (2001) for the tram option – see Table 4.1. Demand for the guided bus option has not been estimated at this study stage, but would be expected to reduce proportionately from the original 9.3m.

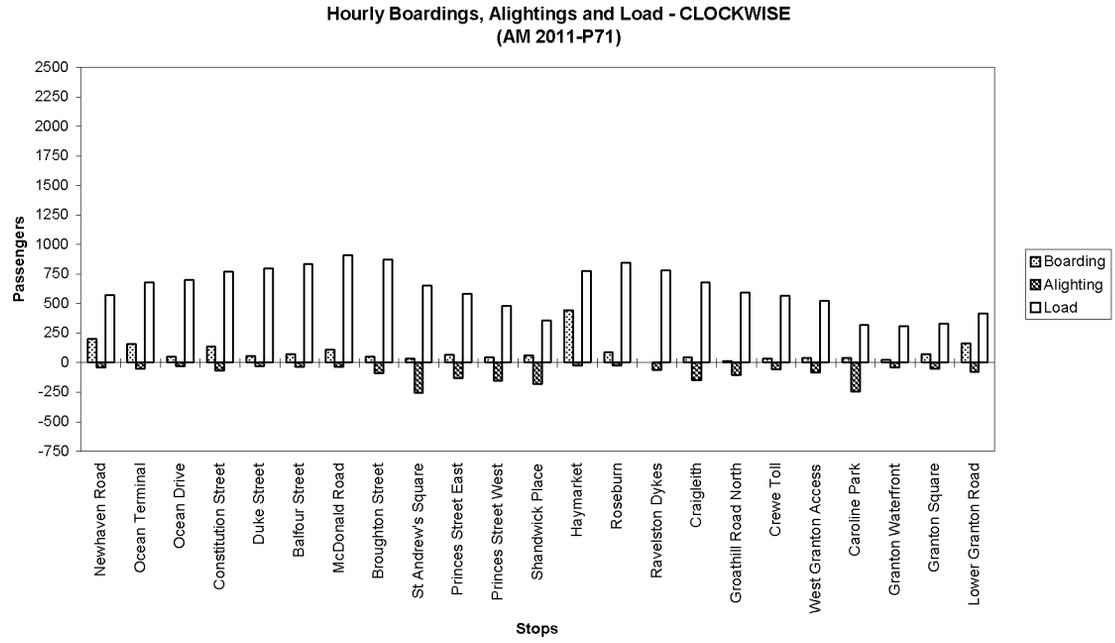
**Table 7.8 Hourly PT Boardings by Mode**

| Test | Mode | 2011 | | | 2026 | | |
|---|---|---|---|---|---|---|---|
| | | AM | IP | PM | AM | IP | PM |
| **Reference Case** | Bus | 41,400 | 26,290 | 40,255 | 41,910 | 27,085 | 41,932 |
| | Rail | 10,878 | 3,851 | 8,905 | 16,545 | 5,128 | 14,403 |
| | Line 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Total | 52,278 | 30,140 | 49,160 | 58,455 | 32,213 | 56,335 |
| | *(Demand* | *45,595* | *27,484* | *42,030* | *48,555* | *28,501* | *46,174)* |
| **Line 1** | Bus | 38,996 | 25,080 | 37,887 | 39,942 | 26,766 | 38,783 |
| | Rail | 10,952 | 3,852 | 8,952 | 17,416 | 5,234 | 15,034 |
| | Line 1 | 4,050 | 2,271 | 3,858 | 6,406 | 2,834 | 5,771 |
| | Total | 53,998 | 31,203 | 50,697 | 63,764 | 34,834 | 59,588 |
| | *(Demand* | *46,980* | *28,442* | *43,406* | *52,484* | *30,769* | *49,007)* |
| **Changes** | Bus | -2,404 | -1,210 | -2,368 | -1,968 | -1,039 | -3,149 |
| | Rail | 74 | 1 | 47 | 871 | 106 | 631 |
| | Line 1 | 4,050 | 2,271 | 3,858 | 6,406 | 2,834 | 5,771 |
| | Total | 1,720 | 1,062 | 1,537 | 5,309 | 1,901 | 3,253 |
| | *(Demand* | *1,385* | *958* | *1,376* | *3,929* | *2,268* | *2,833)* |

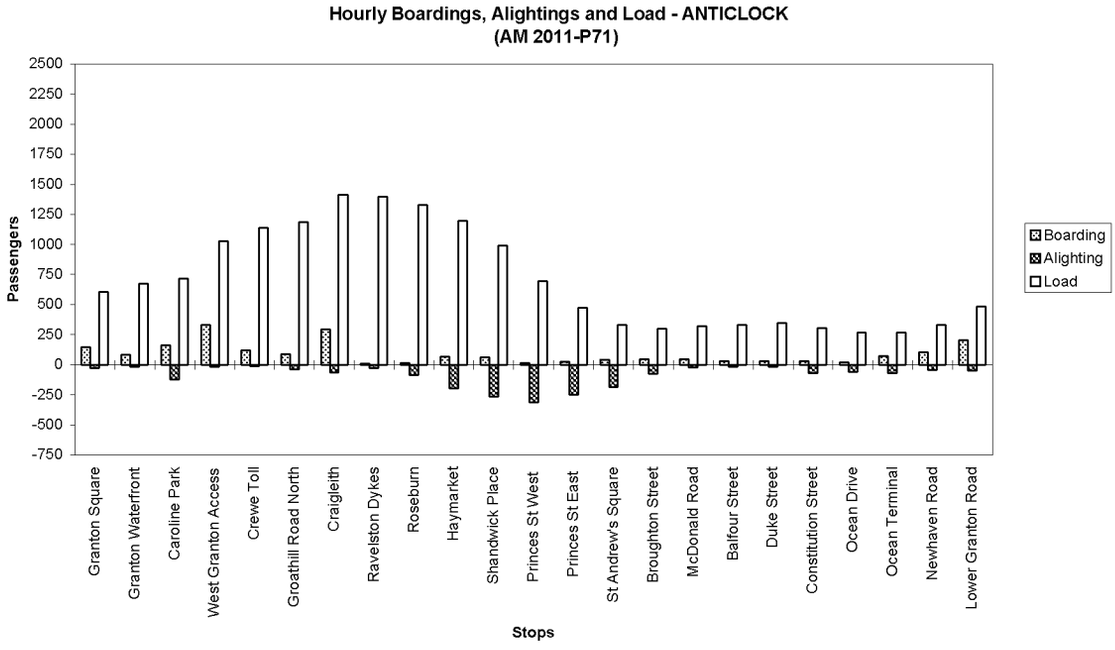
Line 1 demand profiles are presented in the following figures by year (2011 and 2026), period (AM Peak Hour, IP Hour and PM Peak Hour) and by direction (clockwise and anti-clockwise). Key points to note are:

- Although each direction has comparable boarding volumes overall, the trip patterns do lead to differing levels and locations of peak flow;
- The Leith Walk corridor has lower volumes of demand than the Roseburn corridor, due to the high level of bus competition on the former;
- Key trip generators are the section between Haymarket and St. Andrews Square and Granton. Leith and Leith Docks are lower, again reflecting the level of bus competition from this market; and
- The Inter-peak demand is low and even along the route, compared to the Peaks, where the AM Peak anti-clockwise direction and PM Peak clockwise direction have significant peak flows.

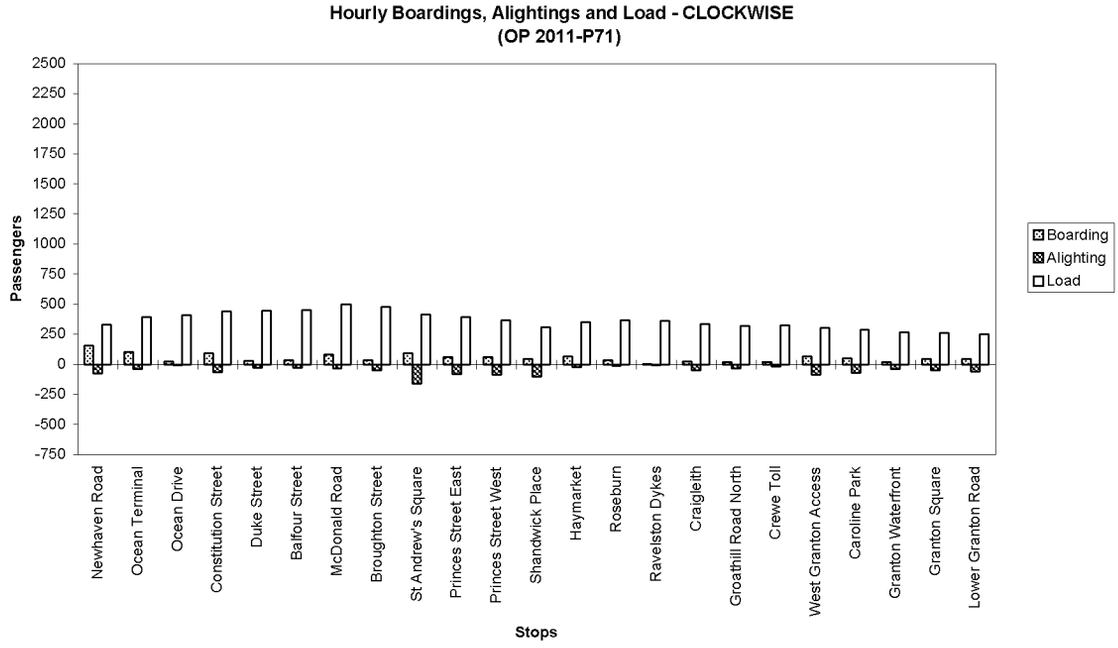
## Figure 7.1 2011 AM Clockwise Flows



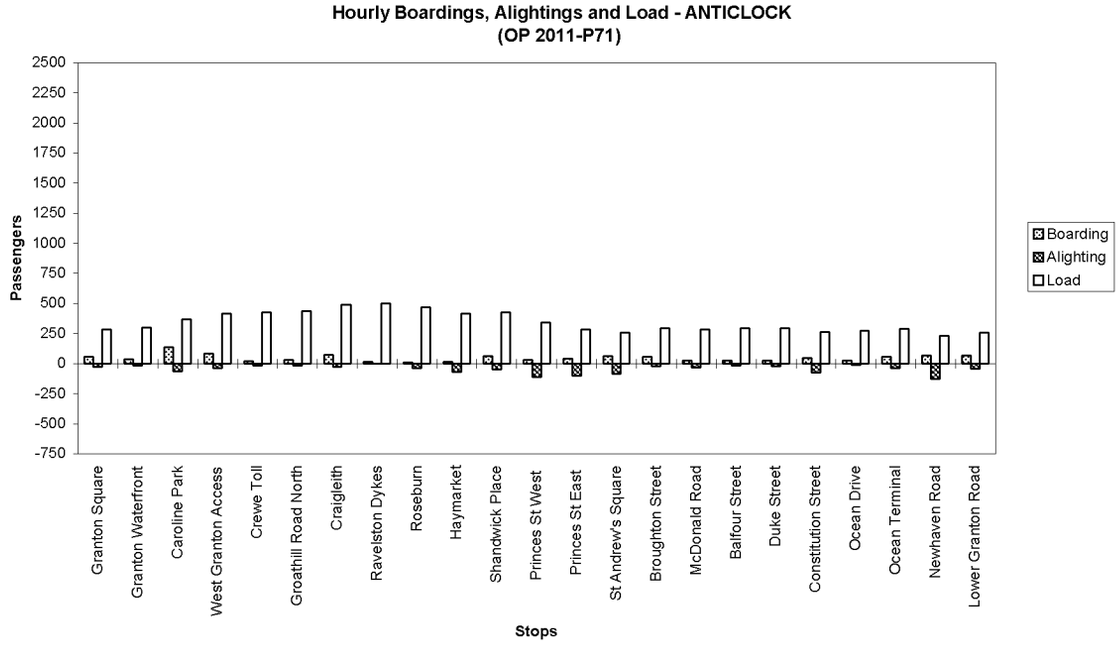

## Figure 7.2 2011 AM Anti Clockwise Flows



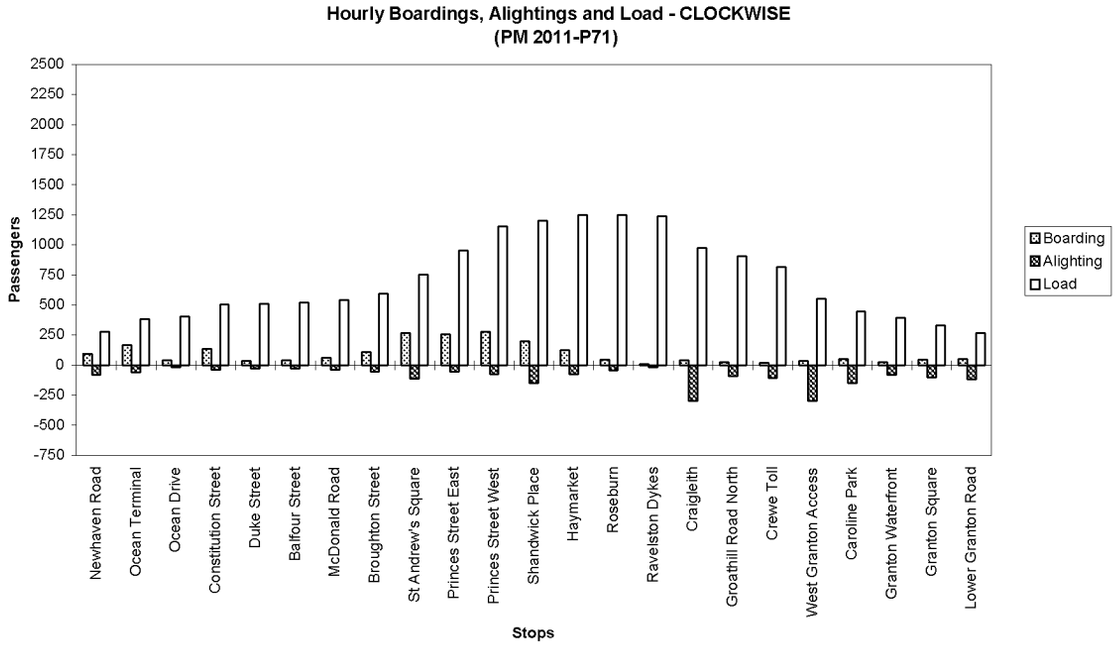
## Figure 7.3 2011 IP Clockwise Flows



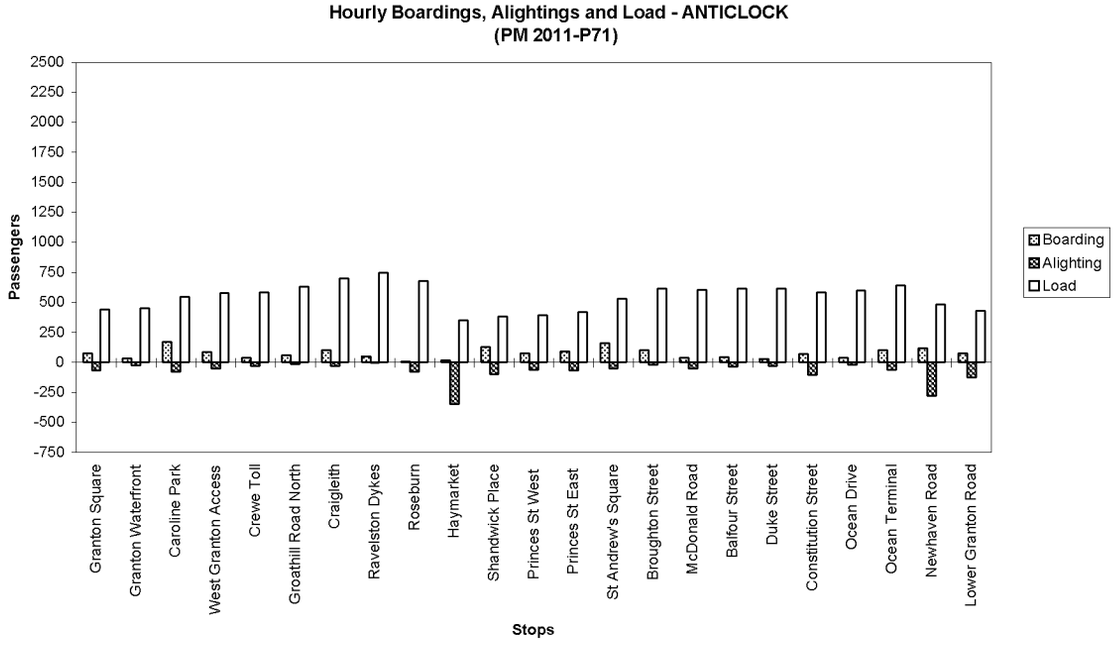

## Figure 7.4 2011 IP Anti Clockwise Flows



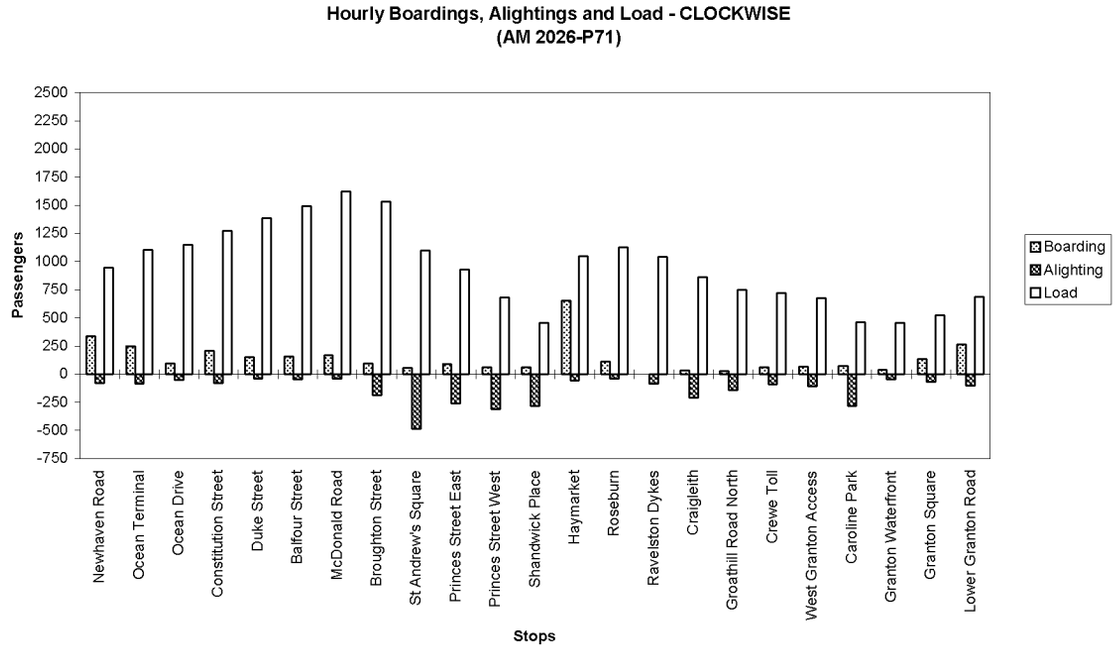
## Figure 7.5 2011 PM Clockwise Flows



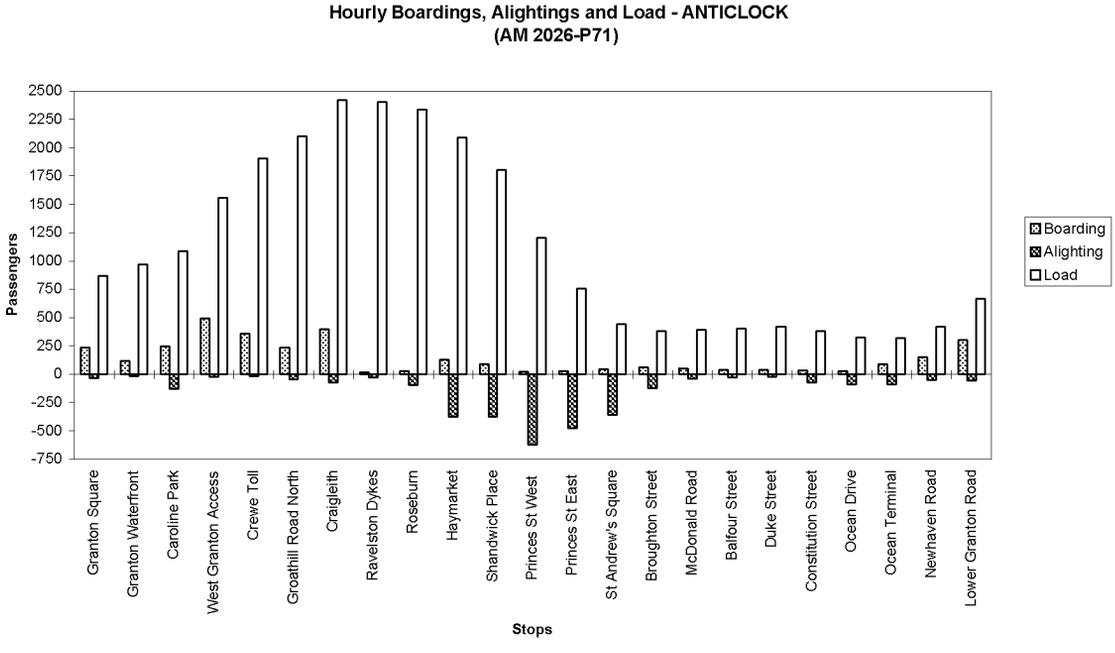

## Figure 7.6 2011 PM Anti Clockwise Flows



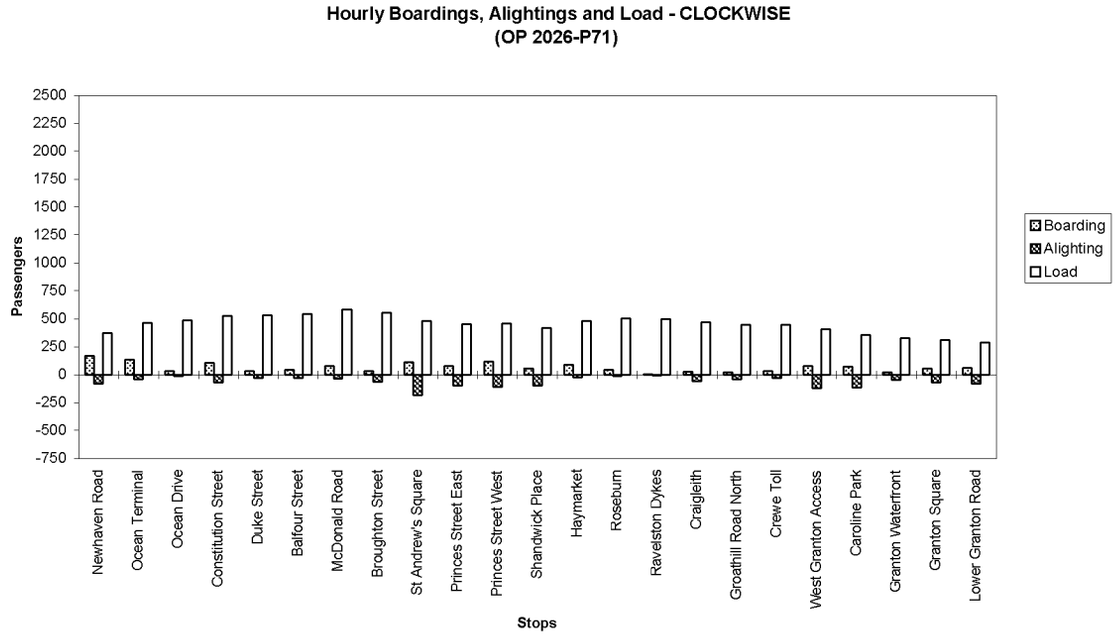
## Figure 7.7 2026 AM Clockwise Flows



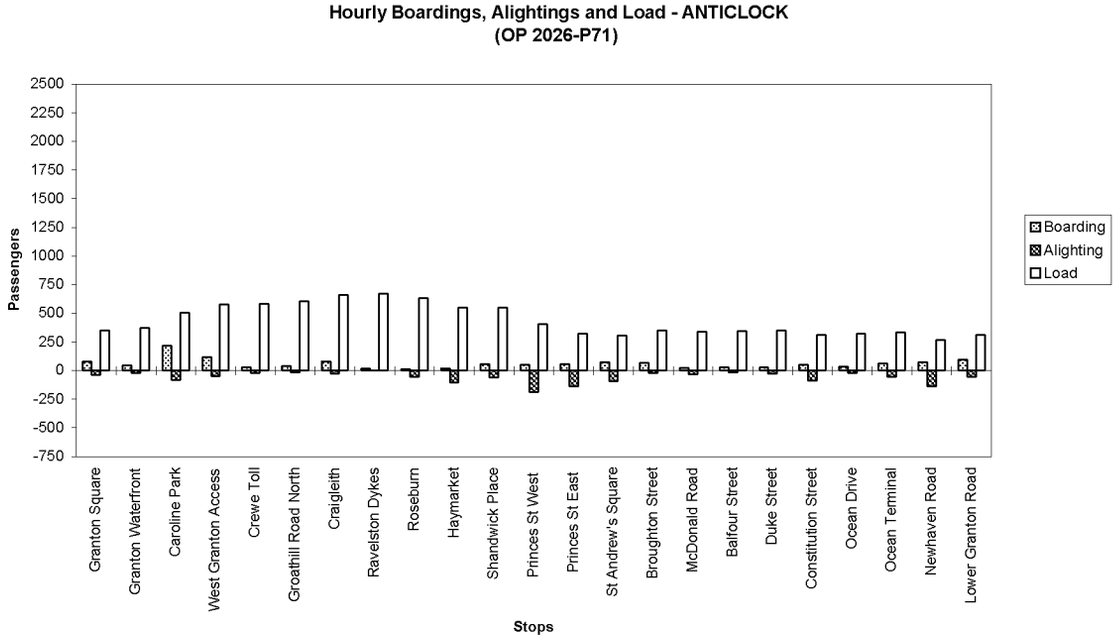

## Figure 7.8 2026 AM Anti Clockwise Flows



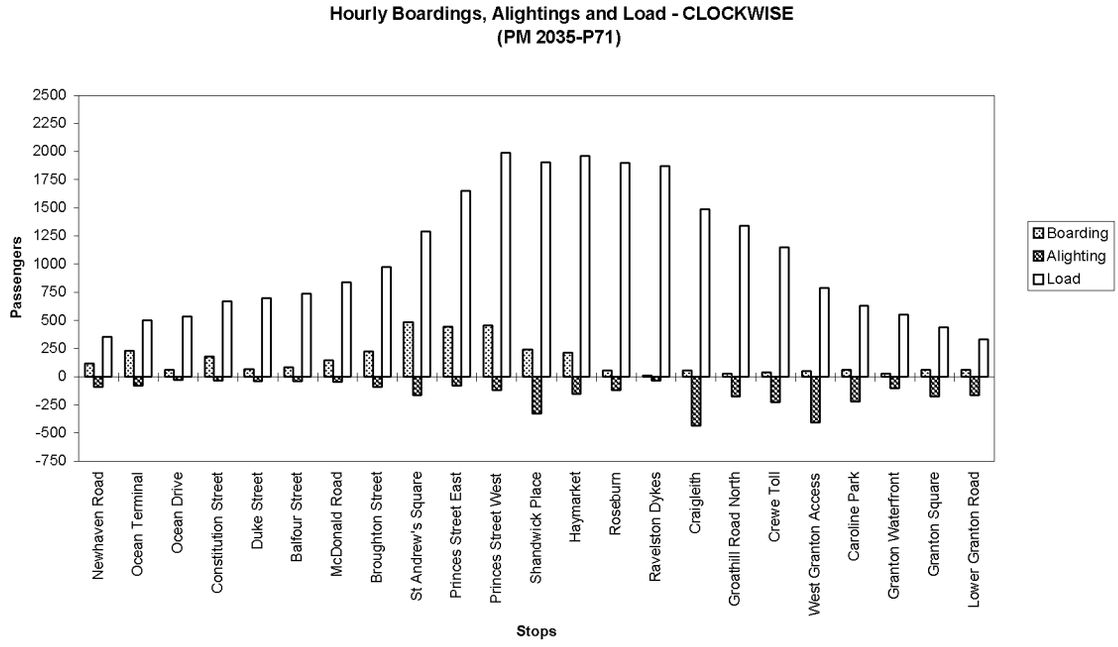
## Figure 7.9 2026 IP Clockwise Flows



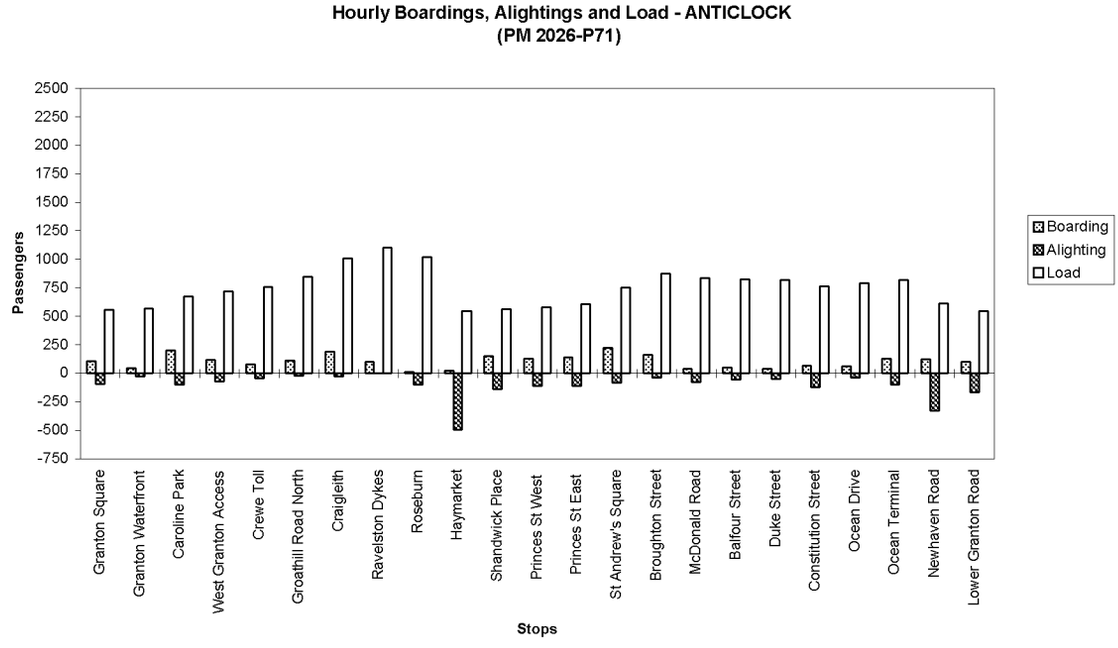

## Figure 7.10 2026 IP Anti Clockwise Flows



## Figure 7.11 2026 PM Clockwise Flows




## Figure 7.12 2026 PM Anti Clockwise Flows



## 7.3 Assessment Against the Planning Objectives

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 Line 1 against the planning objectives (see Section 2.3); the Government's five objectives are considered in detail in the remainder of this chapter.

### 7.3.1 Support the Local Economy by Improving Accessibility

*Improve access to public transport network*

Much of the alignment of Line 1 is along existing public transport (bus) routes and whilst the Central case assumes some withdrawal or restructuring of the bus network along the Line 1 route, buses will continue to run in parallel to Line 1 for much of its length. This will create a number of opportunities for public transport travel (and interchanges) in Edinburgh. In addition, the alignment along the Roseburn corridor will open up new opportunities for public transport access, notably in terms of journeys to Haymarket and the West End.

*Improve access to employment opportunities*

Line 1 will not only improve access to existing employment, it will also provide an opportunity to access new development sites planned for North Edinburgh (see Section 3.4). The wider consideration of public transport network coverage and associated accessibility is considered in section 7.8.1. It is demonstrated that Line 1 considerably improves access for a set of key employment destinations (although a few areas outside the Line 1 corridor experience slightly reduced accessibility due to changes to the bus network).

### 7.3.2 Promote Sustainability and Reduce Environmental Damage

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

The modelling work for Line 1 has forecast increases in public transport demand, with reductions in demand by private car (walking and cycling trips are not modelled). This is shown in Table 7.9, with the associated share by public transport. For all modelled periods and years, the share by public transport increases, by around 0.5% points in 2011 and around 1.0% points in 2026. Note that these data relates to the whole modelled area of Edinburgh and its environs and that at a local level in the vicinity of Line 1 the change in share by public transport is greater.

This is illustrated in Table 7.11, which sets out the % point change in the share by public transport by sector for the 2011 AM peak hour. This shows material increases in the public transport share for trips from Granton, Leith Docks and the Railway Corridor, with large increases for particular sector to sector movements where Line 1 would improve the level of service offered by public transport considerably. These include Leith Docks to the City Centre (11.1%) and Haymarket (15.8%), Granton to the City Centre (9.3%) and Haymarket (14.4%) and the railway corridor to Leith Docks (15.3%).

**Table 7.9 Share of Travel Demand (Person Trips) by Public Transport**

| | | 2011 | | | 2026 | | |
|---|---|---|---|---|---|---|---|
| | | AM | IP | PM | AM | IP | PM |
| Reference Case | Public transport | 45,595 | 27,484 | 42,030 | 48,555 | 28,501 | 46,174 |
| | Private car/LGV | 172,293 | 130,079 | 201,140 | 218,546 | 160,317 | 252,245 |
| | PT share | 20.9% | 17.4% | 17.3% | 18.2% | 15.1% | 15.5% |
| Line 1 | Public transport | 46,980 | 28,442 | 43,406 | 52,484 | 30,769 | 49,007 |
| | Private car/LGV | 171,696 | 130,060 | 200,723 | 216,472 | 160,430 | 250,329 |
| | PT share | 21.5% | 17.9% | 17.8% | 19.5% | 16.1% | 16.4% |
| Change in public transport share | | 0.6% | 0.5% | 0.5% | 1.3% | 1.0% | 0.9% |

**Table 7.10 Share of Travel Demand (Person Trips) by Public Transport**

| No. | Area | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | City Centre | 0.5% | 0.0% | -0.2% | 2.3% | -0.6% | 0.8% | 0.2% | 0.4% | 0.1% | -0.3% | 0.0% | 0.0% | 0.1% | 0.1% |
| 2 | Haymarket | 1.5% | 2.5% | 0.2% | 1.6% | 0.2% | 1.7% | 0.3% | 0.4% | 0.2% | 0.0% | 0.0% | 0.0% | 0.2% | 0.6% |
| 3 | Leith | 0.1% | 1.1% | -2.3% | 4.2% | 0.6% | 2.4% | 3.0% | -1.7% | -0.2% | -0.2% | -0.5% | 0.0% | -0.8% | 0.0% |
| 4 | Granton | 9.3% | 14.4% | 7.5% | 8.0% | 3.7% | 2.2% | 2.8% | 3.0% | 2.6% | 1.0% | 0.6% | 0.1% | 3.5% | 5.3% |
| 5 | North LRT | -2.0% | 5.4% | 4.8% | 4.0% | 5.1% | 2.4% | 3.4% | -0.4% | 1.2% | 2.1% | -0.1% | 0.8% | 1.7% | 1.1% |
| 6 | Leith Docks | 11.1% | 15.8% | 8.9% | 2.6% | 6.4% | 1.8% | 8.9% | 4.9% | 3.1% | 6.4% | -0.1% | 0.8% | 20.5% | 7.8% |
| 7 | Railway Corridor | 4.9% | 6.3% | 5.1% | 2.7% | 4.5% | 15.3% | 4.1% | 2.5% | 2.1% | 2.3% | 0.1% | 0.2% | 5.2% | 4.0% |
| 8 | South Edinburgh | 0.6% | -0.1% | 0.0% | 1.1% | -0.5% | 1.9% | -0.1% | 0.2% | 1.0% | 0.2% | -0.3% | -0.1% | 0.1% | 0.4% |
| 9 | East Edinburgh | 1.3% | 1.9% | 0.8% | 0.5% | 0.3% | 1.7% | 1.1% | 1.2% | -0.2% | 0.9% | 0.0% | -0.1% | 0.1% | 0.8% |
| 10 | West Edinburgh | 2.0% | 1.7% | 0.9% | 3.9% | 2.5% | 2.1% | 1.8% | 0.7% | 0.7% | 0.1% | 0.1% | 0.0% | 0.4% | 1.1% |
| 11 | Fife & North | -0.1% | -0.3% | 0.1% | 1.2% | 0.8% | 0.8% | 1.1% | -0.4% | -0.3% | -0.3% | 0.0% | 0.0% | 0.0% | 0.0% |
| 12 | West Scotland | 0.0% | -0.6% | 0.0% | 2.8% | -0.1% | 2.3% | 0.0% | -0.4% | -0.5% | -0.6% | 0.0% | 0.0% | 0.0% | -0.1% |
| 13 | South & East | 0.1% | 1.0% | 0.9% | 1.8% | 1.3% | 5.8% | 1.1% | 0.3% | 0.0% | -0.1% | 0.0% | 0.0% | -0.7% | 0.2% |
| Total | | 1.0% | 1.5% | 1.2% | 2.8% | 1.7% | 2.8% | 1.4% | 0.4% | 0.3% | 0.1% | 0.0% | 0.0% | 0.0% | 0.6% |

*Reduce local and global emissions*

A detailed analysis has been undertaken to determine the impact of Line 1 on local and global air quality (see section 7.4.2). This analysis demonstrates that the tram has a moderate positive impact on air quality in 2011, and a minor positive impact in 2026, with an Air Quality Index[22] of –88,100 and –37,800 for $NO_2$, respectively.

At a global level, the impact of Line 1 is neutral in 2011, with $CO_2$ emissions resulting from tram operation being offset by decreases in $CO_2$ emissions across the highway network. However, by 2026, the reduction in traffic arising from Line 1 is sufficient to lead to a small reduction in CO2 emissions.

### 7.3.3 Reduce Traffic Congestion

*Reduce number of trips by car*

The modelling analysis undertaken has forecast that Line 1 will remove significant levels of car demand from the highway network; this is detailed in Table 7.11. In 2011, the levels are moderate in the peak hours, increasing substantially by 2026, which reflects the severe levels of congestion forecast by that time. The impact of highway demand in the off peak period is slight.

[22] The product of the weighted number of households 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.

**Table 7.11 Travel Demand (Car/LGV vehicle trips) by Private Transport**

| | 2011 | | | 2026 | | |
|---|---|---|---|---|---|---|
| | AM | IP | PM | AM | IP | PM |
| **Reference Case** | 119,648 | 82,853 | 134,093 | 151,768 | 102,113 | 168,163 |
| **Line 1** | 119,233 | 82,841 | 133,815 | 150,328 | 102,185 | 166,886 |
| **Differences** | -415 | -12 | -278 | -1,440 | 72 | -1,277 |

*Reduce traffic volume on key routes*

The predicted changes in traffic flows as a result of the introduction of Line 1 are shown in Table 7.12[23]. Significant reductions in traffic flow (>100 veh/h) are forecast on Chester Street, Dalry Road (AM and off peak), Haymarket Terrace, Inverleith Row (AM peak and off peak), London Road, MacDonald Road (AM and off peak) and Market Street (PM peak). Conversely, flow increases are forecast on Dalry Road (PM peak), Ferry Road (AM peak), Morrison Street (AM peak and off peak), Palmerston Place, Queen Street (off peak and PM peak), Queensferry Road (off peak), Queensferry Street and The Mound (AM peak). As would be expected in a congested urban centre the patterns differ throughout the day. Generally, the impacts in the off peak periods are less significant than those predicted during the peak hours. The re-assignment impacts from the tram have also been modelled for the future year 2026 and the patterns are found to be very similar to those reported above, albeit with the absolute levels of traffic flow being higher under each case.

**Table 7.12 Changes in Traffic Flows (2011)**

| | Reference Case | | | Line 1 | | | Absolute Change | | |
|---|---|---|---|---|---|---|---|---|---|
| | AM | OP | PM | AM | OP | PM | AM | OP | PM |
| Abbeyhill | 710 | 843 | 1050 | 704 | 854 | 993 | -6 | 11 | -57 |
| Calton Road | 557 | 132 | 582 | 577 | 126 | 516 | 20 | -6 | -66 |
| Chester Street | 1045 | 838 | 838 | 996 | 776 | 726 | -49 | -62 | -112 |
| Commercial Street | 1108 | 1070 | 1325 | 1063 | 1047 | 1325 | -45 | -23 | 0 |
| Constitution St (North of junction with Salamander St) | 1187 | 728 | 1104 | 1175 | 724 | 1093 | -12 | -4 | -11 |
| Constitution St (South of junction with Salamander St) | 674 | 535 | 855 | 744 | 510 | 922 | 70 | -25 | 67 |
| Crewe Road (N) | 739 | 853 | 1035 | 675 | 847 | 1012 | -64 | -6 | -23 |
| Crewe Road (S) | 969 | 436 | 806 | 929 | 443 | 794 | -40 | 7 | -12 |
| Dalry Road | 1323 | 746 | 1468 | 1217 | 606 | 1656 | -106 | -140 | 188 |
| Easter Road | 514 | 454 | 493 | 421 | 486 | 581 | -93 | 32 | 88 |
| Ferry Road | 1395 | 1277 | 1283 | 1513 | 1282 | 1288 | 118 | 5 | 5 |
| George Street | 1153 | 993 | 1222 | 1190 | 1088 | 1284 | 37 | 95 | 62 |
| Granton Road | 1511 | 536 | 1405 | 1504 | 527 | 1406 | -7 | -9 | 1 |
| Haymarket Terrace | 1518 | 1075 | 1314 | 1227 | 721 | 970 | -291 | -354 | -344 |
| Inverleith Row | 1988 | 1089 | 2117 | 1869 | 1008 | 2139 | -119 | -81 | 22 |
| Leith Walk (Cental/North) | 1247 | 957 | 1280 | 1201 | 895 | 1199 | -46 | -62 | -81 |
| London Road | 1283 | 889 | 1442 | 1101 | 682 | 1345 | -182 | -207 | -97 |
| MacDonald Road | 683 | 316 | 786 | 370 | 342 | 683 | -313 | 26 | -103 |
| Market Street | 547 | 103 | 594 | 576 | 100 | 478 | 29 | -3 | -116 |
| Morrison Street | 1371 | 1295 | 1833 | 1978 | 1439 | 1908 | 607 | 144 | 75 |
| Palmerston Place | 543 | 347 | 704 | 900 | 550 | 1099 | 357 | 203 | 395 |

[23] It should be noted that these predictions do not take into account the effects of the Council's proposed Central Edinburgh Traffic Management (CETM) scheme, since these proposals were not committed at the time of the traffic modelling undertaken for Line One.

| | Reference Case | | | Line 1 | | | Absolute Change | | |
|---|---|---|---|---|---|---|---|---|---|
| | AM | OP | PM | AM | OP | PM | AM | OP | PM |
| Pilrig Street | 509 | 335 | 832 | 511 | 369 | 855 | 2 | 34 | 23 |
| Queen Street | 2355 | 2329 | 2302 | 2382 | 2447 | 2407 | 27 | 118 | 105 |
| Queensferry Road | 1808 | 1486 | 1788 | 1852 | 1646 | 1860 | 44 | 160 | 72 |
| Queensferry Street | 1470 | 1159 | 1478 | 1601 | 1402 | 1606 | 131 | 243 | 128 |
| Salamander Street | 1666 | 1545 | 1622 | 1587 | 1526 | 1595 | -79 | -19 | -27 |
| Starbank Road | 1672 | 1390 | 1589 | 1585 | 1365 | 1560 | -87 | -25 | -29 |
| Telford Road | 1847 | 1161 | 1234 | 1832 | 1156 | 1287 | -15 | -5 | 53 |
| The Mound | 1395 | 1277 | 1283 | 1513 | 1282 | 1288 | 118 | 5 | 5 |
| West Granton Road | 2139 | 1160 | 2053 | 2085 | 1116 | 2038 | -54 | -44 | -15 |

Note: AM = morning peak hour traffic flow, OP = inter peak hourly traffic flow, PM = evening peak hour traffic flow. The Reference Case is the situation without the tram operating.

The changes in traffic flow are largely due to 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. (Perhaps the most significant example of the latter is Haymarket, where the preferred layout as it stands would result in Morrison Street becoming two-way, with a westbound contra flow bus lane incorporated within West Maitland Street. Similarly, the preferred layout for the junction of Lothain Road and Princes Street would require the banning of right turn movements from Shandwick Place to Lothian Road. This would result in a re-routing of traffic in this area of the city). It will therefore be necessary, as the scheme develops, to ensure that appropriate mitigation measures are introduced to ensure that the transport network works efficiently in these areas. 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).

In summary, whilst Line 1 removes significant levels of 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, with flow decreases being largely offset by flow increases at a network level.

### 7.3.4 Make the Transport System Safer and More Secure

*Reduce traffic accidents*

The impact of Line 1 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 7.13 (see section 7.5.1 for full details). Overall, Line 1 is forecast to give rise to 7.6 accidents per annum in 2011, but fall thereafter, leading to a reduction of 51.0 accidents in 2026. (This change reflects the mix of flow by road type; by 2026, traffic will be dispersing onto road types with higher accident rates, on which flow reductions gives rise to a proportionally greater reduction in accident levels.) The majority of accidents are accounted for in terms of damage only accidents.

**Table 7.13 Number of Accidents per Severity Level**

| | Annual Changes | |
|---|---|---|
| **Severity** | **2011** | **2026** |
| Damage | -6.8 | 45.5 |
| Slight | -0.7 | 4.8 |
| Serious | -0.1 | 0.6 |
| Fatal | 0.0 | 0.1 |
| **Total** | **-7.6** | **51.0** |

### 7.3.5 Promote Social Benefits

*Improve liveability of streets*

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 Line 1 is focused on delivering a transport scheme, which where possible looks to deliver benefits to the wider urban realm. Line 1 will provide an opportunity to implement wider enhancements to the urban realm, either explicitly planned and implemented in conjunction with Line 1, or through the longer term effects of a planned framework for redevelopment and regeneration.

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.

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*

Line 1 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.

The wider accessibility impacts are considered in section 7.8.2, which explicitly sets out the impact of Line 1 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 Line 1. Whilst some of those households benefit marginally (under 5 minutes reduction in travel time), there are substantial beneficiaries of 10 minutes or more.

### 7.3.6 Summary

Table 7.14 provides a summary of the appraisal of the scheme against the planning objectives and problems in North Edinburgh (set out in Chapters 2 and 3, respectively). The significance of the impact of Line 1 is shown, with '+' representing a positive impact and '-' a negative impact. Across all the objectives, Line 1 is considered to have a positive impact, notably on the level of public transport and car demand and the associated mode share and the consequent impacts on the environment. Notwithstanding some adverse impacts arising from the bus network changes (which further detailed consideration as part of developing an integrated PT network should ameliorate to some degree), Line 1 has a positive impact on accessibility which will support the local economy and reduce social exclusion.

**Table 7.14 Appraisal of Line 1 against Planning Objectives and Problems**

| | | Problems | | |
|---|---|---|---|---|
| **Objective** | **Sub-Objective** | **Socio-economic** | **Environment** | **Transport** |
| Improve accessibility | Improve access to public transport. | + | | + |
| | Improve access to employment. | ++ | | + |
| Promote sustainability and reduce environ-mental damage | Increase journeys by public transport, cycling and walking. | | +++ | +++ |
| | Reduce local and global emissions. | | ++ | |
| Reduce traffic congestion | Reduce trips by car. | | + | +++ |
| | Reduce traffic on key routes. | | + | + |
| Promote safety and security | Reduce traffic accidents. | | | + |
| Promote social benefits | Improve liveability of streets. | + | + | |
| | Reduce social exclusion. | ++ | | |

As can be seen, Line 1 has considerable potential to:

- Contribute to improve the local economy (greater potential for regeneration);
- Facilitate access to employment opportunities (more attractive, integrated, comfortable, efficient and reliable public transport alternative);
- Reduce the adverse impacts of transport on the environment (zero exhaust emissions produced by the trams in urban areas, reduced noise levels, townscape benefits);
- Reduce traffic and congestion (greatest potential as an alternative to the private car, with decongestion benefits); and
- Reduce social exclusion (providing widely accessible, particularly to the new areas of employment and social deprivation in north and west areas of Edinburgh, and affordable transport connections for all).

## 7.4 Environment

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. Figure 7.13 illustrates the local environmental and planning designations, while Figure 7.14 shows a plot of the local road network.

This section reports the findings of the STAG Part 2 appraisal of environmental impacts of the proposed Edinburgh Tram Line 1 project. Further explanation of the methodologies, criteria and impact assessments for each environmental sub-objective is provided in Appendix B to this STAG report. Appendix B is divided according to each environmental sub-objective and incorporates additional information on each sub-objective, including worksheets.

A summary of the appraisal findings is presented in the Appraisal Summary Tables (Part 2), in Section 7.10 of this report.

### 7.4.1 Noise and Vibration

This section of the report appraises the potential noise and vibration impacts arising from the construction and operation of the scheme as a whole.

There are two main potential impacts that can arise from construction and from operation of light rail schemes such as this. These are:

- Airborne noise – noise which propagates through the air to the receptor; and
- Ground vibration – vibration which propagates via the ground into a receptor building.

Details of the positive and negative effects of noise at specific locations in the vicinity of the proposed tram route will be provided in the Environmental Statement (ES).

The methods and criteria used to predict and evaluate noise and vibration impacts have been derived from relevant recognised national and international guidance. They are described in Appendix B1.

## Figure 7.13 Environmental and Planning Designations

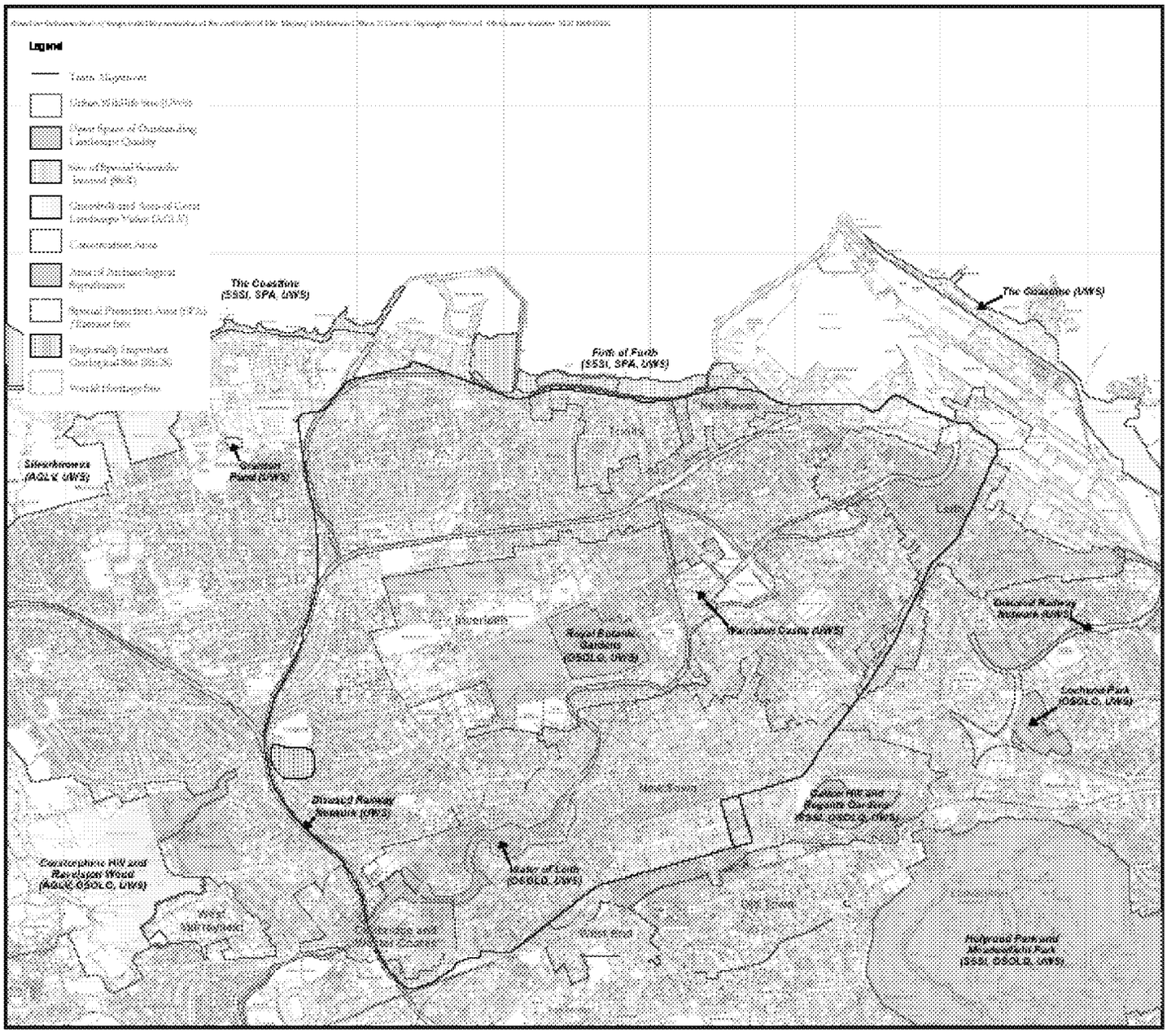
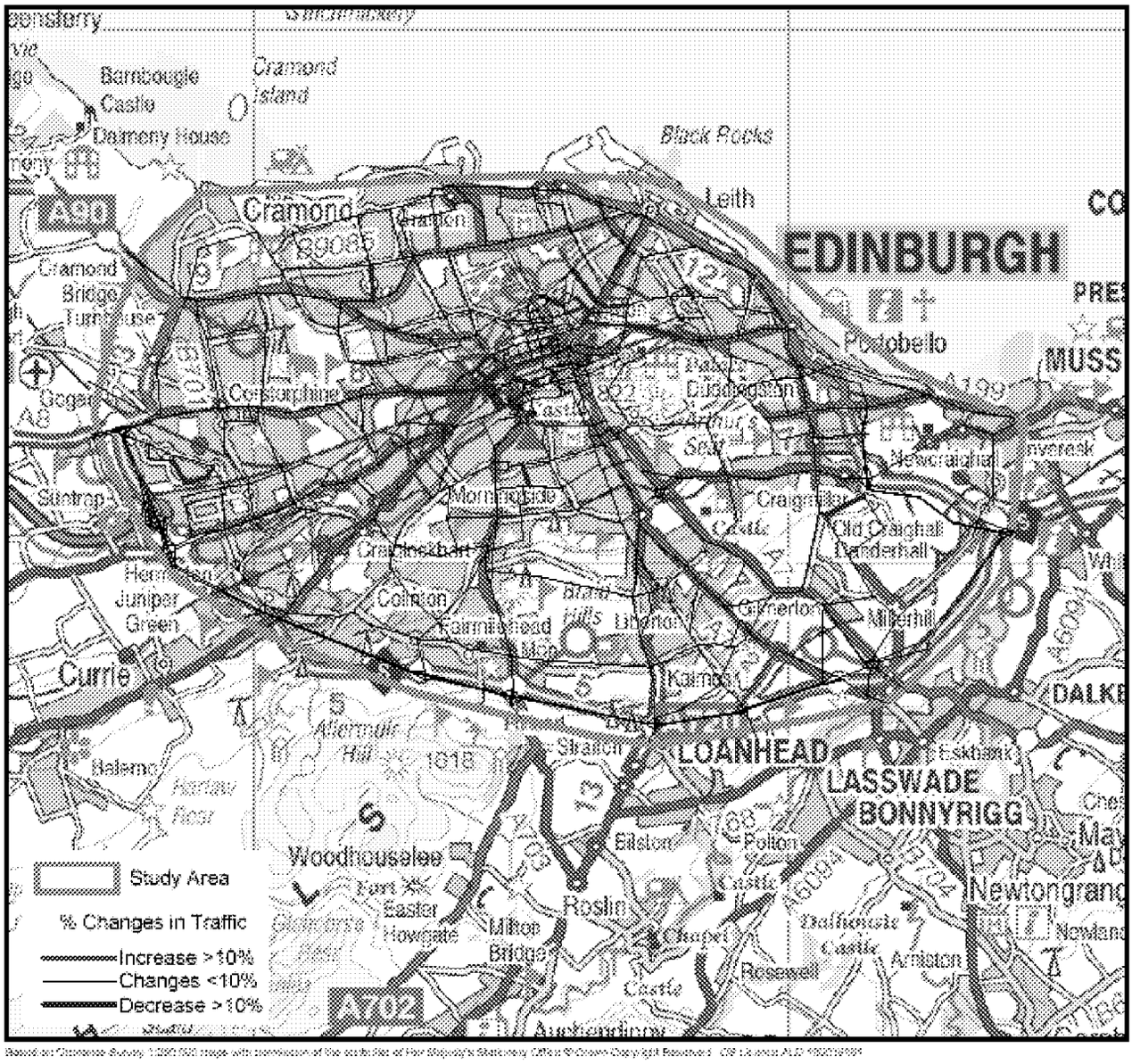


**Figure 7.14 Plot of Road Network**




*Construction noise and vibration*

For the purpose of this appraisal, the following phases of construction have been assumed:

- Enabling works;
- Track laying; and
- Construction of tram stops.

Further consideration will be given to the potential construction phase noise impacts when the details of the construction methodology are developed.

Noise levels associated with enabling works and track laying will be most typical of those to be produced on a day-to-day basis during the construction phase. Enabling works and track laying will affect receptors along the length of the proposed alignment whilst stop construction will only affect those located in the immediate vicinity. Similarly, atypical works such as demolition or night-time

working will only affect those receptors located in the vicinity of the specific work and will not be common to the whole scheme.

Based on typical plant items and using the methods recommended in BS5228, typical noise levels from the various works have been estimated. In the absence of mitigation, significant impacts are expected at receptors within approximately 40m of enabling works and approximately 15m of track laying and stop construction.

Best practicable means including the use of quiet plant and mobile noise barriers/enclosures will be adopted during construction to ensure noise impacts are kept to a minimum. However, some residual noise impacts are expected, albeit over limited durations.

Ground vibration may be perceptible at receptors within close proximity to the alignment construction works 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.

*Tram operating noise and vibration*

The degree of noise impact caused by tram operation will depend on the baseline noise level without the tram, the additional contribution to this caused by the tram, and the resulting overall noise level compared to threshold levels for significant impacts. Separate consideration must be given to day and night time impacts.

Because of low baseline noise levels and the proximity of the tram to houses, significant noise impacts are predicted to occur at receptors along the disused rail corridor/cycle path from Roseburn to Crewe Toll. Houses closest to the tracks and not screened by the railway cutting will be most affected. Other receptors along the route are not predicted to experience significant noise impacts because of the high baseline noise levels from road traffic along the remaining sections.

In those locations along the former railway corridor where significant impacts could occur noise barriers can be provided to mitigate the impact and these will be considered in further detail in the ES. The design of the tram will include acoustic design and damping of wheels to reduce wheel squeal on tight bends. The detailed design of the track on such bends will also include measures to minimise wheel squeal and, if necessary, once the scheme is operating, consideration will be given to other techniques to reduce wheel squeal on tight bends.

Ground vibration will potentially be perceptible at receptors within approximately 20m of the alignment. It is not possible to confirm at this stage whether vibration will be perceptible at any properties, but if it is, the estimated levels are not expected to exceed the daytime assessment criterion beyond approximately 4m from the tracks. Whilst vibration may be perceptible in these areas, it will be transient and low level, and is not expected to give rise to adverse comment. Impacts are therefore not predicted to occur.

The expected levels of ground vibration are well below the criteria relating to the structural integrity of buildings. Consequently, no impacts on buildings located adjacent to the scheme are predicted.

*Strategic assessment of road traffic noise impacts*

The outputs from a transport model have been used to estimate the effect of the tram on road traffic noise, comparing the existing situation and the Do-Minimum in 2011 and 2026 with the with scheme situation in those years using STAG appraisal methodologies. The appraisal method uses the

Calculation of Road Traffic Noise to predict changes in traffic noise on each road link based on changes in traffic flows, speed and composition obtained from the traffic model. Changes in the number of households where residents are likely to be annoyed by noise on each road link have been estimated using GIS analysis of 2001 census data to identify the numbers of properties bordering each road link. The total numbers experiencing an increase, decrease or no change in noise levels have been estimated by the summing of the household estimates for all links in the traffic model. The study area includes the A720 and all road links within it. Appendix B1 gives further details of the appraisal method.

The results are summarised in Table 7.9. It must be appreciated that the approach provides only a broad brush picture of the area-wide impacts of the scheme. Household numbers are only approximate and should be treated as indicative of the broad scale of potential comparative benefits and disbenefits between options. Nonetheless, the appraisal method is considered to be reliable in assessing the nature of the strategic traffic noise impact, in particular whether it is expected to be positive, negative or broadly neutral.

**Table 7.15 Estimated Numbers of Households Potentially Annoyed by Noise**

| Scenario/Scenarios Compared | Estimated Properties experiencing noise levels expected to cause annoyance |
|---|---|
| Base Case (2001)[24] | 14,300 |
| 2011 Do Minimum | 15,200 |
| 2011 With Scheme | 15,200 |
| 2026 Do Minimum | 15,800 |
| 2026 With Scheme | 15,800 |
| 2011 Do Minimum × Base Case (2001) | 900 |
| 2011 With Scheme × Do Minimum | 0 |
| 2026 Do Minimum × Base Case (2001) | 1,500 |
| 2026 With Scheme × Do Minimum | 0 |

The results indicate that the scheme will have no effect on population annoyance due to noise in Edinburgh.

Estimated numbers of properties affected by perceptible changes in noise levels (i.e. increases or decreases of more than 3dB)) are given in Table 7.16 below.

**Table 7.16 Number of Households Experiencing Perceptible Noise Changes**

| Scenarios Compared | Estimated Number of Properties Experiencing Changes | |
|---|---|---|
| | Perceptible increase in noise levels (> plus 3dB) | Perceptible decrease in noise levels (>minus 3dB) |
| 2011 With Scheme × Do Minimum | 0 | 50 |
| 2026 With Scheme × Do Minimum | 0 | 50 |

The methods used to estimate properties experiencing perceptible changes in road traffic noise and levels sufficient to cause annoyance are again approximate. Hence, whilst the scheme appears to deliver a slight positive impact in both 2011 and 2026, with an estimated 50 properties experiencing a

[24] The traffic data for the Base 2001 scenario was incomplete when used in this assessment due to recoding some road links from the Base to future scenarios. This incompatibility of link coding has skewed the results for the roads that have been recoded.

perceptible decrease in traffic noise, the changes are in practice insignificant given the accuracy of the appraisal method and the underlying variability of the baseline noise environment.

*Summary*

The majority 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. Where the tram alignment runs along the disused Roseburn to Crewe Toll rail corridor, noise barriers will be required and, provided an appropriate design can be developed, for most locations they will mitigate significant impacts that would otherwise occur. Acoustic damping will be incorporated in the tram design to mitigate the potential for wheel/rail noise. Some slight residual impacts may be unavoidable.

On the road network traffic changes resulting from the tram's operation will give rise to minor noise decreases in some areas, but the overall effect of the scheme on noise from the road network is predicted to be neutral.

### 7.4.2 Air Quality – Overall

Several air pollutants can significantly affect local air quality if they occur at sufficiently high concentrations. The key pollutants to be considered in this STAG appraisal, in respect 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. An important pollutant at the global level is Carbon Dioxide ($CO_2$) emitted from road traffic and by generation of electricity to power the tram.

*Criteria*

Air quality standards for $NO_2$ and $PM_{10}$ at the local level are presented in Table 7.17.

**Table 7.17 Air Quality Criteria**

| 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 |

Appendix B2 provides information on background air quality in the City of Edinburgh. An Air Quality Management Area (AQMA) has been declared in the city centre as a result of the predicted exceedance of the short term and long term $NO_2$ objectives. Traffic is a major source of pollution in the city centre and measures planned by the Council focus on controlling emissions from this source.

*Methodology*

A spreadsheet model has been used to assess the impact of changes in road traffic from the introduction of the tram. The method is based on STAG and uses the DMRB graphical screening method to estimate changes in roadside concentrations of $NO_2$ and $PM_{10}$ from changes in road traffic due to the operation of the tram. Data on traffic flow, composition and speed are obtained from the traffic model. The assessment covers all road links within and including the A720.

The risk of exposure of the population to changes in pollutant concentrations is assessed based on the number of households within 200m of road links experiencing increases, no change or decreases in

concentrations of $NO_2$ and $PM_{10}$. Data on household numbers are derived from GIS analysis of the 2001 postcode census data. Using this method, properties can be counted more than once if they are located within 200 metres of more than one link. This is corrected for the analysis. Households are then weighted according to their distance from the roadside using standard factors from DMRB, to account for decay in pollutant concentrations from the roadside. The following scenarios are assessed:

- Base Year 2000;
- Do Minimum 2011 (without the tram);
- Do Something 2011 (with the tram);
- Do Minimum 2026 (without the tram); and
- Do Something 2026 (with the tram).

The traffic data for the Base 2001 scenario were incomplete when used in this assessment due to recoding some road links from the Base to future scenarios. This incompatibility of link coding may have skewed the results for the roads that have been recoded but this is not thought to affect the overall assessment from Base 2001 to Do Minimum 2011.

Further details of the air quality assessment method are provided in Appendix B2.

*Air quality results*

An estimate of the weighted number of properties located within 200 metres of roads experiencing an improvement or degradation in air quality is presented below in Table 7.18. The estimated number of households near roads predicted to experience no change in air quality is also presented.

**Table 7.18 Number of Households with Changes in Air Quality**

| Scenarios Compared | Number of Households with | | | | | |
|---|---|---|---|---|---|---|
| | Improvement in Air Quality | | No change in Air Quality | | Worsening in Air Quality | |
| | $NO_2$ | $PM_{10}$ | $NO_2$ | $PM_{10}$ | $NO_2$ | $PM_{10}$ |
| Base 2001 × Do Minimum 2011 | 268,450 | 238,300 | 1,250 | 200 | 11,700 | 9,100 |
| Do Min 2011 × Do Som 2011 | 177,250 | 174,000 | 26,200 | 3,400 | 77,950 | 70,200 |
| Do Min 2026 × Do Som 2026 | 119,100 | 112,050 | 22,750 | 1,000 | 139,550 | 134,500 |

Note: totals for $NO_2$ and $PM_{10}$ differ because of the application of different weighting factors.

During the ten year period from the Base 2001 to Do Minimum 2011 air quality is predicted to improve in most areas in the absence of the tram as a result of improvements in vehicle and fuel technology. The tram, will lead to a further increase in the number of households near roads predicted to experience lower $NO_2$ and $PM_{10}$ concentrations in 2011. More properties will be near roads with improved or unchanged air quality than are near roads with worse air quality.

By 2026 a few more households will be near roads with better or unchanged $NO_2$ concentrations than are near roads with worse, but more households near roads with worse $PM_{10}$ concentrations then better. This is thought to be due to added congestion in 2026.

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 households 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 7.19.

**Table 7.19 Air Quality Indices**

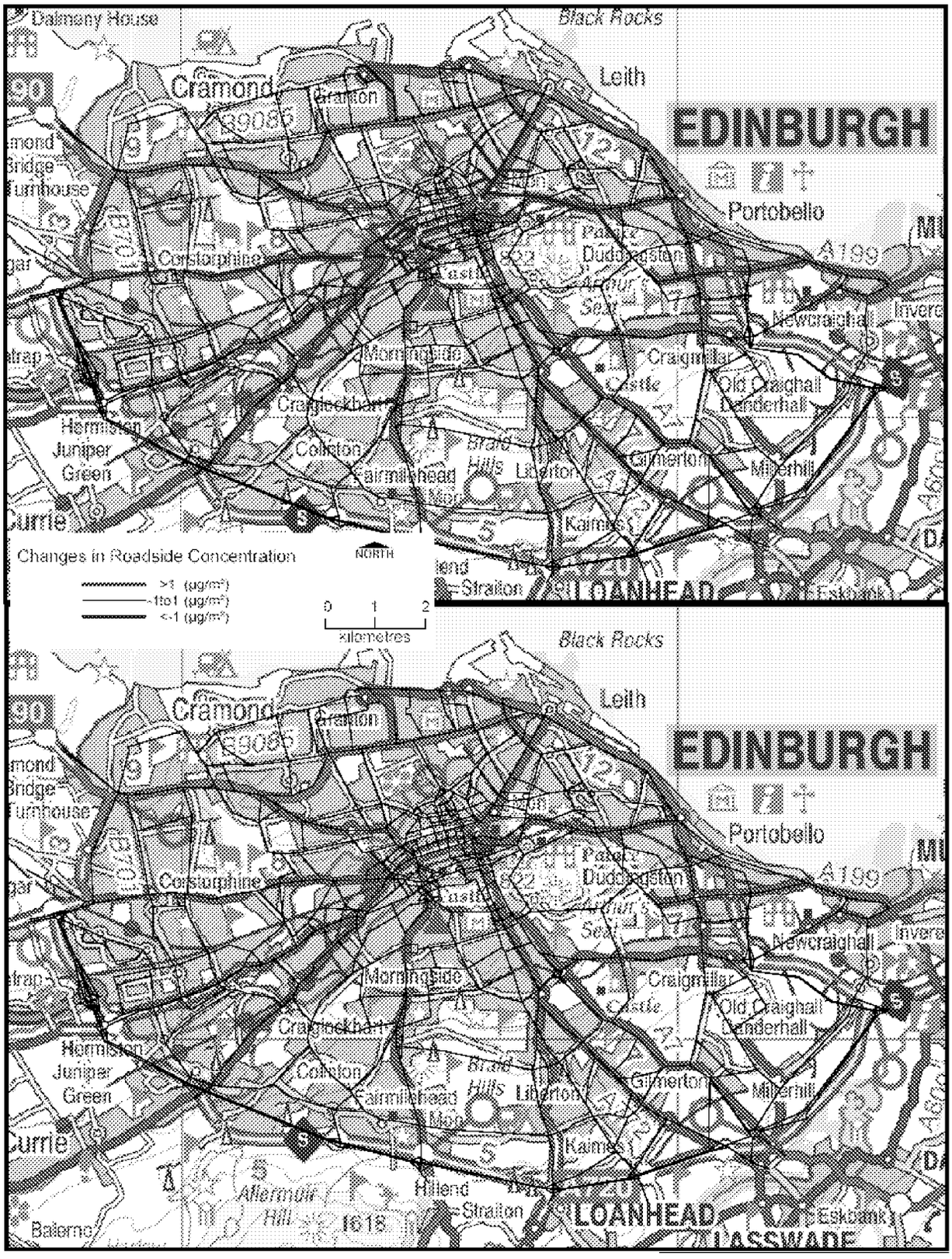
| Scenarios Compared | $NO_2$ Index | $PM_{10}$ Index |
|---|---|---|
| Base × Do Minimum 2011 | -2,949,400 | -354,300 |
| Do Minimum 2011 × Do Something 2011 | -88,100 | -6,000 |
| Do Minimum 2026 × Do Something 2026 | -37,800 | -17,300 |

The indices indicate that the tram has a moderate positive impact on air quality in 2011, in particular for $NO_2$, and a minor positive impact in 2026.

Further analysis has been carried out to assist in the interpretation of these results. The results are presented in Appendix B2. These show that the majority of roads in the study area (approximately 90 % in 2011; approximately 75% in 2026) are predicted to experience negligible changes in pollutant concentrations (changes smaller than 1 $\mu g\ m^{-3}$) as a result of the introduction of the tram. These changes in pollutant concentrations are plotted on a road by road basis Figure 7.15 ($NO_2$ in the upper map and $PM_{10}$ in the lower map).

STAG also requires a qualitative comment on the performance of a scheme in terms of the UK Air Quality Strategy. The assessment indicates that without the tram there will be an improvement in compliance with air quality objectives between 2001 and 2011. The introduction of the tram is predicted to increase compliance further in 2011. By 2026, there should be a slight drop in the non-compliance with $NO_2$ objectives compared to Do Minimum and no change in non-compliance with $PM_{10}$ objectives.

## Figure 7.15 Changes in Roadside $NO_2$ and $PM_{10}$ Concentrations



*Greenhouse gas assessment*

Edinburgh tram Line One has the potential to impact on carbon dioxide emissions by affecting traffic on the road network and by requiring generation of electricity to power the tram.

The effect of the tram on road traffic emissions of $CO_2$ is calculated using data from the traffic model as input to a standard DMRB spreadsheet. This takes account of the impact of changing vehicle and fuel technology on emissions per vehicle kilometre. 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.

Table 7.20 below presents the overall emissions of $CO_2$ in each of the scenarios assessed.

**Table 7.20 Summary of Net Carbon Dioxide Emissions**

| Scenario | Carbon Dioxide Emissions (kilo-tonnes/annum) |
|---|---|
| Base | 1,219 |
| Do Minimum 2011 | 1,252 |
| Do Something 2011 | 1,252 |
| Do Minimum 2026 | 1,451 |
| Do Something 2026 | 1,441 |

The $CO_2$ emissions resulting from power consumption by the tram (626 tonnes) offset the decrease in transport $CO_2$ emissions across the study area road network as a result of its operation in 2011 (see Appendix B2). The result is that there is no overall change in $CO_2$ emissions as a result of the introduction of the tram in 2011. By 2026 the reduction in traffic is sufficient to lead to a small net reduction in $CO_2$ emissions of 10,000 tonnes.

*Conclusions*

A major positive impact on air quality is predicted to occur independently of the tram between 2001 and 2011. Edinburgh Tram Line 1 will lead to a further moderate positive improvement in air quality in the city in 2011. More households are predicted to experience an improvement in air quality than a worsening as a result of the tram, although in most areas the change in air quality will be very small. In 2026 the impact on air quality is predicted to be minor positive.

There will be a moderate negative impact on $CO_2$ emissions between now and 2011 due to traffic growth without the tram, followed by a further moderate negative impact from 2011 to 2026. The effect of the tram on this will be neutral in 2011 and a minor positive impact in 2026.

### 7.4.3 Water Quality, Drainage and Flood Defence

The assessment has considered the effects on water quality of construction, permanent development and operation of the scheme. Water resource issues assessed include surface water features along the route, the quality and sensitivity of these features, hydrogeology and groundwater resources, and 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.

Further information on assessment methodology is provided in Appendix B3.

*Surface water*

The primary watercourses in the corridor of the tram route are the Water of Leith and the Firth of Forth. The scheme crosses the Water of Leith at two locations, at Coltbridge Viaduct and on Ocean Drive. The scheme runs on-street on Starbank Road near the foreshore of the Firth of Forth.

Recent water quality assessments undertaken by the Scottish Environment Protection Agency (SEPA) indicate that near Coltbridge Viaduct, the Water of Leith is of poor quality and near Ocean Drive it is of good quality. Overall, the Water of Leith is classified as a salmonid water of high amenity. 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.

Construction along Starbank Road has the potential to impact on surface water resources within the Firth of Forth due to construction plant and activities located within the tidal area. During construction the contractor will adopt SEPA requirements and guidelines, as outlined in Appendix B3, to minimise potential impacts upon surface water resources. Mitigation measures will include a coffer dam during construction along Starbank Road to ensure no polluting materials enter the Firth of Forth. A construction method statement will be submitted to the relevant statutory authorities for approval prior to commencement of construction.

During operation the scheme will use existing drainage and sustainable urban drainage measures (see below) where appropriate, to reduce impacts from any increase in sediment runoff. As a result it is unlikely to cause any significant impacts upon surface water.

*Hydrogeology and groundwater*

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.

SEPA has confirmed that there are no designated source protection zones along the tram alignment. As no sensitive groundwater resources have been identified along the alignment for the tram and because of the nature of construction and operation activities of the tram, the scheme is not expected to create any significant impacts upon hydrogeology or groundwater resources.

*Drainage*

The majority of the route runs along existing roads and surface run-off will be drained via existing underground sewers and storm drains. 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.

Minor drainage improvements will be implemented in specific locations where required. 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, as outlined in Appendix B3, will ensure that development of the scheme will not result in any significant impacts on existing drainage systems or patterns.

*Flooding*

In 2001, the City of Edinburgh Council (CEC) commissioned a Flood Assessment Report, which identified flood alleviation and prevention works to be constructed along the Water of Leith. The majority of identified flood prevention construction locations are unaffected by the scheme, as it is not located within any identified high-risk flood areas in the vicinity of the Water of Leith. There will be no increase in flood risk along the alignment since no flood risk areas or flood plains are affected by new development. The contractor will be required to consult with CEC and SEPA to ensure that CEC flood prevention and alleviation measures are taken into account during detailed design of the scheme.

*Summary*

Overall the scheme is expected to have a minor negative impact on surface water quality and drainage 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.

Construction and operation of the scheme will not increase flood risks along the alignment. The contractor will consult with SEPA and CEC during detailed design to ensure adherence to all requirements and guidelines.

There are limited existing groundwater resources along the route and the construction and operation of the scheme is not predicted to impact on these.

### 7.4.4 Geology

This section considers the impacts of the development on geology and soils and effects resulting from the presence of potentially contaminated land. It briefly outlines the baseline geological resource and existing features of note, and discusses potential impacts and mitigation measures to reduce negative impacts.

*Geology*

Glacial or raised marine deposits with areas of made ground underlie the route. 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).

The proposed route runs in proximity to the designated sites, two Geological Sites of Special Scientific Interest (SSSI) in the Firth of Forth and at Calton Hill and one Regionally Important Geological Site (RIGS) at Craigleith.

The Firth of Forth is designated as a Geological Site of Special Scientific Interest given its contribution to understanding of the Lower Carboniferous (Dinantian) geology of the Forth area, and the worldwide significance of the sedimentary rock sequence for fossil remains. In particular, Wardie Shore is of international importance, having yielded at least eighteen species of fish fossil remains, including sharks. Consultation with Scottish Natural Heritage (SNH) has indicated that the proposed option for development along the shore of the Firth of Forth SSSI will not result in any adverse impact to the geological interest of the area, provided that construction access to the foreshore adjacent to Starbank Road for works to the seawall avoids the area of geological importance.

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. It will not be affected by the route.

The former quarry at Craigleith 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.

*Soils*

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, for example along the Roseburn Railway Corridor, 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.

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.

Land take associated with the development of Edinburgh Tram Line 1 will not involve loss of any agricultural land.

*Contaminated land*

If contaminant materials are encountered during construction this can present a risk of pollution of subsurface soil and to the health and safety of construction workers and neighbours.

There are no Contaminated Land Register entries or notices in the route corridor, although analysis of historical data suggests that former land uses in some areas may have lead to land contamination. A City of Edinburgh Council report by Environmental and Consumer Services dated 12th September 2003, compiled for ERM, summarises its findings as follows:

> *'A large proportion of the proposed tramline [Line 1] overlays disused railway and tramline routes, which were present from approximately the 1800s until the 1960s. In addition to*

*this…potentially contaminative land-uses were identified along the proposed route, and within the immediate vicinity of the proposed route.'*

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.

### 7.4.5 Biodiversity

*Sources of information*

The following sources of information have been used for the assessment:

- Consultation with statutory and non-statutory bodies;
- A Phase I Habitat Survey[25] undertaken by Edinburgh City Council in 2001[26];
- Site visits;
- A bat survey undertaken by Nocturne Environmental Surveyors in September 2003[27];
- Relevant national and local planning policies; and
- Other relevant published information.

*Prediction and evaluation of impacts*

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 ecological evaluation criteria used in the assessment are set out in Appendix B5.

*Ecological baseline conditions*

General Ecological Context

The proposed route for Line One 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. The proposals follow the Forth Estuary for part of the route between Granton and Leith.

The stretch of the route that supports the most significant terrestrial vegetation is the Roseburn Railway Corridor. This includes woodland and grassland habitats.

[25] A standardised system developed by the former Nature Conservancy Council to allow identification of areas of habitat of nature conservation interest relatively rapidly over a wide area.

[26] Phase 1 Habitat maps and Target Notes from this survey were provided by the Lothian Wildlife Information Centre.

[27] Nocturne Environmental Surveyors (September 2003) *Edinburgh Tram Line 1 Roseburn Corridor Bat Survey.*

Designated Sites

There is one site designated as of national importance for nature conservation interest within 200m of the route:

- *Firth of Forth Site of Special Scientific Interest (SSSI)*[28]*, Special Protection Area (SPA)*[29]*/Ramsar Site*[30]. It extends to approximately 6,314 ha, and is designated primarily for regularly supporting wintering waterfowl, wildfowl and wader populations of European importance. The tram route is aligned within a few metres of the SPA along Lower Granton Road and Trinity Road and will encroach approximately 3m into the SPA along some 250m of Starbank Road at Wardie Bay.

There are also several sites of local nature conservation interest in proximity to the tram route, three of which are located at least in part within the boundary of the scheme. The route is aligned along the Roseburn Railway Corridor, an Urban Wildlife Site (UWS)[31], for approximately 3km and will encroach into the 'Coastline' UWS along approximately 250m at Wardie Shore. The Water of Leith UWS is crossed twice by the route, once via Coltbridge Viaduct in the Wester Coates area and once via Ocean Drive in Leith.

Protected Species

There are extensive signs of breeding and foraging badger[32] along the Roseburn Railway Corridor[33] and pipistrelle bats[34] (55kHz)[35] were recorded foraging along the corridor during a September survey. No roosts were identified.

There are several Local Biodiversity Action Plan (LBAP) habitats and species within the route corridor.

*Impact assessment*

The impacts of the mitigated scheme to biodiversity are reported in Appendix B5 and summarised below.

Designated Sites

Construction of the proposed walkway along Starbank Road will have significant direct and indirect impacts on the bird species of interest using this area, during construction. Mitigation measures will be implemented to reduce these impacts to the minimum necessary for the safe completion of the works. For the longer term opportunities will be sought in the design of the new structures to provide

[28] A site identified by Scottish Natural Heritage (SNH) as requiring special protection because of its flora, fauna, geological or physiographical features under the *Wildlife and Countryside Act, 1981 and amendments.*

[29] Special Protection Area (SPA) - a site designated under the European Directive on Conservation of Wild Birds (79/709/EEC) (known as the Birds Directive) to protect birds that are considered rare or vulnerable within the European Community and all regularly occurring migratory birds. Enacted in the UK through the Wildlife and Countryside Act, 1981 and subsequent amendments and the Conservation (Natural Habitats &c) Regulations, 1994.

[30] Ramsar Site - a site that has been designated under the *Convention on Wetlands of International Importance Especially as Waterfowl Habitat* (known as the Ramsar Convention) to protect internationally important wetlands.

[31] Sites within the local plan area which have been identified by CEC as being of known conservation interest in the local context in terms of their flora, fauna and geological features.

[32] Protected under the *Protection of Badgers Act, 1992.*

[33] Details of the status of badger along the route are contained in a separate and confidential report which is available to **tie**, CEC, SNH and CANHU.

[34] Protected under the *Wildlife and Countryside Act 1981 and amendments* and the *Conservation (Natural Habitats, & c) Regulations 1994.*

[35] Two species of pipistrelle are identified using a bat detector which picks up the frequency of the bat's call. One species emits a call at 45kHz, the other at 55kHz.

additional roosting opportunities for the species using the area and to mimic the existing habitat along the sea wall. SNH has advised that the proposals will require an Appropriate Assessment[36]. Ongoing bird monitoring will be undertaken in agreement with SNH to inform the assessment and guide the development of detailed mitigation for the habitats and species affected.

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. The Water of Leith will not be directly affected by the scheme.

Species of Note

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.

Bats are known to forage along the Roseburn corridor and the loss of a significant amount of vegetation will reduce their foraging habitat. The bat survey did not record any bat roost sites along the route. Prior to construction, all bridges and other built structures and mature and dead trees to be affected will be checked again for roosting bats and if bats are found, appropriate mitigation measures will be agreed with SNH and implemented. If bats are likely to be disturbed, a licence will be sought from CANHU and must be obtained before work can proceed.

There is a possibility of wildlife casualties once the scheme is operational. Mitigation measures such as badger tunnels and fencing will be implemented to accommodate badger movements and reduce the likelihood of casualties occurring. It is likely that wildlife will become habituated to the regular noise from the running of the tram vehicles.

### 7.4.6 Landscape

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.

This section:

- Describes the existing townscape of the area affected by Tram Line 1, dividing it into 'character zones' to aid description and analysis;
- Considers the sensitivity of the various character zones affected;
- Defines the potential townscape impacts; and

[36] An Appropriate Assessment is required to determine the impacts of the proposal upon Natura site interests and specifically to provide the information necessary to ascertain whether it will adversely affect the site's integrity.

- Sets out the measures proposed for mitigation.

The methodology is based on the 'Guidelines for Landscape and Visual Assessment' (LI and IEMA, 2nd Edition, 2002) and the STAG guidelines. Details are given in Appendix B6.

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.

The route has been divided into a series of character zones (as illustrated by Figure 7.16) and the major impacts of Line 1 on townscape and mitigation measures proposed by **tie** are described below, zone by zone. Baseline descriptions and full details of impacts are given in Appendix B6.

*Consultations*

Consultations regarding the townscape impacts of Tram Line 1 have been undertaken with the City of Edinburgh Council City Development (Planning), Historic Scotland and Edinburgh World Heritage Trust.

*Scheme design and mitigation*

The indicative design developed by the Line 1 team has been used as a basis for these assessments. The proposals include the following elements relevant to the assessment of landscape impacts:

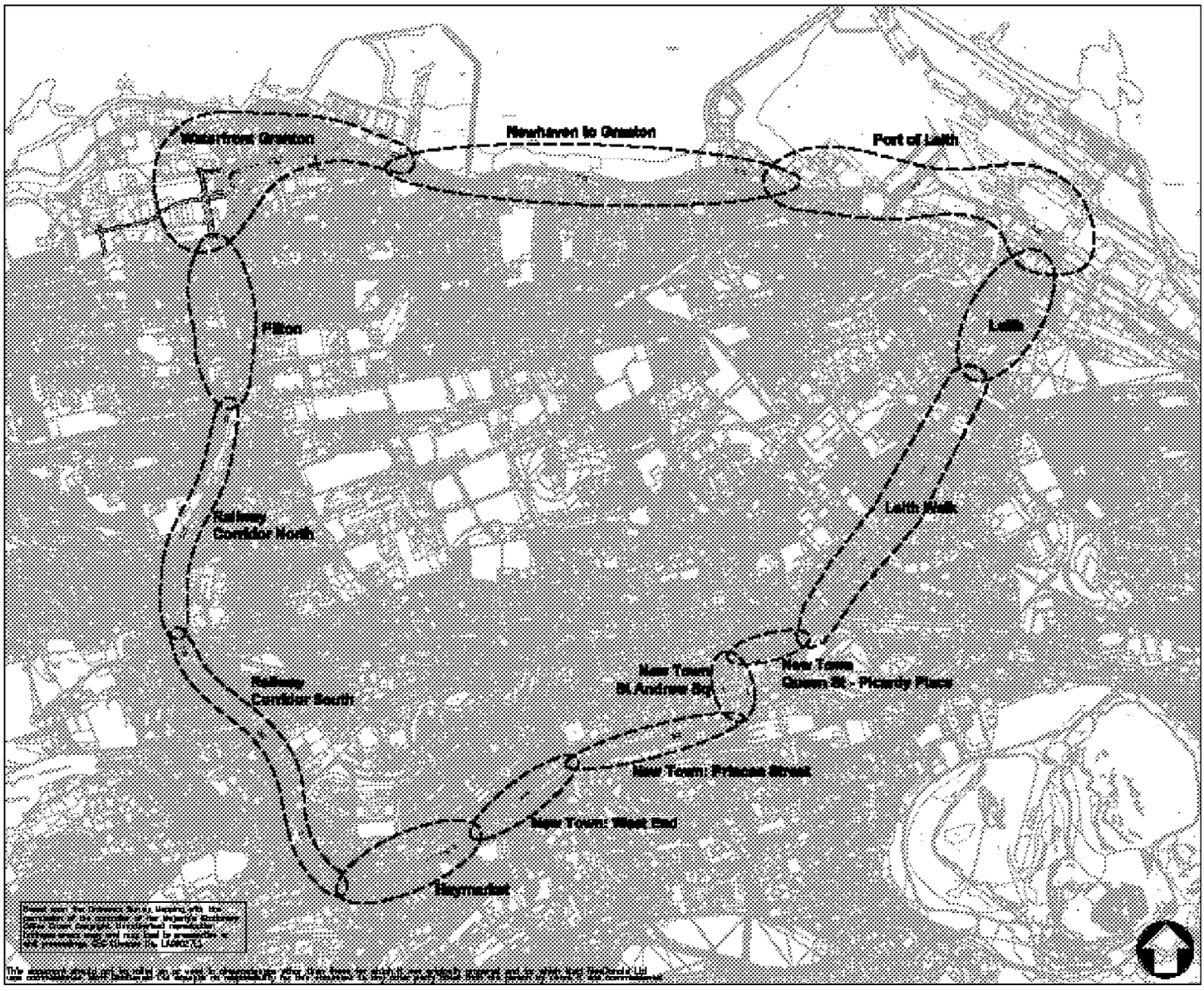
- A twin-track light rapid transit track-bed, generally at existing grade, paved in a variety of materials according to the situation;
- Stops with shelters, lighting, seating, ticketing and information;
- Tram vehicles;
- Overhead line equipment – conductor wires, supported on a combination of cables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

Specific items, such as re-grading of parts of the railway embankment at Roseburn and alterations to structures, are highlighted below.

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 not expected to be sufficient to cause significant impacts on the townscape.

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.

## Figure 7.16 Townscape Zones




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.

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

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. The location and disposition of the major construction compounds is unknown at the time of writing and cannot therefore be specifically assessed.

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.

A Design Manual is being progressed which 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.

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.

*Impacts and mitigation commitments*

Haymarket

West of Haymarket Terrace, the introduction of the tram will have minor townscape impact. East of Haymarket Terrace, the tram will have a major adverse townscape impact on the edge of the New Town and the World Heritage Site.

The demolition of the Caledonian Ale House will have the effect of weakening the already poor enclosure to Haymarket Junction. However, the tram route and stop will visually widen the road at Haymarket Terrace so that Rosebery House appears to be the natural building line where at present it appears incongruously set-back. The widening and flaring out of Morrison Street will set back the future building line in a manner that will weaken the enclosure of Haymarket.

The tram stop itself will constitute a small area of major beneficial impact. The degree to which this offsets some of the major adverse impact above will depend on the quality of design of the area between the station and the stop.

New Town: West End

The West End, from Haymarket to Princes Street, is an architecturally coherent extension of the New Town, and part of the World Heritage site. The tram will run on road with a stop envisaged between Coates and Atholl Crescents. Overall the tram will have a major adverse townscape impact.

Mitigation commitments include use of a straight alignment along West Maitland Street and Shandwick Place to respect the formality of urban design of the New Town and development of a visually integrated design for the tram stop, creating a high quality pedestrian space. To accommodate the stop the edges of the gardens will be reconstructed and made good on a new line set back by up to 2 metres. The redesign and reconstruction of the affected parts of the garden spaces will be to a design and standard acceptable to Historic Scotland and CEC Planning Department.

There is the potential for further mitigation outwith the remit of Line 1 by taking the opportunity to comprehensively upgrade the whole of the garden spaces at Coates and Atholl Crescents.

New Town: Princes Street

The tram will run in a straight line along the centre of Princes Street, on an alignment designed to respect the formality of the street, and allow for the simplest, and thus least intrusive overhead wiring design. Where possible, it will also be designed to allow footway widening.

The works to the road will have a positive effect on the townscape, reducing the carriageway widths and simplifying kerb alignments. The OLE will have a negative effect, particularly in terms of the designed vistas and the iconic tourist views such as the Castle and Old Town skyline. The use of support columns in Princes Street is particularly sensitive because there are no existing permanent vertical elements in the street. For this reason a bespoke support column will be designed which will be attractive in its own right.

A stop is envisaged just east of Castle Street, positioned so that it does not affect the vista of the Castle from Castle Street. It will take the form of extended build-outs of the pavement across the near-side lane. The shelters and other equipment will be designed as an integrated whole, visually light and transparent to reduce their intrusion into views along Princes Street.

Overall the introduction of the tram to Princes Street, despite the committed mitigation, will have a major adverse townscape impact, primarily arising from the OLE.

There is the potential for further mitigation outwith the remit of Line 1 by taking the opportunity to comprehensively redesign and upgrade Princes Street as a whole.

New Town: St Andrew Square

St Andrew Square marks the end point of George Street and is a key element in the formal layout of the New Town. Between Princes Street and Queen Street the tram will run single-track, northbound up South St David Street and down North St David Street and southbound along the equivalent route on North and South St Andrew Streets. Stops are envisaged between St Andrew Square and Meuse Lane, so that they do not impact on the square itself or the vista down George Street, and so they are as close as practical to Waverley Station.

The OLE and the stops will have a major adverse townscape impact through this section, particularly on the designed vista from South St David Street to the Scott Monument.

There is the potential for further mitigation outwith the remit of Line 1 by integrating the design of the tram fully into the planned townscape improvements to St Andrew Square.

New Town: Queen Street to Picardy Place

Similar to the West End, although broader and more austere, this is also part of the World Heritage site and highly sensitive. The northbound tram will run on-street single-track on Queen Street and both north and southbound trams will run twin-track in a straight alignment along the centre of York Place.

In order to accommodate road traffic, two vehicle lanes will be maintained in each direction. This requires the widening of York Place by approximately 3m and replacement of the kerb on the south side between North St Andrew Street and Elder Street East by a low retaining wall. The OLE will have a negative effect particularly in terms of the introduction of support poles into the streetscape of York Place, which currently has no vertical elements apart from the buildings.

Overall the introduction of the tram to Queen Street and York Place, despite the committed mitigation, will have a major adverse townscape impact, primarily arising from the OLE and the level changes.

Leith Walk

The junctions at the top of Leith Walk will be entirely reorganised, with the roundabouts at Picardy Place and London Road both replaced by T-junctions. The introduction of segregated running tram lines will entail the widening of Leith Walk between these junctions, with consequent loss of pavement space at Antigua Street and at Greenside Place in front of the Playhouse and the Omni Centre. The trees at Picardy Place and in front of St Mary's Cathedral will be lost, opening up the space and losing the sense of enclosure to the cathedral. The new large traffic island in front of Picardy Place provides the opportunity to partially fill the void in the townscape created by this junction.

At Elm Row, the south end of the decorative railings, hedge and line of trees will be truncated but these will be reinstated to match the existing on a new line to suit the revised road layout.

Down Leith Walk the tracks will generally follow the alignment of the street, along the centre of the road, but weaving slightly at a number of places to allow for right turn lanes. The OLE will consist of conductor wires supported from span wires between kerb mounted poles. This will have a negative effect on the townscape, particularly in the long views down Leith Walk. To mitigate this, **tie** have committed to the integration of the layout and design of span wire supports and design and positions of street lighting columns to give an ordered layout of a family of columns, including the replacement of the existing street lighting.

At the north end of Leith Walk, some minor road widening and realignment of parking and loading bays will be required which is likely to lead to the loss of a proportion of the existing street trees.

Stops are envisaged at Picardy Place, MacDonald Road, Balfour Street and the foot of Leith Walk, all currently as island stops designed to appear as well-detailed slightly raised areas of pavement, with Picardy Place linked to the large pedestrian traffic island.

Overall the introduction of the tram to Picardy Place and Leith Walk, despite the committed mitigation, will have a negative townscape effect of high magnitude, primarily arising from the OLE, the removal of the maturing trees and the prominent location of the Picardy Place tram stop.

Leith

The tram route will run on-street, sharing road space with all other traffic through Leith from the foot of Leith Walk along Constitution Street to the dock gates at Constitution Place, with a stop at the old town centre between Queen Charlotte and Bernard Streets.

Apart from the area of the stop and minor junction alterations at Bernard Street, the alterations to the streetscape will be minimal. The main mitigation of potential impacts will be to support the OLE from span wires fixed to buildings where practical, to minimise the requirement for kerb mounted poles,

and to carry through a coordinated and visually integrated design for the tram stop, creating a high quality pedestrian space and including improvement to the pedestrian realm in the vicinity.

The old town centre of Leith has a distinctive small-scale local character that is highly sensitive to change. The introduction of the tram, despite the committed mitigation, will have a major adverse townscape impact on this Conservation Area, primarily arising from the OLE and from the tram stop partially filling what is presently a void in the townscape.

There is the potential for further mitigation of the impact of the tram in Leith, outwith the remit of **tie**, by extending the streetscape improvements associated with the stop to encompass the whole of the old Leith town centre.

Port of Leith

The tram route will run partly on-road and partly on new roadside segregated alignments as part of redevelopments, from Constitution Street along the line of Ocean Drive to Ocean Terminal, and along the dock road past the entrance to Chancelot Mill. A ramp will be constructed to link from the dock road up to join Lindsay Road at Anchorfield. There will be two stops, at Ocean Terminal and on Ocean Drive between Constitution Street and Tower Place.

The tram depot will be located just inside the port area, on the east side of the route, immediately north of the dock gates on Constitution Street. The depot building will, by its very nature, take the form of a large industrial shed, albeit well designed and detailed. The size and position of the depot is such that it removes the potential for making the dock area more 'permeable' - new routes into future dock development areas will not be possible. Careful consideration will therefore be given to the quality of pedestrian routes provided around the edge of the site, as well as to the frontage treatments.

In the industrial parts of the port, the tram will be an additional element with a minor impact on the townscape. In the areas currently being redeveloped it will form part of a much wider townscape change: the introduction of overhead cabling and the Ocean Terminal tram stop will have a moderate townscape impact but they will be minor elements compared with the much larger scale changes caused by the redevelopment.

The main mitigation commitment in the port area is the coordination of the design for the tram and for the new developments to ensure, as far as possible, the proper integration of the tram with the new townscape.

Newhaven to Granton

The tram will run from Newhaven to Granton along the waterfront, a quiet, primarily residential, seafront with open views to the Forth. Detailed alterations to the road alignment will be required along much of the length and stops are envisaged at Newhaven, adjacent to Great Michael Square, and at the east end of Lower Granton Road.

Starbank Road is particularly narrow with restricted pavement widths and in a 'Do Nothing' scenario restrictions will have to be imposed on frontage access and informal parking. Abuse of this will impact a tram timetabling. Mitigation is proposed in the form of a new 3 metre wide footway and cycle path provided on the seaward side of the existing sea wall. As this is progressed, the environmental effects on the bird life will have to be further investigated, and liaison on the form undertaken with the City planners.

The route between Trinity Crescent towards Granton Square will be segregated, on street. The arrangement will be one of segregated running to the north of a revised alignment for Lower Granton Road. The revised arrangement offers better provision for parking by residents and improvement in noise and vibration levels caused by traffic, which currently runs close to residential properties. This

alignment also addresses the issues associated with right turns and the aspects of loading points for buses. The tram road alignment to the north also provides the opportunity to use grass track and therefore improve the aspects of urban space being provided.

The introduction of the tram to this area, despite the committed mitigation, will have a major adverse townscape impact in the Newhaven Conservation Area and a moderate adverse townscape impact elsewhere, primarily arising from the partial enclosure that the OLE will give to the open sea-front sections of the line. A well designed stop at Newhaven could have a moderate beneficial impact by providing a focus and visual and functional link between the old village and the new harbour-side developments.

Waterfront Granton

The tram route runs through the Granton Waterfront development area from Granton Square to West Granton Access at the northern edge of Pilton. As the area is currently undergoing comprehensive redevelopment, the tram alignment has been determined primarily through the development master-planning process. Through much of the area, the tram will form part of a transport boulevard, with short sections of roadside segregated track. A stop is envisaged at Granton Square and two at key locations within the new development.

The scale of redevelopment of the Granton Waterfront area is so extensive that its character is primarily one of change, and it will be only slightly sensitive to further change. The townscape impact of the tram will therefore be minor and neutral.

The stop envisaged 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.

As in the Port of Leith, the main mitigation commitment is the coordination of the design for the tram and for the new developments to ensure, as far as this is possible, the proper integration of the tram with the new townscape.

Pilton

The tram route runs along a reserved corridor on the west verge of the recently constructed West Granton Access, which cuts a broad and still fairly raw swathe through this area of social housing. A stop is envisaged approximately mid-way and access to the east may be provided by demolishing a property on Crewe Road West to allow a footpath link.

The road corridor is separated from the neighbouring estates by substantial timber noise barrier fences and hedges and grass verges with a little planting. The construction of the tram will involve the loss of the verge and some planting, and the opening up of the temporary infill under part of the span of the bridge carrying West Pilton Place across the road. To mitigate this, it is envisaged that the track-bed will be infilled with grass and that boundary hedges will be planted where the space permits. The creation of the transport corridor has already had a significant major adverse townscape; the addition of the tram will have minor impact.

Railway Corridor

The tram will follow the former railway solum, now a linear open space and well used cycle and pedestrian path, from Ferry Road to the point where it meets the existing heavy rail just west of Haymarket. Stops are envisaged at Ferry Road, Telford Road, Craigleith and Ravelston Dykes.

The northern end of this corridor is a broad strip of neglected open ground, overgrown grass and shrubs bounded by low-rise housing and in part opening out onto a lightly used playing field. The southern half is mainly a lush woodland valley below surrounding residential areas but occasionally surfaces to level and in parts runs on embankment. A continuous overgrown hedge lines the path on

either side and defines the boundary of the corridor. Stone bridges, extensive stone retaining walls and old platforms act as reminders of the former railway. Parts of the route can feel somewhat insecure and remote, particularly at night, because little of it is overlooked.

Alterations will be required to all the smaller bridges that the tram runs over, as well as the bridge over the A8 at Roseburn. Works will also be required to the Coltbridge viaduct, but the finishes will be reinstated such that there is no significant change to the appearance of the structure. At both ends of the corridor, the existing railway corridor is on embankment and substantial re-grading will be required to ramp the line down to existing grade.

The safety clearances required for the OLE, together with the combined width of the tram tracks and the cycle/foot path, mean that extensive tree clearance will be required, opening up the current enclosed nature of the railway corridor. In places, small retaining structures will be required to allow for the widening.

Significant major adverse landscape impact will be caused by the vegetation clearance although this opening up and the increased activity may make the railway corridor feel safer to cyclist and pedestrian users. Townscape impacts may be caused by work to the bridge at Roseburn. Committed mitigation includes replacement planting, sympathetic boundary treatments at pinch points, and appropriate and sympathetic design of the alterations to the structures.

*Summary*

Although the scheme provides opportunities for enhancing the local landscape in certain areas, other adverse impacts can be expected at varying degrees in different locations along the route. Table 7.21 summarises the landscape impacts for each area affected by the scheme.

**Table 7.21 Summary of Landscape Impacts**

| 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<br>New Town Conservation Area (CA) | West of Haymarket Terrace: minor adverse to minor beneficial.<br>East of Haymarket Terrace: major adverse.<br>The tram stop: small area major beneficial. |
| West End | OLE in designed vista. Road widened into gardens. | World Heritage Site<br>New Town CA<br>West End CA | Major adverse. |
| Princes Street | OLE in designed vista and iconic tourist views. Footway widening. | World Heritage Site<br>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<br>New Town CA | Major adverse impact. |
| Queen St to Picardy Pl | OLE in designed vista. Road widened and awkward level changes. | World Heritage Site<br>New Town CA | Major adverse impact.<br>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)<br>New Town CA (part)<br>Leith CA (part) | Overall major adverse impact. |
| Leith | Distinctive small-scale local character, highly sensitive to | Leith CA | Major adverse impact |

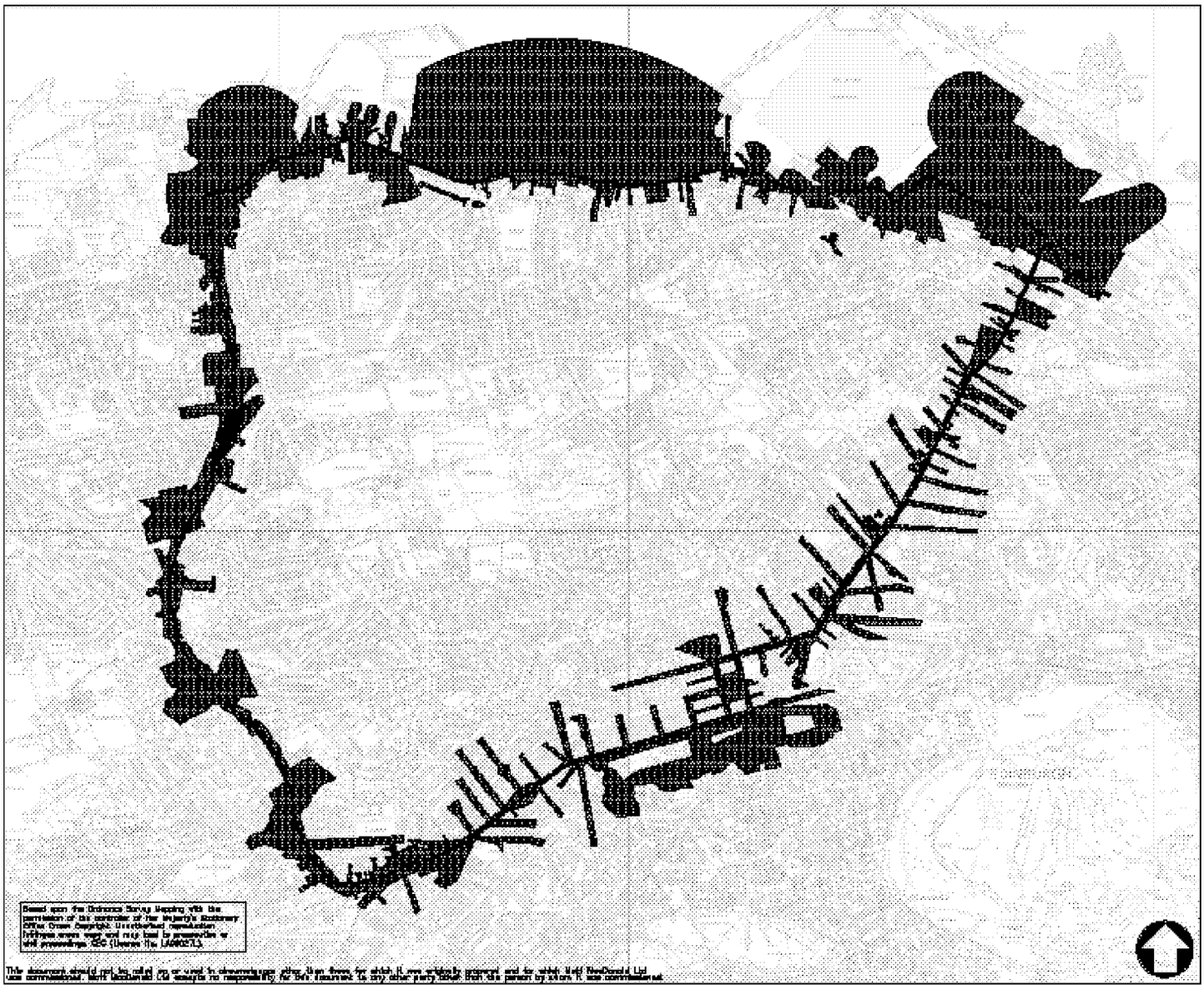
| | | | |
|---|---|---|---|
| | change. | | |
| Port of Leith | Tram a minor additional element in industrial parts, part of a much wider change elsewhere. | Leith CA (part) | Generally, minor impact, moderate in limited areas. |
| Newhaven to Granton | OLE will partially enclose open sea-front sections. New footpath at Starbank beneficial. | Newhaven CA (part)<br>Trinity CA (part) | Stop at Newhaven moderate beneficial impact if well integrated. Moderate adverse impact elsewhere. |
| 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 |

### 7.4.7 Visual Amenity

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.

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, along the waterfront from Newhaven to Granton, and through parts of the Granton Waterfront development area. Figure 7.17 shows the area from which it is anticipated that the tram will be visible: the 'visual envelope'.

**Figure 7.17 Visual Envelope**



This section:

- Describes the extent of the area affected by Tram Line 1;
- Considers the sensitivity of the various receptors of visual impact;
- Defines the extent of visibility of the proposals and the potential visual impacts; and
- Sets out the measures proposed for the mitigation of these impacts.

*Approach*

Consultations regarding the visual impacts of Tram Line 1 have been undertaken with the City of Edinburgh Council 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. Details are given in Appendix B6.

*Visual impacts*

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.

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.

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 the Roseburn cycle route, and from important tourist viewpoints such as Princes Street and Edinburgh Castle.

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.

A summary of the visual amenity impacts is presented in Table 7.22.

**Table 7.22 Visual Amenity Impacts**

| Location and Impact | Importance | Significance of Impact |
|---|---|---|
| Haymarket<br>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<br>New Town Conservation Area<br>See Cultural Heritage for listed buildings | Major to minor adverse |
| New Town: West End<br>OLE generally seen against backdrop of buildings in short views across the road, longer glimpses from side streets. | World Heritage Site<br>New Town Conservation Area<br>West End Conservation Area<br>See Cultural Heritage for listed buildings | Major to minor adverse |
| New Town: Princes Street<br>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<br>New Town Conservation Area<br>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<br>New Town Conservation Area | Neutral (to be confirmed) |

| | | |
|---|---|---|
| Edinburgh Castle<br>Tram discernible but not significant in panoramic views from Castle | World Heritage Site<br>Old Town Conservation Area<br>Listed building | Neutral |
| New Town: St Andrew Square<br>OLE generally seen against backdrop of buildings and trees in short views across the road, longer glimpses from side streets. | World Heritage Site<br>New Town Conservation Area<br>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<br>New Town Conservation Area<br>See Cultural Heritage for listed buildings | Major to minor adverse |
| Leith Walk<br>OLE generally seen against backdrop of buildings and trees in short views across the road, longer glimpses from side streets. | World Heritage Site (part)<br>New Town Conservation Area (part)<br>Leith Conservation Area (part)<br>See Cultural Heritage for listed buildings | Major to minor adverse |
| Leith<br>OLE generally seen against backdrop of buildings and trees in short views across the road, longer glimpses from side streets. | Leith Conservation Area<br>See Cultural Heritage for listed buildings | Major to minor adverse |
| Port of Leith<br>OLE generally seen against sky backdrop in open views across dock areas, against backdrop of buildings in some areas. | Leith Conservation Area (part)<br>See Cultural Heritage for listed buildings | Major to minor adverse |
| Newhaven to Granton<br>OLE generally seen against sky backdrop in open views across Firth of Forth, against backdrop of buildings in limited areas. | Newhaven Conservation Area (part)<br>Trinity Conservation Area (part)<br>See Cultural Heritage for listed buildings | Major to minor adverse |
| Waterfront Granton<br>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<br>OLE generally seen against backdrop of buildings in short views across the road, longer glimpses from side streets | | Moderate to minor adverse |
| Railway Corridor<br>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 |

*Mitigation*

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.

A Design Manual is being progressed which 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.

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.

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.

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.

Major adverse visual impacts will also be suffered along the waterfront where the overhead lines will be particularly visible because they will be seen against the open sky. Again, the mitigation here will be the careful design of the equipment to keep it as simple and uncluttered as possible.

### 7.4.8 Agriculture and Soils

No agricultural land or resources are affected by the proposal. Impacts on soils have been assessed in Section 7.4.4 above.

### 7.4.9 Cultural Heritage

*Approach*

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)[37];
- Listed buildings[38];

[37] Scheduled Ancient Monuments are sites of national cultural heritage importance which are designated under the *Ancient Monuments and Archaeological Areas Act* 1979.

- Conservation areas[39];
- Designed landscapes[40]; and
- Areas and sites of archaeological interest.

Baseline information was collated for a corridor defined by the limits of deviation for the scheme (defined as the buffer zone for the assessment). The assessment has taken account of the significance of the resource (individual and group value), the likely effects of construction and operation of the tram, and the potential for mitigation. Relevant policy guidance has been taken into account. A detailed schedule of the cultural heritage sites identified is presented in Appendix B7 and shown on Figure 7.18.

*The cultural heritage resource*

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

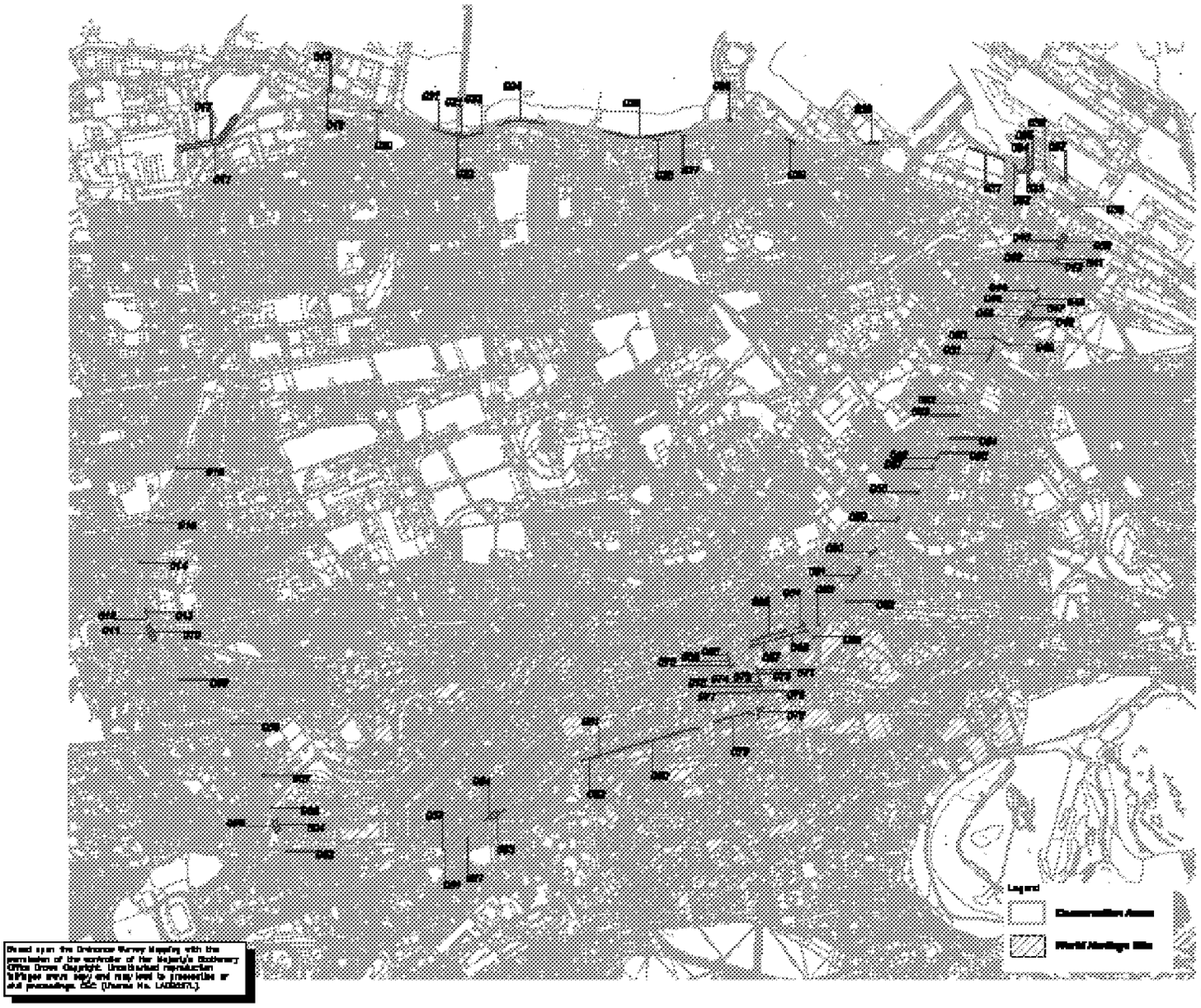
- The Haymarket complex, which includes the Category A listed station and two listed public houses;
- The Roseburn railway corridor, which is the line of the Granton branch of the Caledonian Railway, built in 1861 and closed in the 1980s;
- The designed landscape of Caroline Park;
- The water frontage near Granton where there is potential for a variety of archaeological finds;
- The 19th century development of Granton with high aesthetic quality townscape and minor industrial premises including the lighthouse and warehouses;
- 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 churchyard of South Leith Parish Church;
- The ancient thoroughfare of Leith Walk;
- 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.

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

[39] 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.

[40] 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.

**Figure 7.18 Schedule of Cultural Heritage Sites**



The rich historic fabric of the corridor is recognised in the designation of nine conservation areas along the route (the West End; West Murrayfield; Coltbridge and Wester Coates; Inverleith; Trinity; 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 (section 7.4.6).

*Mitigation and predicted impacts of Line 1*

The preferred approach to mitigation of cultural heritage impacts is to preserve archaeological and architectural resources *in situ*. This principle has been followed in the evolution of the preferred design and all reasonable opportunities have been taken to avoid listed buildings, etc. All mitigation measures for the scheme are to be agreed in advance of construction with Historic Scotland and the City of Edinburgh archaeologist.

Impacts have been assessed on a site-by-site basis for the route and the findings presented in tabular form (see Appendix B7 for detailed tables).

*Assessment findings*

Some 86 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. A total of 316 listed buildings are predicted to have their setting affected, of which 78 are directly affected. The 86 directly affected sites comprise:

- 16 sites of national importance;
- 20 sites of regional importance;
- 27 sites of local importance; and
- 23 sites of little or no importance.

Of the 16 sites of national importance, the only Scheduled Ancient Monument is the Victoria Bridge in Leith Port. Of the remaining 15 sites of national importance (all in the buffer zone), all but Site 73 are railings, gatepiers and lamp standards associated with Category A Listed buildings. The significance of impact to all 16 national sites is described as 'major adverse'.

The 20 sites of regional importance comprise:

- Site 3 - Roseburn Railway Bridge;
- Site 22 - proximity to where bronze age cists were found in 1846;
- Site 28 - Police box, Pier Place, Newhaven;
- Site 31 - Victoria Dock: sandstone dock and iron bollards;
- Site 34 - Alexandra Dry Dock hydraulic station;
- Sites 39 & 49 - proximity to 1560 fortifications (buried archaeology);
- Site 40 – Statue of Robert Burns;
- Sites 41-47 (inc), 51, 76& 84 – Iron railings, gatepiers and boundary; walls associated with Category B Listed Buildings;
- Site 50 – Statue of Queen Victoria; and
- Site 81 – Police box, West Princes Street Gardens.

The 27 sites of local importance comprise:

- 20 non-listed structures (including the clock at London Road which will require relocation and the statues in Picardy Place);
- 1 site with proximity to potential buried archaeology (Site 48);
- 1 site with proximity to the Caroline Park designed landscape (Site 17); and
- 5 Category C(S) Listed Buildings, or part thereof.

The 23 sites of little or no importance comprise:

- 3 sites of historic street furniture associated with Category C(S) Listed Buildings;
- 13 sites of historic street furniture not associated with Listed Buildings;

- 3 boundary structures; and
- 4 sites associated with Leith Docks.

Three sites are to be demolished, all of local importance. These are:

- The Caledonian Alehouse (Category C(S) Listed Building);
- Heart of Midlothian War Memorial (Category C(S) Listed Building) – this will need to be relocated; and
- Bridge at Groathill Road South (Not listed).

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. A summary of the predicted impact categories is presented in the table below.

Table 7.23 below summarises the number of sites impacted upon by the implementation of Line 1 in terms of cultural heritage.

**Table 7.23 Number of Sites with Cultural Heritage Impacts**

| Severity | Importance | | | |
|---|---|---|---|---|
| | National importance | Regional importance | Local importance | Little or no importance |
| Major adverse impact | 16 | 1 | 1 | - |
| Moderate adverse impact | - | 7 | 24 | - |
| Minor adverse impact | - | 12 | 24 | 23 |

The majority of sites (66 out of 86) 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.

Thirteen sites are recommended for Level 2 mitigation (detailed standing building survey). This higher level of survey has been suggested due to risk of physical impact on these sites from engineering works. This includes the "B" listed bridge over Glasgow Road at Roseburn.

Level 3 mitigation (watching brief) is suggested for five sites. These include the 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. The other four sites are areas of archaeological potential.

The two sites recommended for Level 4 mitigation (Detailed standing building survey and salvage) are both at Haymarket. This level of survey is deemed necessary unless it is found by detailed design that the demolition of the C(S) Listed Caledonian Ale House and the dismantling and relocation of the C(S) Listed Heart of Midlothian War Memorial can be avoided.

## 7.5 Safety

The safety objective aims to improve safety for all road users, by reducing the loss of life, injuries and damage to property resulting from transport accidents and crime.

### 7.5.1 Accidents

The assessment of the changes in the number of accidents and associated casualties has been made quantitatively, as far as road traffic is concerned, considering the changes in total private transport travel. Some considerations are also given to the accident impacts on public transport.

*Change in annual personal injury accidents (road traffic)*

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) for the year 2000, but changing over time to reflect technological improvements in safety, have been adopted.

The recommended approach requires as input data (derived from the transport model):

- Total number of road traffic vehicle-km both for the Do-Minimum and Do-Something scenarios (see Section 7.2 *Summary of Transport Impacts* above) for years 2011 and 2026 (taking into account growth rates). The total number of veh-km removed from the road network has been estimated at –5.3 million (an increase) for 2011 and 40.6 million for 2026.
- Breakdown of the above for a range of standard road types.

A comprehensive spreadsheet model has been developed, which 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. A reduction in private vehicle traffic (in terms of veh-km removed from the road network) has promoted an annual saving in the number of accidents in the road network at –7.6 (an increase) in 2011 and 51 in 2026, considering all severity levels (see the split by severity level below). The combined effect of ramp-up, traffic growth, diversion due to congestion and gradual behavioural reaction to the new scheme contributed to such large variation in benefits between 2011 and 2026.

*Change in balance of severity*

Standard accident rates (as mentioned above) are available by severity level: fatal, severe, slight and damage. 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 number of accident savings per severity level was estimated as shown in Table 7.24.

**Table 7.24 Number of Accidents per Severity Level**

| | Annual Changes | |
|---|---|---|
| **Severity** | **2011** | **2026** |
| Damage | -6.8 | 45.5 |
| Slight | -0.7 | 4.8 |
| Serious | -0.1 | 0.6 |
| Fatal | 0.0 | 0.1 |
| **Total** | **-7.6** | **51.0** |

The majority of accidents are accounted for in terms of damage to property. The number of fatalities saved from the implementation of the scheme is expected to be negligible.

*Total discounted savings*

Using standard valuations for casualties, accidents and damage to property by severity level[41] and the accident saving estimations summarised above, the undiscounted monetary valuation of annual accident savings are estimated as shown in Table 7.25.

**Table 7.25 Undiscounted Valuation of Accident Savings**

| Type | Valuation of Annual Changes in Accidents 2011 | 2026 |
|---|---|---|
| **Accident Costs** | | |
| Damage | -£14,840 | £133,770 |
| Slight | -£1,945 | £18,045 |
| Serious | -£413 | £3,745 |
| Fatal | -£157 | £1,405 |
| **Sub-total** | **-£17,355** | **£156,966** |
| **Casualty Costs** | | |
| Slight | -£13,831 | £125,102 |
| Serious | -£20,099 | £179,480 |
| Fatal | -£28,579 | £255,391 |
| **Sub-total** | **-£62,509** | **£559,974** |
| **Total** | **-£79,864** | **£716,939** |

The total savings as a result of reduced traffic on the road network has been calculated at approximately -£80,000 per year for 2011, and £0.7 million per year for 2026. It must be noted that accident values grow over time, reflecting the growth rate applied to accident valuations of about 2% per annum.

Feeding these valuations through cash flow calculations into the accident framework, which discounts the annual valuations to a present value, the NPV of these savings represent £4.8 million (NPV), considering the project life-time. Casualty costs represent approximately 78% of the total costs (the remainder are accounted for accident costs).

*Change in accidents on public transport*

In 2002/03, there were 166 tramway incidents in the UK, 120 of which involved road vehicle collisions and 3 fatalities. It is accepted that the introduction of street running trams in Edinburgh would 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).

However, there is no official guidance on the estimation of public transport accidents in STAG or GOMMMS. 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.

Much of the tram Line 1 route will be segregated from road traffic, limiting the opportunity of traffic-related accidents. In addition, mitigation measures were adopted along the shared sections of the line in order to minimise the incident and severity of accidents involving car users, pedestrian and cyclists.

[41] Monetary values and annual growth rates from NESA Manual, DMRB 15, Section 6 (1998 prices and values).

In order to undertake a quantitative estimation, tram accident rates per vehicle-km would need to be derived according to the level of segregation, since segregated rail services are considerably safer than non-segregated ones, however:

- The national statistics do not specify how many of the accidents have taken place on fully segregated, on-street segregated and on-street mixed running sections of various tram alignments. In addition, these statistics are not broken down by accident severity level. On this basis, the use of average national rates may not be entirely appropriate for the estimation of accident disbenefits for trams in Edinburgh; and
- Reliable data about the total number of vehicle-km for each of the UK tram systems would be required by segregation level.

Therefore, simply using total system statistics could be very misleading, given that the risk to exposure could be materially different by level of segregation. A quantitative estimation would require a great deal of effort and would produce at best some marginal benefits for the tram system in Edinburgh. We consider that a qualitative assessment for tram accidents could be appropriate to complement the quantitative assessment of highway accidents.

Thus, the estimation of accident benefits within the Line 1 STAG has only taken cognisance of highway vehicle related accidents (including those who transfer from road to tram), and no quantified account has been taken of accidents involving on-street trams.

### 7.5.2 Security

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.

The assessment of security for Tram Line 1 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 GOMMMS. Table 7.26 summarises the appreciation of the security impacts for each indicator, considering the changes in conditions between the existing and after implementation scenarios.

**Table 7.26 Security Impacts**

| Indicator | Impact | Assessment |
|---|---|---|
| Site perimeters, entrance and exists | Clear access to stops will not represent a risk to security. | Neutral |
| Formal surveillance | CCTV system (see Section 6.3.2) 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. Conductors 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 |

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 conductors.

The overall impact is considered moderate beneficial.

## 7.6 Economy

### 7.6.1 Transport Economic Efficiency

The TEE analysis for Line 1 has utilized the TUBA (Transport Users Benefit Appraisal) computer program, developed for the DfT to undertake economic appraisal for multi-modal transport studies.

TUBA is compliant with current economic appraisal guidance as set out in the Guidance on the Methodology for Multi-Modal Studies (GOMMMS). However, as required by STAG, the presentation of the TEE analysis here is somewhat different from GOMMMS, notably in that the TEE covers user benefits and private sector operator impacts only. Financial costs and benefits to Government are quantified and presented separately (see Section 7.9).

TUBA undertakes a matrix-based appraisal and the respective trip, time, distance and charge matrices have been obtained from the LUTI model employed in the demand forecasting process (see Appendix A for further details). The data is summarized in Table 7.27; monetary values were converted to 1998 prices using the factors shown. All were produced for the Do-Minimum and the Do-Something scenario, for years 2011 and 2026 and for time periods AM, PM and IP.

**Table 7.27 TUBA Inputs**

| Mode | Type | Unit | Factor to 1998 prices |
|---|---|---|---|
| Highway | Distance | Kilometres | |
| Highway | Time | Minutes | |
| Highway | Demand | Vehicles | |
| Highway | Parking Charge | £2001 prices | 0.940 |
| Public Transport | Generalised Time | | |
| Public Transport | Demand | Persons | |
| Public Transport | Fares | £2001 prices | 0.924[42] |

[42] Fares indices for Scotland of 121.8 (1998) and 131.8 (2001), taken from Transport Statistics of Great Britain 2002

Default TUBA economic parameters were employed, with one exception; the work:non-work split. Household data was analysed to derive a local all-day split of 2.6% of work for PT and 9.1% for highway (compared to default values of 0.2% and 15.1%). The 9.1% for car business trips was factored pro-rata over the time periods to reach 10.1% in AM, 6.8% in PM, and 11.4% in the inter-peak. The purpose split on public transport is assumed constant over all time-periods. A sensitivity test was run using the default splits.

Annualisation factors were also derived from household data and the values set out in Table 7.28 employed. Appendix A sets out the detail on the derivation of these factors.

**Table 7.28 Annualisation Factors**

| Modelling Period | Public Transport | Car |
|---|---|---|
| AM Peak | 557 | 585 |
| Inter Peak | 2,425 | 2,288 |
| PM Peak | 563 | 656 |

Parking revenue data and the changes therein were taken directly from the TRAM model, which models the price and availability of parking within the overall model structure (and hence influences destination, mode and time of travel choice). The data employed was all-day revenue, split by on-street (deemed to represent public sector provided parking) and off-street (deemed to represent private sector provided parking). This was annualised assuming a 6-day week to a full year. Present values were then derived over the 30-year appraisal period and the tax impacts calculated.

*Model PT demand*

The public transport demand within the LUTI model is based on CSTM3 data and given its age and lineage, a review was undertaken to establish the robustness of the current public transport demands being forecast by the model. This involved a comprehensive programme of bus passenger counts in all three of the Edinburgh Tram corridors and comparison with the Base Year model forecasts. Whilst there was variability across all the count sites and corridors, the Line 1 study area had a systematic under forecasting of bus demand.

On this basis, the Line 1 results presented here and the associated economic and financial analysis has assumed a 10% uplift to all public transport demand, revenue and benefits.

*PT revenues*

A key consideration for Line 1 is the impact on the revenues of existing PT modes and a breakdown has therefore been produced of PT revenues by mode.

The basic PT revenue output from TUBA represents the present value of adult single fare revenue in 1998 market prices; it therefore does not account for fare evasion, demand ramp up and ticket type mix factors which reduce revenue accordingly. To this end a reduction factor was estimated to take into account these factors, which was applied to all PT modes. This reduction factor was derived by dividing the forecast LRT revenue by the forecast revenue that would occur if these factors were removed; this gave a factor of 0.823. Thus this represents the value to be applied to the TUBA PT revenue output to represent 'out turn' revenue.

The revenue calculations for the different PT modes were extracted from the DAM model outputs which provides for each mode (directly or indirectly):

- Passenger boardings;
- Passenger distance;
- Average distance per mode (passenger distance divided by passenger boardings); and
- Average fare per mode (based on DAM fare tables and average distance).

Once these values were calculated, the 30 year revenue profile for each mode for the DM and DS was derived by extrapolating the 2011 and 2026 DAM results (assuming no growth post-2026). These values were then converted to present value in 1998 market prices and subtracted (DS minus DM) to obtain the net effect on PT revenues by mode.

The last step involves 'hard coding' the out turn LRT revenue calculations (which has been presented to and reviewed by Grant Thorton for the business case) and the remaining PT modes revenue values are based on the respective proportions of each mode.

*Scheme Costs and Price Base*

All costs were discounted to 1998 market prices and values, and used an RPI value of 181.3 for 2003 quarter 2, in comparison to 162.8 for 1998. An RPF factor of 0.98 was used for construction cost correction to long-term trend prices. No allowance has been made for real term price changes. The current and present value (1998) headline costs are shown in Table 7.29.

The scheme costs within the TEE are all 2003 Q2 prices and are as follows:

- Construction cost of £274.150 million. This includes construction and vehicle capital costs, land and project supervision and design costs. This cost was spread over the years 2006 – 2009 inclusive based on the cost profile provided within the cost estimate;
- Private developer contribution of £11.600 million (included in the construction cost above);
- Annual Line 1 operating cost of £6.287 million (inclusive of operator profit); and
- Lifecycle costs of £44.6 million, allocated over years when particular costs were predicted.

**Table 7.29 Line 1 Scheme Costs (£000's)**

| Cost Element | | Current price (2003 Q2) | 1998 PV Market Prices (£) |
|---|---|---|---|
| Construction | | 274,150 | 213,542 |
| Private Developer Contributions | | 11,600 | 9,563 |
| Operating Costs | Tram Line1 | 6,287 pa | 108,285 |
| | Bus costs | -2,200 pa | -31,141 |
| Lifecycle Costs | | 44,625 | 19,292 |

*User benefits*

Table 7.30 presents the TEE analysis for the Line 1 Central Case scheme. This disaggregates the costs and benefits by consumers and business, by public transport and highway and by public transport mode as appropriate.

## Table 7.30 Line 1 Central Case TEE

| | | STAG Code | Total | Public Transport | Road Users | |
|---|---|---|---|---|---|---|
| | | | | | Cars | Freight |
| **User benefits - Consumers** | | | | | | |
| Travel time | | (PV2) | £184,329 | £116,749 | £67,580 | |
| User Charges | | (PV3) | -£9,166 | -£9,166 | £0 | |
| Vehicle Operating Costs | | (PV4) | £3,105 | £0 | £3,105 | |
| Sub Total | | | £178,268 | £107,582 | £70,685 | |
| **User benefits - Business** | | | | | | |
| Travel time | | (PV2) | £47,717 | £9,244 | £21,294 | £17,179 |
| User Charges | | (PV3) | -£296 | -£296 | £0 | £0 |
| Vehicle Operating Costs | | (PV4) | £2,474 | £0 | £756 | £1,717 |
| Sub Total | | | £49,894 | £8,948 | £22,050 | £18,896 |
| **User benefits - Total** | | | | | | |
| Travel time | | PV2 | £232,045 | £125,993 | £88,874 | £17,179 |
| User Charges | | PV3 | -£9,462 | -£9,462 | £0 | £0 |
| Vehicle Operating Costs | | PV4 | £5,579 | £0 | £3,861 | £1,717 |
| Sub Total | | | £228,162 | £116,531 | £92,735 | £18,896 |
| **Private Sector Provider Impacts** | | | | | | |
| Investment (Capital) Costs | | PV5 | -£213,542 | -£213,542 | | |
| Operating Costs: | Line 1 | PV6 | -£108,285 | -£108,285 | | |
| | Bus | PV6 | £31,141 | £31,141 | | |
| | Rail | PV6 | £0 | | | |
| Revenues: | Line 1 | PV6 | £0 | | | |
| | Bus | PV7 | -£40,278 | -£40,278 | | |
| | Rail | PV7 | £25,514 | £25,514 | | |
| | Off-street Parking | PV7 | -£3,895 | | -£3,895 | |
| Grant/ Subsidy | | PV8 | £321,827 | £321,827 | | |
| | Developer Contribution | PV8 | -£9,563 | -£9,563 | | |
| Sub Total | | | £2,918 | £6,814 | -£3,895 | £0 |
| **Total PVB** | | | **£231,080** | | | |

**Notes:**
1. Disbenefits appear as negative
2. All values are £000s Present Value, 1998 Values and Prices

Issues to note include:

- Total PT benefits of £116.5m;
- Total highway benefits of £111.6m;
- A negative impact on bus operations, with a revenue reduction of £40.3m exceeding the operating cost reduction of £31.1m by some £9.2m;
- A small reduction in off-street parking revenues; and
- An overall present value of benefits of £231.1m.

The predicted level of non-user benefits from the suite of demand models equates to approximately £111.6m over the 30-year evaluation period. While this level of benefits seems somewhat high in comparison to the predicted user benefits, it should be noted that the models are predicting severe levels of congestion, particularly by the end of the evaluation period (the modelled year of 2026). Therefore any reduced level of congestion caused by modal shift could result in a very large number

of travellers experiencing a small level of benefit thereby producing a significant level of cumulative benefits. This was confirmed through the analysis of model output.

However, it should also be noted that models of this size and geographical coverage can produce what is referred to as model noise. This means that the introduction of any changes in the model can often result in theoretical changes in travel patterns in areas that would, in practice, experience no change. In this case for example the model is predicting reduced journey times and therefore economic benefits in places such as Fife and East Lothian. Because of the nature of the modelling, the level of non-user benefits may have been overestimated. Recognising that, a detailed review of the distribution of the benefits was undertaken. The purpose of this review was to identify the magnitude of benefits predicted in such areas with a view to discounting those benefits out with the immediate area of influence of the tram. Following this review a total of some £109m worth of non-user benefits were deducted from those predicted from the demand model. These benefits relate to the movements between the following sectors (see below):

- Fife;
- West Edinburgh and west of Edinburgh;
- South Edinburgh and the south; and
- East of Edinburgh.

It could be argued that any modal transfer of trips to public transport could present, albeit to a minimal extent, benefits to non-users. Therefore, the above reduction could be considered to be conservative and the actual level of benefits may be slightly higher than those shown in the TEE analysis presented.

*Spatial benefits*

The LUTI model employed in the TEE analysis has some 352 zones in the PT network and 345 zones in the highway network. For the purposes of understanding the spatial distribution of the benefits of the scheme, a 13-sector system has been devised. The results obtained from TUBA have been reported at this sector level, in addition to the headline TUBA outputs over time period, purpose split and mode.

Table 7.31 and Table 7.32 show the user time benefit distribution for the PT and car users respectively. For the PT benefits, the largest beneficiaries of Line 1 are the Granton area of north Edinburgh and the (western) Railway corridor. These currently have poor connections with the City Centre and West Edinburgh in particular and Line 1 will result in considerably quicker journey times. Although directly served by Line 1, Leith and Leith Docks have lower benefits due to the, still high, level of bus provision in this corridor. Some trips at a sector level do disbenefit, principally through the removal of bus services on Leith walk and into the City Centre. Overall, the disbenefits of £30.9m are offset by the benefits of £156.9m. The car data indicates the sectors where benefits were removed for the reasons set out previously.

**Table 7.31 Line 1 PT Time Benefits by Sector**

| No. | Area | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | City Centre | -592 | -659 | -1,529 | 9,434 | -528 | 275 | 7,278 | -758 | 1,584 | -2,436 | -1 | -23 | -241 | 11,805 |
| 2 | Haymarket | -45 | 88 | 806 | 3,534 | 425 | 1,121 | 3,022 | 50 | 362 | 941 | -37 | 63 | 113 | 10,443 |
| 3 | Leith | -232 | 1,377 | -1,287 | 4,577 | -382 | -406 | 3,715 | -1,733 | -1,245 | -345 | 172 | -173 | -324 | 3,713 |
| 4 | Granton | 17,919 | 4,315 | 3,750 | 2,060 | 339 | 722 | 2,552 | 3,017 | 1,341 | 4,722 | 1,811 | 2,443 | 836 | 45,828 |
| 5 | North LRT | -342 | 1,116 | -177 | 733 | -252 | -180 | 892 | -1,056 | -180 | 187 | 136 | 88 | -807 | 158 |
| 6 | Leith Docks | 3,009 | 1,984 | -64 | 1,041 | 210 | 48 | 2,267 | -461 | -148 | 1,606 | 501 | 1,318 | 270 | 11,579 |
| 7 | Railway Corridor | 7,672 | 3,133 | 5,471 | 2,717 | 1,016 | 1,567 | 1,306 | 1,468 | 793 | 2,574 | 1,438 | 2,718 | 587 | 32,461 |
| 8 | South Edinburgh | -596 | -386 | -2,282 | 1,337 | -629 | -582 | 909 | -23 | 320 | -1,037 | 119 | -58 | 37 | -2,872 |
| 9 | East Edinburgh | 35 | -585 | -1,073 | 1,680 | -388 | -451 | 655 | 429 | 206 | -667 | 18 | -220 | 2 | -360 |
| 10 | West Edinburgh | -483 | 246 | -838 | 2,900 | -663 | 280 | 1,124 | -322 | -164 | 76 | 39 | 294 | 6 | 2,494 |
| 11 | Fife & North | -87 | -1 | -99 | 2,058 | 123 | 283 | 1,682 | -28 | -14 | 101 | 0 | 0 | 3 | 4,021 |
| 12 | West Scotland | -229 | -8 | -137 | 3,150 | 161 | 386 | 3,506 | -95 | -97 | 353 | 0 | 22 | -18 | 6,993 |
| 13 | South & East | 369 | -299 | -142 | 737 | -1,393 | 35 | 513 | -45 | 7 | -75 | 10 | 10 | 2 | -269 |
| Total | | 26,398 | 10,321 | 2,398 | 35,956 | -1,962 | 3,099 | 29,421 | 444 | 2,765 | 6,001 | 4,206 | 6,481 | 466 | 125,993 |

Note: £m PV in 1998 prices and values.

**Table 7.32 Line 1 Car Time Benefits by Sector**

| No. | Area | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | City Centre | -2,055 | -6,434 | -1,539 | -202 | -507 | -146 | -850 | 1,340 | 1,130 | 287 | 1,415 | 2,785 | 557 | -4,219 |
| 2 | Haymarket | 7,713 | -270 | 3,619 | 933 | 1,512 | 600 | 1,096 | 4,410 | 2,818 | 6,315 | 2,264 | 4,534 | 1,058 | 36,603 |
| 3 | Leith | 1,345 | -1,378 | -312 | 181 | 100 | 14 | 108 | 1,108 | 833 | 1,722 | 723 | 1,032 | 15 | 5,492 |
| 4 | Granton | 653 | 166 | 659 | 239 | 388 | 1,220 | 119 | 852 | 797 | 2,242 | 927 | 731 | 351 | 9,347 |
| 5 | North LRT | 168 | -159 | 197 | 97 | 66 | 148 | -25 | 731 | 396 | 1,563 | 1,097 | 1,987 | 88 | 6,352 |
| 6 | Leith Docks | 124 | -388 | -116 | 408 | -46 | 30 | -66 | 323 | -303 | 323 | 328 | 659 | -347 | 929 |
| 7 | Railway Corridor | 1,009 | -10 | 332 | 182 | 216 | 287 | 62 | 2,421 | 1,728 | 4,649 | 1,975 | 4,212 | 839 | 17,902 |
| 8 | South Edinburgh | 2,711 | -5,554 | 753 | 449 | 783 | 623 | -632 | | 1,798 | 1,488 | 598 | 1,443 | | 4,461 |
| 9 | East Edinburgh | 3,119 | -2,496 | 1,357 | 1,296 | 745 | 1,879 | 592 | 5,196 | | 2,363 | 1,321 | 2,233 | | 17,607 |
| 10 | West Edinburgh | -889 | -3,267 | 1,290 | -702 | 372 | 1,115 | 258 | 3,554 | 2,432 | | | | 6,000 | 10,163 |
| 11 | Fife & North | -2,265 | -1,573 | -558 | -842 | -184 | -584 | -967 | 975 | 213 | | | | | -5,786 |
| 12 | West Scotland | -5,696 | -3,878 | -1,674 | -1,594 | -1,596 | -1,630 | -4,007 | 1,699 | 639 | | | | | -17,738 |
| 13 | South & East | 1,165 | -682 | 491 | 726 | 680 | 1,229 | 425 | | | 3,727 | | | | 7,761 |
| Total | | 7,101 | -25,923 | 4,500 | 1,172 | 2,529 | 4,788 | -3,886 | 22,609 | 12,480 | 24,679 | 10,647 | 19,617 | 8,561 | 88,874 |

Note: £m PV in 1998 prices and values.

### 7.6.2 Economic Activity and Location Impacts

*Overview of approach*

At the STAG2 level of appraisal, the aim of Economic Activity and Location Impact (EALI) analysis is to quantify the impacts of a proposed scheme on the economy at a local or regional level and at the level of Scotland as a whole. The appraisal is undertaken in terms of employment and where possible income. The analysis is intended to identify how different locations may be impacted upon and to capture net additional economic impacts at different spatial levels. These impacts are not however, additional to those captured in the standard cost benefit analysis approach; rather, they express these impacts using an alternative unit of account.

STAG requires the findings to be presented in two ways, both as a net additional impact at the Scotland level and in terms of its gross components, which need to be presented at appropriate spatial levels. The gross analysis distinguishes impacts at the level of particular areas and / or social groups.

The EALI analysis within STAG suggested that impacts are likely to be largely re-distributional, save for the prospect of an International World Trade Centre being developed at the Waterfront. As this development depended on the availability of a unique site and as the tram was at the time a critical component of the Waterfront regeneration scheme, there was a "*prima facie*" case that linked the tram to the employment potential of the Trade Centre project. It was also arguable that the trade Centre employment would be mainly additional at the Scotland level as there was no other comparable site available in Scotland.

In the course of this study it has become clear that the Trade Centre development is unlikely to take place. Accordingly the study has revisited the rationale for possible EALI impacts, which is the basis for the quantitative analysis. Following a preliminary assessment of links from the tram investment to possible economic outcomes, the study team has considered the following:

- Impacts on businesses in the proposed rapid transit corridor who might enjoy better access to labour and customers but who might be negatively affected by localised changes in vehicular access or parking; and
- The role of the tram in the development of the Waterfront area and the possible effects of the tram on land use and the form, rate or quality of that land use.

The appraisal of business impacts involved a survey-based approach, while the land use impacts involved an assessment of development outcomes and discussions with developers to identify the role

of the tram. In addition the team commissioned runs of the Delta model in order to obtain a top down assessment of employment impacts alongside corresponding expected land use changes.

A full report of the EALI appraisal is available, containing more detailed information.

*Proposed rapid transit corridor impacts*

In order to examine micro level impacts for a Part 2 EALI analysis it is necessary to segment economic activity into types of activity, followed by an investigation into how the economic actors relevant to each area of activity might be affected by the transport investment. The aim is to assess how they might respond – in terms of economic decisions – to the changes in costs or accessibility likely to arise as a result of the proposed scheme.

For the tram, these actors include land and property owners and developers; however, these are more conveniently discussed as a separate group in *Property Related Impacts* section below.

For Edinburgh Tram Line 1, the other economic actors expected to be affected are businesses on or close to the tram corridor. Based on maps, databases and a "look round" survey these were identified. Subsequently surveys were undertaken with a representative sample of these actors in order to identify and where relevant quantify potential outcomes in terms of employment.

Interviews with 41 businesses were undertaken across economic sectors. Table 7.33 presents the sample of businesses interviewed across sectors and business size.

**Table 7.33 Business Survey Sample**

| Sector | Number Businesses Interviewed | Small | Medium | Large |
|---|---|---|---|---|
| **Wholesale / retail trade, repair & transport** | **18** | 13 | 2 | 3 |
| - Retail | 10 | 7 | | 3 |
| - Food retail | 2 | 1 | 1 | |
| - Wholesale | 3 | 2 | 1 | |
| - Transport, removal & storage | 3 | 3 | | |
| **Business services & financial mediation** | **7** | 4 | 2 | 1 |
| - Business services | 4 | 3 | 1 | |
| - Financial mediation | 3 | 1 | 1 | 1 |
| Hotels & restaurants | **8** | 4 | 2 | 1 |
| Manufacturing | **5** | 2 | 1 | 2 |
| Health Care | **1** | | | 1 |
| Education | **2** | | 1 | 1 |
| **Total Number Businesses** | **41** | | | |

These businesses were spatially distributed around the route of Tram Line 1, namely in the City Centre, Leith Walk, Constitution Street, Leith, Newhaven, Granton, Crewe Toll and West Edinburgh.

The surveys results indicated that the tram is expected to be of very limited benefit to businesses. It was found that survey respondents hardly perceived any impacts in terms of access to customers, markets or suppliers. This is actually an encouraging result, as it was possible that some respondents

might have expected a loss of business such as passing trade dependent on being able to park near premises.

The surveys found that where the tram is expected to be of benefit to businesses, it was in providing better access to labour. Businesses indicating this were in retail, financial services and the health sector. However, those in retail and financial services are in the city centre and it is difficult to argue that location is the reason for being unable to fill vacancies; it is much more likely that the issue is one of wages and / or conditions. Accordingly a very small change in accessibility at the city centre level by means of a mode which is more expensive than bus is likely to have no impact on filling such vacancies. Put another way, a transport intervention is not going to address any market failure in the city centre labour market.

Turning to the health sector, the location which suggested the tram might be of benefit does experience problems of accessibility for people without access to a car, and could therefore benefit by having much better public transport access to housing areas with surpluses of low skill labour. The analysis based on the findings from the survey indicate that a proportion of the 25 - 30 vacancies which at present are hard to fill could be filled by having better access to the regeneration areas of Pilton and Muirhouse.

There are of course market failure aspects to these vacancies including pay and conditions, and the health sector is more constrained in terms of setting pay rates than city centre shops. However, there are relatively more significant accessibility issues relating to the survey respondent compared with the city centre and hence it was judged that accessibility changes tend to increase the likelihood of being able to fill vacancies.

To the extent that the people filling these vacancies would remain unemployed in the absence of the scheme (which seems a reasonable assumption given that there are over 400 people officially unemployed, allied to below average activity rates) the filling of these vacancies can be counted as a benefit to the regeneration areas. If it is also the case that the stream of employment opportunities represented by problems in filling vacancies would remain in the longer term in the absence of the tram, then the tram would not simply displace other job seekers from these opportunities. Hence, at least a proportion of the stream of additional vacancies filled through better access would be additional at the Scotland level, if it is evident that otherwise they would remain unfilled.

This tentative assessment is based on current conditions and suggests there may be at most 30 vacancies per year, which could be filled through better accessibility to a pool of labour in the regeneration areas served by the tram. However, it is more problematic to quantify the longer term consequences arising once the scheme is implemented in 2009 and beyond. There is, for example, no guarantee that the health care provider will still be operating at the current level from this location or that its labour requirements will remain the same.

Having said this, the medium-term context suggests that demand for staff tends to continue at least at the current level. Considerations here include the context of an ageing population in general; the level of investment recently undertaken at the site and the fact that the location is viable to serve this part of the city.

Accordingly the order of magnitude impact of the tram arising from providing better links between pools of low skill / under-utilised labour and a single large employer which experiences difficulty in filling vacancies is of the order of 20 jobs per annum, possibly growing over time due to increasing demand for and expenditure on health care. These are additional at the regeneration area level. Of these, half might be additional at the Scotland level, representing those jobs which would not be filled without the tram.

The survey also identified other qualitative impacts that arose from the survey process include:

- Strengths: businesses located in Leith as well as the City Centre felt that their location was the main strength;
- Weaknesses: 61% of businesses cited a transport-related issue as being the main weakness of their location:
  - Parking;
  - Congestion; and
  - Lack of public transport.
- Business constraints: congestion in the City Centre, congestion in other areas and lack of public transport access for staff were the three main constraints to business performance; and
- Employee constraints: Road congestion is seen as the biggest constraint for employees travelling to work followed by lack of public transport.

Some interviewees identified customer related constraints, of which parking at or near premises is the biggest constraint for visiting customers.

While these represent issues for the businesses in the survey, the surveys indicate that these are nuisances (rather than real constraints) and removing them would have no employment or income effects. It is also the case that any effects would be very localised and would represent displacement even at the city, far less the Scotland, level.

*Property related impacts*

North Edinburgh is the location for one of the largest urban regeneration projects to be undertaken in Scotland. Waterfront Edinburgh Ltd is one of three landowners, alongside SecondSite and Forth Property Developments Ltd. These three owners / developers plan to re-use 140 hectares of currently vacant, under-used or derelict land. Waterfront Edinburgh Ltd was established in 2000 to implement a Masterplan for the site, transforming the land into a mixed-use, high-density, urban development. In the following the sites for development by these owners / developers are referred to as the North Edinburgh sites. In addition to these designated sites, there are further areas of brownfield land that could be developed, including around 130 hectares at the eastern end of the waterfront area.

The initial plans for the regeneration project included a proposal for the tram and thereafter all planned developments were based on the assumption that Edinburgh Tram Line 1 will be implemented in 2009. The tram was integral to the economics of the development, and it was claimed that the scheme would:

- Enable higher use densities to be achieved, through reducing the need for parking spaces and thereby improving the returns;
- Enable the sites to attract higher value customers for the residential units, again improving the returns;
- Enable rental values to be raised in line with attracting higher value users for the commercial and industrial premises, once the sites were being used up; and
- Reduce the risks of the development and hence make it more attractive.

At the time of the OBC analysis, it was claimed that the tram impacts on densities and values was required in order to make the scheme viable. This is a claim which is impossible to check fully without access to the detailed costs of development and the cash flow estimates for each development.

An estimate of proposed developments across the three principle sites is shown in Table 7.34. This represents the main developments that are currently being considered and proposed within the North Edinburgh sites.

**Table 7.34 Proposed Developments**

| Site | Residential Units | Office ($m^2$) | Hotel Rooms | Retail / Leisure ($m^2$) | Tertiary Education |
|---|---|---|---|---|---|
| **Waterfront** | **3,103** | **107,750** | | **33,680** | |
| **SecondSite** | **2,000** | **75,000** | **300** | **10,000** | **30,000** |
| **Forth Ports** | **5,103** | **182,750** | **300** | **43,680** | |
| Already built/on site | 1,306 | 59,834 | 262 | 65,000 | |
| Edinburgh Harbour | 740 | 101,736 | | 32,519 | |
| Waterfront Plaza | 400 | 40,900 | 200 | 25,000 | |
| Britannia Quay | 300 | 23,228 | | | |
| Western Harbour | 3000 | 50,000 | | 6,000 | |
| Granton Harbour | 3284 | 34,000 | 120 | 11,000 | |
| Albert Quay | 130 | | | | |
| Ocean Heights | 60 | | | | |
| **TOTAL** | **14,323** | **492,448** | **882** | **183,199** | **30,000** |

The promoters of the scheme expect that it will result in the location of between 14,000 and 17,000 jobs in the North Edinburgh area; most of these are likely to be located in the industrial and commercial properties, but additionally there will be employment in providing services to businesses and to residents. This estimate appears to be conservative, as applying the employment densities estimates used by English Partnerships gives estimates of between 14,600 and 19,800 jobs allowing for 10% voids.

Forth Ports plc: 'A New City by the Sea'

Forth Ports plc are responsible for a large proportion of land at the Waterfront site and have already constructed around 60,000 sq m of office space, 65,000 sq m of retail and leisure, plus 262 hotel rooms and 1,300 apartments. The sites are mostly located in the Leith area and include Western Harbour, Britannia Quay, Waterfront Plaza and Edinburgh Harbour. Forth Ports also own Granton Harbour, located adjacent to the Waterfront Edinburgh Ltd site.

*Existing developments* include the Scottish Executive which houses 1,600 employees and Ocean Terminal, which has a weekly footfall of around 110,000 customers of which 32% already travel to the site by bus. This is expected to grow up to as much as 250,000 per week when all retail spaces are let within the complex (which is expected to be around 2009).

*Western and Granton Harbour* are prime areas for residential units, which will be high density, and it is expected that around 600 residential units per year over the next 15 years will come on stream. These areas, along with Edinburgh Harbour will offer prime office space, which will be marketed toward the financial sector and companies seeking a site for headquarters. Rate of development is at

this stage unknown, given the uncertainties in the office market in Edinburgh as a whole. The size of office facilities offered will mainly be 120,000 square feet and upwards.

*Edinburgh Harbour* is an island surrounded by water and is in a central location in Leith. It is intended that the site will house the two tallest buildings in Scotland, which will offer residential and office space. One hotel developer is interested in developing on this site and has specified that they would like a tram stop to be located at the premises. This will be a major factor in the decision to develop on this site and in Edinburgh. The hotel is planned to become a five-star establishment with 30 stories and 500 beds.

*Major Event or Sports Facility*. While not planned or proposed at present, there is potential for the location of a major sporting village facility, which could potentially be based to the east of Edinburgh Harbour. The location of the MTV award ceremony, which is occurring in November 2003 has been considered as a permanent event location, but discounted due to the proximity of residential units. To the east of Edinburgh Harbour consideration may be given for a purpose built sports village, which could ultimately link with a concert arena. These plans are embryonic at this stage, but such developments are dependent to some extent on sufficient public transport links.

Waterfront Edinburgh Ltd

The Waterfront site which lies at Granton, between Granton Harbour and the SecondSite locations, comprises a mix of mainly residential and class 4 office / business space. Again, the residential units will comprise a large proportion of high-density housing. The office accommodation hopes to attract service sector companies looking for new premises at a competitive rate and unlike the other developments mentioned above, does not hope to attract financial services sector companies or companies seeking prime quality office space.

Proposals for leisure developments along the waterfront are currently under consideration, and could include a casino and hotel development. The National Museum of Scotland intends to amalgamate all warehouse sites on this land and open access to the public for viewing.

SecondSite

SecondSite own land to the west of Waterfront Ltd and comprises mostly residential units – potentially up to 2,500 high-density units (approximately 60 units per acre). A major food retail development along with smaller retail units are planned, and several zones have been dedicated for office / industrial use, though at this stage these proposals may change, depending on market conditions.

Developments Likely to Benefit from Tram

Several developments will be reliant on Edinburgh Tram Line 1 in order for the full realisation of the project, in terms of access to employment, education and leisure opportunities for residents within the new developments, employees working within the new developments and business / tourist visitors. These developments are:

- High density housing: the proposed residential units across the sites encompass a large proportion of high density housing, and have been developed on the assumption that the public transport links – namely the tram - will be in place to make the developments sustainable;
- Office / business sites: in terms of prime office locations, the tram will play a large role in attracting businesses away from other prime locations on offer in areas such as the city centre and the Gyle; in terms of class 4 / light industrial sites on offer, the tram will

increase access to employment opportunities for low-skilled and unemployed residents in regeneration areas;

- National Museum of Scotland (NMS): amalgamation of 4 warehouses belonging to NMS, which will be open to the public;
- Casino development: potential locating of a casino on the Waterfront area, which will require sustainable public transport links for employees and visitors, in particular between the site and the City Centre;
- Telford College: 30,000 square metre site will accommodate over 20,000 students; and
- Potential 30-storey hotel and apartment development at Edinburgh Harbour: hotel developers have stated that their preferred location would be adjacent to a tram stop.

A large proportion of office and industrial space will be marketed to the service sector, which will create jobs suitable for the low skilled workers resident within the regeneration areas in North Edinburgh. Other developments such as retail outlets and leisure facilities will also provide a significant number of low skilled vacancies that will be suitable for these residents. Increased accessibility through Edinburgh Tram Line 1 will allow these residents to fill vacancies in the new developments.

*Property related impacts at the Scotland level*

As suggested in STAG, impacts might be claimed at the Scotland level where the site itself is sufficiently unique or distinctive such that if it were not available, the development, and hence the associated employment, would locate outside Scotland.

Such considerations appear not to apply to the mainstream industrial and commercial uses of the site and hence no net additional employment is claimed at the Scotland level. Similarly Telford College and NMS are effectively relocations and while there are almost certainly efficiency gains associated with this it is unlikely that these translate into additional output and employment.

However, in the case of the casino development and any future aspirations that involve the creation of an event site, the site requirements are much more specific and a highly accessible site with a high quality environment is a pre-requisite. Additionally for the casino development a "resort setting" is an important attractor and a waterfront location meets this requirement. Accordingly if the tram is needed to create the ambience / environment / accessibility that the North Edinburgh sites will be able to offer, there is a link between the tram and these sources of employment.

At this time both types of development are very tentative. The casino development depends among other things on a change in the gaming laws, while the events site is merely a concept. It is also difficult, on the basis of present information, to argue that either of these would not locate in Scotland in the absence of the North Edinburgh sites. Accordingly no impacts are claimed; however this assessment is subject to change as plans for these developments mature.

*Property related impacts at the regeneration area level*

The tram will provide a strategic transport link between the regeneration areas of Pilton and Muirhouse in particular, but also existing residential areas in Granton and the North Edinburgh sites, as well as to Leith and the city centre. The benefits at the level of the regeneration areas depend upon how residents of these areas are enabled to access the (gross additional) jobs in the North Edinburgh sites.

The Regeneration Areas

The Scottish Index of Multiple Deprivation (2003) measures deprivation across several domains, namely income, employment, health and disability, education, skills and training and geographical access to services. There are 4 wards in North Edinburgh, which are among the 10 most deprived wards in the City of Edinburgh, which comprises a total of 58 wards.

- Muirhouse / Drylaw West (2nd most deprived);
- Pilton (5th most deprived);
- Granton (8th most deprived); and
- Newhaven (13th most deprived).

Out of the 1,222 wards measured across Scotland, Muirhouse / Drylaw West is ranked as the 33rd most deprived area. Each of these wards are served by Tram Line 1 and will benefit from increased accessibility, in particular to the new jobs that will be created as part of the regeneration of North Edinburgh, and also to employment opportunities in the City Centre and other areas in Edinburgh.

Table 7.35 presents current working age population figures from the 2001 Census along with the number of officially unemployed residents in each area. Unemployment is considerably higher in these areas in comparison to the City of Edinburgh average of 2.5%[43] and the Scottish average rate of 3.3%.

**Table 7.35 Regeneration Areas: Population and Unemployment**

| Area | Working Age Population (16-74) | Number of Unemployed Residents | % Unemployed |
|---|---|---|---|
| Muirhouse / Drylaw W | 6,404 | 410 | 6.4% |
| Pilton | 5,840 | 256 | 4.4% |
| Granton | 5,626 | 229 | 4.1% |
| Newhaven | 5,792 | 209 | 3.6% |

It is also the case that activity rates are below city average levels and that a proportion of people in employment are under-employed. Accordingly a labour resource exists which could in principle be drawn upon in order to fill some of the employment opportunities which will be generated in North Edinburgh.

Employment Opportunities in North Edinburgh

Total employment associated with the sites could range from 14,000 to 20,000 jobs in round numbers. The mix of skills is not known, but even if only 5% of opportunities are for low / no skill activities, this still amounts to 700 to 1,000 jobs in round numbers. Given proximity and the travel to work characteristics of people with low skill and wage levels, it is reasonable to expect some 10 – 20% of these could be filled by residents of the north Edinburgh regeneration areas. This amounts to some 70 – 200 jobs.

Not all of these would be additional at the regeneration area level, as some jobs coming to North Edinburgh sites are likely to be relocations from or would impact on jobs in other regeneration areas in Edinburgh and the Lothians. Consequently, some allowance needs to be made for this and here it is

[43] City of Edinburgh Council Employment Bulletin, April 2003.

assumed that such displacement amounts to 50%. Accordingly, the net impact ranges from a low of 35 jobs to 100 jobs.

However, over the first five years of the development as more tenants come in and the development fills up it is expected that rental values will be raised. In time it is likely that with higher added value activities on site, which will be the consequence of higher rental levels, the proportion of low / no skill jobs will fall. If this happens, the number of regeneration area residents working on the site will tend to be squeezed downwards as higher value uses become more prevalent on these sites. Accordingly in projecting impacts as 10-year jobs, the above estimates need to be reduced.

*LUTI model outputs*

Outputs from the LUTI model indicate a higher number of jobs filled in the regeneration areas, namely **110 vacancies filled**. Again, it is likely that these vacancies filled are distributional only.

## 7.7 Integration

The Transport White Paper recognises that an effective and integrated transport policy at all levels is required to achieve a sustainable environment. Improved integration is sought between modes, with environmental and land use planning policies and with other Government policies beyond transport.

### 7.7.1 Transport Integration

The proposed tram line will provide people living or working near the alignment with a local tram service integrated with the bus system at various locations, as well with rail at Haymarket and Waverley stations (there are better opportunities for integration at Haymarket than at Waverley station). This will allow not only a more efficient commuting, but also a better long distance service provision, with improved connection to a range of local, regional and national rail services.

Thus, considerable integration benefits will be achieved, with increased and improved opportunities for interchange with other modes, and with opportunities for integrated ticketing and passenger information. Ticketing and information measures will contribute to making interchanges more pleasant and efficient.

Because the quantitative benefits of transport integration have already been captured in the economic appraisal (e.g. travel time savings and increase in patronage), the analysis here is broadly related to the qualitative aspects of comfort, service quality, information and co-ordination.

*Services and ticketing*

Co-ordinated and integrated transport services with convenient, simplified (and possibly through) ticketing can contribute to more "seamless" journeys across the public transport network.

Ticket purchase on Line 1 will be on-board for cash sales, although travel cards, season tickets, concession passes and probably the integrated "The One" ticket system will be available for purchase at other locations. Real time passenger information at bus stops will contribute to an integrated public transport system.

*Infrastructure and information*

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

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

It is estimated that all users of the new system will benefit, to varying degrees, from the various aspects of transport integration improvements identified above (compared to existing services). The overall impact of the scheme on transport integration is expected to be moderate beneficial.

### 7.7.2 Land-Use Transport Integration

Recent developments in the UK and Scottish Government policy have provided a clear framework for the integration of land use and transport planning with a focus on sustainability and reducing the need to travel.

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

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

Thus, there is a requirement for the identification of the land use policies or proposals conflicting with statutory planning documents at the local, regional and national levels (which has been carried out to an extent during the preliminary appraisal in the OBC). Any serious conflicts must have been identified at an earlier stage.

At the UK level, the National Planning Policy Guidelines set out the policies on land use and sustainable transport. Line 1 supports a range of land use policy objectives at all levels. National policies supported include:

- Planning Policy Guidance on Transport (PPG 13): the scheme supports policies on improving:
  - Public transport, by establishing "a high quality, safe, secure and reliable network of routes, with good interchanges, which matches the pattern of travel demand in order to maximise usage of public transport" (paragraph 72); and
  - Interchanges, by promoting "more sustainable travel choices, by ensuring that interchange points are well related to travel generating uses, and that the design, layout and access arrangements of … interchanges are safe and convenient so as to maximise the walking and cycling catchment population for public transport services" (paragraph 48).
- Planning Policy Guidance on Housing (PPG 3): this calls on local authorities to "seek to ensure that all housing developments are accessible by a range of non-car modes" (paragraph 47);

- Planning Policy Guidance on Town Centres and Retail Vitality (PPG 6); the following key issues in relation to town centre access are quoted (paragraph 2.28):
  - To promote improvement in the quality and convenience of less environmentally-harmful means of transport so that they provide a realist alternative to the car; and
  - To meet the access and mobility needs of disabled people.

The following guidance provide statements of policy at the Scottish level:

- National Planning Policy Guideline (NPPG) 17, Transport and Planning[44], sets out Government policy on the integration of land use and transport planning, under the following relevant principles (which are also referred to by the accompanying Planning Advice Note PAN 57):
  - Locate and support development in places well served by public transport and restrict associated car parking, so that access to significant travel-generating developments by non-car modes improves significantly;
  - Need to prioritise accessibility within the integrated transport system by sustainable modes of travel;
  - Use Green Transport Plans and planning agreements to promote sustainable transport solutions; and
  - Manage traffic demand effectively and support the provision of high quality public transport services on the road network.
- The Scottish Planning Policy (SPP) 17, Transport and Planning Maximum Parking Standards[45], issues further guidance on maximum parking standards, stating specifically the need to:
  - Manage motorised traffic to contribute to sustainable development objectives;
  - Constrain car parking for new developments;
  - Locate development where it is most accessible to more sustainable modes of travel; and
  - Provide for travel by public transport, on foot and by cycle.

The regional policies supported include:

- The Regional Planning Guidance (RPG) in relation to economic prosperity, regeneration, ensuring quality of live and choices of opportunities for all;
- The overall development principles of the RPG, together with the specific objectives which it defines in relation to transport and regeneration; and
- The aims of the Regional Transport Strategy (RTS).

Further planning objectives have been described in Chapter 2, including those in the Local Transport Strategy 2004-2007 (2001-2004).

It can be surmised that the improvements in public transport brought about by Line 1 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 (especially for those dependent on public transport).

[44] April 1999; http://www.scotland.gov.uk/about/Planning/nppg_17_transportpla.aspx
[45] Addendum to NPPG 17, March 2003, http://www.scotland.gov.uk/library5/planning/spp17-00.asp

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

### 7.7.3 Policy Integration

The White Paper, *Travel Choices for Scotland* (TSO, 1998), quotes education, health and wealth creation as key areas of concern when planning transport, recognising that transport decisions have wide impacts upon communities.

The Policy Integration criterion examines whether the proposed scheme contributes to and is consistent with other Government policies and legislation beyond transport.

Edinburgh Line 1 can contribute to the following wider Government policies:

- Disability – The design of trams and tram stops, fully DDA (1995) compliant and with level boarding, will provide easy access to wheel (and push) chairs, facilitating thus the access not only for the mobility impaired but also the elderly and mothers with babies;
- 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 does not reach rural areas and therefore it can do very little to contribute to improve rural affairs or retaining rural communities; and
- Social exclusion – 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. These benefits are accounted for the following section.

Therefore, it can be seen that the scheme is consistent with national policies beyond transport.

## 7.8 Accessibility and Social Inclusion

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).

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.

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.

### 7.8.1 Community Accessibility

*Public transport network coverage*

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.

This measure has been determined using results from the public transport model, which simulated the introduction of Tram Line 1 onto the public transport network and the exclusion of the bus services planned to be modified or removed as a consequence.

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

- George Street / Frederick Street junction – representing the city centre (employment, shopping, leisure and access to Waverley rail station with integration with bus and rail);
- 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); and
- Crewe Toll/ Western General Hospital (employment, visiting relatives).

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). Seven time bands have been determined and the changes in the number of people with access to the selected locations within these time bands (in the morning peak, during Monday to Friday) have been estimated. Figure 7.19 to Figure 7.24 illustrate the changes in accessibility to each of the above destinations.

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**Figure 7.19 Changes in Accessibility to George Street**

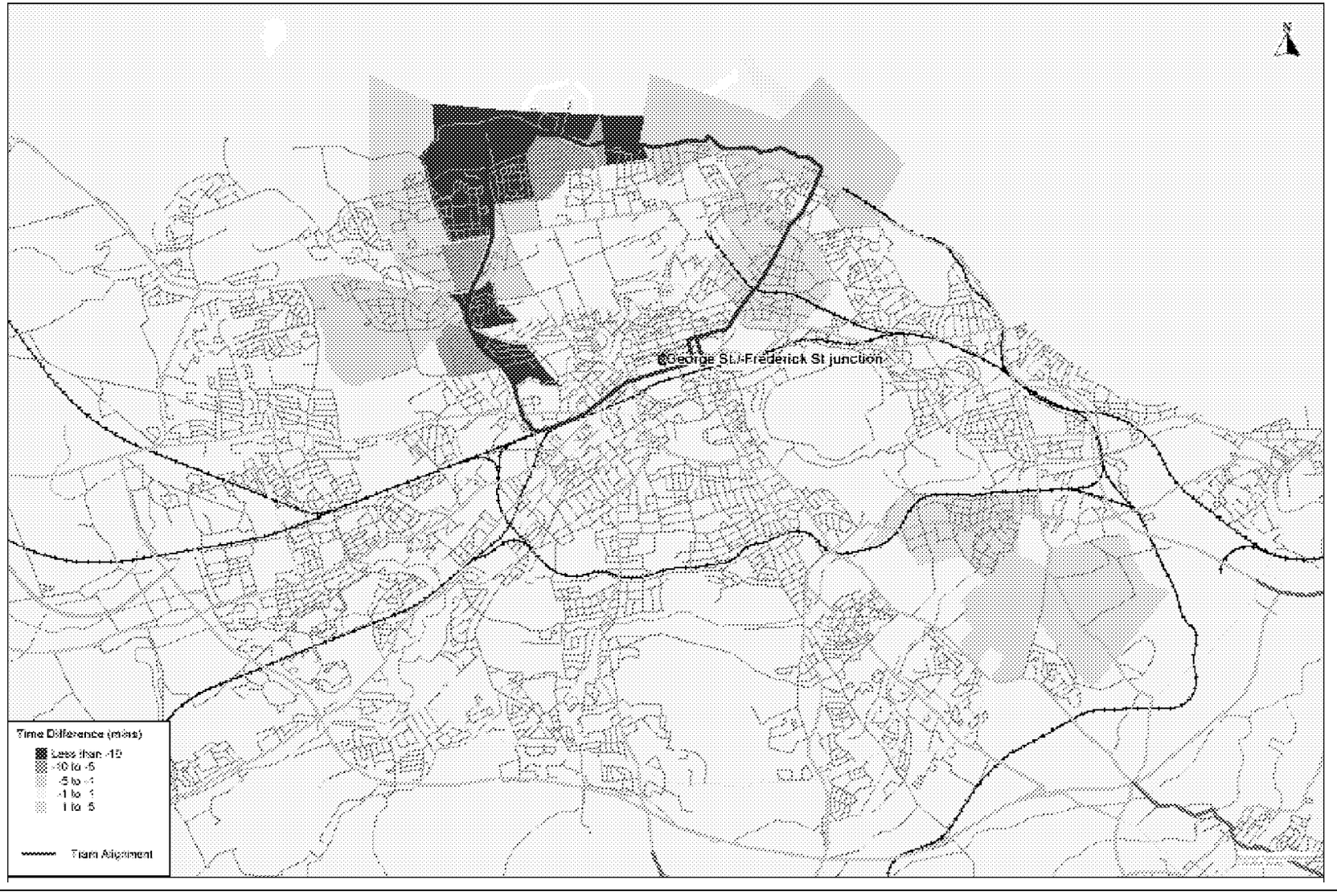

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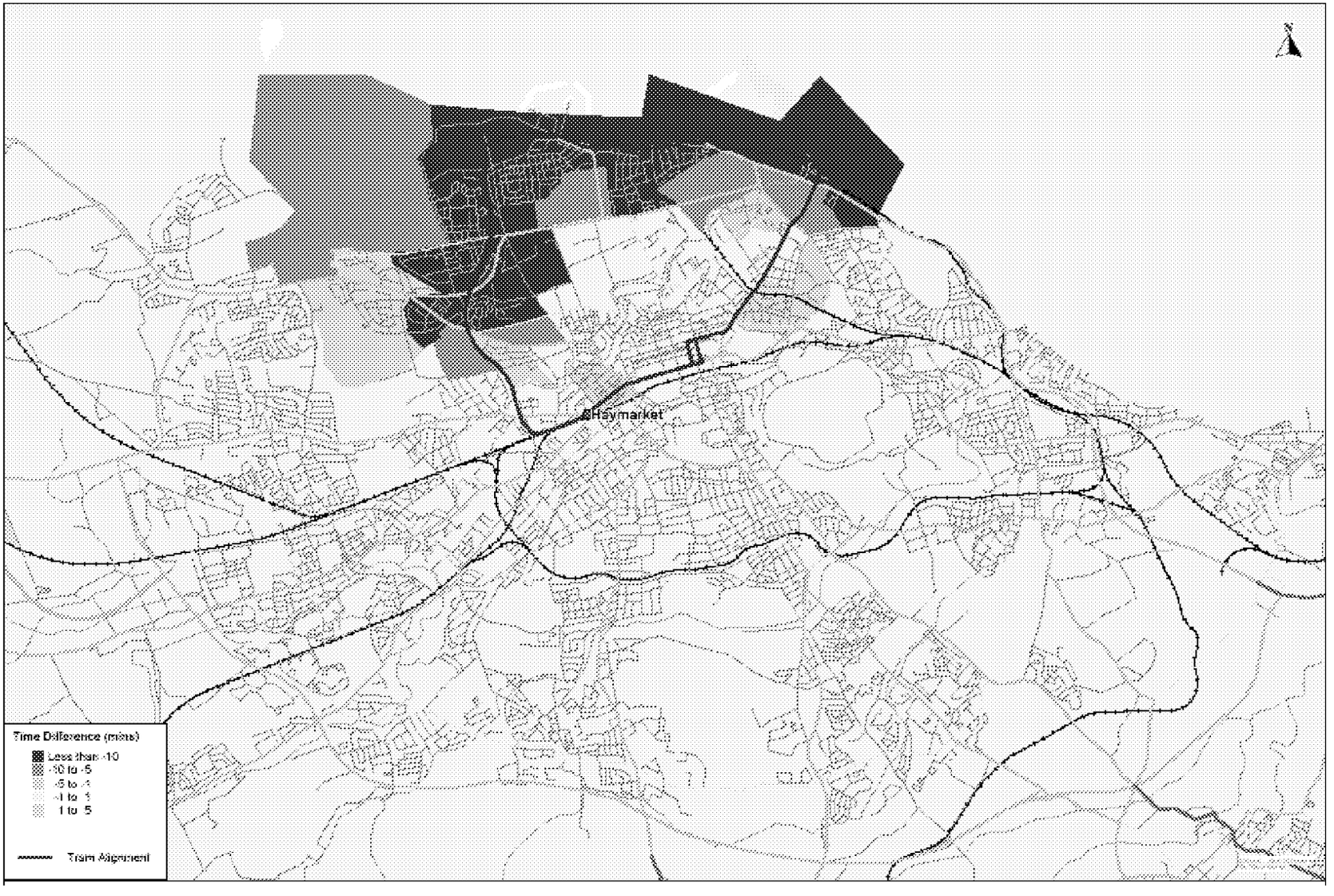
**Figure 7.20 Changes in Accessibility to Haymarket Station**






GILLESPIES TerraQuest McLEAN HAZELL ERM Babtie steer davies gleave

Mott MacDonald

**Figure 7.21 Changes in Accessibility to Foot of Leith Walk**




GILLESPIES TerraQuest McLEAN HAZELL ERM Babtie steer davies gleave

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**Figure 7.22 Changes in Accessibility to Leith Ocean Terminal**

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**Figure 7.23 Changes in Accessibility to Granton**

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**Figure 7.24 Changes in Accessibility to Crewe Toll**




GILLESPIES TerraQuest McLEAN HAZELL ERM Babtie steer davies gleave

It can be seen that accessibility is significantly increased for travel from most zones to all the selected destinations. The most notable exception is for travel from the south-west of Edinburgh to destinations in the north-east (e.g. Leith Ocean Terminal and Foot of Leith Walk), since these trips can currently be made by a single bus journey. With the introduction of the tram, these direct services would be withdrawn and an interchange would be required at or near Haymarket Station, making the journey longer in terms of total travel time (wait and interchange time), but probably more pleasant and comfortable on the tram section. A similar effect takes place also in parts of the south-east for travel to most of the selected destinations.

*Access to local services*

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. In any event, the transport model and accessibility model used lack the degree of detail necessary to represent the impact of transport schemes upon trips made by non-motorised modes.

On the other hand, Line 1 could cause adverse effects on non-motorised accessibility along the entire tram route, 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. On the other hand, stops may introduce additional pedestrian crossings which could contribute to a safer crossing, but possibly at the expense of additional delay.

However, since the tram is street running with little additional physical barriers, marginal road widening and the low frequency of tram vehicles is a trade off to less cars on the roads, the scheme is considered to have minor adverse impacts on local accessibility.

### 7.8.2 Comparative Accessibility

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. The analysis has been carried out for the locations where the local population depends most on public transport provision, that is, where there is no car availability. These locations correspond to a great extent with the deprived areas (and the Social Inclusion Partnership (SIP) areas, as identified in the EALI Section 7.6.2: Muirhouse, Pilton, Granton and Newhaven) and locations where the Index of Multiple Deprivation (IMD)[46] is high.

[46] The IMD represents how deprived an area is in terms of a combination of the following domains at different levels of significance (weightings in brackets): Income (25%); Employment (25%); Health Deprivation and Disability (15%); Education, Skills and Training (15%); Housing (10%); and Geographical Access to Services (10%).

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

Table 7.36 summarises the results of the accessibility analysis for each selected location, per travel time change bands, population, households and the number of households without a car. The analysis comprises model zones which extend beyond the boundaries of the city of Edinburgh. Negative changes indicate reduction in travel time, while positive changes show a disbenefit.

**Table 7.36 Changes in Accessibility per Population and Households**

| | George St | | | Leith Ocean Terminal | | |
|---|---|---|---|---|---|---|
| **Changes in travel time** | **Population** | **Households** | **Household No Car** | **Population** | **Households** | **Household No Car** |
| **>10 min** | - | - | - | 13,980 | 6,255 | 1,437 |
| **5 to 10 min** | - | - | - | 23,437 | 12,646 | 6,377 |
| **1 to 5 min** | 30,217 | 21,804 | 12,604 | 216,549 | 119,822 | 45,362 |
| **No effect** | 1,032,808 | 515,136 | 162,524 | 200,875 | 100,418 | 34,590 |
| **-1 to -5 min** | 12,082 | 6,430 | 2,053 | 373,488 | 182,032 | 55,254 |
| **-5 to -10 min** | 6,172 | 3,456 | 1,743 | 178,957 | 90,218 | 26,716 |
| **>-10 min** | 10,849 | 5,461 | 2,571 | 84,842 | 40,896 | 11,758 |
| **Total disbenefit** | **30,217** | **21,804** | **12,604** | **253,965** | **138,723** | **53,176** |
| **Total benefit** | **29,103** | **15,347** | **6,366** | **637,287** | **313,146** | **93,728** |

| | Foot of Leith Walk | | | Crewe Toll | | |
|---|---|---|---|---|---|---|
| **Changes in travel time** | **Population** | **Households** | **Household No Car** | **Population** | **Households** | **Household No Car** |
| **>10 min** | 23,492 | 10,735 | 3,156 | - | - | - |
| **5 to 10 min** | 34,565 | 18,902 | 7,959 | 3,129 | 2,571 | 1,060 |
| **1 to 5 min** | 126,059 | 70,348 | 28,012 | 25,853 | 15,815 | 8,227 |
| **No effect** | 491,050 | 242,342 | 73,820 | 297,072 | 144,841 | 48,184 |
| **-1 to –5 min** | 306,228 | 155,745 | 52,060 | 162,363 | 81,634 | 26,555 |
| **-5 to -10 min** | 92,595 | 45,614 | 13,618 | 43,445 | 22,118 | 7,364 |
| **>-10 min** | 18,139 | 8,601 | 2,869 | 560,266 | 285,308 | 90,103 |
| **Total disbenefit** | **184,116** | **99,985** | **39,127** | **28,982** | **18,386** | **9,286** |
| **Total benefit** | **416,961** | **209,960** | **68,547** | **766,074** | **389,060** | **124,023** |

| | Haymarket | | | Granton | | |
|---|---|---|---|---|---|---|
| **Changes in travel time** | **Population** | **Households** | **Household No Car** | **Population** | **Households** | **Household No Car** |
| **>10 min** | - | - | - | - | - | - |
| **5 to 10 min** | - | - | - | 11,100 | 6,215 | 3,330 |
| **1 to 5 min** | - | - | - | 19,404 | 11,330 | 6,527 |
| **No effect** | 1,024,457 | 512,527 | 164,157 | 49,212 | 24,934 | 9,639 |
| **-1 to –5 min** | 16,469 | 10,945 | 4,669 | 60,631 | 32,674 | 12,502 |
| **-5 to -10 min** | 23,056 | 13,820 | 6,181 | 186,645 | 94,939 | 32,010 |
| **>-10 min** | 28,146 | 14,995 | 6,487 | 765,137 | 382,195 | 117,486 |
| **Total disbenefit** | - | - | - | **30,503** | **17,545** | **9,856** |
| **Total benefit** | **67,671** | **39,760** | **17,337** | **1,012,412** | **509,808** | **161,998** |

The results vary considerably according to the destination under consideration:

- For George Street, the vast majority of population, households and households without a car are unaffected, but about twice as many households without a car disbenefit than benefit as a result of the scheme – but the numbers are relatively small and the disbenefit is only between 1 and 5 minutes (compared to some people benefiting by more than 10 minutes);
- Haymarket shows a similar impact profile, where the overwhelming majority of the population, households and households without a car is unaffected, with some journey time benefits. However, no accessibility disbenefits have been estimated for this location;
- For Leith Ocean Terminal and Foot of Leith Walk, there is a more even distribution of impacts per time band, but many times more people, households and households without a car benefit than disbenefit from the scheme; and
- For both Granton and Crewe Toll, the majority of population, households and households without a car are likely to benefit significantly (i.e. with a reduction of more than 10 minutes in journey times). They differ in that, for Crewe Toll, a significant proportion would be unaffected.

Considering the six accessibility locations analysed, significant journey time benefits can be realised by the introduction of Line 1 in Edinburgh:

- Population – some 6 times more population benefit than disbenefit:
  - Total population benefit = 2,929,500
  - Total population disbenefit = 527,800
- Households – some 5 times more households benefit than disbenefit:
  - Total households benefit = 1,477,100
  - Total households disbenefit = 296,400
- Households with no car – Some 4 times more households with no car benefit than disbenefit:
  - Total households with no car benefit = 472,000
  - Total households with no car disbenefit = 124,000

It is important to bear in mind that any disbenefit in the accessibility analysis is a result of the changes in bus routes, when the tram is in place. Many journeys are likely to require one (or one additional) interchange, and this tends to increase the total travel time. However, the tram section of the journey would gain in quality, reliability, speed and comfort, which could become acceptable trade-offs for travellers.

## 7.9 Cost to Government

This section sets out the net cost of Line 1 from the public sector's point of view and enables comparison with the transport economic efficiency presented in Section 7.6.1 and the wider, non-monetised, benefits presented in the rest of the appraisal.

Investment costs have been assumed to be solely paid by the private sector and therefore no investment costs appear as a cost to government. All operating costs for Line 1, including lifecycle

costs, are paid for by local government via a grant payment to the private sector operator; local government receives the Line 1 revenues.

The capital grant paid by Central government is assumed to be equal to the total investment cost of the scheme. This is partially offset by the value of the developer contribution, which in the case of Line 1 results from the donation of land from private landowners. Grant/subsidy payments are transfer payments, i.e. the cost to government is equal but of opposite sign to the benefit to the private sector receiving the grant. This results in no net effect on the NPV, only affecting the distribution of costs and benefits.

Revenues are shown in positive monetary values (as negative costs to government). These represent the scheme's impact on parking revenues only and use TRAM model data supplied by MVA. It is assumed revenues from on street parking do not attract VAT, and so are simply factored into market prices, off street parking revenue is received by the private sector and so is not included in cost to government.

Indirect tax revenue calculated by TUBA represents a loss/gain to government caused by the shifting of expenditure between car and public transport travel, since cars and car fuel are heavily taxed, but the indirect tax rate on public transport services is very low. Also included is the effect that changes in parking revenues have on indirect taxes. This latter effect was calculated using TRAM model data.

Table 7.37 presents the summary of the Cost to Government for the Line 1 Central Case. The overall Present Value of Cost to Government is £195.5m, of which the principal component is the grant payment for the construction of Line 1. The overall PVB, including accidents, is some £235.9m. These combine to produce a BCR of 1.21 and an NPV of £40.4m.

### Table 7.37 Line 1 Central Case Cost to Government

| | STAG Code | Total | Public Transport | Road Users: Cars | Road Users: Freight |
|---|---|---|---|---|---|
| **Local Government** | | | | | |
| Public Sector Investment Costs | PV9 | £0 | | | |
| Public Sector Operating & Maintenance Costs | PV10 | £0 | | | |
| Grant/ subsidy payments | PV11 | -£108,285 | -£108,285 | | |
| (Developer Contribution) | | £0 | | | |
| Revenues | PV12 | £142,076 | £116,241 | £25,835 | |
| Taxation impacts | PV13 | £0 | | | |
| **Central Government** | | | | | |
| Public Sector Investment Costs | PV9 | £0 | | | |
| Public Sector Operating & Maintenance Costs | PV10 | £0 | | | |
| Grant/ subsidy payments | PV11 | -£213,542 | -£213,542 | | |
| (Developer Contribution) | | £9,563 | £9,563 | | |
| Revenues | PV12 | £0 | | | |
| Taxation impacts | PV13 | -£25,326 | -£17,087 | -£7,862 | -£377 |
| **Total PVC to Government** | | **-£195,513** | | costs appear as negative | |

| **Monetised Summary** | |
|---|---|
| Present Value of Transport Benefits (PV1-8) | |
| Accidents, PV1 | £4,799 |
| Transport Economic Efficiency | £231,080 |
| Total PVB (PV1-PV8) | £235,879 |
| Present Value of Cost to Government (PV9-13) | -£195,513 |
| Net Present Value | £40,366 |
| Benefit-Cost to Government Ratio | 1.21 |

*Parking revenues*

Public sector (on-street) parking revenues are forecast to increase. This arises primarily because of the increased overall volume of travel to the city centre arising from the improved accessibility afforded by Line 1 (notably in the off-peak period) and the effect of long-term parkers who transfer to Line 1 being replaced by multiple short-term parkers. The overall impact is an increase of around 7% in parking revenues.

It is recognised that the increase in travel demand by car that this represents, focused on the City Centre and in the off-peak periods, is counter to the objectives of reducing traffic and congestion in the City Centre. It has been assumed that the changes in revenue are to be included in the economic and financial appraisal; however, in practice these financial benefits could be 'converted' into environmental gains by implementing changes to the parking regime to discourage the additional trips that are being made.

## 7.10 Appraisal Summary Tables

Table 7.38 summarises the appraisal of the various impacts under STAG2, as described in the previous sections of this chapter. It corresponds to Part 2 of the Appraisal Summary Table in STAG2 (Part 1 has been reported previously in the OBC report).

## 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*<br>*Revenue Support*<br>*PV Costs* | £274.15m (capital cost)<br>£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<br>▪ Promote sustainability<br>▪ Reduce congestion<br>▪ Improve safety and security<br>▪ Social benefits | ▪ Line 1 will improve accessibility to employment opportunities, education, shopping and leisure destinations, contributing to improve the local economy.<br>▪ 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).<br>▪ The tram system will provide a safe and secure means for travel as well as a safe local environment.<br>▪ 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.<br>• 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<br>• 2026: Do minimum to with scheme: No change in population annoyed | • Neutral-slight negative impact on remaining route sections.<br>• 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)<br>• 174,000 households with decrease in $PM_{10}$ in 2001 (112,050 in 2026)<br>• 3,400 households with no change in $PM_{10}$ in 2011 (1,000 in 2026) | Moderate positive (2011)<br>Neutral (2026) |
| | | • 77,950 households with increase in $NO_2$ in 2011 (139,550 in 2026)<br>• 177,250 households with decrease in $NO_2$ in 2011 (119,100 in 2026)<br>• 26,200 households with no change in $NO_2$ in 2011 (22,750 in 2026) | Moderate positive (2011)<br>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).<br>• Existing drainage will be utilised, but where new one is required the principles of SUDS will apply (slight adverse but mitigation will prevent impact).<br>• The scheme is not located in high-risk flood areas and is not expected to increase flood risk (neutral).<br>• Existing groundwater and hydrogeological resources will not be impacted (neutral). | • The scheme crosses the Water of Leith twice.<br>• 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.<br>• 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<br>• 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:<br>• 16 sites of national importance;<br>• 20 sites of regional importance;<br>• 27 sites of local importance;<br>• 23 sites of little or no importance.<br>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.<br>• Additional jobs at the regeneration area level. | • 35 – 100 jobs.<br>• 0 – 10 jobs. |
| | National Economic Impacts | • No net additional employment is claimed at the Scotland level.<br>• Half of extra jobs in the health sector are additional, which would not be filled without tram. | • No impacts.<br>• 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;<br>• Haymarket: vast majority unaffected. No accessibility disbenefits;<br>• Leith Ocean Terminal and Foot of Leith Walk: many times more people/households benefit than disbenefit;<br>• Granton and Crewe Toll: majority benefit significantly (i.e. reduction of 10+ minutes in journey times). | N° of households without a car benefit (disbenefit):<br>• George St: 6,366 (12,604);<br>• Haymarket: 17,337 (0);<br>• Leith Ocean Terminal: 93,728 (53,176);<br>• Foot of Leith Walk: 68,547 (39,127);<br>• Granton: 161,998 (9,856);<br>• 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<br>Revenue from car parking | £116,241m (PV)<br>£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 |

# 8 Sensitivity and Risk Analysis

## 8.1 Introduction

One of the critical success factors for the Tram Line project is the identification and mitigation of the risks inherent in a project of this nature. The HM Treasury's Green Book has identified optimism bias as the systematic tendency for appraisers to be over-optimistic about key project parameters. Evidence from other tram projects in the UK has confirmed this to be a major issue. In order to manage risk in a structured manner, **tie** has appointed a full-time Risk Manager to develop and apply a framework of risk analysis and evaluation to assist in decision-making, and identified the following prime objectives:

- Mitigate all identified risks to a 'medium' significance or less;
- Pass all identified risks to the best parties capable of managing the risk;
- A culture of risk awareness (not risk averse) and management be created;
- Delivery within budget and on time;
- Provide a fully functioning operational service; and
- Obtain support from all key stakeholders.

## 8.2 Risk Management Process

### 8.2.1 Early Strategic Risk Appraisal

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. CEC commissioned a report by Turner & Townsend to review the development of the 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 members and officers on the nature of strategic risks related to the proposed tram system and other 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. This matrix and discussion upon it assisted **tie** in the formulation of an overall Risk Management Plan.

### 8.2.2 Line Specific Activities

In parallel with overall risk management, all advisors appointed by **tie** to provide services associated with the tram network and other ITI schemes were required within their appointment briefs to advise **tie** on risks associated with their particular element of work. The advisors for technical, operational and environmental issues have such responsibilities and this report covers both the overall and line-specific issues related to risk management.

Soon after appointment, a line-specific risk register was compiled for each line, with the intention of populating the register with detailed information on the likelihood and potential impact of each identified risk.

### 8.2.3 tie Risk Management Plan

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

- Appointment of experienced advisors covering legal, financial, technical, operational, environmental, 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, Scottish Executive, etc 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;
- Periodic briefing and updating of CEC 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; and
- Appointment of a full-time Risk Manager to oversee the complete process.

### 8.2.4 Technical Feasibility and Risks

The proposed alignment and options are feasible, based upon a number of key assumptions (and consequent risks, associated with these assumptions):

- The design is based upon vehicle parameters (as described in Section 6.2). No new or innovative, untried technology is proposed, but new traction technologies will be reassessed prior to implementation;
- The run times can be maintained – this depends on achieving adequate tram priority. Agreement with CEC has been reached, on junction and traffic management designs which demonstrate that the required level of tram priority can be achieved through practical and feasible alignment and junction design. Ultimately the design as implemented may vary, in detail by implementation stage, but has been established, in principle;
- Acceptability of urban design issues – this is being addressed through the development of a detailed design manual for agreement with CEC Planning, prior to implementation of the scheme;
- Integration with bus – the design provides opportunity for bus integration and mitigates potential adverse impacts on bus. A degree of modal transfer is assumed to be achieved. The risk of changes in bus routes, competition and predatory bus pricing is significant and has proved to be problematic on other schemes. Mitigation is proposed

through ongoing liaison with bus services and detailed design development aimed at bus integration and may also be achieved through contractual or procurement methods.

### 8.2.5 Consultation

In order to reduce strategic risk, **tie** has taken steps to consult with key organisations such as Scottish Executive, City of Edinburgh Council (CEC) and bus operators in the Edinburgh area. In the case of Scottish Executive:

- In terms of overall knowledge of the progress of scheme development, Scottish Executive has an observer on the board of **tie**. In addition, there have been a series of specific consultations;
- The **tie** Risk Manager has held meetings concerned with scheme economics and risk;
- Grant Thornton (**tie**'s financial advisor) has consulted the Financial Partnerships Unit;
- There have been meetings between tie, **tie**'s technical, advisors and Scottish Executive on the structure and coverage of the STAG report; and
- The Private Bills Unit has been consulted by **tie**'s legal advisor, Bircham Dyson Bell and the land referencing teams.

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 detail 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. In addition, a senior officer from CEC Transport is a member of **tie**'s Steering Group which convenes monthly to discuss all tram projects.

Recognising the importance to the viability of the tram scheme of a properly integrated public transport network, **tie** has been in discussion with major bus operators in the Edinburgh region. In addition to regular liaison at Chief Executive Officer level through the Operator Liaison Group, there have been specific discussions related to the appointment of a tram operator using the DPOF process. See 8.2.6 below.

### 8.2.6 Risk Transfer and Procurement

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. A key element in determining how best to manage and mitigate the risk has been the evaluation of the appropriate procurement route and the conclusion of this analysis is to separate the Operator and Infrastructure contracts. The consequence of adopting this approach has been to allocate the appropriate risks to the Operator contract and similarly the appropriate risks to the Infrastructure contract. This separation is believed to offer a more attractive commercial package to bidders for the respective contracts and should, as a consequence, deliver a better value for money solution to **tie** and CEC. **tie** and CEC will retain certain risks and will require to ensure that during the operation of the tram system that risk is appropriately attributed to either the Operator or the Infrastructure provider(s).

### 8.2.7 Early Operator Involvement / Development Partnering and Operating Franchise

The potential for a lack of integration of public transport services to adversely impact the introduction of a viable tram network was recognised at an early stage of scheme development. The review by Turner and Townsend of comparable transit schemes in the United Kingdom (September 2002) also identified a number of issues and problems associated with their delivery. The report did not fully address the issue of mode integration, nor the legal and financial issues of the proposed Edinburgh network.

**tie** established a Procurement Working Group, comprising representatives from legal, financial and technical advisors, at the end of 2002 in order to address these issues with respect to Edinburgh. The major strategic risks anticipated by the group were:

- Integration of the tram 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.

The group considered a range of potential procurement methods to evaluate the performance of these methods in mitigation of the identified risks, concluding that the early appointment of an Operator as an additional specialist advisor to **tie** would be advantageous.

A briefing paper was presented to the **tie** Board during March 2003 and the Board endorsed a decision to proceed with the early appointment of an Operator, the objectives being:

- To begin development at the earliest practical stage as the basis for a successful operating franchise through efficient procurement;
- To foster intellectual and commercial ownership of the tram system infrastructure and its operational characteristics through **tie**'s partnership with an experienced and incentivised public sector tram operator;
- To achieve tram/bus/heavy rail integration in Edinburgh;
- To make operational expertise available to **tie** in order to refine requirements with regard to system design capacity, expansions and performance and to align procurement expectations with likely market response;
- To help verify and strengthen the economic and technical case to be presented to parliamentary inquiry; and
- To provide continuity in operator support for **tie** in management of the infrastructure procurement process.

A sub-group was appointed by **tie** comprising legal, technical and financial advisors augmented by Partnerships UK to prepare 'Invitation to Negotiate' documentation. This has evolved into an agreement for the Development Partnering and Operating Franchise (DPOF). Market testing suggested considerable support and interest from Operators to this approach which has continued throughout the contract preparation process.

A presentation of the strategic risks associated with the DPOF process was made to CEC officers during May 2003 in order to assure them that issues related to public transport integration were being adequately addressed.

The Operator will be engaged to help development of the scheme throughout the parliamentary approval process and to assist in procurement and commissioning of infrastructure and equipment, thereby mitigating some of the risks associated with these elements of procurement. At the same time, the Operator will develop, in partnership with **tie**, agreed targets for revenue and operating cost, with the payment mechanism dependent upon performance against these figures and other key performance indicators. It is anticipated that this will aid management of risks during the operational phase.

An appointment of the Operator is anticipated during March 2004, prior to the parliamentary inquiry stage.

### 8.2.8 Infrastructure Procurement

The Procurement Working Group is undertaking a review of issues of risk, timing and funding associated with potential methods of procurement of infrastructure and equipment. Following appointment, the Operator will also become part of this advisory Group.

## 8.3 Derivation of Costs and Revenues

The technical teams engaged to advise upon the estimation of costs have extensive experience in the development of tram schemes in the United Kingdom and abroad and are thus cognisant of the likely factors and risks that will impact upon outturn costs. Details of the derivation of costs and projected revenues for the scheme can be found elsewhere in this report.

### 8.3.1 Capital Costs Base Data

Where practicable and appropriate, the assumptions used to derive costs have been agreed between the Line 1 and Line 2 technical teams, and agreed with **tie** and Grant Thornton, as **tie**'s financial advisors. For example, rates used for vehicle costs, contractors' preliminaries, design costs and contingencies are consistent for both lines, as agreed between the advisors. For the majority of other factors, the rates and quantities used vary between Lines 1 and 2, as the individual characteristics of each Line are taken into consideration. However, the teams have worked closely together to ensure an overall consistency between estimates for Lines 1 and 2.

Estimates have been prepared using a combination of benchmarking, previous experience and engineering judgement to define the works elements and to obtain and refine implementation costs.

### 8.3.2 Operating Costs Base Data

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 Section 6.6.4 and Appendix C for further details). These in turn are based upon an assumed operational service pattern and frequency.

The ongoing DPOF process will inform the process to confirm or amend these operating assumptions taking into account advice from the system Operator.

### 8.3.3 Demand and Revenue Benchmarking

The technical adviser team has constructed the cost profiles for the STAG submission and has brought together cost and other relevant information for each of the UK systems that have been developed. It is important to acknowledge that in various projects, significant costs and risks have been avoided through the application of a PFI contracting methodology and, as a result, reference to out-turn costs is difficult to achieve. However, taking examples from publicly quoted companies would indicate that project-wide construction cost over-runs have been up to 25% of award construction cost. **tie** will manage this cost risk by structuring an integrated construction and potentially maintenance contract. The main construction risk areas have included design initiation and scope definition, utilities diversion, scope of streetworks, land acquisition and compensation, overhead line equipment interface with streetworks and utilities, traffic management and construction delays, system integration, railtrack interface and (significantly in all completed projects) a high emphasis upon planning risk. Completed projects have typically over-run by three to six months with minimal Promoter downside risk due to the contractual structures used.

Significant changes to the appetite of the banking, insurance and construction markets have occurred which were not recognised by other Promoters (between 2001 and 2003) and this resulted in considerable time delays and resulting price escalation on three major schemes. Following discussions with current Promoters, it is clear that knowledge of current market thinking would have influenced the shape of proposals sought. **tie** has the benefit of applying the lessons learned.

Advice from Leeds and Manchester would indicate that commercial funders will model as their base case revenue at or around 50% of the Promoter's revenue case. It is believed safe to conclude that the private sector will no longer cost-effectively absorb significant revenue risk and as a result revenue risk is best retained by the public sector. Assuming this approach, most promoters would now be seeking a two-contract structure with separate infrastructure and operations contracts.

Within the DPOF process outlined in Section 5, **tie** has invited the Operator to participate in a revenue pain/gain sharing methodology and will receive responses from the market to this proposal shortly. The closest example to this methodology is the shared risk/payments structure at Nottingham.

There have been significant cost escalations in the utilities diversion budgets for all recently promoted schemes. A benchmark figure of circa £4m per on-street track kilometre is appearing with off-street costs being considerably less. **tie** and its technical advisers have taken this data into account in constructing the cost data. With utilities diversion budgets of circa £80 to £100m in other schemes, **tie** has determined that Promoters are now beginning to re-visit the methodology and justifications for diversions. There is no evidence of any current Promoter seeking to altogether avoid stray current protection. Notably the £4m per kilometre follows two cases of utilities diversion budgets doubling in between approval to proceed and private sector bids being received but is not out of line with experience in Croydon. Episodes of "scope creep" and betterment opportunity taking have created a healthy scepticism between Promoters and utility companies.

Tram priority is virtually universal with due consideration being given to other public transport (buses) and then to other road users. The implementation of tram priority has been aided in Nottingham where the tram scheme Promoter is also the highway authority. In Edinburgh, **tie** and Lothian Buses have an open line of communication.

A majority of tram schemes have an AM peak hour travel time advantage over alternative public transport (bus) and this is thought to be a critical factor in the successful operation of the tram system. The most limited (in travel time advantage) system in operation is Sheffield and as a result this system has struggled since opening. In Sheffield current tram journey prices are below bus fares. This is the only example of tram fares being below bus fares for an equivalent journey currently in the UK. A

majority of schemes have either fare parity or a minor increase based upon travel time savings. A significant travel time advantage and fare structure differential exists at Manchester Metrolink on the Bury-Altrincham line and this has caused political issues.

Bus re-organisation is a feature of London schemes with the potential for high degrees of transferring passengers (from bus to tram). There is evidence that this is not maximised. Elsewhere, there is little evidence of active feeder bus implementation but many discussions are in hand on this.

By the early engagement of the Operator, full discussions with Lothian Buses and other public transport operators, it should be possible to optimise the potential for an integrated transport solution.

The benefit to cost ratios of currently promoted schemes around the UK range between approximately 1.0 and 1.9. All have been subject to considerable reduction through the application of Optimism Bias adjustments. There is however little doubt that considerable cost creep has occurred. **tie** needs to demonstrate that such a bias is too high given that its current knowledge includes the experiences of other Promoters.

In summary, there are currently five operational tram schemes in the UK with Croydon and Manchester (phase 2) being delivered under full-PFI concession agreements. There are currently three projects within sight of preferred bidder/BAFO/financial close but all with funding issues. Edinburgh will continue to be informed by progress on these and other projects.

Table 8.1 compares the model forecasts for Tram Line 1 with existing LRT systems and with the original Edinburgh LRT Masterplan Feasibility Study Report forecasts.

**Table 8.1 Comparison between Existing LRT Systems and Edinburgh Line 1**

| System | Route length (km) | No. of stops | Pax boardings (M) | Pax kms (M kms) | Pax boardings per stop (M) | Pax boardings per route km (M) | Pax kms per route km |
|---|---|---|---|---|---|---|---|
| Manchester Metrolink | | | | | | | |
| Bury/Altrincham | 30.9 | 24 | 13.7 | 136.1 | 0.57 | 0.44 | 4.40 |
| Eccles | 9.2 | 15 | 2.3 | 16.2 | 0.15 | 0.25 | 1.76 |
| Croydon Tramlink | 28.0 | 38 | 16.2 | 97.0 | 0.43 | 0.58 | 3.46 |
| Sheffield Supertram | 29.0 | 47 | 11.1 | 38.0 | 0.24 | 0.38 | 1.31 |
| Midland Metro | 20.4 | 23 | 5.4 | 55.8 | 0.23 | 0.26 | 2.74 |
| Edinburgh LRT Masterplan | | | | | | | |
| Line 1 | 15.6 | | 11.6 | 59.5 | | 0.74 | 3.81 |
| Line 2 | 16.4 | | 4.2 | 41.1 | | 0.26 | 2.51 |
| Line 3 | 10.1 | | 3.8 | 19.6 | | 0.38 | 1.94 |
| Line 1 study | | | | | | | |
| 2011 | 15.6 | 23 | 9.44 | 45.4 | 0.41 | 0.60 | 2.91 |
| 2026 | | | 13.69 | 65.5 | 0.60 | 0.88 | 4.20 |

Sources: Edinburgh LRT Masterplan Feasibility Study Final Report and Line 1 Study model results

This comparison shows that Line 1 on its own is relatively shorter than other existing UK systems, but when combined with Line 2, Edinburgh tram is comparable in length with existing UK systems.

Line 1 boardings are comparable to existing systems, though in terms of passengers per route kilometre, Line 1 by 2026 will exceed all existing systems. Data on passenger kilometres shows a similar story.

Table 8.2 compares the fare statistics for Tram Line 1 with existing LRT systems in the UK and with the original Edinburgh LRT Masterplan Feasibility Study Report forecasts. The revenue per passenger is in the centre of the range for existing systems, whilst the revenue per tram km is at the upper end of the range.

**Table 8.2 Fare Comparison between Existing LRT Systems and Edinburgh Line 1**

| System | Annual revenue (£M) | Revenue per passenger (£) | Revenue per tram km (£) |
|---|---|---|---|
| Manchester Metrolink | | | |
| Bury/Altrincham | 15.8 | 1.15 | 4.65 |
| Eccles | 1.9 | 0.83 | 1.90 |
| Croydon Tramlink | 12.2 | 0.75 | 4.36 |
| Sheffield Supertram | 7.1 | 0.64 | 2.96 |
| Midland Metro | 3.1 | 0.57 | 1.63 |
| Edinburgh LRT Masterplan | | | |
| Line 1 | 9.6 | 0.83 | 6.4 |
| Line 2 | 6.0 | 1.42 | 4.0 |
| Line 3 | 3.9 | 1.03 | 4.3 |
| Line 1 | | | |
| 2011 | 6.59 | 0.70 | 5.07 |
| 2026 | 9.62 | 0.70 | 7.40 |

Sources: Edinburgh LRT Masterplan Feasibility Study Final Report and Line 1 Study model results

Note that Edinburgh LRT Masterplan assumed everyone paid full adult fare and, though patronage forecasts assumed tram fares were the same as bus, the fare values used for part of the revenue calculation were about 50% higher than actual bus fares.

### 8.3.4 Scheme Benchmarking

**tie** has undertaken a comparison with other operational tram schemes within the United Kingdom to assess the values adopted for the Edinburgh tram projections. These are reported fully in the Business Case. The principal points of note are summarised as follows:

- Project-wide construction cost overruns have been up to 25% of award construction cost. **tie** will manage this risk by structuring and integrated construction and (potentially) maintenance contract. Current optimism bias value is at 25% (See 8.4.2);
- Completed projects have typically overrun by three to six months with minimal Promoter downside risk due to contractual structures used. Current optimism bias suggests a value of 14%, which represents an additional 5 months on a 36 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 expectations, 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**;

- The potential advantage to be gained from full cooperation of bus and tram operators has not always been forthcoming on other projects. **tie** has progressed the DPOF process to facilitate this; and
- **tie** continues to liase with other Promoters to obtain maximum benefit from their experiences.

## 8.4 Optimism Bias

### 8.4.1 Process

**tie** and its advisers have considered the implications of the new Green Book Guidance as issued by the Treasury and have discussed the application of this guidance to the Line One project with PUK and the Scottish Executive.

The Optimism Bias process as required by Scottish Executive for all major public transport schemes is being followed. **tie**'s Risk Manager has taken management control of this process and has consulted both the Executive and the originators of the report developed on Optimism Bias to discuss various aspects of its application to the Edinburgh Tram network.

Optimism Bias provides a methodology to determine what level of additional cost and programme delay should be applied to a project given its particular stage of development. A project at the stage of developing a business case is inherently less certain, in terms of its cost envelope, than one which is close to contract signature. The Optimism Bias adjustment allows a factor to be applied to the capital costs of a project to reflect this and the costs involved in mitigating the impact of this. Standard factors are given dependent upon the nature of the project based on analysis of previous schemes. This Optimism Bias adjustment sits as a percentage factor above any specific contingencies identified for the particular scheme. It is not therefore a predictor of where the costs might finally end up. No Optimism Bias adjustments exist at present to cover operating costs, lifecycle costs or revenue.

The steps involved are:

- Determine capital expenditure;
- Determine works duration;
- Identify project risks;
- Confirm the impact of risks on capital expenditure and programme;
- Determine risk mitigation strategies;
- Determine the cost of managing risks;
- Review the implementation of risk management;
- Allocate risks to Optimism Bias;
- Review the scope of the Risk Register;
- Assess the Project Type;
- Determine starting values for Optimism Bias;
- Determine the mitigation Factor for each risk;
- Independent review of evidence to support mitigation factor;

- Determine Optimism Bias;
- Check lower bound is not below recommended values;
- Final estimate of Optimism Bias incorporating risk management;
- Consider need for further mitigation; and
- Incorporate capital expenditure including Optimism Bias and risk management costs in financial model.

### 8.4.2 Benchmarking / Factors Adopted

As there are a number of light rail or tram schemes either in operation or under development in the United Kingdom, it is considered that the starting Optimism Bias factors to be adopted for the Edinburgh Tram are those appropriate to a 'Standard Civil Engineering' project, i.e.:

- Works duration 20%
- Capital expenditure 44%

Various actions to mitigate these factors have been undertaken.

Optimism Bias does not appear to account for the rigorous capital costing methodology employed by **tie**'s technical advisors, that is, determining the cost from the out-turn costs of a number of recent tram schemes. It is, therefore, considered that the capital costs (net of contingency) include for a portion of Optimism Bias. It has not been possible to quantify this portion and therefore it may be considered that the Capital Cost Optimism Bias is conservative.

The factors adopted as the staring point for the Optimism Bias process have been discussed and agreed with the originators of the report prepared for the Treasury.

## 8.5 Current Risk Status

### 8.5.1 Risk Identification

**tie** and its advisors have identified project risks through workshops, strategic reviews, experience of other UK tram schemes and recording of risks throughout the development process. These risks have been recorded on a register which has been further developed from checklists contained in the following published industry guidance:

- RAMP Risk Analysis and Management for Projects;
- CIRIA Funders Report: Developing a risk communication tool (RiskCom); and
- HM Treasury Review of Large Public Procurement in the UK.

### 8.5.2 Risk Matrix

A consolidated risk register has been prepared for the tram network. For each risk identified, the register identifies:

- The stage of 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, etc)
- Likelihood of realisation prior to mitigation and following mitigation
- Mitigation strategy
- Responsibility for mitigation management
- Mitigation factor achieved
- Status of risk; and
- Dates for action.

In order to review timing, the risks have been categorised in order to identify the risk level of each of the following five stages of the project and to ensure risks are reviewed and mitigated for each stage of the project.

- Planning – STAG2 appraisal and business case preparation;
- Application for Powers – Private Bill preparation;
- Procurement – Operator and Infrastructure Contracts;
- Construction; and
- Operation.

**tie** and advisers identified all potential risks. These risks were categorised into the following groups in accordance with HM Treasury guidance:

- Procurement;
- Project specific;
- Client specific;
- Environment; and
- External influences.

Each of the project risks have been assessed against the following principal impacts:

- Capital costs;
- Operating costs;
- Revenue;
- Programme;
- Quality;
- Functionality; and
- Approvability.

Of these areas, capital costs, operating 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 Green Book guidance. The first has been to calculate the 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.

The significance of each risk is classified by means of a 5-point AS/NZS system for combining 'impact' and 'likelihood' aspects of each risk in order to prioritise actions.

The financial and programme tolerances shown in Table 8.3 have been adopted.

**Table 8.3 Financial and Programme Tolerances**

| Level | Impact | CAPEX (£) | OPEX/ Life-cycle/ Revenue (£ per annum) | Programme |
|---|---|---|---|---|
| 1 | Insignificant | Up to £25k | Up to £25k | Up to 1 week |
| 2 | Minor | >£25k to £100k | >£25k to £100k | >1 week to 2 weeks |
| 3 | Moderate | >£100k to £500k | >£100k to £500k | >2 weeks to 1 month |
| 4 | Significant | >£500k to £1m | >£500k to £1m | >1 month to 3 months |
| 5 | Major | >£1m | >£1m | >3 months |

The ranges of likelihood presented in Table 8.4 are proposed.

**Table 8.4 Ranges of Likelihood**

| Level | Likelihood |
|---|---|
| 1 | Remote |
| 2 | Unusual |
| 3 | Possible |
| 4 | Probable |
| 5 | Expected |

The likelihood of risks and impacts can be combined in a two-dimensional table as illustrated in Table 8.5.

**Table 8.5 Risk Likelihood and Impacts**

| Likelihood/ Impact | Insignificant | Minor | Moderate | Significant | Major |
|---|---|---|---|---|---|
| Remote | 1 | 2 | 3 | 4 | 5 |
| Unusual | 2 | 4 | 6 | 8 | 10 |
| Possible | 3 | 6 | 9 | 12 | 15 |
| Probable | 4 | 8 | 12 | 16 | 20 |
| Expected | 5 | 10 | 15 | 20 | 25 |

Table 8.6 shows the ranges of risk significance that have been adopted.

**Table 8.6 Significance of Risk**

| Significance | Range | | Colour |
|---|---|---|---|
| Negligible Risk | >=0 | <4 | WHITE |
| Low Risk | >=4 | <8 | WHITE |
| Medium Risk | >=8 | <12 | ORANGE |
| High Risk | >=12 | <16 | ORANGE |
| Very High Risk | >=16 | | RED |

### 8.5.3 Key Risks

**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.

A number of lessons have also been learnt from the previous UK tram schemes. The following key risks 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.

Utilising the ranking process identified above the principal very high risks arising from this exercise can be summarised as follows:

- SE funding availability is less than tie requires to proceed – A key element of this Business Case is to demonstrate the requirement for a minimum amount of SE funding to enable the project to proceed;
- Delay in securing other funding sources beyond SE funding – **tie** have mitigated this risk through review of alternative funding options by **tie**'s financial advisors and discussions with potential lenders;
- Passenger numbers are lower than forecast – **tie** and their technical advisors have established a conservative and credible base model and reviewed the factors affecting revenue, assumptions and sensitivities. Further comfort will be gained through early involvement of an experienced Operator;
- Delay and cost increases due to CEC Planning requirements – **tie** have significantly mitigated this risk through convening a Planning and Environment Working Group who have held regular meetings with Planning Department and sought approvals of Design Manual and proposals to account for the World Heritage Site;
- Inclusion of CETM influence on the Project – **tie** and their advisors are considering the influence of CETM and discussed this with CEC;
- Delays due to lack of Parliamentary time with other Bills under consideration, Bus Operator Objections or change of Transport Minister – **tie** and their Parliamentary Legal

Advisors have discussed protocol with Parliamentary Bills Unit and commenced procurement of a tram Operator to bring about integration with Bus Operators;

- 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 following completion of the DPOF process and breach the contingency level included within the model. This risk should be mitigated through the level of work undertaken to date by the technical advisers and inclusion of Optimism Bias to account for further design development; and
- Operating costs exceed current projections due to lack of priority to tram at junctions. The DPOF process will identify cost issues but not until after completion of considerable further work by the selected partner. This could be influenced by specification issues, such as staffing levels.

The risks listed above represent, in some instances, those considered as most serious to the success of the project in the short term and also certain ongoing risks which will require management as the project progresses. **tie** will use the risk mitigation summary as a means to undertake this process through regular reviews and updates of the risk documentation and proactive management of the risks.

### 8.5.4 Treatment of Contingency

The technical advisors have included where appropriate a contingency allowance against possible increases in capital costs. It should be noted that such allowances are deemed to be included within the allowance for Optimism Bias.

### 8.5.5 Residual Optimism Bias Factors

The extent to which risks have been mitigated is measured by a mitigation factor, that is, 0.0 means that risks in a project risk area are not mitigated and 1.0 means all the risks in a project risk area are fully mitigated. **tie** has ensured that clear and tangible evidence has been observed prior to reducing the Optimism Bias.

Responsibilities were allocated amongst **tie**, various tie Working Groups and advisers for each risk and, in particular, to develop a risk mitigation strategy. The risk mitigation strategy sets out an understanding of the risk identified, the actions to be taken to minimise the impact of the risk, by whom and to an agreed timescale. Furthermore, the list of risks was reviewed to identify the "critical path" risks, being either fundamental in principle, or time critical to the success of the project. These risks have been managed by tie to ensure risks are addressed in an ongoing positive manner. It is intended that the risk register will be updated regularly as the project progresses, and will be utilised by **tie** as a live risk management tool.

Given the level of development the project has reached, together with the amount of mitigation that has been carried out across the range of risk areas identified by Optimism Bias, it is considered appropriate to use lower factors of 25% for Capital Cost Optimism Bias and 14% Works Duration Optimism Bias.

## 8.6 Sensitivity Analysis

A number of sensitivities have been tested to simulate a number of the key project risks. These sensitivities are designed to test the overall economic and financial robustness of the project, and to give an indication of the impact of key project risks on the financial structure proposed.

### 8.6.1 Demand and Cost Changes

The overall economic case for Line 1 will be impacted upon directly by capital and operating cost increases and by demand falling lower than forecast. To illustrate this, the 'switching value' of the capital cost, operating cost and scale of demand have been established where the NPV would fall to zero:

- The capital cost would have to increase by 19%;
- Operating cost would have to increase by 37%; and
- Transport benefits would have to fall by 11%.

### 8.6.2 Sensitivity Tests

Table 8.7 summarises the results from the various sensitivity tests undertaken; the following text discusses each in turn.

## Table 8.7 Line 1 Sensitivities

| Test | NPV[1] (£000's) | BCR[1] | Line 1 demand (m pax p.a.) | | Line 1 revenue[2] (£m p.a.) | | Operating cost[2] (£m p.a.) | Operating surplus[2] (£m p.a.) | |
|---|---|---|---|---|---|---|---|---|---|
| | | | 2011 | 2026 | 2011 | 2026 | | 2011 | 2026 |
| Central case | 40,366 | 1.21 | 9.44 | 13.69 | 6.59 | 9.62 | 6.29 | 0.30 | 3.33 |
| Unchanged bus network | 127,356 | 1.57 | 8.02 | 11.95 | 5.62 | 8.39 | 6.29 | -0.67 | 2.10 |
| Mode constant | 15,259 | 1.07 | 8.49 | 12.59 | 5.94 | 8.82 | 6.29 | -0.35 | 2.53 |
| Tram frequency | 44,299 | 1.21 | 10.61 | 15.15 | 7.40 | 10.67 | 7.41 | -0.01 | 3.26 |
| Tram run time | 18,549 | 1.09 | 9.01 | 13.19 | 6.30 | 9.23 | 6.76 | -0.46 | 2.47 |
| Work split | 54,660 | 1.28 | 9.44 | 13.69 | 6.59 | 9.62 | 6.29 | 0.30 | 3.33 |
| Worst credible scenario | 66,288 | 1.26 | 6.08 | 9.35 | 4.26 | 6.56 | 6.76 | -2.50 | -0.20 |

Notes:

1. NPV and BCR based on 1998 present value and prices
2. Line 1 revenue, operating cost and surplus are annual costs and revenues expressed in 2003 Q2 prices

*Unchanged Bus Network*

It is acknowledged by **tie** that the integration of bus and tram services is critical to successful operation and CEC/**tie** are seeking to ensure maximum cooperation of the bus operators through the DPOF process. On this basis, the Line 1 Central Case assumes that there is limited bus network restructuring, particularly between the City Centre and Leith. However, it is possible that bus operators might not act cooperatively and a scenario was therefore tested assuming an unchanged network from that existing in the Reference Case.

The analysis shows significantly improved benefits on both the public transport and highway networks; this is expected given the higher level of public transport supply and the attendant mode split impacts. The resultant BCR is 1.57. However, this has the impact of giving a poor operating ratio for Line 1, with operating costs now materially exceeding revenue. Commensurately, the bus network would lose some £27.0m in revenue, with no countervailing reduction in operating costs. In essence, Line 1 would add significant public transport supply, diluting the available revenue to the various public transport operators. Therefore, from a financial viewpoint, this option performs noticeably worse.

Given the importance of the impacts of bus network assumptions on the economic and financial case for Line 1, the full TEE and Cost to Government analysis are shown in Table 8.8 and Table 8.9.

**Table 8.8 Unchanged Bus Network TEE Analysis**

| | | STAG Code | Total | Public Transport | Road Users | |
|---|---|---|---|---|---|---|
| | | | | | Cars | Freight |
| **User benefits - Consumers** | | | | | | |
| Travel time | | (PV2) | £269,393 | £161,954 | £107,439 | |
| User Charges | | (PV3) | -£9,498 | -£9,498 | £0 | |
| Vehicle Operating Costs | | (PV4) | £8,726 | £0 | £8,726 | |
| Sub Total | | | £268,621 | £152,456 | £116,165 | |
| **User benefits - Business** | | | | | | |
| Travel time | | (PV2) | £76,883 | £12,824 | £38,222 | £25,837 |
| User Charges | | (PV3) | -£307 | -£307 | £0 | £0 |
| Vehicle Operating Costs | | (PV4) | £5,686 | £0 | £1,714 | £3,972 |
| Sub Total | | | £82,261 | £12,517 | £39,936 | £29,808 |
| **User benefits - Total** | | | | | | |
| Travel time | | PV2 | £346,275 | £174,778 | £145,661 | £25,837 |
| User Charges | | PV3 | -£9,805 | -£9,805 | £0 | £0 |
| Vehicle Operating Costs | | PV4 | £14,412 | £0 | £10,440 | £3,972 |
| Sub Total | | | £350,882 | £164,973 | £156,101 | £29,808 |
| **Private Sector Provider Impacts** | | | | | | |
| Investment (Capital) Costs | | PV5 | -£213,542 | -£213,542 | | |
| Operating Costs: | Line 1 | PV6 | -£108,285 | -£108,285 | | |
| | Bus | PV6 | £0 | £0 | | |
| | Rail | PV6 | £0 | | | |
| Revenues: | Line 1 | PV6 | £0 | | | |
| | Bus | PV7 | -£27,021 | -£27,021 | | |
| | Rail | PV7 | £22,949 | £22,949 | | |
| | Off-street Parking | PV7 | -£4,018 | | -£4,018 | |
| Grant/ Subsidy | | PV8 | £321,827 | £321,827 | | |
| | Developer Contribution | PV8 | -£9,563 | -£9,563 | | |
| Sub Total | | | -£17,652 | -£13,635 | -£4,018 | £0 |
| **Total PVB** | | | **£333,230** | | | |

**Notes:**
1. Disbenefits appear as negative
2. All values are £000s Present Value, 1998 Values and Prices

## Table 8.9 Unchanged Bus Network Cost to Government

| | STAG Code | Total | Public Transport | Cars | Road Users Freight |
|---|---|---|---|---|---|
| **Local Government** | | | | | |
| Public Sector Investment Costs | PV9 | £0 | | | |
| Public Sector Operating & Maintenance Costs | PV10 | £0 | | | |
| Grant/ subsidy payments | PV11 | -£108,285 | -£108,285 | | |
| (Developer Contribution) | | £0 | | | |
| Revenues | PV12 | £119,365 | £100,472 | £18,893 | |
| Taxation impacts | PV13 | £0 | | | |
| **Central Government** | | | | | |
| Public Sector Investment Costs | PV9 | £0 | | | |
| Public Sector Operating & Maintenance Costs | PV10 | £0 | | | |
| Grant/ subsidy payments | PV11 | -£213,542 | -£213,542 | | |
| (Developer Contribution) | | £9,563 | £9,563 | | |
| Revenues | PV12 | £0 | | | |
| Taxation impacts | PV13 | -£30,181 | -£16,232 | -£12,251 | -£1,698 |
| **Total PVC to Government** | | **-£223,080** | | costs appear as negative | |

| **Monetised Summary** | |
|---|---|
| Present Value of Transport Benefits (PV1-8) | |
| Accidents, PV1 | £17,206 |
| Transport Economic Efficiency | £333,230 |
| Total PVB (PV1-PV8) | £350,436 |
| Present Value of Cost to Government (PV9-13) | -£223,080 |
| Net Present Value | £127,356 |
| Benefit-Cost to Government Ratio | 1.57 |

*Mode Constant*

The Central Case assumes a modal preference of 0.8 in-vehicle weighting. A test has been undertaken assuming a value of 0.9. This reduces the level of demand and benefits accruing to Line 1, reducing the BCR to 1.07.

*Tram Frequency*

The current central case assumes a frequency of 8tph; however, by 2026 demand is forecast to be near or at the capacity of this frequency. On this basis, a test has been undertaken assuming 10tph. The increase in operating cost is some £1.12m p.a., to £7.41m p.a. Furthermore, the additional frequency will require a fleet of 18 trams, compared to the Central Case requirement of 14 trams at an additional cost of some £7.75m (including 25% optimism bias).

The impact is positive on Line 1 demand and benefits, but with the BCR remaining essentially unchanged from the Central Case due to the higher operating costs negating the benefit increase. Financially, the operating ratio of the tram is marginally worse, where the increase in revenue is insufficient to offset the increased capital and operating costs.

*Tram Run Time*

The Central case run time is some 40.5 minutes; this assumes a reasonable level of priority at junctions. However, it is possible that this is not achieved and that longer run times would result. On that basis, run times have been developed assuming lower junction priorities, resulting in a loop time of 43.0 minutes (note that the increase is focused on the Leith Walk to Haymarket section of Line 1).

The increase in operating cost is some £0.47m p.a., to £6.76m p.a. Furthermore, the longer run time will require a fleet of 16 trams, compared to the Central Case requirement of 14 trams at an additional cost of some £3.87m (including 25% optimism bias). These additional costs and the disbenefit of the slower run time result in a lower BCR of 1.09.

*Work Split*

The Central Case TEE appraisal assumed a local work split based on Edinburgh household survey data. Using default TUBA work splits increases the PVB by some 6.3%, in most part due to the higher default work split for car users. On this basis, the BCR increases to 1.28. The increase is driven by the highway car benefits, by the virtue of the default work split being around twice the level of the local highway work split.

*Worst Credible Scenario*

The worst credible scenario, with respect to the financial case for Line 1, arising from the above is a combination of the following:

- An unchanged bus network;
- A mode constant of 0.9;
- Slower run times of 43.0 minutes; and
- No 10% uplift to the base PT demand (see section 7.6.1).

The impact of this is to substantially erode the Line 1 operating ratio. Bus operations will be similarly affected. This scenario produces a BCR of 1.26, marginally above the Central Case.

### 8.6.3 Congestion Charging

Congestion charging is not an approved scheme and therefore its impact has not been considered nor sensitivity testing tests undertaken within the current STAG assessment. Its impact is likely to increase the modal split towards public transport and therefore improve the case for tram.

## 8.7 Ongoing Risk Management Process

### 8.7.1 tie Risk Management Structure

Ultimate responsibility for risk is taken by the **tie** Board, with responsibility delegated to the Projects Director. He has appointed a Risk Working Group comprising advisors covering technical, legal and financial issues, together with **tie**'s appointed Risk Manager. He is responsible for executing or overseeing actions necessary to mitigate risk on the tram scheme.

### 8.7.2 Development Partnering and Operating Franchise Agreement

It is expected that the DPOF Agreement will be signed with the selected Operator about March or April 2004. During Phases A and B of this agreement, the Operator will work in conjunction with **tie** and **tie**'s other advisors to agree contractual target costs and revenues, based upon accepted operating assumptions. Target costs will be based upon information submitted in a competitive tendering situation, adjusted as appropriate to accommodate any agreed changes in operating assumptions.

During Phases A and B, the Operator will also be advising upon the extent and quality of the infrastructure and equipment to be procured under the Infrastructure Delivery Agreements.

# 9 Monitoring and Evaluation

## 9.1 General

### 9.1.1 Requirements of STAG

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.

### 9.1.2 Stages of the Project

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.

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.

## 9.2 Objectives

The objectives for this scheme are described in Chapter 2 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.

### 9.2.1 Project Objectives

Project objectives have been set out as a more measurable and specific account of the planning objectives (as described in Chapter 2), 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.

### 9.2.2 Project Stage Influences

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 which will undergo periodic revision to reflect and enhance the city streetscape;
- 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.

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 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 between the tram Operator and bus companies to encourage optimum use of public transport;
- Junction operation will be reviewed with the Operator and CEC to optimise priorities for public transport modes and minimise congestion;
- Operating plans will be developed with the Operator covering all aspects of operational safety;
- The Design Manual will continue to be developed to reflect the wishes of CEC and the community with respect to streetscape;
- Specifications for infrastructure and equipment will be developed in conjunction with the Operator 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 the Operator for future fares policies, possibly including discounted fares which will encourage tram use by low-income groups.

## 9.3 Base Case

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 2009. It is also possible that tram introduction may be phased.

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 the Scottish Executive 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.

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.

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.

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.

## 9.4 Project Development, Procurement and Construction

### 9.4.1 Project Validation

There is a 5-6 year period required for 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 will be implementing various Integrated Transport Initiative 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.

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.

### 9.4.2 Cost and Revenue Review

The DPOF contract through which the Operator will be appointed, will be initiated during the spring of 2004. The initial phases of this contract, in place during 2004 and 2005, cover continuing development of the scheme leading to procurement of the infrastructure and equipment. It is a requirement of the contract during these phases that the Operator reviews the operating assumptions leading to existing estimates of patronage, revenue and operating costs. Any changes to the factors which affect these estimates must be agreed between **tie**, its advisors and the Operator. The DPOF Target Costs will be adjusted using the cost build-up submitted by the Operator as part of their Bid as a basis. Similarly any change in revenue estimates will be agreed.

DPOF 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 DPOF Agreement includes a mechanism for adjustment of target costs and revenues and incentivises the Operator to achieve these targets through a pain/gain sharing formula during operations.

Thus the operating costs and revenues will be under continual review throughout the project development and operating phases.

In addition, **tie** will instigate a regular review of the costs associated with infrastructure and equipment during the development, procurement, construction and commissioning phases to confirm the ongoing validity of estimates and underlying assumptions.

### 9.4.3 Programme Monitoring

**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.

## 9.5 Operations

### 9.5.1 Process Evaluation

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).

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.

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.

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 9.1

**Table 9.1 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<br>• Patronage<br>• 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 highway model results reflect reality | • Traffic diversion<br>• Congestion<br>• 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<br>• Commerce<br>• Tourism | Before and after surveys | Comparison between before and one year after implementation, by location and activity |

### 9.5.2 Outcome Evaluation

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 DPOF contract proposes a review and possible revision of Target Costs and Revenues 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.

### 9.5.3 Monitoring

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.

The payment mechanism within the DPOF 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.

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 and in any revenues generated in excess of the

Target Revenues. The performance of the system with respect to operating costs and revenues will be undertaken on a daily basis and evaluated at no greater an interval than 28 days.

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.

The KPIs against which the service will be measured are:

- Headway – measuring performance against scheduled service intervals;
- First and last tram – punctuality of first and last services;
- 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.

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.

The Vision Achievement Bonus is also payable dependent upon a consistent performance against these KPIs over time, promoting continued high quality service.

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.

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).

The KPIs and monitoring programme are summarised in Table 9.2.

## Table 9.2 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<br>• Public transport use | • X% by 2014 (5 years after opening)<br>• X million per year by 2014 | • Population distribution, car availability (from Census/ Scottish Registry Office), PT routes<br>• TIMS | • Yearly population and distribution updates by ward<br>• 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 2014 | • Population distribution, car availability, PT routes.<br>• Employee survey | • Annual population and distribution.<br>• 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 2014<br>• Y% reduction on cars by 2014 | • 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)<br>• Growth in car traffic | • Road Traffic Reduction Act (RTRA) local targets<br>• Car traffic growth not to exceed X% in 2014 | • 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 2014 | • 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 |

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.

Emphasis has been placed in the DPOF 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 DPOF contract for monitoring purposes.

## 9.6 Overall

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.

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 an Operator using the DPOF procedure. This action alone will contribute significantly to minimisation of risk and regular review of the project in that:

- Forecasts for operating costs and revenues will be validated during the scheme development phase;
- Operator advice on equipment and infrastructure will inform the procurement process and assist project validation;
- The operator will manage the commissioning and testing process, thereby exercising some degree of coordination between operator and infrastructure supplier; and
- An extensive, regular (and where possible automated) monitoring procedure will be followed during operations, with contracted parties incentivised to achieve KPIs targeted towards meeting scheme objectives.

## Bibliography

City of Edinburgh Council
http://www.edinburgh.gov.uk/CEC/City_Development/Economic_Development_and_Estates/Edinburgh_Facts_and_Figures/Road/road.html

City Plan for Edinburgh (1999) http://download.edinburgh.gov.uk/CityPlan.pdf

Edinburgh Census (2001)
(http://www.edinburgh.gov.uk/CEC/City_Development/Planning_and_Strategy/Edinburghs_Census_2001/Report1Feb03menu.html)

European Regional Prospects (2001) ERECO Group of leading research institutes (Cambridge Econometrics UK), August 2001.

Andersen, Steer Davies Gleave and Mott MacDonald (2001), Feasibility Study for a North Edinburgh Rapid Transit Solution

Halcrow Fox (1999) *Review of the Economic and Social Profile of the NEAR Area* – Final Report, and Technical Appendix: Survey Cross-Tabulations North Edinburgh Area Renewal. November 1999.

Local Transport Strategy 2004-2007 2001- 2004, The City of Edinburgh Council,
http://www.edinburgh.gov.uk/CEC/City_Development/Transport_and_Communications/Local_Transport_Strategy/consultleaflet3.html

Oscar Faber (2000) *North Edinburgh Public Transport Strategy* – Final Report Forth Properties Ltd, The City of Edinburgh Council, Lothian and Edinburgh Enterprise Ltd.

Steer Davies Gleave (2001) *Waterfront Issues Paper*, for Waterfront Edinburgh.

The Stationery Office (1998) *Travel Choices for Scotland*, The Scottish Integrated Transport White Paper, Presented to Parliament by the Secretary of State for Scotland, by Command of Her Majesty
http://www.archive.official-documents.co.uk/document/cm40/4010/4010.htm

Transport Initiatives Edinburgh (2002) *Integrated Transport Initiative for Edinburgh and South East Scotland*, A Vision for Edinburgh 30 September 2002.
(http://download.edinburgh.gov.uk/traffic/A_Vision_for_Edinburgh.pdf).

Scottish Executive (2003), Scottish Transport Appraisal Guidance, Version 1.0, September 2003

## 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 $L_A$.

**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 $N/m^2$).

**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.

**E**

**EALI**. Economic Activity and Location Impacts

**ELTIS**. European Local transport Information Services

**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.

**ERM**. Environmental Resources Management

**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.

**Grade Separation** is the provision of two or more vertical levels of road infrastructure in order to segregate traffic movements. An at grade junction is one formed on a single vertical level.

**Grade Separated Junction**. A junction where a road crosses another road at a different level separating the two roads and thus avoiding the potential conflict of traffic movements of an at-grade junction.

**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** is 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.

## L

$L_{Aeq}$. 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.

**Listed buildings** are 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 2004-2007

**M**

**Mitigation**. In the context of this report, mitigation is the provision of measures to remedy or reduce adverse environmental impacts.

**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 ($NO_2$)**. 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**

**OBC**. Outline Business Case.

**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 ($NO_x$)**. The collective term used to refer to nitric oxide (NO) and nitrogen dioxide ($NO_2$).

**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** 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.

**SDG.** Steer Davies Gleave.

**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.

**tie.** Transport Initiatives Edinburgh

**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.