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Rail Links to Glasgow and Edinburgh Airports

Final Report

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SINCLAIR KNIGHT MERZ

in association with

Mott MacDonald

ERM

JAMES BARR

Contents

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1. Introduction

1.1 Background

(1) The Scottish Executive has commissioned Sinclair Knight Merz (SKM) to undertake an assessment of Rail Links to Glasgow and Edinburgh Airports.

(2) The study was conducted in four phases and reports have been presented at the end of each phase. During Phase 1, we reviewed a wide range of infrastructure options and appraised them in a simplified STAG Part 1 Appraisal Summary Table. In Phase 2, we made use of a shortlist of the Phase 1 infrastructure options to develop a series service options. Our work in Phase 2 included:

- development of preliminary engineering designs and derivation of capital costs;
- calculation of operating costs;
- preparation of demand forecasts for a single year;
- examination of rail capacity issues and other operational constraints;
- presentation of the information in updated STAG Part 1 Appraisal Summary Tables;
- discussions of stakeholders and their role; and
- development of a shortlist of options at each airport for detailed appraisal in Phase 3.

(3) The objectives for Phase 3 of the study, were to:

- undertake a detailed appraisal of the shortlisted options using the Scottish Executive's Scottish Transport Appraisal Guidance;
- assess the robustness of our core appraisals to alternative input assumptions; and
- prepare advice on funding and procurement options, including appropriate apportionment of costs, risks and rewards between key stakeholders.

(4) Phase 4 of the study was the reporting phase, culminating in the delivery of this final report. This includes a summary of the work undertaken and the conclusions reached in earlier study phases.

1.2 Structure of this Report

(5) The remainder of this report is structured as follows:

- Chapter 2 reiterates our conclusions from Phases 1 and 2;
- Chapter 3 discusses the main characteristics of the shortlisted options;
- Chapter 4 outlines key forecasting and appraisal issues;
- Chapter 5 presents our detailed appraisal;
- Chapter 6 contains the results of sensitivity testing;
- Chapter 7 provides advice on funding and procurement options; and
- Chapter 8 contains a summary and recommendations.

(6) The STAG Appraisal Summary Tables are presented in a separately bound volume. There are eleven appendices to this report, also in a separately bound volume:

- Appendix A reproduces the advice we have received from Railtrack on Glasgow;
- Appendix B reproduces the advice we have received from Railtrack on Edinburgh;

- Appendix C contains the Environmental Baseline Report for Glasgow;
- Appendix D contains the Environmental Baseline Report for Edinburgh;
- Appendix E contains the Planning and Land Use Report for Glasgow;
- Appendix F contains the Planning and Land Use Report for Edinburgh;
- Appendix G outlines key forecasting and appraisal issues;
- Appendix H contains detailed Financial Tables;
- Appendix I contains details of our contamination investigation at the St John's Link;
- Appendix J contains notes from our meeting with the HMRI on Edinburgh Runway Tunnel issues; and
- Appendix K contains a list of key documents.

2. Phase 1 and 2 Conclusions

2.1 Background

2.1.1 Option Definitions

(7) Phase 1 concentrated on a review of ***infrastructure options***. The objective was to review previously identified options and to develop any further feasible means of connecting the airports to the railway network. From these, and our review of service pattern and rolling stock issues, a series of infrastructure options was identified for further consideration. In Phase 2, these were developed into ***service options***.

2.1.2 Phase 1 Study Objectives

(8) During Phase 1 of the study, we:

- proposed planning objectives for a rail link to either or both of Glasgow and Edinburgh Airports;
- considered what makes an airport rail link successful;
- identified a long list of options for providing ***heavy*** rail links to Glasgow and Edinburgh Airports;
- reviewed the engineering feasibility of the long list of options;
- considered the implications of the options for service patterns and rolling stock;
- conducted an initial and simplified STAG Part 1 appraisal of ***infrastructure options***; and
- developed our demand forecasting methodology.

(9) Note that this report is concerned only with ***heavy*** rail options. Light rail options will be considered in a separate report.

2.1.3 Phase 2 Study Objectives

(10) During Phase 2 of the study, we:

- costed the options identified in Phase 1 to the equivalent of Railtrack's "Level 2" in its hierarchy of project development;
- developed our demand forecasting model and undertaken initial, single year demand forecasting;
- prepared a simplified STAG Part 1 appraisal of ***service options***; and
- identified the potential stakeholders and their role in the delivery of the options listed.

(11) The aim of our appraisal in Phase 2 was to develop a shortlist of schemes at each airport for detailed appraisal in Phase 3.

2.2 Phase 1 Infrastructure Options

(12) A full description of our Phase 1 infrastructure options is given in our Phase 1 report. This section briefly reiterates what these were.

(13) Tables 2.1 to 2.3 summarise the options considered.

■ **Table 2-1: Phase 1 Long List of Infrastructure Options: Glasgow Airport**

Option Ref.	Location	Description	Proposed
GA1	Glasgow Airport	Heavy Rail-Link From Paisley St James Station	MVA/MM/ERM
GA2	Glasgow Airport	Heavy Rail Link Along The Former Arkleston Branch	MVA/MM/ERM
GA3	Glasgow Airport	Heavy Rail Link From Cardonald via Braehead and Renfrew	MVA/MM/ERM
GA4	Glasgow Airport	Heavy Rail Link From Jordanhill via a Tunnel under the Clyde	MVA/MM/ERM
GA6	Glasgow Airport	Tunnelled Heavy Rail Link via Braehead, Renfrew & Paisley St James	SKM/MM
GA7	Glasgow Airport	Tunnelled Heavy Rail Link from Paisley St James	SKM/MM
GA8	Glasgow Airport	Heavy Rail Link From Jordanhill via a Tunnel under the Clyde, combined with St James Link in tunnel. North of the Clyde, services to run via Anniesland and Maryhill to Queen Street High Level	SKM/MM

■ **Table 2-2: Phase 1 Long List of Infrastructure Options: Glasgow City Centre**

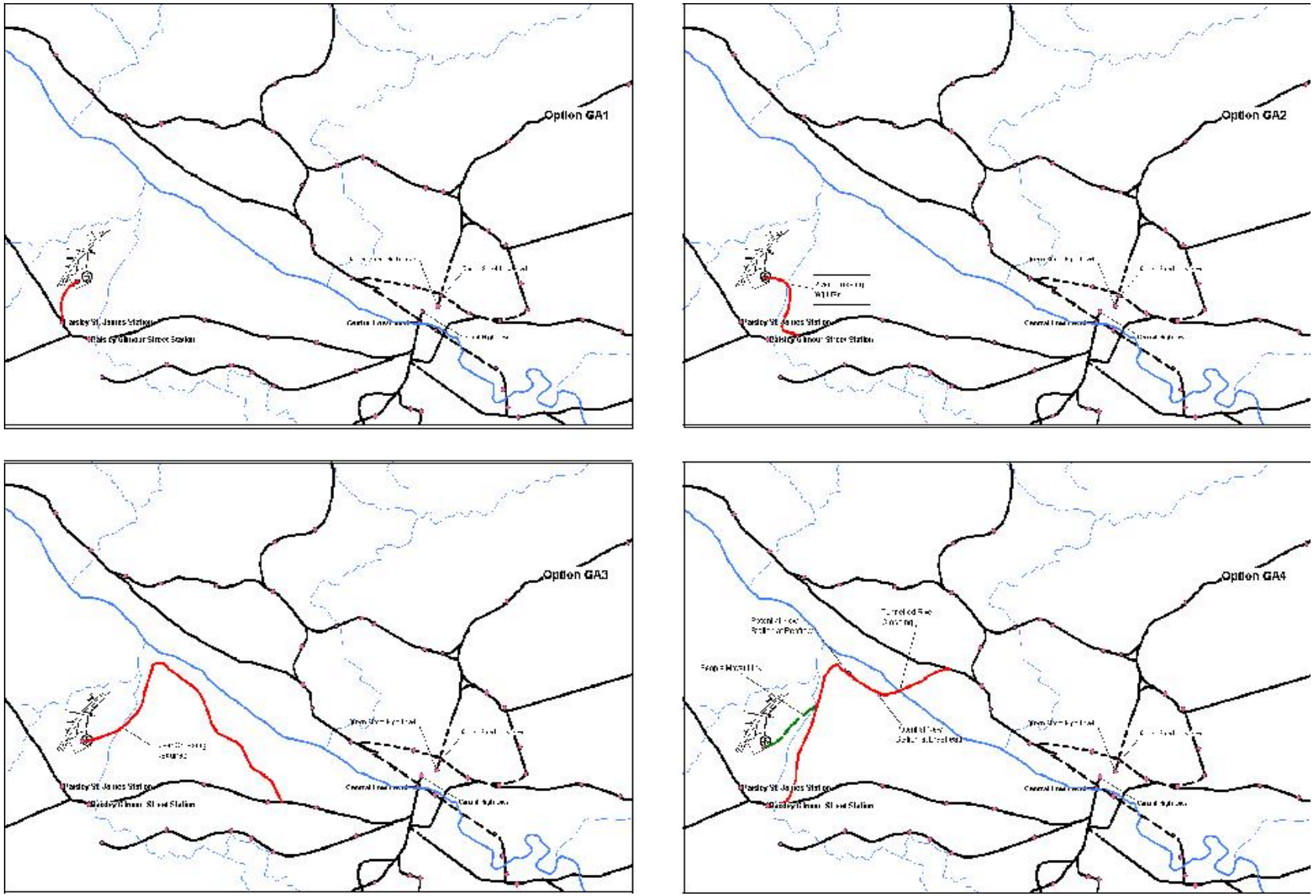
Option Ref.	Location	Description	Proposed
GC1	Glasgow Cross-City	Central Station	MVA/MM/ERM
GC2	Glasgow Cross-City	St John's Link (Crossrail) to Queen Street Station	MVA/MM/ERM
GC3	Glasgow Cross-City	Glasgow International Link to New Cowlairs International Station	MVA/MM/ERM
GC4	Glasgow Cross-City	City Centre Tunnel with One & Two Station Variants	MVA/MM/ERM
GC5	Glasgow Cross-City	St John's Link (Crossrail) & Strathbungo Link	MVA/MM/ERM
GC6	Glasgow Cross-City	Barnhill Link to Cumbernauld Line	SKM/MM
GC7	Glasgow Cross-City	Glasgow Central – Shotts – Edinburgh Service	BAH
GC8	Glasgow Cross-City	Glasgow Queen St High Level via Cowlairs Chord	SRA

■ **Table 2-3: Phase 1 Long List of Infrastructure Options: Edinburgh Airport**

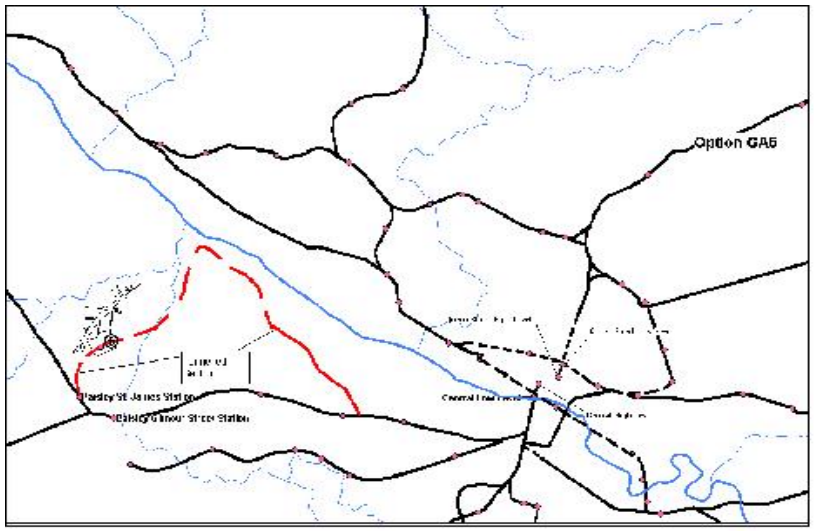
Option Ref.	Location	Description	Proposed
EA1	Edinburgh Airport	Winchburgh - Edinburgh Park with New Underground Airport Station	SWK
EA2	Edinburgh Airport	Ratho / Port Edgar Line From Dalmeny in Combination with EA1	SWK
EA3	Edinburgh Airport	New Chord from EA1 to Adjoin Winchburgh / Dalmeny Chord	SWK
EA5	Edinburgh Airport	New Chord from EA1 to Glasgow/Bathgate Line Near Ratho with EA1 Terminating at Airport Station	SKM/MM
EA6	Edinburgh Airport	Winchburgh - South Gyle with New Underground Airport Station Largely Following Turnhouse Runway (if obsolete)	SKM/MM
EA7	Edinburgh Airport	South Gyle - Hilton Hotel - Airport Terminal Station (surface route assumed)	BAA
EA10	Edinburgh Airport	Winchburgh - South Gyle with New Underground Airport Station Largely Following Turnhouse Runway (if obsolete), with a new chord adjoin Winchburgh / Dalmeny Chord	SKM/MM
EA11	Edinburgh Airport	New Chord off the Fife Line, with an airport station parallel to the runway, and connection back to the E&G line, combined with a new chord from the E&G line to the Winchburgh / Dalmeny Chord.	DTLR

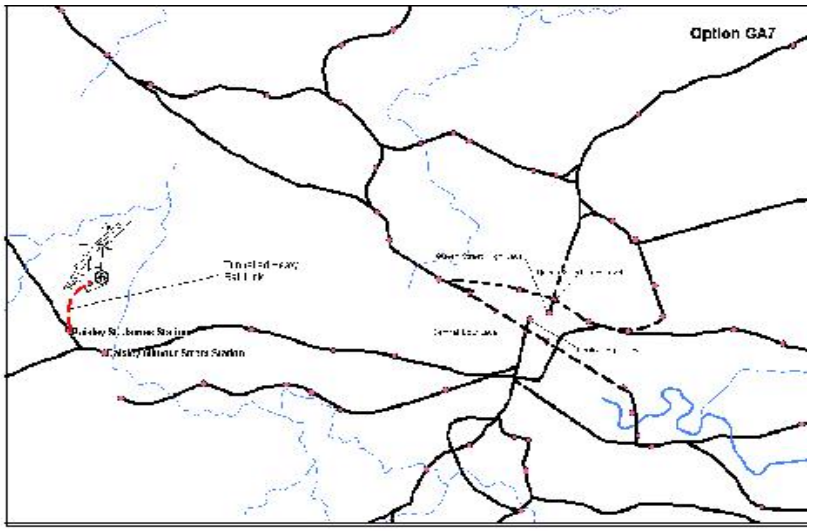
(14) Glasgow Airport options are shown graphically in figures 2.1 and 2.2. Infrastructure options in Glasgow city centre are illustrated in figures 2.3 and 2.4. Edinburgh options are shown in figures 2.5 and 2.6.

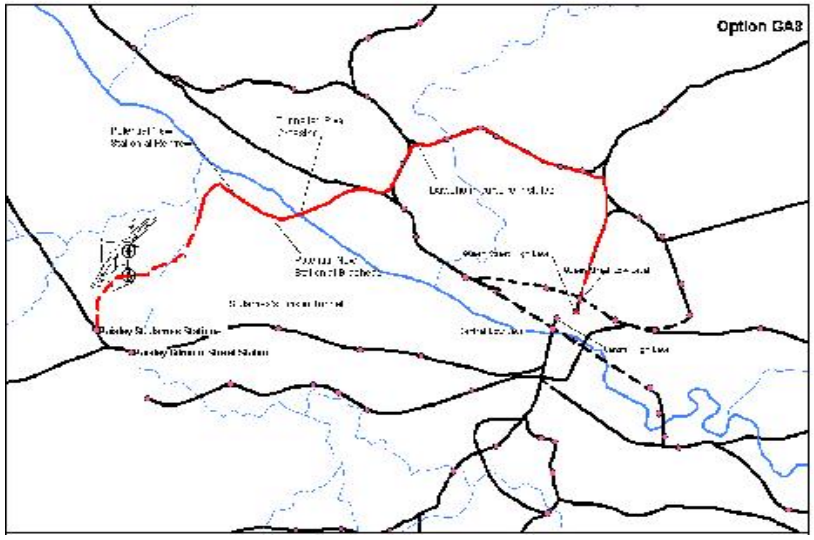
■ **Figure 2-1: Glasgow Airport Infrastructure Options**



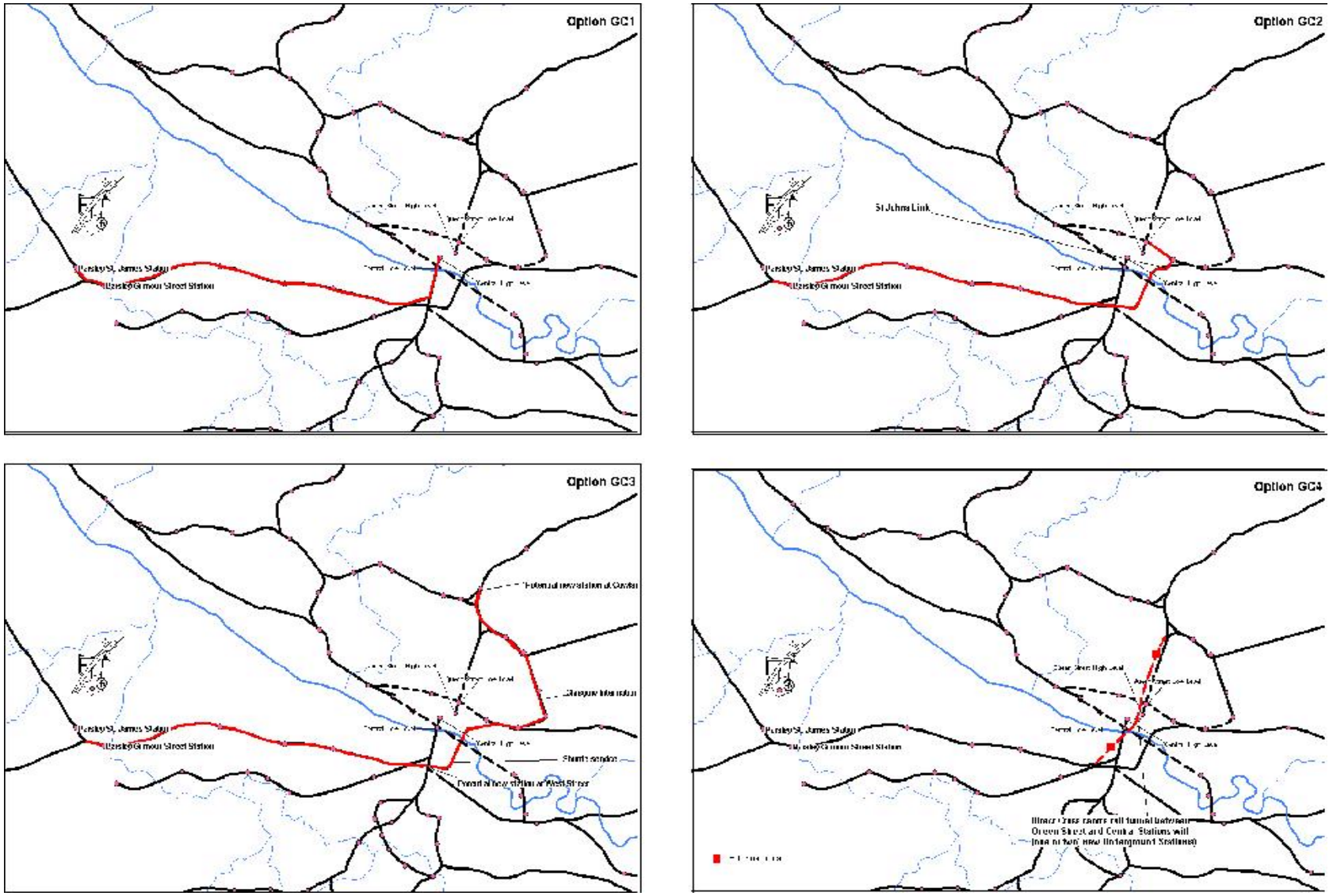
■ **Figure 2-2: Glasgow Airport Infrastructure Options (cont.)**



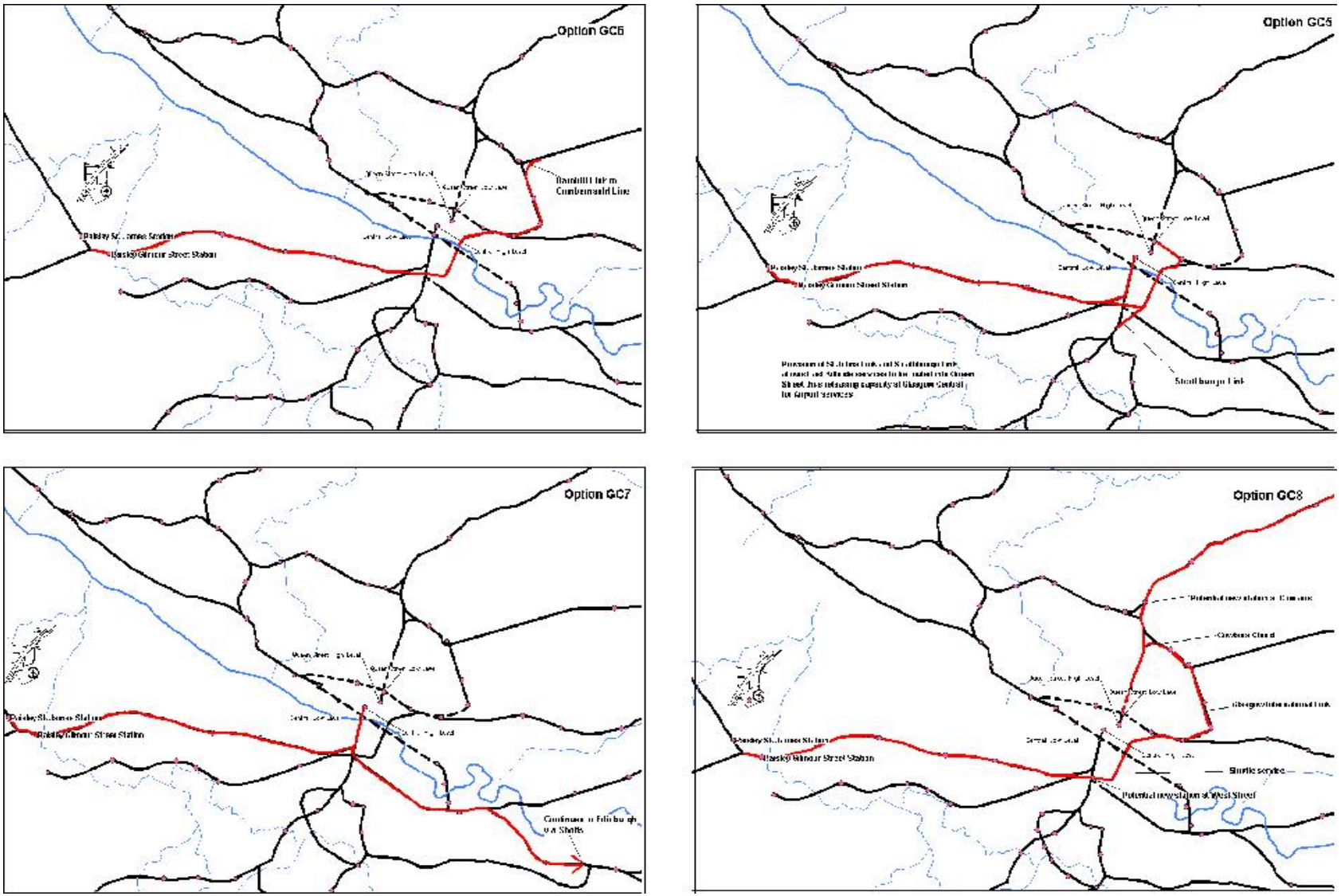




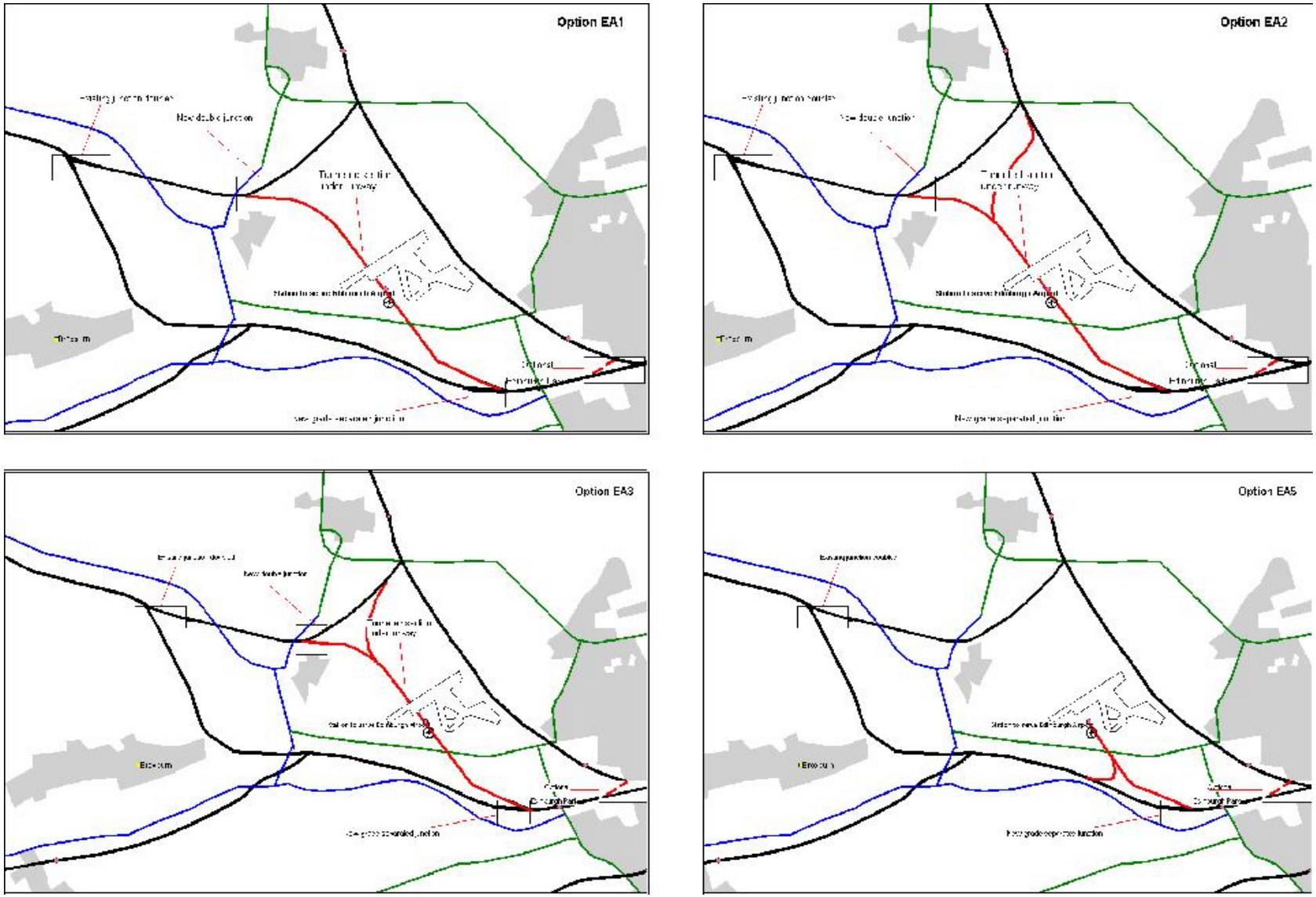
■ **Figure 2-3: Glasgow Centre Infrastructure Option**



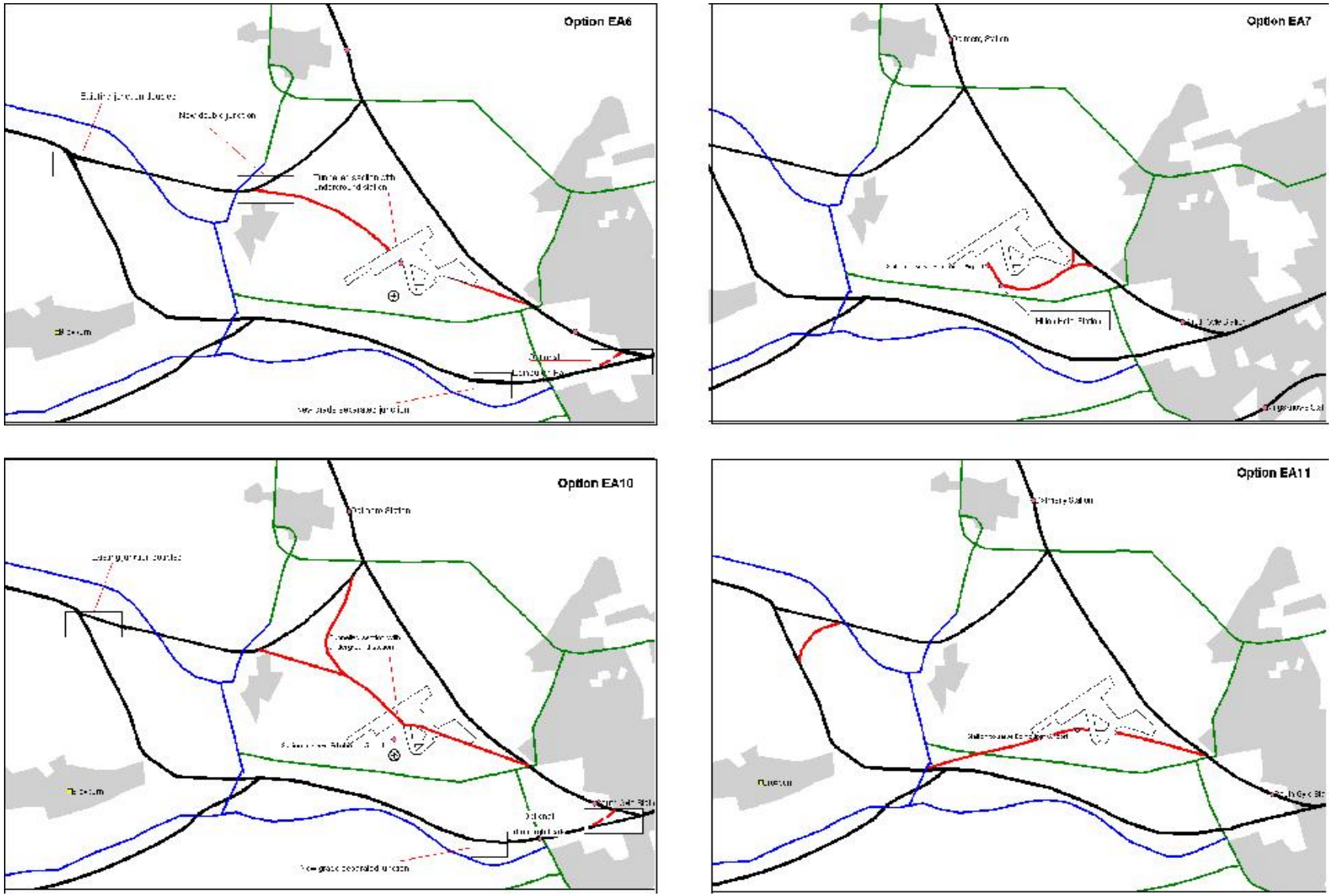
■ **Figure 2-4: Glasgow Centre Infrastructure Options (cont.)**



■ **Figure 2-5: Edinburgh Infrastructure Options**



■ **Figure 2-6: Edinburgh Infrastructure Options (cont.)**



2.3 Conclusions from Phase 1

2.3.1 Background

(15) This section reproduces the conclusions from Phase 1, which led to an initial shortlist of infrastructure options at the two airports and in the centre of Glasgow. This has been updated with findings from the Central Scotland Transport Corridor Studies on the Glasgow cross-city link tunnel as available at the time of our Phase 2 report.

(16) In order for Glasgow Airport to be accessed from the wider rail network, a cross-city link is required as well as a rail link between the Airport and central Glasgow. At Edinburgh, in contrast, the airport is surrounded by main rail lines.

2.3.2 At Glasgow Airport

(17) All the options which would approach the airport from the east at surface level would conflict with the current plans for the development of the Airport. We concluded that, if this issue is regarded as paramount, Options GA2 (Arkleston Branch) and GA3 (via Braehead and Renfrew) should be ruled out from further consideration.

(18) We concluded that, if a fast, direct, non-stopping service is seen as essential, Options GA3 (via Braehead and Renfrew), GA4 (Clyde Tunnel) and GA8 (between Queen Street High Level and Paisley St James via a Clyde Tunnel) should be ruled out.

(19) We concluded that, if significant property demolition is to be avoided, Options GA2 (Arkleston Branch), GA3 (via Braehead and Renfrew) and GA4 (Clyde Tunnel) should be ruled out.

(20) We concluded that, if the need for a complex bridge over the White Cart, of questionable feasibility, is to be avoided, Options GA2 (Arkleston Branch), GA3 (via Braehead and Renfrew) and GA4 (Clyde Tunnel) should be ruled out.

(21) We concluded that, if the poor access provided by either a travelator or people mover into the airport from the rail link is considered unacceptable, Option GA4 (Clyde Tunnel) should be ruled out.

(22) We concluded that, if technical risk, with the attendant potential for cost escalation, were to be a major concern, Options GA2, GA3 and GA4 (all involving a complex bridge over the White Cart), and Options GA4, GA6, GA7 and GA8 (all involving a tunnel of uncertain feasibility) should be ruled out.

(23) At the time of our Phase 1 work, only very broad implementation cost estimates were available for all options. Previous demand forecasting work had shown that, for the best options, revenues would not exceed operating costs by much. In addition, it was considered that the diversions from car were likely to be so small as to make decongestion benefits elusive. Under these circumstances, high capital cost schemes were considered unlikely to be justified. We concluded that, if this is accepted, Options GA4 (Clyde Tunnel), GA6 (via Braehead and Renfrew to Paisley St James partly in tunnel), and Option GA8 (between Queen Street High Level and Paisley St James via a Clyde Tunnel) should be ruled out.

(24) We concluded that, if the amenity and environmental impacts on St James playing fields are considered unacceptable, Option GA1 (Paisley St James) should be ruled out. It was not clear at that time whether the surplus revenues would be sufficient to cover the additional cost of tunnelling under the park, as required by Option GA7.

(25) On this basis, we concluded that Options GA2, GA3, GA4, GA6, possibly GA7, and GA8 would all have significant disadvantages. The disadvantage of Option GA1 was seen to be primarily a matter of local perception and concern but it seemed possible to us that this ***may*** be a less substantial obstacle than those relating to the other options.

(26) We also considered the options from a positive point of view – would any of those options which we had identified as having significant disadvantages also have any significant merits compared with the Paisley St James Option GA1, bearing in mind that we are only considering heavy rail options in this report? Our answer was: only possibly Option GA7.

(27) Our opinion was, therefore, that the Paisley St James Link (heavy rail) Options GA1 and GA7 were to be preferred to the other options at the airport end.

2.3.3 In Glasgow City Centre

(28) The most direct link is to Central Station (Option GC1).

(29) The Strathbungo Link (Option GC5) would free up capacity on the approach to Glasgow Central for use by airport services. What effect this would have on the scale of track capacity improvements required between Shields Junction and Paisley Gilmour Street was unclear.

(30) A link to Queen Street Station could be provided cost-effectively by the St John's Link and, although travel times to and from the Airport would be longer than to Central Station, services to Queen Street would provide access to a range of services north of the Clyde (Option GC2).

(31) A variety of through city services could be enabled by Options GC3, GC6 and GC8, either in their own right or in combination with either the direct link to Central Station or the St John's Link.

(32) Previous work had shown that there is likely to be such a large shortfall in surplus revenues that the City Centre Tunnel (Option GC4) cannot be justified.

(33) A service via Glasgow Central and Shotts to Edinburgh (Option GC7) would involve services running across the throat of Central Station with consequent substantial adverse impacts on capacity. In contrast to other options for links to Edinburgh, it would also bypass Edinburgh Airport.

(34) On this basis, we concluded that the St John's Link and, to a lesser extent, the Strathbungo Link, would enable a wide range of service routeings to be considered (Options GC2, GC3, GC5, GC6 and GC8) and these were the preferred options at the City Centre end, in addition to the direct service to Central Station (Option GC1).

(35) We asked: would Options GC4 and GC7 have any significant merit which would warrant further investigation in Phase 2? In the case of Option GC7, our answer was: no. In the case of Option GC4, the position was seen to be more complicated.

(36) With respect to our Option GC4, MVA drew the following conclusion from their appraisal of the Cross-City Tunnel carried our for SPT and reported in November 2001[1]: "*the high capital costs of the Tunnel, including construction and rolling stock replacement costs, could not be justified by the additional demand and revenues resulting from the options (considered).*". In their final chapter, MVA then recommended that SPT refer this finding (among others) to the Scottish Executive for possible consideration as part of the Central Scotland Transport Corridor Studies (CSTCS) (being carried out by MVA). At the CSTCS Steering Group on 14 February 2002, MVA recommended that, following a STAG Part 1 appraisal, this Cross-City Tunnel be dropped from further consideration. The Steering Group rejected this advice, however, and asked MVA to conduct a more detailed appraisal of the proposal.

(37) A number of rail investment packages has been considered in CSTCS, including, for Glasgow cross-city movements, the Strathbungo Link and greater use of the City Union Line, with the Garngad curve for Cumbernauld services, and the Cross City tunnel (our option GC4). In the final report of each of the Corridors, the CSTCS team concluded:

- "*Both packages, which included cross-Glasgow links in various forms, substantially reduce use of the Glasgow Underground – this is mainly through improved distribution of passengers in Central Glasgow to stations such as Charing Cross and High Street with the new 'metro' style services*"; and
- "*the Cross-Glasgow tunnel does not show a substantially greater impact on rail patronage than the other package, which has less concentrated (but less direct) cross Glasgow links.*".

(38) On the basis of that information, the CSTCS team recommended that:

- "*the public transport plan for the corridors for 2010 should be based around the cross Glasgow links included in Package 2 – **not** the Cross City Tunnel;*
- *the Cross City Tunnel should not be considered further in the Corridor Studies on the basis of the TEE figures and the extended timescale to implementation; and*
- *the pattern of cross Glasgow services should be further considered to maximise interchange opportunities and allow a simple pattern of service to be operated to maximise available capacity.*".

(39) Our (SKM's) view is that the costs of the Cross-City Tunnel are so high that justification by airport-related demand alone is impossible. If a fair view of the merits of the Tunnel is to be reached, it must be considered in its widest possible role and context. Our view, therefore, was that, given the CSTCS findings outlined above (that the case for a Cross-City Tunnel in 2010 was not found to be strong and bearing in mind that the airport link is seen as desirable in that timeframe), we should ***not*** consider our Option GC4 further.

[1] Glasgow Cross-City Rail Link Demand Study, Final Report by MVA for SPT, November 2001

2.3.4 In Edinburgh

(40) We concluded that, if a high service frequency with small additional operating costs and direct access to the wider network of rail services were seen as paramount, options which involve tunnelling under the main runway should be favoured (Options EA1, EA2, EA3, EA6 and EA10). Of these, Option EA3 would perform the same functions as option EA2 with lower costs and conflicts with current land uses. Options EA1 and EA3 would link Edinburgh Park on the Edinburgh-Glasgow (E&G) line with the Winchburgh – Dalmeny line, while Options EA6 and EA10 would link South Gyle on the Fife line with the Winchburgh – Dalmeny line. Options EA1 and EA6 would only allow E&G services to be routed through the airport, whereas options EA3 and EA10 would allow Fife - Edinburgh services to be routed through the airport as well. We concluded that all these options have merit.

(41) We concluded that, if technical risk with the attendant potential for cost escalation, were to be a major concern, the options involving tunnels under the airport (Options EA1, EA2, EA3, EA6 and EA10) should be ruled out. We noted, however, that the feasibility of a tunnel under the main runway had been established to some extent.

(42) We concluded that, if technical risk and costs are to be minimised in the first instance, but the option of developing the rail link into a tunnel under the runway is to be retained, Options EA5 and EA7 should be considered. Of these two, Option EA5 was preferred as it would provide direct access to both Edinburgh and Glasgow, whereas Option EA7 would require a dedicated airport service.

(43) Option EA11 would have the merit of providing all the service connections that the best tunnelled option would provide but without the need for costly and potentially risky tunnel works.

(44) On this basis, we concluded that Option EA5 appeared to be a good first phase which it may be possible to develop into Options EA1 and EA3, and that Option EA7 could be a first phase which it may be possible to develop into Options EA6 and EA10. We concluded that these should all be considered further along with Option EA11 which would provide the same service options but without requiring a tunnel under the main runway.

2.3.5 Recommendations from Phase 1

(45) At the end of Phase 1, we recommended that the following ***infrastructure*** options should be taken forward into Phase 2.

At Glasgow Airport:

GA1: Paisley St James Link at surface level
GA7: Paisley St James Link underground

In Glasgow City Centre:

GC1: Central Station
GC2: St John's Link
GC5: Strathbungo Link
GC3/6/8: Various service options, either alone or in combination with GC1 or GC2

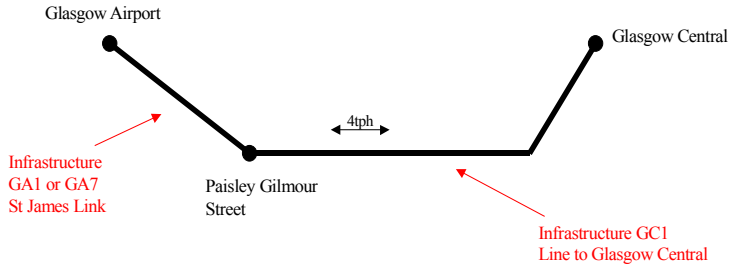
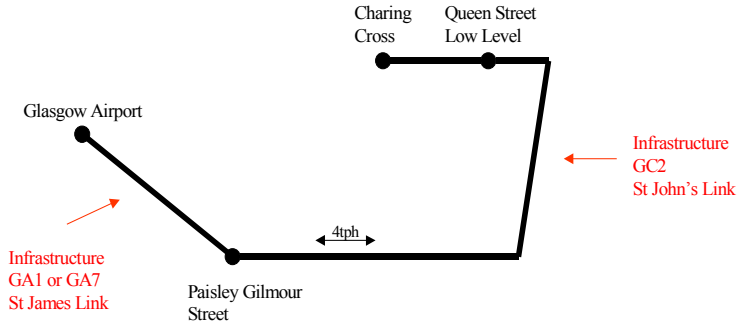
At Edinburgh Airport:

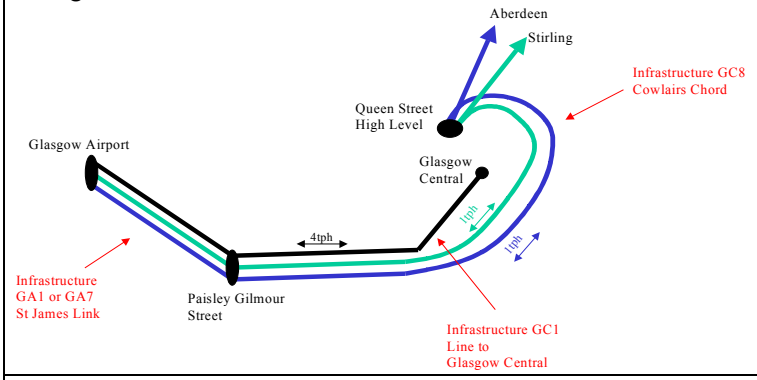
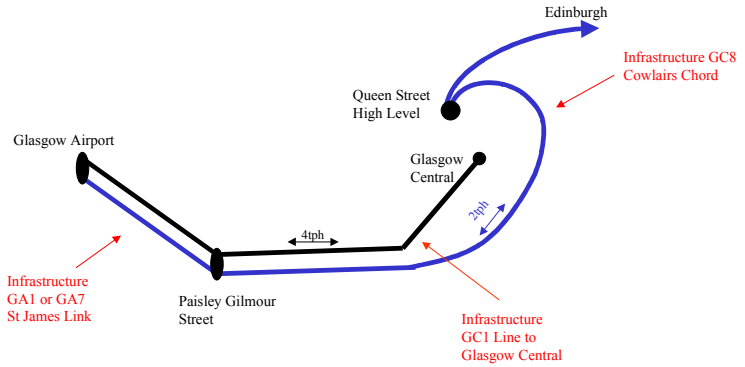
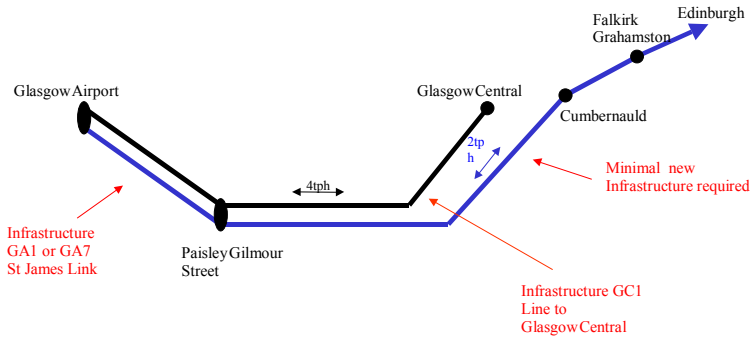
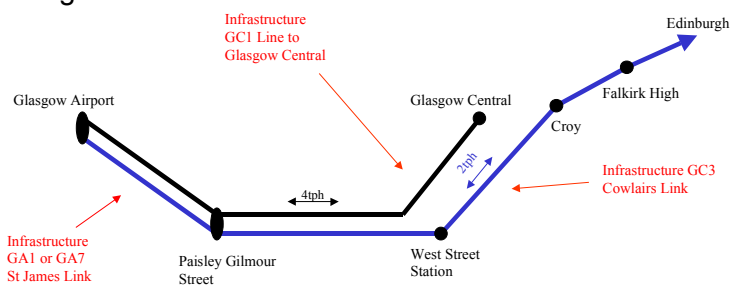
EA5: Edinburgh Park to Airport Spur
EA1: Edinburgh Park to Winchburgh under the Airport
EA3: Edinburgh Park to Winchburgh and Dalmeny under the Airport
EA7: South Gyle to Airport Spur
EA6: South Gyle to Winchburgh under the Airport
EA10: South Gyle to Winchburgh and Dalmeny under the Airport
EA11: Link between Fife and Falkirk Lines via the Airport at surface level

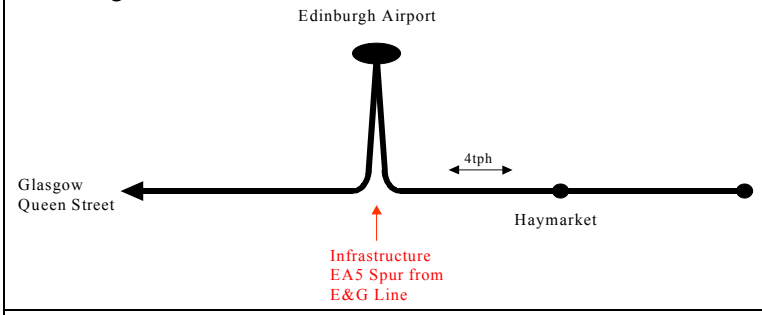
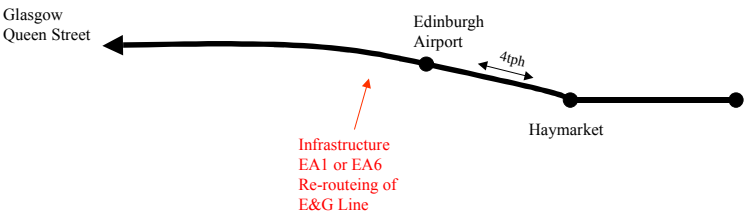
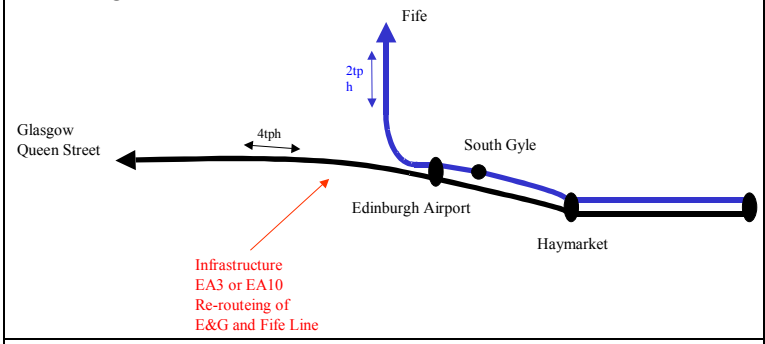
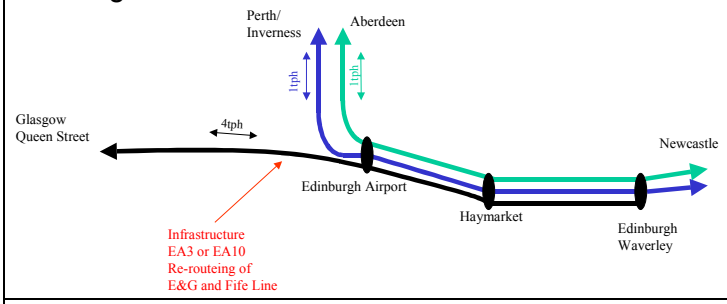
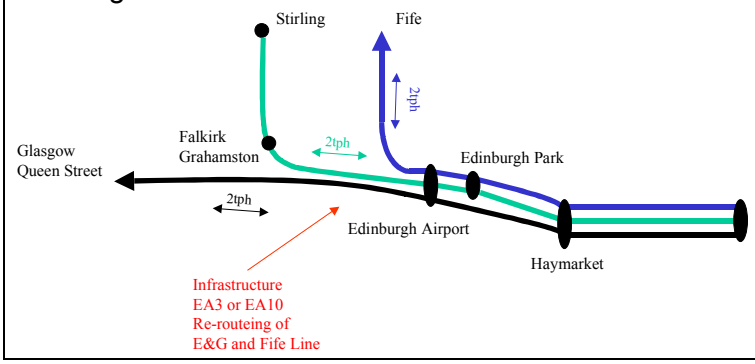
2.4 Phase 2 Options Summary

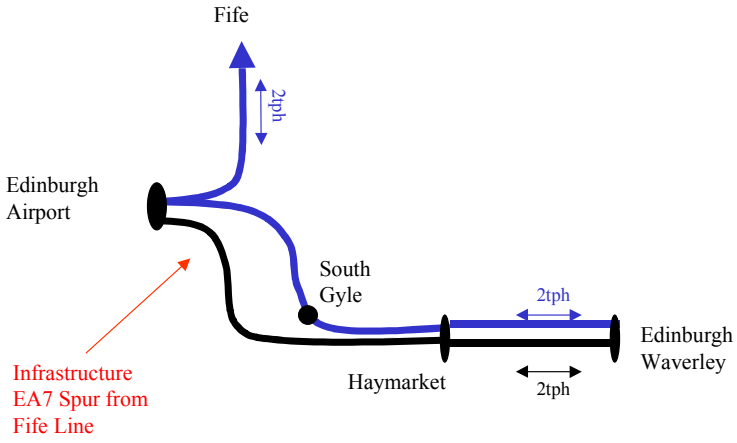
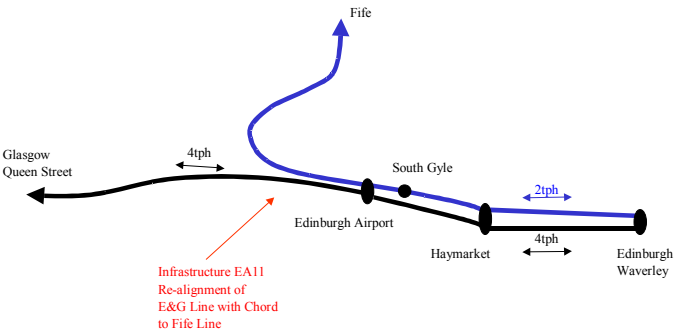
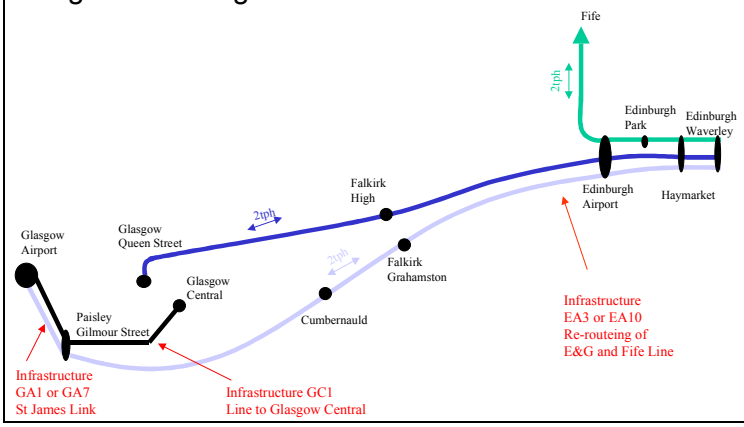
(46) In Phase 2, the infrastructure options were developed into service options. Capital and operating costs were derived for these options and a single-year demand forecast was prepared. Table 2.4 summarises the indicative cost estimates and revenue forecasts for the service options defined for Phase 2 of the study. We concluded that, in some cases, variations of the options should be considered, as noted below.

■ **Table 2-4: Cost and Revenue Summary**

Scheme Option	Capital Cost (£m)	Operating Cost (£m pa)	2010 Patronage, Air Pax (million Trips pa)	2010 Revenue from Air Pax (£m pa)
Glasgow 1 	85.5 (GA1) or 220.0 (GA7)	3.14	0.47	2.64
Glasgow 2 	103.5 (GA1) or 238.0 (GA7)	3.45	0.45	2.52

Glasgow 3 	104.5 (GA1) or 239.0 (GA7)	5.50	0.55	3.08
Glasgow 4 	104.5 (GA1) or 239.0 (GA7)	5.41	0.56	3.06
Glasgow 5 	86.0 (GA1) or 220.5 (GA7)	6.84	0.60	3.25
Glasgow 6 	102.5 (GA1) or 237.0 (GA7)	6.97	0.59	3.04

Edinburgh 1 	42.5	0.75	1.49	5.70
Edinburgh 2 	226.0 (EA1) or 211.5 (EA6)	0.15	1.53	5.89
Edinburgh 3 	228.5 (EA3) or 214.0 (EA10)	0.87	1.74	6.18
Edinburgh 4 	228.5 (EA3) or 214.0 (EA10)	8.04	1.96	7.25
Edinburgh 5 	228.5 (EA3) or 214.0 (EA10)	0.87	1.78	6.43

Edinburgh 6 	23.0	1.44	1.49	5.32
Edinburgh 7 	86.5	1.55	1.30	4.54
Glasgow-Edinburgh 	86.0 (GA1) or 220.5 (GA7) & 228.5 (EA3) or 214.0 (EA10)	7.64	2.28	10.92

2.5 Phase 2 Conclusions for Glasgow

2.5.1 The Study Team's Initial Recommendations

(47) Using the information available at the end of May 2002, the study team drew the following conclusions.

(48) Option 1 (4 tph airport to Glasgow Central) is the only option where revenues would come near covering operating costs. It would also have the lowest capital costs. So we considered that Option 1 must be on the shortlist for Phase 3.

(49) There appeared to be little advantage over Option 1, from an airport user's point of view, in looping round to Queen Street Low Level (Option 2). Compared with Option 1, capital and operating costs would be higher and revenue lower. However, none of the infrastructure or service options developed at Glasgow would be fundamentally incompatible with a routeing of services to Queen Street Low Level. If the infrastructure of the St John's link were to be justified separately, and/or the lack of platform space at Glasgow Central precluded Option 1, Option 2 could be usefully examined further.

(50) Of the through running options, we identified two broad "families":

- services via Queen Street High Level; and
- services bypassing the centre of Glasgow altogether.

(51) None of the through running options would cover their operating costs. They would all generate broadly similar revenue levels. Their relative merits would be as follows:

- options via Queen Street High Level (Options 3 and 4) would incur the capital cost of doubling the Cowlairs Chord, but operating costs would be restricted to the section between the airport and Queen Street only as they would take over existing services beyond Queen Street; and
- options for bypassing Glasgow (Options 5 and 6) would incur smaller additional capital costs, but their operating costs would be higher as there is no existing service to take over.

(52) Based on the revenues generated by the airport users alone, we concluded that there would be little merit in pursuing these options if even the cheapest services to operate (via Queen Street High Level) do not cover their operating costs. Compared with Option 1 (Glasgow Central only), these options would increase operating costs by more than the additional revenue they generate.

(53) Our initial conclusion, therefore, was that only Service Option 1 (services to Glasgow Central) should be shortlisted for further consideration in Phase 3.

(54) We saw no case initially for pursuing airport services via the St John's Link to Queen Street Low Level (Option 2), unless it emerged that there is insufficient platform space in Glasgow Central for the airport services.

(55) However, there were some further considerations relating to line capacity between Shields junctions and Paisley Gilmour Street, station capacity at Glasgow Central, and the potential for the infrastructure cost of the St John's link to be borne by other projects. These issues were explored further following the submission of the draft Phase 2 report and some important conclusions are outlined below.

2.5.2 Stakeholders' Perspective

(56) A summary of the options and the study team's initial conclusions were presented to a stakeholder workshop in Glasgow on the 5th of June 2002. Specifically on the Glasgow options, the following comments were made.

(57) The issue of platform capacity at Glasgow Central is clearly a key consideration in what had now emerged as the front runner option. The consensus at the stakeholders' meeting appeared to be that the removal of some existing services from Glasgow Central was preferable to any major infrastructure works at the station. Strathbungo Link and the St John's Link were suggested as a way of rerouting East Kilbride services, thereby releasing platform capacity at Central Station.

(58) ScotRail's preferred option was to run 4 tph between Glasgow Airport and Glasgow Central, plus some longer-distance services to the airport. Capacity at Glasgow Central should be resolved by diversion of (probably) the Whifflet and Paisley Canal services. Four tracks should be provided as far as possible between Paisley and Glasgow, with a grade-separated junction for the airport branch.

(59) SRA and Railtrack wanted to see the platform issue at Glasgow Central resolved. Their preferred option was for 4 tph between Glasgow Airport and Glasgow Central and they considered that low cost ways for connecting longer-distance services should be investigated.

(60) SPT saw services to Glasgow Central as the frontrunner option, but would still have liked to retain the option of running the Queen Street Low Level via the St John's Link.

2.5.3 Further Investigations

(61) Following the initial recommendations of the study team, and the comments offered by the stakeholders' group, a number of meetings were held to explore further some of the issues highlighted above. These included meetings of the whole Steering Group, of the study team with some Steering Group members, and of the study team with Railtrack, SPT and ScotRail. During a meeting on the 1st of August on the issue of Glasgow Central capacity, the following position has emerged.

(62) The capacity of Glasgow Central Station is a key issue, which has no easy or obvious solution. A resignalling of the station was being designed and negotiated with the Railway Inspectorate and the Health and Safety Executive. During this process, it emerged that the only way to preserve the current capacity of Glasgow Central station is a replacement of equipment, whilst retaining the existing layout of the signalling system. Any changes to the station layout (such as adding a new platform) would require a complete redesign of the station signalling to current standards, which would reduce capacity. So, adding a platform to the station would actually *reduce* its capacity. Even if a new platform was combined with an extra bridge across the Clyde, it is likely that the combination of constraints in the station throat and modern signalling standards would restrict overall station capacity at the current level.

(63) The conclusion from these meetings was that the removal of existing services from the station was the only realistic option. However, such removal would be contingent on a number of other infrastructure schemes, including the Strathbungo Link, the St John's Link, a turnback siding at Yokerhill and various electrification

schemes, along with a number of changes to services to make use of the new infrastructure.

(64) Furthermore, the scheduling of a 4tph *regular* airport service may require the removal of more than 4tph of existing services, and even then it may be difficult to dedicate one platform to airport services. It was recognised, however, that the possibility of using platform 11A (the little used platform outside the train shed) may be worthwhile. This may provide a dedicated platform for airport services, but it would not be a very convenient or visible platform for air passengers to use, nor would it provide a solution to the capacity problems at Glasgow Central station (its only benefit would lie in providing a dedicated platform for airport services). It was noted that platform 11A is needed in normal operation for breakdowns and emergencies.

2.5.4 Steering Group's Conclusions

(65) Following the recommendations of the study team, the comments offered by the stakeholders' group and the further investigations undertaken at the end of Phase 2, the Steering Group came to the following conclusions.

(66) The key to Option 1 is clearly Glasgow Central platform capacity. It was thought that this issue would not be fully resolved by this study. Nevertheless, the option should be taken forward into Phase 3.

(67) Option 2 was seen as attractive because it offers interchange opportunities to onward connections at Queen Street. It can also serve as a fall-back option if the capacity issues at Glasgow Central cannot be resolved.

(68) There is a long-standing aspiration by various stakeholders to provide direct services between Paisley and the Ayrshire lines in the west, and destinations to the east and north of Glasgow. The benefits to non-airport related travellers may therefore help to justify longer-distance services from Glasgow Airport. If such services are to be attractive to non-airport users, they need to be fast and direct, which points to either Option 5 or 6 in preference to Option 2 or 4.

(69) The difference between Options 5 and 6 was relatively marginal and the choice between the two options could be affected by the scale of benefits to non-airport users. The Steering Group asked the study team to outline further the relative merits of Service Options 5 and 6.

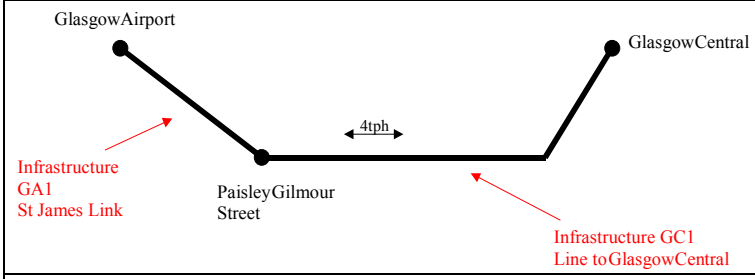
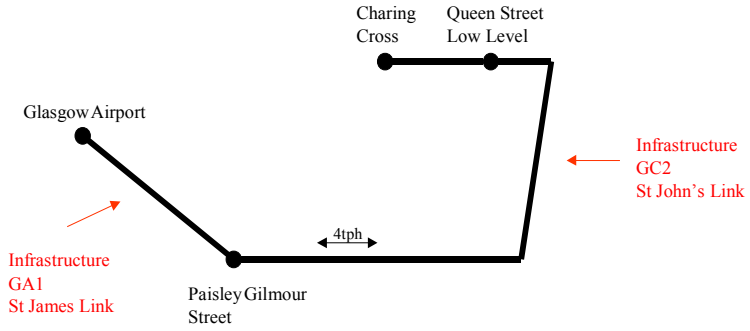
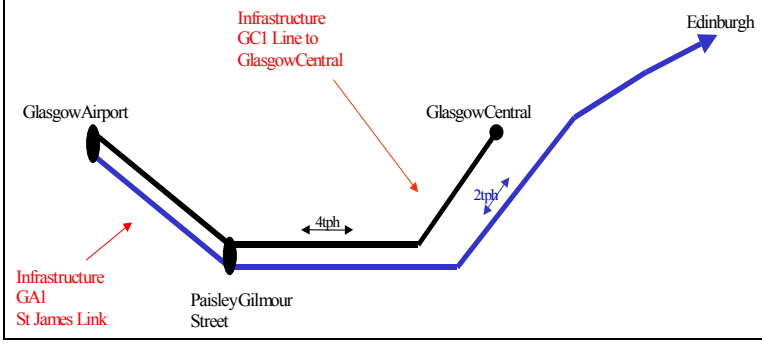
(70) Despite a faster journey time and the presence of West Street station, Service Option 6 performed less well than Service Option 5. It would require higher capital expenditure and would incur slightly higher operating costs. In our initial forecasting, it also generated slightly less revenue than Option 5. In addition, there may be more severe capacity problems with use of the main Edinburgh & Glasgow line via Croy and Falkirk High in this option, compared with Option 5 which would runs via Cumbernauld and Falkirk Grahamston. We therefore saw the routeing via Cumbernauld as preferable. However, there is a further complication here in that there are two options for routeing trains via Cumbernauld:

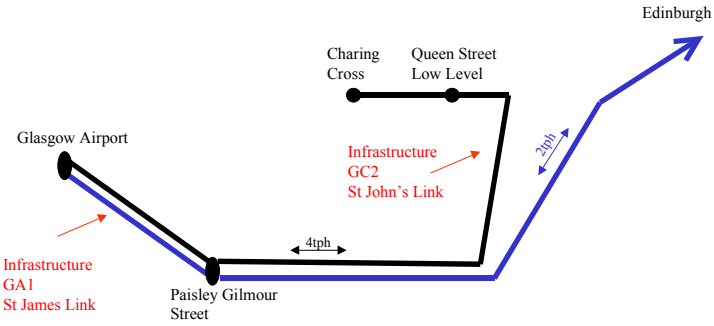
- using the Clydesdale Lines, Rutherglen & Carmyle Line to Coatbridge and Cumbernauld; and

- using the City and Union Line, to Bellgrove, Garngad Curve, Stepps and Cumbernauld.

(71) When Service Option 5 was defined at the beginning of Phase 2, it had been assumed that the Carmyle line could be upgraded at minimal cost to provide a journey time comparable to the routeing via the City and Union Line. Further investigation of the engineering feasibility indicated that cost-effective solutions to an upgrade of the Carmyle line are unlikely and the costing above includes only minimal upgrades, to make the routeing of passenger trains possible across some sections of line which are currently used by freight services only. Depending on capital costs, a routeing via the City and Union Line and Bellgrove may therefore be preferable, as this would offer better journey times and the potential for providing an interchange station with Glasgow Underground at West Street.

(72) After detailed consideration of the available information, the Steering Group concluded that the study team should take four options at Glasgow into Phase 3. For ease of reference, these were now no longer numbered but named.

	**GLASGOW CENTRAL** Service option 1: 4 tph to Glasgow Central, using infrastructure options GA1 and GC1
	**QUEEN STREET** Service option 2: 4tph to Queen Street Low Level, using infrastructure options GA1 and GC2
	**GLASGOW CENTRAL PLUS** Service option 1: 4 tph to Glasgow Central, using infrastructure options GA1 and GC1, plus 2tph longer distance service based either on service option 5 (services to Edinburgh via Carmyle) or service option 6 (services to Edinburgh via Cowlairs)



QUEEN STREET PLUS

Service option 2: 4tph to Queen Street Low Level, using infrastructure options GA1 and GC2, plus 2tph longer distance service based either on service option 5 (services to Edinburgh via Carmyle) or service option 6 (services to Edinburgh via Cowlairs)

(73) The issue of platform capacity at Glasgow Central remained unresolved at this stage. It was thought that, for appraisal purposes, while highlighting the issue, we might have to leave to one side the question of whether a way could be found to provide sufficient capacity at the station through the re-routeing of other services. The appraisal might therefore be partial, but it would able to indicate what kind of costs for the provision of capacity at Glasgow Central the scheme would support.

(74) For the longer-distance service, there is still a choice of routeing, which was to be clarified during Phase 3 in further discussions with Railtrack. Phase 3 was then to appraise the route which shows most promise.

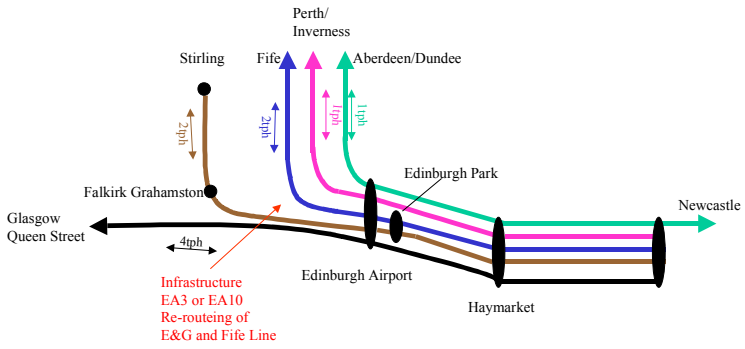
2.6 Phase 2 Conclusions for Edinburgh

2.6.1 The Study Team's Initial Recommendations

(75) Using the information available at the end of May 2002, the study team drew the following conclusions.

(76) At Edinburgh, the highest revenue would be generated by the full through running scheme with services to Aberdeen and Newcastle (Option 4). Option 5 (services to Fife and Stirling, in addition to Glasgow) would perform better than Option 3 (services to Fife and Glasgow only), so it must be beneficial to route as many services via the Airport as possible if we were to adopt the infrastructure option which allowed through running with no additional journey time to Glasgow and little additional time to Fife.

(77) So, a combination or further development of Options 4 and 5 was considered to be one front runner. The following table outlines how such an option may be composed and what its indicative costs and revenues would be.

Scheme Option	Capital Cost (£m)	Operating Cost (£m pa)	2010 Patronage, Air Pax (million Trips pa)	2010 Revenue from Air Pax (£m pa)
Edinburgh 4/5 Hybrid 	228.5 (EA3) or 214.0 (EA10)	2.63	2.11	7.71

(78) This assumes that services between Aberdeen and Newcastle can be provided by using existing services re-routed via the Airport, and therefore operating costs would be relatively low. Additional work was to be undertaken in Phase 3 to optimise this option.

(79) Option 7 (routeing both E&G and Fife services via the airport without tunnelling under the runway) would perform less well than any of the spur options which would be significantly cheaper. This is as a result of both the additional journey time (especially to Fife) and the extra access time at the Airport, where the station would be less accessible than with other options.

(80) Of the spurs, Option 6 (spur off the Fife line) was thought to be only attractive in cost terms if the Turnhouse runway can be abandoned. We were given to understand that this is not likely to be the case in the foreseeable future.

(81) That left Option 1 (Spur off the E&G line) and Option 2 (re-routeing of the E&G line only under the runway). In comparing the two, Option 1 would perform almost as well as Option 2 for air passengers, while incurring substantially lower capital costs. The other difference is that Option 1 would generate disbenefits to others because it would increase the journey time between Edinburgh and Glasgow. However, these disbenefits may not be sufficient to outweigh the significant cost savings compared with a full through running scheme.

(82) We concluded therefore that the Edinburgh shortlist for further consideration in Phase 3 should contain three schemes:

- Option 1, or a variation of it which minimises impacts on the E&G line;
- Option 2 (full diversion of the E&G line through the Airport); and
- a development of Options 4 and 5 (diversion of both the E&G and the Fife line through the Airport), running the fullest possible service through the Airport.

(83) These could either represent three separate options or a staged implementation. There were two further considerations, however.

(84) There are two separate infrastructure options which enable service Options 2 or 4/5:

- EA1 or EA3, where services connect from the E&G line; and
- EA6 or EA10, where services connect from the Fife line.

(85) Similarly, it would be possible to develop an infrastructure variant to EA5, to enable Service Option 1, which connects from the Fife line instead of the E&G line. On assumptions current at the time, connecting from the Fife line would be some £15m cheaper than connecting from the E&G line. This assumes that a connection with the Fife line can be achieved with a flat junction. We thought that we needed to further consider operational issues, and seek further feedback from other stakeholders before reaching a view on the relative merits of either connecting from the Fife or the E&G line.

(86) The second consideration is the approach to the Airport for the spur Option (1). The cheapest approach would be at surface level. If Option 1 were to be implemented as a first stage to Option 2, then it would be desirable to implement the final approach to the Airport with an underground station suitable for onward connection under the terminal building and runway.

2.6.2 Stakeholders' Perspective

(87) There was general consensus among stakeholders that a full through running scheme based on a combination of Service Options 4 and 5 would be desirable if its viability can be proven. Specifically, the following preferences were expressed.

(88) ScotRail's preference at Edinburgh was for a full scheme with 4 tph to the west and 4 tph to the north: 2 tph to Glasgow, 2 tph to Stirling/Dunblane, 2 tph round the Fife Circle, 1 tph to Dundee and 1 tph to Aberdeen.

(89) Railtrack acknowledged that the spur option looked the cheapest superficially, but Railtrack were looking for schemes which provide other benefits and revenues. The airport traffic should be "the icing on the cake".

(90) The SRA favoured a phased development, starting with a spur option and then examining through running depending on the timing of airport growth.

(91) Stakeholders had strong views on Option 1, and in particular its impact on the existing E&G line. In addition to the passenger disbenefits and potential loss of revenue on the E&G line, there would be timetabling difficulties with services stopping at the airport. The journey time increase would also run counter to recent developments and aspirations on this important corridor. The service has been enhanced recently and is due to be enhanced further.

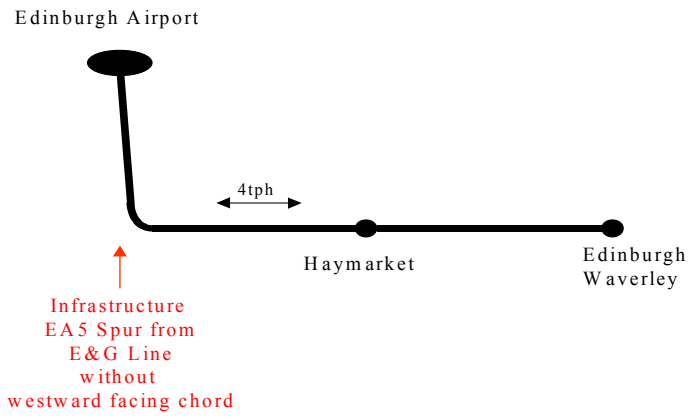
(92) Stakeholders regarded the disbenefits associated with Option 1 as unacceptable.

(93) We therefore considered a variation called Option 1a/2a, in which a 4 tph shuttle service would run between the Airport and Edinburgh Waverley only. This would avoid the infrastructure for a west facing chord. It would offer fewer journey

opportunities for airport users than Option 1, and would incur higher operating costs as it would use dedicated services. However, it would be cheaper to build than Option 1, it would avoid disruption to existing Glasgow services, and it could serve as a first stage to a larger through-running scheme.

(94) Option 1a is a simple surface level variant of Option 1. Option 2a assumes an underground alignment, which would be consistent with providing an onward connection under the runway as in Option 2 at a later stage.

(95) Indicative cost, patronage and revenue forecasts for such a scheme variant are outlined below.

Scheme Option	Capital Cost (£m)	Operating Cost (£m pa)	2010 Patronage, Air Pax (million Trips pa)	2010 Revenue from Air Pax (£m pa)
Edinburgh 1a/2a 	30.0 at surface or 119.0 underground	3.10	1.39	5.37

(96) This shows that, despite the additional operating costs, a simple shuttle service at Edinburgh would have the potential to cover its operating costs. The scheme would have modest capital costs if constructed at surface level. Underground construction of the final approach to the Airport in preparation of an extension under the runway at a later date would increase the capital costs substantially.

2.6.3 Further Investigations

(97) Both Service Options 6 and 7, as originally envisaged with the information available at the time, would conflict with the operation of the Turnhouse Runway. However, in the interest of finding a viable lower cost solution, both BAA and DfT wanted to explore further how these options could be refined.

(98) This showed that both options are capable of realignment to avoid the Runway End Safeguarding Area (RESA) of the Turnhouse Runway. This makes both options identical at the eastern end (the turn-out from the Fife line). The RESA and airport safeguarded surfaces can be avoided, even allowing for safeguarding for future overhead equipment.

(99) However, the northward-facing spur to the Fife line in Service Option 6 would not be possible at surface level without affecting the RESA. A redesigned Option 6 would therefore enable a shuttle service between the Airport and Waverley only.

(100) An initial redesign of Option 7 to respect both the RESA and the Airport's future expansion plan would place the station at some 450m from the southern edge of the current terminal building (just under 700m from the current terminal entrance).

2.6.4 Steering Group's Conclusions

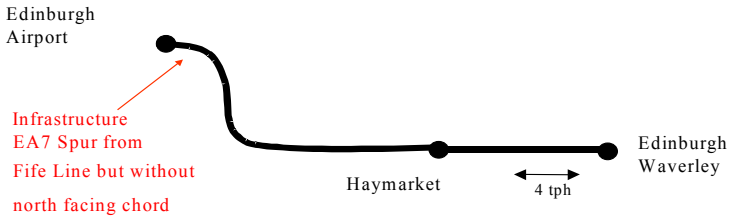
(101) Following the recommendations of the study team, the comments offered by the stakeholder group and the further investigations undertaken at the end of Phase 2, the Steering Group came to the following conclusions.

(102) The Steering Group had reservations about the shuttle Service Options 1a and 6a. The lack of longer-distance services would clearly be a drawback, as would be the need to schedule additional trains between the Airport and Edinburgh Waverley, on a corridor which is already capacity constrained. However, it was felt that these options should be retained, either as a cheaper alternative or as a first stage to a full through running scheme. The issue of capacity at Edinburgh Waverley and its approaches was to be explored further with Railtrack during Phase 3.

(103) In considering the through running options, the Steering Group felt that the large capital expenditure of a runway tunnel may only be justified if it allowed the fullest possible train service (Option 4/5). In comparison with the cost of the tunnel, the incremental expenditure for a chord to the Fife line would be very small. The Steering Group therefore felt that Service Option 2 (which incurs the cost of the runway tunnel but does not enable services to run to Fife and the North) was not worth pursuing further.

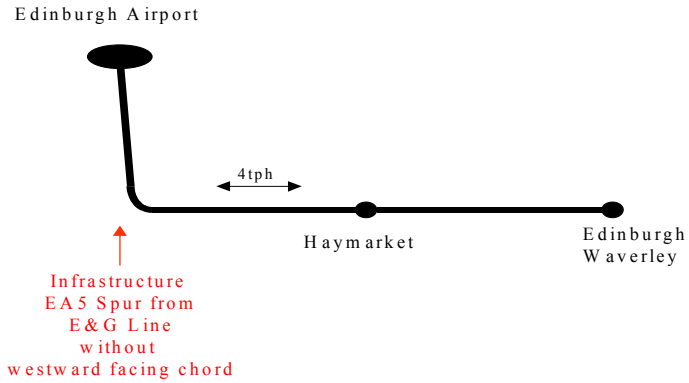
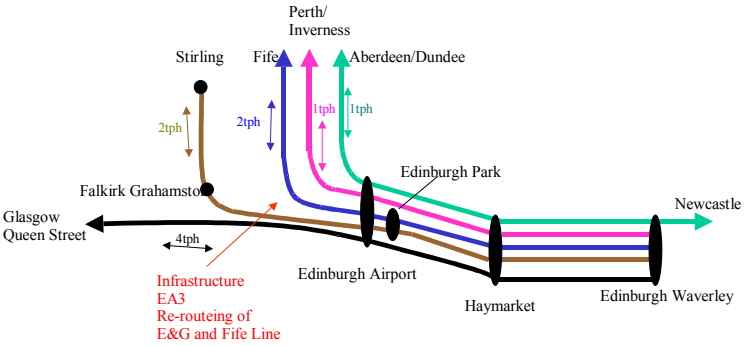
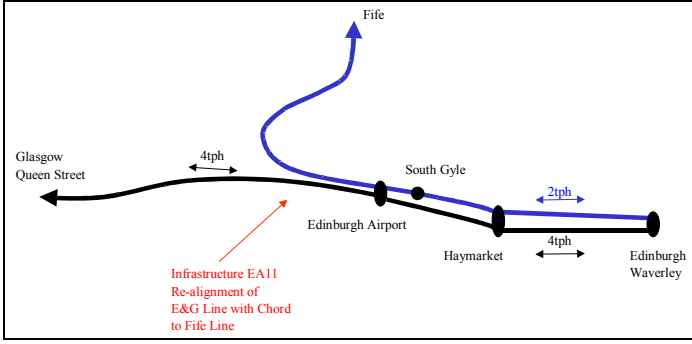
(104) It was considered that Service Option 7, if it could be brought no closer to the terminal entrance than 700 metres, would be unattractive. However, the Steering Group wished to undertake some further work to ascertain whether or not this option could be optimised at reasonable cost.

(105) The shortlist at Edinburgh therefore consisted of up to four schemes; it was recognised that one of these could drop out after further investigation.



FIFE SPUR

Service option 6a: 4 tph shuttle service between Edinburgh Airport and Edinburgh Waverley, using infrastructure option EA7, but without the northward facing chord

	**E&G SPUR** Service option 1a: 4 tph shuttle service between Edinburgh Airport and Edinburgh Waverley, using infrastructure option EA5, but without the westward facing chord
	**Runway Tunnel** Combination of service options 4 and 5, running the fullest possible service through an airport station, using infrastructure option EA3
	**E&G Diversion** Service option 7, using an optimised version of Infrastructure option EA11

(106)It was acknowledged that, during Phase 3, we would need to explore further the operational implications of the spur options. It was assumed at this stage that, if the spur were to remain the only rail scheme, then a spur off the Fife line would be preferable on cost grounds. This would be at surface level. The E&G spur would be preferable if it were to form the first stage of the runway tunnel scheme. This would approach the Airport underground.

(107)Whilst the Runway Tunnel Scheme could theoretically be achieved via an approach from the Fife line, it was assumed that the need to provide services to the new Edinburgh Park station (in a situation where the majority of services would be routed through the Airport) would necessitate an approach from the E&G line.

(108)The E&G Diversion scheme attempts to provide access to the Airport for through-running services without the need to tunnel under the runway. It was acknowledged that further investigations were needed to ascertain whether a sufficiently attractive alignment (and station location) could be derived whilst protecting current airport operations and safeguarding future expansion plans. Thus, depending on the outcome of these investigations, this option would or would not be taken forward.

3. Characteristics of Shortlisted Options

3.1 Background

(109) In Phase 2, we concentrated on compiling sufficient information for each option to enable an indicative STAG Part 1 appraisal. The emphasis was on comparability of information on each option to inform a shortlisting process. In chapter 2, we have outlined the options generation and shortlisting, leading to the selection of four options at each airport.

(110) A number of further, more detailed, investigations were undertaken for each option during Phase 3. The results of these are summarised below for each of the eight shortlisted options under four broad headings:

- Railtrack advice;
- environmental issues;
- planning and land use issues; and, specifically for the Edinburgh options,
- major risk factors as outlined below.

(111) In Edinburgh, there are three key issues which could potentially threaten the project feasibility, either because they cannot be resolved technically, or because their resolution would make the project prohibitively expensive. These are:

- for the Runway Tunnel option, the risk of diesel operation in a tunnel under the runway not being acceptable to the HM Railway Inspectorate;
- for the Spur options, the risk that capacity for extra train paths for shuttle service options cannot be made available at Edinburgh Waverley and its approaches; and
- for the E&G Diversion option, the risk that taking land currently occupied by the Royal Highland Showground would be politically unacceptable and/or prohibitively expensive.

(112) In addition, we have explored the extent to which some of the infrastructure costs in Glasgow can be assumed to be borne by other projects.

(113) As part of the planning assessment, we had indicative land valuations undertaken for all options to provide estimates of costs for the required property acquisition.

(114) The planning and environmental advice has also been fed into the appraisal summary tables. The details of Railtrack's advice to the study team can be found in appendices A (for Glasgow) and B (for Edinburgh). The environmental baseline reports for Glasgow and Edinburgh are included in appendices C and D respectively. Appendices E (for Glasgow) and F (for Edinburgh) contain the report on planning and land use issues, including detailed site-specific information sheets.

3.2 Glasgow Options

3.2.1 Background

(115) All Glasgow options would follow the same alignment at the Airport, the "St James Link", and the routeing along the Inverclyde and Ayrshire lines between Paisley St James and Shields Junction. Issues pertaining to this common alignment are

described below, before the individual options for routeings in and beyond the City Centre are discussed in more detail.

(116)Common to all Glasgow options are the potential environmental mitigation measures which could be adopted. Elevated sections of new alignment would be visually prominent. Viaduct and embankment design should be of high architectural design quality and materials finish. Embankments should provide opportunity for new habitat creation and local biodiversity enhancement.

3.2.2 Shields Junction to Glasgow Airport

3.2.2.1 Scheme Summary

(117)The common section of route extends from Shields Junction (2.7 kms from the west side terminal platforms at Central Station) through Cardonald (6.1 kms) and Arkleston Junction (10.0kms) to Paisley Gilmour Street (11.7 kms). There are already three stations in this section and proposals for at least one more. In the peak hours, the section is already used to its full capacity with some non-stop trains forced to slow down because they cannot overtake trains stopping at the intermediate stations.

(118)In the past, the whole route from Shields Junction to Paisley Gilmour Street was four tracks, apart from a short section in rock cutting immediately east of Arkleston Junction. Most of it was reduced to two tracks at or before the time of electrification. From Shields Junction to Cardonald, subsequent construction of the M8 Motorway, which is built over the railway at two critical locations, makes it impossible to reinstate both of the former tracks. However, it would be possible to install one additional track, making a total of three. The extra track would be signalled for bi-directional operation and would be used on a tidal flow basis at different times of each hour. In addition, as well as the additional trackwork, the masts for electrification of the existing tracks would need to be relocated and Overhead Line Equipment (OLE) infrastructure replaced.

(119)From Cardonald to Paisley Gilmour Street, the former tracks could be reinstated on their previous alignment, subject to HM Railway Inspectorate approval of sub-standard lateral spacings to current standards. The cutting could be widened east of Arkleston Junction, the Goods Loops west of this junction could be up-graded and one of the former tracks could be reinstated at Wallneuk Junction east of Paisley Gilmour Street. All of the work described above would more than double the present route capacity. As well as the additional trackwork, the masts for electrification of the existing tracks would need to be relocated and Overhead Line Equipment infrastructure replaced.

(120)The airport spur would leave the Inverclyde Line east of Paisley St James Station, to cross Murray Street, the former Goods Yard north of St James Station, and Clark Street. It would then run on viaduct over Clark Street and parallel to Greenhill Road but behind Dobies Court before crossing McFarlane Street and the A726 onto the St James Playing Fields. After running diagonally across the Playing Fields, the rail link would cross the M8 Motorway and its parallel slip roads at the south end of St Andrews Crescent and would then curve round past the Tank Farms to terminate between the Terminal Building and the new multi-storey car park.

(121) In our scheme costing, we have assumed that the St James Rail Link would be double track throughout and that it would terminate at a two-track station. In summary, the engineering works required to implement the airport link and provide the required train capacity between Paisley Gilmour Street and Shields Junction includes the following:

- 3 and 4 tracking throughout corridor including OLE, signalling and telecommunications;
- civil/structural works to a rock cutting, an underbridge, an overbridge and a footbridge;
- improvements at Wallneuk and Shields Junctions;
- double track railway infrastructure between Paisley St James and the Airport, including overhead line equipment, signalling & telecommunications;
- a flat double junction with existing line;
- an elevated alignment (on viaduct) over St James' playing fields, the M8 and the airport site; and
- an elevated station south of the airport terminal building.

3.2.2.2 Railtrack Advice

(122) Railtrack have not commented specifically on the spur line between Paisley St James and the Airport. There are no issues related to the operational practicality of this section.

(123) For the section between Paisley Gilmour Street and Shields Junction, Railtrack have confirmed that the introduction of an additional 4 tph from the Airport to the existing service level would be "*completely impractical for an operationally robust timetable*." Railtrack have concluded that "*enhancement of the infrastructure over this corridor is therefore considered to be a pre-requisite to the operation of the proposed airport services.*".

(124) Railtrack have recommended "*an examination of the lateral clearances throughout the corridor to identify where there are insurmountable constraints on the provision of the additional tracks proposed.*". Railtrack have outlined a number of solutions which would provide the additional capacity and which are also compatible with the engineering developed for our costing.

(125) The upgrade of an existing line, involving the removal and replacement of the existing electrification, would clearly cause major disruption. We have made a significant allowance for Railtrack Possession and Train Operating Companies (TOC) Compensation costs, amounting to 20% of capital costs for each of these items. We have consulted with the SRA and Railtrack on these assumptions and Railtrack have commented as follows:

> *"We are gradually building up local experience on the level of TOC compensation payable from major disruptive possessions under the new payment arrangements, but unfortunately we have no instances of such works on this corridor or of works on a similar scale elsewhere in Scotland from which comparisons could be drawn.*
>
> *Although the proposed works have a high interaction with the existing network, we would anticipate that through careful phasing of the work it should be*

possible to undertake it in such a manner that the disruptive effect is minimised by maximising the amount of work undertaken in a Green Zone. There is a lot of width available in the former four track formation to allow work to be phased in a north to south or vice versa manner with intermediate changeovers between phases.

Although we cannot quote a firm figure for the reasons outlined above, a 40% mark up seems very high, and we would suggest that a 20% total figure is likely to be more appropriate.".

(126) We have therefore revised our original Phase 2 costs downwards to include an allowance of 10% each for Railtrack Possession and TOC Compensation costs.

3.2.2.3 Planning Issues

(127) The key planning issues for this alignment clearly lie with the St James Link. All the capacity enhancements between Shields Junction and Paisley Gilmour Street are contained within existing railway operational land. No land purchase would therefore be required until immediately before the station at Paisley St James.

(128) The land take in that area can be roughly summarised into three categories:

- industrial uses;
- leisure uses; and
- airport uses.

(129) Of these, the industrial properties in the Murray Street Industrial Area should be readily obtainable, although each business would seek relocation costs. The area is also designated as an industrial improvement area and Renfrewshire Council have provided many of the local businesses with grants and financial assistance towards property and business improvements. The Council would be reluctant to see any businesses lost to the area and would wish to see relocation within the Murray Street industrial improvement area where possible. Currently there are some vacant sites within the area, mostly in private ownership.

(130) The St James' Park Sports Fields are clearly the most sensitive planning issue generated by the link. Relocation of the entire playing fields would be difficult due to the scale of the pitches. The design of the rail link in bridge form rather than on embankment would create opportunities to retain many of the pitches and the changing pavilions. It is likely that relocation would be spread around Paisley and could include expanding playing facilities at Ferguslie Park and Linwood. Other poor quality football pitch provision, such as Lochfield Road and Caplethill Road, could possibly be upgraded. New facilities could possibly be established at Ferguslie Park, Phoenix and Seedhill.

(131) Across the M8, the link would affect an area currently used for car rental returns. These operators would expect to be able to relocate within or very close to the airport boundary. Based on currently available design detail, the alignment would come close to, but would not require relocation of the BP fuel storage facility.

3.2.2.4 Environmental Issues

(132)A full environmental baseline report for the Glasgow options can be found in appendix C. This analyses the environmental issues under ten headings:

- Air Quality;
- Noise and Vibration;
- Water Quality;
- Geology;
- Biodiversity;
- Landscape;
- Visual Amenity;
- Agriculture and Soils;
- Cultural Heritage; and
- Recreational Access.

(133)The key environmental impacts are summarised below.

(134) The main concern for air quality in Glasgow is the City Centre where an Air Quality Management Area has been designated. Any infrastructure outside the Glasgow City Centre is not considered to significantly contribute to air pollution as in these areas the air quality is well below the standards required. The service from the Airport to Glasgow Central Station would be operated using electric trains and therefore would not produce significantly more air pollution within the City Centre.

(135)More significant is the impact of construction activity on receptors to air and noise pollution. Properties close to the alignment of the St James Link would be subjected to temporary air pollution from dust caused by construction of the track and pylons. There are approximately 50 properties within 100m of the new link. The required upgrades between Paisley and Shields Junction would be largely contained within existing railway land. However, the rock cutting required at Arkleston would generate air pollutants and dust. There are approximately 25 properties within 100m of the western part of the required cutting.

(136)All of the rivers around Glasgow Airport can potentially flood. However, none of the normal flood areas are considered to affect the rail alignment and none of the new infrastructure required would pass within 50m of a watercourse.

(137)There are a few areas of natural importance within the broader study area. From the Airport the proposed route would cross the M8 and St James' Park. On both sides of the M8 are beech hedges and broad neutral grassland and, a little to the west of the proposed crossing, the Paisley Moss Local Nature Reserve. Beside the pavilion and on the A726 at the southwest end of the playing fields are non-native formal beds of shrubs and semi-mature pollards of Ash, Lime and Sycamore. The route would cross a cycleway at the A726 and a trim trail immediately adjacent to the north side of the M8. Beyond the A726 the route is largely within derelict and built environment of low ecological interest.

(138)Scottish National Heritage have previously expressed concern that the bridge over the M8 could interfere with the flight path of Whooper Swans, protected species which feed and winter to the north of the Airport at the Black Cart. The route would also pass to the south of the Paisley Moss Site of Importance for Nature Conservation

(SINC), the M8 SINC and the Boghead Pool Site of Special Scientific Interest (SSSI) but is not considered to affect these areas. The existing South Arkleston Cutting may require widening. A hawthorn hedge borders the improved grassland and stubble on the north side but only east of the Golf Course to the east bridge on the south side. The fields on the south side are used for planting winter cereals. There is extensive scrub on both sides of the cutting and a small plantation bordering the Golf Course. The project would impact on many old buildings adjacent to suitable feeding corridors for bats, a protected species.

(139) The St James Link would be overlooked by residents of Greenhill Road, McFarlane Street and Greenock Road. In Old Greenock Road, three dwellings would have clear views of the St James Link. Fourteen two storey dwellings on Greenock Road would have views across the park and would experience visual intrusion caused by the St James Link. Some residents along the south side of St James' Park would have views of the St James Link.

(140) Workers at commercial properties on Murray Street, Mackean Street, Clark Street, Greenhill Road and McFarlane Street would also be affected. Recreational users of St James' Park would be able to see the elevated railway as it crosses the park. Finally, motorists, cyclists and pedestrians on all local streets would be affected.

(141) Significant effects would also occur where the proposed railway passes within 50m of the rear of residential properties on Greenhill Road. However, the low quality of the existing view, consisting of industrial premises, portacabins, etc, would limit the likely impact.

(142) Significant effects would be experienced as the elevated railway crosses St James' Park. There would be substantial adverse impacts on recreational users of the park, due to the close range of this view. Impacts on residents of Greenock Road are likely to be substantially adverse, as a result of the imposition of the railway structure into the existing good quality view of the open space.

(143) Views of the link would also be possible from the M8 for both east and westbound traffic (although partially obscured by crash barriers at some points).

(144) For the purpose of the agricultural analysis, maps from The Macaulay Institute for Soil Research were used to determine land capabilities in the study area. There are no designated land capabilities in line with this route.

(145) There are no Scheduled Ancient Monuments within the vicinity of this route. St James' Park, or 'The Racecourse' is of local historic significance and is culturally important for local people. The park originally belonged to the Race Committee, and since 1877 has allowed people to enter upon the ground and play cricket, golf, football, quoits and other games. In June 1880 the park came into public possession. Since 1922 there has been 'a pavilion of unique design'. Prior to the use of the area as a racecourse it has been assumed that the site was once heavily wooded. There are currently 22 football pitches on the site including one all weather hard pitch.

(146) The Four Square tobacco factory on the corner of Greenhill Road and Clark St is listed and would lie to the west of the St James Link and may be partly demolished (Category B listed).

(147)Glasgow City Centre, the Airport and its surroundings are classified as urban land in the relevant Landscape Character Assessment, and are not characterised further. The urban fringe to the north and west of the Airport is characterised as the Houston Alluvial Plain but this landscape would be unaffected by the proposals. The River Clyde and the White Cart Water are classed as Green Corridors.

(148)New transport infrastructure should be designed very sensitively where it crosses Green Corridors. The link would not have any impacts upon designated sites of landscape or townscape value, however.

(149)The link would have an effect on the landscape aspects of St James' Park. The park is well used, particularly at weekends. Views from the park to the towers and spires of Paisley City Centre are available, and the rail link would affect the setting of these landmarks. The impact of the rail link running through this area would be substantially adverse, due to the interruption of the open space, and the dominant effect of an elevated railway in a wide, open area.

(150)This link would potentially result in a severance of St James' Park depending on the character of the viaduct structure.

3.2.2.5 Property Costs

(151)The costs for property acquisition have been estimated at £10m. This includes total reinstatement of football pitches. This figure could be reduced if betterment could be achieved (such as selling the remainder of St James' Park for housing) This would be extremely controversial but financially beneficial. We believe that Renfrewshire Council would be unlikely to support more than a handful of new houses on the St James' Park site.

(152)In deriving the property cost, our surveyors have not included the purchase of the BP oil depot at the airport end of the link. Based on available mapping, they believe that it would not need to be relocated. The cost of relocating the car rental facilities has been included in our estimate.

3.2.3 Glasgow Central

3.2.3.1 Scheme Summary

(153)The shortest route from Shields Junction to the City Centre of Glasgow would terminate at Glasgow Central. For airport services, it would provide the shortest journey time. However, Glasgow Central Station currently does not have spare capacity for additional services. As part of this study, we have undertaken a detailed investigation into the feasibility of providing platform space at Glasgow Central Station, and this has been a key focus of Railtrack's advice to the project.

3.2.3.2 Railtrack Advice

(154)At the outset of the study, it had been assumed that a solution to the capacity at Glasgow Central Station may be found through a re-signalling scheme at the Station. However, during a meeting on the 1st of August on the issue of Glasgow Central capacity, the following position emerged.

(155)A resignalling of the station is currently being designed and negotiated with the Railway Inspectorate and the Health and Safety Executive. During this process, it

emerged that the only way to preserve the current capacity of Glasgow Central station is a replacement of equipment, whilst retaining the existing layout of the signalling system. Any changes to the station layout (such as adding a new platform) would require a complete redesign of the station signalling to current standards, which would reduce capacity. So, adding a platform to the station would actually *reduce* its capacity. Even if a new platform was combined with an extra bridge across the Clyde, it is likely that the combination of constraints in the station throat and modern signalling standards would restrict overall station capacity at the current level.

(156)However, following further consideration, Railtrack have now advised that the use of platform 11a (the little used platform outside the train shed) would provide a solution for the airport services. The platform could be extended into the train shed to occupy the area currently used by the carriageway and short-term car parking. Railtrack quote an estimated cost of between £10m and £15m for this extension.

(157)Figure 3.1 shows the area currently occupied by the carriageway and short-term car parking between platforms 11 and 12, which would be taken over by an extended platform 11a. The view is towards the south from the end of platforms 11 and 12. Visible in the background is the arch through which platform 11a would be extended.

■ **Figure 3-1 Glasgow Central: Area between platforms 11 and 12**

(158) The study team have questioned further the feasibility of using this platform and sought further clarification on the implications for other station facilities. On ***feasibility***, Railtrack have responded as follows:

> *"It would be possible to allocate one platform (Platform 11a) exclusively to Airport services at Glasgow Central station. It would be possible to operate 4 trains per hour from this platform to and from the Airport but there would not always be a train available for boarding in the station. The use of this platform*

on a regular basis has previously been unacceptable to train operators because of its remoteness from the main station concourse. This could be addressed by extending the platform through the existing archway at the end of Platforms 11 and 12 along the alignment of the current carriageway drive, thereby integrating it with the remainder of the station. This would be acceptable to Railtrack as it would not require any alterations to the existing signalling system in the station area.".

(159)On the ***impacts of using platform 11a on the renewal of Signalling Interlocking Proposals***, Railtrack have stated:

"Railtrack is proposing to renew the existing signalling interlocking at Glasgow Central over the next 5 years. Because of the restrictions placed on working on the existing wiring due to its condition and the implications on the capacity of the station arising from any requirement to comply with modern standards, this work will retain the existing track layout and the associated signalling logic. Based on this philosophy, an extension of the existing Platform 11a would be technically acceptable, whereas more comprehensive works such as alterations to the station throat or the provision of additional platforms would not.".

(160)On the ***implications of extending platform 11a***, Railtrack have advised as follows:

"This extension would occupy the space currently occupied by the carriageway drive. This would mean the loss of the existing car parking facility in this area which would have to be relocated to an alternative site outwith the station. It would also either require diversion of the existing driveway or its replacement by an alternative facility. Significant strengthening works would be required at the point where the driveway descends to street level if it were to be retained. A significant amount of further development work is therefore needed if this option is to be considered further and accurate costings are required.".

(161)On the ***implications of losing platform 11a for use during breakdowns and emergencies***, Railtrack have commented:

"The dedication of Platform 11a exclusively to Airport traffic would mean that the small number of movements that currently use it would have to be accommodated elsewhere in the station. As the majority of these movements are associated with rolling stock problems and require shunting movements from other parts of the station, no major difficulty is foreseen in accommodating these outwith the immediate station area.".

(162)With respect to ***the feasibility of always having one airport train visible in the station***, Railtrack have advised:

"The provision of one dedicated platform to Airport services would not mean that an Airport service was always in the station to allow passengers to board. If this facility were required, a second dedicated platform would have to be provided. This could only be provided if some existing services using Glasgow Central were diverted away to provide additional capacity. Extension of this logic also means

that the Platform 11a extension would not be required in the first place if a sufficient number of services could be diverted.".

(163)On the ***costs and risks of the proposed platform extension***, Railtrack have stated:

"The study we referred to in our report was undertaken by Arup for Railtrack in 2000. This indicated a cost of between £6m and £10m for the platform and track works associated with the construction of two additional platforms between the existing Platforms 11 and 12. For the reasons outlined above, we do not believe that the creation of two new platforms is practical until after implementation of our re-interlocking project.".

"Notwithstanding the reduction in scope of the Arup proposals to provide only one new platform, we still believe that the costs quoted are very light. Significant issues associated with substructure strengthening works and the provision of alternative acceptable traffic arrangements were not addressed in the report. Once these have been fully scoped and quantified, we would expect the costs to rise significantly, hence our indicative assessment of £10m to £15m.".

(164)Regarding the ***replacement of the car drop-off facility***, Railtrack have advised:

"This facility would have to be relocated, and the obvious location for this would be the station frontage at Gordon Street. This area is already used as the taxi pick up rank, and could be adapted to fulfil this role as well. This would require consultation with, and approval from, Glasgow City Council's Roads Department.".

(165)On ***short term car parking***, Railtrack have responded:

"This facility would be lost and could not be re-created within the existing station footprint. An alternative off-station site would therefore have to be found. One possibility would be to convert part of the existing Oswald St car park for this purpose. This would have to be progressed in consultation with the owners.".

(166)On ***access to the Oswald St Car Park***, Railtrack have stated:

"No changes are envisaged to the existing pedestrian access from Platform 13.".

(167)On ***other station facilities***, Railtrack have advised:

"As well as the re-location of the facilities mentioned above, there are a number of other current uses of the carriageway road that would need to be re-located elsewhere within the station. The most significant of these are access for contractors to the lineside and the waste compaction facility located above the existing outbound ramp. Suitable alternatives would have to be found for both of these but would not necessarily involve any significant cost.".

(168)The overall conclusion from these further investigations is that capacity for airport services can be found at Glasgow Central station if platform 11a is brought into general use. The use of platform 11a is feasible in principle and this platform can be

extended into the station at reasonable, though not insignificant, cost. This extension can be accommodated without triggering a full resignalling of the station. However, the extension would impact on a number of other station facilities, including the short-term car parking and taxi drop-off facilities. These would need to be resolved in consultation with SPT, but are not expected to present insurmountable problems. We have no explicit cost estimates for the relocation of these facilities, which are likely to be relatively small. However, in our appraisal, we have used the higher figure from the indicative range of cost estimates Railtrack have provided for the extension of platform 11A.

3.2.3.3 Planning and Environmental Issues

(169) Any alterations to Glasgow Central Station and its approaches are expected to be contained within current railway operational land and there are no specific planning or environmental issues arising from the routeing of services into Glasgow Central.

3.2.4 Glasgow Queen Street

3.2.4.1 Scheme Summary

(170) Although it would offer an inferior journey time to the centre of Glasgow compared with the Glasgow Central routeing, the option of running to Queen Street Low Level Station has two key advantages:

- it offers better city centre penetration and more interchange opportunities than the Glasgow Central option; and
- it avoids the problems with platform capacity at Glasgow Central.

(171) East of Shields Junction, this alignment would use the City Union line and then the new St John's Link to access the line into Queen Street Low level at High Street. This would require the City Union Line to be electrified and re-signalled and its connection with the Ayrshire Coastal route at Shields Junction improved. In this option, a through service of four trains each way per hour could be operated from stations in northwest Glasgow to the Airport using existing SPT rolling stock. Alternatively, a shuttle service with special rolling stock could be operated from a turn-back siding to be provided west of Queen Street Low Level. In both cases, there would be good connections with other services covering a wide area in north Glasgow. In order to reduce interdependencies and make the airport scheme as free-standing as possible, we have assumed a self-contained shuttle service and we have costed a turnback siding at Finnieston as part of our scheme.

(172) SPT have also considered the provision of additional stations on the City Union Line at Glasgow Cross, and at West Street for interchange with the Underground although this is not assumed as part of our core scheme and is not included in our cost estimate.

(173) In summary, the engineering works required to implement this Option include the following:

- adoption of freight dive-under with new connection to City Union Line;
- electrification and resignalling;
- a double track curve with flat junctions at each end and additional bridge over Bell Street;

- demolition of about half of a residential block developed from former railway stables;
- the present platforms at High Street moved eastwards and no platforms on new curve; and
- a turn-back siding near Finnieston.

(174) Advice from Railtrack was sought in particular on the question whether a flat junction at High Street would suffice or whether grade-separation would be required.

3.2.4.2 Railtrack Advice

(175) Railtrack have commented on the feasibility of operating 4 tph from the Airport into Queen Street Low Level. They have generated a nominal clockface timetable for airport services but have not attempted to interwork these services with the existing services on the North Electric network. However, these services are due to be significantly recast on introduction of the Larkhall to Milngavie project and Railtrack are proposing that that recast should take account of the airport services. Specifically on the need for a grade-separated junction at High Street, Railtrack propose that the timetable risk of providing only a flat junction should be assessed as part of that timetabling exercise.

(176) We conclude from this that there are no insurmountable operational problems in implementing the Queen Street Low level option. The advice on the need for a grade-separated junction at High Street is not conclusive. In our appraisal we can only highlight the risk that further investigations may establish that need and thus escalate the costs of this option.

3.2.4.3 Planning Issues

(177) Between the Airport and Shields Junction, this scheme would generate the same planning issues as the route into Glasgow Central. East of Shields Junction, this option would utilise the St John's Link. This covers land which falls within the proposed High Street Goods Yard/Collegelands masterplan, but has long been designated for railway use. The land is owned by Merchant City Properties, who are understood to be willing to sell for railway use, but to date there has been no full land valuation undertaken.

(178) The link may also require the demolition of a residential block at Bell Street, which is in private ownership. Property owners would seek compensation to purchase new properties. There is no requirement for the public sector to provide alternative facilities.

3.2.4.4 Environmental Issues

(179) Between the Airport and Shields Junction, this scheme would generate the same environmental issues as the route into Glasgow Central. East of Shields Junction, this option would utilise the St John's Link. Properties that are likely to be the most sensitive receptors to air pollution and dust resulting from the construction of track and pylons would be those in close proximity to the proposed works. These properties would also be subject to noise and vibration impacts. These include the flats adjacent to Bell Street, and residential and commercial properties immediately adjacent to the City and Union Line, in particular:

- 'Precious' the Recording Studio under the Osborne Street arches;

- the Glasgow College of Nautical Studies; and
- the Citizen's Theatre.

(180) The route would also skirt the Miller Home development and crosses the Molendinar Street arches development. It would also pass close to the Saltmarket Judiciary Court development. The route would pass within 100m of approximately 50 properties.

(181) There are approximately 10 properties within 100m of the required turn-back siding at Finnieston.

(182) The Molendinar Burn runs in a culvert from north to south across the Goods Yard. The route of St John's Link would therefore pass within 50m of this burn.

(183) The St John's Link, leaving the City Union Line and passing over Bell Street, would pass over underlying sandstone and then over Ophitic alkali olivine-dolerite. In terms of drift geology this route would pass over Alluvium and Glaciomarine deposits. No Sites of Special Scientific Interest (SSSI) or Regionally Important Geological Sites (RIGS) would be affected within this area. The new St John's link would connect two existing lines and would be situated in a former siding primarily used for car parking. Both car parks are unsurfaced and have been bulldozed from dense Silver Birch scrub, which is most dense along the existing electrified line to the High Street station.

(184) The Glasgow Local Plan indicates that there is a corridor of wildlife and landscape importance along the disused railway line to the east of the proposed St John's Link. The key ecological interest is a broad-leaved Helleborine at St John's (this is a Glasgow speciality).

(185) Numerous residential properties on Parsonage Row, Parsonage Square, and Bell Street would overlook the new link. Workers in industrial units on Bell Street, and train passengers at High Street Station would also be affected.

(186) Significant effects would also occur where the railway crosses Bell Street. Visual impacts would arise from construction of a new bridge across the street, and demolition of a residential building, opening up views of unattractive railway land behind. The new infrastructure would be seen in the context of existing railway infrastructure. It would run in cutting across the existing car park, reducing the visibility and therefore the significance of the impact, although the view from Parsonage Square is at close range.

(187) There are no designated land capabilities in line with this route. SEPA identified that there is likely to be contaminated land situated on the Goods Yard site through which the St John's Link runs but the level of contamination is unknown.

(188) There are no Scheduled Ancient Monuments within the vicinity of this route.

(189) With regard to archaeology, Glasgow East Centre is regarded as an area of 'outstanding archaeological significance' in the Structure Plan because it was a medieval burgh and there are a number of identified sites within the area. West of Scotland Archaeological Services have indicated that it is highly likely that archaeological deposits (pre 19th century) of major significance are situated in the area

of the proposed new link on the College Goods Yard site. The development work may provide an opportunity for research and excavation.

(190) The former railway stables block on Bell Street (a category B listed building) that would require demolition to create the St John's Link is of regional archaeological significance.

(191) The new track would run very close to the Category A listed former railway warehouse building on Bell Street which has been converted into flats. This warehouse has arched wide openings at the ground level with cast iron columns supporting cast-iron beams and concrete arches. It is an early example of the use of mass concrete in Glasgow. There is a further Category A building near to the Link on Bell Street with the corner of Watson Street. This is a Robert Turnbull 1876 warehouse.

(192) The St John's Link would further require the electrification of the City Line. The City Union line runs across the Category B listed Union railway bridge, and pylons would need to be installed here as part of the electrification system.

(193) The railway represents the boundary of the Central Conservation Area. The former stables block and other properties on Bell Street lie within the Conservation Area. To the north of the St John's Link lies the Cathedral which is a Listed Building of Special Importance, but this is not expected to be affected by the construction or existence of this link.

(194) At High Street station, Victorian sandstone retaining walls would be removed. A new bridge over Bell Street would be required, adjacent to an existing steel girder rail bridge.

(195) The effects of the new link on the car park site are not considered to be significant in terms of townscape. Impacts would arise due to loss of a short section of retaining wall from High Street Station.

(196) Overall impacts of the scheme are predicted to be substantially adverse, largely due to the loss of the former stables block and changes to Bell Street. Part of the scheme, including this demolition, would be within the Central Glasgow Conservation Area. The integrity of the conservation area would not be affected, as the building which would be demolished lies on the fringe of the designation and, despite its adverse impacts, the Glasgow City Plan states that it supports the development of the St John's Link.

3.2.4.5 Infrastructure Sharing

(197) The St John's Link is a scheme in its own right, which, together with the Strathbungo Link, would enable the re-routeing of some services which currently terminate at Glasgow Central into Queen Street Low Level and beyond. SPT have undertaken their own studies which shows a positive case for the scheme. Although this has not been appraised in line with the latest Treasury guidelines (using a 3.5% discount rate and uplift factors for "optimism bias"), the case appears to have sufficient margin and it is likely that it would to remain positive under the new assumptions, even if the additional infrastructure costs identified as part of this study are included.

(198) Whilst we did not want to construct our main case for the airport link on the premise that it would be dependent on another project, we have undertaken a sensitivity test where we exclude all the costs of the St John's link, assuming that they would be borne by another project.

3.2.4.6 Site Contamination

(199) During Phase 3, the study team's attention was drawn to the potential for heavy contamination along the alignment of the St John's Link. We have therefore conducted a detailed desk investigation of the site to ascertain the risk of cost escalation. The results of this investigation are detailed in appendix I. We concluded form this that there is unlikely to be any contamination over and above what could be expected in an urban railway site and that there would not be any significant decontamination costs incurred.

3.2.4.7 Property Costs

(200) The Queen Street option would increase land purchase costs by approximately £6m, making a total of £16m. This is mainly due to the need to purchase the block of flats at the stables and the St John's Link land. Although we have not undertaken a full residential market assessment, we believe that the total purchase could not be achieved for less than £5m.

(201) In addition to the land required for the infrastructure directly, we need to allow for the sterilisation of a piece of land which would be entirely contained within a railway triangle. Our property valuers have undertaken an indicative assessment of the site. They conclude that if the whole site needed to be acquired, it would incur a property cost of around £1.6m. If it was possible to maintain access to the site to allow for some development, then the cost may be reduced to around £650,000. We have added the latter sum to our appraisal.

3.2.5 Glasgow Central Plus

3.2.5.1 Scheme Summary

(202) A variety of infrastructure options for enabling airport services to reach destinations beyond the centre of Glasgow has been explored in Phase 1. During Phase 2, in the development of the service options, a decision was taken, in consultation with the Steering Group and SPT, that such longer-distance services should only be considered ***in addition*** to a basic service of 4 tph to the centre of Glasgow.

(203) Phase 2 left the precise routeing of longer-distance services open, pending further investigation during Phase 3 and advice from Railtrack. The demand forecasting in Phase 2 indicated that the different options for longer-distance services would attract similar amounts of patronage and that the decision on routeing would need to be based on other considerations.

(204) The routeing which is ultimately adopted may be influenced by the degree to which other schemes will have been implemented at that time. For example, the Garngard Chord, which would allow a routeing from the City Union line to Cumbernauld, is one of the recommendations of the Central Scotland Transport Corridor Studies. However, allocating the cost of the Garngard Chord to airport services would weaken the case for longer-distance airport services.

(205) The Phase 2 demand forecasting indicated that it would be extremely difficult to justify any additional infrastructure provision on the basis of benefits to air passengers and airport users alone. The position should therefore be that airport services would, in time, take advantage of additional infrastructure if it is justified and provided as part of other projects.

(206) However, the case for the development of airport services would become very vulnerable if it was based on the assumption that some of these other projects would proceed. Therefore, for appraisal purposes at this stage, the most robust case is to adopt a routeing which would require a minimum of additional infrastructure. This points to the routeing via the West Coast Main Line to Rutherglen East, the Rutherglen and Carmyle Line, Cumbernauld and Falkirk Grahamston to Edinburgh.

(207) That route would not enable the provision of an interchange station with the Underground at West Street, which would only be possible with a routeing along the City Union Line. We understand that SPT have aspirations for that interchange station and believe that it would add value to airport services. However, in the context of providing these longer-distance services in addition to a basic airport service of 4tph to Glasgow Central, the value of that interchange from the perspective of airport services must be relatively small and extremely unlikely to justify the cost of a different routeing.

(208) It should be noted that the infrastructure development implicit in the airport schemes we have appraised does not rule out either a different routeing of longer-distance services or the provision of a West Street station. It simply does not include the additional infrastructure required in the appraisal.

3.2.5.2 Railtrack Advice

(209) In looking at different routeings for longer distance services, Railtrack have advised that a routeing via Cowlairs to the main E&G line, then via Falkirk High to Edinburgh should be ruled out on capacity grounds. Railtrack have commented on three routeing options:

- via the City Union Line, Garngard Chord, Cumbernauld and Falkirk Grahamston to Edinburgh;
- via the West Coast Main Line to Rutherglen East, the Rutherglen and Carmyle Line, Cumbernauld and Falkirk Grahamston to Edinburgh; and
- via the West Coast Main Line, Uddingston Junction and Shotts.

(210) The Steering Group had already ruled out the routeing via Shotts as it would not allow access to Edinburgh Airport. In 3.2.5.1 above, we have outlined the case for using the second routeing, via Carmyle.

(211) Railtrack also confirmed that:

> *"None of these additional services could operate into Edinburgh Waverley without major investment in the provision of additional track and platform capacity."*.

3.2.5.3 Edinburgh Waverley Capacity

(212) The issue of station capacity at Edinburgh Waverley is discussed in more detail under the Edinburgh options in 3.3.2.3 below. It clearly has a major bearing on the Edinburgh spur options. However, it also has implications for any scheme to run services from Glasgow Airport to Edinburgh.

(213) Throughout our option appraisal in Phase 3, we have sought to avoid creating interdependencies between projects and, as outlined in 3.3.2.3 below, we feel therefore that the full cost of providing extra train paths into Waverley needs to be allocated to the Edinburgh spur options.

(214) However, it is clearly not plausible to suggest that an upgrade of Waverley station would be undertaken for the sake of services to Glasgow Airport. It is also unreasonable to assume that if Waverley Station was upgraded, services from Glasgow Airport would have top priority in taking up the additional capacity. Therefore, allocating the ***full cost*** of two additional train paths at Waverley to Glasgow Airport schemes would not seem a credible assumption.

(215) In our appraisal, we have therefore assumed that longer-distance services from Glasgow Airport to Edinburgh Waverley ***would not happen*** unless they were facilitated by a general capacity upgrade of Waverley station which is, at least in part, justified by other service aspirations.

(216) We believe therefore that in this case we should take account of the ***average cost only*** of the two additional train paths to Waverley in a scenario where a higher specification upgrade takes place. We assume that paths for Glasgow Airport services to Waverley would only become available under a high upgrade scenario, which provides significant additional train path capacity. The Waverley Station project was still under development at the time of concluding this report and both the costs for, and the number of train paths that were thought to be achievable under different options were still under discussion at this point in time and the assumptions we have used in our appraisal are based on the best available information at the end of January 2003.

(217) It is our understanding that there is a do-minimum option for Waverley Station (known as "Option 1"), which would provide platform capacity for the East Coast Main Line Upgrade, but no additional train paths. Against that, options 2 to 6 would provide varying numbers of extra train paths, as well as other station features. Based on information supplied to us by Railtrack on the 27th of January 2003, the cost of the do-minimum option would be £178.9m. The lowest cost upgrade to provide 8 additional train paths from the west would be option 4, which has been costed at £462.8m. The incremental cost of 8 additional train paths would therefore be £283.9m, and the average cost for the two paths taken up by Glasgow Airport services would be **£71.0m.**

3.2.5.4 The "Union Project"

(218) During the development of our Phase 3 options, details of the "Union Project", a proposal by the Rail Passengers Committee (RPC) Scotland became available.

(219) The scheme is to upgrade the City Union Line and close Queen Street High Level station with a new chord giving access from the City Union Line into Glasgow Central High Level.

(220) The attraction of the project for airport services specifically is that it would facilitate more easily the through-running of longer-distance services from the Airport to a larger range of destinations to the North and East of Glasgow.

(221) However, at present, the case for the project is not established and there is no clear indication as to the likelihood of it proceeding, even to a project development stage. In particular, we can see the following issues.

- The diversion of ***all*** Queen Street High Level services to Glasgow Central High Level would yield both benefits ***and*** disbenefits to existing passengers.
- The idea of splitting trains is not unique to the Union Project and could be used with other ideas for linking the Airport to the wider network. There would be issues of reliability to consider in this approach.
- It is not feasible to add a further 9 trains per hour into Glasgow Central High Level. It is also unclear how the West Highland services would be dealt with.
- The sequence of events is an issue. The project finance is contingent on getting funds released by the closure and redevelopment of Queen Street High Level, yet the project needs to be in place before Queen Street High Level is closed.

(222) All of these are issues which may be capable of being resolved. They are listed here to demonstrate that the Union Project is far off being a justified or implementable scheme.

(223) Railtrack have commented on the project as follows:

> *"We have reservations on some aspects of the proposals (capital cost, capacity at Glasgow Central and extended journey times to some key destinations), but equally feel that some aspects of the proposals merit further consideration (Garngad Chord, diversion of services away from Glasgow Central)…. On completion of the SSRS the Scottish Executive / SRA may wish to progress a similar high level exercise to the one that is currently underway for the Edinburgh area to inform the evaluation of options for the Edinburgh Waverley re-development project."*.

(224) The project has not currently been developed beyond the stage of a discussion paper and we have decided, in consultation with the Scottish Executive, to leave it to one side in our scheme appraisal for airport schemes. However, it should be noted that there is nothing in the airport schemes currently developed which would prevent these schemes from taking advantage of the Union Project, should it be pursued.

3.2.5.5 Planning Issues

(225) The routeing for longer-distance services would involve minimal infrastructure works within existing railway operational land only, and there are no specific planning issues arising here.

3.2.5.6 Environmental Issues

(226) The routeing for longer-distance services would involve minimal infrastructure works within existing railway operational land only. New infrastructure required for this route does would not lie within 50m of a watercourse. However, four additional electric trains per hour would run along existing track from the new St James Link to Edinburgh via Carmyle.

3.2.6 Queen Street Plus

(227) All the issues relating to longer-distance service discussed above apply similarly to the Queen Street Plus option. There are no additional considerations.

3.3 Edinburgh Options

3.3.1 Background

(228) At Edinburgh, we have retained for Phase 3 appraisal two spur options which would allow a shuttle service to Edinburgh Waverley only, and two through-running options which would be more expensive to construct but cheaper to operate as they can rely on existing services. During Phase 3, we have also developed a fifth option which was designed to avoid all the major project delivery risks identified in this study phase. This is introduced at the end of this section.

(229) Of the spur options, one, the Fife spur, would be relatively cheap to implement at the Airport but would offer no prospect of being developed into a through-running scheme at a later stage. The spur from the E&G line, on the other hand, could serve as a first stage of a runway tunnel scheme in a staged implementation programme. Both spur options have implications for capacity at Edinburgh Waverley and its approaches.

(230) The most expensive infrastructure option is the Runway Tunnel option, which would divert both the E&G and the Fife lines through the Airport.

(231) In searching for a cheaper alternative, we have examined ways of diverting the E&G line via the Airport without tunnelling under the runway. During Phase 3, we have undertaken some additional optioneering on this option, which is reported below. We have ascertained that it is possible to develop a surface-level option which avoids major project risk areas associated with major tunnelling, disruption to the airport itself or to the showground and achieves the main aim of providing connections between the Airport, Edinburgh and the rest of the Scottish rail network. There are a number of possible variants to this option and one of these has been appraised as a fifth option in Edinburgh.

(232) Common to all Edinburgh options are the potential environmental mitigation measures which could be adopted. Elevated sections of new alignment would be visually prominent. Viaduct and embankment design should be of high architectural design quality and materials finish. Routes should be designed to mitigate impacts to protected species (such as badgers), walkers and farm vehicles where appropriate, and provide opportunity for new habitat creation and local biodiversity enhancement.

3.3.2 Fife Spur

3.3.2.1 Scheme Summary

(233) This entirely surface running solution would involve leaving the Fife line to the northwest of South Gyle Station, between the Gogar Roundabout and the southern end of the Turnhouse runway. As originally envisaged, the spur would be connected to the Fife line via a flat double junction. In their advice, Railtrack stated that grade-separation would be required at that location. We have investigated the engineering aspects of this and have established that a grade-separated junction at this location can be achieved despite the constraints placed on the area by the Turnhouse runway. We have revised our costings accordingly.

(234) From its junction with the Fife line, the route would then turn westwards crossing Meadowfield Road, the access road to Gogar Castle and the Gogar Burn, before crossing the access track to Gogar Mains. The route would then head north towards the terminal building, running east of and parallel to Gogar Burn before terminating in an 'at grade' station at the airport terminal. There would be four diesel trains per hour in both directions, each with three carriages.

(235) An earlier envisaged chord to allow services from Fife to access the airport station was found to be incompatible with the operation of the Turnhouse Runway.

(236) In summary, the engineering works required to implement this option would include the following:

- a grade-separated junction from the Fife Line north west of South Gyle Station;
- new double track, signalling and control/communications cabling throughout; and
- a 300m long at-grade station.

(237) The level of service envisaged for this option would be four diesel trains per hour in each direction.

3.3.2.2 Interaction with Airport Operations

(238) Following detailed consultation with BAA, the original route alignment was refined to ensure compatibility with current airport operations and future expansion plans. Detailed investigations during Phase 3 have established that an alignment can be found which respects both the Runway End Safeguarding Area (RESA) and a planned additional road access to the Airport from the Gogar Roundabout. Further north, the alignment, running to the west of the Gogar Burn, would be compatible with the planned expansion of airport operations to provide additional aircraft stands in the area west of the Turnhouse Runway.

3.3.2.3 Railtrack Advice

(239) Railtrack have considered the implications of this scheme with particular reference to operational feasibility and capacity at Edinburgh Waverley Station. With respect to ***operational feasibility***, Railtrack have stated:

> *"The infrastructure required to support the operation of this service pattern is as follows :*
>
> - *grade separated junction in the area of South Gyle where the Airport branch*

- *diverges from the existing Fife Lines;*
- *double track branch to the new Airport station;*
- *two platform Airport station with facing and trailing crossovers immediately at the platform ends.".*

"The possibility of providing a flat junction at South Gyle was considered. This was discounted on the grounds that it was not possible to develop a junction conflict free timetable within the constraints imposed by the fixed arrival and departure slots at Edinburgh Waverley.".

(240) On the issue of ***capacity at Waverley Station***, Railtrack have advised:

> *"Edinburgh Waverley station is now operating at its maximum practical capacity for long periods of the day following the implementation of a number of service enhancements over the past 10 years….".*
>
> *"The provision of additional track and platform capacity at Edinburgh Waverley is therefore an essential enabler for Edinburgh Airport Options 1* [The Fife Spur] *and 2* [The E&G Spur]*, both of which introduce an additional 4 trains per hour between Haymarket and Edinburgh Waverley. …".*
>
> *"The Scottish Executive and the SRA acknowledge that no meaningful further service enhancement aspirations can be implemented in the Edinburgh area until the Edinburgh Waverley bottleneck has been addressed. The Scottish Executive is therefore funding further project development work to inform their appraisal of the available options for providing the desired additional capacity at Edinburgh Waverley. Railtrack is currently managing this work on behalf of the Scottish Executive and the SRA, acting as procurement agents for the Executive.".*
>
> *"A number of potential options that would deliver additional capacity at Edinburgh Waverley have been identified. Each of these would provide a different level of additional capacity on the Edinburgh Waverley to Haymarket corridor.".*
>
> *"The appraisal work referred to above that will quantify the costs and benefits of each of these options will not be complete until the end of the year…. ".*
>
> *"It is not yet clear whether it is intended to allocate a proportion of the Edinburgh Waverley upgrading costs against each of the potential new services that might use the additional capacity created, and further clarification on this point should be sought from the Scottish Executive. It is currently anticipated that sufficient development work will have been undertaken by early 2003 to allow an informed decision to be taken on the preferred option by the funders.".*

(241) We have sought further clarification on the cost of providing 4 train paths for airport services and, in consultation with Railtrack and the study team of the Scottish Strategic Rail Study, we have arrived at the following position.

(242) As outlined in 3.2.5.3 above, the Waverley Station project was still under development at the time of concluding this report and both the costs for, and the number of train paths that were thought to be achievable under different options were still under discussion at this point in time.

(243) It is our understanding that there is a do-minimum option for Waverley station (known as "Option 1"), which provides platform capacity for the East Coast Main Line Upgrade, but no additional train paths. Against that, options 2 to 6 provide varying degrees of extra train paths, as well as other station features. Based on information supplied to us by Railtrack on the 27th of January 2003, the cost of the do-minimum option would be £178.9m. The lowest cost upgrade to provide 4 additional train paths from the west would be option 4, which has been costed at £334.7m. The incremental upgrade to Waverley to accommodate an airport shuttle service of 4 tph would therefore be **£155.8m**.

(244) There clearly would be synergies between this project and other service enhancement aspirations which would also require additional capacity at Waverley. It is therefore possible that the cost allocated to the airport scheme could be reduced if a higher specification Waverley scheme was pursued. For example, Option 4, which would provide train paths for 32tph from the west, has been costed at £462.8m, an increment over the do-minimum of £283.9m. A pro-rata allocation of the cost of 4 tph (out of the additional 8tph provided) to the airport scheme would generate a cost of £142.0m.

(245) However, in the absence of such a scheme being fully justified or committed, we need to take the do-minimum situation as our starting point and allocate the full cost of the additional train paths **(£155.8m)** to the airport scheme.

3.3.2.4 Planning Issues

(246) This route would diverge from the Edinburgh – Fife line immediately north of the A8 Trunk Road and would pass through agricultural holdings belonging to Gogar Farm. From here it would pass through New Ingleston Ltd owned fields before entering land owned by Edinburgh Airport Ltd.

(247) The nature of the land required is summarised as:

- agricultural; and
- agricultural with "hope" value.

(248) For much of the route, the agricultural landholdings are designated as Green Belt and appear to have little potential development value under normal circumstances. Much of the land is owned by New Ingleston Ltd, a consortium of landowners who have set up an organisation which aims to maximise its interest in this area. For this reason, there will be an expectation by the landowners that some of these sites could be developed for airport related business use.

(249) However, the limitations highlighted in the West Edinburgh Planning Framework consultation and the most recent draft Structure Plan suggest that development opportunities will be limited to "world class" opportunities.

3.3.2.5 Environmental Issues

(250) The key environmental impacts are summarised below.

(251) The main concern for air quality in Edinburgh is the City Centre, extending out to Haymarket and Roseburn, where an Air Quality Management Area has been designated. Any infrastructure outside the Edinburgh City Centre is not considered to significantly contribute to air pollution as in these areas the air quality is well below the standards required. Although the service from Edinburgh Airport to Edinburgh Waverley would be run by diesel trains, the level of new services envisaged would not significantly add to air pollution within the City Centre.

(252) More significant is the potential impact of construction activity on receptors to air and noise pollution. Properties close to the alignment of the Fife Spur would be sensitive to temporary air pollution from dust due to the construction of the new track. There are approximately 20 – 30 properties within 100 metres of the new link.

(253) The route would cross the Gogar Burn and two minor burns that drain into the Gogar Burn. Impacts on the burns would be minimised by appropriate engineering design and the implementation of basic best practice construction management. All of the rivers and burns around Edinburgh Airport can potentially flood. However, none of the normal flood areas are considered to affect the rail alignment.

(254) There are several areas of nature conservation importance within the broader study area. From the built and amenity environment of the Airport, the proposed route would cross improved and semi-improved grassland with mature trees at field boundaries, and then cross the Gogar Burn SINC, an important local wildlife corridor, before the new junction on the Fife line. Badger activity along the route is likely.

(255) No designated geological features would be affected and no important mineral reserves would be sterilised by the new route.

(256) Approximately eight residential properties, potentially including Castle Gogar, and a couple of commercial properties would be affected by views of the route. Visual impacts would be greatest where the route is seen as it crosses open fields. Visitors, including at the Hilton Hotel, workers locally and travellers on the A8 and Fife line would also receive views, but there are unlikely to be any recreational receptors affected. Moderate adverse visual impacts are assessed overall.

(257) The route crosses agricultural land classified as capable of producing a wide range of crops (Grade 2). The loss of agricultural land would be relatively minor and is not expected to affect the viability of farm holdings, particularly as the land is largely designated for airport-related commercial development. The route would cross a former landfill site to the north of Gogar Farm, but the risks of encountering contaminated land are judged to be low.

(258) The route would pass close to or crosses several features of archaeological significance, including the Fort Scheduled Ancient Monument, three designated Archaeological Sites, two non-statutory Archaeological Sites of Potential, one A Listed building (Castle Gogar) and four B Listed buildings. These features would have an influence in the design of the final route alignment, and further mitigation measures may be required to further reduce potential impacts on the archaeological interest of the area. No buildings would require demolition.

(259) The area around Edinburgh Airport is classified in the relevant Landscape Character Assessment as The Lower Almond Farmlands landscape character area where the stated strategic aim is to prevent the further fragmentation of rural character. Three Areas of Great Landscape Value (AGLV) lie close to the route, and the route would cross the driveway of Castle Gogar, a non-inventory designed landscape where several mature trees would be lost. Overall a moderate adverse impact on the landscape is predicted, due to the poor fit of the route with the landscape.

(260) The link would not have any impacts upon Rights of Way or designated cycleways.

3.3.2.6 Property Costs

(261) Property costs for this option have been estimated at £5m. The valuation is relatively straightforward and is based entirely on agricultural value.

3.3.3 E&G Spur

3.3.3.1 Scheme Summary

(262) The E&G Spur would leave the Edinburgh and Glasgow Line (E&G) west of the A720 City Bypass near Roddinglaw by a new grade-separated double track junction. The track would pass over the E & G line in a northerly direction crossing Roddinglaw Road. A cutting would then be required extending to south of Freelands Road. The route would then cross Freelands Road and the A8. The track would then cross Fairview Road and extend to the eastern gable of the terminal building with a 300m long station. We have assumed that the station would be built underground to allow the scheme to serve as a first stage of the larger Runway Tunnel option.

(263) The level of service for this option would be four diesel trains per hour in both directions, between the Airport and Edinburgh Waverley with one intermediate stop at Haymarket. In our demand forecasting, we have assumed that the service would not stop at Edinburgh Park, as this would undermine the competitive journey time advantage compared with current bus services. However, this scheme would be compatible with a stop at Edinburgh Park should it be felt that that would add value to the service at a later stage.

3.3.3.2 Railtrack Advice

(264) Railtrack have commented on the operational feasibility of this scheme as follows:

> *"As with Option 1* [The Fife Spur], *it is an essential pre-requisite for this Option that additional platforms have been provided at Edinburgh Waverley and re-modelling of the west end station throat has been undertaken to allow more services to operate on the Edinburgh Waverley to Haymarket corridor."*.
>
> *"On the assumption that the works referred to above have been implemented, a notional timetable for this Option has been developed….."*.
>
> *" The clock face pattern proposed has been developed to be compatible with the clock face pattern of existing services west of Edinburgh as far as practically possible."*.

"No significant alteration to these service patterns is required to accommodate the proposed Airport services. The requirement that currently applies to divert a limited number of services currently using the South Lines onto the North Lines because of conflicts with services from the Shotts line still applies.".

"Identifying suitable slots on the South Lines where a clockface Airport service could operate is significantly more difficult that on the North Lines because of the greater volume of traffic and the need to path trains across the junction at Haymarket East. The above timetable can be accommodated in the current basic interval timetable pattern.".

"As with Option 1 [The Fife Spur] *a 10 minute journey time between Edinburgh Waverley and Edinburgh Airport with one intermediate stop at Haymarket has been assumed. An evaluation of the detailed point timings between these points can only be undertaken once the length of the new branch and the ruling speeds for the diverging junction and on the branch have been determined.".*

"In the event of further project development work leading to a change in this journey time assessment having to change, it is envisaged that any consequential timetable alterations would be made at the Airport end as the timing slots in and out of Edinburgh Waverley are fixed.".

"The infrastructure required to support the operation of this service pattern is as follows:

- *grade separated junction to the west of Edinburgh Park where the Airport branch diverges from the existing E&G Lines;*
- *double track branch to the new Airport station;*
- *two platform Airport station with facing and trailing crossovers immediately at the platform ends.".*

"The possibility of providing a flat junction west of Edinburgh Park was considered. This was discounted on the grounds that it was not possible to develop a junction conflict free timetable within the constraints imposed by the fixed arrival and departure slots at Edinburgh Waverley.".

(265) With regard to capacity at Waverley Station, this option would face the same issues as those listed under the Fife Spur option in 3.3.2.3 above.

3.3.3.3 "Underground Railway" Issues

(266) During Phase 3, we have examined more closely the issues associated with operating diesel trains in tunnel near or under the airport. We have explored these issues with particular reference to the Runway Tunnel option and the results of our deliberations are outlined in section 3.3.4.3 below. At the start of these investigations, it was thought that the key issue was the length of tunnel and therefore, the issue would not arise for the E&G spur scheme.

(267) However, during a meeting with Her Majesty's Railway Inspectorate, it emerged that a more important issue than tunnel length is the design of the station and that in

this context, the operation of diesel services to an underground ***terminal*** station was particularly problematic.

(268) At that stage, it was already becoming apparent that the E&G Spur option was unlikely to emerge as the preferred option and it did not seem good use of resources to explore the issue further. However, we have highlighted the issue as a major risk area in our appraisal.

3.3.3.4 Grade-Separation

(269) We have re-examined the engineering for the grade-separation where the airport spur leaves the E&G line. More detailed assessment of the vertical alignment shows that this needs to be engineered as an underpass under the E&G line rather than an overbridge in order to reach the level of the tunnel portal. This would increase the costs of grade-separation at this location by approximately £20m.

3.3.3.5 Planning Issues

(270) This option involves a spur form the Edinburgh – Glasgow line which would cross agricultural lands, partially in cutting, bridges the A8 and crosses further greenfield sites before entering airport land immediately to the east of the Hilton Hotel.

(271) The land to the south of the A8 is largely agricultural and appears initially to have limited development potential. However, it is known that at least one landowner may have aspirations for developments on one part of the site.

(272) To the north of the A8, land is also designated Green Belt, and may immediately appear to have limited development potential. However, there have been significant and complex planning issues surrounding this area in recent years.

(273) The West Edinburgh Planning Framework Consultation Draft states that "*the development pressure and transport constraints being experienced in the area means that safeguarding and enhancing the area's competitive advantage for future generations will require careful planning.*". The document indicates that strategic Green Belt objectives should not be undermined through the "*unnecessary development of green belt land and that the environmental quality….. is protected and enhanced."*.

(274) The Framework document states that Edinburgh has more than adequate development capacity for class 4 type business uses in other parts of the city through to 2015, and that Green Belt land, including this part of western Edinburgh should not be given over to this type of development. Even after 2015, there is no evidence to suggest that there would be any general need for the release of Green Belt land in West Edinburgh to meet forecast demand.

(275) While this would suggest that the development value of these Green Belt-designated sites is strictly limited, the landowners would still wish to express "hope value" for their land. To this end, several landowners have formed a group to promote parts of this area for development purposes and indicate that they would expect opportunities to obtain planning consents for appropriate developments. They believe that such appropriate developments could include "world class" business

developments such as company headquarters, or strongly aviation-related business activity.

(276) In summary, the complex planning history for much of this area suggests that it should nominally remain as Green Belt with limited development potential, although the landowners believe that there could be potential to secure planning consent for a limited number, perhaps even "one-off" major investments.

3.3.3.6 Environmental Issues

(277) The key environmental impacts are summarised below.

(278) The main concern for air quality in Edinburgh is the City Centre, extending out to Haymarket and Roseburn, where an Air Quality Management Area has been designated. Any infrastructure outside the Edinburgh City Centre is not considered to significantly contribute to air pollution as in these areas the air quality is well below the standards required. Although the service from Edinburgh Airport to Edinburgh Waverley would be run by diesel trains, the level of new services envisaged would not significantly add to air pollution within the City Centre.

(279) More significant is the potential impact of construction activity on receptors to air and noise pollution. Properties close to the alignment of the E & G Spur would be sensitive to temporary air pollution from dust due to the construction of the new track. There are approximately 20 properties within 100 metres of the new link.

(280) The route would cross the Gogar Burn to the south east of Easter Norton and again near the Hilton Hotel where another minor burn that drains into the Gogar Burn would also be crossed. Impacts on the burns would be minimised by appropriate engineering design and the implementation of basic best practice construction management. All of the rivers and burns around Edinburgh Airport can potentially flood. However, none of the normal flood areas are considered to affect the rail alignment.

(281) There are several areas of nature conservation importance within the broader study area. From the E & G line, the proposed route would cross arable land with mature trees at field boundaries and cross the Gogar Burn SINC, an important local wildlife corridor, improved and semi-improved grassland with mature trees at field boundaries at Ingliston, before passing through the built and amenity environment of the Airport. Badger activity along the route is likely.

(282) No designated geological features would be affected and no important mineral reserves would be sterilised by the new route.

(283) Residential properties and occupants of the small business centre at Roddinglaw would be visual receptors. There would be approximately eight other residential receptors, including Gogar Stone, Gogar Mount and Easter Norton Farm. Users of the Golf Course at Gogar would be the only recreational receptors. Users of the Airport, staff and occupants of the Hilton Hotel, workers in airport buildings, and motorists on the M8 would also potentially receive views.

(284) High sensitivity residential receptors would see the scheme as it crosses open fields. Less sensitive receptors would see the railway in less prominent locations, such

as within the terminal area. A moderate adverse impact is predicted, mainly due to the effects on residential receptors.

(285) The route would cross agricultural land classified as capable of producing a wide range of crops (Grade 2) in the Roddinglaw and Ingliston areas and land capable of producing a moderate range of crops (Grade 3) at Ingliston. The loss of agricultural land would be relatively minor and is not expected to affect the viability of farm holdings, particularly land at Ingliston designated for airport-related commercial development.

(286) The route would pass close to or crosses several features of archaeological significance, including the Easter Norton Standing Stone Scheduled Ancient Monument, three designated Archaeological Sites, and three B Listed buildings. There would be no direct impacts on the archaeological interest of the area, and no buildings would require demolition.

(287) The area around Edinburgh Airport is classified in the relevant Landscape Character Assessment as The Lower Almond Farmlands landscape character area where the stated strategic aim is to prevent the further fragmentation of rural character. An Area of Great Landscape Value (AGLV) lies close to the route. The proposals would have no effect on any designated areas. There would be no major losses of individual landscape features. A slight adverse impact is predicted overall, as the route fits reasonably well within the existing landscape.

(288) The link would pass over the A8 cycleway without impacts and no Rights of Way would be affected.

3.3.3.7 Property Costs

(289) Property costs for this option have been estimated at £6.5m. This is based on agricultural value with "hope value" where planning applications have been submitted. Landowners NIL are currently working with the council to develop a planning strategy for their landholdings. They are a consortium of landowners with substantial holdings between them. Currently their land is designated as Green Belt. The West Edinburgh Framework / Structure Plan agree that Edinburgh is well served for class 4 or light industrial land elsewhere until 2020,and that greenfield sites in west Edinburgh should not be lost to this type of development. The "hope value" for a business park is therefore limited. However, it is understood that planners would have a more open mind to a world class development such as a company headquarters requiring airport proximity. For this reason, it is difficult to estimate the "hope value".

3.3.4 Runway Tunnel

3.3.4.1 Scheme Summary

(290) The Runway Tunnel option would connect at its western and eastern extremities with the Edinburgh - Glasgow (E&G) line via a new railway between Winchburgh and the proposed Edinburgh Park Station with the alignment passing beneath the airport runway.

(291) The south-eastern part of the alignment would be identical to the E&G Spur option which could also serve as a first stage in a staged construction of this scheme. It would then enter a tunnel portal south of the Hilton Hotel. The twin bore tunnel would extend 1,500m under the runway and the River Almond, surfacing at a tunnel portal to

the east of Carlowrie Estate. An underground station would be constructed within the tunnel, near the south east corner of the airport terminal.

(292) The route would then cross a road running from Carlowrie to Carlowrie cottages, a disused railway and then the Kirkliston to Carlowrie B Road. The track would then split with one double track joining the Winchburgh to Dalmeny chord via a flat double junction facing west (towards Glasgow), and a single-track chord joining the Winchburgh to Dalmeny Chord via a flat single juction facing north-east (towards Dalmeny and Fife).

(293) The tunnel section would need to be constructed in bored tunnel. Two single track tunnels would be bored under the runway and River Almond. To restrict settlement to less than 25mm, it was decided to allow for sufficient pre-tunnelling stabilisation works in our project costing.

(294) In summary, the engineering works required to implement this option would include the following:

- a flat double junction from Winchburgh to Dalmeny chord (west) and flat single junction from the Winchburgh to Dalmeny chord (east);
- approximately 1500m long twin single track tunnels passing beneath the River Almond and the airport runway including a 300m long by 20m wide "sub-surface" station box;
- a new double track, signalling and control/communications cabling throughout; and
- a new grade-separated double junction from the E&G line west of the proposed Edinburgh Park station.

(295) During Phase 3, Railtrack have advised that the envisaged service pattern would require additional capacity to be provided between Soughton and the airport junction, essentially creating a 4-track layout through Edinburgh Park station. We have reviewed the engineering of this option, and have included an allowance for the required capacity upgrade in our costs.

(296) Following the optioneering and demand forecasting in Phase 2, it was decided that this expensive infrastructure would be best utilised by routeing as many trains as possible via the Airport. The assumed service level includes services to Glasgow and Stirling as well as Fife and the north, amounting to a total of 10 trains per hour.

(297) When our airport service patterns were developed during Phase 2, no clear guidance was available on which train service would stop at Edinburgh Park Station. We have made the working assumption for our do-minimum case, that only services to Stirling (2 tph) and Fife (2 tph) would call at the new station. Services to Glasgow, whose timetable time is critical, and longer-distance services to Perth/ Inverness or Aberdeen/Dundee would not call at the Station. This assumption was retained for our do-something situation, where only airport services to Stirling and Fife would call at Edinburgh Park and others would not.

3.3.4.2 Railtrack Advice

(298) Railtrack have confirmed that this option, as it would divert existing services via the Airport, would have no implications for ***capacity at Edinburgh Waverley***:

"... this Option is not dependant on the creation of additional track and platform capacity at Edinburgh Waverley.".

(299) However, Railtrack have highlighted a capacity problem in the Edinburgh Park area:

"The proposed new station at Edinburgh Park is located on this section of line and is currently scheduled to open during 2003. This station will only be served at the outset by Edinburgh to Dunblane and Edinburgh to Bathgate services. There are no current plans for Edinburgh to Glasgow services to call at the station. The impact of this mix of stopping and non-stopping services at Edinburgh Park will exhaust any available capacity to run additional services on this corridor without significant additional infrastructure works.".

"Option 3 [The Runway Tunnel] *encompasses the diversion of 4 trains per hour from the Fife direction that currently operate over the North Lines and via South Gyle onto the South Lines and over this corridor. Because of the constraints identified above, these cannot be accommodated unless additional infrastructure is provided over the corridor between Saughton (where the North Lines and the South Lines currently diverge) and the site of the new Airport Junction."*.

"These works, if implemented, would also deliver a number of other significant operational benefits. A number of train movements that currently use the South lines would be transferred onto the North Lines where additional capacity exists. This would create scope to accommodate potential additional services from the Bathgate and Shotts lines once Edinburgh Waverley station has been re-developed..".

"No costings are available for these proposed infrastructure works. A major cost element within these would be the requirement for a new overbridge where the Edinburgh City By-Pass crosses the existing E&G route immediately to the west of Edinburgh Park.".

(300) We have therefore reviewed our costing for this scheme and added an allowance for additional capacity through Edinburgh Park.

3.3.4.3 "Underground Railway" Issues

(301) The Runway Tunnel option involves the alignment passing into tunnel south of the Hilton Hotel to arrive at a sub-surface station close, but not beneath, the terminal building. From the station, the alignment would continue in tunnel passing under the main runway and the River Almond to the north before returning to grade and joining the Winchburgh to Dalmeny chord.

(302) At present the length of the tunnel is approximately 1,500m. This length is based on the depths assumed by Scott Wilson Kirkpatrick in their study. The length of the tunnel could increase if the tunnel nadir requires to be lowered following a detailed geological investigation which could affect the information presented below.

(303) During Phase 3, BAA and other Steering Group members expressed concern about the potential classification of a runway tunnel as an "underground railway", which may make the operation of diesel services very difficult, or lead to significant cost escalation.

(304) Her Majesty's Railway Inspectorate (HMRI) publish "Railway Safety Principles & Guidance", part 2, section A, "Guidance on Infrastructure", known as the "Blue Book". This provides detailed guidance on the following issues for railway tunnels:

- method of evacuation from trains in an emergency;
- stability of a tunnel during or after a fire;
- access points;
- cross passages;
- side walkways;
- fire-fighting facilities;
- ventilation; and
- lighting and communications.

(305) The document states:

> *"The normal arrangement for a sub-surface (underground) railway and for long tunnels, over 1.5 km in length, should be twin single-track tunnels. Twin tunnels created by the internal division of a larger tunnel will be acceptable.".*

(306) This implies that tunnels 1,500m in length or under and that are not component parts of a subsurface railway system are not classified as "underground" tunnels. Up to that they are just lines in tunnels, though of course many existing mainline railway tunnels are much longer. The Blue Book does not comment specifically on the desirability of electric traction in long tunnels, but states that "*the following guidance anticipates that all underground railways will use electric traction. An overhead electric traction supply system is preferred for new railways*.".

(307) The use of separate tunnels for the two directions to reduce fire risk is already part of our proposed design solution for the Runway Tunnel option. The safety issues for any length of tunnel remain the same. From the aforementioned guidance and our experience, where twin-bored tunnels are used, as long as there are adequate cross-passages (at approx. 300m spacing) then the surface egress points should be in the order of 1000m apart (e.g. every third cross passage).

(308) One further issue arises from the potential lengthening of the tunnel section to cross a possible second runway which could be constructed parallel to the existing main runway to the north of the River Almond. From a railway engineering point of view, the longer tunnel would not present a problem, especially as the water table in the area would necessitate the second runway to be built on higher ground, thus allowing the railway tunnel to begin to rise after its crossing of the River Almond. As a second runway is not currently safeguarded, the cost of the longer tunnel would clearly be an issue for the second runway and should not feature in our appraisal. However, it was considered appropriate that we should explore at this stage whether a potential lengthening of the railway tunnel would alter the position regarding its designation as an "underground railway".

(309) We have sought a meeting with the HMRI and met with their tunnelling advisor. The notes from the meeting are included in appendix J. The HMRI's main concern with the Runway Tunnel scheme would be the operation of an underground (section 12) station. Whilst they would not see any insurmountable technical problems with that, there would clearly be additional costs involved in providing the ventilation and emergency facilities which would be acceptable to the HMRI.

(310) We have therefore derived additional cost estimates for the facilities likely to be required and fed these costs through our appraisal. In the further scheme development, there may be a commercial choice to be made between providing these facilities and constructing the station in open cut which would avoid its classification as a section 12 station but would lead to a loss of developable land over the station.

(311) It should be noted that to quantify the costs associated with systems necessary to allow Diesel Multiple Units operation in tunnels and a sub-surface station with sufficient confidence should be based on fully worked up designs to Network Rail Level 4 Design Stage. The costs in the following are based on Network Rail Level 2 Design Stage - conceptual/feasibility designs. Without fully worked up designs for the civil, structural, M&E elements of this project, we have had to rely heavily on past experience of similar projects of a similar size and nature (albeit involving electric traction systems).

(312) The tunnel costs are based on the assumption that the total length including the station does not exceed 2000m. It should be noted that, should the tunnel require to be deepened and hence lengthened following detailed geotechnical investigation, then these costs will rise linearly. Furthermore, the tunnel cost is based on the assumption that the geological strata that the tunnel will pass through is homogeneous and consistent. Should the strata prove to be variable this is likely to result in an escalation of costs and therefore represents a significant cost risk.

(313) As there has been insufficient time since our meeting with HMRI on the 7th of January to consult with the Local Fire Service, this also remains a significant cost risk if we have assumed - through lack of design and consultation - particular designs, products and materials that may not be granted Section 12 Fire Safety Certification.

(314) The main reasons for the uplift in costs from £228.5m to £310m include the following:

- more robust estimates of 3 Access/Ventilation Shaft including associated plant (+£35M) (assumed to be positioned at either end of the station and centrally in section of tunnel north of the station);
- separate provision of passenger, service and fireman lifts;
- more robust and specific costing of Ventilation Ductwork (inc. for fire rating & internal booster fans);
- more robust estimates of Public Address System & Communications Links to Station Manager, Train Control Centre & Train Communications System;
- more robust and specific costing of Fire Fighting Main, Fire Detection & Alarm System (it is assumed that these costs exclude a sprinkler system);
- increased signalling costs to cover one complete interlocking;
- increased length of Gogar Burn culverted;
- introduction of general tunnel stabilisation costs to counter geotechnical risk;

- all additional M&E services costs have been increased as all components will require to be fire rated; and
- an increase on design fees of 5% (+£10M) to include for Network Rail PM, HMRI & Local Fire Service inputs (allows for 21 full-time staff for a period of 7 years based on a 7.5 hr day and a charge rate of £120/hr).

(315) As a comparator we have knowledge of a similar sized project (2.5km twin single track tunnels but with a smaller station box) in the London area which costs around £250M to 2001 prices. With escalation of costs and likely increased costs associated with specifying particular designs, products and materials to satisfy the more stringent requirements associated with diesel traction, the £310M seems reasonable (with due cognisance to cost risks outlined above).

(316) If a decision to safeguard for a second runway was made before the rail link was engineered in detail, the most appropriate way of accommodating it may be to continue the railway in open cutting after it crosses under the River Almond in tunnel. The retaining walls of the cutting would be designed such that they would enable the construction of the new runway over it. A section of the railway, between the River Almond and the new runway, could remain in open cutting, to enable ventilation of the railway tunnel.

(317) We have consulted with BAA on the potential safety issues with an open cutting between two runways. They have commented, based on the Civil Aviation Authority's guidance "CAP 168, Licensing of Aerodromes":

> *"Whilst it would be less than ideal to do so, it would be possible to accommodate a rail cutting between two 760m spaced parallel runways. Indeed this is a similar situation to that which currently exists at Manchester airport where a road cutting is located between the two runways.*
>
> *The length of cutting would vary depending upon the taxiway layout adopted to serve the two runways, but could be of 300 to 400m in length. The shorter the better from an airfield perspective. This would then leave an approximately 400m tunnel beneath the new northern runway and of 1100 to 1500m beneath the terminal and the existing runway, the longer the better to enable a flexible arrangement of landside facilities.*
>
> *Any cutting would have to be isolated from the airfield by a 3m high airside fence located at the top or within the cutting.*
>
> *Any cutting of the length indicated is likely to clash with the River Almond either requiring the provision of an aqueduct or the diversion of the river to the north of the new runway.*
>
> *The cutting is likely to be difficult and expensive to construct, it is suggested that it should be as short as possible, maybe even a large diameter shaft, as this may also avoid any conflict with the River Almond.".*

(318) We conclude from the above deliberations that there are no insurmountable obstacles to constructing the runway tunnel scheme for diesel operation. We have now included an estimate for additional safety and ventilation features in our project costings and have thus transferred project risks to project costs. We have also included

an additional allowance of £300,000 pa for operating a section 12 station in our operating costs.

(319)It will ultimately be a commercial decision whether these costs need to be incurred to enable the construction of an underground station, whose airspace can be developed over, or whether that development opportunity should be forgone.

3.3.4.4 Grade-Separation

(320)As with the E&G option, we have re-examined the engineering for the grade-separation where the airport spur leaves the E&G line. More detailed assessment of the vertical alignment shows that this needs to be engineered as an underpass under the E&G line rather than an overbridge in order to reach the level of the tunnel portal. This would increase the costs of grade-separation at this location by approximately £20m.

3.3.4.5 Train Capacity

(321)The basic premise for this option is that it will rely entirely on the diversion of existing services via the Airport. To ensure that the capacity implications of airport demand on existing services is fully understood, we have undertaken an indicative analysis, from flight schedules, of the likely concentration of airport access journeys during peak times. This indicates that the most concentrated demand is likely to be for access to the Airport during the morning peak hour. During that time period, we could expect about 11% of all daily access journeys to the Airport to take place. Assuming that about 65% of travellers would access the Airport from an easterly (Edinburgh) direction, we can estimate the heaviest flow to be around 7% of the daily demand between Edinburgh Waverley and the Airport.

(322)The total forecast demand for the Runway Tunnel option is 3.3m air passengers and 0.2m employees in 2020. Total annual journeys to the airport are therefore 1.8m, equivalent to just under 6,000 per average weekday. This can be translated into 420 in peak hour, or 42 per train with a service level of 10tph. This additional demand would be incurred in the counter-peak direction and is unlikely to present a significant capacity problem. However, to test the robustness of the Runway Tunnel option appraisal, we have run a sensitivity test assuming some extra operating costs for longer trains. On the advice of the Scottish Executive, we have assumed that these can be accommodated on the network and that no platform lengthening costs would need to be included.

3.3.4.6 Planning Issues

(323)This option follows the same route as the E&G Spur as far as the airport terminal building, where, with this option, the new station would be submerged. The route would continue northwards beyond the runway.

(324)After crossing the runway in tunnel, the route would pass through further agricultural holdings to the north of the airport before joining the existing railway line to Linlithgow.

(325)It should be noted that the agricultural land to the north of the Airport has been highlighted in the Future Development of Air Transport in the United Kingdom: Scotland consultation document as a possible option for a second runway at Edinburgh Airport. While the runway options are no more than possibilities at the current time,

the location of the tunnel portal could impact on the location of any future second runway.

3.3.4.7 Environmental Issues

(326) The key environmental impacts are summarised below.

(327) The main concern for air quality in Edinburgh is the City Centre, extending out to Haymarket and Roseburn, where an Air Quality Management Area has been designated. Any infrastructure outside the Edinburgh City Centre is not considered to significantly contribute to air pollution as in these areas the air quality is well below the standards required. Although the service from Edinburgh Airport to Edinburgh Waverley would be run by diesel trains, services would be formed entirely of existing services and therefore not significantly add to air pollution within the City Centre.

(328) More significant is the potential impact of construction activity on receptors to air and noise pollution. Properties close to the alignment of the Runway Tunnel option would be sensitive to temporary air pollution from dust due to the construction of the new track. There are approximately 30 properties within 100 metres of the new link.

(329) The route would cross the Gogar Burn to the south east of Easter Norton and again near the Hilton Hotel where another minor burn that drains into the Gogar Burn would also be crossed before the route enters the tunnel section and passes beneath the River Almond. To the north of the tunnel section, the route would cross a minor watercourse in two places. Impacts on the burns would be minimised by appropriate engineering design and the implementation of basic best practice construction management. All of the rivers and burns around Edinburgh Airport can potentially flood. However, none of the normal flood areas are considered to affect the rail alignment.

(330) There are several areas of nature conservation importance within the broader study area. From the E & G main line the proposed route would cross arable land with mature trees at field boundaries and cross the Gogar Burn SINC, an important local wildlife corridor, improved and semi-improved grassland with mature trees at field boundaries at Ingliston, before passing through the built and amenity environment of the Airport where it enters the tunnel portal. To the north of the tunnel section, the route would cross arable land with hawthorn hedges, ditches and improved pasture. Badger activity along the route is likely.

(331) No designated geological features would be affected and no important mineral reserves would be sterilised by the new route.

(332) Residential properties and occupants of the small business centre at Roddinglaw would be visual receptors. There would be approximately eight other residential receptors, including Gogar Stone, Gogar Mount and Easter Norton Farm. Users of the Golf Course at Gogar would be the only recreational receptors. Users of the Airport, staff and occupants of the Hilton Hotel, workers in airport buildings, and motorists on the M8 would also potentially receive views.

(333) Residential properties at Carlowrie, Wheatlands, Almondhill, Almondhill Cottages, Craigbrae Farm, and Carlowrie Cottages, would all be receptors to the scheme. Several residential properties in the village of Kirkliston would potentially receive views of the scheme. Walkers and cyclists on the Newbridge to South

Queensferry Walkway would be the main recreational receptors, although walkers also use the paths along the River Almond and farm tracks around Almondhill. Traveller receptors would include users of local minor roads and passengers on the Falkirk to Fife Rail line.

(334) There would be numerous high sensitivity receptors who would all see the railway in prominent locations, with some close range views. A substantial adverse impact is predicted overall, due to the large magnitude of change being seen from many viewpoints.

(335) The route would cross agricultural land classified as capable of producing a wide range of crops (Grade 2) in the Roddinglaw and Ingliston areas and land capable of producing a moderate range of crops (Grade 3) at Ingliston. To the north of the tunnel section further Grade 2 and Grade 3 agricultural land would be crossed. The loss of agricultural land would be relatively minor and is not expected to affect the viability of farm holdings, particularly land at Ingliston designated for airport-related commercial development.

(336) The route would pass close to or crosses several features of archaeological significance, including the Easter Norton Standing Stone and Cat Stance Scheduled Ancient Monuments, nine designated Archaeological Sites, one A Listed building (Carlowrie House) and three B Listed buildings. These features would have an influence in the design of the final route alignment, and further mitigation measures may be required to further educe potential impacts on the archaeological interest of the area. No buildings would require demolition.

(337) The area around Edinburgh Airport is classified in the relevant Landscape Character Assessment as The Lower Almond Farmlands landscape character area where the stated strategic aim is to prevent the further fragmentation of rural character. Two Areas of Great Landscape Value (AGLV)and a designed landscape lie close to the route. The proposals would have a direct effect on a the north corner of the designed landscape at Carlowrie House where the woodland belts and stone walls are well maintained. The route would also cross the tree belt of the Newbridge to South Queensferry Walkway, a disused railway track.

(338) The proposals would have no effect on any designated areas, but there would be adverse effects on the non-inventory designed landscape of Carlowrie House, as well as on the belt of mature trees along the former railway line. The route also represents a relatively poor fit with the existing landscape, although this is offset by the significant presence of existing railway lines and embankments in the area. Overall a moderate adverse impact is predicted.

(339) The link would pass over the A8 cycleway without impacts. The proposed route in tunnel would pass under the River Almond along which is aligned a public footpath and cycle route linking Kirkliston to Turnhouse. Edinburgh Council has a policy to protect access along watercourses such as the River Almond.

(340) To the north of Carlowrie the proposed route would cross a disused railway line which forms the Newbridge to South Queensferry Walkway and is also a designated cycle route. It is envisaged that an alternative route across the railway would be provided to maintain access along the Right of Way.

3.3.4.8 Property Costs

(341) Property costs have been estimated at £7m. This does not include a figure for the compensation for land between the submerged section and the river Almond, which could be reinstated after construction. At the southern end of the scheme, the valuation reflects purchase of agricultural sites up to the submerged station. Land north of the runway is valued at agricultural value. It is not our opinion that there are prospects for residential consents, although it is likely that some farmers may suggest that their land could achieve a residential consent and seek higher compensation.

3.3.5 E&G Diversion

3.3.5.1 Scheme Summary

(342) As a lower cost alternative to the options involving tunnelling under the runway, we were requested to consider an alignment, which would not require to pass beneath the main airport runway, but would allow through running services between Edinburgh and Glasgow.

(343) We therefore developed the E&G Diversion option, which would run from a junction with the Fife line immediately northwest of South Gyle Station and the A8, which would then pass by Castle Gogar and across the Gogar Burn floodplain. This part of the alignment would be identical to the Fife Spur option. The alignment would then ramp up onto viaduct to cross the airport site in an east to west direction. The alignment would continue on viaduct through part of the area that currently is venue to the Royal Highland Show and Ingliston Sunday Market, before crossing the A8 on viaduct to join the E&G line at Ratho Station.

(344) To allow services from Fife and further North to access the Airport, it would also be necessary to make provision for a single track chord with flat junctions from the E&G line to the Winchburgh to Dalmeny Chord.

(345) As with the Fife Spur option, this alignment could be engineered to be compatible with the continued operation of the Turnhouse Runway. In addition, it would need to take account of the airport expansion plans to the south-east and the south-west of the current terminal buildings. If these are to be fully respected, the scheme could only achieve a station about 450m from the southern edge of the current terminal building, some 700m from the current terminal entrance.

(346) As with the Fife Spur option, it was originally envisaged that this scheme would be connected to the Fife line via a flat double junction. Although Railtrack have not been asked to comment specifically on this scheme, their advice on the Fife spur option would apply to this scheme also and it can therefore be assumed that grade-separation would be required at that location. We have also inferred from Railtrack's advice on other options that a grade-separated junction with the E&G line would be required at Ratho Station, and we have reviewed our costs to include an allowance for both these junctions.

(347) In summary, the engineering works required to implement this option would include the following:

- two grade-separated junctions from the Fife and E&G lines;
- a double track viaduct;
- new double track, signalling and control/communications cabling throughout; and

- a 300m long elevated station.

3.3.5.2 Interaction with Airport Operations

(348) This scheme would follow that same alignment as the Fife Spur option at the eastern end and, as noted above, this has been optimised to be compatible with both the continued operation of the Turnhouse Runway and the airport expansion plans. The remainder of the alignment has been designed to avoid currently earmarked airport expansion areas.

3.3.5.3 Further Optioneering

(349) As the distance of an airport station from the terminal is clearly a key issue, we have examined during Phase 3 how this option may be refined to achieve a station closer to the terminal while minimising the disruption to airport expansion plans. This was based on the assumption that the Turnhouse Runway could be closed for a period of time, enabling cut-and-cover tunnelling across it.

(350) The result of these investigations was the development, in outline, of two broad alignments, both of which were identical at the eastern end. Here, the line would diverge from the Fife line in the area of the Gogar Roundabout initially in an easterly direction before crossing under the current Fife line, traversing the Turnhouse Runway in cut-and-cover tunnel and leading to a station in tunnel in the current car park area. From here, there are two alignment options:

- turning south and reaching surface level in the area of the Royal Highland Showground, then crossing over the A8 (which would need to be vertically re-aligned), crossing under the current E&G before rejoining it from the south; or
- continuing parallel to the main runway, then crossing over the M9 to the north of the intersection with the A8, across an industrial estate in Newbridge, before rejoining the E&G Line in the area of Niddry Castle.

(351) The principal issues with these options are as follows.

- Although both options would involve significant changes in level, they are believed to be feasible in principle. The second alignment would be preferable in railway alignment terms.
- Both options would include substantial tunnel sections of some 2.5 kms in length, which are likely to make them very expensive.
- At the eastern end, the feasibility of a grade-separated junction off the Fife Line is not yet established. Given that this option would involve continuing services on the existing Fife Line, grade-separation would almost certainly be required.
- The precise means of crossing the A8 would require further detailed engineering. However, it appears that this is only feasible if the A8 is lowered.
- Crossing under the E&G Line may require the line to be raised slightly, which could be very costly and disruptive.
- The precise levels of the M9 and its slip roads were not known to the study team and that crossing may also require a realignment of the road.
- Subject to finding a way of crossing the M9 broadly at ground level, the alignment appears to be compatible with the take-off cone of the main runway. However, this would need to be confirmed by BAA.
- The precise nature of the industrial estate that would be traversed had not yet been established.

(352) When these options were presented to the Steering Group on the 8th of November, it decided that neither of these options were sufficiently attractive to be developed further. In particular, it was felt that the characteristics of the presented options were such that they were unlikely to present a cost-effective alternative to the Runway Tunnel option, whilst the length of the tunnel presented significant risk. The Steering Group therefore decided that we should revert to the original E&G Diversion option described under 3.3.5.1 above for the appraisal. However, subsequently, a "family" of surface level options emerged which would avoid most of the major risk areas in Edinburgh, and a representative scheme has been appraised as a fifth option. This is outlined in detail under 3.3.6 below.

3.3.5.4 Planning Issues

(353) This route option follows the Fife Spur option as far as the Edinburgh Airport landholdings at the Hilton Hotel.

(354) With this option, the route would then cross the main airport access road before passing through an existing golf driving range. An elevated station would be built and connected to the terminal building through a travelator link.

(355) The route would continue passing through the Royal Highland Showground and crossing the A8 Trunk Road before rejoining the Edinburgh- Glasgow south of Ratho.

(356) The land take is summarised as:

- agricultural;
- agricultural with "hope" value; and
- Royal Highland Showground.

(357) For much of the route, the agricultural landholdings are designated greenbelt and appear to have little potential development value under normal circumstances.

(358) Where the route passes through the Royal Highland Showground, it is difficult to imagine how the Showground could continue to operate in an economic and effective manner. At this stage, it is suggested that further research is carried out into the Showground operations. The further work required includes: an assessment of the showground's operations (there are a complex range of activities and it is reported to add £200m to the local economy each year[2]), the status of the proposed £40m upgrade, a valuation exercise, and an initial consultation with the Showground management regarding possible relocation. Following such a study, there would be a better idea of the possibility of retaining the Showground in this location and co-existent with a railway line, or the potential for a relocation to new premises.

(359) However, it should be noted that, within the range of options highlighted in the Future Development of Air Transport in the United Kingdom: Scotland consultation document, there are options which identify the Airport expanding onto the land currently owned and operated by the Royal Highland Showground. Clearly, should any of these options be pursued, there would be a major and sensitive consultation over the relocation of the Showground. At this stage, however, this suggestion appears to be no more than a possible option highlighted in a consultation document.

[2] West Edinburgh Planning Framework Consultation Draft 2002

(360)Given the agricultural nature of much of the land, there may be no need for relocations other than the Showground as described above. It is unlikely there would be any building demolition outside of the Showground site.

3.3.5.5 Environmental Issues

(361)The key environmental impacts are summarised below.

(362)The main concern for air quality in Edinburgh is the City Centre, extending out to Haymarket and Roseburn, where an Air Quality Management Area has been designated. Any infrastructure outside the Edinburgh City Centre is not considered to significantly contribute to air pollution as in these areas the air quality is well below the standards required. Although the service from Edinburgh Airport to Edinburgh Waverley would be run by diesel trains, the service would be formed by the through running of existing services and would not significantly add to air pollution within the City Centre.

(363)More significant is the potential impact of construction activity on receptors to air and noise pollution. Properties close to the alignment of the E & G Diversion option would be sensitive to temporary air pollution from dust due to the construction of the new track. There are approximately 50 properties within 100 metres of the new link.

(364)The route would cross the Gogar Burn and two minor burns that drain into the Gogar Burn. The Winchburgh Chord would cross the Swine Burn in two places. Impacts on the burns would be minimised by appropriate engineering design and the implementation of basic best practice construction management.

(365)All of the rivers and burns around Edinburgh Airport can potentially flood. However, none of the normal flood areas are considered to affect the rail alignment.

(366)There are several areas of nature conservation importance within the broader study area. From the Fife Line the proposed route would cross improved and semi-improved grassland with mature trees at field boundaries, and cross the Gogar Burn SINC, an important local wildlife corridor, before passing through the built and amenity environment of the Airport and Royal Highland Showground on elevated section. After crossing the A8, the route would pass through improved pasture and light scrub dominated by silver birch adjacent to the E & G line at Ratho Station. At the Winchburgh Chord habitats affected would include arable land, neutral grassland, scrub, ditches and hedgerows with trees. Badger activity along the route is likely.

(367)No designated geological features would be affected and no important mineral reserves would be sterilised by the new route.

(368)Residential receptors to this line would include several properties at Ratho Station, and potentially the Norton House Hotel, where the route would join the existing E&G line, properties at Ingliston, Castle Gogar, and approximately eight residential properties along the A8. Visitors to the Royal Highland Showground, Exhibition Centre, Ingliston Market, and the Hilton Hotel would be affected. Recreational receptors will be limited to users of the golf driving range. Workers at Ratho, Ingliston, the Showground and the Airport would receive views.

(369) There would be numerous high sensitivity receptors, including visitors to the Showground, who would see the railway in a particularly prominent location. A substantial adverse impact is predicted, due to the large magnitude of change being seen from many close range viewpoints.

(370) The route would cross agricultural land classified as capable of producing a wide range of crops (Grade 2) in the Ingliston area and land capable of producing a moderate range of crops (Grade 3) at Ratho Station and the Winchburgh Chord. The loss of agricultural land would be relatively minor and is not expected to affect the viability of farm holdings, particularly land at Ingliston designated for airport-related commercial development. The route would cross a former landfill site to the north of Gogar Farm, but the risks of encountering contaminated land are judged to be low.

(371) The route would pass close to or crosses several features of archaeological significance, including the Fort Scheduled Ancient Monument, five designated Archaeological Sites, two non-statutory Archaeological Sites of Potential, two A Listed buildings (Castle Gogar and Ingliston House) and ten B Listed buildings. These features would have an influence in the design of the final route alignment, and further mitigation measures may be required to further reduce potential impacts on the archaeological interest of the area. No buildings would require demolition.

(372) The area around Edinburgh Airport is classified in the relevant Landscape Character Assessment as The Lower Almond Farmlands landscape character area where the stated strategic aim is to prevent the further fragmentation of rural character.

(373) Three Areas of Great Landscape Value (AGLV) lie close to the route, and the route crosses the driveway of Castle Gogar, a non-inventory designed landscape where several mature trees would be lost.

(374) The proposals would have no effect on any designated areas. As in the E&G Spur option, the loss of mature trees at Castle Gogar driveway represents a significant effect. There would also be adverse effects on the showground area. Overall the scheme has a very poor fit with the landscape, and would introduce a dominating element in the form of extensive new viaducts. Substantial impacts are predicted overall.

(375) The link would pass over the A8 cycleway without impacts and a Right of Way between Ratho Station and Norton Mains would be crossed. It is envisaged that an alternative route across the new rail link would be provided to maintain access along the Right of Way.

3.3.5.6 Property Costs

(376) Property costs excluding the Royal Highland Showground have been estimated at £6.5m. This is based on land purchase of agricultural land. Our valuers are not prepared to put a cost to the acquisition/relocation of the showground without detailed knowledge of relocation scenarios and options for alternative sites. However, the Showground is currently undertaking a £40m upgrade. We would not expect any business to contemplate this level of upgrade unless they believed their land was worth substantially more. We have therefore included an indicative estimate for the cost of the showground of £100m in our costing.

(377) We have sought a meeting with the City of Edinburgh Council to discuss further the options for retention or relocation of the Showground. However, this did not shed any further light on the potential costs of a relocation of the Showground and we felt we should retain our indicative allowance of £100m in the appraisal. Sensitivity tests showing values of £50m and £150m have been included to explore how sensitive the appraisal of this option is to the Showground cost assumptions.

3.3.6 Edinburgh Surface Diversion

3.3.6.1 Background

(378) At the Steering Group meeting on the 5th of December 2002, a series of new options was tabled which aimed to achieve a through running service without the need for a runway tunnel spanning potentially two parallel runways, or avoiding a runway tunnel altogether.

(379) However, each of these options retains either one or two of the following major risk factors:

- disruption to airport operations through the removal of the Turnhouse Runway and other interactions with airport land;
- disruption of the Royal Highland Showground; and
- the risks associated with a runway tunnel.

(380) The alternatives of shuttle services to the Airport carry the costs and risk associated with the need to find capacity into Waverley Station.

(381) In discussion between the Scottish Executive and SKM, three further options have now been developed, which avoid some or all of these infrastructure risk factors.

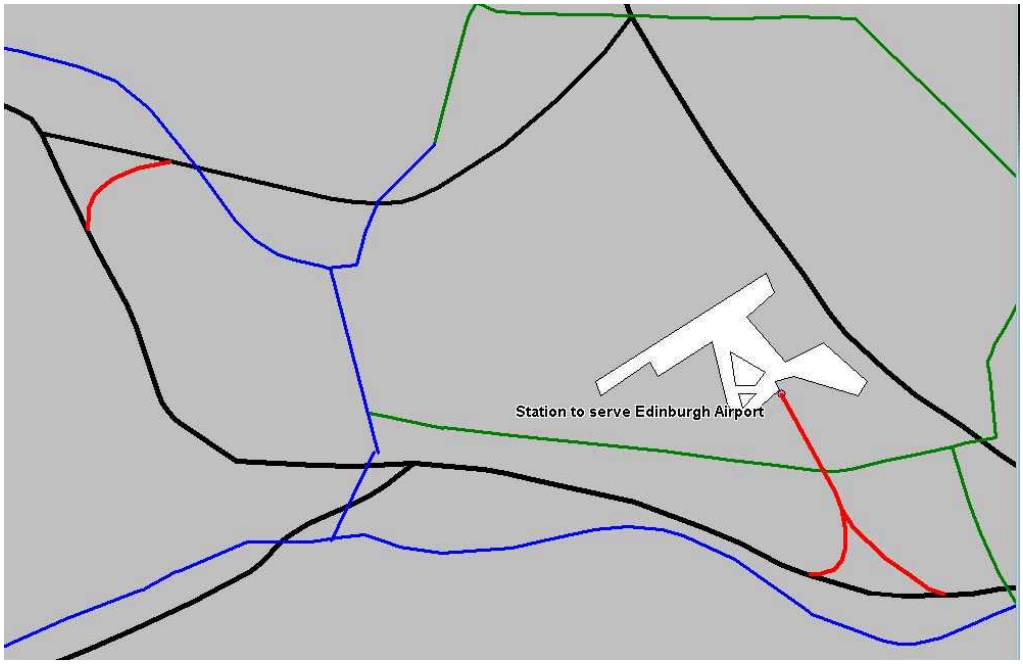
3.3.6.2 Infrastructure Options

(382) Based on our previous option generation, we can devise three composite options which combine some of the characteristics of spur options with those of through running options and achieve a service between the Airport and major destinations in Scotland whilst avoiding some or all of the major risk factors above.

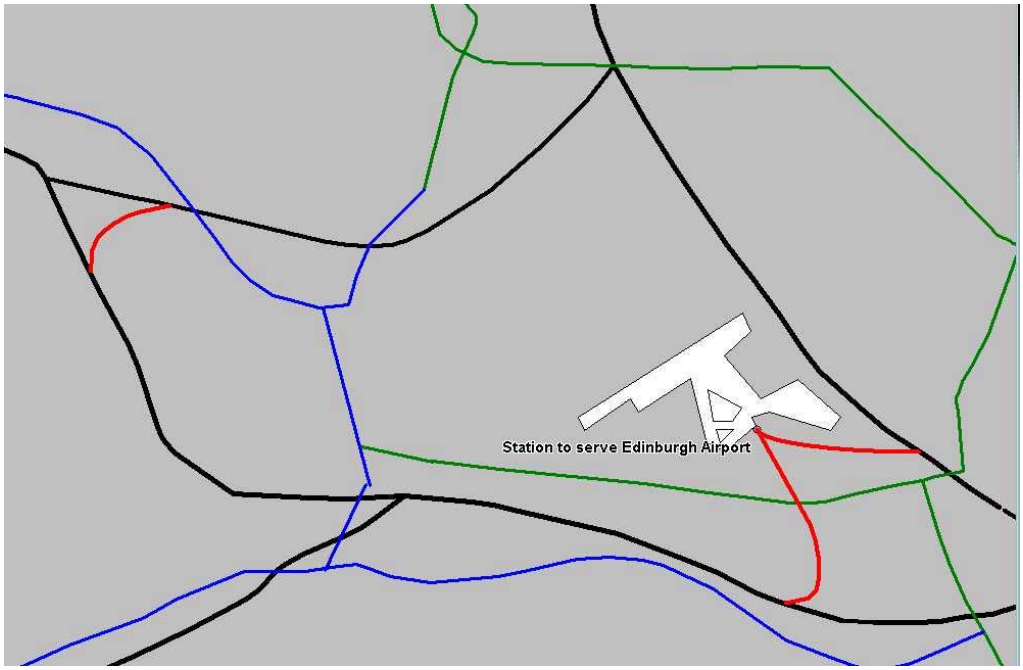
(383) Common to all these options is that they would incur disbenefits to through running passengers, which could be carefully managed through a combination of re-routed and new services.

(384) The first of the options is based on a spur from the E&G line only. The second combines a spur off the E&G line with one off the Fife line. The third option is based on a spur from the Fife line only. The options are referred to as options A, B and C respectively in the following.

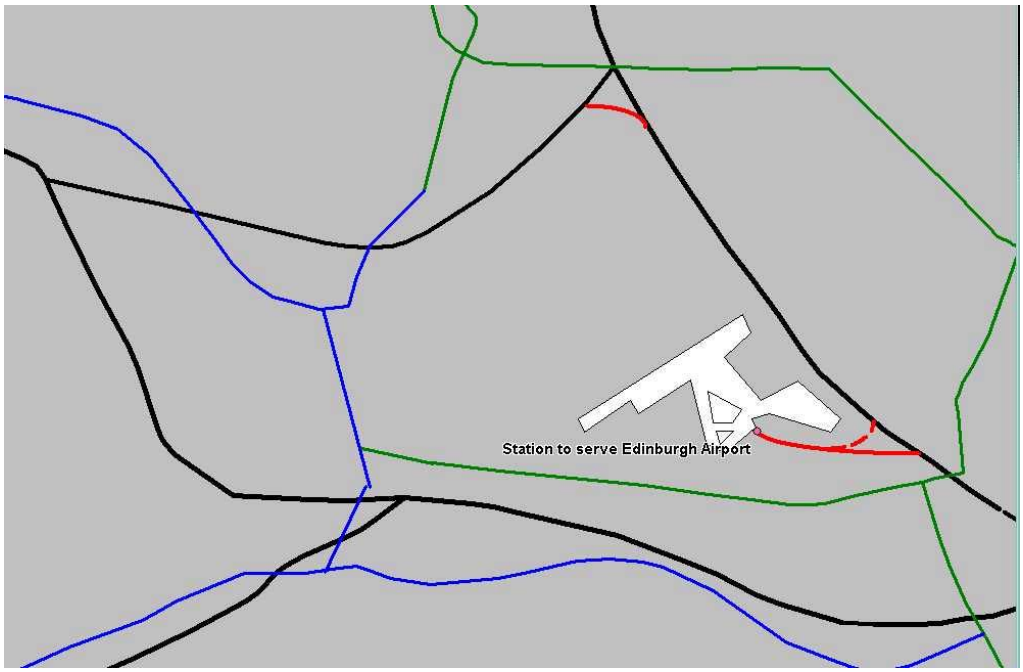
■ **Figure 3-2 Edinburgh Surface Diversion: Alignment Option A**



■ **Figure 3-3 Edinburgh Surface Diversion: Alignment Option B**



■ **Figure 3-4 Edinburgh Surface Diversion: Alignment Option C**



(385)In terms of passenger service, options A and B are identical. The difference lies in the capital costs and operational feasibility. Option C may be operationally simpler and the disbenefit to through travellers, especially for services to Fife, would be less. However, Option C would require the northward facing chord at the E&G line to be constructed in tunnel or cutting and would lead to, at least temporary, disruption of the Turnhouse Runway. It has been included here because, if these disruptions can be managed effectively, it may be the better option. However, in our appraisal, we have concentrated on a scheme which avoids all the major risk areas.

(386)For costing purposes, we have used scheme B, because this avoids the risks of scheme C and the extra capacity requirements through Edinburgh Park which would be incurred under scheme A.

(387)We have carefully considered the capacity implication of re-routeing some Fife services via the E&G line. We have identified a potential capacity bottleneck between the new airport junction and Newbridge junction, where Bathgate services diverge from the main E&G line. We have therefore costed the additional capacity required for this section. At Ratho Station, the railway is in a rock cutting and as a result we have costed this section on the basis that the existing tracks would be lifted and rearranged to allow the new section of track to be put in on the north side of the corridor. The cutting is lower on the north side and therefore the rock blasting required is reduced. It is possible to carry out the blasting operation adjacent to the tracks; however, the northern track would be subject to a a possession during the day (outwith peak operation) to allow these works to be undertaken. This will impact on the operation and as a result percentages for the Railtrack Possession and Train Operating Company (TOC) Compensation Costs have been increased.

3.3.6.3 Service Options

(388)A large variety of service patterns would be possible with this scheme. However, the journey time penalty for services re-routed via the Airport would be significant, which restricts the service patterns that may be acceptable. If train paths into Waverley became available, it would be possible to provide this option with a combination of new and re-routed services. However, to avoid all major risk areas and interdependencies, the following assumptions have been made:

- a time penalty to the Edinburgh-Glasgow Queen Street service is not acceptable;
- there is no spare capacity at Queen Street Station for additional services;
- there is no spare capacity across the Forth Bridge for additional services;
- the Airport should be served by services to both the North and the West; and
- the Airport should be served by a service of 4 tph to Waverley Station.

(389)This points to a service pattern which re-routes 2 tph from Fife and 2 tph from Stirling/Dunblane via the Airport. Edinburgh Airport would then become accessible to all points north and to Glasgow via just one interchange at either Inverkeithing, Linlithgow or Falkirk. As an alternative, to Stirling/Dunblane services, the Bathgate trains could be re-routed via the Airport. This would be less attractive in terms of connectivity.

(390)These options have the attraction of unhooking the airport services from Waverley capacity considerations, while avoiding all the infrastructure risks at the Airport outlined above.

(391)If the journey time penalty for Stirling/Dunblane or Bathgate services is considered unacceptable, the re-routeing of 2 tph from Fife via the Airport could be combined with an additional service of 2 tph from Waverley via the Airport to the west, terminating perhaps at Falkirk, Stirling or Cumbernauld. That would trigger the need to provide additional train paths into Waverley Station.

(392)Another possible service option would be to extend the existing Glasgow - Cumbernauld - Falkirk Grahamston services (1 tph) through to Edinburgh via the Airport. This would provide a direct service between the airport and Glasgow, albeit a fairly slow one (probably 15 minutes longer than an express would take) and still only one an hour. The other 3 services would then be Stirling/Dunblane (1 tph) and Fife circle (2 tph).

(393)Given the existing timetable, we could probably extend the Cumbernauld trains to leave Falkirk Grahamston at xx49, running non-stop to the Airport to arrive there at about x115. They would be about 7 minutes ahead of a Dunblane - Edinburgh train. In the opposite direction they would need to leave the Airport at xx33 to pick up their normal path from Falkirk Grahamston at xx59, arriving at Queen Street at x141.

(394)Journey time to Glasgow is therefore about 68 minutes with no changing, compared with about 55 minutes with a change at Linlithgow. This option would need one extra train set.

(395)If the Cumbernauld train continued to Edinburgh, then we could probably let one of the Stirling/Dunblane trains by-pass the Airport, thus sustaining current journey times for existing passengers on one train an hour.

(396) The fact that the line terminates at the Airport means that trains could also terminate there rather than simply reverse and carry on. So, as an alternative to taking up capacity into Waverley Station, we could just have a Glasgow - Cumbernauld - Falkirk - Airport service, on top of 2 tph, Edinburgh - Airport - Stirling and 2 tph, Edinburgh -Airport - Fife.

3.3.6.4 Modelled Scheme

(397) As outlined above, this scheme could enable a wide range of service options to be developed. This would need to strike a balance between the benefits to air passengers and the disbenefits to other rail users who would be inconvenienced by longer journey times. To provide an initial appraisal, we have assumed that 2tph to Fife and 2tph to Stirling/Dunblane would be re-routed via the airport.

3.4 Scheme Costs

3.4.1 Background

(398) Engineering costs and operating costs were developed for all shortlisted Phase 2 options. The further examinations undertaken during Phase 3 have confirmed these, in principle, but have identified additional items in some cases. In particular, the costs of capacity at Glasgow Central Station and Edinburgh Waverley Station need to be added to some of the options and the implications of HMRI advice on an underground station at Edinburgh have been costed. In addition, we now have outline estimates of property costs.

(399) On the 16th of January, Her Majesty's Treasury published its new guidance on "Appraisal and Evaluation in Central Government", known as "The Green Book". The Treasury's news release accompanying the publications stipulates that all projects that have not yet reached Invitation to Tender stage by 1 April 2003 should be assessed against the new guidance. The projects in question here clearly fall into that category.

(400) For our project appraisal, there are two key implications:

- the use of a lower (3.5%) discount rate; and
- an uplift in costs to account for "optimism bias".

(401) The latter is intended to ensure that the risk of underestimating project costs (particularly rail projects) are mitigated. Different uplifts are recommended for different project types. For standard civil engineering projects, an uplift of 44% is recommended. This can be reduced if it can be demonstrated that major project risk areas have been effectively managed and we have investigated to what extent we can assume such reductions.

(402) The costings undertaken for this study are based on "Level 2" in Railtrack's hierarchy of project development. From an engineering point of view, the project is still at concept stage, without detailed design. One exception to this is the station at Glasgow Airport, where a more detailed design exercise was undertaken with BAA.

(403) The Treasury state in their guidance:

> *"Project appraisers should note that the upper bound percentages in Table 1* [ie 44% for standard Civil Engineering Projects] *relate to the average historic*

> *optimism bias found at the outline business case stage for traditionally procured projects. Higher optimism bias may therefore be required at an earlier stage in the appraisal process.".*

(404) In guidance on how to apply the adjustment, the document states *"Always start with the upper bound"* (ie 44%). Lower values can be used if it can be demonstrated that project risk areas have been mitigated, but the Treasury guidance states that *"clear and tangible evidence must be observed, and independently verified, for the mitigation of risks in project risk areas before reductions in optimism bias should be made.".*

(405) The rail links have not yet been developed to a level of detail where such clear and tangible, and independently verified, evidence can be supplied.

(406) We have also sought advice on which costs the adjustment should be applied to from the author of the report on Optimism Bias for the Treasury, and were advised as follows:

> *"Optimism bias should be applied to civil engineering cost estimate, excluding land and contingencies, but including items such as Railtrack compensation, consultancy fees, design fees and mobilisation fees. Contingencies cater for optimism therefore contingencies should not be included in an optimism bias calculation.".*

(407) When questioning further whether the optimism bias adjustment should replace contingencies or simply not be applied to the contingencies assumed, we were advised:

> *"Optimism bias adjustment does not replace contingencies. The optimism bias adjustment provides a measure of the level of optimism anticipated in initial project estimates.*
>
> *The term 'optimism bias' is used as a measure of optimism in project estimates (excluding contingencies). Effective risk management should be applied to reduce the published optimism bias adjustment figure for a project. Please note that there is a cost attached to managing project risks identified after the initial project estimates have been prepared. Managing these risks allows a reduction in optimism bias levels but can result in an increase in the project cost estimate (project duration is not necessarily affected).*
>
> *Since contingency sums are a way of pricing for the cost of unforeseen risk occurrences in projects, contingencies funds are a means of costing for the anticipated residual optimism bias level for your project (after effective risk management has reduced the optimism bias adjustment to an anticipated optimism bias level specific to the project).".*

(408) The approach we have adopted in our project costing was therefore to apply the full 44% adjustment to all capital costs of all schemes, excluding land costs and contingencies, and excluding Glasgow Airport station, where a lower adjustment of 10% was used.

(409) The operating costs as currently calculated include an allowance for track access charges. The philosophy underlying the calculation of track access charges is far from

transparent and it is not clear to what extent they cover just maintenance of existing assets or the provision of new infrastructure where appropriate. Where track access charges relate to pieces of infrastructure whose provision we have also costed as a capital expenditure, there ***may*** therefore be an element of double-counting. In our sensitivity testing, we have therefore included a test where track access charges are removed from the operating costs.

(410)Our aim in this study was to provide robust costings which take account of all known factors that may impact on the project. More detailed design and engineering assessments of any preferred option would be required to refine these costs. Our costings include all infrastructure elements which we believe to be necessary to implement the airport schemes as free-standing projects.

(411)There may be opportunities to avoid certain cost elements or to allocate them differently. This applies in particular to the costs of the St John's Link and the capacity upgrades between Paisley and Shields Junction in Glasgow, and the costs of additional capacity through Edinburgh Park and of constructing and operating a section 12 (underground) station with the Runway Tunnel scheme in Edinburgh. We have undertaken a series of sensitivity tests to examine the sensitivity of our results to these assumptions. These are summarised in chapter 6.

3.4.2 Glasgow Scheme Costs

(412)Table 3.1 summarises the cost estimates for the shortlisted options at Glasgow. For traceability of changes, we start with the costs shown in our Phase 2 report and then show costs changes identified since.

■ **Table 3-1 Glasgow Schemes Cost Summary (£m in 2002 prices)**

	Glasgow Central	Queen Street	Central Plus	Queen Street Plus
Phase 2 Costs				
St James Link at the Airport	50.6	50.6	50.6	50.6
Capacity between Paisley and Shields Junction	35.1	35.1	35.1	35.1
St John's Link	-	17.9	-	17.9
Upgrades to the Carmyle Route	-	-	0.4	0.4
Total Phase 2 Costs	**85.7**	**103.6**	**86.1**	**104.0**
Costs Changes				
Glasgow Central Station Capacity	15.0	-	15.0	-
Edinburgh Waverley Station Capacity	-	-	71.0	71.0
Land Costs (indicative estimate)	10.0	16.7	10.0	16.7
Reduced RT Possession and TOC Compensation	-5.6	-8.5	-5.6	-8.5
Optimism Bias Adjustment	34.9	35.0	63.0	63.1
Total Phase 4 Costs	**140.0**	**146.8**	**239.5**	**246.3**
Operating Costs (pa)	3.1	3.5	6.8	7.2

3.4.3 Edinburgh Scheme Costs

Table 3.2 summarises the cost estimates for the shortlisted options at Edinburgh. For traceability of changes, we again start with the costs shown in our Phase 2 report and then show costs changes identified since.

■ **Table 3-2 Edinburgh Schemes Cost Summary (£m in 2002 prices)**

	Fife Spur	E&G Spur	Runway Tunnel	E&G Diversion	Surface Diversion Option B
Phase 2 Costs					
Engineering at the Airport	22.9	119.0	228.5	86.5	39.4
Total Phase 2 Costs	**22.9**	**119.0**	**228.5**	**86.5**	**39.4**
Costs Changes					
Grade-separated junction at Fife Line	25.7	-	-	25.7	25.7
Grade-separated junction at the E&G Line	-	20.0	20.0	25.7	25.7
Additional Capacity at Edinburgh Park	-	-	30.2	-	-
Additional Capacity to Newbridge Junction	-	-	-	-	13.5
Additional Provision for S12 Station	-	-	81.6	-	-
Edinburgh Waverley Station Capacity	155.8	155.8	-	-	-
Land Costs (indicative estimate)	5.0	6.5	7.0	106.5(1)	11.5
Optimism Bias adjustment	80.7	115.2	138.3	54.3	40.6
Total Phase 4 Costs	**290.0**	**416.6**	**505.6**	**298.7**	**156.4**
Operating Costs (pa)	3.1	3.1	2.9(2)	1.6	1.6

(1) This includes an indicative allowance of £100m for the acquisition and reinstatement/relocation of the Royal Highland Showground.

(2) This includes an allowance for operating the airport station as a Section 12 (underground) station.

4. Forecasting and Appraisal Issues

4.1 Background

(413) During Phases 1 and 2 of the study, we have presented indicative appraisal summary tables based on STAG Part 1 guidelines. The tables had been simplified to ensure that only information which helps to distinguish between options was included. Information common to all options at one airport was provided separately.

(414) The appraisal of infrastructure options at the end of Phase 1 was largely based on a review of previous studies and other readily available information. The Phase 2 appraisal of service options included the findings from our study team on engineering and environmental issues, as well as infrastructure costings and single year (2010) demand and revenue forecasts.

(415) In Phase 3, we report our detailed demand and revenue forecasting, full environmental assessment, planning advice and further engineering work in a full STAG Part 2 appraisal. In addition, we report separately the results of our Transport Economic Efficiency Analysis (TEE).

(416) In undertaking a full TEE analysis, we have encountered a number of forecasting and appraisal issues, which are outlined in the following and detailed in Appendix G.

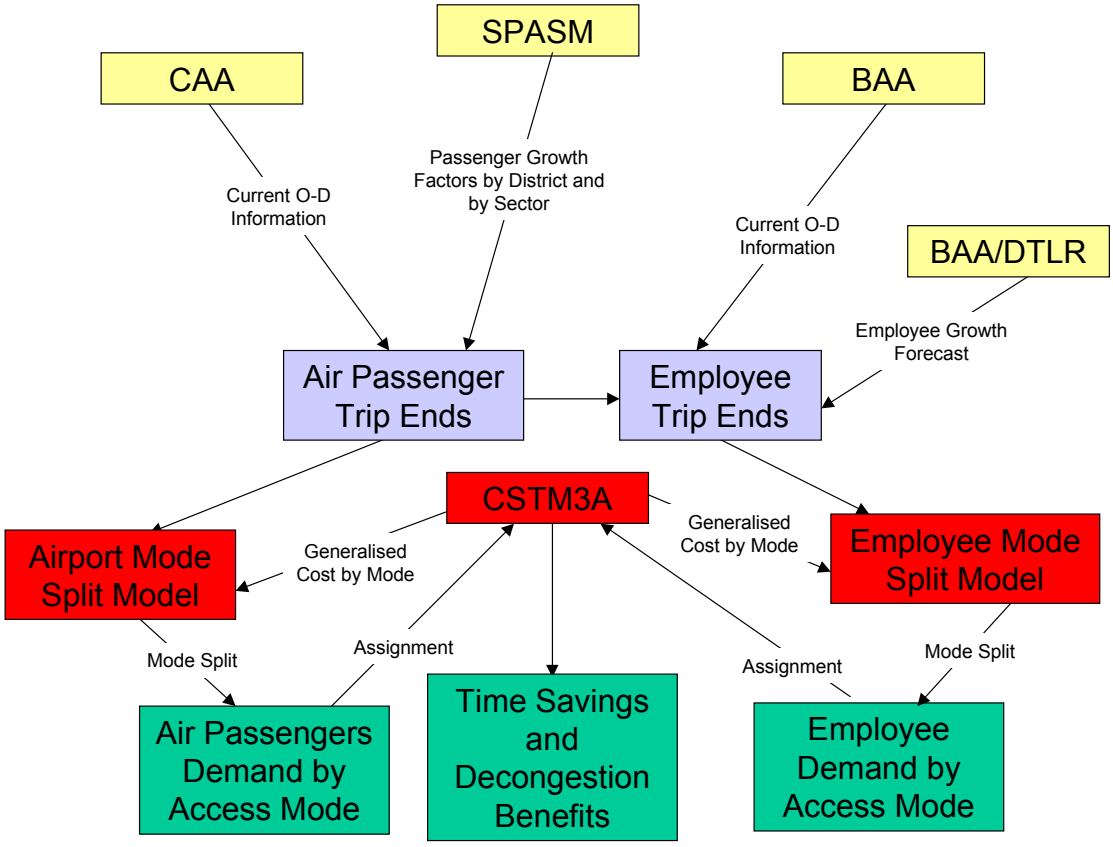
4.2 Key Forecasting Assumptions

4.2.1 The Forecasting Model

(417) The details of our modelling approach have evolved throughout the study and have been documented in our Inception, Phase 1 and Phase 2 reports as well as a technical model development report.

(418) The approach is outlined in figure 4.1.

■ **Figure 4-1 Modelling Process Outline**



(419) The basic principle of our approach was to use a specific, logit-based mode split model for air passengers and employees, with separate models implemented for different travel sectors. The model takes as inputs passenger and employee landside origin and destination data from BAA and CAA surveys, passenger growth forecasts from the Department for Transport's "SPASM" model and transport network data from the Central Scotland Transport Model Version 3A (CSTM3A).

4.2.2 SPASM

(420) The Department for Transport (DfT) and the Scottish Executive have just published their consultation document on "The Future Development of Air Transport in the United Kingdom: Scotland". The main forecasting tool used for this is the SPASM model, the Department's Air Passenger Allocation Model, which forecasts the number of passenger and air traffic movements at UK mainland airports.

(421) The overall air traffic demand used in SPASM is based on the DfT's "Air Traffic Forecasts for the United Kingdom 2000", which has been reproduced in the appendix to our Phase 2 report. The full document is available on http://www.aviation.dft.gov.uk/atfuk2000. The main points are:

- UK GDP was assumed to increase by 2.25% pa between 2002 and 2020;

- a reduction in air fares of 1% real pa was assumed between 1999 and 2020;
- as a result, total demand for air travel was forecast to increase from a base of 160m passengers in 1998 to 257m (low forecast) or 297m (high forecast) in 2010, and 348m (low) or 461m (high) in 2020; and
- high and low forecasts were generated by assuming a plus or minus 15% divergence from the central case forecast by 2020.

(422)It is understood that the implementation of SPASM involved a number of regional adjustments for the forecasts for Scotland, and for Edinburgh and Glasgow specifically. In particular, demand outside the South East of England was assumed to grow more strongly than within the South East, and within Scotland, a more rapid growth in demand was assumed in the East compared with the West.

(423)On advice from the DfT, we used data from a SPASM scenario known as "J62" as our base forecast. Although the Steering Group accepted the DfT's advice, BAA in particular wished the robustness of our findings to other growth forecasts to be tested. The results of these sensitivity tests are set out in chapter 6.

4.2.3 Overall Demand

(424)The demand forecasting model for air passengers was calibrated using grossed-up data from 2001 CAA passenger survey at Glasgow and Edinburgh. The CAA data are available by geographical district and were disaggregated to CSTM3A zones using appropriate factors based on employment, households and hotel beds.

(425)In our forecasting in Phase 2, we produced single year figures for a 2010 forecasting year. During Phase 3, we developed forecasts for the shortlisted schemes for two forecast years, 2010 and 2020, to generate a demand and revenue stream for the appraisal. Table 4.1 summarises passenger demand totals for both airports which were used in our forecasting.

Table 4-1: Overall Annual Air Passenger Demand

	Glasgow Passengers			Edinburgh Passengers		
	Domestic	International	**Total**	Domestic	International	**Total**
2001 Observed (CAA)	n/a	n/a	**7,249,400**	n/a	n/a	**6,039,300**
2010 SPASM J62	5,137,010	6,289,748	**11,426,758**	5,493,253	4,741,889	**10,235,142**
2020 SPASM J62	6,259,123	8,615,180	**14,874,303**	8,357,146	9,094,259	**17,451,405**
2030 SPASM J62	7,555,413	9,531,697	**17,087,110**	9,904,130	13,963,754	**23,867,884**

4.2.4 Airport Employees

(426)For present day employee origin-destination patterns, current BAA employee survey data provided a good source. As for air passengers, we allocated these to CSTM3A zones.

(427)BAA also produce forecasts of future employee numbers, and have provided a forecast for 2030 which is compatible with the SPASM "J62" figures above, using their model. However, we have not been able to obtain SPASM-consistent Air Traffic Movements and Cargo numbers for intervening years to allow BAA to calculate employment numbers for 2010 and 2020 in a similar manner.

(428) We have been unable to facilitate agreement between BAA and DfT on the actual employment forecasts to be assumed. We therefore undertook a factoring based on the known present day figures and BAA's "SPASM J62-compatible" 2030 numbers. We used these data and interpolations of ATM and Cargo numbers to generate employee numbers for intervening years. The resulting figures are summarised in table 4.2.

■ **Table 4-2: Airport Employee Forecasts**

	Glasgow Employees	Edinburgh Employees
2001 Estimate	**5,300**	**2,500**
2010 Forecast	**8,100**	**4,500**
2020 Forecast	**9,500**	**9,100**
2030 Forecast	**11,000**	**12,000**

(429) These numbers were circulated to BAA and DfT for further comments. BAA felt that the figures were possibly on the high side, but did not wish to propose alternatives and were happy for the study team to apply its own judgement. DfT wanted to consider the matter in more detail but were unable to offer further advice within the study timescale. We have therefore used the above numbers in our demand forecasting. It should be noted that the number of airport employees is not critical in the overall justification of the rail schemes.

4.2.5 Airport Visitors

(430) Airports generate additional traffic from visitors, such as meeters and greeters, or people coming to meetings at the airport. Our investigations during this study showed that there are scant data available about such trips.

(431) There is some anecdotal evidence that meeter and greeter trips occur on public transport only at very large airports in highly congested major conurbations, such as at London Heathrow. For smaller airports, the overwhelming majority of such trips will be made by private car and would therefore play a very minor role in the justification of any rail links.

(432) In the absence of any data on such trips, we have not included any estimates in our forecasts. Trips by airport visitors could therefore be regarded as a minor upside on our forecasts presented in this document.

4.2.6 Other Forecasting Assumptions

(433) In addition to the assumptions for air passenger demand and related number of employees outlined above, our study requires assumptions about the factors which influence the level of demand for, and congestion on, the road system and the levels of non-airport-related public transport passenger demand.

(434) The corridor from the Glasgow Airport to the city centre is part of one of the corridors being investigated in the Central Scotland Transport Corridor Studies (CSTCS). There are considerable advantages in using the same forecasts in both CSTCS and this Airport Rail Links Study, including the following.

- it avoids differences arising between the studies simply because different, plausible, assumptions had been made in preparing forecasts of future demand in the corridor; and
- it avoids a considerable amount of work in developing and agreeing a revised set of assumptions and in re-running CSTM3A to produce new forecasts at a time when the resources available for this are severely limited.

(435)For 2020, the CSTCS study team has produced an initial do-minimum run based on an extrapolation of the assumptions underlying the Glasgow and Clyde Valley Structure Plan.

(436)Outside the Glasgow and Clyde Valley Structure Plan area, the extant Structure Plans have been used as the basis for the CSTCS forecasts. While this might be acceptable for the purpose of CSTCS (where the prime area of interest is on Glasgow and corridors to the east of Glasgow), it is apparent from the West Edinburgh Planning Framework that some variations from the Structure Plan could arise in the vicinity of Edinburgh Airport. However, we were not able to generate a new up-to-date forecasts for 2020 which took account of the latest proposals and permissions in West Edinburgh, partly because plans are still somewhat fluid but mainly because a special re-run of the CSTM3A would have required more effort than warranted. Our approach, therefore, was to accept the forecasts produced in CSTCS for 2020 as the basis for our appraisals, but to assess the robustness of our findings to variations in highway congestion levels, as explained in chapter 5.

4.2.7 Fares

(437)In discussions with the Steering Group, it was decided that we should assume a premium fare for rail which is consistent with the current bus and coach fares. In practice, this means a premium fare of £3.30 in both cities for journeys to the city centre. Standard rail fares take over for longer distances. At Glasgow, the fare from Paisley Gilmour Street to the Airport has been set at 90 pence. At Edinburgh, £3.30 was implemented as a minimum fare from the Airport to anywhere. During Phase 3, we tested a number of fare sensitivities to derive revenue-maximising fare levels, as explained in chapter 6.

(438)We assumed that fares would change over time in the same way as assumed in CSTCS, as follows:

- a decline in real terms for rail fares; and
- an increase in real terms for bus fares.

(439)However, we have deviated slightly from a strict application of the above by assuming that the premium-fare airport shuttle bus would follow the trend of rail fares rather than that of bus fares.

4.3 Appraisal Issues

4.3.1 Background

(440)During Phase 3, we undertook an appraisal of a shortlist of schemes to STAG Part 2 level. In addition to a more detailed assessment of environmental, accessibility, land use and social inclusion issues, this includes a full Transport Economic Efficiency Appraisal. In the process, we had to resolve some issues arising for the

methodology for, and input assumptions to, that appraisal. These issues are detailed in appendix G and outlined briefly below.

4.3.2 Behavioural Values of Time

(441) This section provides a detailed justification for the values of time used in the demand forecasting and appraisal for air passengers. Air passengers would generate the overwhelming majority of the scheme benefits and are therefore the most important user group to analyse in detail. For other affected groups (employees, other rail passengers and beneficiaries from road decongestion) we used standard values of time from the DfT's Transport Economics Note (TEN).

(442) The key issue here is: we need to use "behavioural" ("willingness to pay") values of time in our demand forecasting to accurately predict people's behaviour. Air passengers have particularly high values of time. In the following, we discuss how appropriate it is to use these values of time in the appraisal. This issue also interacts with the question of how these values should grow over time, and how to treat the "new mode", which are discussed in turn below.

(443) The values of time we derived for our modelling and appraisal are based on those generated for the Heathrow Surface Access Model (HSAM)[3]. These were researched based on detailed stated preference surveys specifically with air passengers at the time.

(444) However, in addition to updating the values to a 2001 base, we made appropriate local adjustments to account for two issues:

- lower incomes for local users of Glasgow and Edinburgh Airports compared with those at Heathrow; and
- a different segmentation of demand in our forecasting.

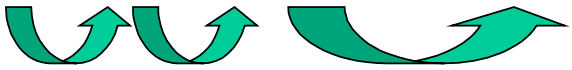
(445) The adjustment for lower incomes has been applied to UK demand only, not to foreign demand. In contrast to HSAM with its 6 travel sectors, we do not distinguish between domestic and international travel. The 4 sectors we do model are also slightly different from HSAM – instead of distinguishing between "UK" and "Foreign", we have segmented our demand into "Scottish" and "Non-Scottish". This meant we had to calculate weighted average values for our sectors.

(446) Table 4.3 shows the values used and outlines their derivation.

[3] Recalibration of the Heathrow Surface Access Model, Final Report, MVA Consultancy, January 1994

■ **Table 4-3 Derivation of Values of Time**

	Derived Values					For Comparison					
	Heathrow (HSAM)	Heathrow	Scotland		Weighted Average	SPASM	TEN Car Driver	TEN Car Passenger	TEN Bus Passenger	TEN Taxi Passenger	TEN Rail Passenger
	2000 values in 2000 prices	2001 values in 2001 prices	2001 values in 2001 prices		2001 values in 2001 prices	1998 values in 1998 prices	1998 values in 1998 prices	1998 values in 1998 prices	1998 values in 1998 prices	1998 values in 1998 prices	1998 values in 1998 prices
UKBD	36.0	37.5	29.5	SB	31.2	69.5	29.1	22.8	18.5	39.6	42.0
UKBI	58.5	61.0	47.9								
UKLD	11.9	12.4	9.7	SL	12.0	11.6	7.5	7.5	7.5	7.5	7.5
UKLI	16.8	17.5	13.8								
FB	56.9	59.3		NSB	45.5	79.7	29.1	22.8	18.5	39.6	42.0
FL	14.2	14.8		NSL	15.0	11.6	7.5	7.5	7.5	7.5	7.5



Adjusted for RPI and AEI growth

Adjusted for Scottish Incomes

Weighted average value calculated for those travel segments that were combined in the model

(447) This approach was discussed and agreed with key members of the client team at a seminar on modelling and appraisal issues held on the 18th of October 2002.

4.3.3 Growth in Value of Time

(448) The preferred and most consistent approach is to assume an increase of the values of time in line with income for both modelling and appraisal. We have assumed this approach in our main forecast, but have shown in sensitivity testing (in chapter 6) the impact of not increasing values of time over time.

4.3.4 Rail as New Mode

(449) The treatment of rail as a new mode leads to some complexities in scheme appraisal. This is the result of using an appropriate, complex demand forecasting model which produces specific air passenger demand and revenue forecasts for the rail links by user segment.

(450) The key issue is that with the treatment of rail as a new mode in the scheme test (do-something), there is no equivalent do-minimum mode from which to derive generalised costs for the appraisal. This issue is explained in greater depth in appendix G.

(451) Our solution for this problem was the use of "composite" cost of bus and rail in the do-something situation (the composite public transport cost) to compare with the bus cost in the do-minimum. However, this composite cost can only be derived from the forecasting model and this gives rise to two issues:

- as the forecasting model converts all benefits to one common unit ("generalised cost"), it would not be possible to distinguish between time and money benefits as stipulated in STAG; and
- the composite cost enshrines the values of time used in the demand forecasting model, thereby making the use of identical values of time for forecasting and appraisal imperative.

(452) It is our understanding that STAG is not intended to be prescriptive. Variations in approach for good reasons are permissible. We therefore believe that the inability to distinguish between time and money benefits should not present a problem.

(453) The need to use consistent values of time for modelling and appraisal was discussed and agreed with key members of the client team at a seminar on modelling and appraisal issues on the 18th of October 2002. Different values of time feature in our sensitivity testing in chapter 6.

4.3.5 Foreign Travellers

(454) The Treasury's guidance states that "*Costs and benefits should usually be confined to those which fall on United Kingdom residents.*". We assume that the basis for this is that money available to Government is derived from taxes which are paid predominantly by UK residents. However, with the gradual movement away from direct taxes (income) to indirect (expenditure) this is less valid than it used to be.

(455) In practice, within the transport sector there is normally no effort made to distinguish benefits accruing to non-UK residents. This is largely because the key sources of data do not relate explicitly to non-UK residents: NTS is collected from UK residents only, and traffic census data does not distinguish between UK and non-UK movements. In addition, the proportion of travel in the UK carried out by non-UK residents will be small (even though it might be more significant in the SE region), and there is a "quid pro quo" argument that UK residents get unpaid-for benefits from travel improvements in foreign countries which they visit.

(456) The situation is rather different in the case of airports, because the proportion of non-UK residents is likely to be significantly higher than for transport schemes in general. There is then certainly a case for following the Green Book advice to the letter, and excluding the benefits to "Foreign" travellers, though their revenue should of course be included in the overall calculus. However, in consultation with the steering group, it was decided that the main appraisal should treat foreign travellers as no different from UK residents from an appraisal point of view. A variant appraisal excluding the benefits to foreign travellers has been included in our TEE tables.

(457) One particular issue arises for our appraisal. Because the key determinant of behaviour with respect to airport access is not nationality but place of residence, our demand forecasting model segments the market into Scottish and non-Scottish travellers, and not into UK and foreign. In our appraisal, we used a factoring method,

based on present day passenger surveys, to separate foreign travellers out from our "non-Scottish" segment.

4.3.6 Road Decongestion Benefits

(458) The theory of road decongestion benefits is straightforward but, in practice, they can be very difficult to calculate. The issue is how journey time changes if traffic is removed from the highway network and how this benefits the remaining traffic. This needs to recognise that, if journey times change, there may be traffic and traveller adaptations in consequence.

(459) In particular, as we are predicting some transfer of airport trips from car to public transport, we wish to know how the reduced congestion would benefit other car trips. Although this appears to be a straightforward problem for a traffic model to address, we had concerns about "noise" in assignment routines of the existing CSTM3A model which would make the small impacts of public transport schemes on the road network undetectable.

(460) We therefore needed to devise an artificial test to enable us to estimate these benefits. This was developed following discussions with MVA, the custodians of CSTM3A, who also undertook the CSTM3A model runs for us. The method we adopted was as follows.

(461) For the 2020 morning peak period at Glasgow Airport (the time period and location where we could expect a significant level of congestion), we took the do-minimum trip, cost and distance matrices. We then removed all trips to and from the Airport from the trip matrix and ran a re-assignment (i.e. we re-loaded the reduced trip matrix onto the network and allowed trips to find new routes to take account of changed congestion levels).

(462) This gave us a revised set of cost matrices from which we could derive the changes which would arise from a 100% reduction of all the Glasgow Airport trips. This was based on the assumption, borne out by an analysis of where (geographically) journey time changes occurred, that the effect we were trying to measure far outweighed the "model noise" introduced by the re-assignment. From the revised cost, trip and distance matrices, we calculated an average benefit to other road user for every car kilometre removed from the network. Using information from CSTCS on the relationships between morning peak (07.00-10.00), interpeak (10.00-16.00) and evening peak (16.00-19.00) benefits for the Harmonised Plan, we then calculated equivalent figures for other time periods and for 2010.

(463) We then analysed from flight schedules what proportions of access and egress journeys occur during the morning peak, interpeak and evening peak periods and calculated the actual reductions in car kilometres caused by the mode shift generated by our airport rail schemes in each of these time periods. This was then applied to the above average benefit per removed vehicle kilometre by time period. We assumed that outside the peak and interpeak periods, that benefit would be negligible.

(464) The benefit thus derived represents an overestimate, because it takes no account of the reaction of other travellers to the freed-up roadspace, in particular the effect of induced traffic (the generation of new travel demand as a result of changed travel

costs) which would absorb some of the benefits which would otherwise be apparent as a decongestion effect.

(465) In theory, CSTM3A would give us induced traffic effects by running the demand/supply model interactions, but the changes would be so small that we would be unlikely to detect them.

(466) Our approach also implied that all the mode transfers would have one end at the airport. This simplistically ignores second order effects as a result of the airport passenger transfers, which can be assumed to be small.

(467) A standard approach, used elsewhere (such as the LTS model in London) is to simply factor down decongestion benefits thus calculated by 50% to allow for all the above effects. As can be seen from the Transport Economic Efficiency results in chapter 6, the road decongestion benefits, though not insignificant, are small in comparison with other benefits and do not play a dominant part in the scheme justification.

4.3.7 Appraisal Period

(468) The standard appraisal period for major schemes of this type is 30 years from the scheme opening, which we assume to be in 2010.

(469) Our demand forecasting model produces forecasts for 2010 and 2020, in line with CSTCS and the underlying model data from CSTM3A. It is standard practice for appraisal purposes (as embodied in the DfT's TUBA software), to interpolate between forecast years and to assume a flat profile of benefits beyond the last forecasting year. That means, we have assumed no further growth beyond 2020 in our appraisal.

(470) There was a choice of two software suites for our appraisal:

- TUBA, the standard Department for Transport appraisal software for projects affecting more than one mode; and
- TREVAL and PTEVAL, a suite of appraisal programs developed specifically for the Scottish Executive to interface with CSTM3A.

(471) Both programs are consistent with stipulations in STAG. Our use and application of CSTM3A is a highly specific and customised one, which does not enable us to benefit from the standard interface arrangements between CSTM3A and TREVAL/PTEVAL. We have therefore used TUBA in our appraisal.

4.3.8 Discount Rate and Optimism Bias

(472) At the outset of the study, the standard discount rate used in UK scheme appraisal was 6%. In January 2003, the Treasury have published an update to their guidance on Appraisal and Evaluation in Central Government, the "Green Book".

(473) This new guidance applies to all projects that have not yet reached Invitation to Tender stage by 1 April 2003. The main impact of the new guidance on the rail links study is the use of a 3.5% discount rate in conjunction with an uplift in costs to account for "optimism bias". The latter is intended to ensure that the risk of underestimating project costs (particularly rail projects) are mitigated. Supplementary Green Book guidance on optimism bias stipulates that this uplift should be 44% for

Standard Civil Engineering projects. In addition, the works duration should be increased by 20%.

(474) The guidance does explain that if project appraisers can demonstrate that good practice has been adopted (ie that risk areas contributing to optimism bias have been effectively managed) then the uplift may be reduced. As outlined in 3.4.1 above, with the exception of the station at Glasgow Airport, we do not feel that the rail links have been developed to a level of detail where such reductions would be justified.

(475) Following further consultation with the Treasury advisor on Optimism Bias, we have adopted an approach where we applied the full 44% adjustment to all capital costs of all schemes, excluding land costs and contingencies, and excluding Glasgow airport station, where a lower adjustment of 10% was used. The works duration was extended by 20% by assuming a construction period of 6 instead of 5 years.

5. Scheme Appraisal

5.1 Background

(476) During Phases 1 and 2 of the study, we presented indicative appraisal summary tables based on STAG Part 1 guidelines. The tables had been simplified to ensure that only information which helped to distinguish between options was included. Information common to all options at one airport was provided separately.

(477) The appraisal of infrastructure options at the end of Phase 1 was largely based on a review of previous studies and other readily available information. The Phase 2 appraisal of service options included the findings from our study team on engineering and environmental issues, as well as infrastructure costings and single year (2010) demand and revenue forecasts.

(478) In Phase 3, we reported our detailed demand and revenue forecasting, full environmental assessment, planning advice and further engineering work in a full STAG Part 2 appraisal. In addition, we reported separately the results of our Transport Economic Efficiency Analysis (TEE).

(479) STAG stipulates that Part 2 Appraisal Summary Tables (ASTs) should repeat any information presented in an earlier Part 1 appraisal, suitably updated where appropriate. We have modified the STAG Part 2 Appraisal Summary Tables slightly to make them compatible with the format used in the Central Scotland Transport Corridor Studies (CSTCS) and the requirements of the Transport Economic Efficiency appraisal stipulated in the Guidance on the Methodology for Multi-Modal Studies (GOMMMS). These modifications are:

- under "proposal background" we omit the line "alternatives to the proposal considered" because all the schemes we appraise are alternatives to each other;
- "Part 1b" is omitted as this information is elaborated upon in the Part 2 table;
- a detailed description of project costs has been moved from the start of the Part 1 table to the start of the Part 2 table, which also contains the detailed appraisal; and
- at the end of Part 2, we include a section on social exclusion.

(480) In our presentation of the Transport Economic Efficiency Tables, we have also made small amendments to the standard table layout to provide additional information which we feel are important for the airport schemes specifically. We therefore report benefits separately for different beneficiaries, based on the segmentation used in our forecasting. The segments reported separately are:

- Scottish Business;
- Scottish Leisure;
- Non-Scottish Business;
- Non-Scottish Leisure;
- Employees; and
- Non-Airport Users.

(481) Under the last heading, we include benefits and disbenefits to other rail users who are in some way affected by the airport schemes, and decongestion benefits. We have also disaggregated the Non-Scottish sectors further to separate out benefits to

foreign residents. Total benefits and the Benefit/Cost Ratio are presented with and without benefits accruing to foreign residents.

5.2 Planning Objectives

(482) STAG requires the definition of planning objectives against which the schemes are to be appraised. During Phase 1 of this study, the following planning objectives were agreed by the Steering Group:

To provide (a) rail link(s) to Glasgow and/or Edinburgh Airport(s), and/or to each other with the following characteristics:

- ***Operating costs should, at least, be covered by revenues, or be supported by third party contributions, based on other benefits.***
- ***Any public sector contribution to capital costs should, at least, be matched by non-user benefits.***
- ***Options should be compatible with potential long term development strategies being considered at each airport as part of the preparations for the UK Air Transport White Paper and should address the specific market and strategic functions being identified for each.***

5.3 Demand and Revenue Forecasts

(483) In Phase 2 of the study, we have produced a single year forecast for 2010 for all schemes at both airports. During Phase 3, we have developed a second forecast year (2020) to enable a demand, revenue and benefits stream to be calculated. In the process, we have also reviewed the consistency of all input assumptions, which led to an update of our 2010 forecast. The 2010 figures presented here are therefore not identical to those presented in Phase 2.

(484) Table 5.1 summarises the air passenger demand forecasts for all schemes. Airport employee demands for all schemes are summarised in table 5.2.

■ **Table 5-1: Air Passenger Demand Forecast for all schemes (million trips pa)**

	Scottish Business		Scottish Leisure		Foreign Business		Foreign Leisure		**Public Transport**		**Total Rail**	
Scheme Option	Public Transport	Rail	Public Transport	Rail	Public Transport	Rail	Public Transport	Rail	**Demand**	**Mode Share**	**Demand**	**Mode Share**
2010												
Glasgow DM Base	0.05		0.51		0.06		0.24		**0.86**	**7.5%**		
Glasgow Central	0.05	0.03	0.63	0.38	0.08	0.05	0.29	0.16	**1.05**	**9.2%**	**0.62**	**5.4%**
Queen Street	0.05	0.03	0.63	0.38	0.07	0.04	0.29	0.15	**1.04**	**9.1%**	**0.60**	**5.2%**
Central Plus	0.05	0.03	0.63	0.38	0.08	0.05	0.30	0.16	**1.09**	**9.5%**	**0.62**	**5.4%**
Queen Street Plus	0.05	0.03	0.63	0.41	0.08	0.05	0.30	0.16	**1.06**	**9.3%**	**0.65**	**5.7%**
Edinburgh DM Base	0.09		0.68		0.23		0.78		**1.78**	**17.4%**		
Fife Spur	0.15	0.09	0.92	0.50	0.39	0.23	1.02	0.57	**2.48**	**24.2%**	**1.39**	**13.6%**
E&G Spur	0.15	0.09	0.92	0.50	0.39	0.23	1.02	0.57	**2.48**	**24.2%**	**1.39**	**13.6%**
Runway Tunnel	0.18	0.11	1.07	0.68	0.45	0.30	1.15	0.76	**2.85**	**27.8%**	**1.85**	**18.1%**
E&G Diversion	0.15	0.08	0.94	0.52	0.38	0.22	1.03	0.59	**2.50**	**24.5%**	**1.41**	**13.8%**
Surface Diversion	0.15	0.09	0.94	0.52	0.40	0.24	1.04	0.61	**2.53**	**24.8%**	**1.46**	**14.3%**
2020												
Glasgow DM Base	0.06		0.62		0.09		0.37		**1.14**	**7.7%**		
Glasgow Central	0.06	0.03	0.74	0.48	0.12	0.07	0.45	0.26	**1.37**	**9.2%**	**0.84**	**5.6%**
Queen Street	0.06	0.03	0.74	0.49	0.11	0.07	0.45	0.26	**1.36**	**9.1%**	**0.85**	**5.7%**
Central Plus	0.06	0.04	0.77	0.48	0.12	0.07	0.45	0.26	**1.40**	**9.4%**	**0.85**	**5.7%**
Queen Street Plus	0.06	0.04	0.77	0.52	0.12	0.07	0.45	0.27	**1.40**	**9.4%**	**0.90**	**6.0%**
Edinburgh DM Base	0.15		0.99		0.40		1.30		**2.84**	**16.3%**		
Fife Spur	0.26	0.15	1.34	0.75	0.68	0.42	1.67	0.99	**3.95**	**22.7%**	**2.31**	**13.3%**
E&G Spur	0.26	0.15	1.34	0.75	0.68	0.42	1.67	0.99	**3.95**	**22.7%**	**2.31**	**13.3%**
Runway Tunnel	0.31	0.21	1.58	1.05	0.80	0.55	1.90	1.30	**4.59**	**26.3%**	**3.31**	**19.0%**
E&G Diversion	0.26	0.15	1.37	0.79	0.67	0.40	1.70	1.02	**4.00**	**23.0%**	**2.36**	**13.6%**
Surface Diversion	0.27	0.16	1.37	0.79	0.69	0.43	1.71	1.03	**4.04**	**23.2%**	**2.41**	**13.8%**

■ **Table 5-2: Airport Employee Forecast for all schemes (million trips pa)**

Scheme Option	Employee Rail Demand 2010	Employee Rail Demand 2020
Glasgow Central	0.04	0.07
Queen Street	0.03	0.06
Central Plus	0.04	0.07
Queen Street Plus	0.05	0.08
Fife Spur	0.06	0.14
E&G Spur	0.06	0.14
Runway Tunnel	0.14	0.29
E&G Diversion	0.11	0.22
Surface Diversion	0.09	0.18

(485)Revenue forecasts were calculated using the premium fares to the airport. In discussions with the Steering Group, it was decided our forecasting should assume a premium fare on rail consistent with the current bus and coach fares. In practice, this means a premium fare of £3.30 in both cities for journeys to the city centre. Standard rail fares take over for longer distances. At Glasgow, the fare from Paisley Gilmour Street to the Airport was set at 90 pence. At Edinburgh, £3.30 was implemented as a minimum fare from the airport to anywhere. These present day fare levels were assumed to decline over time in real terms in line with CSTCS assumptions. During Phase 3, we have also tested a number of fare sensitivities with a view to deriving revenue-maximising fare levels. This is reported in chapter 6 under sensitivity tests.

(486)Revenues are rail revenues only and are incremental to the base case (do-minimum) situation. This means that where users of the new rail link would have used a rail leg as part of their airport access journey in the do-minimum situation, the rail revenue from that journey is deducted from the do-something rail revenue. This provides the true incremental revenue for scheme appraisal purposes, that is the additional rail revenue being generated if the scheme is implemented.

(487)Table 5.3 summarises our revenue forecast.

■ **Table 5-3: Revenue Forecast for All Options (£m, 2001 prices)**

Scheme Option	Air Passenger Revenue 2010	Employee Revenue 2010	Air Passenger Revenue 2020	Employee Revenue 2020
Glasgow Central	2.3	0.03	2.9	0.13
Queen Street	2.2	0.01	2.8	0.10
Central Plus	2.8	0.07	3.2	0.18
Queen Street Plus	2.6	0.04	3.2	0.16
Fife Spur	4.8	0.12	7.7	0.51
E&G Spur	4.8	0.12	7.7	0.51
Runway Tunnel	6.6	0.30	10.6	0.89
E&G Diversion	4.5	0.21	7.3	0.69
Surface Diversion	4.5	0.14	7.8	0.56

5.4 Transport Economic Efficiency Appraisal

5.4.1 Background to the TEE Tables

(488) Full Transport Economic Efficiency (TEE) appraisal tables for all schemes at each airport are shown in the following. As outlined in 5.1 above, we have made some amendments to the standard layout of the TEE tables to provide additional information which we feel are important for the airport schemes specifically, to disaggregate benefits for different beneficiaries and show values under different mode headings. The general philosophy of presentation is that all data in shaded areas is "of which" data, which provides further details on the make-up of the numbers in the unshaded areas, and is not additive to these.

(489) In the summary at the bottom of the table, we show a separate assessment which excludes benefits accruing to, but not revenues gained from foreign residents.

(490) All figures are in 1998 prices and actual year values, discounted to 1998, and are shown in thousands of pounds (£000s). A scheme opening year of 2010 has been assumed and the schemes have been appraised over a 30-year appraisal period up to 2039. One of the key assumptions used in the TUBA approach is that the profile of benefits will remain flat after the last forecast year, which is 2020 in our case.

5.4.2 Segmentation of Benefits Data

(491) Because of the use of composite public transport cost in our benefits calculation for the reasons explained in chapter 4, we are show a column for total public transport rather than just "rail". Of course, all the public transport benefits reported are rail-related, since the rail scheme is the only intervention between the do-minimum and the do-something scenario. However, revenue impacts for public transport as a whole are different to those for rail, because they include the loss of revenue to other services, not just the revenue gain on the railway. We have therefore pulled out the cost and revenue effects specific to rail as an additional item for information.

(492) The figures for the different air passenger segments and airport employees should be self-explanatory. In the "non-airport users" section, we show highways decongestion benefits under the "car" column and other rail users' benefits under the "PT" column. The latter is negative for all the schemes which re-route existing services via the airport.

(493) In the "private sector provider impacts", we show the main scheme investment and operating costs under the "PT" column, together with the public transport revenue impact of the scheme.

5.4.3 Revenue Issues

(494) The revenue impact shown under "PT" is the net effect of additional revenue generated on rail (and feeder modes) and the lost revenue from trips transferred from other public transport services to rail. It is therefore lower than the rail revenue shown under "rail" in the shaded column to the right. That rail revenue in turn is the net rail revenue attracted by the scheme (the *incremental* rail revenue generated by the scheme), not the actual revenue derived from every rail traveller to the airport. It is derived by comparing rail revenue from the do-something situation with that in the do-minimum situation.

(495) The actual rail revenue from travellers to the airport will be higher because it includes revenue that would have been generated in the do-minimum. For example, a traveller from Newcastle to Edinburgh Airport who would have used rail to Waverley and then another access mode to the Airport in the do-minimum situation and who now travels directly by rail to the Airport will generate a large amount of "actual" rail revenue to the Airport, but only a small amount of "incremental" rail revenue. For some trips, the incremental rail revenue may even be negative. For example, a journey from Falkirk to Edinburgh Airport, which would have involved a rail journey to Waverley and then another access mode to the Airport would be more direct with the rail scheme and would generate less revenue in the do-something than in the do-minimum.

(496) These revenue effects are made explicit in the section on provider impacts. They also form part of user benefits, but because of the use of composite cost, the fares paid (or saved) by users are not separated out from the time-based benefits.

5.4.4 Government Grant Assumptions

(497) In common with the practice adopted in CSTCS, we have assumed that the "Private Sector Provider Impacts" cannot become negative overall for rail. Whilst an overall loss to other modes (because of lost revenue) lies outwith the responsibility of the public sector, we have assumed that Government would need to "balance the books" for rail. We have therefore assumed that the rail sector would receive a Grant/Subsidy equivalent to the net shortfall between revenues, operating and investment costs. This is then mirrored under "Other Government Impacts" as a Grant/Subsidy cost. This assumption has no impact on the overall case as it does not affect the project benefit/cost ratios. It is merely a re-allocation of funds between the different parties considered in the TEE tables.

5.4.5 Taxi Impacts

(498) Impacts on taxi services are shown in the Taxi column as lost revenue and reduced operating costs. The starting point for our appraisal was to calculate the total loss in trade resulting from a mode shift from taxi to the new rail mode. We have then assumed that taxi operators will be able to recover some of that loss through the generation of new trade. In terms of our socio-economic appraisal, that recovery can only be counted as a benefit if it results from entirely new trade. Attracting trade from other modes such as bus or rail services away from the airport, incurs disbenefits on those modes in turn. It is impossible to predict the full extent of these secondary effects and we have made the simple assumption that taxi operators will be able to recover one third of the revenue lost to the rail links at the airport through other, entirely new trade.

5.4.6 Parking Impacts

(499) As with taxis, the mode shift to the rail links will result in a loss of revenue for parking operators. Although the mode shift from "park and fly" mode is predicted to be modest, the lost parking revenue is not insignificant. The rail links attract predominantly leisure travellers from the "park and fly" mode and their average parking duration is high.

(500) The scope for calculating reduced operating costs for car park operators is limited. Once the infrastructure is in place, most of the operating costs are fixed and

the marginal operating costs relating to reduced parking demand are small. However, if parking demand is reduced on a permanent basis by the rail links, then car park operators can save investment costs in parking facilities and that saving is potentially significant.

(501) At Glasgow, a multi-storey car park in front of the terminal has just been completed. At Edinburgh, a multi-storey car park is currently being planned. All future investment in car parking spaces at the both airports can therefore be assumed to relate to multi-storey rather than surface parking.

(502) How reduced parking demand is ultimately translated into investment savings is to a large extent a policy decision and we have only been able to make an indicative assumption for our appraisal. We have calculated potential investment savings as follows.

(503) From our mode split forecast for the rail links, we have calculated the total reduction in travellers with access mode "park and fly". Using average car occupancy factors and average parking duration for different user segments, we have translated that into "lost parking space days per annum". Dividing that figure by 365 days would give the total number of parking bays saved if demand was completely uniform throughout the year. We have multiplied the resulting figure by 2 to allow for peaks in demand and inefficiencies in the use of spaces. We have then assumed that each saved parking space saves an investment of £8,400. This is understood to be the average cost per space in the recently completed multi-storey car park at Glasgow. It is understood that costs for the planned multi-storey car park at Edinburgh will be higher because they include significant allowances for the provision of services (electricity, water supply etc). These service costs would not be incurred for the provision of incremental spaces which we are trying to assess here.

(504) Clearly investment in parking is made in large units, not individual spaces and the precise timing of the investment would be difficult to assess at this stage. Under the "predict and provide fully" policy traditionally used for airport car parking investment, the investment would have to be made some years before the spaces are needed. We have based our calculation on the 2020 demand and have assumed that the investment would need to be made in 2010. In reality, some, more limited, investment would need to occur before 2010, with additional investment between 2010 and 2020.

(505) These impacts (of lost revenue and reduced investment costs) are shown in our TEE in the "car" column under "Private Sector Provider Impacts". The resulting figures show that the loss in parking revenue is balanced against saved investment costs amounting to about half that loss. The figures are explicit in our TEE tables and readers can draw their own conclusions on the importance of these costs and revenues and the impacts of different assumptions.

5.4.7 Glasgow Tables

(506) Tables 5.4 to 5.7 present our Transport Economic Efficiency Appraisal for Glasgow options in expanded TEE tables. These represent our base case, where we need to allocate the full costs of all necessary infrastructure to the airport schemes and where rolling stock is leased rather than bought.

■ Table 5-4 TEE Appraisal: Glasgow Central (£ 000's)

Economic Efficiency of the Transport System (TEE)
(1998 prices discounted to 1998)

Project : Rail Links to Glasgow and Edinburgh Airports

Scheme : Glasgow - CENTRAL

	TOTAL		CAR	TAXI	PT	Of Which RAIL
User and Non-User Benefits						
Travel Time	£ 117,525		£ 11,992	£ -	£ 105,533	
Vehicle Operating Costs	£ -		£ -	£ -	£ -	
User Charges	£ -		£ -	£ -	£ -	
NET IMPACT	**£ 117,525**	**(1)**	**£ 11,992**	£ -	**£ 105,533**	
Of Which						
Scottish Business						
Travel Time	£ 7,028		£ -	£ -	£ 7,028	
Vehicle Operating Costs	£ -		£ -	£ -	£ -	
User Charges	£ -		£ -	£ -	£ -	
NET IMPACT	**£ 7,028**		**£ -**	**£ -**	**£ 7,028**	
Scottish Leisure						
Travel Time	£ 57,783		£ -	£ -	£ 57,783	
Vehicle Operating Costs	£ -		£ -	£ -	£ -	
User Charges	£ -		£ -	£ -	£ -	
NET IMPACT	**£ 57,783**		**£ -**	**£ -**	**£ 57,783**	
Non-Scottish Business						
Travel Time	£ 9,485		£ -	£ -	£ 9,485	
Vehicle Operating Costs	£ -		£ -	£ -	£ -	
User Charges	£ -		£ -	£ -	£ -	
NET IMPACT	**£ 9,485**		**£ -**	**£ -**	**£ 9,485**	
Of Which						
Foreign Business						
Travel Time	£ 2,846		£ -	£ -	£ 2,846	
Vehicle Operating Costs	£ -		£ -	£ -	£ -	
User Charges	£ -		£ -	£ -	£ -	
NET IMPACT	**£ 2,846**		**£ -**	**£ -**	**£ 2,846**	
Non-Scottish Leisure						
Travel Time	£ 29,685		£ -	£ -	£ 29,685	
Vehicle Operating Costs	£ -		£ -	£ -	£ -	
User Charges	£ -		£ -	£ -	£ -	
NET IMPACT	**£ 29,685**		**£ -**	**£ -**	**£ 29,685**	
Of Which						
Foreign Leisure						
Travel Time	£ 17,811		£ -	£ -	£ 17,811	
Vehicle Operating Costs	£ -		£ -	£ -	£ -	
User Charges	£ -		£ -	£ -	£ -	
NET IMPACT	**£ 17,811**		**£ -**	**£ -**	**£ 17,811**	
Employees						
Travel Time	£ 447		£ -	£ -	£ 447	
Vehicle Operating Costs	£ -		£ -	£ -	£ -	
User Charges	£ -		£ -	£ -	£ -	
NET IMPACT	**£ 447**		**£ -**	**£ -**	**£ 447**	
Non-Airport Users						
Travel Time	£ 13,097		£ 11,992	£ -	£ 1,105	
Vehicle Operating Costs	£ -		£ -	£ -	£ -	
User Charges	£ -		£ -	£ -	£ -	
NET IMPACT	**£ 13,097**		**£ 11,992**	**£ -**	**£ 1,105**	
Private Sector Provider Impacts						
Revenue	£ 11,809		-£ 11,077	-£ 9,922	£ 32,807	£ 42,434
Operating Costs	-£ 45,038	(a)	£ -	£ 733	-£ 45,771	-£ 45,771
Investment Costs	-£ 108,947	(b)	£ 6,039	£ -	-£ 114,986	-£ 114,986
Grant / Subsidy	£ 118,323		£ -	£ -	£ 118,323	£ 118,323
NET IMPACT	**-£ 23,853**	**(2)**	**-£ 5,038**	**-£ 9,189**	**-£ 9,626**	**£ -**
Public Sector Provider Impacts						
Revenue	£ -		£ -	£ -	£ -	
Operating Costs	£ -	(c)	£ -	£ -	£ -	
Investment Costs	£ -	(d)	£ -	£ -	£ -	
NET IMPACTS	**£ -**	**(3)**	**£ -**	**£ -**	**£ -**	
Other Government Impacts						
Grant / Subsidy Payments	-£ 118,323	(e)	£ -	£ -	-£ 118,323	
Indirect Tax Revenues	-£ 6,012		-£ 2,547	£ 688	-£ 4,153	
NET IMPACTS	**-£ 124,335**	**(4)**	**-£ 2,547**	**£ 688**	**-£ 122,476**	

TOTAL		**TOTAL EXCLUDING FOREIGN BENEFITS**	
Net Present Value (NPV)	-£ 30,663	-£ 51,319	(6) = (1) + (2) + (3) + (4)
Present Value of Costs (PVC)	-£ 153,985	-£ 153,985	(7) = (a) + (b) + (c) + (d)
Present Value of Benefits (PVB)	£ 123,322	£ 102,665	(8) = (6) - (7)
Present Value of Costs to Government	-£ 124,335	-£ 124,335	(9) = (4) + (3)
Benefit / Cost Ratio (BCR)	**0.80**	**0.67**	(10) = - (8) / (7)
Value / Cost to Government Ratio (VCGR)	-0.25	-0.41	(11) = - (6) / (9)

■ Table 5-5 TEE Appraisal: Glasgow Queen Street (£ 000's)

Economic Efficiency of the Transport System (TEE)
(1998 prices discounted to 1998)

Project : Scottish Airports Rail Link Study

Scheme : Glasgow - QUEEN STREET

	TOTAL		CAR	TAXI	PT	Of Which RAIL
User and Non-User Benefits						
Travel Time	£ 120,105		£ 11,865	£ -	£ 108,240	
Vehicle Operating Costs	£ -		£ -	£ -	£ -	
User Charges	£ -		£ -	£ -	£ -	
NET IMPACT	**£ 120,105**	**(1)**	**£ 11,865**	£ -	**£ 108,240**	
Of Which						
Scottish Business						
Travel Time	£ 6,587		£ -	£ -	£ 6,587	
Vehicle Operating Costs	£ -		£ -	£ -	£ -	
User Charges	£ -		£ -	£ -	£ -	
NET IMPACT	**£ 6,587**		£ -	£ -	**£ 6,587**	
Scottish Leisure						
Travel Time	£ 58,872		£ -	£ -	£ 58,872	
Vehicle Operating Costs	£ -		£ -	£ -	£ -	
User Charges	£ -		£ -	£ -	£ -	
NET IMPACT	**£ 58,872**		£ -	£ -	**£ 58,872**	
Non-Scottish Business						
Travel Time	£ 8,075		£ -	£ -	£ 8,075	
Vehicle Operating Costs	£ -		£ -	£ -	£ -	
User Charges	£ -		£ -	£ -	£ -	
NET IMPACT	**£ 8,075**		£ -	£ -	**£ 8,075**	
Of Which						
Foreign Business						
Travel Time	£ 2,423		£ -	£ -	£ 2,423	
Vehicle Operating Costs	£ -		£ -	£ -	£ -	
User Charges	£ -		£ -	£ -	£ -	
NET IMPACT	**£ 2,423**		£ -	£ -	**£ 2,423**	
Non-Scottish Leisure						
Travel Time	£ 31,286		£ -	£ -	£ 31,286	
Vehicle Operating Costs	£ -		£ -	£ -	£ -	
User Charges	£ -		£ -	£ -	£ -	
NET IMPACT	**£ 31,286**		£ -	£ -	**£ 31,286**	
Of Which						
Foreign Leisure						
Travel Time	£ 18,772		£ -	£ -	£ 18,772	
Vehicle Operating Costs	£ -		£ -	£ -	£ -	
User Charges	£ -		£ -	£ -	£ -	
NET IMPACT	**£ 18,772**		£ -	£ -	**£ 18,772**	
Employees						
Travel Time	£ 105		£ -	£ -	£ 105	
Vehicle Operating Costs	£ -		£ -	£ -	£ -	
User Charges	£ -		£ -	£ -	£ -	
NET IMPACT	**£ 105**		£ -	£ -	**£ 105**	
Non-Airport Users						
Travel Time	£ 15,180		£ 11,865	£ -	£ 3,315	
Vehicle Operating Costs	£ -		£ -	£ -	£ -	
User Charges	£ -		£ -	£ -	£ -	
NET IMPACT	**£ 15,180**		**£ 11,865**	£ -	**£ 3,315**	
Private Sector Provider Impacts						
Revenue	£ 11,586		-£ 10,216	-£ 9,732	£ 31,534	£ 41,504
Operating Costs	-£ 49,549	(a)	£ -	£ 741	-£ 50,290	-£ 50,290
Investment Costs	-£ 115,157	(b)	£ 5,645	£ -	-£ 120,802	-£ 120,802
Grant / Subsidy	£ 129,588		£ -	£ -	£ 129,588	£ 129,588
NET IMPACT	**-£ 23,532**	**(2)**	**-£ 4,571**	**-£ 8,991**	**-£ 9,970**	**£ -**
Public Sector Provider Impacts						
Revenue	£ -		£ -	£ -	£ -	
Operating Costs	£ -	(c)	£ -	£ -	£ -	
Investment Costs	£ -	(d)	£ -	£ -	£ -	
NET IMPACTS	**£ -**	**(3)**	**£ -**	**£ -**	**£ -**	
Other Government Impacts						
Grant / Subsidy Payments	-£ 129,588	(e)	£ -	£ -	-£ 129,588	
Indirect Tax Revenues	-£ 5,835		-£ 2,499	£ 734	-£ 4,070	
NET IMPACTS	**-£ 135,423**	**(4)**	**-£ 2,499**	**£ 734**	**-£ 133,658**	

TOTAL		**TOTAL EXCLUDING FOREIGN BENEFITS**	
Net Present Value (NPV)	-£ 38,850	-£ 60,044	(6) = (1) + (2) + (3) + (4)
Present Value of Costs (PVC)	-£ 164,706	-£ 164,706	(7) = (a) + (b) + (c) + (d)
Present Value of Benefits (PVB)	£ 125,856	£ 104,662	(8) = (6) / (7)
Present Value of Costs to Government	-£ 135,423	-£ 135,423	(9) = (4) + (3)
Benefit / Cost Ratio (BCR)	**0.76**	**0.64**	(10) = - (8) / (7)
Value / Cost to Government Ratio (VCGR)	-0.29	-0.44	(11) = - (6) / (9)

■ Table 5-6 TEE Appraisal: Glasgow Central Plus (£ 000's)

Economic Efficiency of the Transport System (TEE)
(1998 prices discounted to 1998)

Project : Scottish Airports Rail Link Study

Scheme : Glasgow - CENTRAL PLUS

	TOTAL		CAR	TAXI	PT	Of Which RAIL
User and Non-User Benefits						
Travel Time	£ 155,029		£ 14,902	£ -	£ 140,127	
Vehicle Operating Costs	£ -		£ -	£ -	£ -	
User Charges	£ -		£ -	£ -	£ -	
NET IMPACT	**£ 155,029**	**(1)**	**£ 14,902**	**£ -**	**£ 140,127**	
Of Which						
Scottish Business						
Travel Time	£ 8,205		£ -	£ -	£ 8,205	
Vehicle Operating Costs	£ -		£ -	£ -	£ -	
User Charges	£ -		£ -	£ -	£ -	
NET IMPACT	**£ 8,205**		**£ -**	**£ -**	**£ 8,205**	
Scottish Leisure						
Travel Time	£ 72,693		£ -	£ -	£ 72,693	
Vehicle Operating Costs	£ -		£ -	£ -	£ -	
User Charges	£ -		£ -	£ -	£ -	
NET IMPACT	**£ 72,693**		**£ -**	**£ -**	**£ 72,693**	
Non-Scottish Business						
Travel Time	£ 10,421		£ -	£ -	£ 10,421	
Vehicle Operating Costs	£ -		£ -	£ -	£ -	
User Charges	£ -		£ -	£ -	£ -	
NET IMPACT	**£ 10,421**		**£ -**	**£ -**	**£ 10,421**	
Of Which						
Foreign Business						
Travel Time	£ 3,126		£ -	£ -	£ 3,126	
Vehicle Operating Costs	£ -		£ -	£ -	£ -	
User Charges	£ -		£ -	£ -	£ -	
NET IMPACT	**£ 3,126**		**£ -**	**£ -**	**£ 3,126**	
Non-Scottish Leisure						
Travel Time	£ 39,696		£ -	£ -	£ 39,696	
Vehicle Operating Costs	£ -		£ -	£ -	£ -	
User Charges	£ -		£ -	£ -	£ -	
NET IMPACT	**£ 39,696**		**£ -**	**£ -**	**£ 39,696**	
Of Which						
Foreign Leisure						
Travel Time	£ 23,818		£ -	£ -	£ 23,818	
Vehicle Operating Costs	£ -		£ -	£ -	£ -	
User Charges	£ -		£ -	£ -	£ -	
NET IMPACT	**£ 23,818**		**£ -**	**£ -**	**£ 23,818**	
Employees						
Travel Time	£ 935		£ -	£ -	£ 935	
Vehicle Operating Costs	£ -		£ -	£ -	£ -	
User Charges	£ -		£ -	£ -	£ -	
NET IMPACT	**£ 935**		**£ -**	**£ -**	**£ 935**	
Non-Airport Users						
Travel Time	£ 23,079		£ 14,902	£ -	£ 8,177	
Vehicle Operating Costs	£ -		£ -	£ -	£ -	
User Charges	£ -		£ -	£ -	£ -	
NET IMPACT	**£ 23,079**		**£ 14,902**	**£ -**	**£ 8,177**	
Private Sector Provider Impacts						
Revenue	£ 11,219		-£ 13,051	-£ 12,355	£ 36,625	£ 49,185
Operating Costs	-£ 98,759	(a)	£ -	£ 947	-£ 99,706	-£ 99,706
Investment Costs	-£ 189,999	(b)	£ 7,138	£ -	-£ 197,137	-£ 197,137
Grant / Subsidy	£ 247,658		£ -	£ -	£ 247,658	£ 247,658
NET IMPACT	**-£ 29,881**	**(2)**	**-£ 5,913**	**-£ 11,408**	**-£ 12,559**	**£ -**
Public Sector Provider Impacts						
Revenue	£ -		£ -	£ -	£ -	
Operating Costs	£ -	(c)	£ -	£ -	£ -	
Investment Costs	£ -	(d)	£ -	£ -	£ -	
NET IMPACTS	**£ -**	**(3)**	**£ -**	**£ -**	**£ -**	
Other Government Impacts						
Grant / Subsidy Payments	-£ 247,658	(e)	£ -	£ -	-£ 247,658	
Indirect Tax Revenues	-£ 6,909		-£ 3,143	£ 954	-£ 4,720	
NET IMPACTS	**-£ 254,567**	**(4)**	**-£ 3,143**	**£ 954**	**-£ 252,378**	

TOTAL		**TOTAL EXCLUDING FOREIGN BENEFITS**	
Net Present Value (NPV)	-£ 129,419	-£ 156,363	(6) = (1) + (2) + (3) + (4)
Present Value of Costs (PVC)	-£ 288,759	-£ 288,759	(7) = (a) + (b) + (c) + (d)
Present Value of Benefits (PVB)	£ 159,339	£ 132,395	(8) = (6) - (7)
Present Value of Costs to Government	-£ 254,567	-£ 254,567	(9) = (4) + (3)
Benefit / Cost Ratio (BCR)	**0.55**	**0.46**	(10) = - (8) / (7)
Value / Cost to Government Ratio (VCGR)	-0.51	-0.61	(11) = - (6) / (9)

■ Table 5-7 TEE Appraisal: Glasgow Queen Street Plus (£ 000's)

Economic Efficiency of the Transport System (TEE)
(1998 prices discounted to 1998)

Project : Scottish Airports Rail Link Study

Scheme : Glasgow - QUEEN STREET PLUS

	TOTAL		CAR	TAXI	PT	Of Which RAIL
User and Non-User Benefits						
Travel Time	£ 157,032		£ 14,619	£ -	£ 142,413	
Vehicle Operating Costs	£ -		£ -	£ -	£ -	
User Charges	£ -		£ -	£ -	£ -	
NET IMPACT	**£ 157,032**	**(1)**	**£ 14,619**	**£ -**	**£ 142,413**	
Of Which						
Scottish Business						
Travel Time	£ 7,594		£ -	£ -	£ 7,594	
Vehicle Operating Costs	£ -		£ -	£ -	£ -	
User Charges	£ -		£ -	£ -	£ -	
NET IMPACT	**£ 7,594**		**£ -**	**£ -**	**£ 7,594**	
Scottish Leisure						
Travel Time	£ 72,556		£ -	£ -	£ 72,556	
Vehicle Operating Costs	£ -		£ -	£ -	£ -	
User Charges	£ -		£ -	£ -	£ -	
NET IMPACT	**£ 72,556**		**£ -**	**£ -**	**£ 72,556**	
Non-Scottish Business						
Travel Time	£ 9,913		£ -	£ -	£ 9,913	
Vehicle Operating Costs	£ -		£ -	£ -	£ -	
User Charges	£ -		£ -	£ -	£ -	
NET IMPACT	**£ 9,913**		**£ -**	**£ -**	**£ 9,913**	
Of Which						
Foreign Business						
Travel Time	£ 2,974		£ -	£ -	£ 2,974	
Vehicle Operating Costs	£ -		£ -	£ -	£ -	
User Charges	£ -		£ -	£ -	£ -	
NET IMPACT	**£ 2,974**		**£ -**	**£ -**	**£ 2,974**	
Non-Scottish Leisure						
Travel Time	£ 40,702		£ -	£ -	£ 40,702	
Vehicle Operating Costs	£ -		£ -	£ -	£ -	
User Charges	£ -		£ -	£ -	£ -	
NET IMPACT	**£ 40,702**		**£ -**	**£ -**	**£ 40,702**	
Of Which						
Foreign Leisure						
Travel Time	£ 24,421		£ -	£ -	£ 24,421	
Vehicle Operating Costs	£ -		£ -	£ -	£ -	
User Charges	£ -		£ -	£ -	£ -	
NET IMPACT	**£ 24,421**		**£ -**	**£ -**	**£ 24,421**	
Employees						
Travel Time	£ 598		£ -	£ -	£ 598	
Vehicle Operating Costs	£ -		£ -	£ -	£ -	
User Charges	£ -		£ -	£ -	£ -	
NET IMPACT	**£ 598**		**£ -**	**£ -**	**£ 598**	
Non-Airport Users						
Travel Time	£ 25,669		£ 14,619	£ -	£ 11,050	
Vehicle Operating Costs	£ -		£ -	£ -	£ -	
User Charges	£ -		£ -	£ -	£ -	
NET IMPACT	**£ 25,669**		**£ 14,619**	**£ -**	**£ 11,050**	
Private Sector Provider Impacts						
Revenue	£ 9,463		-£ 13,959	-£ 11,976	£ 35,397	£ 39,676
Operating Costs	-£ 103,290	(a)	£ -	£ 935	-£ 104,225	-£ 104,225
Investment Costs	-£ 195,095	(b)	£ 7,640	£ -	-£ 202,735	-£ 202,735
Grant / Subsidy	£ 267,284		£ -	£ -	£ 267,284	£ 267,284
NET IMPACT	**-£ 21,638**	**(2)**	**£ 6,319**	**-£ 11,040**	**-£ 4,279**	**£ -**
Public Sector Provider Impacts						
Revenue	£ -		£ -	£ -	£ -	
Operating Costs	£ -	(c)	£ -	£ -	£ -	
Investment Costs	£ -	(d)	£ -	£ -	£ -	
NET IMPACTS	**£ -**	**(3)**	**£ -**	**£ -**	**£ -**	
Other Government Impacts						
Grant / Subsidy Payments	-£ 267,284	(e)	£ -	£ -	-£ 267,284	
Indirect Tax Revenues	-£ 6,722		-£ 3,080	£ 984	-£ 4,626	
NET IMPACTS	**-£ 274,006**	**(4)**	**-£ 3,080**	**£ 984**	**-£ 271,910**	

TOTAL		**TOTAL EXCLUDING FOREIGN BENEFITS**	
Net Present Value (NPV)	-£ 138,611	-£ 166,006	(6) = (1) + (2) + (3) + (4)
Present Value of Costs (PVC)	-£ 298,384	-£ 298,384	(7) = (a) + (b) + (c) + (d)
Present Value of Benefits (PVB)	£ 159,773	£ 132,378	(8) = (6) - (7)
Present Value of Costs to Government	-£ 274,006	-£ 274,006	(9) = (4) + (3)
Benefit / Cost Ratio (BCR)	**0.54**	**0.44**	(10) = - (8) / (7)
Value / Cost to Government Ratio (VCGR)	-0.51	-0.61	(11) = - (6) / (9)

(507) These tables show that, under our base case assumptions, none would generate sufficient revenue to cover operating costs, none would generate sufficient economic benefits to cover more than about 80% of the capital and operating costs, and the Net Present Value/Cost to Government Ratio would be very poor in all cases (mainly because, most cases, the Net Present Value would be negative).

(508) Common to all schemes is the following broad pattern:

- benefits would be generally highest for the Scottish Leisure sector, followed by non-Scottish Leisure;
- benefits to both business sectors would be significantly lower;
- benefits to employees would be small;
- highway decongestion benefits (shown under "Car" in the non-airport user sector) would be much smaller than user benefits, but would be significant in all cases;
- benefits to other rail users (shown under "Public Transport" in the non-airport sector) would be very small; and
- vehicle operating cost and taxation impacts would be very small in comparison with the costs, benefits and revenue effects on public transport.

(509) The costs and benefits of the Central and Queen Street options, under our base case assumptions, are very similar, with the result that the Benefit/Cost Ratios are also very similar. Both options which would provide longer-distance connections with Edinburgh would generate significant additional benefits but the additional costs would be very considerable due to the extra capacity which is required to provide additional train paths into, and platform space at, Waverley Station.

(510) There are some variants of appraisal assumptions for the Glasgow options that can be considered, which present a less negative and, under some assumptions, a more positive case. These are explored in our sensitivity tests in chapter 6.

(511) Tables 5.8 to 5.12 present our Transport Economic Efficiency Appraisal for Edinburgh options in expanded TEE tables. These again represent our base case, where we need to allocate the full costs of all necessary infrastructure to the airport schemes, including facilities and operating costs for a section 12 station for the Runway Tunnel scheme.

■ Table 5-8 TEE Appraisal: Edinburgh: Fife Spur (£ 000's)

Economic Efficiency of the Transport System (TEE)
(1998 prices discounted to 1998)

Project : Rail Links to Glasgow and Edinburgh Airports

Scheme : Edinburgh - FIFE SPUR

	TOTAL		CAR	TAXI	PT
User and Non-User Benefits					
Travel Time	£ 372,992		£ 25,981	£ -	£ 347,012
Vehicle Operating Costs	£ -		£ -	£ -	£ -
User Charges	£ -		£ -	£ -	£ -
NET IMPACT	**£ 372,992**	**(1)**	**£ 25,981**	**£ -**	**£ 347,012**
Of Which					
Scottish Business					
Travel Time	£ 42,916		£ -	£ -	£ 42,916
Vehicle Operating Costs	£ -		£ -	£ -	£ -
User Charges	£ -		£ -	£ -	£ -
NET IMPACT	**£ 42,916**		**£ -**	**£ -**	**£ 42,916**
Scottish Leisure					
Travel Time	£ 98,951		£ -	£ -	£ 98,951
Vehicle Operating Costs	£ -		£ -	£ -	£ -
User Charges	£ -		£ -	£ -	£ -
NET IMPACT	**£ 98,951**		**£ -**	**£ -**	**£ 98,951**
Non-Scottish Business					
Travel Time	£ 53,861		£ -	£ -	£ 53,861
Vehicle Operating Costs	£ -		£ -	£ -	£ -
User Charges	£ -		£ -	£ -	£ -
NET IMPACT	**£ 53,861**		**£ -**	**£ -**	**£ 53,861**
Of Which					
Foreign Business					
Travel Time	£ 16,158		£ -	£ -	£ 16,158
Vehicle Operating Costs	£ -		£ -	£ -	£ -
User Charges	£ -		£ -	£ -	£ -
NET IMPACT	**£ 16,158**		**£ -**	**£ -**	**£ 16,158**
Non-Scottish Leisure					
Travel Time	£ 146,363		£ -	£ -	£ 146,363
Vehicle Operating Costs	£ -		£ -	£ -	£ -
User Charges	£ -		£ -	£ -	£ -
NET IMPACT	**£ 146,363**		**£ -**	**£ -**	**£ 146,363**
Of Which					
Foreign Leisure					
Travel Time	£ 87,818		£ -	£ -	£ 87,818
Vehicle Operating Costs	£ -		£ -	£ -	£ -
User Charges	£ -		£ -	£ -	£ -
NET IMPACT	**£ 87,818**		**£ -**	**£ -**	**£ 87,818**
Employees					
Travel Time	£ 2,821		£ -	£ -	£ 2,821
Vehicle Operating Costs	£ -		£ -	£ -	£ -
User Charges	£ -		£ -	£ -	£ -
NET IMPACT	**£ 2,821**		**£ -**	**£ -**	**£ 2,821**
Non-Airport Users					
Travel Time	£ 28,080		£ 25,981	£ -	£ 2,100
Vehicle Operating Costs	£ -		£ -	£ -	£ -
User Charges	£ -		£ -	£ -	£ -
NET IMPACT	**£ 28,080**		**£ 25,981**	**£ -**	**£ 2,100**

						Of Which RAIL
Private Sector Provider Impacts						
Revenue	£ 24,324		-£ 23,498	-£ 35,473	£ 83,295	£ 105,797
Operating Costs	-£ 42,451	(a)	£ -	£ 2,737	-£ 45,188	-£ 45,188
Investment Costs	-£ 224,773	(b)	£ 13,933	£ -	-£ 238,706	-£ 238,706
Grant / Subsidy	£ 178,097		£ -	£ -	£ 178,097	£ 178,097
NET IMPACT	**-£ 64,802**	**(2)**	**-£ 9,565**	**-£ 32,736**	**-£ 22,502**	**£ -**
Public Sector Provider Impacts						
Revenue	£ -			£ -	£ -	
Operating Costs	£ -	(c)	£ -	£ -	£ -	
Investment Costs	£ -	(d)	£ -	£ -	£ -	
NET IMPACTS	**£ -**	**(3)**	**£ -**	**£ -**	**£ -**	
Other Government Impacts						
Grant / Subsidy Payments	-£ 178,097	(e)	£ -	£ -	-£ 178,097	
Indirect Tax Revenues	-£ 11,401		-£ 3,487	£ 740	-£ 8,654	
NET IMPACTS	**-£ 189,498**	**(4)**	**-£ 3,487**	**£ 740**	**-£ 186,751**	

TOTAL			**TOTAL EXCLUDING FOREIGN BENEFITS**	
Net Present Value (NPV)	£ 118,693	£	14,717	(6) = (1) + (2) + (3) + (4)
Present Value of Costs (PVC)	-£ 267,223	-£	267,223	(7) = (a) + (b) + (c) + (d)
Present Value of Benefits (PVB)	£ 385,916	£	281,940	(8) = (6) - (7)
Present Value of Costs to Government	-£ 189,498	-£	189,498	(9) = (4) + (3)
Benefit / Cost Ratio (BCR)	**1.44**		**1.06**	(10) = - (8) / (7)
Value / Cost to Government Ratio (VCGR)	0.63		0.08	(11) = - (6) / (9)

■ Table 5-9 TEE Appraisal: Edinburgh: E&G Spur (£ 000's)

Economic Efficiency of the Transport System (TEE)
(1998 prices discounted to 1998)

Project : Rail Links to Glasgow and Edinburgh Airports

Scheme : Edinburgh - E & G SPUR

	TOTAL		CAR	TAXI	PT	Of Which RAIL
User and Non-User Benefits						
Travel Time	£ 372,992		£ 25,981	£ -	£ 347,012	
Vehicle Operating Costs	£ -		£ -	£ -	£ -	
User Charges	£ -		£ -	£ -	£ -	
NET IMPACT	**£ 372,992**	**(1)**	**£ 25,981**	£ -	**£ 347,012**	
Of Which						
Scottish Business						
Travel Time	£ 42,916		£ -	£ -	£ 42,916	
Vehicle Operating Costs	£ -		£ -	£ -	£ -	
User Charges	£ -		£ -	£ -	£ -	
NET IMPACT	**£ 42,916**		**£ -**	**£ -**	**£ 42,916**	
Scottish Leisure						
Travel Time	£ 98,951		£ -	£ -	£ 98,951	
Vehicle Operating Costs	£ -		£ -	£ -	£ -	
User Charges	£ -		£ -	£ -	£ -	
NET IMPACT	**£ 98,951**		**£ -**	**£ -**	**£ 98,951**	
Non-Scottish Business						
Travel Time	£ 53,861		£ -	£ -	£ 53,861	
Vehicle Operating Costs	£ -		£ -	£ -	£ -	
User Charges	£ -		£ -	£ -	£ -	
NET IMPACT	**£ 53,861**		**£ -**	**£ -**	**£ 53,861**	
Of Which						
Foreign Business						
Travel Time	£ 16,158		£ -	£ -	£ 16,158	
Vehicle Operating Costs	£ -		£ -	£ -	£ -	
User Charges	£ -		£ -	£ -	£ -	
NET IMPACT	**£ 16,158**		**£ -**	**£ -**	**£ 16,158**	
Non-Scottish Leisure						
Travel Time	£ 146,363		£ -	£ -	£ 146,363	
Vehicle Operating Costs	£ -		£ -	£ -	£ -	
User Charges	£ -		£ -	£ -	£ -	
NET IMPACT	**£ 146,363**		**£ -**	**£ -**	**£ 146,363**	
Of Which						
Foreign Leisure						
Travel Time	£ 87,818		£ -	£ -	£ 87,818	
Vehicle Operating Costs	£ -		£ -	£ -	£ -	
User Charges	£ -		£ -	£ -	£ -	
NET IMPACT	**£ 87,818**		**£ -**	**£ -**	**£ 87,818**	
Employees						
Travel Time	£ 2,821		£ -	£ -	£ 2,821	
Vehicle Operating Costs	£ -		£ -	£ -	£ -	
User Charges	£ -		£ -	£ -	£ -	
NET IMPACT	**£ 2,821**		**£ -**	**£ -**	**£ 2,821**	
Non-Airport Users						
Travel Time	£ 28,080		£ 25,981	£ -	£ 2,100	
Vehicle Operating Costs	£ -		£ -	£ -	£ -	
User Charges	£ -		£ -	£ -	£ -	
NET IMPACT	**£ 28,080**		**£ 25,981**	**£ -**	**£ 2,100**	
Private Sector Provider Impacts						
Revenue	£ 24,324		-£ 23,498	-£ 35,473	£ 83,295	£ 105,797
Operating Costs	-£ 42,451	(a)	£ -	£ 2,737	-£ 45,188	-£ 45,188
Investment Costs	-£ 328,945	(b)	£ 13,933	£ -	-£ 342,878	-£ 342,878
Grant / Subsidy	£ 282,269		£ -	£ -	£ 282,269	£ 282,269
NET IMPACT	**-£ 64,802**	**(2)**	**-£ 9,565**	**-£ 32,736**	**-£ 22,502**	**£ -**
Public Sector Provider Impacts						
Revenue	£ -		£ -	£ -	£ -	
Operating Costs	£ -	(c)	£ -	£ -	£ -	
Investment Costs	£ -	(d)	£ -	£ -	£ -	
NET IMPACTS	**£ -**	**(3)**	**£ -**	**£ -**	**£ -**	
Other Government Impacts						
Grant / Subsidy Payments	-£ 282,269	(e)	£ -	£ -	-£ 282,269	
Indirect Tax Revenues	-£ 11,401		-£ 3,487	£ 740	-£ 8,654	
NET IMPACTS	**-£ 293,670**	**(4)**	**-£ 3,487**	**£ 740**	**-£ 290,923**	

TOTAL		**TOTAL EXCLUDING FOREIGN BENEFITS**	
Net Present Value (NPV)	£ 14,521	-£ 89,455	(6) = (1) + (2) + (3) + (4)
Present Value of Costs (PVC)	-£ 371,395	-£ 371,395	(7) = (a) + (b) + (c) + (d)
Present Value of Benefits (PVB)	£ 385,916	£ 281,940	(8) = (6) - (7)
Present Value of Costs to Government	-£ 293,670	-£ 293,670	(9) = (4) + (3)
Benefit / Cost Ratio (BCR)	**1.04**	**0.76**	(10) = - (8) / (7)
Value / Cost to Government Ratio (VCGR)	0.05	-0.30	(11) = - (6) / (9)

■ Table 5-10 TEE Appraisal: Edinburgh: Runway Tunnel (£ 000's)

Economic Efficiency of the Transport System (TEE)
(1998 prices discounted to 1998)

Project : Rail Links to Glasgow and Edinburgh Airports

Scheme : Edinburgh - Runway Tunnel

	TOTAL		CAR	TAXI	PT
User and Non-User Benefits					
Travel Time	£ 692,893		£ 51,997	£ -	£ 640,896
Vehicle Operating Costs	£ -		£ -	£ -	£ -
User Charges	£ -		£ -	£ -	£ -
NET IMPACT	**£ 692,893**	**(1)**	**£ 51,997**	£ -	**£ 640,896**
Of Which					
Scottish Business					
Travel Time	£ 74,480		£ -	£ -	£ 74,480
Vehicle Operating Costs	£ -		£ -	£ -	£ -
User Charges	£ -		£ -	£ -	£ -
NET IMPACT	**£ 74,480**		**£ -**	**£ -**	**£ 74,480**
Scottish Leisure					
Travel Time	£ 192,280		£ -	£ -	£ 192,280
Vehicle Operating Costs	£ -		£ -	£ -	£ -
User Charges	£ -		£ -	£ -	£ -
NET IMPACT	**£ 192,280**		**£ -**	**£ -**	**£ 192,280**
Non-Scottish Business					
Travel Time	£ 92,710		£ -	£ -	£ 92,710
Vehicle Operating Costs	£ -		£ -	£ -	£ -
User Charges	£ -		£ -	£ -	£ -
NET IMPACT	**£ 92,710**		**£ -**	**£ -**	**£ 92,710**
Of Which					
Foreign Business					
Travel Time	£ 27,813		£ -	£ -	£ 27,813
Vehicle Operating Costs	£ -		£ -	£ -	£ -
User Charges	£ -		£ -	£ -	£ -
NET IMPACT	**£ 27,813**		**£ -**	**£ -**	**£ 27,813**
Non-Scottish Leisure					
Travel Time	£ 282,082		£ -	£ -	£ 282,082
Vehicle Operating Costs	£ -		£ -	£ -	£ -
User Charges	£ -		£ -	£ -	£ -
NET IMPACT	**£ 282,082**		**£ -**	**£ -**	**£ 282,082**
Of Which					
Foreign Leisure					
Travel Time	£ 169,249		£ -	£ -	£ 169,249
Vehicle Operating Costs	£ -		£ -	£ -	£ -
User Charges	£ -		£ -	£ -	£ -
NET IMPACT	**£ 169,249**		**£ -**	**£ -**	**£ 169,249**
Employees					
Travel Time	£ 8,847		£ -	£ -	£ 8,847
Vehicle Operating Costs	£ -		£ -	£ -	£ -
User Charges	£ -		£ -	£ -	£ -
NET IMPACT	**£ 8,847**		**£ -**	**£ -**	**£ 8,847**
Non-Airport Users					
Travel Time	£ 42,494		£ 51,997	£ -	-£ 9,503
Vehicle Operating Costs	£ -		£ -	£ -	£ -
User Charges	£ -		£ -	£ -	£ -
NET IMPACT	**£ 42,494**		**£ 51,997**	**£ -**	**-£ 9,503**

						Of Which RAIL
Private Sector Provider Impacts						
Revenue	£ 2,385		-£ 46,102	-£ 56,801	£ 105,288	£ 145,973
Operating Costs	-£ 38,299	(a)	£ -	£ 4,411	-£ 42,710	-£ 42,710
Investment Costs	-£ 388,899	(b)	£ 27,287	£ -	-£ 416,186	-£ 416,186
Grant / Subsidy	£ 312,923		£ -	£ -	£ 312,923	£ 312,923
NET IMPACT	**-£ 111,890**	**(2)**	**-£ 18,815**	**-£ 52,390**	**-£ 40,685**	**£ -**
Public Sector Provider Impacts						
Revenue	£ -		£ -	£ -	£ -	
Operating Costs	£ -	(c)	£ -	£ -	£ -	
Investment Costs	£ -	(d)	£ -	£ -	£ -	
NET IMPACTS	**£ -**	**(3)**	**£ -**	**£ -**	**£ -**	
Other Government Impacts						
Grant / Subsidy Payments	-£ 312,923	(e)	£ -	£ -	-£ 312,923	
Indirect Tax Revenues	-£ 17,692		-£ 8,604	£ 1,839	-£ 10,927	
NET IMPACTS	**-£ 330,615**	**(4)**	**-£ 8,604**	**£ 1,839**	**-£ 323,850**	

TOTAL		**TOTAL EXCLUDING FOREIGN BENEFITS**	
Net Present Value (NPV)	£ 250,388	£ 53,326	(6) = (1) + (2) + (3) + (4)
Present Value of Costs (PVC)	-£ 427,198	-£ 427,198	(7) = (a) + (b) + (c) + (d)
Present Value of Benefits (PVB)	£ 677,586	£ 480,523	(8) = (6) - (7)
Present Value of Costs to Government	-£ 330,615	-£ 330,615	(9) = (4) + (3)
Benefit / Cost Ratio (BCR)	**1.59**	**1.12**	(10) = - (8) / (7)
Value / Cost to Government Ratio (VCGR)	0.76	0.16	(11) = - (6) / (9)

■ Table 5-11 TEE Appraisal: Edinburgh: E&G Diversion (£ 000's)

Economic Efficiency of the Transport System (TEE)
(1998 prices discounted to 1998)

Project : Rail Links to Glasgow and Edinburgh Airports

Scheme : Edinburgh - E & G DIVERSION

	TOTAL		CAR	TAXI	PT	Of Which RAIL
User and Non-User Benefits						
Travel Time	£ 365,949		£ 29,767	£ -	£ 336,183	
Vehicle Operating Costs	£ -		£ -	£ -	£ -	
User Charges	£ -		£ -	£ -	£ -	
NET IMPACT	**£ 365,949**	**(1)**	**£ 29,767**	**£ -**	**£ 336,183**	
Of Which						
Scottish Business						
Travel Time	£ 43,370		£ -	£ -	£ 43,370	
Vehicle Operating Costs	£ -		£ -	£ -	£ -	
User Charges	£ -		£ -	£ -	£ -	
NET IMPACT	**£ 43,370**		**£ -**	**£ -**	**£ 43,370**	
Scottish Leisure						
Travel Time	£ 110,355		£ -	£ -	£ 110,355	
Vehicle Operating Costs	£ -		£ -	£ -	£ -	
User Charges	£ -		£ -	£ -	£ -	
NET IMPACT	**£ 110,355**		**£ -**	**£ -**	**£ 110,355**	
Non-Scottish Business						
Travel Time	£ 51,016		£ -	£ -	£ 51,016	
Vehicle Operating Costs	£ -		£ -	£ -	£ -	
User Charges	£ -		£ -	£ -	£ -	
NET IMPACT	**£ 51,016**		**£ -**	**£ -**	**£ 51,016**	
Of Which						
Foreign Business						
Travel Time	£ 15,305		£ -	£ -	£ 15,305	
Vehicle Operating Costs	£ -		£ -	£ -	£ -	
User Charges	£ -		£ -	£ -	£ -	
NET IMPACT	**£ 15,305**		**£ -**	**£ -**	**£ 15,305**	
Non-Scottish Leisure						
Travel Time	£ 155,823		£ -	£ -	£ 155,823	
Vehicle Operating Costs	£ -		£ -	£ -	£ -	
User Charges	£ -		£ -	£ -	£ -	
NET IMPACT	**£ 155,823**		**£ -**	**£ -**	**£ 155,823**	
Of Which						
Foreign Leisure						
Travel Time	£ 93,494		£ -	£ -	£ 93,494	
Vehicle Operating Costs	£ -		£ -	£ -	£ -	
User Charges	£ -		£ -	£ -	£ -	
NET IMPACT	**£ 93,494**		**£ -**	**£ -**	**£ 93,494**	
Employees						
Travel Time	£ 5,564		£ -	£ -	£ 5,564	
Vehicle Operating Costs	£ -		£ -	£ -	£ -	
User Charges	£ -		£ -	£ -	£ -	
NET IMPACT	**£ 5,564**		**£ -**	**£ -**	**£ 5,564**	
Non-Airport Users						
Travel Time	-£ 179		£ 29,767	£ -	-£ 29,946	
Vehicle Operating Costs	£ -		£ -	£ -	£ -	
User Charges	£ -		£ -	£ -	£ -	
NET IMPACT	**-£ 179**		**£ 29,767**	**£ -**	**-£ 29,946**	
Private Sector Provider Impacts						
Revenue	£ 12,411		-£ 25,373	-£ 36,338	£ 74,121	£ 101,780
Operating Costs	-£ 19,760	(a)	£ -	£ 2,834	-£ 22,594	-£ 22,594
Investment Costs	-£ 230,800	(b)	£ 15,071	£ -	-£ 245,871	-£ 245,871
Grant / Subsidy	£ 166,685		£ -	£ -	£ 166,685	£ 166,685
NET IMPACT	**-£ 71,465**	**(2)**	**-£ 10,302**	**-£ 33,504**	**-£ 27,659**	**£ -**
Public Sector Provider Impacts						
Revenue	£ -		£ -	£ -	£ -	
Operating Costs	£ -	(c)	£ -	£ -	£ -	
Investment Costs	£ -	(d)	£ -	£ -	£ -	
NET IMPACTS	**£ -**	**(3)**	**£ -**	**£ -**	**£ -**	
Other Government Impacts						
Grant / Subsidy Payments	-£ 166,685	(e)	£ -	£ -	-£ 166,685	
Indirect Tax Revenues	-£ 11,336		-£ 4,461	£ 986	-£ 7,861	
NET IMPACTS	**-£ 178,021**	**(4)**	**-£ 4,461**	**£ 986**	**-£ 174,546**	

TOTAL		**TOTAL EXCLUDING FOREIGN BENEFITS**	
Net Present Value (NPV)	£ 116,464	£ 7,665	(6) = (1) + (2) + (3) + (4)
Present Value of Costs (PVC)	-£ 250,560	-£ 250,560	(7) = (a) + (b) + (c) + (d)
Present Value of Benefits (PVB)	£ 367,024	£ 258,225	(8) = (6) + (7)
Present Value of Costs to Government	-£ 178,021	-£ 178,021	(9) = (4) + (3)
Benefit / Cost Ratio (BCR)	**1.46**	**1.03**	(10) = - (8) / (7)
Value / Cost to Government Ratio (VCGR)	0.65	0.04	(11) = - (6) / (9)

■ Table 5-12 TEE Appraisal: Edinburgh: Surface Diversion (£ 000's)

Economic Efficiency of the Transport System (TEE)
(1998 prices discounted to 1998)

Project : Rail Links to Glasgow and Edinburgh Airports

Scheme : Edinburgh - Surface Diversion Scheme

	TOTAL		CAR	TAXI	PT	Of Which RAIL
User and Non-User Benefits						
Travel Time	£ 379,188		£ 29,006	£ -	£ 350,182	
Vehicle Operating Costs	£ -		£ -	£ -	£ -	
User Charges	£ -		£ -	£ -	£ -	
NET IMPACT	**£ 379,188**	**(1)**	**£ 29,006**	**£ -**	**£ 350,182**	
Of Which						
Scottish Business						
Travel Time	£ 46,334		£ -	£ -	£ 46,334	
Vehicle Operating Costs	£ -		£ -	£ -	£ -	
User Charges	£ -		£ -	£ -	£ -	
NET IMPACT	**£ 46,334**		**£ -**	**£ -**	**£ 46,334**	
Scottish Leisure						
Travel Time	£ 108,094		£ -	£ -	£ 108,094	
Vehicle Operating Costs	£ -		£ -	£ -	£ -	
User Charges	£ -		£ -	£ -	£ -	
NET IMPACT	**£ 108,094**		**£ -**	**£ -**	**£ 108,094**	
Non-Scottish Business						
Travel Time	£ 55,669		£ -	£ -	£ 55,669	
Vehicle Operating Costs	£ -		£ -	£ -	£ -	
User Charges	£ -		£ -	£ -	£ -	
NET IMPACT	**£ 55,669**		**£ -**	**£ -**	**£ 55,669**	
Of Which						
Foreign Business						
Travel Time	£ 16,701		£ -	£ -	£ 16,701	
Vehicle Operating Costs	£ -		£ -	£ -	£ -	
User Charges	£ -		£ -	£ -	£ -	
NET IMPACT	**£ 16,701**		**£ -**	**£ -**	**£ 16,701**	
Non-Scottish Leisure						
Travel Time	£ 160,441		£ -	£ -	£ 160,441	
Vehicle Operating Costs	£ -		£ -	£ -	£ -	
User Charges	£ -		£ -	£ -	£ -	
NET IMPACT	**£ 160,441**		**£ -**	**£ -**	**£ 160,441**	
Of Which						
Foreign Leisure						
Travel Time	£ 96,265		£ -	£ -	£ 96,265	
Vehicle Operating Costs	£ -		£ -	£ -	£ -	
User Charges	£ -		£ -	£ -	£ -	
NET IMPACT	**£ 96,265**		**£ -**	**£ -**	**£ 96,265**	
Employees						
Travel Time	£ 3,512		£ -	£ -	£ 3,512	
Vehicle Operating Costs	£ -		£ -	£ -	£ -	
User Charges	£ -		£ -	£ -	£ -	
NET IMPACT	**£ 3,512**		**£ -**	**£ -**	**£ 3,512**	
Non-Airport Users						
Travel Time	£ 5,138		£ 29,006	£ -	-£ 23,868	
Vehicle Operating Costs	£ -		£ -	£ -	£ -	
User Charges	£ -		£ -	£ -	£ -	
NET IMPACT	**£ 5,138**		**£ 29,006**	**£ -**	**-£ 23,868**	
Private Sector Provider Impacts						
Revenue	£ 15,604		-£ 25,805	-£ 38,187	£ 79,596	£ 107,981
Operating Costs	-£ 19,658	(a)	£ -	£ 2,936	-£ 22,594	-£ 22,594
Investment Costs	-£ 113,385	(b)	£ 15,269	£ -	-£ 128,654	-£ 128,654
Grant / Subsidy	£ 43,267		£ -	£ -	£ 43,267	£ 43,267
NET IMPACT	**-£ 74,172**	**(2)**	**-£ 10,536**	**-£ 35,251**	**-£ 28,385**	**£ -**
Public Sector Provider Impacts						
Revenue	£ -			£ -	£ -	
Operating Costs	£ -	(c)	£ -	£ -	£ -	
Investment Costs	£ -	(d)	£ -	£ -	£ -	
NET IMPACTS	**£ -**	**(3)**	**£ -**	**£ -**	**£ -**	
Other Government Impacts						
Grant / Subsidy Payments	-£ 43,267	(e)	£ -	£ -	-£ 43,267	
Indirect Tax Revenues	-£ 11,478		-£ 4,133	£ 949	-£ 8,294	
NET IMPACTS	**-£ 54,745**	**(4)**	**-£ 4,133**	**£ 949**	**-£ 51,561**	

TOTAL			**TOTAL EXCLUDING FOREIGN BENEFITS**	
Net Present Value (NPV)	£ 250,271	£	137,306	(6) = (1) + (2) + (3) + (4)
Present Value of Costs (PVC)	-£ 133,043	-£	133,043	(7) = (a) + (b) + (c) + (d)
Present Value of Benefits (PVB)	£ 383,314	£	270,349	(8) = (6) - (7)
Present Value of Costs to Government	-£ 54,745	-£	54,745	(9) = (4) + (3)
Benefit / Cost Ratio (BCR)	**2.88**		**2.03**	(10) = - (8) / (7)
Value / Cost to Government Ratio (VCGR)	4.57		2.51	(11) = - (6) / (9)

(512) Our appraisals of Edinburgh options show that, under our base case assumptions, all would generate significantly more revenue than operating costs, all would generate economic benefits in excess of their capital and operating costs, but only the Surface Diversion option would have a Net Present Value/Cost to Government Ratio in excess of one – in fact, our calculations show a value for this ratio which is just under four which indicates that, from the Executive's point of view, this option would be a very good economic value for money. All options would generate significantly more revenue than operating costs.

(513) As with the Glasgow schemes, the following broad pattern is common to all options:

- benefits would be generally highest for the Leisure sectors, though in Edinburgh non-Scottish Leisure would generate higher benefits than Scottish Leisure;
- benefits to both business sectors would be lower, though not as significantly as in Glasgow;
- benefits to employees would be small;
- highway decongestion benefits (shown under "Car" in the non-airport user sector) would be much smaller than user benefits, but would be significant in all cases;
- benefits to other rail users (shown under "Public Transport" in the non-airport sector) would be very small and in some cases negative overall; and
- vehicle operating cost and taxation impacts would be very small in comparison with the costs, benefits and revenue effects on public transport.

(514) By far the highest benefits would be generated by the Runway Tunnel option but, because of its high capital cost, it would yield only a relatively modest Benefit/Cost Ratio. The E&G Spur option would be poor value for money as its cost would be high, not least because of the need to provide over-run tunnels under the airport (the station would be underground in this option, the idea being that this would form the first phase of the full Runway Tunnel option). The Fife Spur and the E&G Diversion would yield modest Benefit/Cost Ratios. The best Benefit/Cost Ratio by far would be provided by the Surface Diversion option, although its benefits would be about half those yielded by the Runway Tunnel option and significant disbenefits would accrue to existing passengers who are re-routed via the airport.

(515) The comparison of overall costs between the cheaper solutions and the expensive Runway Tunnel option is worthy of note. All of the options which are cheaper to engineer at the Airport would incur significant additional costs, except for the Surface Diversion option. The two Spur options would incur the additional operating costs for the shuttle services and the costs of additional train paths into, and platform space at, Waverley Station, whereas the E&G Diversion option would involve the expense of relocating the Royal Highland Showground. Therefore, the difference in overall Present Value of Costs between the schemes is much smaller than suggested by the engineering costs at the Airport alone.

(516) In the cases of the Spur options, the benefits to other rail users would be restricted to a slightly enhanced frequency between Waverley Station and Haymarket. In the case of the Runway Tunnel and E&G Diversion, there would be no enhanced service frequencies and the only benefit to other rail users would be the additional interchange opportunity at the Airport for travellers between services to/from the West and services to/from Fife and the North. This is balanced against the disbenefit of additional travel time via the Airport for Fife services in the Runway Tunnel option

and for all services in the E&G Diversion option, generating an overall disbenefit in both cases. The Surface Diversion option would impose significant delays to those services diverted to serve the Airport.

6. Sensitivity Testing

6.1 Background

(517) The robustness of the appraisals reported in chapter 5 needed to be tested against a range of different assumptions.

(518) Some sensitivity testing was undertaken during the development of the demand forecasting model to help us understand how the model behaves in response to different input parameters. We did not therefore undertake any further sensitivity tests which might affect the set-up of the calibrated base model. Instead, we concentrated on parameters which test the robustness of the option appraisals to different assumptions about future year scenarios.

(519) Clearly, the sensitivity testing programme needed to be managed quite carefully. With eight scheme options and a number of sensitivity tests under each of the headings below, we could have generated a very large matrix of well in excess of 100 tests. We have therefore concentrated on, what seemed during Phase 3 to be the front-runner scheme for each airport, Glasgow Central and the Runway Tunnel in Edinburgh.

(520) Since then, we have developed an additional option in Edinburgh which performs better, in benefit/cost terms, than the Runway Tunnel option. However, that option has been developed specifically to avoid project risks and its benefit/cost case has a considerable margin. It is therefore both less likely to be subject to major variations in the appraisal assumptions we have used in the base case, and less vulnerable to such variations. We therefore believe it is appropriate that the key sensitivity testing at Edinburgh should still focus on the Runway Tunnel option.

(521) We have undertaken some additional sensitivity tests for other schemes to help us understand the circumstances under which the scheme ranking may change.

6.2 Range of Sensitivity Tests

6.2.1 Scheme Costs

(522) During Phases 2 and 3, we sought to minimise the risk of getting the costs significantly wrong by a thorough and detailed exploration of all key issues with Railtrack. However, the infrastructure costings to Railtrack level 2 are only accurate to ± 30% and in common with all major infrastructure projects, cost escalation does remain an area of risk.

(523) To explore the robustness of the scheme appraisal to significant cost escalation, we have explored the effects of increases of 30% and 50% of total project costs.

6.2.2 Rolling Stock

(524) The normal modus operandi for both ScotRail and SPT is to lease their rolling stock and this has been assumed in our base case. However, SPT have in the past purchased their rolling stock and could, in principle, do so for the Airport Link. As this may improve the case for the link, we have included a sensitivity test with bought rolling stock at Glasgow.

6.2.3 Track Access Charges

(525) As noted in chapter 3, the operating costs as currently calculated include an allowance for track access charges, which *may* include an element of double-counting with capital costs.

(526) We have therefore assessed the effect of assuming no track access charges.

6.2.4 Air Passenger Demand

(527) Our current air passenger demand forecasts are based on DfT's SPASM model, and, more specifically, the run J62 produced for the air strategy consultation. The resulting predictions in air passenger demand are outlined in table 4.1 above, and the future year numbers are re-iterated in table 6.1 for ease of reference.

■ **Table 6-1 Overall Annual Air Passenger Demand: SPASM J62**

	Glasgow Passengers			Edinburgh Passengers		
	Domestic	International	**Total**	Domestic	International	**Total**
2010	5,137,010	6,289,748	**11,426,758**	5,493,253	4,741,889	**10,235,142**
2020	6,259,123	8,615,180	**14,874,303**	8,357,146	9,094,259	**17,451,405**
2030	7,555,413	9,531,697	**17,087,110**	9,904,130	13,963,754	**23,867,884**

(528) BAA have proposed alternative demand figures, which assume similar overall demand for the two airports together, but an even split of demand between Glasgow and Edinburgh Airports. However, although the totals are identical for both airports, the segmentation of that demand is different between the two airports. This is in line with current characteristics, with more domestic traffic at Edinburgh and more international demand at Glasgow. Table 6.2 summarises the figures.

■ **Table 6-2 Overall Annual Air Passenger Demand: BAA Sensitivity Test**

	Glasgow Passengers			Edinburgh Passengers		
	Domestic	International	**Total**	Domestic	International	**Total**
2010	5,000,000	5,000,000	**10,000,000**	6,000,000	4,000,000	**10,000,000**
2020	6,000,000	9,000,000	**15,000,000**	7,000,000	8,000,000	**15,000,000**
2030	7,000,000	13,000,000	**20,000,000**	8,000,000	12,000,000	**20,000,000**

(529) We have implemented BAA's alternative forecast by factoring the zonal trip totals which we derived from the above SPASM data.

6.2.5 Rail Fares

(530) The fares used in our Phase 2 forecasting were based on the assumption that rail services would charge a premium commensurate with the current bus services. As part of our sensitivity testing, we have explored where a revenue-maximising fare level lies. This could, in theory, be either higher or lower than the current bus premium fare.

(531) It is reasonable to assume that the rail service would be the "dominant" public transport mode to the airports and that bus services would need to respond competitively to whatever fare levels are set for rail services (rather than the other way round).

(532) In the derivation of a revenue-maximising fare for rail services, we have therefore assumed that bus fares for the premium fare airport service would move in tandem with the rail fare. This could be regarded as a "best case" for the rail services. Bus fares higher than rail fares are not a credible scenario. The notion of a competitive response by bus operators is explored further below.

(533) In addition to a revenue-maximising fares level, we have explored the effect of assuming standard rail fares.

6.2.6 Bus Competition

(534) Bus operators could clearly decide to compete head-on with the rail schemes. As they have little scope to improve journey times, their main tool for competition will be the fare. We have tested a 20% reduction in airport bus fares.

(535) Current bus frequencies at both airports are already at a level where further improvements would not seem plausible. The other response by bus operators to the presence of the rail scheme would therefore be a reduction of service frequencies in an attempt to contain costs. We have tested a halving in frequency of airport bus services.

6.2.7 Airport Parking Costs

(536) The base case assumption, derived in discussion with the Scottish Executive and BAA, is that airport parking costs would not change over time in real terms. We believe a downward variation on the current airport parking costs is not realistic. We have therefore tested a doubling of parking costs.

6.2.8 Taxi Costs

(537) Although taxi costs are regulated in both cities, we believe that taxi operators could lobby for changes in fares in response to the rail links. We have tested both an upwards and a downwards variation of 20%.

6.2.9 Airport Toll

(538) We have tested the concept of a road access toll to the airports. We have assumed that the toll would apply to all road-based access modes, including taxis, but excluding buses.

(539) When we first suggested this sensitivity test in a discussion note during Phase 3, we received a number of strong reactions. In particular, it was suggested that the study team had misunderstood the proposals for road user charging in Edinburgh.

(540) We are aware that road user charging is a very contentious issue that elicits strong public reactions. We are not suggesting that there is any connection with the road user charging scheme currently under discussion for Edinburgh, nor are we making any assumption about the likelihood of that scheme, or a separate scheme at the Airport, going ahead.

(541) We have tested an access charge of £5 (in 2002 prices) to ascertain whether this would make a measurable difference to the viability of the rail scheme.

6.2.10 Highway Congestion

(542) We do not have at our disposal a detailed highway model. However, we can broadly simulate increased congestion by factoring the highway generalised cost matrices used in our mode split forecasting. We have tested the impact of increasing overall highways costs by 10% to simulate a general increase in congestion levels compared with those underlying our base forecast.

6.2.11 Highways Decongestion Benefits

(543) As outlined in 4.3.6 above, we have not undertaken detailed highways modelling to calculate highways decongestion benefits. We have used information from a specially undertaken run on CSTM3A to help us estimate what highways decongestion benefits would be generated from the airport schemes.

(544) The benefits thus derived are small in comparison with user benefits, but by no means insignificant. We have therefore undertaken two sensitivity tests:

- decongestion benefit halved; and
- decongestion benefit doubled.

(545) This provides a good indication of the sensitivity of the appraisal to road decongestion benefits.

6.2.12 Values of Time in Appraisal

(546) The issue of values of time is discussed in some detail in chapter 4, where the issues arising from the use of the same values of time in forecasting and appraisal are discussed. To address some of the issues raised in chapter 4, we have tested two sets of different values of time used in appraisal only:

- standard TEN values; and
- SPASM values.

(547) These tests indicate how the economic performance of the schemes would change under different value of time assumptions. They represent approximations, however, for two reasons:

- we have only changed the value of time in the appraisal and not in our behavioural forecasting; and
- the value of time sensitivity is applied to the entire composite cost and therefore to money benefits as well as time benefits.

(548) Applying different values of time in our forecasting without re-calibrating the entire model would give us results which are not interpretable.

(549) The application of the value of time sensitivity to the whole composite cost means that money-based costs (such as fares), which have been converted to time in our model using our standard values of time, will be re-converted to money in the appraisal using different (and therefore inconsistent) values of time. However, this inconsistency is tolerable because the overwhelming majority of benefits will be time-based rather than money-based.

6.2.13 Growth in Values of Time in Modelling

(550) Our standard assumption for the growth in values of time is an increase in line with GDP, as stipulated by TEN. We have tested the effects of assuming no growth in the forecasting model to show the effect of value of time growth on modal splits.

6.2.14 Rail Service Levels

(551) Although different rail service levels seem to be obvious sensitivity tests to undertake, our considerations during Phase 2, leading to the current shortlist, led us to the conclusion that there are no plausible alternatives to the currently defined service levels.

(552) For the shuttle services from Glasgow Airport to Glasgow Central or Queen Street, it is very unlikely that a service level of less than 4 tph would be at all attractive to air passengers. More than 4 tph, on the other hand, is very unlikely to be operationally feasible.

(553) Similarly, for the shuttle services from Edinburgh Airport to Waverley, either via the Fife line or via the E&G line, it is unlikely that less than 4 tph would be acceptable or that more could be accommodated at Waverley station.

(554) For the longer-distance services at Glasgow, we have already established that it would be very difficult to make a case for 2 tph on the basis of operating costs and revenue. Furthermore, it is extremely unlikely that more than 2 tph can be accommodated on the network. Less than 2 tph, on the other hand is unlikely to provide any measurable benefit over and above the basic city centre shuttle service.

(555) For the Runway Tunnel option at Edinburgh, we have already established that it is most beneficial to run as full a service via the Airport as possible. With the minimal operating cost incurred through the diversion of existing services, there simply is no reason not to.

(556) Finally, for the E&G Diversion option at Edinburgh, we believe that the currently proposed service pattern strikes a good balance between providing a high service level for the Airport and minimising disruption to other users who will be delayed through the diversion.

6.2.15 Foreign Travellers

(557) The issue of benefits to non-UK residents has been discussed in chapter 4. In all our TEE tables, we have separated out these benefits and shown the Net Present Value of the project as well as the Benefit/Cost Ratio with and without benefits to foreign travellers. We have therefore not undertaken any further sensitivity testing on foreign travellers.

6.3 Glasgow Sensitivities

(558) The results of our sensitivity testing programme for the Glasgow Central option are summarised in table 6.3.

■ **Table 6-3 Sensitivity Tests: Glasgow Central**

all costs and benefits in £million	Net Present Value	PV of Costs	PV of Benefits	PV of Rail Revenue	Rail Revenue 2010	Rail Revenue 2020	Benefit / Cost Ratio
Base Case	**-30.7**	**154.0**	**123.3**	**42.4**	**2.4**	**3.0**	**0.80**
Scheme Costs							
30% escalation	-76.9	200.2	123.3	42.4	2.4	3.0	0.62
50% escalation	-107.7	231.0	123.3	42.4	2.4	3.0	0.53
Rolling Stock Costs							
Purchased rather than leased trains	-14.8	138.1	123.3	42.4	2.4	3.0	0.89
Rail Operating Costs							
Track Access Charges excluded	-27.6	150.9	123.3	42.4	2.4	3.0	0.82
Air Passenger Demand							
BAA test	-34.0	154.0	120.0	41.3	2.3	2.9	0.78
Rail Fares							
No premium fare	-35.1	154.0	118.9	40.9	2.3	2.9	0.77
Revenue maximising	-30.7	154.0	123.3	42.4	2.4	3.0	0.80
Bus Competition							
20% lower bus fares				37.7	2.1	2.7	
Bus frequency halved				42.4	2.4	3.0	
Airport Parking							
Parking costs doubled				48.2	2.7	3.4	
Taxi Cost							
20% lower				40.3	2.3	2.9	
20% higher				43.7	2.5	3.1	
Airport Toll							
£5 Access Charge to Cars and Taxis				45.4	2.6	3.2	
Highways Congestion							
Overall highways cost increased 10%				45.4	2.6	3.2	
Highways Decongestion Benefits							
Highways Decongestion Benefits Doubled	-18.8	154.0	135.2	42.4	2.4	3.0	0.88
Highways Decongestion Benefits Halved	-36.7	154.0	117.4	42.4	2.4	3.0	0.76
Value of Time in appraisal							
Standard TEN values in appraisal	-98.6	154.0	55.4	42.4	2.4	3.0	0.36
SPASM values in appraisal	-7.3	154.0	146.7	42.4	2.4	3.0	0.95
Value of Time Growth in modelling							
No real growth in mode split modelling	-32.9	154.0	121.1	41.6	2.4	2.9	0.79

Note: Tests on Bus Competition, Airport Parking Costs, Taxi Costs, Airport Acccess Toll and Highways Congestion have been undertaken specifically to test out their impact on the airport rail scheme revenues. Their impact on benefits is much more wide-ranging and conceptionally difficult to appraise.

(559) This illustrates that the scheme value is fairly robust against most downside risks with the exception of major cost escalation and the use of standard TEN values of time in the appraisal. The Net Present Value does not become positive under any of the scenarios tested here. The case will improve, however, if major cost reductions can be assumed. This is explored in the following.

(560) As is apparent from the TEE tables in chapter 5, the appraisal results for Glasgow Central and Queen Street are quite similar. Both schemes generate similar levels of benefit and both schemes are similar in cost: They share the same infrastructure between the Airport and Shields Junction and the costs of providing additional capacity at Glasgow Central is similar to the cost of the St John's link which enables services to reach Queen Street Low Level. It can therefore be concluded that a similar sensitivity testing programme would lead to similar conclusions for the Queen Street option.

(561) As outlined in chapter 3, we have explored circumstances under which some of the project costs could be allocated to other schemes and would not need to be borne by the airport project. This could apply, in theory, to the cost of additional capacity between Paisley and Shields Junction, the St John's link and, to a lesser extent, the

platform capacity at Glasgow Central which would provide sufficient train paths for additional services, for example to Prestwick and Ayrshire.

(562)The most promising line of enquiry was the St John's link, which, together with the Strathbungo link, forms a project in its own right. It would enable the re-routeing of some services which currently terminate at Glasgow Central into Queen Street Low Level and beyond. SPT have undertaken their own studies which show a positive case for the scheme. Although this has not been appraised in line with the latest Treasury guidelines (using a 3.5% discount rate and cost uplift factors for "optimism bias"), the case appears to have sufficient margin and it is likely that it would to remain positive under the new assumptions, even if the additional infrastructure costs identified as part of this study are included.

(563) We have therefore tested the effects of allocating all of the St John's link costs and of some of the Paisley to Shields Junction capacity costs to other schemes on the case for the Airport link to Queen Street. Table 6.4 summarises the results.

■ **Table 6-4 Cost Sensitivities: Glasgow Queen Street**

all costs and benefits in £million	Net Present Value	PV of Costs	PV of Benefits	PV of Rail Revenue	Rail Revenue 2010	Rail Revenue 2020	Benefit / Cost Ratio
Base Case	**-38.8**	**164.7**	**125.9**	**41.5**	**2.3**	**2.9**	**0.76**
Scheme Costs							
No St John's Link Costs	-16.0	141.9	125.9	41.5	2.3	2.9	0.89
No St John's Link and half of Paisley - Shields Costs	4.1	121.8	125.9	41.5	2.3	2.9	1.03
Rolling Stock Costs							
Purchased rather than leased trains	-22.0	147.9	125.9	41.5	2.3	2.9	0.85
Combined Tests							
No St John's Link Costs and rolling stock purchased	0.9	125.0	125.9	41.5	2.3	2.9	1.01
No St John's Link and half of Paisley - Shields Costs and rolling stock purchased	21.0	104.9	125.9	41.5	2.3	2.9	1.20

(564)This shows that a positive case can be made for Glasgow Queen Street is some of the project costs can be shared with other schemes. Again, similar conclusions might be reached for Glasgow Central, but we found the prospect of cost sharing less likely here.

6.4 Edinburgh Sensitivities

(565)Table 6.5 summarises sensitivity tests for the Edinburgh Runway Tunnel option. In addition to the cost escalation tests outlined above, we have also explored the impact on the some further cost sensitivities:

- the airport station not being classified as a section 12 station;
- the extra line capacity through Edinburgh Park not being required in combination with the above; and
- the additional costs incurred if some trains would need to be lengthened to provide sufficient train capacity.

■ Table 6-5 Sensitivity Tests: Edinburgh Runway Tunnel

all costs and benefits in £million	Net Present Value	PV of Costs	PV of Benefits	PV of Rail Revenue	Rail Revenue 2010	Rail Revenue 2020	Benefit / Cost Ratio
Base Case	**250.4**	**427.2**	**677.6**	**146.0**	**6.7**	**10.7**	**1.59**
Scheme Costs							
30% escalation	122.2	555.4	677.6	146.0	6.7	10.7	1.22
50% escalation	36.8	640.8	677.6	146.0	6.7	10.7	1.06
No Section 12 Station Costs	343.4	334.2	677.6	146.0	6.7	10.7	2.03
No Sect. 12 Costs & no extra Edin Park Capacity	379.0	298.6	677.6	146.0	6.7	10.7	2.27
Extra £2.5m pa for train lengthening	214.5	463.1	677.6	146.0	6.7	10.7	1.46
Rail Operating Costs							
Track Access Charges excluded	274.2	403.4	677.6	146.0	6.7	10.7	1.68
Air Passenger Demand							
BAA test	172.2	427.2	599.4	129.1	5.9	9.5	1.40
Rail Fares							
No premium fare	327.6	427.2	754.8	130.6	6.0	9.6	1.77
Revenue maximising	-233.2	427.2	194.0	379.7	10.7	26.7	0.45
Bus Competition							
20% lower bus fares				136.2	6.3	10.0	
Bus frequency halved				153.3	7.0	11.2	
Airport Parking							
Parking costs doubled				168.9	7.8	12.4	
Taxi Cost							
20% lower				143.1	6.6	8.7	
20% higher				151.8	7.0	11.1	
Airport Toll							
£5 Access Charge to Cars and Taxis				160.6	7.4	11.8	
Highways Congestion							
Overall highways cost increased 10%				153.3	7.0	11.2	
Highways Decongestion Benefits							
Highways Decongestion Benefits Doubled	302.4	427.2	729.6	146.0	6.7	10.7	1.71
Highways Decongestion Benefits Halved	224.4	427.2	651.6	146.0	6.7	10.7	1.53
Value of Time in appraisal							
Standard TEN values in appraisal	-62.6	427.2	364.6	146.0	6.7	10.7	0.85
SPASM values in appraisal	544.1	427.2	971.3	146.0	6.7	10.7	2.27
Value of Time Growth in modelling							
No real growth in mode split modelling	313.8	427.2	741.0	159.7	7.3	11.7	1.73

Note: Tests on Bus Competition, Airport Parking Costs, Taxi Costs, Airport Acccess Toll and Highways Congestion have been undertaken specifically to test out their impact on the airport rail scheme revenues. Their impact on benefits is much more wide-ranging and conceptionally difficult to appraise.

(566) This illustrates that the scheme is robust against most sensitivities tested, with a positive Net Present Value in all cases except standard TEN values of time and the use of revenue-maximising fare levels, which would substantially reduce passenger benefits. Apart from these, the most significant downside risk is major cost escalation. The case could be improved materially if some or all of the facilities for a section 12 station were not required. However, that would then need to be balanced against the lost development opportunities above a station in open cutting.

(567) The other sensitivity testing we have undertaken at Edinburgh was for the E&G Diversion option, where major uncertainty is attached to the cost of relocating the Royal Highland Showground. Our base case includes an indicative assumption of £100m for this. Against that, we have tested costs of £50m and £150m. The results are summarised in table 6.6.

■ **Table 6-6 Cost Sensitivities: Edinburgh E&G Diversion**

all costs and benefits in £million	Net Present Value	PV of Costs	PV of Benefits	PV of Rail Revenue	Rail Revenue 2010	Rail Revenue 2020	Benefit / Cost Ratio
Base Case	**116.4**	**250.6**	**367**	**101.8**	**4.7**	**8.0**	**1.46**
Scheme Costs							
+ £50M property cost	75.2	291.8	367	101.8	4.7	8.0	1.26
- £50M property cost	157.6	209.4	367	101.8	4.7	8.0	1.75

(568)This shows that while the property cost assumed for the showground does not affect this option's ranking with respect to a Surface Diversion option, a lower property cost could make it perform marginally better than the Runway Tunnel option under its base case assumptions.

7. Funding and Procurement

7.1 Background

(569) The Terms of Reference identified two prime objectives in respect of the financial implications of the schemes for Glasgow and Edinburgh Airports:

- financial viability; and
- possible funding sources.

(570) In addition, comment was required with respect to the allocation of risk and procurement. These two latter issues are inter-dependent on the proposed corporate structure for the project(s), which in turn is dependent on the conclusions coming out of the analysis of financial viability and funding sources.

7.2 Scope of Work

7.2.1 Financial Viability

(571) Economic and financial cash-flow appraisals have been undertaken to ascertain the outline financial viability of each short-listed scheme based on the cost data identified under Phases 2 and 3 of the Study.

(572) The economic appraisal comprised a Funding Gap and Net Present Value analysis, based on "real" revenue and capital and operating cost data, together with estimates for User and non-User Benefits. The results showed the magnitude of any Funding Gap and identified whether the Net Present Value figure was positive, thereby qualifying the project, in principle, for Government grant support.

(573) For the financial analysis, cash-flow projections have been prepared using the same revenue and cost data, inflated to represent actual (nominal) values, and the main appraisal criteria are potential investor (equity) rates of return and the acceptability of the calculated cover ratios for commercial lenders. These results were determined from the cash-flows, which included any contribution by way of Government grant that might be available. The balance of capital costs are assumed to be as funded by a simple 80/20 debt/equity ratio corporate structure based on a single long-term loan at what was deemed to be market, but conservative, rates.

7.2.2 Funding Sources

(574) The outline financial analysis has given some pointers as to the types of funding required. The main sources are likely to include (in no order of priority):

- UK Government grant through the SRA;
- Scottish Executive;
- European Union;
- private capital: equity funds;
- commercial banks; and
- Scottish stakeholders.

(575) Leasing and similar such private sector funding facilities are seen as a sub-set of commercial bank lending, given that the terms and conditions often reflect those of the commercial loans.

(576) It may now be appropriate in the further project development to review such sources in direct interaction with potential financiers.

7.2.3 Corporate Structure

(577) Given the desirability of keeping the financial burden for these rail links off the public balance sheet, it is likely that some form of Special Purpose Vehicle would be required for each project selected for implementation. It has been noted that parts of the Executive have a preference for not-for-profit-type companies, such as the Company Limited by Guarantee ("CLG") for Network Rail, for PFI/PPP ventures. However, there remain some unresolved issues as to whether such corporate structures really represent "off-balance sheet" structures for such projects.

7.2.4 Risks and Risk Allocation

(578) The financial analysis undertaken to date has been preliminary. The focus has been on the identification of base case options for both Glasgow and Edinburgh Airports in the first instance. A limited amount of sensitivity analysis was undertaken with respect to identifying the impact of increased revenues on funding gaps, but further analysis on key project variables remain to be carried out once option choices are firmed up. However, in such transport schemes from experience there is little doubt that the major risks to financial viability and attractiveness of such projects to private investors and lenders lie with revenue and capital cost forecasts rather than with the assumptions for financial terms and conditions.

7.2.5 Implementation and Procurement

(579) In the light of the above assessment for each option, suggestions have been made as to the steps to be taken to implement such project(s) and the procurement processes that might have to be adopted.

7.3 Financial Viability

7.3.1 Background

(580) In any private sector funding of infrastructure, private financiers (debt and equity) will endeavour to ring-fence their risks. They will wish to control all activities within the ring-fence, i.e. the project envelope, and the public service concession documents will define the interface(s) between the public and private sectors in this respect.

(581) There are a number of precedents for private sector financing of transportation infrastructure in the UK over recent years, e.g. Croydon Tramlink; CTRL; DLR extension to Lewisham; numerous DBFO road projects, etc.. Some have been financially successful, some not. Where success has been only partially achieved or elusive, the reasons can usually be found in unfulfilled expectations and a failure to fully assess and/or a miss-allocation of the inherent project risks.

(582) In urban transport financings using private capital, sustainable traffic revenues and an acceptable project risk profile will have to be achieved to attract lenders and investors. Lenders will measure project performance primarily by reference to forecast Debt Service Cover Ratios (i.e. the ratio between the amount of cash generated by the project in any one period, after operating costs and tax, against the amount due for debt service (interest and loan principal) in that same period.

Typically an acceptable minimum ratio is 1.4, or above, and only in exceptional circumstances will lenders accept anything less and only then for short periods. Investors, on the other hand, will evaluate the forecast equity/shareholder rates of return, when typically a rate of 15-20% p.a. will be expected. Investors will also look to the profile of dividend payments over the project life: if they have to wait a long time before receiving their first dividend payment, the more nervous they will be.

(583)It comes as no surprise, then, that most public transport schemes require a Government subvention in order to achieve economic and financial viability. There have been few exceptions in the UK and overseas. The Scottish Airport rail links are no such exceptions. The anticipated traffic volumes are not so great such that the projects would be financially sustainable without Government support.

(584)Normally, any Government grant element is injected into the construction cost structure, with operational revenues expected to repay any commercial debt and investor returns. On those occasions when subvention is required during the operational period - the LUL PPP is a case in point - a long-term commitment by Government to continue to provide subvention or grant on a continuous and sustainable basis is necessary. However, governments are usually reluctant to provide such subventions for operations, and prefer to use whatever grant funding may be available to support investment costs.

(585)Recent project precedents comparable with the proposed rail links to Glasgow and Edinburgh Airports include the Croydon Tramlink, which economically and socially probably contributes significantly to the well-being and quality-of-life of the area. However, that project significantly under-achieved (around 70-80%) on its traffic forecasts in its early years of operations. Hence, the lenders have been concerned, as the debt service coverage has been threatened, potentially triggering loan covenants. On the other hand, lenders would be very reluctant to step in to terminate the concession, which would amount to a take-over of the project. Whereas the traffic forecasts were probably too optimistic at the outset, some of the blame for under-performance in that case could possibly be laid with Transport for London (TfL), who have apparently failed to honour undertakings to adjust local bus transport routes in support of Tramlink, as the original concession agreements required. The transfer of responsibilities from London Underground Ltd (LUL) to TfL, and the political ramifications of changes in regional government transport policies have contributed to the discord. Hence, both the enabling environment changed during project implementation and there was a mis-assessment of the associated project risks (i.e. traffic).

(586)Such events are not atypical of private sector ventures in rail transport, and the financial community view these developments with concern, as they could just as well happen on other ventures. The result is that, not only are private sector rail transport projects more difficult to structure and fund, but there is also an inherent nervousness of financiers to such proposals, unless the project economics are demonstrably robust.

(587)Finally, in the context of the viability of such funding mechanisms using private capital, it is clear that the financial markets are ready to accept such structures, provided that the risks are identifiable and that the Government plays its part too. However, the up-front costs and the time required for the necessary negotiations to arrive at an acceptable package are high, such that, for transactions where the private

sector contribution comprises less than £25-30 million commercial debt, the costs do not normally outweigh the benefits.

7.3.2 Financial Modelling

(588)A description of our Financial Model and detailed results tables are shown in appendix H.

(589)The key results are reproduced in table 7.1 for Glasgow and 7.2 for Edinburgh. The following information is shown:

- "**Net Present Value [1998 @ 3.5%]":** the economic results reported in chapters 5 and 6 are reported in real figures, on a 1998 price base, discounted to 1998. As the economic results are usually used to determine whether a project receives public sector support, (usually, only projects with a positive NPV qualify), we have shown the NPV as reported in our TEEs (in 1998 prices, discounted to 1998).

- **"Funding Gap [2002 @ 3.5%]":** this represents the Net Present Value discounted at 3.5% of Capital and Operating Costs against Revenues using economic (i.e 2002 un-inflated) values.

- **"Equity IRR [%]"** represents the rate of return for (equity) investors in the project. This is calculated from, on the one hand, the cash-flow of equity injections into the project to meet capital Costs (see "Funding" and Cash-Flow" worksheets) against, on the other, the cash-flow of dividend payments received by the shareholders.

  Due to the possibility that grant payments may be made to support the project and grant monies are used up first, equity funds may not be required at the start of construction, but later on when all grant has been used up. The equity IRR calculation is made from the year when equity funds are actually injected, not at either 2005 or 2002 date.

  Clearly, depending on the dividend policy, there may be shareholders' funds remaining in the project at the end of the concession (30 year) period. The amount outstanding was therefore added to the dividend stream for distribution to shareholders in the last project period, year 3034.

- **"1st Year DSCR > 1.2":** "DSCR", the Debt Service Cover Ratio, is the ratio of the cash-flow which is available in any period (Operating Profit less Tax) divided by the amount of debt service (interest, plus principal) due in that same period. Obviously, it should be greater than 1.0 for the project cash-flows to be able to meet such obligations.

  However, lenders usually required there to be a margin. The extent of such margin will depend on the inherent risks in the project. In the Model the DSCR target level is an item of data input but, for example, a level of 1.2 is a minimum, although in many quarters this may be considered too low. Quite often, particularly with transport projects, which rely on traffic growth, this ratio may be low in the early years of operations. However, a ratio of 1.5 or above is only considered acceptable for a project in maturity. In the Model this Result shows the first year in the project life-cycle that such a target is reached.

- **"1st Year Int. CR > 1.5":** "Int. CR", the Interest Cover Ratio, is the ratio of the cash-flow which is available in any period (Operating Profit less Tax) divided by the amount of interest on debt due in that same period. Obviously, as for DSCR, it should be greater than 1.0 for the project cash-flows to be able to meet such obligations.

  Lenders usually expect the "Int. CR" to be significantly better than "DSCR", and a ratio of 2.0 plus would be considered comfortable (as one also has to remember the margin tpo repay capital).

- Also in the Results Table the aggregate (out-turn) Capital Costs and other costs are shown together with details as to how they were funded.

Table 7-1 Financial Analysis Summary: Glasgow

		GLASGOW	GLASGOW	GLASGOW	GLASGOW
	Units	Glasgow Central	Queen Street	Central Plus	Queen Street Plus
Net Present Value[1998] @ 3.5%	£ mn.	[30.66]	[38.85]	[129.42]	[138.61]
Funding Gap [2002] @ 3.5%	£ mn.	118.62	132.87	242.54	252.91
Equity IRR (Yr. of Inv.)	% pa.	-ve (2004)	-ve (2004)	-ve (2004)	-ve (2004)
1st year DSCR > 1.2*		never	never	never	never
1st year Int. CR > 1.5**		never	never	never	never
Project Costs:					
Capital Costs	£ mn.	162.437	170.322	277.933	285.817
Loan Fees	£ mn.	1.434	1.504	2.454	2.523
Cap. Int.	£ mn.	15.384	16.131	26.322	27.069
Sub-Total	£ mn.	179.255	187.956	306.709	315.049
Funded by:					
Grant	£ mn.	0.000	0.000	0.000	0.000
Equity	£ mn.	35.851	37.591	61.342	63.082
Loan	£ mn.	143.404	150.365	245.367	252.328
Sub-Total	£ mn.	179.255	187.956	366.709	315.409

Notes:
* : DSCR = Debt Service Cover Ratio: a ratio of 1.4 is a typical market minimum, but in the early years of operations a ratio of 1.2 may be acceptable.
** : Int. CR = Interest Cover Ratio: a typical market norm is 1.5 or above. Many financiers will seek ratios of 2.0 or above.

■ **Table 7-2 Financial Analysis Summary: Edinburgh**

		EDINBURGH	EDINBURGH	EDINBURGH	EDINBURGH	EDINBURGH
	Units	Fife Spur	E & G Spur	Runway Tunnel	E & G Diversion	Surface Diversion
Net Present Value [1998] @ 3.5%	£ mn.	118.69	14.52	250.39	116.46	250.27
Funding Gap [2002] @ 3.5%	£ mn.	188.82	292.12	329.10	179.65	60.38
Equity IRR (yr. of inv.)	% pa.	-ve (2009)	-ve (2009)	-ve (2009)	ve (2009)	3.03% (2008)
1st year DSCR > 1.2*		2024	2027	2025	2023	2022
1st year Int. CR > 1.5**		2018	2019	2018	2017	2015
Project Costs:						
Capital Costs	£ mn.	336.572	483.443	586.814	346.673	181.431
Loan Fees	£ mn.	1.007	1.237	1.757	1.186	0.963
Cap. Int.	£ mn.	2.328	2.239	4.064	3.181	4.830
Sub-Total	£ mn.	339.907	486.920	592.635	351.040	187.225
Funded by:						
Grant	£ mn.	214.011	332.277	372.999	202.770	66.862
Equity	£ mn.	25.179	30.929	43.927	29.654	24.073
Loan	£ mn.	100.717	123.715	175.709	118.616	96.290
Sub-Total	£ mn.	339.907	486.920	592.815	351.040	187.225

Notes:
* : DSCR = Debt Service Cover Ratio: a ratio of 1.4 is a typical market minimum, but in the early years of operations a ratio of 1.2 may be acceptable.
** : Int. CR = Interest Cover Ratio: a typical market norm is 1.5 or above. Many financiers will seek ratios of 2.0 or above.

(590) A number of initial conclusions can be drawn.

- All the Glasgow Base Case options show a Funding Gap, but none achieves a positive Net Present Value, which might qualify them for Central Government grant support. In all base cases, the operating costs exceed the forecast revenues. As a result, for these options to proceed they would receive no grant and would have to be funded purely by private capital. With financial viability not achieved by a significant margin, such a possibility is inconceivable .
- All the Edinburgh options demonstrate a Funding Gap and also show a positive Net Value after User and non-User Benefits are taken into account, qualifying these options for Central Government grant support.
- Whilst the cash-flows of the Edinburgh options are stronger than for the Glasgow counterparts, operating margins are still too thin to allow financial feasibility to

private sector lenders and investors. Distributing the Funding Gap amount between capital cost support and operations to reflect rolling stock leasing options makes marginal difference.

- The strongest Edinburgh options, financially speaking, is the Surface Diversion option. However, overall cash-flows remain weak. Investor returns and lender margins are, hence, unacceptable for these options, based on the assumptions made, and additional support, which does not have a net cost to the cash-flows, is required.

It should be stressed that the Financial Model simulations are preliminary at this time. There are still many details for each option to be closely defined and costed. Nevertheless, the level of detail embedded in the Model is quite sufficient at this time to test commercial and financial feasibility in the generality and to simulate different financial structures for each option.

A limited number of sensitivity tests were carried out on both Glasgow and Edinburgh options:

- Taking Glasgow Central option as the preferential 'base' option for Glasgow, revenues would have to be twice those forecast and the grant input would have to represent 70-80% of the estimated capital costs before returns and cover ratios approach the levels which might be acceptable to financiers.
- For Edinburgh, the Runway Tunnel option was taken as one of two preferential options for further tests. Increasing the grant component from 38 to 80% of capital costs improved the investor returns and cover ratios to just below the levels acceptable to investors and lenders. The main problem with this option is that the capital costs are high relative to net revenues (revenues less operating costs), so a proportionately higher amount of funding gap contribution is required to attain financial feasibility. For the alternative preferred option, the Surface Diversion, increasing the funding gap contribution to around 60-70% of capital costs has a greater impact. Financial feasibility for this option is more easily achieved and the magnitude of the grant required lower. Nevertheless, the funding gap contribution for this option will have to be greater than would normally be expected under Treasury guidelines to attract private investors. Similarly, simulating a 'company limited by guarantee' structure (i.e. 100% debt) under those circumstances had minimal impact on the results. These results confirmed the need for the Edinburgh options to receive additional support to achieve viability for private finance.
- The position was simulated whereby the grant was distributed, say 50/50, between capital costs and as a subsidy each year for the first ten years of operations, as opposed to the grant just being available to fund capital costs (as was assumed in all 'base cases' for each option). The impact was, not surprisingly, minimal. An improvement in debt service cover ratio was counterbalanced by a deterioration in investor returns, et vice versa, depending on the distribution ratio assumed. In the event that the net operational margins (i.e. revenues less operating costs) were such that attractive returns to investors could be achieved, there clearly could be some cash-flow advantages in distributing the use of grant between construction and operations. Unfortunately, the economics of none of the options quite achieves that level of profitability in their 'base cases'.

7.4 Funding Sources

(591) The outline financial analysis gave some pointers as to the types of funding required. The likely main sources are described in turn below.

(592) *Scottish Executive:* the Integrated Transport Fund ("ITF"), and any other Executive sources set aside for such infrastructure developments. Additional funding could possibly be generated through the Executive, if it has the powers to impose selective taxes to fund such developments, e.g. tax or stamp duty on incremental property values.

(593) *UK Government:* UK Government funds could be channelled through the SRA in the first instance.

(594) *European Union:* any EU sources that are likely to be available are likely to be inclusive of the total grant support that may be available through the UK Government or Scottish Executive rather than incremental.

(595) *Private Capital: Equity Funding:* assuming that the project(s) demonstrate financial viability, private sector investors and stakeholders could be interested to own and operate the project(s) under some form of concession. In the first instance, such investors are likely to comprise companies with experience of constructing and/or equipping such project(s), along with private operators of trains and/or airports (e.g. BAA). Should such parties show possible interest, then their equity might be complemented by one of the PFI/PPP equity investment funds. It is rather unlikely, however, that the latter institutions would show any interest without the direct involvement of contractors, suppliers or an experienced operator in the implementation of the project(s).

(596) *Commercial Banks:* provided that the project(s) demonstrate long-term and assured financial viability and that equity investors have shown interest, it is likely that lenders likewise would be prepared to consider providing debt capital, amounting to 75-80% of the private funding sought, so long as the risks to be assumed by such banks are commensurate with normal lending criteria and the deal(s) are well structured corporately.

(597) *Scottish Stakeholders:* other possible stakeholders could include Edinburgh Council, SPT, Renfrewshire Council, and Glasgow City Council, although the cash-flow projections have made no assumptions in this respect.

(598) The financial analysis has shown that additional grant funding resources would be required, over and above what may be provided by the SRA/Central Government, for injection into the project(s) to make them commercially and financially sustainable. The first port of call in this respect would be the Scottish Executive.

(599) Following devolution, the Scottish Executive committed itself to the enhancement of all types of public transport, as an essential requirement for building an integrated transport system for Scotland. Apart from some key improvements to inter-urban rail links, most enhancements of public transport flow either from the preparation of local and regional transport strategies by local authorities or, in the west of Scotland, through Strathclyde Passenger Transport (SPT). Alternatively, they

emerge from studies for specific transport projects and be subsequently incorporated into local and regional strategies accordingly.

(600)The main source of funding for capital investment in public transport by local authorities and the SPT in recent years has been the Public Transport Fund (PTF), originally introduced in 1999, which took the form of regular bidding for financial support for capital projects. The PTF held its fifth and final round in 2002, and an announcement on how the Executive will support further local transport projects is awaited. Strategic public transport projects are now being supported through a separate regime called the Integrated Transport Fund (ITF) which was established in 2000 to fund strategic public transport projects that fit in with Executive priorities. It is already funding schemes such as the development of tram proposals in Edinburgh and providing additional rolling stock for Strathclyde Passenger Transport, and others are being worked up, such as taking forward parliamentary powers for the Glasgow airport rail link and the expansion of engineering development work for the Airdrie to Bathgate rail link.

(601)Unlike the Public Transport Fund, the ITF is not subject to an annual bidding cycle. Instead, suitable projects will be identified by Executive officials, in discussion with transport authorities and operators.

(602)As an indication of the level of funding directed towards public transport, the Scottish Executive Draft Budget 2003-04 has budget provision for Integrated Transport funding (largely composed of committed PTF resources and the ITF baseline) of £139.2 million for 2003-04, £193.5 million for 2004-05 and £296 million for 2005-06.

(603)Again, it is not clear what, if any, ITF funding could be used to contribute towards the funding of any airport rail link. Not just that, past experience has shown that, whatever money might be available through these two sources, the impact on the overall funding for projects with the magnitude of the airport rail links could well be marginal.

(604)In the context of railways, responsibility for Central Government oversight of the development and funding of railways in Scotland is split between two bodies – the Scottish Executive and the Strategic Rail Authority (SRA). With devolution, the Scottish Executive took on responsibility for most matters of transport policy and their financing and implementation. However, the development and funding of the rail network was retained as a 'reserved power' of the UK Government to be administered through the SRA, although subject to guidance and direction from the Executive.

(605)Under the Transport Act 2000 [Cl. 208] the Scottish Executive will have full responsibility for the determination and funding of the ScotRail franchise from its present termination at the end of March 2004, although SRA will administer the re-franchising process. Other railway matters will remain the primary responsibility of SRA, although clearly subject to Scottish Executive influence.

(606)In West Central Scotland, the main role in the development and funding of passenger rail operations is played by the SPT, the statutory local authority body responsible for formulating policies on public transport for a large area centred on Glasgow. SPT is also a co-signatory of the existing ScotRail franchise and is responsible for setting the Passenger Service Requirement (PSR), fares and ticketing

arrangements for the network of locally supported services in Strathclyde. Furthermore, SPT owns most of the rolling stock used to provide these services. However, the interests of SPT in rail services extend beyond its immediate area of responsibility, due to the inter-working of services and rolling stock between SPT sponsored services and other ScotRail services.

(607) Ownership of most of the UK railway infrastructure, however, track, signalling and stations, etc., resides with Network Rail (previously, Railtrack plc.), although most stations are leased to the franchisees of passenger rail services. With the exception of Glasgow Central, which is managed by Network Rail, all stations in west central Scotland are leased to ScotRail. However, given the recent transfer of assets from Railtrack plc. to Network Rail and the role that the Strategic Rail Authority, there remains some uncertainty as to the focus of responsibility and the funding of new railway infrastructure for such schemes as the Scottish airport rail links.

(608) Improvement to the Scottish rail network is currently the subject of several major studies. In addition to this Study of Rail Links with Edinburgh and Glasgow Airports, there has been the Central Scotland Transport Corridor Studies with the Plans for 2010 completed earlier in 2002, and the Executive are currently overseeing a Scottish Strategic Rail Study. Furthermore, the SRA is engaged on identifying improvement needs over the whole rail network, and has recently published its Strategic Plan.

(609) The existing ScotRail franchise, which is operated by a subsidiary of National Express Group plc (NEG), was let in 1997, before devolution took place, and runs until 31st March 2004. The Scottish Executive will have responsibility for the determination and funding of the successor franchise. However, the progress and process for this re-franchising exercise is clouded with uncertainty, and it is quite possible timetable milestones will not be met.

(610) Against this backdrop it is not clear what resources the Scottish Executive may have, or may not have, at its disposal to support either of the airport rail links, should it so wish. It is recommended that, complementary to discussions with the SRA as to their possible grant support for these projects, discussions with the Executive are undertaken in tandem.

(611) The European Union funding has been cited as a potential source of funding for these projects. That may be so, but in two limited scenarios:

- any EU grant funding that might be available on whatever grounds is likely to be counted against any UK Central Government grant support, so the net effect is zero; and
- if and when such projects can be structured so as to attract private capital, the European Investment Bank ("EIB") can on occasion be a provider of long-term debt capital, which once committed can of itself attract other lenders to join the transaction.

(612) With respect to private (equity and debt) capital, provided that the project proposal meets minimal investment and lending criteria, there is adequate liquidity in the market to support such transactions. Indeed, one has seen in recent months that the dearth of attractive corporate banking business in the U.K for the major banks and the higher margins available to lenders in the PFI/PPP market suggest that "bankable" deals can be funded with very long-term capital without great difficulty. Similarly,

whereas some of the smaller companies have felt the strain on their balance sheets of competing in the PFI/PPP market, there are PFI/PPP equity funds ready to fill the void, should such participant companies drop out. The key to success in this sector is to establish bankability for the proposals.

(613) Another possible source of private sector funding for rail improvement might be financial contributions from third parties engaged in development at or adjacent to rail stations or otherwise benefiting from rail improvement projects. Such contributions have proved very difficult to obtain in practice on anything other than a token scale, and there are no pre-determined mechanisms for structuring this input. The main drawback is perceived as the delay in the realisation of property benefits accruing from the specific infrastructure development. Invariably, these arise some time after investment takes place. However, such contributions can, on occasion, be forthcoming in specific circumstances where development could not be contemplated without transport improvements or where the benefits of improvement accrue very clearly to a particular party.

(614) In conclusion, it is clear that, under normal UK Central Government grant criteria, none of the proposed Glasgow and Edinburgh airport rail links would be commercially and financially viable without an extra ingredient of Governmental support. Such support would either have to be through direct grant, or alternatively indirectly through local taxation mechanisms, e.g. on property development contiguous to the right-of-way, or similar such schemes. Time in Phase 3 has not allowed the exploration of such possibilities but, should the decision be taken to proceed with any of the options, then this is clearly one of the next topics to be studied.

7.5 Corporate Structure

(615) In theory, private sector funds can be introduced into funding of rail improvements in a number of different ways. The easiest way is probably through the franchising process. However, the implementation of successful private sector transport initiatives to date has unfortunately fallen somewhat short of expectations.

(616) The main alternative route for introducing private sector funding into the rail network is the use of consortia in the form of Special Purpose Vehicles (SPVs) to deliver major improvements. The role of SPVs in development of the rail network has been under consideration by SRA and Government since the limitations of resources available to Railtrack, now Network Rail, for network expansion became apparent at the beginning of 2001. The SRA have promoted the concept of longer term Design, Build, Finance and Maintain (DBFM) contracts for new infrastructure, where the SPV would have a continuing responsibility to maintain track and other new infrastructure after new construction works have been completed. The Plan said that "*almost all new projects will be financed by Public Private Partnerships*", with financiers and passengers paying for the use of projects, once delivered, through long term payment structures.

(617) However, such funding vehicles as SPVs will not remove a payment obligation from the public sector in the long-term, and over time there will be an obligation on the state to meet availability charges, or the like, to the concessionaire. Such payment will be the minimum security that lenders will accept, i.e. there will be a notional contingent liability on the state. The complexities and costs of establishing SPV

arrangements within the existing rail industry framework mean that this approach is probably only suitable for the larger projects, and the Scottish airports rail links could be suitable candidates for such entities, provided that the economic criteria back-up the argument.

(618)Notwithstanding the inherent conceptual attractiveness of SPVs, recent events have re-focussed minds as to the inherent conflicts which can arise between profitability and safety in having the private sector companies, possibly with limited capitalisation, responsible for track operations and maintenance. In turn, this raises issues in relation to the capital adequacy and financial strength of the private sector concessionaires, contractors and operators in respect of the associated liabilities they carry. SPVs, representing "off-balance" sheet financial structures for Railtrack/ Network Rail, fall into this category, when shareholders of the SPVs will seek to limit the extent of their investment and liability. To date there are no recent SPV precedents to follow in this sector, and it is seems unlikely that all the issues will be resolved in the near future such that this funding structure offers an immediately viable alternative. The £9 billion funding of Network Rail itself will set the precedents to be followed by other, smaller investment initiatives.

7.6 Risks and Risk Allocation

(619)Much has already been stated on this topic, but it is crucial to successful, off balance sheet project financing. Two features dominate:

- risk is a subjective issue: what is a risk to one party, may not be to another, and vice versa; and
- successful project financing requires the allocation of perceived risks to those best able to carry them.

(620)In terms of risk, the biggest challenge to sustainable financial viability is the two components of revenue: traffic/demand forecasts and pricing. Construction costs can also represent a major risk, if massive and technologically advanced construction work is involved. It is the former (traffic forecasts), however, which tend to create the greatest difficulties, and there is a long history of failed private sector transport projects, particularly for toll-roads, where forecast traffic has been tragically too optimistic. Forecasting traffic volumes and acceptable tariffs appears to lenders to be more an art than a science, which is not an attractive or easily accepted risk for lenders.

(621)Project sponsors and operators will be loath to assume traffic risk. Similarly, lenders, who may provide up to 80% of the private debt, will similarly be averse to traffic/pricing risk. Lenders will seek to have their debt service payments covered by a periodic availability or capacity charge payable come what may, with a throughput charge providing the "icing on the cake". Hence, the allocation of this risk to the private sector will be difficult, unless the traffic flows are readily identifiable and justifiable. In reality, the airport operators may be one of the better placed to assess and carry this risk in respect of the airport links.

7.7 Implementation and Procurement

(622)When the Transport and Works Act (TWA) was passed by Westminster Parliament in 1992, the Government at the time decided that the new order-making

powers should only apply to England and Wales. At present, therefore, the construction of railways infrastructure in Scotland is still covered by the Private Legislation Procedures (Scotland) Act 1936, which is a consolidation of the Private Legislation Procedure (Scotland) Act 1899 and an amending Act passed in 1933.

(623) Under this Act, persons wishing to pursue schemes affecting public or private interests in Scotland, must obtain parliamentary powers through the Private Bills procedure. These powers have recently been devolved from Westminster to Holyrood.

(624) There are statutory requirements with respect to environmental assessments, and the applicants are expected to show that there is "*a reasonable prospect of a scheme attracting the necessary funds to implement it*".

(625) With respect to procurement, any major infrastructure project will be bound by EU requirements. In June 2002 the EU reached political agreement on the principles to be contained in a new "Classical Directive" on the public procurement of works, services and supplies, which will in due course be formulated into legislation. This Directive has particular comment to make on PFI/PPP-types of transaction.

(626) Concern had arisen because o the complex nature of PFI/PPP transactions and the need to often negotiate many of the terms and conditions with the winning, or preferred, bidder, which could on occasion compromise the openness of the original biding process. The concept of "competitive dialogue" has been introduced, and it is to be hoped that this may establish what is acceptable process and what is not.

(627) The procedure to be adopted for PFI/PPP-type deals will be:

- advertisement in OJEC;
- submission of pre-qualification questionnaires by interested parties;
- pre-qualification of at lest 3 bidders;
- competitive dialogue: separately with each of the bidders;
- authority issues invitation to tender;
- tenderers submit definitive proposed solution and prices;
- award of preferred bidder status; and
- exclusive dialogue with preferred bidder.

(628) The above steps are as yet not cast in stone. Private sector bidders have expressed concern nonetheless that the above process increases their up-front costs of bidding. On the other hand the EU procedures now accept that losing bidders on occasion deserve some recompense for their efforts: a yardstick of 15% of bid costs has been suggested, but is not mandatory.

8. Summary and Conclusions

8.1 Background

(629) At the end of Phase 2, the Steering Group decided that four options at each airport should be taken forward for detailed appraisal. At Glasgow, these were:

- Glasgow Central: 4 tph between the airport and Glasgow Central Station;
- Queen Street: 4 tph between the airport and Queen Street Low Level Station;
- Central Plus: as Glasgow Central, but with an additional 2 tph running to Edinburgh; and
- Queen Street Plus: as Queen Street, but with an additional 2 tph running to Edinburgh.

(630) In addition to appraising these four options, the study team were remitted to explore further the feasibility of these options with particular emphasis on:

- capacity issues at Glasgow Central Station;
- feasibility of the routeing to Queen Street Low Level Station; and
- the most advantageous route for longer-distance services.

(631) At Edinburgh, the four options were:

- Fife Spur: 4 tph shuttle service to Waverley Station using a spur off the Fife line and approaching the airport at surface level;
- E&G Spur: 4 tph shuttle service to Waverley Station using a spur off the E&G line and approaching the airport underground;
- Runway Tunnel: re-routeing both the E&G and Fife lines under the runway, running the fullest possible service level through the airport; and
- E&G Diversion: an above-ground alternative to the Runway Tunnel option.

(632) Particular issues to explore around these options were:

- interactions of the Fife Spur option with the Turnhouse Runway;
- Edinburgh Waverley Station capacity;
- ways of optimising a through-running option which does not rely on a runway tunnel;
- operational safety issues with the Runway Tunnel; and
- the interaction of the Runway Tunnel with a possible second parallel runway.

(633) During these investigations, we developed an additional surface level option which enables connections to the wider network but avoids all of the major risk areas. A version of such a scheme has been appraised as our fifth option.

8.2 Glasgow Issues

8.2.1 Glasgow Central

(634) At the outset of the study, it had been assumed that a solution to the capacity at Glasgow Central Station may be found through a re-signalling scheme at the Station. However, at the end of Phase 2, we were advised that the only way to preserve the current capacity of Glasgow Central Station is a replacement of equipment, whilst

retaining the existing layout of the signalling system. Any changes to the station layout (such as adding a new platform) would require a complete redesign of the station signalling to current standards, which would reduce capacity. So, adding a platform to the Station would actually *reduce* its capacity. Even if a new platform was combined with an extra bridge across the Clyde, it is likely that the combination of constraints in the station throat and modern signalling standards would restrict overall station capacity at the current level.

(635) The issue of platform capacity at Glasgow Central remained unresolved at this stage. It was thought that, for appraisal purposes, while highlighting the issue, we might have to leave to one side the question of whether a way could be found to provide sufficient capacity at the station through the re-routeing of other services. The appraisal might therefore be partial, but it would able to indicate what kind of costs for the provision of capacity at Glasgow Central the scheme would support.

(636) However, following further consideration, Railtrack have now advised that the use of platform 11a (the little used platform outside the train shed) *would* provide a solution for the airport services. The platform could be extended into the train shed to occupy the area currently used by the carriageway and short-term car parking. Railtrack quote an estimated cost of between £10m and £15m for this extension. This has a number of implications for services at Glasgow Central Station, most notably the short-term car parking, taxi drop-off and access to the long-term car park. However, in consultation with Railtrack and SPT, we found that none of these are thought to be insurmountable.

8.2.2 Queen Street Routeing

(637) We have also sought Railtrack's advice on the feasibility of the routeing to Queen Street Low Level Station. We concluded from this that there are no insurmountable operational problems in implementing the Queen Street Low Level option. The advice on the need for a grade-separated junction at High Street is not conclusive. In our appraisal we can only highlight the risk that further investigations may establish that need and thus escalate the costs of this option.

(638) The St John's Link which would enable the routeing of airport services to Queen Street Low Level is a scheme in its own right. Together with the Strathbungo Link, it would enable the re-routeing of some services which currently terminate at Glasgow Central into Queen Street Low Level and beyond. SPT have undertaken their own studies which show a positive case for the scheme. Although this has not been appraised in line with the latest Treasury guidelines (using a 3.5% discount rate and uplift factors for "optimism bias"), the case appears to have sufficient margin and it is likely that it would remain positive under the new assumptions, even if the additional infrastructure costs identified as part of this study were included.

(639) Whilst we did not want to construct our main case for the airport link on the premise that it would be dependent on another project, we have undertaken a sensitivity test where we exclude all the costs of the St John's link, assuming that they would be borne by another project.

8.2.3 Site Contamination

(640) During Phase 3, the study team's attention was drawn to the potential for heavy contamination along the alignment of the St John's Link. We have therefore

conducted a detailed desk investigation of the site to ascertain the risk of cost escalation. We concluded from this that there is unlikely to be any contamination over and above what could be expected in an urban railway site and that there would not be any significant decontamination costs incurred.

8.2.4 Longer-Distance Services

(641) For longer-distance services, we concluded that the level of demand generated from such options would not justify any additional investment and that we would therefore need to assume the Carmyle route in our appraisal. Although this would not require any significant infrastructure works at the Glasgow end, we would need to allow for capacity upgrades at Edinburgh Waverley Station.

8.3 Edinburgh Issues

8.3.1 Turnhouse Runway Interaction

(642) Detailed engineering investigations in consultation with BAA have shown that an approach from the Fife line can be achieved whilst respecting the integrity of the Turnhouse Runway and airport expansion plans.

8.3.2 Edinburgh Waverley Capacity

(643) The upgrade of Waverley Station cannot be assumed and both of the Spur options needed to include an allowance for an upgrade which provides an additional four train paths. This is a significant cost, which outweighs the engineering costs at the Airport itself. The Waverley project was still evolving at the time of concluding this report and assumptions for project costs and for the number of train paths likely to become available were still developing. In our appraisal, we have used cost assumptions based on the best available information at the end of January 2003.

8.3.3 Scheme Optimisation

(644) The E&G Diversion option attempts to provide access to the Airport for through-running services without the need to tunnel under the runway. It was acknowledged that further investigations were needed to ascertain whether a sufficiently attractive alignment (and station location) could be derived whilst protecting current airport operations and safeguarding future expansion plans.

(645) During Phase 3 we have explored a number of alternative alignment options. The main drawbacks included the following:

- in order to locate the station close to the airport terminal without impacting adversely on airport operations, the line would need to be in tunnel for about 2.5 kms, and this length of tunnel is likely to be classed as an “underground railway”, thereby requiring electric traction and fire resistance rolling stock;
- unresolved difficulties in linking into the Fife line with a grade-separated junction to the east of the Airport; and
- unresolved impacts on the A8 where the line would join the E&G line to the south-west of the Airport and on the E&G line itself in order to make a grade-separated connection.

(646) None of these alternatives to the ground level version of the E&G Diversion option were found sufficiently attractive by the steering group and we reverted to appraising the original E&G Diversion scheme.

8.3.4 Operational Safety of Runway Tunnel

(647) During Phase 3, BAA expressed concern about the potential classification of a runway tunnel as an "underground railway", which may make the operation of diesel services very difficult, if not impossible.

We sought a meeting with the HMRI and met with their tunnelling advisor. The HMRI's main concern with the Runway Tunnel scheme would be the operation of an underground ("section 12") station. Whilst they would not see any insurmountable technical problems with that, there would clearly be additional costs involved in providing the ventilation and emergency facilities which would be acceptable to the HMRI.

We have therefore derived additional cost estimates for the facilities likely to be required and fed these costs through our appraisal. In the further scheme development, there may be a commercial choice to be made between providing these facilities and constructing the station in open cut which would avoid its classification as a section 12 station but would lead to a loss of developable land over the station.

(648) It will ultimately be a commercial decision whether these costs need to be incurred to enable the construction of an underground station, whose airspace can be developed over, or whether that development opportunity should be forgone.

(649) We conclude from the above deliberations that there are no insurmountable obstacles to constructing the runway tunnel scheme for diesel operation. We have now included an estimate for additional safety and ventilation features in our project costings and have thus transferred project risks to project costs. We have also included an additional allowance of £300,000 pa for operating a section 12 station in our operating costs.

8.3.5 Second Runway Interaction

(650) One further issue arises from the potential lengthening of the tunnel section to cross a possible second runway which could be constructed parallel to the existing main runway to the north of the River Almond. From a railway engineering point of view, the longer tunnel would not present a problem, especially as the water table in the area would necessitate the second runway to be built on higher ground, thus allowing the railway tunnel to begin to rise after its crossing of the River Almond. As a second runway is not currently safeguarded, the cost of the longer tunnel would clearly be an issue for the second runway and should not feature in our appraisal. However, it was considered appropriate that we should explore at this stage whether a potential lengthening of the railway tunnel would alter the position regarding its designation as an "underground railway".

(651) If a decision to safeguard for a second runway was made before the rail link was engineered in detail, the most appropriate way of accommodating it may be to continue the railway in open cutting after it crosses under the River Almond in tunnel. The retaining walls of the cutting would be designed such that they would enable the construction of the new runway over it. A section of the railway, between the River

Almond and the new runway, could remain in open cutting, to enable ventilation of the railway tunnel.

(652) We have consulted with BAA on the potential safety issues with an open cutting between two runways. They have commented that, whilst it would be less than ideal to do so, it would be possible to accommodate a rail cutting between two 760m spaced parallel runways.

8.3.6 Surface Diversion Option

(653) Although we believe we have now explored all key issues with the Edinburgh options and have developed a clear understanding of the project risks, it was felt that a "fall-back" option was required which avoided all the major risk areas.

(654) In discussion with the Scottish Executive, three further options have now been developed, which avoid some or all of these infrastructure risk factors. These combine some of the characteristics of spur options with those of through running options and achieve a service between the Airport and major destinations in Scotland whilst avoiding some or all of the major risk factors above.

(655) Common to all these options is that they would incur disbenefits to through running passengers, which could be carefully managed through a combination of re-routed and new services. A version of this "Surface Diversion Option" has been subject of a full appraisal. If this option were to be pursued further, there would be additional infrastructure and service pattern optimisation work to be done.

8.4 Summary of Appraisal Results

8.4.1 Background

(656) From our investigations, we have concluded that there are no insurmountable issues of engineering or operational feasibility with any of the options, but that we needed to allow (in some cases significant) additional costs for measures to overcome some of the issues outlined above. These additional costs have been fed into our appraisal.

8.4.2 Glasgow Results

(657) There are many variants of the appraisal assumptions for the Glasgow options that can be considered. We regard the following base cases as the most reasonable assumptions to make:

- services between the Airport and Central Station – rolling stock leased rather than purchased, and full costs of the capacity upgrade between Shields Junction and Paisley Gilmour Street included; and
- services between the Airport and Queen Street Station – rolling stock leased rather than purchased, and full costs of both the capacity upgrade between Shields Junction and Paisley Gilmour Street and the St John's Link included.

(658) The base case assumption that rolling stock would be leased rather than purchased accords with SPT's practice on the majority of their services but there are instances where SPT has purchased rolling stock and could, in principle, do so for the Airport Link. That rolling stock would be leased is the more conservative assumption.

(659) The assumption that these Airport Link options should carry the full costs of the necessary infrastructure is a conservative assumption (as far as these costs are concerned) because there are possibilities that these costs could be shared between the Airport Link and other SPT projects. However, the consequence of this assumption is that these options would, on this basis, be independent of these other projects.

(660) Under our base case assumptions, our economic appraisals of Glasgow options show that none would generate sufficient revenue to cover operating costs and sufficient economic benefits to cover more than about 80% of the capital and operating costs. The Net Present Value/Cost to Government Ratio would be very poor in all cases (mainly because, in most cases, the Net Present Value would be negative).

(661) Common to all options is the following broad pattern:

- benefits would be generally highest for the Scottish Leisure sector, followed by non-Scottish Leisure;
- benefits to both business sectors would be significantly lower;
- benefits to employees would be small;
- highway decongestion benefits would be much smaller than user benefits, but would be significant in all cases;
- benefits to other rail users would be small; and
- vehicle operating cost and taxation impacts would be small in comparison with the costs, benefits and revenue effects on public transport.

(662) The costs and benefits of the Central and Queen Street options, under our base case assumptions, would be very similar, with the result that the Benefit/Cost Ratios would also be very similar. Both options which would provide longer-distance connections with Edinburgh would generate significant additional benefits but the additional costs would be very considerable due to the extra capacity required to provide additional train paths into, and platform space at, Waverley Station.

(663) Our sensitivity testing illustrates that our economic appraisal of the Central Station option is fairly robust against most downside risks, with the exception of major cost escalation and the use of standard TEN values of time in the appraisal. The economic case for the Central Station option would improve with higher values of time than we have assumed (such as the values used in the Department for Transport's SPASM modelling) and by purchasing rather than leasing rolling stock. Neither of these assumptions on their own would be sufficient for the economic benefits exceed the costs.

(664) The comment above about the downside risks also applies to the Queen Street Station option. Again, the economic case would improve with higher values of time and by purchasing rather than leasing rolling stock. Again, however, neither of these assumptions on their own would be sufficient for the economic benefits to exceed the costs.

(665) We have explored the effect of assuming that the costs of the St John's Link can be covered wholly by the benefits which would accrue to SPT's plans for improved cross-city services using both the St John's Link and the Strathbungo Link. While this assumption on its own would not result in the costs being exceeded by the benefits, if combined with the assumption that rolling stock would be purchased rather than leased, benefits and costs would about balance. If, however, half the cost of the

capacity upgrade between Shields Junction and Paisley Gilmour Street were to be covered by the benefits from other projects, the Benefit/Cost Ratio would improve to just above one.

(666)Our financial appraisals have shown that none of the Glasgow options would generate a positive return for equity investors, and that the Debt Service Cover Ratio would be unacceptably low in all cases for lenders. Also, the Interest Service Cover Ratio would only approach acceptability about ten years after opening, and then only if rolling stock is purchased in the case of the Central Station option and only if rolling stock is purchased and the St John's Link costs are excluded in the case of the Queen Street option.

8.4.3 Edinburgh Results

(667)As with the Glasgow options, our base case assumptions for the appraisal of the Edinburgh options are that rolling stock would be leased rather than purchased and that the infrastructure costs would not be shared with any other projects. For the Runway Tunnel option, our base case assumes that the station under the airport would be covered and therefore classified as an underground "Section 12" station, which would impose additional capital and operating costs on the scheme.

(668)Our appraisals of Edinburgh options show that, under our base case assumptions, all would generate significantly more revenue than operating costs, all would generate economic benefits in excess of their capital and operating costs, but only the Surface Diversion option would provide a Net Present Value/Cost to Government Ratio in excess of one – in fact, our calculations show a value for this ratio which is in excess of four which indicates that, from the Executive's point of view, this option would be a very good economic value for money.

(669)As with the Glasgow schemes, the following broad pattern is common to all options:

- benefits would be generally highest for the Leisure sectors, though in Edinburgh non-Scottish Leisure would generate higher benefits than Scottish Leisure;
- benefits to both business sectors would be lower, though not as significantly as in Glasgow;
- benefits to employees would be small;
- highway decongestion benefits would be much smaller than user benefits, but would be significant in all cases;
- benefits to other rail users would be negligible for the two Spur options, moderately negative for the Runway Tunnel option and substantially more negative for the two Diversion options; and
- vehicle operating cost and taxation impacts would be small in comparison with the costs, benefits and revenue effects on public transport.

(670)By far the highest benefits would be generated by the Runway Tunnel option but, because of its high capital cost, it would yield only a relatively modest Benefit/Cost Ratio. The E&G Spur option would be poor value for money as its cost would be high, not least because of the need to provide over-run tunnels under the airport (the station would be underground in this option, the idea being that this would form the first phase of the full Runway Tunnel option). The Fife Spur and the E&G Diversion options would yield modest Benefit/Cost Ratios. The best Benefit/Cost

Ratio by far would be provided by the Surface Diversion option, although its benefits would be about half those yielded by the Runway Tunnel option and significant disbenefits would accrue to existing passengers who are re-routed via the Airport.

(671) The comparison of overall costs between the cheaper solutions and the expensive Runway Tunnel option is worthy of note. All of the options which are cheaper to engineer at the Airport would incur significant additional costs, except for the Surface Diversion option. The two Spur options would incur the additional operating costs for the shuttle services and the costs of additional train paths into, and platform space at, Waverley Station, whereas the E&G Diversion option would involve the expense of relocating the Royal Highland Showground. Therefore, the difference in overall Present Value of Costs between the schemes is much smaller than suggested by the engineering costs at the Airport alone.

(672) In the cases of the Spur options, the benefits to other rail users would be restricted to a slightly enhanced frequency between Waverley Station and Haymarket. In the case of the Runway Tunnel and E&G Diversion options, there would be no enhanced service frequencies, and the only benefit to other rail users would be the additional interchange opportunity at the Airport for travellers between services to/from the West and services to/from Fife and the North. This is balanced against the disbenefit of additional travel time via the Airport for Fife services in the Runway Tunnel option and for all services in the E&G Diversion option, generating an overall disbenefit in both cases. As noted earlier, the Surface Diversion option would impose significant delays to those services diverted to serve the Airport.

There are a number of significant risks with all but one of the Edinburgh options, as follows:

- the Runway Tunnel option would require that the HMRI and emergency services are satisfied about the safety of the underground station and tunnels, although we have made allowance for the costs of providing appropriate ventilation and safety features;
- both Spur options are subject to the continuing uncertainty over the costs of providing sufficient train paths into, and platform space at, Waverley Station; and
- the E&G Diversion option would require the relocation of the Showground and, although we have made allowance for the costs involved, it is not clear that the owners would be willing to consider relocation.

(673) The Surface Diversion option would avoid these risks.

(674) Our sensitivity testing illustrates that our economic appraisal of the Runway Tunnel option is fairly robust against most downside risks, with the exception of major cost escalation, the use of standard TEN values of time in the appraisal, and under a fares regime which sought to maximise revenues. The economic case for the Runway Tunnel option would improve significantly with higher values of time than we have assumed (such as the values used in the Department for Transport's SPASM modelling) and by purchasing rather than leasing rolling stock. The Benefit/Cost Ratio for this option would also improve if the station under the airport was partially uncovered and was therefore not classified as an underground station (although we have not been able to take into account the impacts, from BAA's point of view, of the loss of space at ground level that partial covering would cause). The Benefit/Cost

Ratio would improve further still if the costs of extra track capacity at Edinburgh Park station could be avoided.

(675) The Benefit/Cost Ratio of the E&G Diversion option is vulnerable, to an extent, to the assumption we have made about the costs of relocating the Showground. Halving these costs would move the Benefit/Cost Ratio for the E&G Diversion option above that of the Runway Tunnel option, although not by much.

(676) Our financial appraisals have shown that, of the Edinburgh options, only the Surface Diversion option would generate a positive return for equity investors, although at around 3% the return would be small and unattractive to investors. For all of the options the Debt Service Cover Ratio would not become acceptable for many years, and the Interest Service Cover Ratio would be similarly weak, only approaching an acceptable level ten years after opening.

8.5 Conclusions

8.5.1 Planning Objectives

(677) The following planning objectives were agreed by the Steering Group:

(678) To provide (a) rail link(s) to Glasgow and/or Edinburgh Airport(s), and/or to each other, with the following characteristics:

- operating costs should, at least, be covered by revenues, or be supported by third party contributions, based on other benefits;
- any public sector contribution to capital costs should, at least, be matched by non-user benefits; and
- options should be compatible with potential long-term development strategies being considered at each airport as part of the preparations for the UK Air Transport White Paper and should address the specific market and strategic functions being identified for each.

8.5.2 Glasgow

(679) Under our base case assumptions, none of the options at Glasgow would generate economic benefits which would exceed the costs of implementation and operation. There is little to choose between the Central Station and Queen Street Station options under base case assumptions.

(680) With none of the options would the extra revenues accruing to rail operators cover the additional rail operating costs. All the options for Glasgow would therefore fail to meet the first planning objective, namely that "operating costs should, at least, be covered by revenues, or be supported by third party contributions, based on other benefits".

(681) In all cases, the funding gap (capital and operating costs less revenues) would far exceed the non-user benefits. This means that, for the second planning objective ("any public sector contribution to capital costs should, at least, be matched by non-user benefits") to be met, the private sector would have to make a very significant contribution to the costs of the project for it to proceed.

(682) All the options would meet the third planning objective ("options should be compatible with potential long-term development strategies being considered at each airport as part of the UK strategy for air transport").

(683) Because the extra rail revenues would not exceed the additional rail operating costs, the project would not be commercially viable let alone attractive to private sector lenders and investors.

(684) If revenues were twice our forecasts (thereby meeting the first planning objective), and the funding gap were to be covered by a public sector grant (in contravention of the second planning objective), then, although the cash-flows would be improved, they would almost certainly be unacceptable to lenders and investors.

(685) In making the statements above about the achievement of the planning objectives, we have assumed that rolling stock would be leased. Outright purchase would enable the options to meet the first planning objective but would not significantly change the overall financial viability.

(686) The factors that could materially improve the case for a rail link to Glasgow Airport include: increased parking charges or tolls at the Airport; increased highway congestion levels and therefore increased decongestion benefits; use of even higher values of time than the values used which are significantly higher than the standard appraisal values advised in the Department for Transport's Transport Economics Note (TEN); and reduced capital costs. None of these factors on their own is likely to make the case convincingly positive.

(687) The factors that could make the case materially worse include: increases in scheme costs; increased competition from other modes; and the use of standard appraisal values of time. Any one of these factors could make an already weak case substantially worse.

(688) The most promising assumptions seem to be that the whole of the St John's Link costs and half the costs of the capacity upgrade between Shields Junction and Paisley Gilmour Street are covered by benefits from non-Airport services. Under these circumstances, the Queen Street Station option would be better than the Central Station option and if, in addition, the rolling stock is purchased rather than leased, the Benefit/Cost Ratio for the Queen Street option would just exceed one.

(689) None of the options considered for a rail link to Glasgow Airport would cater for more than about 5 to 6% of the passengers accessing the Airport.

8.5.3 Edinburgh

(690) Under base case assumptions, all of the options at Edinburgh would generate economic benefits which would exceed the costs of implementation and operation.

(691) Taking account of all the impacts recorded in the Appraisal Summary Table, the Surface Diversion option would offer the best value for money. However, this option would impose a significant time delay to passengers using the services diverted into the Airport (10 minutes to Stirling and 15 minutes to Fife).

(692) The next best option is the Runway Tunnel option, although, under base case assumptions, the value for money would be appreciably lower than that for the Surface

Diversion option. The Runway Tunnel option would add around 5 minutes to the journey time of services to the north but, because the Edinburgh & Glasgow Line would be realigned through the Airport, it would have no impact on journey times for services to the west. The benefits would be about twice those of any other option because it would offer a wider range of connections with little penalty to non-Airport travellers. However, the Benefit/Cost Ratio would be relatively modest, the tunnel would be expensive, there would be significant risks associated with its construction and the requirements of HMRI and the emergency services, and there is the potential for a significant cost escalation.

(693) With all the options, the extra revenues accruing to rail operators would exceed the additional rail operating costs by a considerable margin. All the options for Edinburgh would therefore meet the first planning objective, namely that "operating costs should, at least, be covered by revenues, or be supported by third party contributions, based on other benefits".

(694) In all cases, the funding gap (capital and operating costs less revenues) would far exceed the non-user benefits. This means that, for the second planning objective ("any public sector contribution to capital costs should, at least, be matched by non-user benefits") to be met, the private sector would have to make a very significant contribution to the costs of the project for it to proceed.

(695) The Runway Tunnel, the E&G Diversion and the Surface Diversion options would meet the third planning objective ("options should be compatible with potential long-term development strategies being considered at each airport as part of the UK strategy for air transport") better than the two Spur options.

(696) If the public sector contribution were to be limited to the magnitude of the non-user benefits, none of the options would be financially attractive to the private sector, although the Surface Diversion option would be most attractive by some margin. Increasing the public sector contribution to match the funding gap (in contravention of the second planning objective) would make all the options more financially feasible, although the most financially attractive option, the Surface Diversion option, would still fall short of being potentially attractive to investors and lenders.

(697) Our financial appraisals have shown that, while it would be difficult to attract private sector investment in the Runway Tunnel option, it may be possible to make the Surface Diversion option sufficiently attractive for significant private sector involvement. As matters stand, and under neutral assumptions, the Runway Tunnel option could only be taken forward with a large public sector funding contribution.

(698) The factors that could materially improve the financial case for a rail link to Edinburgh Airport are increased parking charges or tolls at the Airport, and reduced capital costs brought about, for example, by leaving the underground station partially uncovered and thereby avoiding some of the more costly requirements of the HMRI.

(699) The main factor that could make the financial case materially worse is an increase in the capital costs.

(700) The Runway Tunnel option would cater for about 18 to 19% of the passengers accessing Edinburgh Airport, with the other options attracting 13 to 14%.

(701)If funds are limited to the extent that the Runway Tunnel option is deemed unaffordable, the Surface Diversion option is worthy of being progressed towards implementation. If, however, funding constraints are not over-riding at this stage, the Runway Tunnel option could be developed further so that a deeper understanding of the risks and costs can be established. In this circumstance, it would be prudent not to discard the Surface Diversion option at this stage but to progress its development in parallel with the Runway Tunnel option.