- 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:

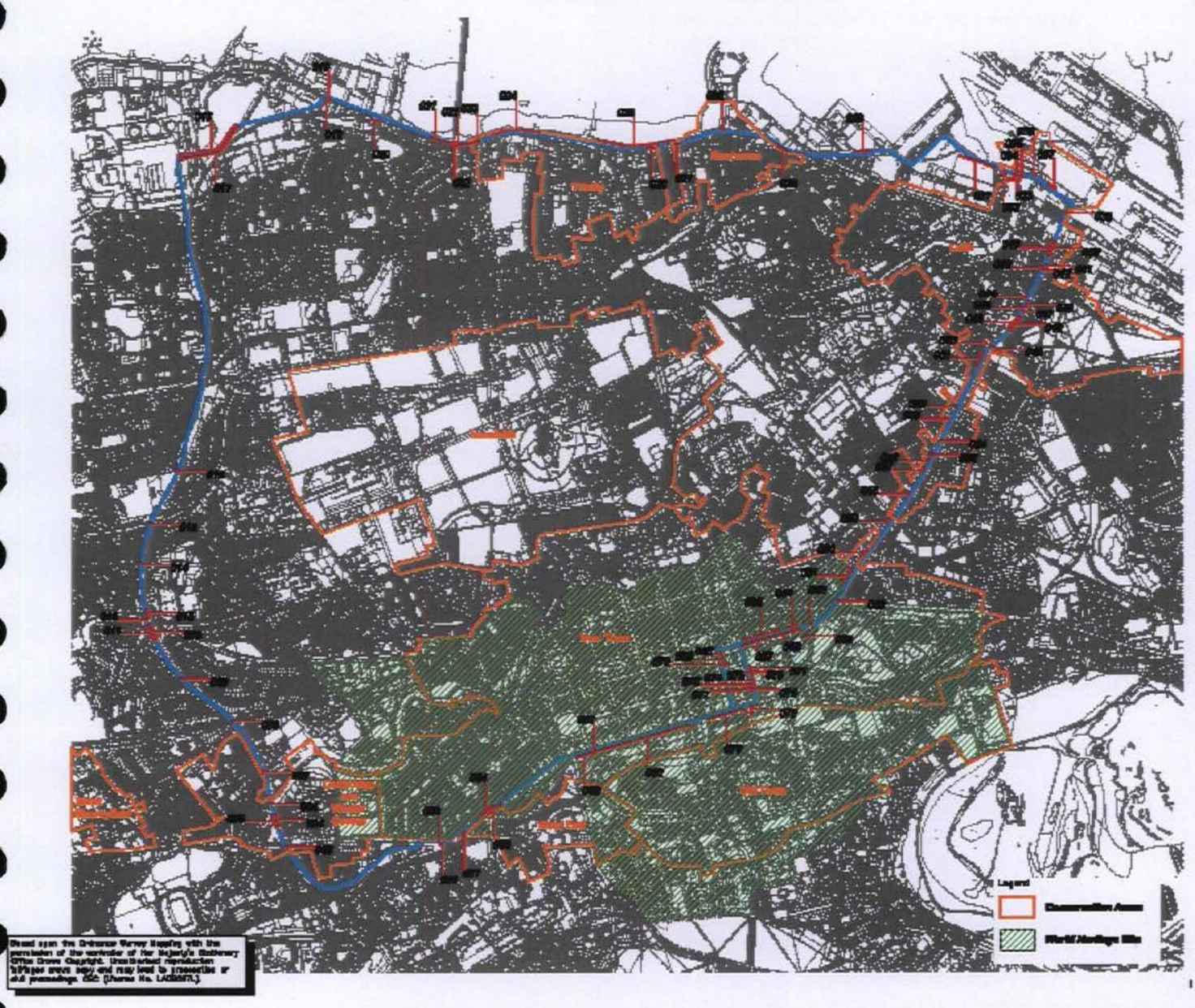
- The Haymarket complex, which includes the Category A listed station and two listed public houses;
- The Roseburn railway corridor, which is the line of the Granton branch of the Caledonian Railway, built in 1861 and closed in the 1980s;
- The designed landscape of Caroline Park;
- The water frontage 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.

<u>The Regeneration Areas</u>

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 (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

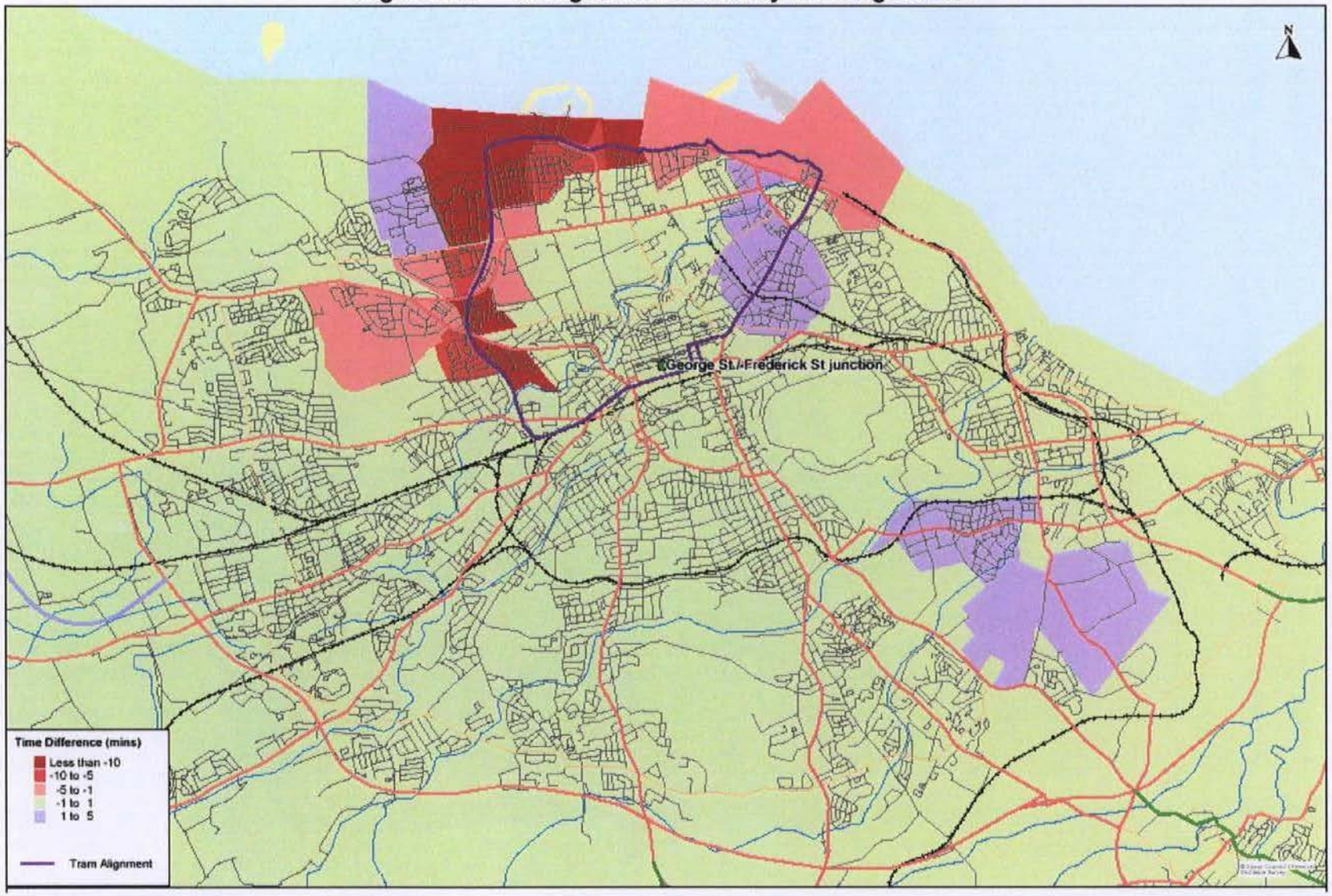

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Figure 7.20 Changes in Accessibility to Haymarket Station

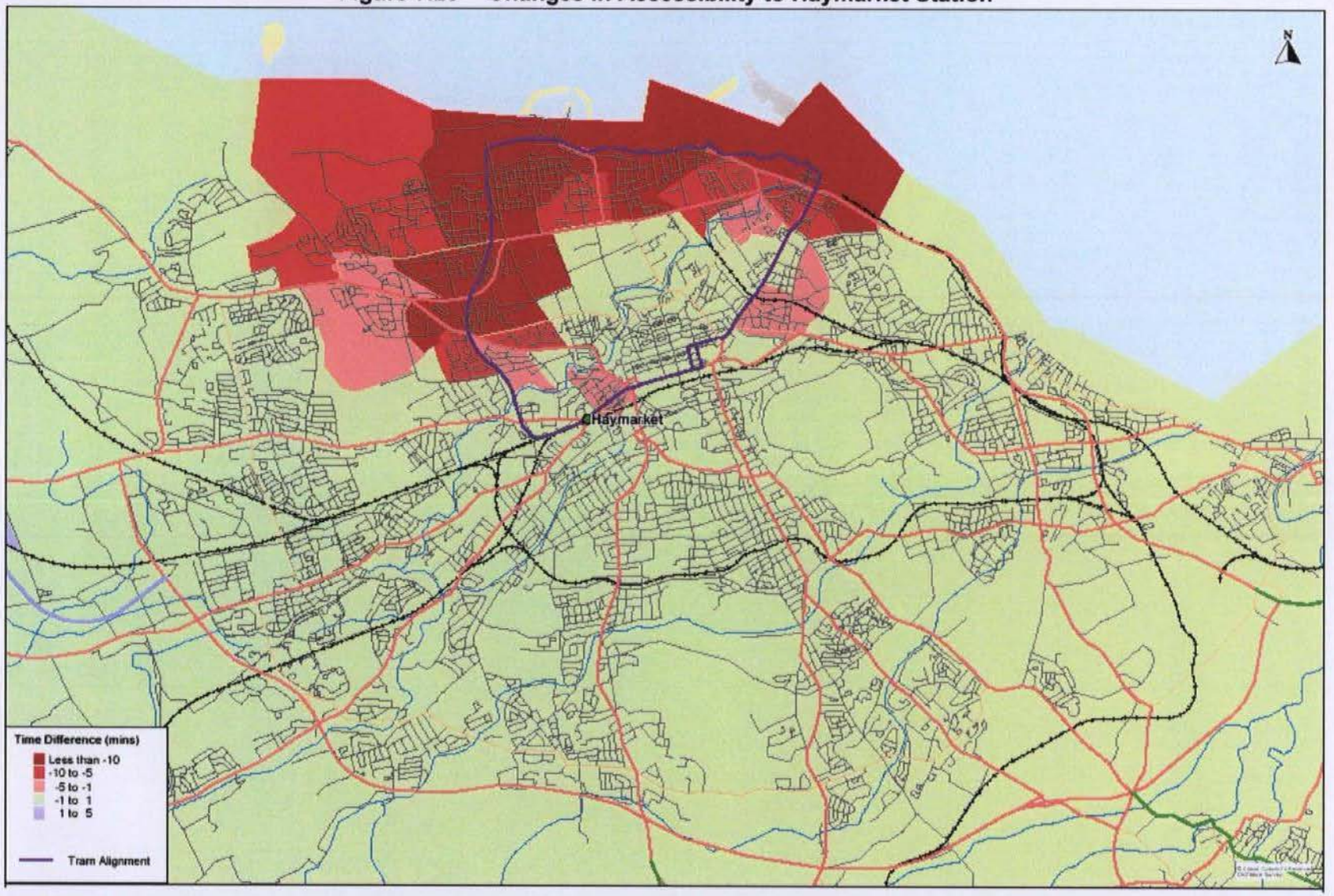

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Figure 7.21 Changes in Accessibility to Foot of Leith Walk

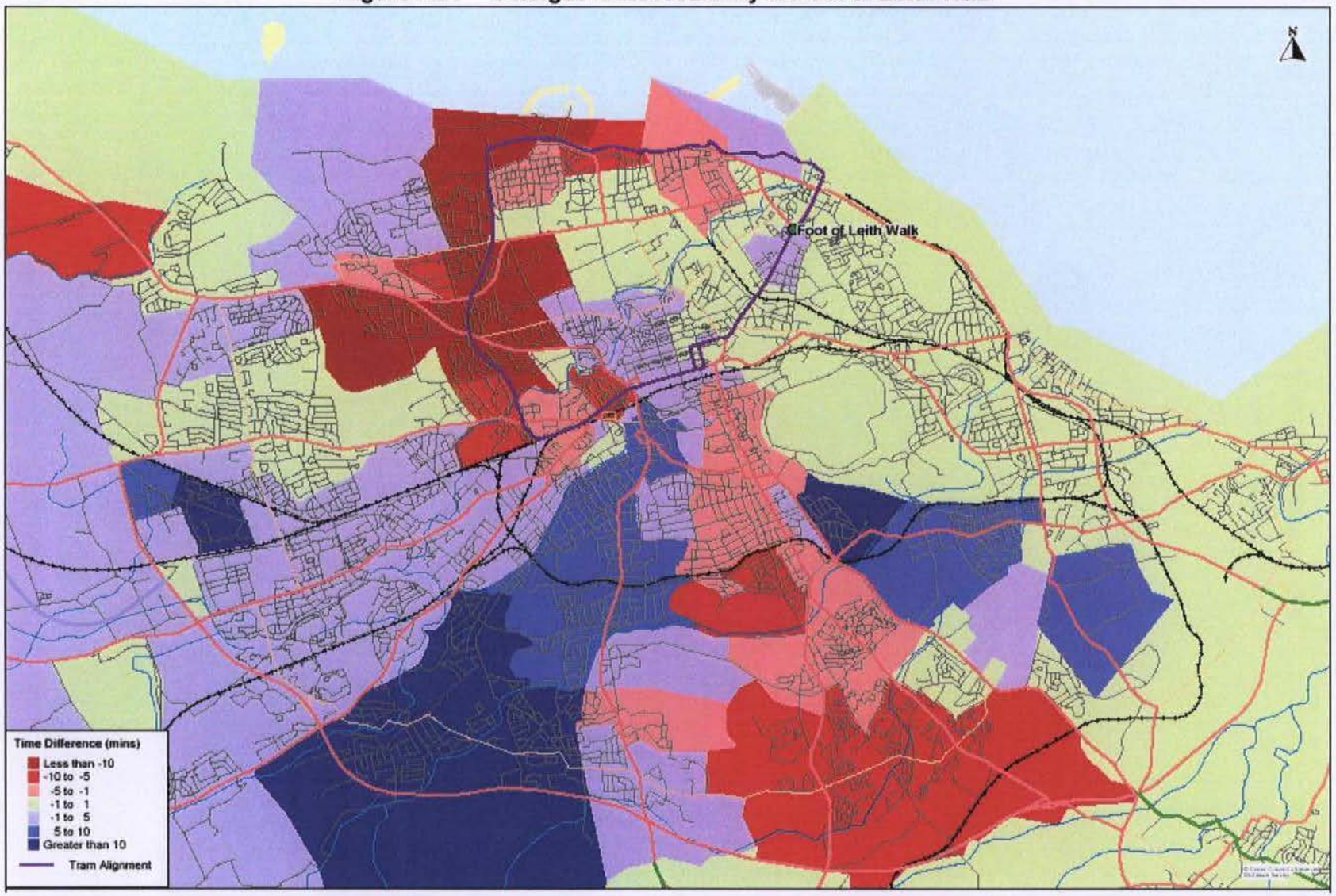

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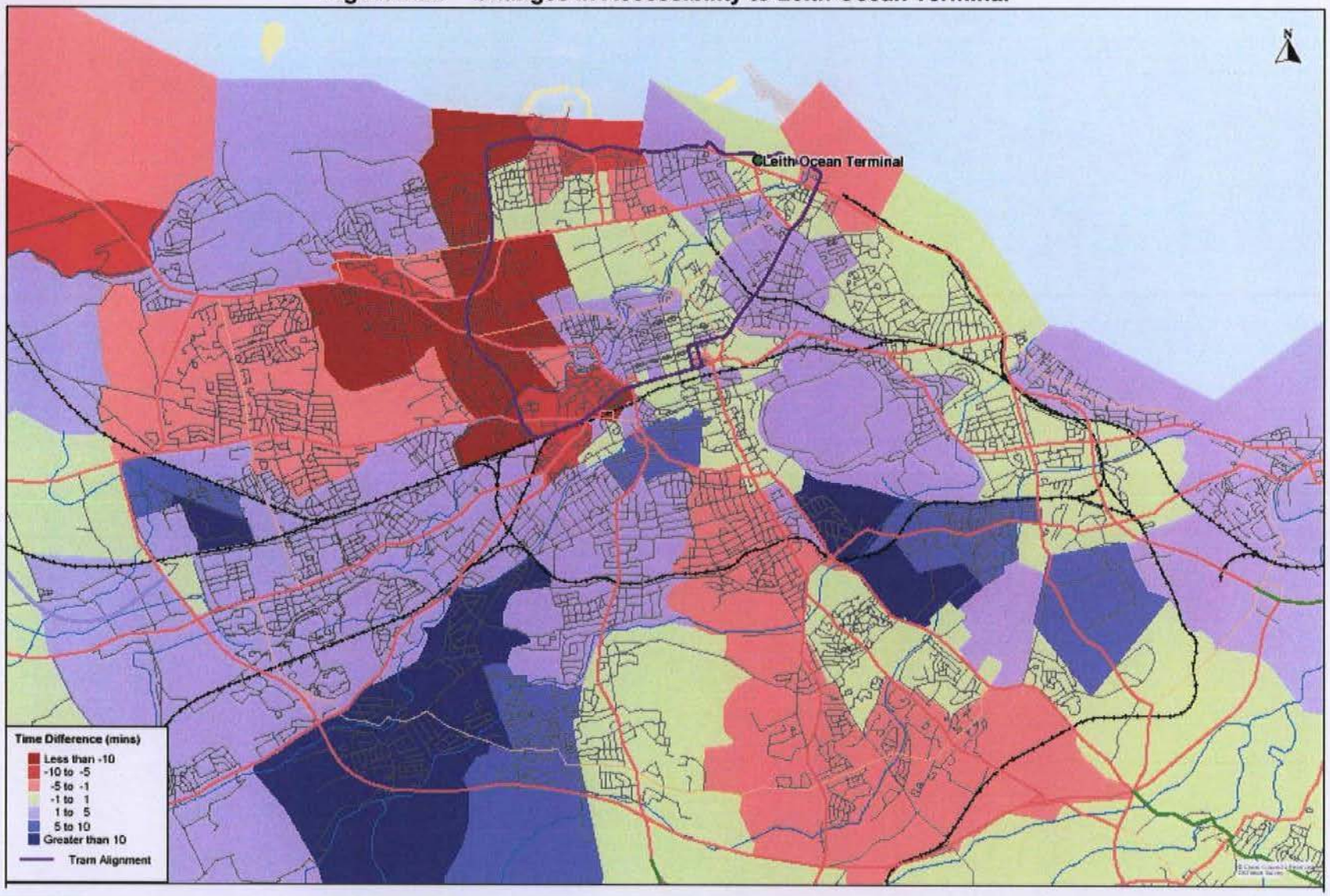
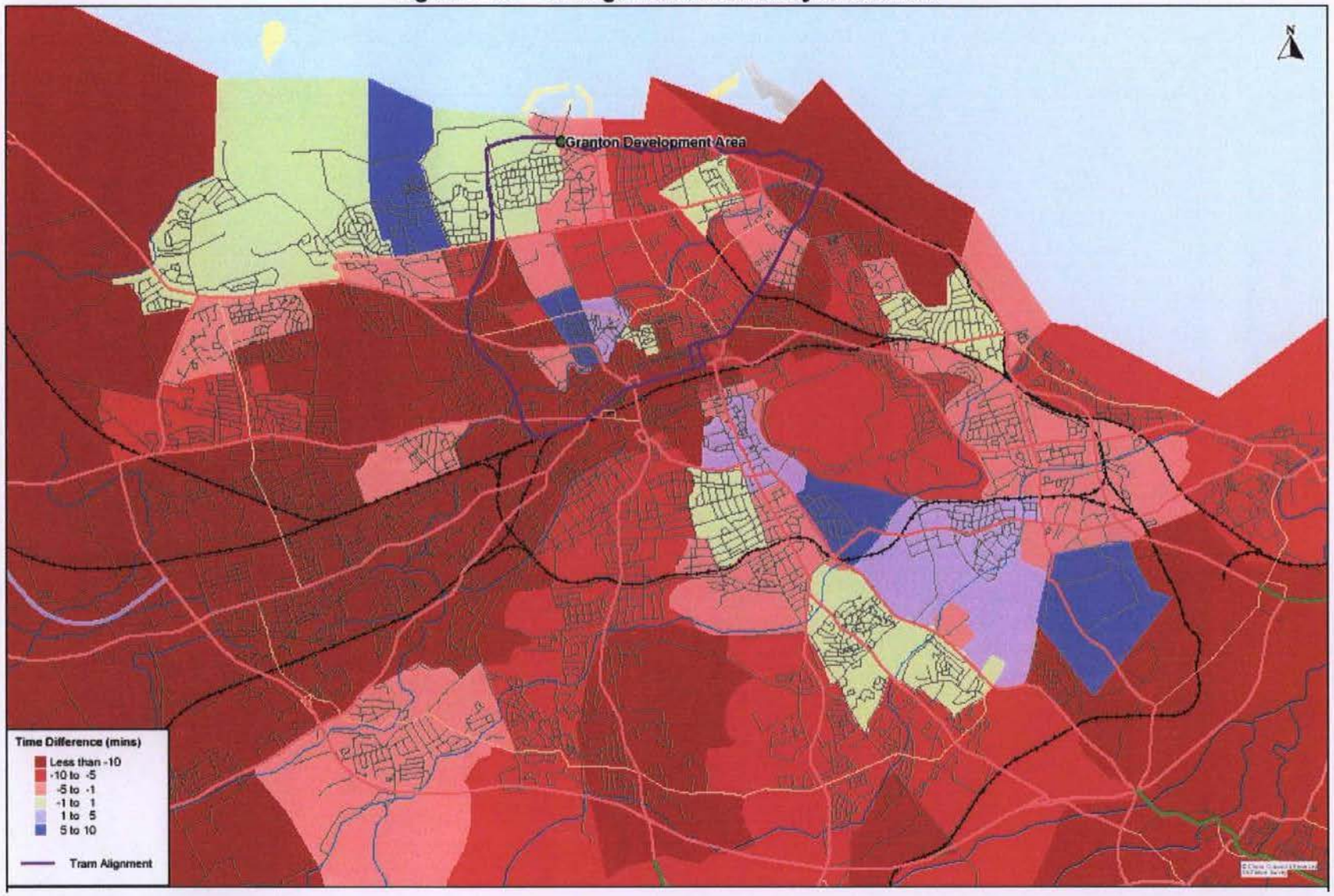
Figure 7.22 Changes in Accessibility to Leith Ocean Terminal



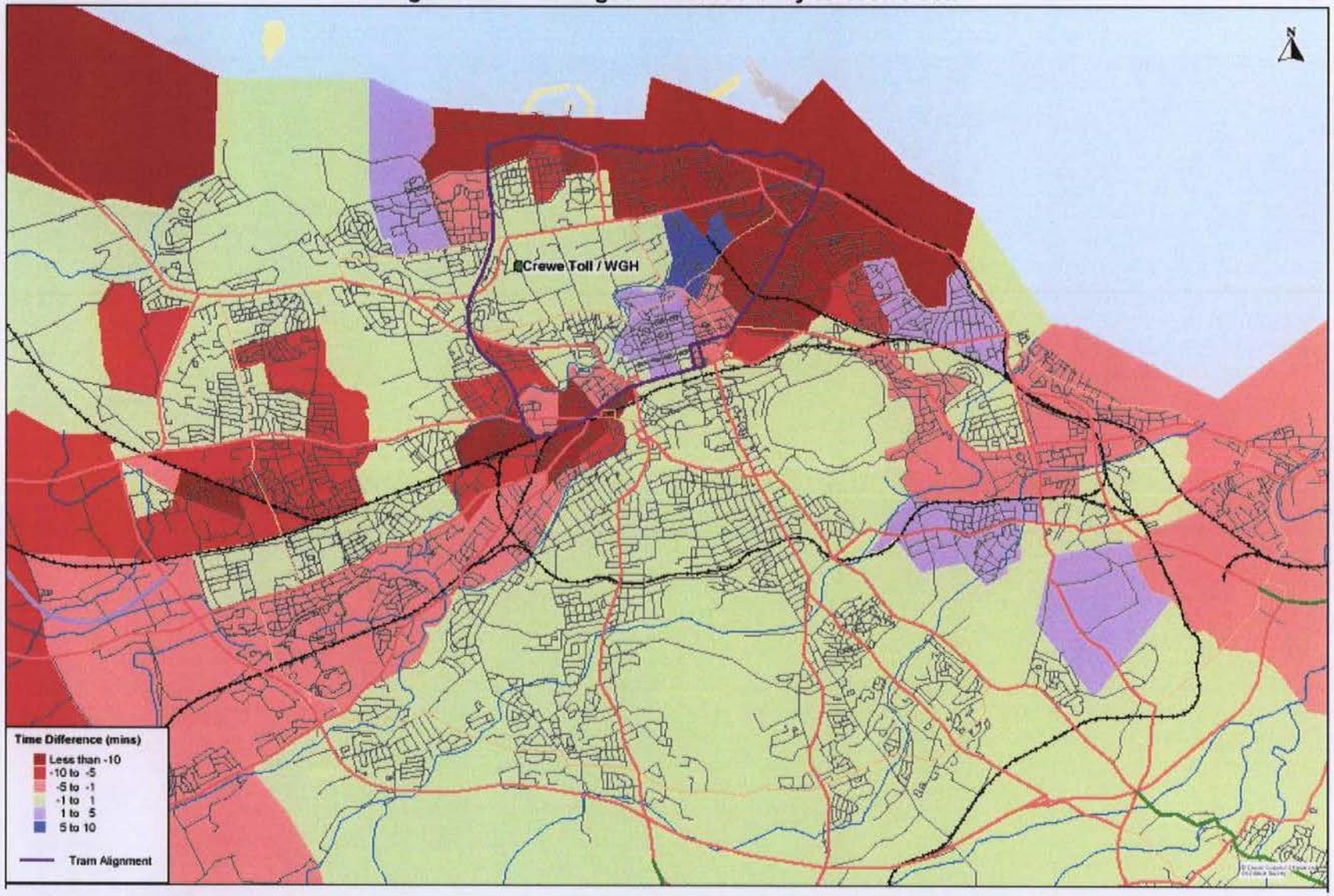
Mott MacDonald

Figure 7.23 Changes in Accessibility to Granton



Mott MacDonald

Figure 7.24 Changes in Accessibility to Crewe Toll



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

Changes in travel time	George St			Leith Ocean Terminal		
	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**

Changes in travel time	Foot of Leith Walk			Crewe Toll		
	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**

Changes in travel time	Haymarket			Granton		
	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	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* *Revenue Support* *PV Costs*	£274.15m (capital cost) £6.29m/year (operating cost)
Funding sought from	Scottish Executive	*Amount of application*	N/A
Proposal Background			
Geographic context	Edinburgh is the capital of Scotland, a World Heritage city, spread over 100 square miles in area, built upon a jumble of hills and valleys.		
Social context	High population density in areas covered by the route. 39.5% of households in Edinburgh do not have a car (2001 Census), and the route will serve much of the areas of low car ownership. The north east part of Edinburgh (served by the route) is the most deprived and of lowest income levels. Unemployment is at a 25-year low. The tram services will enable non-car owners and the socially excluded increased access to the public transport network.		
Economic context	Edinburgh's regional economy is expected to be the fastest growing economy of any major UK city over the next five years, with correspondent growth in population and jobs.		
Planning Objectives			
Planning objectives	*Performance against planning objectives*		
▪ Improve accessibility ▪ Promote sustainability ▪ Reduce congestion ▪ Improve safety and security ▪ Social benefits	▪ Line 1 will improve accessibility to employment opportunities, education, shopping and leisure destinations, contributing to improve the local economy. ▪ The scheme will contribute to sustainable travel (zero emissions produced by trams in urban areas, reduced noise, townscape benefits) and less congestion (more public transport trips and less car trips). ▪ The tram system will provide a safe and secure means for travel as well as a safe local environment. ▪ The tram will provide social benefits in terms of enhanced liveability on streets and accessibility to mobility impaired and deprived segment of the population.		
Rationale for selection of proposal	George Street and Princes Street options have comparable capital costs. Run times are slower on George Street, there are fewer opportunities for transport integration and accessibility and greater environmental and heritage impacts. Therefore, Princes Street is the preferred option. Telford Road option is more costly, slower and environmentally adverse than the railway solum, and would impact significantly highway operations, while the former railway solum is completely segregated; hence chosen.		
Implementability Appraisal			
Technical	The proposed alignment is technically feasible, as no untried technology is used, run times are maintained, urban design issues are acceptable and it is integrated with buses.		
Operational	Journey times can be minimised to maximise the attractiveness of the service and minimise operating costs and rolling stock resources. The line capacity is 640 seated and 1,840 total passengers per hour (pph) in each direction.		
Financial	The costs will be met from a number of sources, including developer contributions and grant-funding from Public Transport Fund. Revenue will broadly cover operating costs.		
Public acceptability	The results of the consultation show that there is broad support for trams, despite concerns with the impact on properties in proximity to the route, the requirement for CPOs in certain areas, disruption caused by construction, environmental impact, destruction of local wildlife and the impact of the tram on local traffic and parking.		
Environment			
Mitigation options included (cost/benefit)	Noise barriers have been assumed to be installed along some sections of the Roseburn Railway Corridor to reduce noise impacts at adjacent properties.		
Sub-objective	**Qualitative information**	**Quantitative information**	**Significance of impact**
Noise and vibration	Impact of noise from tram operations on receptors adjacent to the proposed tram route	• Roseburn rail corridor: Residential properties adversely affected by	• Significant (major) negative impact of tram noise on receptors

		tram operations. • Remaining sections of tram route: no significant impact.	along Roseburn corridor. These reduce to slight after mitigation.
	Residential receptors either side of the roads where traffic flow changes have been predicted	• 2011: Do minimum to with scheme: No change in population annoyed • 2026: Do minimum to with scheme: No change in population annoyed	• Neutral-slight negative impact on remaining route sections. • Neutral
Local air quality — PM_{10} and NO_2	In 2011 there will be an increase in properties near roads with improved air quality compared to the do minimum and more properties will benefit from roadside improvements than from degradations in roadside air quality, for both pollutants. In 2026 a greater number of households will be near roads with worse PM_{10} concentrations than better (due to predicted increased congestion in 2026), but with improved or unchanged NO_2 compared with the do minimum.	• 70,200 households with increase in PM_{10} in 2011 (134,500 in 2026) • 174,000 households with decrease in PM_{10} in 2001 (112,050 in 2026) • 3,400 households with no change in PM_{10} in 2011 (1,000 in 2026)	Moderate positive (2011) Neutral (2026)
		• 77,950 households with increase in NO_2 in 2011 (139,550 in 2026) • 177,250 households with decrease in NO_2 in 2011 (119,100 in 2026) • 26,200 households with no change in NO_2 in 2011 (22,750 in 2026)	Moderate positive (2011) Minor positive (2026)
Global emissions — CO_2	There will be a small reduction in CO_2 emissions in the long term	• No net change in CO_2 emissions in 2011. Net reduction of 10,000 tonnes in 2026	Minor positive
Water quality, drainage and flood defence	• Potential short-term increase in sediment-laden runoff during construction due to earthworks (slight adverse but mitigation measures will reduce potential). • Existing drainage will be utilised, but where new one is required the principles of SUDS will apply (slight adverse but mitigation will prevent impact). • The scheme is not located in high-risk flood areas and is not expected to increase flood risk (neutral). • Existing groundwater and hydrogeological resources will not be impacted (neutral).	• The scheme crosses the Water of Leith twice. • Works to the seawall at Starbank Road run adjacent to the Firth of Forth for 250m. Potential for impacts on water quality during construction.	Neutral
Geology	• The route will pass south of the designated Firth of Forth Geological SSSI. No significant impacts are predicted. • The route will pass 30m west of the RIGS site at Craigleith Quarry, now a retail park. The rock outcrops will not be impacted upon.	• 1 SSSI • 1RIGS	Neutral

Biodiversity	• The Firth of Forth is designated as SPA/Ramsar Site and SSSI, for supporting populations of European importance: Moderate adverse.	250m of the Firth of Forth will be affected in construction of the walk/cycleway over the sea wall, extending out by 3m (≅ 0.1ha in total).	• Moderate adverse
	• The Roseburn Corridor is designated as an Urban Wildlife Site for its function as a wildlife corridor: Large adverse.	Significant amount of vegetation lost from ≅ 3km of Roseburn Corridor between Roseburn Terrace and Telford Rd.	• Major adverse
	• Badger and bats have been recorded from the Roseburn Railway Corridor: Moderate adverse.	Badgers and habitats directly affected by works within Roseburn Railway Corridor.	• Major adverse
		Bats affected by reduction in foraging habitat along Roseburn Railway Corridor.	• Slight adverse
Landscape / Townscape	Townscape improvements at specific locations but major adverse impacts, primarily from OLE, in many sensitive areas. Significant vegetation removal and tree loss along the Roseburn corridor	World Heritage Site and Conservation Areas	Major adverse
Visual amenity	Varying range of visual impacts (mainly OLE) all along the route. Most significant in the New Town where iconic views are affected, open areas and Roseburn Railway corridor where views are opened up. Screening can mitigate in Railway corridor, but elsewhere design of tram system will need to fit to scene.	World Heritage Site and Conservation Areas	Major adverse
Agriculture and soils	No agricultural land affected. Soils addressed above under '*Geology, Soils and Contaminated Land*'.		Neutral
Cultural heritage	• One listed building, the Caledonian Ale House (Category C(S)) at Haymarket is likely to require demolition. Mod adverse.	86 sites of potential significance in the swept path or buffer zone will be directly affected: • 16 sites of national importance; • 20 sites of regional importance; • 27 sites of local importance; • 23 sites of little or no importance. In addition, the setting of a further 230 listed buildings will be affected	Moderate adverse
	• The war memorial/clock at Haymarket (Category C(S)) may require relocation. Slight adverse		
	• The settings of groups of listed buildings will be affected (see Townscape).		

Safety

Sub-objective	Item	Qualitative information statement	Quantitative information
Accidents	Change in annual personal injury accidents	Standard rates and methodology from NESA	Change in annual accidents: -7.6 in 2011 and +51 in 2026, for all severity levels

	Change in balance of severity	Rates by severity level: fatal, severe, slight and damage.	Annual changes (2026): Damage = 45.4; Slight = 4.8; Serious = 0.6; Fatal = 0.1
	Total discounted savings	PV 30 years	PV £4.8m
Security		CCTV system at all stops and vehicles. Good proximity of tram stops to retailers and other urban activities. Positive design. Conductors present in all vehicles. Lighting and help points at all stops.	Moderate beneficial
Economy			
Sub-objective	**Item**	**Qualitative information**	**Quantitative information**
User Benefits	Travel Time	Public transport journey time savings: Roseburn Corridor / Pilton to Ocean Terminal / Leith 10+ min; access times to Granton development area improved by 10+ minutes from most of Edinburgh; access time to Haymarket from Granton and Leith improved by 5+ min.	£232,045m (PV)
	User Charges	Public transport fares	-£9,462m (PV)
	Vehicle Operating Costs		£5,579m (PV)
	Quality / Reliability Benefits	The higher quality afforded by Line 1 compared to the alternative public transport modes has been encapsulated in the demand modelling and appraisal through the use of differential in-vehicle time factors.	
Private Sector Operator Impacts	Investment Costs	Scheme's capital cost	-£213,542m (PV)
	Operating and Maintenance Costs	Operating cost = £6.29m pa. Bus operating costs savings = £2.2m pa.	-£77,144m (PV)
	Revenues	Reduction of bus revenue = £40,278m (PV). Rail revenue increase = £25,514m (PV).	-£14,764m (PV)
	Grant/Subsidy payments	Total grant for capital and operating costs = £321,827m (PV). Potential developer contribution of £9,563m (PV)	£312,264m (PV)
Economic activity and location impacts	Local Economic Impacts	• 5% of opportunities for low / no skill activities, some of which could be filled by residents of north Edinburgh regeneration areas. • Additional jobs at the regeneration area level.	• 35 – 100 jobs. • 0 – 10 jobs.
	National Economic Impacts	• No net additional employment is claimed at the Scotland level. • Half of extra jobs in the health sector are additional, which would not be filled without tram.	• No impacts. • 0 – 10 jobs.
	Distributional Impacts	• Not all jobs coming to North Edinburgh will be additional, as some will be relocations from other areas. Displacement assumed at 50%	• 35 – 100 jobs.
Integration			
Sub-objective	**Item**	**Qualitative information**	**Quantitative information**

Transport interchanges	Services & ticketing	Integrated transport services and ticketing contribute to more "seamless" journeys across the public transport network.	All users benefited – moderate beneficial
	Infrastructure & information	Infrastructure facilities at tram stops, grater opportunities for bus and rail interchange with the tram at key locations, real-time information at all tram and bus stops.	All users benefited – moderate beneficial
Land-use transport integration	Transport assessment	The scheme is expected to meet or support most local, regional and national policy objectives, in particular related to regeneration, improving access and sustainable travel.	Moderate beneficial
Policy integration	Fit with key policies	The scheme is consistent with national policies beyond transport (disability, health and social exclusion).	Slight beneficial

Accessibility & Social Inclusion

Sub-objective	Item	Qualitative information	Quantitative information
Community accessibility	Public transport network coverage	Accessibility is significantly increased for travel from most zones to all the selected destinations (apart from travel from the south-west of Edinburgh to the north-east).	
	Access to other local services	The tram provides increased opportunities for walking and cycling as access modes, but it has limitations to promote further non-motorised trips to access local services.	
Comparative accessibility	Distribution / Spatial impacts by social group	Significant accessibility benefits can be realised, also for households without a car.	Some 4 times as many households with no car benefit than disbenefit as a result of the scheme.
	Distribution / Spatial impacts by area	• George Street: vast majority unaffected. Twice as many disbenefit than benefit; • Haymarket: vast majority unaffected. No accessibility disbenefits; • Leith Ocean Terminal and Foot of Leith Walk: many times more people/households benefit than disbenefit; • Granton and Crewe Toll: majority benefit significantly (i.e. reduction of 10+ minutes in journey times).	N° of households without a car benefit (disbenefit): • George St: 6,366 (12,604); • Haymarket: 17,337 (0); • Leith Ocean Terminal: 93,728 (53,176); • Foot of Leith Walk: 68,547 (39,127); • Granton: 161,998 (9,856); • Crewe Toll: 124,023 (9,286).

Cost to Public Sector

Item	Qualitative information	Quantitative information
Public Sector Investment Costs		
Public Sector Operating & Maintenance Costs		

Grant/Subsidy Payments	Grant to the private sector to cover the capital (£213,542 PV) and operating costs (£108,285 PV) of Line 1 = £321,827m (PV). Potential developer contribution of £9,563m (PV).	£312,264m (PV)
Revenues	Revenue from operation of Line 1 Revenue from car parking	£116,241m (PV) £25,835m (PV)
Taxation Impacts	Reduction in tax receipts arising from reduced travel and congestion on the highway network reducing fuel and other vehicle related taxes. Increased use of public transport (non-taxed) will reduce tax take from former consumption.	£25,326m (PV)

Monetised Summary	
Present Value of Transport Benefits	£235,879
Present Value of Cost to Government	-£195,513
Net Present Value	£40,366
Benefit-Cost to Government Ratio	1.21

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 have considered 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 22%;
- Operating cost would have to increase by 43%; and
- Transport benefits would have to fall by 12%.

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 • Patronage • N. bus services withdrawn or modified	PT model, TIMS, bus operator timetable and after surveys	Comparison between modelled and actual – after implementation and again one year later
	The extent to which highway model results reflect reality	• Traffic diversion • Congestion • Delays	Highway model and traffic surveys	Comparison between modelled and actual – after implementation and again one year later
Local economy	Actual impact on economic activity	• Employment • Commerce • Tourism	Before and after surveys	Comparison between before and one year after implementation, by location and activity

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 • Public transport use	• X% by 2014 (5 years after opening) • X million per year by 2014	• Population distribution, car availability (from Census/ Scottish Registry Office), PT routes • TIMS	• Yearly population and distribution updates by ward • Continuous monitoring of bus and tram ticketing
	Access to employment opportunities	• Number of people with access to employment in Granton, Leith, Muirhouse, Pilton and Newhaven	• X% employees at key locations being able to access jobs by public transport by 2014	• Population distribution, car availability, PT routes. • Employee survey	• Annual population and distribution. • Annual survey with employees from key employment locations.
Sustainability and Environment	Use of sustainable transport modes	• Increased modal share on public transport, cycle and walk.	• X% increase on PT by 2014 • 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) • Growth in car traffic	• Road Traffic Reduction Act (RTRA) local targets • 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.

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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

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.