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Forth Replacement Crossing Study

Strategic Environmental Assessment

Environmental Report

Grant Thornton

TRIBAL

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Authorisation

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1	31/08/07	1st Draft Report	DR,EW	IAB, BAC
2	07/09/07	Final Draft	DR, EW	IAB, BAC

Contents

1 Non-Technical Summary

1.1 Forth Replacement Crossing

As a result of the long term deterioration of the fabric of the bridge, uncertainties exist over the future availability of the Forth Road Bridge (FRB). These uncertainties combined with the potential economic impacts associated with closure of the bridge mean that a Forth Replacement Crossing (FRC) is being considered.

The FRC Strategy addresses the need to provide a fixed link across the Forth to replace the existing FRB. The draft Strategy includes a number of options which are currently under consideration including a bridge and tunnels at several locations to the west of the FRB. The final Strategy will set out the preferred option to be taken forward.

1.2 Strategic Environmental Assessment

This Environmental Report presents the findings of a Strategic Environmental Assessment (SEA) of the draft FRC Strategy. The SEA of the draft Strategy aims to integrate environmental considerations into the decision making process regarding any replacement crossing and identify opportunities to mitigate adverse environmental effects. It assesses the environmental effects of a number of corridor and crossing options.

Prior to the assessment of impacts, a Scoping Report was produced which set out the proposed method and level of detail for the SEA. This was submitted to the Scottish Executive and allowed Historic Scotland, Scottish Natural Heritage (SNH) and the Scottish Environment Protection Agency (SEPA) to provide comments and recommendations. The Scoping Report also set out relevant environmental problems, key aspects of the current state of the environment and relationships with other plans, programmes and strategies.

1.3 Alternatives

Prior to this SEA, a considerable amount of work has informed the Forth Replacement Crossing Study (FRCS). Initially as part of the sifting process, 65 crossing options including causeways, tidal barrages, heavy and light rail, hovercrafts and ferries as well as bridges and tunnels were considered following the Scottish Transport Appraisal Guidance (STAG).

The options were considered in terms of technical feasibility and then appraised against eight planning objectives that considered the effects of each option on environment, safety, economy, integration and accessibility. The majority were rejected, either because they were not technically feasible or because they did not satisfy the planning objectives, principally maintaining the cross Forth transport links for all modes to at least the level of service offered in 2006.

A do nothing scenario (in which the existing FRB is closed to all traffic in 2019 and no replacement crossing was constructed) was rejected by Transport Scotland on the basis that it did not meet the objectives of the FRCS. *Report 2: Gaps and Shortfalls* concluded that without intervention in the transport network, over and above that currently planned, the objectives of the study would not be met.

Following the initial sift, five corridors where a replacement crossing might be located were identified based on the physical and environmental constraints in and around the Firth of Forth. The corridors, A, B, C and D to the west of the FRB and E to the east of the FRB, containing either a bridge or tunnel, were then assessed against the study's planning objectives and the Government's five key objectives of Environment, Economy, Safety, Accessibility/Social Inclusion and Integration.

Bridge and tunnel options in three corridors, two upstream and one downstream of the existing FRB, were taken forward for assessment using STAG Part 1. Bridges in Corridors C and E were rejected as a result of potential direct impacts on the Special Protection Area (SPA). This reduced the number of options under consideration to four; three corridors considering tunnels only and a fourth corridor considering either a tunnel or a bridge. These options were then taken forward for a more detailed assessment following STAG Part 2 methodology.

Following completion of the STAG appraisal a series of public exhibitions were held in August 2007. The options presented within the exhibition have been based on those developed during the FRCS and make up the draft FRC Strategy. These are:

- **Corridor C – Tunnel**
- **Corridor C2 - Immersed Tube Tunnel**
- **Corridor D – Bridge**
- **Corridor D – Tunnel**

It is from these options that the Scottish Ministers will select the preferred option which will then form the adopted FRC Strategy.

1.4 SEA of the Forth Replacement Crossing

The potential environmental impacts of the four crossing options that comprise the draft strategy and a "No New Crossing Scenario", essentially a Do Minimum approach, have been assessed and are summarised in Table 1.1. The assessment involved predicting the effects of each alternative option against the SEA objectives and identifying how the environmental baseline situation is likely to change. The assessment identified whether each option is likely to have a positive or negative effect on the SEA objectives and the relative significance of this effect.

When assessing the environmental effects of the draft FRC Strategy the strategic mitigation described in Section 6 has been taken into account and residual effects are reported. However, a cautious approach has been adopted and consequently the residual effects are likely to represent a worst case. It is considered that the proposed strategic mitigation set out in this report provides considerable scope for further avoiding, reducing and offsetting environmental effects, particularly as detailed project level mitigation is developed and implemented.

Table 1.1 Summary of Assessment

SEA Objective	Corridor C Tunnel (Bored)	Corridor C2 Tunnel (Immersed Tube)	Corridor D Bridge	Corridor D Tunnel (Bored)	No New Crossing
To protect and conserve biodiversity	Moderate to Minor Adverse	Major Adverse	Major to Moderate Adverse	Moderate to Minor Adverse	Moderate Adverse
To safeguard the character and diversity of the Scottish landscape and visual amenity	Minor to Major Adverse	Minor to Major Adverse	Minor to Major Adverse	Minor to Major Adverse	Minor to Major Adverse
To safeguard cultural heritage features and their settings	Moderate Adverse	Moderate Adverse	Major Adverse	Moderate Adverse	Major Adverse
To contribute to an improvement in national and local air quality by reducing the level of transport related air pollution emissions	Minor Positive	Minor Positive	Minor Positive	Minor Positive	Minor Adverse
To contribute towards the reduction of national carbon output from transport	Minor Positive	Minor Positive	Minor Positive	Minor Positive	Minor Adverse
To protect surface water and groundwater bodies from the impacts of transport	Minor Adverse	Major Adverse	Minor Adverse	Minor Adverse	Minor Adverse
To reduce and manage flood risks from transport infrastructure	Minor Adverse	Minor Adverse	Minor Adverse	Minor Adverse	Minor Adverse
To safeguard the quality of` Scotland's geomorphological, geological and pedologic (soil) resources	Moderate Adverse	Moderate Adverse	Moderate Adverse	Moderate Adverse	Moderate Adverse
To contribute to improving health in Scotland by supporting modes of transport which contribute to a healthier lifestyle and by reducing noise and vibration	Major Adverse to Moderate Positive	Major Adverse to Moderate Positive	Major Adverse to Moderate Positive	Major Adverse to Moderate Positive	Major Adverse to Moderate Positive
To provide sustainable access to employment and essential services, and the countryside	Minor Adverse to Minor Positive	Minor Adverse to Minor Positive	Minor Positive	Minor Adverse	Moderate Adverse
To maximise the opportunity for community linkages and reduce severance effects of transport	Moderate Adverse	Moderate Adverse	Minor Adverse	Moderate Adverse	Negligible
To promote the sustainable use of natural resources – reduce, reuse, recycle and recover	Moderate Adverse	Moderate Adverse	Moderate Adverse	Moderate Adverse	Moderate Adverse

1.5 Mitigation

For an SEA of this type the most effective form of strategic level mitigation is avoidance. The FRC option selection process including option generation and sifting is in itself a key element of mitigation. Strategic or policy level mitigation has also been developed and will be incorporated into the final FRC Strategy.

Mitigation has been defined for all SEA environmental categories where significant effects may result from a replacement crossing. For each SEA category an *objective* has been established, and *principles* for environmental mitigation described. These objectives will inform the planning, design, construction and operation of the FRC. Fundamentally, the mitigation proposals will act as a "green thread" and will underpin the approach to minimising the environmental effects of the FRC from adoption of the final Strategy through to opening of the FRC. The mitigation objectives are listed below:

Table 1.2 Mitigation Objectives

SEA Category	Mitigation Objective
Biodiversity	In the delivery of the preferred option, the final design and construction of the crossing and associated infrastructure will have the objective of maintaining the biodiversity of the affected study area by, as far as possible, avoiding adverse effects or, where practicable, compensating for significant adverse effects.
Landscape and Visual Amenity	In the delivery of the preferred option, the design and construction of the crossing and associated infrastructure will be completed to high design standards in order to ensure that adverse effects on landscape character and visual amenity are minimised.
Cultural Heritage	In the delivery of the preferred option, the design and construction of the crossing and associated infrastructure will, as far as is practicably possible, avoid impacting on sites of cultural heritage interest and, where appropriate, aim to preserve in situ or by record all cultural heritage resources disturbed.
Air Quality and Climatic Factors	In line with the National Transport Strategy, aim to reduce emissions to tackle climate change and improve air quality.
Water Environment	In the delivery of the preferred option, aim to prevent the deterioration of the "status1" of affected surface waters as described in the Water Framework Directive.
Geology and Soils	In the delivery of the preferred option, effects on geology and soils (including agricultural land) will be minimised, by aiming to reduce the overall footprint of the preferred scheme (including land temporarily required for construction activities) and through good construction practice and reinstatement.
Human Health and Population	In the delivery of the preferred option, aim to prevent adverse effects on human health and where possible provide measures to improve health. With respect to population, maintain or improve access for traffic, pedestrians, cyclists and others including users of the Firth of Forth.
Material Assets	In the delivery of the preferred option, the design of final alignment of the crossing and associated infrastructure will aim to minimise effects on residences and businesses. In the delivery of the preferred option, aim to minimise the use of raw materials and reuse, recycle and dispose of waste materials, as appropriate.

[1] "Status" is a general term meaning the status achieved by a surface water body when both the ecological status and its chemical status are at least good or, for groundwater, and when both its quantitative status and chemical status are at least good.

There is a statutory requirement for an Environmental Impact Assessment (EIA) to be carried out for the FRC. Once the preferred option is taken forward through the EIA process project specific mitigation measures will be developed. In addition to project level mitigation it is practical to assume all elements of the planning, construction and operation of the FRC will adhere to relevant legislation and follow the most current good practice and guidance, including the production of a Code of Construction Practice (CoCP).

1.6 Monitoring and Adoption

Monitoring must be seen in the context of the Strategy which is being proposed; in this case a preferred crossing will be chosen by Scottish Ministers and that scheme will be subject to a consents process (which will include an EIA) followed by detailed design and construction. The monitoring is therefore linked to the implementation of the Strategy.

Monitoring has been developed based on the mitigation objectives and principles (which follow from the SEA objectives and the assessment of impacts). The aim of the objectives and principles, as explained above, is to act as a 'green thread' running throughout the implementation of the strategy. In order to maintain the "green thread" concept, monitoring will examine whether the mitigation measures, if relevant to the crossing option selected, have been:

- Incorporated into the initial design of the scheme and encompassed within the EIA for the purpose of gaining consent. The results of the EIA, as presented in the Environmental Statement, will be checked against the results of the SEA.
- Translated into contract documents and incorporated into detailed designs.
- Used to monitor performance during construction and, where necessary, following the opening of the crossing.

It is recognised that as the scheme develops some mitigation measures may not be applicable or indeed, other measures may be identified.

Following adoption of the final FRC Strategy, a Post-Adoption SEA Statement will be produced setting out the finalised monitoring framework

2 Introduction

2.1 Forth Replacement Crossing

2.1.1 Background

The existing Forth Road Bridge (FRB), mainly as a result of the growth and increase in weight of traffic together with the influence of the weather and climate, is showing signs of deterioration. A Forth Replacement Crossing (FRC) is being considered as there is a lack of certainty that the existing FRB will be available in the future due to the long term deterioration of the bridge's fabric. Additionally, concerns over the future of the FRB are exacerbated because it is recognised that the repair or refurbishment of the existing crossing will have too severe a set of impacts on the east of Scotland economy if the bridge were to be closed or even severely restricted for a period of time.

The Forth Replacement Crossing Study (FRCS) is being progressed concurrently with the Strategic Transport Projects Review (STPR). The STPR, being undertaken by Transport Scotland, seeks to identify a programme of interventions that will make a significant contribution to the delivery of the National Transport Strategy (NTS) for the period 2012 – 2022. The FRC will form part of the STPR, however, due to its national significance and the implications of the forecasted closure of the FRB in 2019, it has been fast-tracked and is being progressed separate to the STPR.

Work undertaken on the FRCS to date has followed Scottish Transport Appraisal Guidance (STAG), an appraisal framework designed to aid transport planners and decision-makers in the development of transport policies, plans, programmes and projects in Scotland. The FRCS study comprises:

- *Report 1: Network Performance*;
- *Report 2: Gaps and Shortfalls*;
- *Report 3: Option Generation and Sifting*;
- *Report 4: Appraisal Report*; and
- *Report 5: Final Report*.

An overview of the contents and aims of each of the reports is included in **Appendix A**. The complete reports can be viewed on the Transport Scotland website[2]:

Following completion of the STAG appraisal, the Scottish Ministers expressed their support for a replacement crossing of the Forth, however, currently no final decision on the scope, form or location of the crossing has been made.

[2] http://www.transportscotland.gov.uk/defaultpage1221cde0.aspx?pageID=253

2.2 Strategic Environmental Assessment

2.2.1 Overview

SEA is a systematic method for considering the likely environmental effects of plans, programmes and strategies. The draft Strategy for the Forth Replacement Crossing, which is the subject of this SEA, is as follows:

The Forth Replacement Crossing Strategy addresses the need to provide a fixed link across the Forth to replace the existing Forth Road Bridge. The draft Strategy includes a number of options which are currently under consideration including a bridge and tunnels at several locations. The final Strategy will set out the preferred option to be taken forward.

The SEA of the FRC draft Strategy aims to integrate environmental considerations into the decision making process regarding any replacement crossing and identify opportunities to mitigate environmental effects. It assesses the effects of a number of corridor and crossing options. Wider and more strategic effects are also considered by the SEA.

SEA is required under the Environmental Assessment (Scotland) Act 2005[3], also known as the 'SEA Act'. The key SEA stages provided for in the Act are set out below in Table 2.1:

Table 2.1 Key Stages

Stage	Description
Scoping	Deciding on the scope and level of detail of the Environmental Report, and the consultation period for the report –this is done in consultation with Scottish Natural Heritage, The Scottish Ministers (Historic Scotland) and the Scottish Environment Protection Agency.
Environmental Report	Publishing an Environmental Report on the FRC and its environmental effects, and consulting on that report.
Adopting	Providing information on: the adopted Strategy; how the results of the environmental assessment and consultation comments have been taken into account; and methods for monitoring the significant environmental effects of the implementation of the strategy.
Monitoring	Monitoring significant environmental effects in such a manner so as to also enable Transport Scotland to identify any unforeseen adverse effects at an early stage and undertake appropriate remedial action.

2.3 SEA Activities to Date

Table 2.2 summarises the aspects of the SEA that have been carried out so far and identifies where further information can be obtained relating to each stage. The remaining stages of SEA are described in Section 8.

[3] http://www.opsi.gov.uk/legislation/scotland/acts2005/20050015.htm

Table 2.2 Activities to Date

SEA Activity	Description	Dates
Scoping the consultation periods and the level of detail to be included in this Environmental Report	The proposed method for the SEA and consultation timescales were included in the SEA Scoping Report, which was submitted to the statutory Consultation Authorities (SNH, SEPA and Historic Scotland) via the Scottish Executive's SEA Gateway. Responses were received on 23 August 2007.	July 2007
Relationship with other plans, programmes and environmental objectives established	Draft details were included in the SEA Scoping Report and amendments have been made based on the comments from the Consultation Authorities.	July - August 2007
Environmental baseline situation identified		
Environmental problems identified		
SEA methods established		
Alternatives appraised	An initial set of 65 alternatives were considered. A number of options for the FRC were appraised using the Scottish Executive's Scottish Transport Appraisal Guidance (STAG). This is discussed in more detail in Section 4.	December 2006 - August 2007
Environmental impacts identified and mitigation proposed	Environmental impacts and mitigation measures are identified in this Environmental Report. There may be the opportunity for further mitigation to be agreed following receipt of comments on this report.	August - September 2007
Monitoring proposed	Initial monitoring proposals are included in this report. Following comments from the public and statutory Consultation Authorities, a monitoring framework will be finalised and included in the post-adoption SEA Statement.	September 2007 and on publication of the SEA Statement (date to be determined)

2.3.1 Appropriate Assessment and Relationship to SEA

The Habitats Directive[4] requires that an Appropriate Assessment is carried out for any plan or project with the potential for significant effects on a Natura 2000 site (a Special Protection Area (SPA) or Special Area of Conservation (SAC) and in Scotland, Ramsar sites, Wetlands of International Importance). The Directive states that the plan or project should only be agreed if the Appropriate Assessment finds that, following mitigation, there will be no adverse impacts on the integrity of the site, with respect to the specific conservation objectives of that site.

A new Forth crossing has the potential to affect up to three Natura sites: the Firth of Forth SPA, the Forth Islands SPA, the River Teith SAC and the Firth of Forth Ramsar site. It has therefore been necessary to carry out a strategic-level Appropriate Assessment of the replacement crossing options. This will inform a project-level Appropriate Assessment which will be carried out following the announcement of a preferred option and in association with more detailed environmental impact assessment (EIA) work.

[4] Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora

In this report, the potential for effects on the aforementioned Natura sites forms an important part of the assessment of effects on biodiversity. However, the results described in this report are for *all* aspects of biodiversity and it should not be assumed that the overall impact described represents the effects on Natura sites. The Appropriate Assessment, due to be completed in October 2007, will provide a more detailed description of the effects on Natura sites *only* and additional mitigation may be proposed. The results of the SEA and Appropriate Assessment may therefore differ.

2.3.2 The Environmental Report

The purpose of this Environmental Report (ER) is to:

- Provide information on the FRC and the SEA process;
- Identify, describe and evaluate the likely significant effects of the FRC and reasonable alternatives; and
- Provide an early and effective opportunity for the Consultation Authorities and the public to offer views on any aspect of this Environmental Report.

This Environmental Report has been prepared following the guidance contained within the Scottish Executive's SEA Tool Kit (September 2006). Key facts relating to the FRC are set out below in Table 2.3.

Table 2.3 Key Facts

Key Fact	Detail
Name of Responsible Authority	Transport Scotland
Title of Strategy	Forth Replacement Crossing (FRC)
What Prompted the FRC	The Forth Replacement Crossing is required because of a lack of certainty that the existing FRB will be available in the future due to the long term deterioration of the bridge's fabric. It is recognised that the repair/refurbishment of the existing crossing may have severe impacts on the east of Scotland economy if the bridge were to be closed. The strategic importance of the FRC makes it appropriate for its impacts on the environment to be subject to a SEA.
Plan Subject	Transport
Frequency of Updates	n/a
Area covered	Firth of Forth and central /east Scotland
Purpose of the FRC	To identify the form and function of any potential replacement to the Forth Road Bridge (FRB).
Contact Point	ain Bell, Faber Maunsell Dunedin House 25 Ravelston Terrace, Edinburgh, EH4 3TP Iain.belll@fabermaunsell.com
Consultation Timescale	6 weeks

3 Forth Replacement Crossing in Context

3.1 Introduction

This section outlines the objectives for the FRC and sets out the context for the SEA including:

- The study area;
- The relationship between the FRC and other plans, programmes and strategies;
- A summary of the baseline environment, and
- Existing environmental problems.

3.2 Objective of the Forth Replacement Crossing

The overarching aim of the FRCS is to identify the scope, form and function of any potential replacement to the FRB. As discussed in the previous section the FRC is closely linked to the STPR and the NTS. The objectives of both the STPR and NTS are not explicitly applicable to FRC, however, they are outlined below to provide an overview of the strategic context against which the FRC is set.

3.2.1 National Transport Strategy

The transport white paper entitled Scotland's Transport Future (June 2004) set out the Scottish Executive's national transport objectives; these are to:

- Promote economic growth;
- Improve integration;
- Promote social inclusion;
- Improve safety of journeys; and
- Protect our environment and improve health.

The objectives highlighted in the white paper were later used as the basis for developing the National Transport Strategy (December 2006). The NTS sets out the long term vision for transport in Scotland along with a number of objectives, priorities and plans. There are three key strategic outcomes the NTS seeks to deliver:

- Improve journey times and connections;
- Reduce emissions; and
- Improve quality, accessibility and affordability.

3.2.2 Strategic Transport Projects Review

The STPR involves a two year review of the strengths and weaknesses of the Scottish strategic transport network and is being undertaken by Jacobs (with Faber Maunsell, Grant Thornton and Tribal), on behalf of Transport Scotland. The overall aim of the STPR is to assist in the delivery of the NTS objectives and strategic outcomes described above through a programme of transport interventions. These could comprise options for new road and rail infrastructure projects and well as policy based interventions. The outcome of the review will comprise a programme of prioritised transport interventions proposed for the period 2012 – 2022.

The FRC is one such infrastructure intervention that the STPR shall consider; however, as stated in Section 2 a combination of concerns over the long term fabric of the existing FRB and the potential economic impacts associated with closing or even severely restricting the FRB for it to be refurbished have meant that this intervention has been fast-tracked. As such the timescales for the FRC and the STPR are different; with this Environmental Report being published ahead of the STPR Environmental Report. In order to maintain a degree of consistency between the two SEAs and ensure the findings of the FRC SEA can be readily inserted into the STPR, the teams involved in the preparation of the SEAs have been in close dialogue and the SEA objectives against which FRC has been assessed are similar to those being used for the STPR.

3.2.3 Scottish Transport Appraisal Guidance

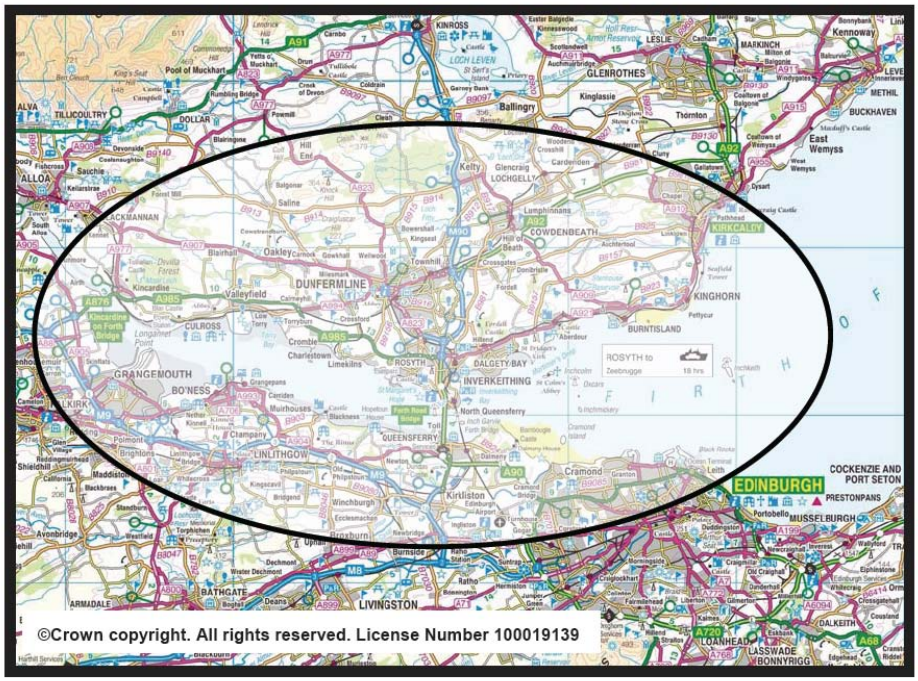
Prior to this SEA a considerable amount of work has been undertaken in identifying the potential form, function and location of a replacement crossing. The culmination of this work has been an assessment of potential crossing options following the approach described in the STAG. In order to ensure a consistent approach to the assessment, a number of planning objectives, informed by the NTS, have been prepared. These underpin the STAG assessment and are listed below:

- Maintain cross Forth transport links for all modes to at least the level of service offered in 2006.
- Connect to the strategic transport network to aid optimisation of the network as a whole.
- Improve the reliability of journey times for all modes.
- Increase travel choices and improve integration across modes to encourage modal shift of people and goods.
- Improve accessibility and social inclusion.
- Minimise the impacts of maintenance on the effective operation of the transport network.
- Support sustainable development and economic growth.
- Minimise the impact on people, the natural and cultural heritage of the Forth area.

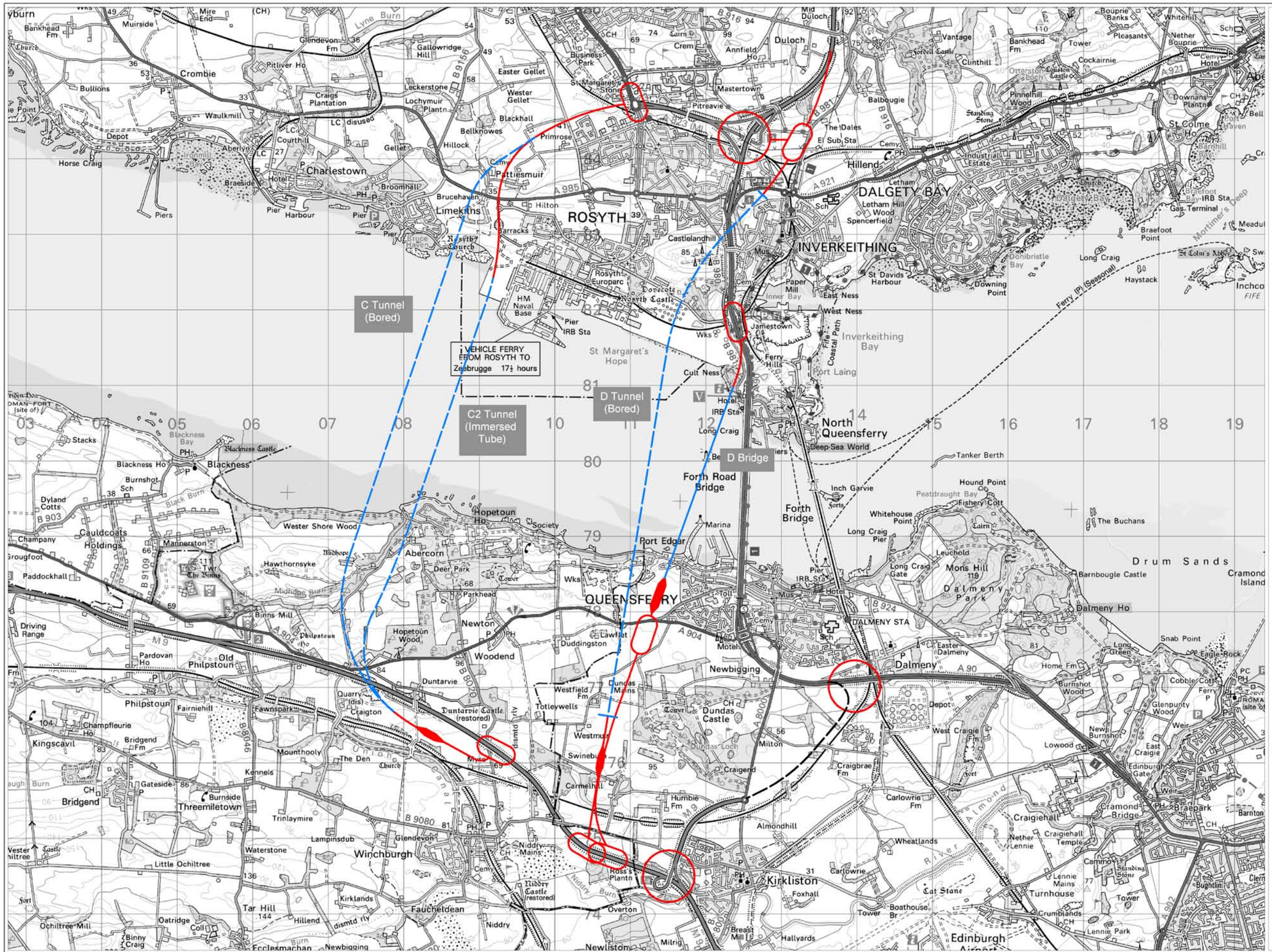
3.3 Study Area for Option Selection and SEA

For the purpose of generating and sifting options a wide study area was drawn as illustrated in Figure 3.1.

Figure 3.1 Study Area for Option Generation and Sifting



For the purposes of this Environmental Report a new study area, illustrated in Figure 3.2, has been defined. This reduced area focuses on the options being appraised through the SEA. However, it is recognised that there is a wider context that needs to be considered in the SEA, particularly in respect of the relationship between the FRC and other plans programmes and strategies, as described below.



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Rev	Date	Purpose of revision	Drawn	Check	App
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Drawn	Checked	Approved	Project	
DR		IAB	FORTH REPLACEMENT CROSSING STUDY	
Scale	Status	Date	Title	
1:50,000@A3	FINAL	27/08/07	FIG 3.2 APPROPRIATE ASSESSMENT FORTH REPLACEMENT CROSSING OPTIONS	
Project No. 49550	Drawing No. 49550/FRC/01	Rev. 1		

3.4 Relationship with Other Plans, Programmes and Strategies

The SEA Act requires that this Environmental Report includes an outline of the strategy's relationships with other relevant plans and programmes. Key relevant plans, programmes and strategies are listed below in Table 3.1. **Appendix B** provides details of the relevant environmental objectives within each of these documents, and others, and briefly highlights their relevance to the FRC.

Table 3.1 Relevant PPS, Legislation and Environmental Protection Objectives

International
Kyoto Protocol to the UN Framework Convention on Climate Change 1992
Convention of Biological Diversity (Rio de Janeiro, 1992)
The Johannesburg Declaration on Sustainable Development (2002)
European
European Commission Transport White Paper - European Transport Policy for 2010: Time to Decide (2001)
EU Urban Transport Green Paper: Clean Urban Transport (anticipated for adoption of Autumn 2007)
European Climate Change Programme (2001 - 2003)
Habitats Directive (92/43/EEC)
Wild Birds Directive (79/409/EEC)
Water Framework Directive (2000/60/EC)
Environmental Noise Directive (2002/49/EC)
Air Quality Directive (1996/62/EC)
Biofuels Directive (2003/30/EC)
National
Wildlife and Countryside Act 1981 and Amendments
The Conservation (Natural Habitats & c) Regulations 1994 and Amendments
Nature Conservation (Scotland) Act 2004
Ancient Monuments and Archaeological Areas Act 1979
Planning (Listed Buildings and Conservation Areas) (Scotland) Act 1997
Creating Our Future… Minding Our Past. Scotland's National Cultural Strategy, Scottish Executive, 1999
Scotland's Historic Environment Policy (SHEP 1): Scotland's Historic Environment, March 2006
Scotland's Historic Environment Policy (SHEP 2): Scheduling: protecting Scotland's nationally important monuments, 2006
Air Quality Strategy for England, Scotland, Wales and Northern Ireland (2000)
The Air Quality Limit Values (Scotland) Regulations 2003
Water Environment and Water Services (Scotland) Act 2003
The Pollution Prevention and Control (Scotland) Regulations 2000
Road Traffic Reduction Act 1997

National Planning Framework 2004
Environmental Assessment (Scotland) Act 2005
Environmental Impact Assessment (Scotland) Regulations 1999 and Amendments
Transport (Scotland) Act 2005
UK Climate Change Programme (2006)
Our Energy Future – Creating a Low Carbon Economy 2003
Scottish Climate Change Programme (2006)
UK Biodiversity Action Plan (1994) and Amendments
Scotland's Biodiversity: It's in Your Hands - A strategy for the conservation and enhancement of biodiversity in Scotland
Scotland's Transport Future – Transport White Paper 2004
Choosing our Future: Scotland's Sustainable Development Strategy
National Transport Strategy
National Waste Strategy
National Cycling Strategy (Department for Transport) (1996)
Memorandum of Guidance on Listed Buildings and Conservation Areas 1998
Passed to the Future (Historic Scotland's policy for the sustainable management of the historic environment)
Securing the Future (2005) UK Government Sustainable Development Strategy
Towards a Transport Strategy for Scotland (2006) - rail consultation paper
Choosing our Future (2005) Scotland's Sustainable Development Strategy
Scottish Energy Efficiency Strategy (forthcoming)
Securing a Renewable Future: Scotland's Renewable Energy (2003)
Lets Make Scotland More Active (2003)
The Planning etc (Scotland) Act 2006 (formerly Modernising the Planning System -Planning White Paper)
Scotland's Transport, Delivering Improvements, Scottish Executive, March 2002
SEPA Groundwater Protection Policy
SEPA Policy on the Culverting of Watercourses
Scottish Transport Appraisal Guidance (STAG) 2000
Scottish Natural Heritage Policy Summary: Environmental Justice and the Natural Heritage, August 2004
Regional and Local
Tayside and Central Scotland Regional Transport Partnership, Regional Transport Strategy, Finalised Strategy March 2007
South-East of Scotland Transport Partnership, Regional Transport Strategy, Finalised Strategy, March 2007
Edinburgh and Lothian Structure Plan
Fife Structure Plan 2006
Perth and Kinross Structure Plan

The Central Edinburgh Local Plan (adopted 29 May 1997, reviewed in 2000)
The South East Edinburgh Local Plan (adopted 18 August 2005)
The North East Edinburgh Local Plan (adopted 30 April 1998 and incorporating an alteration on 22 January 2004)
Draft West Edinburgh Local Plan (supersedes North West Edinburgh Local Plan (adopted 23 January 1992) and South West Edinburgh Local Plan (adopted 11 March 1993))
The Rural West Edinburgh Local Plan (adopted 1 June 2006)
West Lothian Local Plan 2005

3.5 Environmental Baseline

The SEA Act requires the Environmental Report to include a description of 'the relevant aspects of the current state of the environment' and 'the environmental characteristics of areas likely to be significantly affected'. Environmental baseline information/data provides the basis for predicting, evaluating and monitoring the environmental effects of the strategy. It also highlights some of the environmental issues/problems detailed below in Section 3.6 and has informed the setting of SEA Objectives in Section 5.

A summary of the baseline data collected for this SEA is presented in **Appendix C**. The study area for this information is based on Figure 3.2.

3.6 Environmental Problems

Table 3.2 identifies existing environmental issues and potential problems associated with the development of the FRC.

Table 3.2 Existing and Potential Environmental Problems

SEA Category	Environmental Issue
Biodiversity, Flora & Fauna	The landfalls of a new crossing could impact on SPA/Ramsar/SSSI designated sites along the Firth of Forth shorelines and the Forth Islands.
	Construction activities and bridge design may affect open water areas and affect the qualifying objective(s) of the Forth Shore and Forth Islands SPAs and River Teith SAC.
	The road network ties on either shore could necessitate the loss of ancient and semi-natural woodland.
	The potential exists for impacts on European Protected Species such as bats, otters, badgers, water voles, salmon, lamprey and cetaceans.
	Loss, fragmentation and isolation of habitats and disturbance to species could result from the construction of new transport schemes.
	Pollution of the water environment through construction and ongoing run-off has negative effects on aquatic habitats.
	Habitat loss and fragmentation due to culverting of water courses for transport projects. Roads which cross surface waters could damage riparian and aquatic habitats including salmon associated with the River Teith SAC.
	Historic and sustained pressure on the Forth through for example, continued residential development, oil spills and diffuse agricultural pollution, has had a cumulative adverse effect on the area's biodiversity. There are currently proposals for ship-to-ship oil transfer in the Forth which are controversial due to concerns

SEA Category	Environmental Issue
	regarding the potential for future pollution incidents, which could have serious consequences for biodiversity, in particular Annex 1 species, the 3 Natura 2000 sites and the large populations of seabirds.
	Historic land take around the Forth has led to 'piecemeal' habitat loss which when considered in its entirety, has had a significant effect on habitats and species in the area. Future development such as the FRC has the potential to contribute to this cumulative degradation of natural resources.
Landscape and Visual Amenity	Proposed road network tie-ins could be located close to or within the boundaries of landscape designations including Gardens and Designed Landscapes and Areas of Great Landscape Value.
	A new crossing and the associated infrastructure is likely to impact on visual amenity.
	The construction of new transport infrastructure is likely to have negative effects on landscape character.
	Light pollution can negatively affect landscape character and visual amenity.
Cultural Heritage	New infrastructure can directly affect heritage designations such as listed buildings or Scheduled Ancient Monuments through land take.
	New infrastructure can indirectly affect designated sites, impacting on their setting.
	Transport infrastructure can adversely affect historic landscape and townscape character.
	There is the potential for war graves within the Forth and these could be disturbed by construction activities such as dredging.
	The FRC and associated road infrastructure could have direct physical impacts and indirect landscape and visual impacts upon archaeological sites, built heritage and historic landscapes/townscapes.
Air Quality & Climatic Factors	There are two Air Quality Management Areas (AQMAs) in Edinburgh. The first is located on the western side of Edinburgh at St John's Road and the second comprises Edinburgh city centre and main roads into it including roads from Roseburn and Gorgie at the west of the city. All these roads could be used by city centre-bound traffic from the FRB.
	If the FRC results in additional road capacity it could result in greater traffic flows in the longer term and consequently increased emissions of pollutants that reduce air quality and influence climate change.
Water Quality and Flooding	Water quality in the Firth of Forth is ranges in classification from B to C. The poor classification, C is as a result of the number of discharges it receives and its inherent turbidity. Significant negative effects on water quality are associated with the culverting or re-aligning of surface waters due to road network linkages. Such impacts could prevent waterbodies achieving the objectives of WFD.
	Disturbance of sediments within the Forth as a result of dredging and construction activities could result in increased turbidity and loss/alteration of intertidal areas and mobilisation of contaminated sediments.
	Old mine workings are prevalent in this area. These can have an adverse effect on surface and groundwater quality.
	Run-off of pollutants from roads, including oil, fuel, metals and rock salt. This is of greatest significance in rural locations where drains and ditches are more likely to empty directly into watercourses rather than entering sewage treatment systems.
	Short-term pollution of water courses due to construction and widening of roads. New road construction and widening schemes now require Sustainable Urban Drainage Systems (SUDS). Road construction activities cause short-term negative effects on water quality however, for schemes SUDS can provide long-term benefits by reducing existing pollution associated with run-off.

SEA Category	Environmental Issue
	Culverting of water courses exacerbates flooding problems. Flooding events are predicted to increase in frequency and severity due to the effects of climate change.
	As well as potential damage to the banks and/or bed of affected watercourses during the construction of culverts, in the long term there would be reductions in water quality and secondary indirect impacts on the riparian or aquatic ecosystems
	Diffuse agricultural pollution, oil spills, ongoing residential and commercial development and other human activities have a cumulative effect on water quality in the Forth. This could be exacerbated by the FRC.
	Potential disturbance to the groundwater regime if grouting of mine workings is required. In the long term this could have direct adverse effects on the water quality of the Forth.
Geology and Soils	The potential exists for contaminated land in industrial areas such as those at Rosyth.
	New infrastructure would result in both temporary impacts on, and permanent loss of, agricultural land.
Population & Human Health	There are potential human health issues associated with exceedances of key air pollution indicators. Equally, traffic management measures can assist in reducing existing air quality problems.
	Noise associated with high traffic flows can have a detrimental effect on human health/quality of life. A new crossing and associated roads may increase road capacity and the potential for increased traffic-related noise. Alternatively, road traffic may be reduced in some locations with a subsequent reduction in noise disturbance.
	On the wider road traffic network, roads to the north and south of the existing FRB do experience significant levels of congestion during peak hours. Existing problems associated with congestion could increase driver stress. Re-modelled road junctions and network connections associated with the FRC could reduce congestion and consequently driver stress.
	A reduction to the current levels of access across the Forth has major implications for population and the economy (See section 3.7 below). Effects on navigation on the Forth are also a potential impact.
	It is noted that cross-Forth passenger train frequency is due to increase as a result of re-locating coal freight trains onto the Stirling-Alloa-Kincardine rail line and expansion at Waverley Railway Station in Edinburgh. Improved rail services would maintain an effective and commutable transport link between Fife and Edinburgh.
	New infrastructure can have a 'severance' effect; acting as a barrier between communities and reducing access to certain locations or reducing use of footpaths and cycleways. Effects on recreation may also result e.g. recreational sailing on the Firth of Forth.
Material Assets	Any new infrastructure will require land and is therefore likely to affect private property including agricultural land, residential property and businesses.

3.7 Likely Evolution of the Environment without the FRC

This section considers the likely evolution of the environment without the FRC Strategy. Particular emphasis is placed on changes that would occur in the absence of the physical infrastructure associated with the FRC, however, the wider strategic context is noted. Table 3.3 below summarises the likely changes to the environment without the FRC.

By way of context, it should be noted that a range of activities with the potential to influence the evolution of the environment are taking place both north and south of the Firth of Forth. In particular, development across the region is controlled by a number of development plans including:

- Edinburgh and Lothian Structure Plan 2004;
- Fife Structure Plan 2006;
- Perth and Kinross Structure Plan 2003, and
- Local plans within these areas.

The relationship of these development plans with the FRC is acknowledged and briefly summarised (see Section 3.4 above and **Appendix B**).

Environmental changes would occur as a result of activities and policies aimed at encouraging or facilitating development from such as housing, business development, leisure and recreation and local transport. Access across the Forth has a major influence on development activities and the absence of a crossing would likely result in different development patterns and consequentially different effects on the environment.

In the wider context, the closure of the FRB may result in the longer term re-location of residential, commercial and industrial activities. The loss of a major road transport link between Fife and Edinburgh and the Lothians would directly impact on those in the region who use the crossing as part of their daily commute or other work and leisure reasons. Indirectly this could lead to longer term demographic changes as people seek employment or housing in areas that are better served by the road transport network. Whilst in some instances this may result in fewer environmental impacts in areas such as Fife that are dependent on access to employment in Edinburgh and the Lothians; it is also likely that development activities will be transferred to other areas with better transport links. The environmental impacts may therefore occur elsewhere.

Although there would be a loss of a road based transport connection across the Forth; in the long term there is expected to be an increase in the frequency of cross-Forth passenger trains. This is due to the reduction in freight trains carrying coal across the Forth Bridge, junction and signalling improvements and the extension of platforms at Waverley railway station in Edinburgh. Improved rail services would maintain an effective and commutable transport link between Fife and Edinburgh and could promote modal shift, however, this would not offset the closure of the FRB.

It is also worth noting that the FRB is part of the arterial route which connects other major towns and cities including Perth, Dundee, Aberdeen and Inverness as well as the Highlands to the south east of the country. In this context there will be reduced access between the north of Scotland and the south east, in particular the eastern Central Belt. Both recreational users of the bridge (tourists, day shoppers, etc.) and commercial users (businesses in particular haulage firms) would have to follow alternative routes including the Kincardine Bridge Crossings. Again, changes in access would influence development patterns which in turn would affect the population and the environment. Use of alternative transport routes would also transfer the environmental effects (such as noise and increased air pollution) to other areas.

Table 3.3 Likely Evolution of the Environment without the FRC

SEA Category	Likely Evolution of the Environment without the FRC
Biodiversity, Flora & Fauna	The ecological impacts, particularly those directly on the SPA, resulting from construction and operation of the FRC would not occur.
Landscape and Visual Amenity	Impacts on landscape and/or streetscape character and visual amenity, caused by the replacement crossing and associated road network tie ins would not occur.
Cultural Heritage	The effects on the historic environment resulting from the FRC would not occur.
Air Quality & Climatic Factors	In the absence of the FRC, and taking into account the likely operational restrictions with the existing FRB, traffic congestion is predicted to increase. Additionally vehicles may have to divert and cross the Forth further upstream at Kincardine increasing the vehicle kilometres travelled. The result of increased congestion and increased vehicle kilometres will be increased emissions of pollutants, including greenhouse gases, and reductions in local air quality in some localities.
Water Quality and Flooding	Without the FRC and associated road network connections the potential effects on the water environment would not occur. Negative impacts resulting from existing road maintenance activities in the surrounding area, including the use of salt, would remain. However, in the longer term adverse effects associated with the operation and maintenance of the existing FRB would be reduced.
Geology and Soils	Geology and soils, including agricultural land would remain largely unaffected.
Population & Human Health	The FRB is important to the economy locally, regionally and nationally. The Edinburgh economy has relied, in part, on its neighbouring authorities as a source of labour. In 2001, over 60,000 people lived in the neighbouring authorities and worked in Edinburgh. Some 11,000 of these people lived in Fife. There are some parts of Fife where 20-40 per cent of residents are working in Edinburgh. In the absence of the FRC and the potential restrictions and/or closure of the FRB commuters may leave the area in order to be closer to employment opportunities. There could be a lack of available labour to the Edinburgh economy while the Fife economy could suffer from a lack of development and investment as residents leave the region. However, more frequent rail services between Fife and Edinburgh are planned as a result of additional capacity over the Forth Bridge and improvements to Waverley Station. This could promote modal shift and maintains an effective commutable link between Fife and Edinburgh. In terms of human health, traffic related noise and air pollution would remain for as long as the FRB remains operational. In the long term diversionary routes are likely to be required as a result of restrictions or closure of the FRB. In the vicinity of the FRB traffic related noise and air pollution is likely to be reduced, however, noise and

SEA Category	Likely Evolution of the Environment without the FRC
	pollution levels will increase in other areas as road traffic is re-distributed across the surrounding road network.
Material Assets	There is a strong relationship between transport infrastructure and development activities including land for employment, leisure and residential uses. Without the FRC and considering the potential closure of the FRB, development may not occur due to the lack of a Forth Crossing. Fife, in particular, as a result of poor transport links could suffer through a lack of investment in new development opportunities. This could result in secondary impacts on the economy and population. In the wider context, development activities may re-locate elsewhere in Scotland exerting pressure on land use and land availability. This could in turn result in economic stimulation of other local economies.

4 Option Selection Process

4.1 Alternatives

A number of alternatives have been considered to date using the STAG. This section briefly summaries STAG, the appraisal process to date and how the SEA addresses alternatives. This section should be read along with **Appendix D** which contains a more detailed review of the option generation and sifting process and identifies why options were discounted.

4.1.1 Scottish Transport Appraisal Guidance

STAG is the official appraisal framework developed by Transport Scotland to aid transport planners and decision-makers in the development of transport policies, plans, programmes and projects in Scotland. It is a requirement that all transport projects, for which Transport Scotland support or approval is required, are appraised in accordance with STAG.

The first element of the STAG process is consideration of problems, opportunities, constraints and uncertainties. This is accompanied by the development of planning objectives (Section 3.2.3). After confirmation of the objectives, there is a process of option generation and sifting. These elements of the FRCS have been presented within *Report 1 (Network Performance), Report 2 (Gaps and Shortfalls) and Report 3 (Option Generation and Sifting)*.

4.1.2 Previous Assessment of Alternatives

The various stages in the option appraisals that have been carried out to date are set out in *Forth Replacement Crossing Study Report 3: Option Generation and Sifting and Report 4: Appraisal Report (May 2007)* [5]. This sets out the alternatives that have been considered and the reasons some of these have not been taken further.

To summarise, a long list of 65 potential options was developed and was then subject to an initial sifting process. The list included tunnels and bridges at 5 different locations along the Forth, as well as other transport mode options such as heavy and light rail, boat and hovercraft. The majority were rejected, either because they were not technically feasible or because they did not satisfy the planning objectives, principally maintaining the cross Forth transport links for all modes to at least the level of service offered in 2006. Options rejected on environmental grounds during the sifting process included tidal barrages and causeways. **Appendix D** contains a more detailed review of the option generation and sifting process and identifies why options were discounted.

A do nothing scenario (Option 51), in which the existing FRB is closed to all traffic in 2019 and no replacement crossing is constructed, was rejected by Transport Scotland on the basis that it did not meet the objectives of the FRCS. *Report 2: Gaps and Shortfalls* concluded that without intervention in the transport network, over and above that currently planned, the objectives of the study would not be met.

[5] http://www.transportscotland.gov.uk/defaultpage1221cde0.aspx?pageID=704

Following the initial sift, five corridors where a replacement crossing might be located were identified based on the physical and environmental constraints in and around the Forth. The corridors, A, B, C and D to the west of the FRB and E to the east of the FRB, containing either a bridge or tunnel, were then assessed against the FRCS's planning objectives and the Government's five key objectives of Environment, Economy, Safety, Accessibility/Social Inclusion and Integration.

Bridge and tunnel options in three corridors, two upstream and one downstream of the existing FRB, were taken forward for assessment using STAG Part 1. Bridges in Corridors C and E were rejected as a result of potential direct impacts on the Special Protection Area (SPA). This reduced the number of options under consideration to four; three corridors considering tunnels only and a fourth corridor considering either tunnel or a bridge. These options were then taken forward for a more detailed assessment following STAG Part 2 methodology. Figure 4.1 at the end of this section provides a summary of the option appraisal process to date.

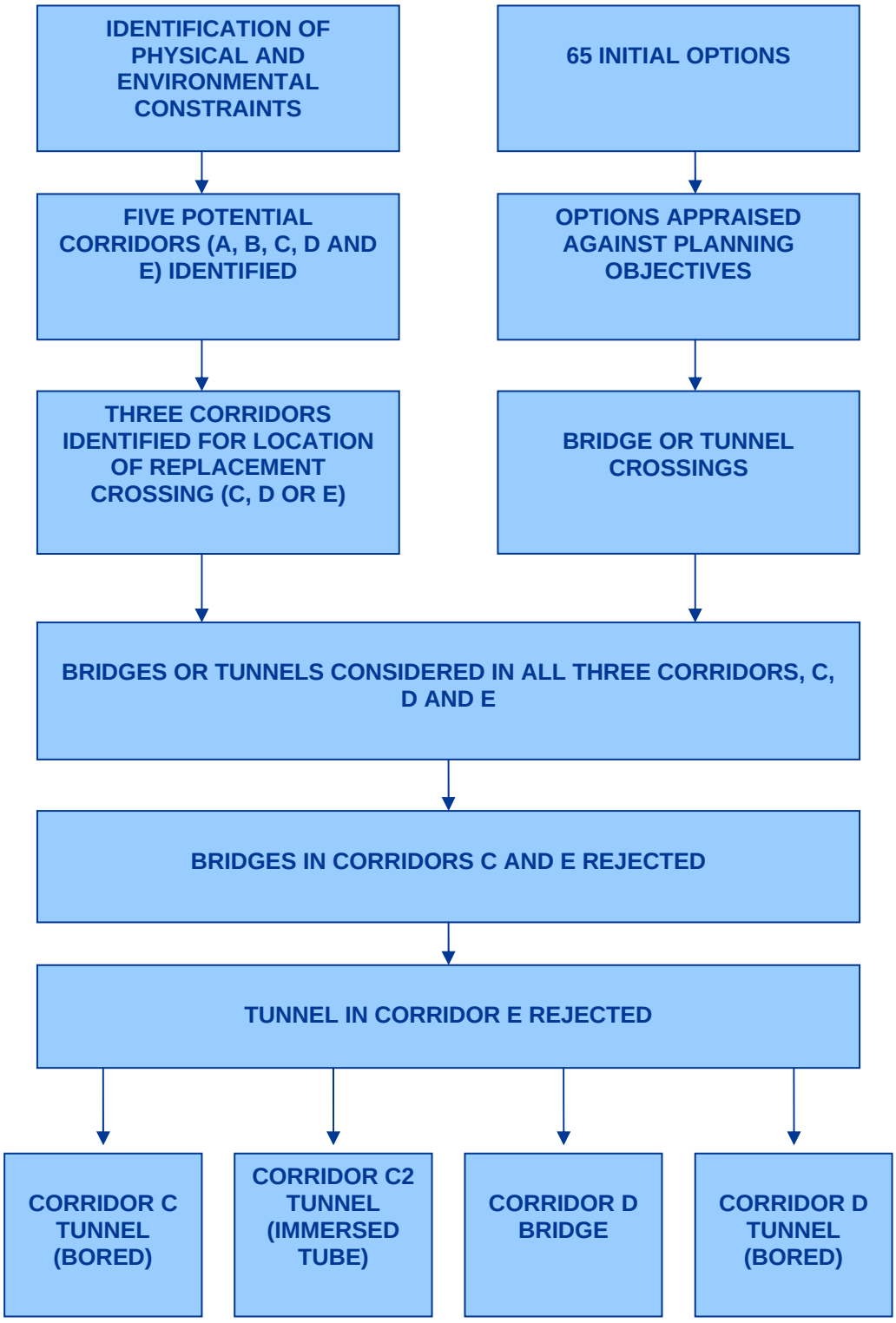
4.2 Forth Replacement Crossing Public Exhibitions

Following completion of the STAG appraisal a series of public exhibitions were held between the 20th August 2007 and the 31st of August 2007. The aim of these was to inform the public of the process by which the crossing options have been identified and how they have been assessed. The options presented within the exhibition have been based on those developed during the FRCS. These are:

- **Corridor C – Tunnel**
- **Corridor C2 - Immersed Tube Tunnel**
- **Corridor D – Bridge**
- **Corridor D – Tunnel**

These 4 options are shown on Figure 3.2.

Figure 4.1 Summary of Option Selection Process



5 Environmental Assessment of Final Options

5.1 Introduction

This chapter summarises the results of the assessment of the final FRC options. The results take into account the strategic mitigation set out in Section 6 of this Environmental Report. A summary of the method used for the assessment, including the SEA objectives, is provided below. A more detailed description is presented in **Appendix E**. Assessment matrices used to record the likely effects of each of the options can be found in **Appendix F**.

5.2 Method

5.2.1 Summary of Approach

The purpose of this stage of the SEA process is to predict and to evaluate the environmental effects of the various options being considered for the FRC and the likely future scenarios. The appraisal process developed for the SEA of the FRC involved the following:

- Defining the **SEA objectives** to be used in assessment
- Prediction of the likely environmental effects of each option and identification of the **magnitude** of these effects.
- Determination of the **importance** of the receptors.
- Evaluation of the **significance** of the predicted effects, taking into account the strategic **mitigation**.
- Consideration of potential **cumulative impacts**.

The first phase in the assessment has been to predict what effects are likely to occur. This involved predicting the effects of each alternative option against the SEA objectives and identifying how the baseline situation is likely to change as a result. The assessment identified whether each option is likely to have a positive or negative effect on the SEA objectives and the likely relative significance of this effect.

Predicted effects have been described in terms of their magnitude and impact significance determined by considering the sensitivity of the receptor in relation to the magnitude of the predicted effect. In undertaking the assessment, consideration has been given to the questions listed in Table 5.1 below.

A comprehensive description of the methodology is contained within **Appendix E**.

5.2.2 Cautious Approach and Strategic Mitigation

When assessing the likely environmental effects of the FRC Strategy the mitigation described in Section 6 has been taken into account and residual effects are reported. However, a cautious approach has been adopted and consequently the residual effects are likely to represent a worst case. It is considered that the proposed strategic mitigation set out in this report provides considerable scope for further avoiding, reducing and offsetting environmental effects, particularly as more detailed project level mitigation is developed and implemented.

5.2.3 SEA Objectives

The SEA objectives set out in Table 5.1 have been developed for each key environmental issue. SEA objectives are the basis upon which the environmental effects of the FRC will be predicted and assessed. Each objective is an environmental aspiration and the assessment will predict whether the options will have a positive, negative or neutral effect on this objective.

To assist the assessment of likely effects, questions have been developed for each SEA objective. These highlight the issues that will be considered in the assessment. SEA objectives and associated questions are set out in Table 5.1 below.

The SEA objectives are based on the objectives which were prepared for the SEA Scoping Report for the STPR, which were in turn developed to be consistent with the SEA of the Scottish NTS. The SEA objectives for the FRC have been tailored to be more specific to issues of relevance to the FRC draft strategy, whilst remaining strategic enough to capture all appropriate potential effects.

Table 5.1 SEA Objectives

SEA Issues	SEA Objectives	Questions
Biodiversity, Flora and Fauna	To protect and conserve biodiversity	Does the FRC affect biodiversity? Does the FRC affect designated sites (for example Special Protection Areas, Special Areas of Conservation, Ramsar sites, Sites of Special Scientific Interest and Sites of Interest for Nature Conservation)? Does the FRC affect protected species?
Landscape	To safeguard the character and diversity of the Scottish landscape and visual amenity	How will the FRC affect national, regional or local landscape character? Does the FRC affect any areas designated for their landscape value e.g. Gardens and Designed Landscapes? Does the FRC have the potential for adverse effects on visual amenity?
Cultural Heritage, including architectural and archaeological heritage	To safeguard cultural heritage features and their settings	Does the FRC affect any features designated for their cultural heritage value (for example listed buildings, Conservation Areas, Scheduled Ancient Monuments, known or unknown archaeology)? Does the FRC affect the setting of any of the above cultural heritage features?

SEA Issues	SEA Objectives	Questions
Air	To contribute to an improvement in national and local air quality by reducing the level of transport related air pollution emissions	Is the FRC likely to have positive or negative effects on any Air Quality Management Areas? Does the FRC contribute to an increase or decrease of the following pollutants: Benzene 1,3-Butadiene Carbon Monoxide Lead Nitrogen Dioxide Particles (PM_{10}) Sulphur Dioxide?
Climatic Factors	To contribute towards the reduction of national carbon output from transport	Does the FRC contribute to an increase or decrease in transport related CO_2 emissions? Does the FRC have the potential to result in a shift towards more sustainable modes of transport?
Water	To protect surface water and groundwater bodies from the impacts of transport To reduce and manage flood risks from transport infrastructure	Does the FRC have the potential to affect water quality? Does the FRC have the potential to contribute to flooding? Does the FRC affect vulnerability to flooding?
Geology and Soils	To safeguard the quality of` Scotland's geomorphological, geological and pedologic (soil) resources	Does the FRC affect geomorphological, geological and pedologic (soil) resources? Does the FRC affect sites designated for geological value?
Human Health	To contribute to improving health in Scotland by supporting modes of transport which contribute to a healthier lifestyle and by reducing noise and vibration	Does the FRC promote more active lifestyles? Does the FRC result in increased noise and/or vibration?
Population	To provide sustainable access to employment and essential services, and the countryside To maximise the opportunity for community linkages and reduce severance effects of transport	Does the FRC result in severance? Does the FRC contribute to increased access to services via public transport? Does the FRC contribute to increased access to the natural and historic environment?
Material Assets	To promote the sustainable use of natural resources – reduce, reuse, recycle and recover	Does the FRC result in the production of large amounts of waste? Can the FRC be designed to reduce, reuse, recycle or recover waste? Does the FRC affect private property or land?

5.3 Assessment of Final Options

To maintain consistency with the FRCS, the SEA has assessed the options taken forward to the public exhibitions and from which the Scottish Ministers will select the preferred option. In addition to those options and following SEA good practice, a do minimum option has also been assessed. As discussed in Section 4, a do nothing scenario was rejected by Transport Scotland as it did not meet the FRC study objectives.

Consequently, this section of the Environmental Report highlights the likely environmental effects of the following options:

- **Corridor C Tunnel (Bored);**
- **Corridor C2 Tunnel (Immersed Tube);**
- **Corridor D Bridge;**
- **Corridor D Tunnel (Bored); and**
- **Do Minimum - 'No New Crossing Scenario' i.e. refurbishment of the existing Forth Road Bridge).**

It should be noted that the assessment takes into account the mitigation discussed later in this report in Section 6, as such only the residual effects of the options are described. Assessment matrices used to record the likely effects of each of the options can be found in **Appendix F**.

It is also important to note that this is a high-level environmental assessment of strategic options. Detailed site-specific impacts have not been identified at this stage as specific designs and alignments have not yet been defined. The alignments shown on Figures 4.1 are for indicative purposes only; the assessment focuses on route corridors rather than precise locations. The precise location of the preferred option will be determined at a later date and the finalised design will be informed by a detailed Environmental Impact Assessment (EIA).

It is recognised that the Forth Replacement Crossing has regional and national implications. The assessment has therefore considered the potential effects of a new crossing on the wider environment. This is discussed further under cumulative effects in Section 5.9.

As noted in Section 2.3.1, effects on Natura Sites will be addressed by the strategic-level Appropriate Assessment. The results described in this report are for *all* aspects of biodiversity and it should not be assumed that the overall impact described represents the effects on Natura sites. The Appropriate Assessment will provide a more detailed description of the effects on Natura sites *only* and additional mitigation may be proposed. The results of the SEA and Appropriate Assessment may therefore differ.

5.4 Corridor C Tunnel (Bored)

See Table F.1 for a summary matrix of the assessment.

5.4.1 Option Description

This option is illustrated in Figure 3.2 and is the most westerly of all the options. On the southern shore the tunnel portal, located at Craigton Quarry is reached via a new spur road on the south of the M9. On the northern shore the tunnel portal is located to the west of Rosyth, immediately north of Pattiesmuir. A new road links the tunnel to the A823 north of Rosyth. The option also includes re-modelling of junctions on both the northern and southern shores. The tunnel would be constructed through a combination of Tunnel Boring Machine (TBM) and Sprayed Concrete Lining (SCL) tunnel techniques.

5.4.2 Biodiversity, Flora and Fauna

The proposed tunnel would pass beneath the Firth of Forth SPA, avoiding direct impacts, however, the proposed shaft and site entrance on the northern shore is adjacent to the SPA so there could be indirect impacts, particularly on birds.

A bored tunnel, due to the construction techniques involved occurring below the bed of the Forth, is likely to have an overall neutral effect on marine ecology i.e. cetaceans, seals, and fish as the. There is unlikely to be disturbance associated with operational noise and vibration due to the depth tunnel would be located at.

On both the northern and southern shores the potential exists for road network connections to impact on terrestrial ecology including European Protected Species (EPS) as well as valuable habitats. Impacts could include temporary habitat loss due to construction activities, permanent habitat loss as a result of the landtake associated with road connections and fragmentation of wildlife corridors such as woodland, hedgerows and surface watercourses.

With regards to impacts on species, there will be temporary disturbance associated with construction activities which may interfere with breeding seasons and movement of species. In the long term impacts associated with movement of species could be impacted upon. Otters, an EPS, are present on the Union Canal which lies to the south of this option. It is likely that otters would move along ditches and small burns to access ponds present to the south of Hopetoun Estate for feeding, particularly in spring when amphibians are spawning. The construction of new roads could increase the number of otter mortalities.

Overall impacts on biodiversity are considered to be *Moderate to Minor Adverse*.

5.4.3 Landscape and Visual Amenity

No designated landscapes are directly affected, however, the tunnel and associated road connections run beneath or adjacent to a number of designated features including Hopetoun House Garden and Designed Landscape (GDL), the Belleknowes and Forth Shore Areas of Great Landscape Value (AGLVs) on the northern and southern shores respectively and an Area of Outstanding Landscape Quality (AOLQ) at Humbie.

The proposed junction alignment to the north around Pattiesmuir would sever the attractive matrix of rolling arable farmland with boundary hedgerow and tree planting features being lost. It would result in the loss of a swathe of deciduous woodland planting which forms an attractive landscape feature. The tunnel portal and road infrastructure to the south of the Forth would lie in a relatively contained section of the landscape with the existing M9 motorway corridor to the immediate north and a band of woodland planting around the railway and the Union Canal to the south. Overall impacts on landscape are considered to be Moderate to Major Adverse.

With regards to visual amenity, there will be short term impacts resulting from construction while permanent impacts will be associated with the tunnel portals and the road network connections. There are a number of visual receptors, particularly on the northern shore that will be afforded views of both the tunnel portal and the new road connecting to the A823. Receptors have been identified as being of high importance due to the potential for impacts on the views experienced from residential properties. Dependent on the receptors' proximity to the tunnel portals and road infrastructure as well as angle and direction of view, impacts range from Minor to Major Adverse.

Overall impacts on landscape and visual amenity are considered to be *Minor to Major Adverse*.

5.4.4 Cultural Heritage

Road network connections on both the northern and southern shores would result in indirect visual impacts on the setting of four sites of national importance including Duntarvie Castle and Aldcathie Church which would experience minor and moderate adverse visual impacts respectively. Local and regional sites, including Blackhall Farm and two military defence sites, could experience direct physical and indirect visual impacts. The effects on GDLs are as described in the landscape and visual assessment. Overall, impacts on cultural heritage features are considered to be *Moderate Adverse*.

5.4.5 Air Quality and Climatic Factors

The tunnel option does not include provision for HOV/priority bus lanes, as a result reductions in emissions due to modal shift are unlikely to occur, however, new and improved junction layouts and roads connections to the tunnel could reduce air quality problems associated with congestion. The tunnel which includes four lanes, operating as a replacement, does not provide additional vehicle capacity. The traffic modelling undertaken during the STAG appraisal assessed traffic flows in 2017 compared with the "do minimum". As a result of reduced congestion; reductions in the emissions of NO_X (-2.1%), PM_{10} (-0.4%).and CO_2 (-1.6%) are predicted to occur. Additionally the tunnel does not increase capacity hence operating as a replacement crossing there should not be an increase in traffic flows. Overall *Minor Positive* effects are predicted to occur.

There are no Air Quality Management Areas (AQMAs) located in close proximity to the Firth of Forth, however, the proposal has the potential to influence traffic and hence pollutant emissions across an extensive geographic area including Edinburgh. It should be noted that within Edinburgh there are two AQMAs covering arterial routes on the west of the city which could be used by city-bound traffic from the bridge.

5.4.6 Water Environment

The most significant effects on the water environment are associated with the construction of the scheme. Construction of the bored tunnel would have a negligible effect on the Firth of Forth as works occur beneath it, however, construction of road network connections could impact on adjacent or nearby surface waters either as a result of culverting, realignment or pollution arising from contaminated surface runoff or spillages. The increase in hardstanding areas and poorly designed culverts or road drainage systems could increase flood risk. Overall *Minor Adverse* impacts are predicted to occur.

It is noted that there are old mine workings in the vicinity of the Midhope Burn. Tunnelling activities in this area have the potential to impact on the groundwater regime, however, the overall impact is considered to be *Minor Adverse*.

5.4.7 Geology and Soils

The designation of the Firth of Forth Site of Special Scientific Interest (SSSI) covers geological as well as biological interests, consequently the receptor is considered to be of High Importance, however, the tunnel and associated road network connections are unlikely to impact on the SSSI. Impacts on local geology are not considered to be significant.

No fields designated under national or local designation are likely to be affected by this option, however, loss of agricultural land, including some deemed prime quality agricultural land would occur. The tunnel boring activities would disturb larger quantities of soil, particularly during cut and cover activities, however, the effect is predicted to be *Moderate Adverse* due to the potential to mitigate impacts through storage of affected soil.

5.4.8 Human Health and Population

Impacts on human health and population relate mainly to air, noise, accessibility and physical activity.

Due to the proximity of residential properties to this option and the health effects of noise and vibration, the receptor is defined as being of High Importance. The construction of this option will result in significant adverse, albeit temporary, impacts. Permanent operational effects are likely to vary with *Moderate Positive* impacts in some locations and *Major Adverse* impact in others. These impacts are predicted due to changes in traffic flows and are likely to occur across a wide geographic area.

With regards to accessibility, this proposal will result in increased accessibility, particularly for car users, in areas such as Rosyth, Dunfermline, Limekilns and Charlestown, however, there will be a loss of cross-Forth accessibility in the South Queensferry and Dalmeny area. Overall this is assessed to be *Minor Adverse to Minor Positive*.

The tunnel does not include provisions for pedestrians or cyclists, consequently operating as a replacement crossing this means there will be severance for existing pedestrians and cyclists. The introduction of new transport corridors associated with the road connections would result in severance effects for a number of residential properties to the west of Rosyth. There is likely to be community severance between Rosyth and Dunfermline. Impacts relating to severance cannot be effectively mitigated, as a result this is considered to be a *Moderate Adverse* effect.

5.4.9 Material Assets

The construction of a bored tunnel would generate large amounts of waste and the majority of materials used in construction could not be obtained from renewable sources. There is the opportunity to reuse waste materials generated from the tunnel boring in the construction of new road infrastructure.

The finalised alignment of the connecting roads could result in the demolition of properties and the loss of agricultural land. Overall this effect is assessed as *Moderate Adverse*.

5.5 Corridor C2 Tunnel (Immersed Tube)

See Table F.2 for a summary matrix of the assessment.

5.5.1 Option Description

This option is illustrated in Figure 3.2. On the southern shore the tunnel portal, located at Craigton Quarry is reached via a new spur road on the south of the M9. On the northern shore the tunnel portal is located to the immediate west of the naval docks. A new road links the tunnel to the A823 north of Rosyth crossing over the A985. The option also includes re-modelling of junctions on both the northern and southern shores. Construction involves the dredging of a channel across the Forth. A pre-fabricated tunnel would be towed out and then sunk into the channel. Cut and Cover (C&C) tunnels would be required on both the northern and southern shores to provide a transition and interface between the land based mined tunnel and the immersed tube tunnel.

5.5.2 Biodiversity, Flora and Fauna

The proposed alignment for Tunnel C2 (immersed tube) avoids, though is adjacent to, the intertidal areas of the Forth designated as the Firth of Forth SPA. However, when considering the potential impacts on an SPA the important factor is whether there will be adverse impacts on the qualifying features of the SPA, whether they are actually present within the boundaries of the SPA or not. WeBS low tide data for the winter of 03/04 indicates that redshank, curlew and wigeon all occur in significant numbers in this corridor (above one per cent of SPA designated threshold level).

The construction method and alignment proposed for Tunnel C2 are likely to have significant adverse effects on the SPA and in a wider context the biodiversity of the Firth of Forth through disturbance and changes to the morphological regime. There will also be a loss of feeding habitat during the construction period. As a result of construction activities there will be increased disturbance of marine and bird species in both the open water and in the intertidal areas.

With regard to the consequence of dredging the channel that will take the immersed tube below the low water mark there are likely to impacts on water quality and consequently on related ecology within the Forth during the construction period. The characterisation of the Firth of Forth undertaken by SEPA as part of the implementation of the Water Framework Directive identifies the Forth as being in Category 1a – at risk of not achieving "good" status - the target of the Directive. SEPA recognises the water quality in the Firth of Forth is historically poor citing historic discharges and the Forth's inherently turbid nature.

However, the displacement of sediments associated with Tunnel C2 would exacerbate existing water quality problems and could have significant indirect impacts on ecology and the wildlife that inhabits the Firth of Forth. Impacts resulting from increased suspended sediment in the Forth include;

- A reduction in the depth of light penetration into the water. This effectively decreases rates of photosynthetic activity and thus primary productivity in submerged plants such as eelgrass (Zostera spp.), which is a basic food source for aquatic animals. A reduction in the food source at the primary level may then have a knock-on effect upon higher trophic levels, including birds;

- High turbidity levels can adversely affect invertebrate populations, interfere with the behaviour, migration, feeding and growth of salmonids and other fish species such as lamphrey. It can also cause damage to fish gills by abrasion (hyperplasia), and clogging. This is significant in relation to potential impacts on Atlantic salmon which are a qualifying feature of the River Teith SAC. Note that such effects would not be spatially limited to the construction zone; and

- Cetaceans, protected by the Habitat Regulations 1994 as amended, the Wildlife and Countryside Act (1981) as amended by the Nature Conservation (Scotland) Act 2004 do use the Forth. The construction and operation of an immersed tube tunnel could have an impact on these species through the displacement of sediments on the sea bed and by reducing the availability of food to them as well as disturbance during construction.

The proposed location for the shaft and site entrance for the southern shore is generally screened from the Firth of Forth SPA by linear belts of woodland but the scale and duration of the works may still lead to disturbance issues. Indirect effects relating to the works on the northern shore and in open water areas may also have adverse effects.

On both the northern and southern shores the potential exists for road network connections to impact on terrestrial ecology including European Protected Species (EPS) as well as valuable habitats. Impacts could include temporary habitat loss due to construction activities, permanent habitat loss as a result of the landtake associated with road connections and fragmentation of wildlife corridors such as woodland, hedgerows and surface watercourses.

With regards to impacts on species, there will be temporary disturbance associated with construction activities which may interfere with breeding seasons and movement of species. In the long term impacts associated with movement of species could be impacted upon. Otters, an EPS, are present on the Union Canal which lies to the south of this option. It is likely that otters would move along ditches and small burns to access ponds present to the south of Hopetoun Estate for feeding, particularly in spring when amphibians are spawning. The construction of new roads could increase the number of otter mortalities.

Overall impacts on biodiversity are considered to be *Major Adverse*.

5.5.3 Landscape and Visual Amenity

The tunnel and associated road connections run beneath or adjacent to a number of designated features including Hopetoun House Garden and Designed Landscape (GDL), Forth Shore Areas of Great Landscape Value (AGLVs) on the southern shores and an Area of Outstanding Landscape Quality (AOLQ) at Humbie. Road connections on the northern shore encroach upon and are adjacent to the Belleknowes AGLV.

The proposed junction alignment to the north of the Forth around Pattiesmuir would sever the attractive matrix of rolling arable farmland with boundary hedgerow and tree planting features being lost. It would result in the loss of a swathe of deciduous woodland planting which forms an attractive landscape feature. The tunnel portal and road infrastructure to the south of the Forth would lie in a relatively contained section of the landscape with the existing M9 motorway corridor to the immediate north and a band of woodland planting around the railway and the Union Canal to the south. Overall impacts on landscape are considered to be Moderate to Major Adverse.

With regards to visual amenity, there will be short term impacts resulting from construction while permanent impacts will be associated with the tunnel portals and the road network connections. There are a number of visual receptors, particularly on the northern shore that will be afforded views of both the tunnel portal and the new road connecting to the A985 and A823. Receptors have been identified as being of high importance due to the potential for impacts on the views experienced from residential properties. Dependent on the receptors' proximity to the tunnel portals and road infrastructure as well as angle and direction of view, impacts range from Minor to Major Adverse.

Overall impacts on landscape and visual amenity are considered to be *Minor to Major Adverse*.

5.5.4 Cultural Heritage

Road network connections on both the northern and southern shores would result in indirect visual impacts on the setting of four sites of national importance including Duntarvie Castle and Aldcathie Church which would experience minor and moderate adverse visual impacts respectively. On the northern shore this option would result in indirect impacts on a number of listed buildings in the Pattiesmuir area, also a conservation area. Local and regional sites, including Blackhall Farm and two military defence sites, could experience direct physical and indirect visual impacts. There is also the potential for impacts on marine archaeology within the Forth including impacts on war graves. Vibration from construction activities could impact on nearby buildings or sites of heritage value. . The effects on GDLs are as described in the landscape and visual assessment. Overall, impacts on cultural heritage features are considered to be *Moderate Adverse*.

5.5.5 Air Quality and Climatic Factors

The tunnel option does not include provision for High Occupancy Vehicle (HOV)/priority bus lanes, as a result reductions in emissions due to modal shift are unlikely to occur, however, new and improved junction layouts and roads connections to the tunnel could reduce air quality problems associated with congestion. The tunnel which includes four lanes, operating as a replacement, does not provide additional vehicle capacity. The traffic modelling undertaken during the STAG appraisal assessed traffic flows in 2017 compared with the “do minimum”. As a result of reduced congestion; reductions in the emissions of NO_X (-2.1%), PM_{10} (-0.4%).and CO_2 (-1.6%) are predicted to occur. *Minor Positive* effects are predicted to occur.

There are no Air Quality Management Areas (AQMAs) located in close proximity to the Firth of Forth, however, the proposal has the potential to influence traffic and hence pollutant emissions across an extensive geographic area including Edinburgh. Within Edinburgh there are two AQMAs covering arterial routes on the west of the city which could be used by city-bound traffic from the proposal.

5.5.6 Water Environment

The most significant effects on the water environment are associated with the construction of the scheme. The construction of the immersed tube tunnel involves the dredging of a trench on the bed of the Forth which could result in the displacement of substantial volumes of sediment. A significant increase in turbidity could result in direct impacts on water quality with secondary impacts on ecological status of the Forth, including impacts on protected species which inhabit the Forth as well as the benthic community on the seabed. Construction activities in the Rosyth area could result in the mobilisation of contaminants. Additionally, construction of road network connections could impact on adjacent or nearby surface waters either as a result of culverting, realignment or pollution arising from contaminated surface runoff or spillages. Overall, in particular as a result of the dredging activities, the effects on the water environment are considered to be *Major Adverse*.

The increase in hardstanding areas and poorly designed culverts or road drainage systems could increase flood risk, however, taking into account mitigation this considered to be *Minor Adverse*.

5.5.7 Geology and Soils

The designation of the Firth of Forth Site of Special Scientific Interest (SSSI) covers geological as well as biological interests, consequently the receptor is considered to be of High Importance, however, the tunnel and associated road network connections are unlikely to impact on the SSSI. Impacts on local geology are not considered to be significant.

No fields designated under national or local designation are likely to be affected by this option, however, loss of agricultural land, including some deemed prime quality agricultural land would occur. The tunnel boring activities would disturb larger quantities of soil, particularly during cut and cover activities, including potentially contaminated soils, however, the effect is predicted to be *Moderate Adverse* due to the potential to mitigate impacts through storage of affected soil.

5.5.8 Human Health and Population

Due to the proximity of residential properties to this option and the health effects of noise and vibration, the receptor is defined as being of High Importance. The construction of this option will result in significant adverse, albeit temporary, impacts. Permanent operational effects are likely to vary with *Moderate Positive* impacts in some locations and *Major Adverse* impact in others. These impacts are predicted due to changes in traffic flows and are likely to occur across a wide geographic area.

This proposal will result in increased accessibility, particularly for car users, in areas such as Rosyth, Dunfermline, Limekilns and Charlestown, however, there will be a loss of cross-Forth accessibility in the South Queensferry and Dalmeny area. This is considered to result in *Minor Adverse to Minor Positive* effects.

The tunnel does not include provisions for pedestrians or cyclists, consequently operating as a replacement crossing this means there will be severance for existing pedestrians and cyclists. The introduction of new transport corridors associated with the road connections would result in severance effects for a number of residential properties to the west of Rosyth such as Pattiesmuir. There is likely to be community severance between Rosyth and Dunfermline. Impacts relating to severance cannot be effectively mitigated, as a result this is considered to be a *Moderate Adverse* effect.

5.5.9 Material Assets

The construction of an immersed tube tunnel would generate significant amounts of waste material and the majority of materials used in construction could not be obtained from renewable sources. There is the opportunity to reuse waste materials generated from the tunnel boring in the construction of new road infrastructure.

The finalised alignment of the connecting roads could result in the demolition of properties and the loss of agricultural land. Overall this effect is assessed as *Moderate Adverse*.

5.6 Corridor D Bridge

See Table F.3 for a summary matrix of the assessment.

5.6.1 Option Description

This option is illustrated in Figure 3.2. The bridge is located to the immediate west of the existing Forth Road Bridge. A new spur road from the north of the M9 links the bridge on the southern shore to the road network. The southern bridgehead is located to the west of South Queensferry adjacent to Port Edgar. On the northern shore the bridge ties into the M90. The option also includes re-modelling of junctions on both the northern and southern shores.

5.6.2 Biodiversity, Flora and Fauna

The bridge crossing has the potential for negative impact on all three Natura 2000 sites, although there are no direct impacts on these sites. The construction of the bridge could potentially cause disturbance to the wintering bird assemblages of the Firth of Forth SPA, both in the intertidal areas and open water.

The Forth Islands SPA is designated for its breeding common, roseate, sandwich and arctic tern colonies and breeding seabird assemblages. Most of this SPA is located in the outer Firth of Forth, however, Long Craig Island is situated beneath the Forth Road Bridge and supports important tern colonies. Breeding common terns have only been found on four of the thirteen Islands surveyed on the Firth of Forth by the Forth Sea Bird Group. The Forth Islands SPA is designated for 334 pairs accounting for three per cent of the Great British Population.

Leith Docks SPA holds the largest breeding common tern colony on the Forth and is designated for 558 pairs, which is five per cent of the British population. Terns are very mobile, and would readily move between colonies and birds are unlikely to breed only in one colony or another. There is therefore an ecological link between these two SPAs.

It is noted that the terns of the Forth use undesignated habitats such as open water and congregate in areas such as Port Edgar for loafing/roosting after breeding and pre migration.

Long Craig Island is approximately 400 metres from the proposed bridge alignment; the impacts of construction on the shore and open water have potential for disturbance to feeding and flight lines to foraging areas and construction activities such as pile driving may cause disturbance to breeding birds. Mitigation may be possible to avoid invasive construction techniques such as pile driving at the most sensitive time of year, but timing may conflict with the wintering bird interest of the Firth of Forth.

The River Teith SAC relies upon the successful migration through the Forth of salmon, sea lamprey and river lamprey. There is potential for this migration to be interrupted by temporary indirect impacts of construction such as increased turbidity. The acoustic impact of pile driving, in particular can create a barrier for migrating fish. It is not known at this stage whether construction can be timed to avoid all such impacts since these spread through a large portion of the year. Similarly for cetaceans and seals, construction activities, in particular pile driving, could result in disturbance.

On both the northern and southern shores the potential exists for road network connections to impact on terrestrial ecology including European Protected Species (EPS), St Margarets Marsh SSSI and other valuable habitats.

St Margaret's Marsh SSSI is a 26.4ha area designated for its coastland habitat, particularly its reed bed which represents approximately three per cent of the Scottish coastal reed bed resource. A small area of salt marsh showing transitions from lower to mid/upper salt marsh is also present. Breeding birds are important with water rail, sedge warbler and reed bunting and there is scattered scrub supporting breeding whitethroat, willow warbler, linnet and green woodpecker. Wintering snipe, redshank, curlew and oystercatcher use the site and so there is a direct ecological relationship with the Firth of Forth SPA. The proposed junctions to link the bridge to the motorway will result in loss of habitat in the east of the SSSI. Indirect impacts are also indicated such as modification of remaining habitat through disturbance, shading and dust, disturbance to birds from construction and operation, and alterations to ground water conditions.

Additional terrestrial impacts on ecology could include temporary habitat loss due to construction activities, permanent habitat loss as a result of the landtake associated with road connections and fragmentation of wildlife corridors such as woodland, hedgerows and surface watercourses. Otters (EPS) are common in the Lothians and evidence of otters has been noted within the vicinity of the proposed roads. This proposal has the potential to fragment corridors that otters may travel along.

Overall impacts on biodiversity are considered to be *Major to Moderate Adverse*.

5.6.3 Landscape and Visual Amenity

No designated landscapes would be directly affected by this option. GDLs and an AGLV are located approximately 1-2 km from possible road construction activities but the setting of these is unlikely to be affected. Road works are, however, likely to result in Minor Adverse effects on the setting of designated greenbelt. To the south of the river, new road infrastructure would be located in the vicinity of two GDLs (Hopetoun House and Dundas Castle). It is likely that this road infrastructure would result in Moderate Adverse effects on the setting of the Hopetoun House GDL.

The proposed bridge crossing options would be taller than both existing bridges. A new bridge could increase the influence of the bridges on the landscape, decreasing the apparent scale of the Firth of Forth from closer viewpoints.

A new junction to the north of the Forth would result in the loss of a large section of attractive ancient woodland to the east of St Margaret's Hope. The junction and associated roads would create prominent structures within the landscape, further severing the open valley landscape. To the south of the Forth, an extensive area of shoreline woodland which connects various designed landscapes would also be lost. New road infrastructure in this area would further increase the prominence of transport corridors in this open landscape, fragmenting rolling farmland which is typical or this area and resulting in the loss of hedgerows, trees and shelterbelt planting. In addition to these Major Adverse permanent effects, the creation of construction compounds at Port Edgar and South Queensferry would result in Moderate Adverse temporary effects.

In terms of visual amenity, receptors have again been identified as being of High Importance, due to the potential for impacts on the views experienced from residential properties. Impacts would range from Minor to Major Adverse depending on the sensitivity of the receptor and the receptor's proximity, angle and direction of view of the bridge.

In summary, this option would substantially change the character of the Firth of Forth and its hinterland; as a result it has the potential for Minor to Major Adverse effects on both landscape character and visual amenity.

Overall impacts on landscape and visual amenity are considered to be *Minor to Major Adverse*.

5.6.4 Cultural Heritage

This option could have direct impacts on a Scheduled Ancient Monument; a souterrain at Middlebank House. A new bridge is likely to result in adverse impacts on the setting of three Grade A Listed Buildings. Impacts on the setting of the existing bridges, both of which are Grade A Listed structures, are predicted to result in Moderate Adverse effects. Major Adverse effects are also predicted as Hopetoun House is listed in Inventory of Gardens and Designed Landscapes. Additionally there is likely to be impacts on the 3 settings of three non-inventory GDLs, Dundas Castle, Fordell Castle and Newliston. . The effects on GDLs are as described in the landscape and visual assessment. This option is also likely to result in Moderate Adverse impacts on the Queensferry Conservation Area. There is also the potential for impacts on marine archaeology within the Forth including impacts on war graves.

The overall impacts on Cultural Heritage are predicted to be *Major Adverse.*

5.6.5 Air Quality and Climatic Factors

The bridge option includes provision for six lanes i.e. an increase in vehicle capacity, however, it should be noted that no decision on how these are operated has been made. Potentially the additional lanes could be used as HOV/priority bus lanes which could encourage modal shift thereby reducing emissions. New and improved junction layouts and roads connections to the tunnel could reduce air quality problems associated with congestion. The traffic modelling undertaken during the STAG appraisal assessed traffic flows in 2017 compared with the "do minimum". As a result of reduced congestion; reductions in the emissions of NO_X (-3.2%), PM_{10} (-0.4%).and CO_2 (-2.2%) are predicted to occur. *Minor Positive* effects are therefore predicted to occur.

There are no Air Quality Management Areas (AQMAs) located in close proximity to the Firth of Forth, however, the proposal has the potential to influence traffic and hence pollutant emissions across an extensive geographic area including Edinburgh. Within Edinburgh there are two AQMAs covering arterial routes on the west of the city which could be used by city-bound traffic from the proposal.

5.6.6 Water Environment

The most significant effects on the water environment are associated with the construction of the scheme. Construction of road network connections could impact on adjacent or nearby surface waters either as a result of culverting, realignment or pollution arising from contaminated surface runoff or spillages. The increase in hardstanding areas and poorly designed culverts or road drainage systems could increase flood risk, however, overall the impacts are predicted to *Minor Adverse*.

Construction of the bridge would have short term effects on the morphology of the Firth of Forth, however, in long term the effect of new tower structures which support the bridge are predicted to be Neutral. Overall, as a result of the effects of road connections, *Minor Adverse* impacts are predicted to occur.

5.6.7 Geology and Soils

The designation of the Firth of Forth Site of Special Scientific Interest (SSSI) covers geological as well as biological interests, consequently the receptor is considered to be of High Importance, however, this proposal is unlikely to impact on the SSSI.

This option would not affect any fields designated under national or local designation, however, loss of agricultural land, including agricultural land deemed prime quality, would occur. No significant impacts on local geology are predicted, however, there will be impacts on soil through the loss of agricultural land. Overall impacts are predicted to be *Moderate Adverse*.

5.6.8 Human Health and Population

Due to the proximity of residential properties to this option and the health effects of noise and vibration, the receptor is defined as being of High Importance. The construction of this option will result in significant adverse, albeit temporary, impacts. Permanent operational effects are likely to vary with *Moderate Positive* impacts in some locations and *Major Adverse* impact in others. These impacts are predicted due to changes in traffic flows and are likely to occur across a wide geographic area.

Operating as a replacement for the existing FRB, the similarity of this proposal to the existing crossing, on the north shore of the Firth of Forth, would result in minimal impacts upon accessibility depending upon the detail of the network connections. On the southern shore of the Firth of Forth, this proposal would link with South Queensferry and retain existing levels of accessibility in this area, albeit Dalmeny residents may have to travel further to access the new crossing which is likely to entail disproportionate disbenefits for non-car owners. The proximity of the proposal to the existing public transport network, associated infrastructure and developed areas would enable an enhanced public transport network to better serve the needs of its users. Overall impacts are predicted to be *Minor Positive*.

The bridge does include provisions for pedestrians or cyclists, consequently operating as a replacement crossing this means there will be no severance for existing pedestrians and cyclists. Due to the potential for direct effects on residents, the receptor is defined as being of high importance. The introduction of new transport corridors would result in *Minor Adverse* severance effects for a number of residential properties in the Totley Wells area.

5.6.9 Material Assets

The construction of Bridge D would generate large amounts of waste material and the majority of materials used could not be obtained from renewable sources. There is the opportunity to reuse waste materials in the construction of new road infrastructure.

Private property could be affected as construction of the road network connections may require the demolition of properties as well as the loss of agricultural land. Overall this effect is assessed as *Moderate Adverse*.

5.7 Corridor D Tunnel (Bored)

See Table F.4 for a summary matrix of the assessment.

5.7.1 Option Description

This option is illustrated in Figure 3.1. The tunnel is located to the west of the existing crossing. On the southern shore the tunnel portal is located north of Westmuir and is linked to the road network by a new spur on the north of the M9. The northern tunnel portal is located north of Inverkeithing and is reached via a new spur road from the M90. The option also includes re-modelling of junctions on both the northern and southern shores. The tunnel would be constructed by a combination of TBM and SCL.

5.7.2 Biodiversity, Flora and Fauna

A bored tunnel, due to the construction techniques involved occurring below the bed of the Forth, is likely to have an overall neutral effect on marine ecology i.e. cetaceans, seals, and fish as the. There is unlikely to be disturbance associated with operational noise and vibration due to the depth tunnel would be located at.

This tunnel would pass beneath the Firth of Forth SPA, avoiding direct impacts, but the proposed location of the northern shaft may have indirect impacts on the Firth of Forth SPA and also St Margaret's Marsh SSSI, both which lie adjacent to this shaft site. The impacts on both of these sites relate to disturbance of birds, and also indirect effects of construction such as dust and contaminated run off. The site is currently scattered scrub, and bird communities will be using this for breeding in conjunction with St Margaret's Marsh. St Margaret's Marsh, being a coastal water reed bed, is also vulnerable to changes in groundwater conditions.

On both the northern and southern shores the potential exists for road network connections to impact on terrestrial ecology including European Protected Species (EPS) as well as valuable habitats. Impacts could include temporary habitat loss due to construction activities, permanent habitat loss as a result of the landtake associated with road connections and fragmentation of wildlife corridors such as woodland, hedgerows and surface watercourses

The proposed construction site for the portal lies approximately 400 metres from a pond with an extant great crested newt population. The distribution of great crested newts in other ponds in this area has not fully been studied, although many ponds in the area were surveyed in 1996 and no further ponds were found to be positive for great crested newt. The accepted radius to assess probability of use of terrestrial habitat from breeding ponds is 500 metres, although most are found within 50 metres. The proposed road linkages into the existing road infrastructure may result in increased isolation of this population when the scheme is in operation, but a broader analysis of the status of great crested newt in this area would be required to confirm this.

Otters are common in the Lothians. The connecting infrastructure to the M9, the southern connections to the A90 and the linking road to Hillend indicate potential for impacts to otters, particularly in terms of fragmentation as many small burns are crossed. Otter signs were found at Parsgillis Bridge indicating use of these small burns. To the west of Kirkliston, there are several reservoirs surrounded by woodland providing good habitat that is part of the River Almond catchment, which supports a good otter population. The new link road would pass over the Swine Burn, the Humbie Reservoir and the Dolphinton Burn. Mitigating the impacts of increased otter mortality on the new roads and junctions frequently includes measures such as otter fencing and habitat creation. Avoiding fragmentation by excluding culvert in crossing watercourses, appropriate bridge design and construction considerations would facilitate commuting otters.

Overall impacts on biodiversity are considered to be *Moderate to Minor Adverse*.

5.7.3 Landscape and Visual Amenity

The new roads and junction improvements to the north of the Forth would result in the introduction of prominent structures into the open valley landscape to the north of Inverkeithing and further severance of scrub woodland and grassland which currently separates the existing bridge road network from the western edge of Inverkeithing. The tunnel portal construction to the south of the Forth would result in significant earthworks which would appear relatively incongruous with the existing landscape structure. The road network connection would result in the loss of a number of features which contribute to Humbie AOLQ including woodland, boundary planting and watercourses. The Humbie AOLQ would be directly affected by road infrastructure located on southern shore as it would be dissected by the road network connection. New Liston, Dundas Castle and Hopetoun House Gardens and Designed Landscape will experience indirect effects on their settings. The Forth Shore/Hopetoun AGLV will be directly impacted on during construction of the tunnel portal. Overall impacts on the landscape character of the area affected by this option are considered to be Major to Moderate Adverse.

With regards to visual amenity, there will be short term impacts resulting from construction while permanent impacts will be associated with the tunnel portals and the road network connections. Receptors have been identified as being of high importance due to the impacts on the views experienced from residential properties. Dependent on the receptors' proximity to the tunnel portals and road infrastructure as well as angle and direction of view, impacts range from Minor to Major Adverse.

Overall impacts on landscape and visual amenity are considered to be *Minor to Major Adverse*.

5.7.4 Cultural Heritage

This option will create both direct physical impacts and indirect visual impacts upon archaeological sites, the built heritage and historic landscapes.

Direct physical and indirect visual impacts will be caused by road network connections and tunnel portals. Scheduled Ancient Monuments (SAMs) including a souterrain at Middlebank House and Duntarvie Castle will experience negative indirect effects on their respective setting. The effects on GDLs are as described in the landscape and visual assessment. Overall *Moderate Adverse* effects are predicted.

5.7.5 Air Quality and Climatic Factors

The tunnel option does not include provision for HOV/priority bus lanes, as a result reductions in emissions due to modal shift are unlikely to occur, however, new and improved junction layouts and roads connections to the tunnel could reduce air quality problems associated with congestion. The tunnel which includes four lanes, operating as a replacement, does not provide additional vehicle capacity. The traffic modelling undertaken during the STAG appraisal assessed traffic flows in 2017 compared with the "do minimum". As a result of reduced congestion; reductions in the emissions of NO_X (-2.0%), and CO_2 (-1.1%) are predicted to occur while a slight increase in PM_{10} (+0.8%). Overall *Minor Positive* effects are predicted to occur.

There are no Air Quality Management Areas (AQMAs) located in close proximity to the Firth of Forth, however, the proposal has the potential to influence traffic and hence pollutant emissions across an extensive geographic area including Edinburgh. Within Edinburgh there are two AQMAs covering arterial routes on the west of the city which could be used by city-bound traffic from the proposal.

5.7.6 Water Environment

The most significant effects on the water environment are associated with the construction of the scheme. Construction of the bored tunnel would have a negligible effect on the Firth of Forth as works occur beneath it, however, construction of road network connections could impact on adjacent or nearby surface waters either as a result of culverting, realignment or pollution arising from contaminated surface runoff or spillages. The increase in hardstanding areas and poorly designed culverts or road drainage systems could increase flood risk. Overall *Minor Adverse* impacts are predicted to occur with regards to both flood risk and surface waterbodies.

5.7.7 Geology and Soils

The designation of the Firth of Forth Site of Special Scientific Interest (SSSI) covers geological as well as biological interests, consequently the receptor is considered to be of High Importance, however, the tunnel and associated road network connections are unlikely to impact on the SSSI.

Corridor D Tunnel affects agricultural land, classified as prime quality agricultural land, and land that is also within the Countryside Policy Area (Rural West Edinburgh Local Plan).

The tunnel boring activities would disturb larger quantities of soil, particularly during cut and cover activities, however, no significant impacts on local geology are predicted to occur. Overall, as a result of impacts on soil overall *Moderate Adverse* effects are predicted.

5.7.8 Human Health and Population

Due to the proximity of residential properties to this option and the health effects of noise and vibration, the receptor is defined as being of High Importance. The construction of this option will result in significant adverse, albeit temporary, impacts. Permanent operational effects are likely to vary with *Moderate Positive* impacts in some locations and *Major Adverse* impact in others. These impacts are predicted due to changes in traffic flows and are likely to occur across a wide geographic area.

Operating as a Replacement Crossing, and due to its proximity to the existing crossing, Tunnel D would have minimal impacts on the northern shore, however, on the southern shoe the tunnel ties into the M9 as opposed to South Queensferry. The proximity of the proposal to the existing public transport network, associated infrastructure and developed areas would enable an enhanced public transport network to better serve the needs of its users. Overall impacts relating to accessibility are considered to be *Minor Adverse.*

The road network connections on the southern shore are likely to result in severance in the Carmelhill area and on the northern shore the junctions connecting to the existing road network would lead to severance in the Inverkeithing area. The tunnel does not include provisions for pedestrians or cyclists, consequently operating as a replacement crossing this means there will be severance for existing pedestrians and cyclists. Overall impacts relating to severance are predicted to be *Moderate Adverse*.

5.7.9 Material Assets

The construction of a bored tunnel would generate large amounts of waste and the majority of materials used in construction could not be obtained from renewable sources. There is the opportunity to reuse waste materials generated from the tunnel boring in the construction of new road infrastructure.

The finalised alignment of the connecting roads could result in the demolition of properties and the loss of agricultural land. Overall this effect is assessed as *Moderate Adverse*.

5.8 No New Crossing Scenario

See Table F.5 for a summary matrix of the assessment.

5.8.1 Option Description

The No New Crossing scenario has been conceived with the aim of maximising the operational efficiency of the existing Cross-Forth crossings, whilst not actually replacing the existing crossing. It is, in effect, an enhanced “do minimum” scenario. A core assumption is that the existing Forth Road Bridge is refurbished and fully operational.

Public transport and High Occupancy Vehicle (HOV) priority measures would be provided on and around the crossing to ensure that capacity for cross-Forth person trips can be increased and that the operational efficiency of the existing infrastructure can be maximised. Furthermore, diversionary routes (principally the A985 between Kincardine and the M90) would be improved to dual carriageway standard.

The assessment of the No New Crossing scenario is based upon the assumptions detailed below:

- The Forth Road Bridge is assumed to have been successfully refurbished and will operate with 2 lanes available in each direction. However one lane in each direction will be reserved for HOV / public transport use throughout the day;
- The A985 will be upgraded to dual carriageway from Kincardine to the M90;
- An HOV/Public transport lane will be provided on the M90/A90 from Halbeath southbound to the bridge;
- An HOV/public transport will be provided northbound on the A90 and A8000/M9 Spur towards the bridge;
- Further public transport priority measures will be provided on all main routes out of Dunfermline/Inverkeithing;
- Park and Choose Sites will be provided in the Fife Bridgehead area;
- Additional cross-Forth Express Bus Services will be provided from the Park and Choose Sites;
- Local Feeder Bus Services will be provided to the Park and Choose Sites;
- Rail services will be upgraded to provide additional capacity;
- Public transport fares will remain as forecast; and
- A cross Forth ferry will be provided between Kirkcaldy and Leith.

It should be noted that this scenario is purely indicative of possible interventions and does not represent a commitment by Transport Scotland to implement any of them. At this point in time there is also considerable uncertainty as to the extent of the remedial works associated with refurbishment of the existing bridge and their consequential impact on traffic flows.

5.8.2 Biodiversity, Flora and Fauna

Dependent on the location of public transport infrastructure there should be no effects on the SPA. The dualling of the A985 should also have no effects on the SPAs.

However, the potential exists for the dualling of the A985 and public transport schemes to impact on terrestrial ecology including European Protected Species (EPS) as well as valuable habitats. Impacts could include temporary habitat loss due to construction activities, permanent habitat loss as a result of the landtake associated with road connections and fragmentation of wildlife corridors such as woodland, hedgerows and surface watercourses.

Overall this is considered to be a Moderate Adverse impact.

5.8.3 Landscape and Visual Amenity

There will be adverse effects on landscape associated with dualling the A985 as the road crosses through the Belleknowes AGLV. The location of public transport infrastructure would, assuming they are sited within an urban environment, have minimal impacts on landscape character. Overall impacts on landscape are likely to be Moderate Adverse.

In terms of visual amenity, receptors have again been identified as being of High importance, due to the potential for impacts on the views experienced from residential properties. Impacts would range from Minor to Major Adverse depending on the proposal, i.e. the sensitivity of the receptor and the receptor's proximity, angle and direction of view of the developments; either: the dualling of the A985 or the public transport measures.

Overall impacts on landscape and visual amenity are considered to be *Minor to Major Adverse*.

5.8.4 Cultural Heritage

The proposal, in particular the dualling of the A985, has the potential to have direct physical and indirect visual impacts on a number of sites of heritage or archaeological value. The Tuilyies Standing Stone a Schedule Ancient Monument and a number of listed buildings are close to or immediately adjacent to the A985, consequently they may experience adverse impacts on their settings and in some cases direct physical impacts.

There may be some impacts on the settings of listed buildings and sites of regional or local importance resulting from the development of public transport related facilities and infrastructure.

The overall impacts on Cultural Heritage are considered to be *Major Adverse*.

5.8.5 Air Quality and Climatic Factors

During refurbishment of the existing bridge there will be significant adverse effects on air quality as a result of increased congestion and the diversionary routes that will be in place.

The proposal includes a number of measures that aim to promote modal shift including a cross-Forth ferry service, Park and Choose sites and increases in bus and rail services. Should these measures result in reductions in private car use there may be positive effects on air quality as a result of reduced emissions.

Following refurbishment, the proposal also includes the provision of High Occupancy Vehicle/public transport lanes on the existing bridge and approach roads to it, while this may encourage some modal shift it will also result in increased traffic congestion.

The dualling of the A985, also included within this option, will increase road capacity and may result in increased traffic levels and greater emissions of pollutants. Traffic modelling suggests that, as a result of reduced capacity on the bridge for Heavy Goods Vehicles (HGVs) and Single Occupancy Vehicles (SOVs), traffic flows could be re-distributed and lengthier diversionary routes followed.

There are no Air Quality Management Areas (AQMAs) located in close proximity to the Firth of Forth, however, the proposal has the potential to influence pollutant emissions across an extensive geographic area, in particular Edinburgh. Within Edinburgh there are two AQMAs covering arterial routes on the west of the city which could be used by city-bound traffic from the existing bridge. This option may reduce the volume of Edinburgh-bound traffic and positively impact on the AQMAs.

Overall, however, it is likely that option will have a *Minor Adverse* impact on air quality.

5.8.6 Water Environment

The refurbishment of the bridge is unlikely to result in significant impacts on the Firth of Forth. Dependent on proximity to surface waters, dualling the A985 and construction of public transport infrastructure could impact on adjacent or nearby surface waters either as a result of culverting, realignment or pollution arising from contaminated surface runoff or spillages. These impacts are predicted to be *Minor Adverse*.

Public transport infrastructure and dualling the A985 will result in an increase in hardstanding surfaces that will increase surface run off and flood risk. Overall impacts are considered to be *Minor Adverse*.

5.8.7 Geology and Soils

Some agricultural land will be lost as a result of dualling the A985 and potentially, dependent on location, new public transport facilities and infrastructure. Overall this effect is likely to be *Moderate Adverse*.

5.8.8 Human Health and Population

Construction of the schemes comprising this option will result in significant adverse noise and vibration related impacts. Major Adverse temporary effects are predicted from construction activities. Permanent operational effects are likely to vary with *Moderate Positive* impacts in some locations and *Major Adverse* impacts in others. These impacts are predicted due to changes in traffic flows and are likely to occur across a wide geographic area.

As result of additional public transport services there will be an increase in capacity for cross-Forth person trips which will have a positive impact on public transport accessibility between north Edinburgh and South Fife. However, accessibility for HGVs and SOVs will be significantly reduced. Impacts on accessibility are therefore predicted to be *Moderate Adverse.*

By refurbishing the existing bridge cross-Forth accessibility for pedestrians and cyclists will be maintained. There are no severance related impacts as therefore this option is considered to have a *Negligible* impact.

5.8.9 Material Assets

The construction of public transport facilities and dualling the A985 would generate significant amounts of waste and the majority of materials used could not be obtained from renewable sources.

Some properties and agricultural land could be affected by the development of public transport infrastructure and dualling of the A985. Overall effects are likely to *Moderate Adverse*.

5.9 Summary of Assessment

Table 5.3 below summarises the residual effects of each of the options assessed.

Table 5.3 Summary of Residual Effects

SEA Objective	Corridor C Tunnel (Bored)	Corridor C2 Tunnel (Immersed Tube)	Corridor D Bridge	Corridor D Tunnel (Bored)	No New Crossing
To protect and conserve biodiversity	Moderate to Minor Adverse	Major Adverse	Major to Moderate Adverse	Moderate to Minor Adverse	Moderate Adverse
To safeguard the character and diversity of the Scottish landscape and visual amenity	Minor to Major Adverse	Minor to Major Adverse	Minor to Major Adverse	Minor to Major Adverse	Minor to Major Adverse
To safeguard cultural heritage features and their settings	Moderate Adverse	Moderate Adverse	Major Adverse	Moderate Adverse	Major Adverse
To contribute to an improvement in national and local air quality by reducing the level of transport related air pollution emissions	Minor Positive	Minor Positive	Minor Positive	Minor Positive	Minor Adverse
To contribute towards the reduction of national carbon output from transport	Minor Positive	Minor Positive	Minor Positive	Minor Positive	Minor Adverse
To protect surface water and groundwater bodies from the impacts of transport	Minor Adverse	Major Adverse	Minor Adverse	Minor Adverse	Minor Adverse
To reduce and manage flood risks from transport infrastructure	Minor Adverse	Minor Adverse	Minor Adverse	Minor Adverse	Minor Adverse
To safeguard the quality of` Scotland's geomorphological, geological and pedologic (soil) resources	Moderate Adverse	Moderate Adverse	Moderate Adverse	Moderate Adverse	Moderate Adverse
To contribute to improving health in Scotland by supporting modes of transport which contribute to a healthier lifestyle and by reducing noise and vibration	Major Adverse to Moderate Positive	Major Adverse to Moderate Positive	Major Adverse to Moderate Positive	Major Adverse to Moderate Positive	Major Adverse to Moderate Positive
To provide sustainable access to employment and essential services, and the countryside	Minor Adverse to Minor Positive	Minor Adverse to Minor Positive	Minor Positive	Minor Adverse	Moderate Adverse
To maximise the opportunity for community linkages and reduce severance effects of transport	Moderate Adverse	Moderate Adverse	Minor Adverse	Moderate Adverse	Negligible
To promote the sustainable use of natural resources – reduce, reuse, recycle and recover	Moderate Adverse	Moderate Adverse	Moderate Adverse	Moderate Adverse	Moderate Adverse

5.10 Wider and Cumulative Effects

In addition to the effects identified in Sections 5.4 to 5.8, there is the potential for further wider or cumulative effects associated with a new crossing.

The premise of FRCS has been that any new crossing is a direct replacement for the existing FRB. The assessment of effects set out in the previous sections assumed that the existing bridge closes to all traffic in 2019. The rationale for this assumption was based on the information available to Transport Scotland at the time of this assessment. A 'two-crossing scenario' is not being promoted by Transport Scotland. The wider strategic effects of the FRC should therefore be negligible as access is maintained at current levels.

A study is currently being carried out for Forth Estuary Transport Authority (FETA) to determine the feasibility of replacement or augmentation of the suspension cables of the FRB. The need for this study is as a consequence of the level of corrosion that was found in the cables. The preliminary report of the feasibility study, published in early June 2007, found that the replacement or augmentation of the cables presents significant engineering challenges but is achievable, however, a high degree of uncertainty regarding the future of the existing FRB remains. All of the following are possible:

- Permanent closure;
- Temporary closure;
- Long-term weight restrictions; and
- Total refurbishment with no weight restrictions.

Dismantling the bridge has also been considered, however, the cost of this is predicted to be extremely high.

Although it is not known at this time if two crossings will be operated in the future, it is important to be aware of the potential impacts should the FRB be refurbished. Two fully operational crossings could potentially double the existing road capacity. Increased access across the Forth could increase the future potential for economic development and commuting between Edinburgh and areas to the north of the Forth e.g. Fife, Perth and Kinross. An increase in road capacity may lead to an increase in vehicle use, thereby increasing emissions of CO_2, other pollutants and noise. Increased traffic would also put pressure on existing road infrastructure and may require upgrades of trunk road and local roads. This would in turn have potentially adverse effects on e.g. biodiversity, heritage and landscape.

In order to address these issues, a range of operational scenarios focused on traffic management measures, including for example High Occupancy Vehicle (HOV) and public transport priority lanes have been considered in Report 4 (Appraisal Report) of the FRCS. Of all operational options considered, two were recommended: OP1 and OP3. These are described below in Table 5.2.

Table 5.2 Two Crossing Scenario – Operational Considerations

Option	Operational Description
Option OP1	Replacement crossing: Two lanes for any vehicles Existing Crossing: One bus lane and one high occupancy vehicle lane
Option OP3	Replacement Crossing: One lane for any vehicles and one lane for bus and high occupancy vehicles Existing Crossing: One lane for any vehicles and one lane for bus and high occupancy vehicle

It is also noted that the FRC is one of a number of activities which my affect the Firth of Forth in the future. Cumulative effects may result from the combined effects of other developments (such as works at Rosyth Docks) and activities such as navigation and recreational boating. Of particular importance are the potential cumulative effects on Natura sites. As part of the Appropriate Assessment (see Section 2.3.1) the cumulative effects of other activities and developments will be considered. The results of the Appropriate Assessment will be reported separately in due course.

6 Mitigation

6.1 Mitigation Overview

For an SEA of this type the most effective form of strategic level mitigation is **avoidance**. In this respect, the FRC option selection process including generation and sifting as discussed in Section 4 and **Appendix D** is in itself an important form of mitigation. The purpose of this section of the Environmental Report is to set out the strategic or policy level mitigation that has been used for the purpose of option selection and that will be incorporated into the final FRC Strategy.

Mitigation has been defined for all SEA environmental categories where significant effects may result from a crossing. For each SEA category an *objective* has been established, and following from this objective a set of *principles* for environmental mitigation are set out. These objectives and principles will inform the planning, design, construction and operation of the FRC. Fundamentally, the mitigation proposals will underpin the approach to minimising the environmental effects of the FRC from adoption of the final Strategy through to opening of the FRC.

A standard hierarchical approach to defining mitigation has been used to address significant adverse effects that the FRC Strategy may have on the environment:

- **Avoid** – In the first instance, mitigation should seek to avoid the adverse effect at source for example, by locating development away from a sensitive receptor.
- **Reduce** – If the effect is unavoidable, mitigation should seek to reduce the significance of the impact.
- **Offset** – If the effect can neither be avoided nor reduced, mitigation should seek to offset the impact through the implementation of compensatory mitigation.

Mitigation, described below, has been taken into account when considering the effects of the options (Section 5.4 to 5.8), such that those effects that are described are residual effects. However, a cautious approach has been used and the residual effects are likely to represent a worst case. It is considered that the proposed mitigation measures set out in this report provide considerable scope for further avoiding, reducing and offsetting environmental effects.

It is worth noting at the outset that there is a statutory requirement for an EIA to be carried out for the FRC. Once the preferred option is taken forward through the EIA process project specific mitigation measures will be developed. In addition to project level mitigation it is practical to assume all elements of the planning, construction and operation of the FRC will adhere to relevant legislation and follow the most current good practice and guidance. Furthermore, as part of the EIA process a Code of Construction Practice (CoCP) will be produced. The provisions of the CoCP will be included in the Contract for the construction of the preferred option. The Contractor will be obliged to comply fully with the terms of the CoCP.

6.2 Biodiversity, Flora and Fauna

Mitigation Objective:

In the delivery of the preferred option, the final design and construction of the crossing and associated infrastructure will have the objective of maintaining the biodiversity of the affected study area by, as far as possible, avoiding adverse effects or, where practicable, compensating for significant adverse effects.

The key *principles* for mitigation of effects on biodiversity will include:

- Through careful siting and design, as far as practicable, avoid effects on protected sites and habitats or species of conservation importance.
- Construction methods relating to the preferred option will be designed to prevent or reduce impacts on biodiversity. Construction activities, where appropriate, will be timed such that they reduce disturbance on species during sensitive periods e.g. breeding season.
- The principle of a biodiversity balance will be implemented. The aim of this will be to offset the reduction in the value of high quality habitat (temporary and permanent) by providing for the creation of an equal or greater amount of habitat.
- Where possible, other measures to offset biodiversity effects will be implemented. Such measures may include planting species of local provenance and the creation or retention of wildlife corridors along (or across) road networks to maintain and encourage the movement of species.
- A detailed ecological impact assessment will be carried out as part of the EIA of the preferred option, which will influence the design and 'micro-siting' of the crossing and associated infrastructure. Specialist surveys will be required for any schemes with the potential to adversely affect species protected under legislations or priority Biodiversity Action Plan (BAP) species / habitats. Potential licensing requirements will be discussed and taken forward with SNH or SEERAD. Any developments likely to affect European Protected Species (EPS) will require specialist surveys to be carried out and for specific mitigation to be identified prior to consent being issued.

6.3 Landscape and Visual Amenity

Mitigation Objective:

In the delivery of the preferred option, the design and construction of the crossing and associated infrastructure will be completed to high design standards in order to ensure that adverse effects on landscape character and visual amenity are minimised.

The key *principles* for mitigation of landscape and visual impacts will include:

- During the design stage, the detailed consideration of the vertical and horizontal alignment of the new roads, junction arrangements, bridge infrastructure or tunnel portals.

- As far as possible, avoid, or reduce effects on, landscape features (such as specimen trees, hedges, water features), retain and make best use of existing vegetation; and achieve best fit with the contours.

- Where important and distinctive landscape features must be removed/modified or where landscape character will be altered, Landscape Management Plans will be produced highlighting how affected areas will be restored, reinstated or, if possible, enhanced.

- Any new planting should be carefully considered to integrate with the local landscape character whilst meeting the design objectives of the preferred option and making a positive contribution to the cultural heritage, biodiversity and nature conservation value of the area. It is anticipated that this would primarily require the use of native species of local provenance.

- Landscape planting, earthworks (mounding and earth shaping) and other mitigation measures, where appropriate, to minimise the visual impact of the scheme and enhance the existing local landscape character and structure.

- A detailed landscape & visual assessment will be carried out as part of the EIA of the preferred option, which will influence the 'micro-siting' of the crossing and associated road infrastructure.

6.4 Cultural Heritage

Mitigation Objective:

In the delivery of the preferred option, the design and construction of the crossing and associated infrastructure will, as far as is practicably possible, avoid impacting on sites of cultural heritage interest and, where appropriate, aim to preserve in situ or by record all cultural heritage resources disturbed.

The key *principles* for mitigation measures would include the following:

- 'Micro-siting' of the route away from identified archaeological features to avoid or minimise direct impacts.

- Detailed survey evaluation of those sites directly affected by the preferred option prior to construction work commencing.

- Where appropriate, targeted archaeological monitoring in the form of watching briefs during construction at archaeologically sensitive locations.

- A detailed cultural heritage assessment will be carried out as part of the EIA of the preferred option, which will influence the 'micro-siting' and detailed mitigation measures for the crossing and associated road infrastructure.

- Further mitigation measures, particularly those related to the setting of features, are included under Landscape and Visual Amenity.

6.5 Air Quality and Climactic Factors

Mitigation Objective:

In line with the National Transport Strategy, aim to reduce emissions to tackle climate change and improve air quality.

The key *principles* for mitigation of effects on air quality, both locally and globally, will include:

- Consideration will be given to reducing the carbon footprint of the scheme as part of its design and implementation.
- The final design of the preferred option (including complementary traffic management measures) will aim to reduce traffic congestion.
- Transport Scotland will investigate the feasibility of incorporating public transport/High Occupancy Vehicle (HOV) lanes into the operation of the replacement crossing. Modal shift will be encouraged by integrating the preferred option with other modes of transport (e.g. bus, train).

6.6 Water Environment

Mitigation Objective:

In the delivery of the preferred option, aim to prevent the deterioration of the "status[6]" of affected surface waters as described in the Water Framework Directive.

The key *principles* for the mitigation of impacts on the water environment will include the following:

- The overarching principle will be to ensure that the objectives of the Water Framework Directive (WFD) and the draft Scotland River Basin District Management Plan (to be published in 2008) and that the status of affected surface waters, as defined in the WFD, are not adversely affected.
- During the design of the road network linkages aim to minimise the number of surface water crossings required and, where appropriate, aim to limit the number of culverts required. Where unavoidable, crossings will be designed such that they do not affect the hydraulic capacity of a watercourse (allowing for climate change), minimise the effects on the morphology/geomorphology of all watercourses, reduce the risk of flooding and allow free passage of migratory fish and other species.
- Incorporate pollution control measures and in particular aim to include Sustainable Urban Drainage Systems (SUDS) into the design of temporary and permanent drainage systems and, where possible, integrate SUDS into the design of habitat mitigation proposals such that they become useful habitat features as well as water attenuation features.

[6] "Status" is a general term meaning the status achieved by a surface water body when both the ecological status and its chemical status are at least good or, for groundwater, and when both its quantitative status and chemical status are at least good.

6.7 Geology and Soils

Mitigation Objective:

In the delivery of the preferred option, effects on geology and soils (including agricultural land) will be minimised, by aiming to reduce the overall footprint of the preferred scheme (including land temporarily required for construction activities) and through good construction practice and reinstatement.

The key *principles* for the mitigation of impacts on geology and soils will include the following:

- Avoiding as far as possible sites designated for their geological interest.
- The loss of, or temporary use of, agricultural land will be minimised as far as practicable.
- Agricultural land temporarily affected by the preferred option will be restored to pre-construction conditions.
- Excavated material will be safely stored and, where appropriate, re-used in landscaping mitigation proposals.
- Avoid areas of potential contamination and where necessary implement specific measures to ensure that people and environment are not at risk from the mobilisation of contaminants.
- A detailed assessment will be carried out as part of the EIA of the preferred option, which will consider in detail the effects on geology and soils including agricultural land and contaminated land.

6.8 Human Health and Population

Mitigation Objective:

In the delivery of the preferred option, aim to prevent adverse effects on human health and where possible provide measures to improve health.

With respect to population, maintain or improve access for traffic, pedestrians, cyclists and others including users of the Firth of Forth.

The key *principles* for the mitigation of impacts on human health will include the following:

- The timing of construction activities will defined in order to minimise noise impacts.
- Where possible, the horizontal and vertical alignment of the preferred option will be designed such that they minimise the potential noise impacts on adjacent communities.
- Where potential noise impacts cannot be avoided by deviation of the road connections; mitigation measures including, use of low noise road surfacing, landscaping and construction of acoustic barriers will, where appropriate, form part of the final design.

- The establishment of a community liaison group(s), throughout the construction period, in order to maintain good community relations and ensure the local population are aware of progress as regards construction.

- Adopting construction methods which, as far as possible, maintain access for road users, cyclists, pedestrians etc and navigation on the Firth of Forth.

6.9 Material Assets

Mitigation Objective:

In the delivery of the preferred option, the design of final alignment of the crossing and associated infrastructure will aim to minimise effects on residences and businesses.

In the delivery of the preferred option, aim to minimise the use of raw materials and reuse, recycle and dispose of waste materials, as appropriate.

The key *principles* for the mitigation of impacts on material assets will include the following:

- The final design will aim to minimise landtake, as much as is practicably possible.

- Where landtake is unavoidable, 'micro-siting' of temporary and permanent infrastructure, will be undertaken in order to minimise adverse effects on private properties and businesses.

- The use of raw materials will be minimised, where appropriate through the use of recycled materials. In order to minimise waste generation, where appropriate, materials will be re-used throughout scheme.

7 Monitoring

7.1 Approach

This section of the Environmental Report presents proposals for monitoring the environmental effects of implementing the adopted FRC Strategy. Monitoring must be seen in the context of the Strategy which is being proposed; in this case a preferred crossing will be chosen by Scottish Ministers and that scheme will be subject to a consents process which will include a detailed EIA. This will be followed by detailed design and construction. Logically, monitoring must be linked to the implementation of the Strategy.

For the purpose of this SEA, monitoring will be based on the strategic mitigation set out in Section 6. The mitigation objectives and principles will act as a 'green thread' running throughout the implementation of the strategy. Periodic monitoring will examine whether the mitigation measures, if relevant to the crossing selected, have been:

- Incorporated into the initial design of the scheme and encompassed within the EIA for the purpose of gaining consent. The results of the EIA, as presented in the Environmental Statement, will be checked against the results of the SEA.
- Translated into contract documents and incorporated into detailed designs.
- Used to monitor performance during construction and, where necessary, following the opening of the crossing.

It is recognised that as the scheme develops some mitigation measures may not be applicable or indeed, other measures may be identified.

7.2 Monitoring Indicators

For the purpose of SEA, monitoring involves the use of 'indicators'. An indicator is a measure of how the environmental baseline has changed. Indicators can comprise both quantitative (facts and figures) and qualitative (descriptive) information. The proposed SEA monitoring indicators are set out in Table 7.1. Following consultation on the draft Strategy and this Environmental Report, a final and more detailed monitoring framework will be developed and presented in the SEA post-adoption Statement.

Table 7.1 Proposed Monitoring Indicators

SEA Issues	Proposed Indicators
Biodiversity, Flora and Fauna	Significance of effects on: • Natura Sites • RAMSAR Sites • Sites of Special Scientific Interest • Other designated habitats • European Protected Species
Landscape	Significance of effects on: • Gardens and Designed Landscapes (Inventory and non-Inventory) • Areas of Great Landscape Value • Areas of Outstanding Landscape Value • Visual amenity of local receptors
Cultural Heritage	Significance of effects on: • Scheduled Ancient Monuments • Listed Buildings • Conservation Areas • Gardens and Designed Landscapes (Inventory and non-Inventory) • Other designated sites • Marine archaeology • Known and unknown archaeology
Air and Climatic Factors	Significance of effects on: • Local air quality • Air Quality Management Areas GHG emissions will be calculated
Water	Significance of effects on: • Surface Waters • Groundwater • Flood Risk
Geology and Soils	Significance of effects on: • Geological designations (SSSIs and Regionally Important Geological Sites, RIGS) • Agricultural land • Potentially contaminated land, i.e. mobilisation of contaminated sediments
Human Health and Population	Significance of effects on: • Local people and receptors as a result of changes in noise levels, local air quality • Population as a result of changes in access
Material Assets	Significance of effects on: • Land use activities including private property, businesses, including agriculture • Amount of waste generated

8 Next Steps

Table 8.1 sets out approximate dates for key milestones in the development of a preferred option for the Forth Replacement Crossing (FRC) Strategy. Note that these dates are indicative only and are based on the information that was available at the time of writing. Dates are subject to change dependent on the preferred option selected by the Scottish Ministers.

Table 8.1 Next Steps

Milestone	Date
End of statutory consultation on Draft FRC Strategy and SEA Environmental Report	19/10/07
Strategic Appropriate Assessment prepared	October 2007
Adopt final FRC Strategy - announce preferred option	Autumn 2007
Publish Post-Adoption SEA Statement	Following adoption of Strategy
Commence work on initial design and Environmental Impact Assessment for purpose of gaining consent. Project level Appropriate Assessment required.	Work on the design and EIA is expected to continue throughout 2008. Transport Scotland aim to obtain consent by 2009/2010**.**
Commence construction	Construction is expected to commence in 2011.
Complete construction	Construction completion dates are dependent on the preferred option. Construction is expected to be completed between 2016 and 2018.

Appendix A - Summary of FRCS Reports

Report 1: Network Performance

The objective of this element of the Study was to:

- Propose a set of relevant and well-defined performance measures that shall be used to establish the current, and forecast future, base conditions on the transport network on and around the Forth road and rail bridges, for example, route reliability and average journey times;
- Identify the most reliable baseline study of the origins, destinations, purposes, and modes of journeys made on the transport network on and around the existing Forth road and rail bridges;
- With reference to the agreed performance measures, assess the current performance of the transport network on and around the Forth road and rail bridges; and
- With reference to the agreed performance measures, forecast the performance of the transport network on and around the Forth road and rail bridges, for 2012, 2017, and 2022.

It should be noted that this report includes forecasts for 2012, 2017 and 2022. These forecast years will be updated in a subsequent addendum, as forecasts for 2012, 2017 and 2022 from the Transport Model for Scotland were not available in time for inclusion.

Although it focuses primarily on the existing condition and operation of the Forth Road Bridge it also covers the immediate road network as well as the Rail Bridge and network.

Report 2: Gaps and Shortfalls

The objective of this report was to establish the high level expectations for transport network performance on and in the vicinity of, the Forth Road Bridge and Forth (rail) Bridge, over the ten year period from 2012 taking cognisance of the emerging Government policies and action plans. These high level expectations were used to determine strategic transport network objectives and consequently identify disparity between desired and forecast performance levels, such that potential interventions could be identified and prioritised.

Report 3: Option Generation and Sifting

The objective of this element of the Study was to generate robust options for a potential replacement Forth Crossing. This was done by utilising the outputs from the first two reports generated by this study together with other information taken from previous studies.

Report 4: Appraisal Report

The objective of this report was to present the appraisal of the proposals against the established project-specific objectives, implementability criteria, and the Government's transport criteria covering environment, safety, the economy, integration, and social inclusion and accessibility, in line with Scottish Transport Appraisal Guidance (STAG).

Report 5: Final Report

This Report was the final element of the Forth Replacement Crossing Study (FRCS) and summarises the findings of all the work undertaken during the course of the study.

Appendix B - Relevant Policies, Plans and Strategies

Table B.1 Relevant Policies, Plans and Strategies

Name of Programme / Plan / Strategy	Relevant Objective of Programme / Plan / Strategy	Relationship with Forth Replacement Crossing
International		
Kyoto Protocol to the UN Framework Convention on Climate Change 1992	The objective of the Kyoto Protocol is to stabilise and reduce greenhouse gas (GHG) emissions, mitigate climate change, and promote sustainable development worldwide.	Transport is a significant contributor of CO_2 emissions and the FRC will influence traffic levels and congestion on one the busiest routes in Scotland.
Convention of Biological Diversity (Rio de Janeiro, 1992)	▪ Global, comprehensive agreement addressing all aspects of biological diversity and including conservation of biological diversity, sustainable use and fair and equitable sharing of benefits arising from genetic resources. ▪ The objective is to develop national strategies for the conservation and sustainable use of biological diversity (i.e. BAPs). All parties are required to develop new or adapt existing national strategies, plans or programmes for the conservation, integration and sustainable use of biological diversity (Article 6) and include the identification and monitoring of biological diversity components. Processes and categories of activities that are likely to have significant adverse impacts on the conservation and sustainable use of biological diversity are required to be identified and monitored (Article 7).	The FRC has the potential to adversely affect biodiversity. An Appropriate Assessment of the potential effects on the Special Protection Areas within the Forth and mitigation is set out in the associated report.
The Johannesburg Declaration on Sustainable Development (2002)	Include commitments to avoid environmental degradation and to protect the environment and biodiversity.	Through the protection of the environment and biodiversity the FRC should seek to contribute to sustainability.
European		
European Commission Transport White Paper - European Transport Policy for 2010: Time to Decide (2001)	Series of principles presented, including: ▪ Revitalise the railways; ▪ Improve quality in the road transport sector; ▪ Balance growth in air transport and the environment; ▪ Turn intermodality into reality; ▪ Improve road safety; ▪ Policy on effective road charging; ▪ Develop high quality urban transport; and ▪ Develop medium and long-term environmental objectives for a sustainable transport system.	The FRC seeks to 'improve quality in the road transport sector'.
EU Urban Transport Green Paper: Clean Urban Transport (anticipated for adoption of Autumn 2007)	The aim of the Green Paper will be to examine whether there are any barriers to urban transport policy at EU level and to assess whether there is support for developing and implementing joint solutions to urban transport issues.	The FRC has the potential to influence traffic flows in and out of urban areas, in particular Edinburgh.
European Climate Change Programme (2001 - 2003)	The primary aim is to identify and develop within the ECCP the main elements of an EU strategy to implement the greenhouse gas emission reduction target set by the Kyoto Protocol.	Transport is a significant contributor of CO2 emissions and the FRC will influence traffic levels and congestion on one the busiest routes in Scotland.
Habitats Directive (92/43/EEC)	▪ Preservation, protection and improvement of the quality of the environment, including the conservation of natural habitats and of wild fauna and flora. ▪ Maintain and restore natural habitats and of wild fauna and flora, working towards ensuring bio diversity and taking account of economic social and cultural requirements and regional and local characteristics.	The FRC must comply with the Habitats Directive. The Directive requires an Appropriate Assessment to be carried out where proposals have the potential for adverse effects on the integrity of Natura 2000 sites – Special Protection Areas (SPA) and Special Areas of Conservation (SAC). An Appropriate Assessment is being carried out for the FRC due to the potential for effects on the two SPAs in the Firth of Forth.
Wild Birds Directive (79/409/EEC)	▪ Protect birds naturally occurring in the European territory, applies to birds, eggs, nests and habitats. ▪ Preserve, maintain or re-establish a sufficient diversity and area of habitats. Maintain populations of species taking into account ecological, scientific, economic and cultural requirements. ▪ Pay particular attention to wetlands especially those of international importance.	SPAs are designated under this Directive and there are two located in the Firth of Forth. As described above, an Appropriate Assessment is being carried out due to the potential for adverse effects on the integrity of these sites.
Water Framework Directive (2000/60/EC)	▪ To establish a frame work for the protection of inland surface waters, transitional waters, coastal waters and groundwater. ▪ To enhance protection and improvement of the aquatic environment and promote sustainable water use.	The FRC has the potential for adverse effects on water quality. The SEA assesses effects in relation to the objectives of the Water Framework Directive i.e. if the ability to achieve the objectives.
Environmental Noise Directive (2002/49/EC)	▪ Monitoring the environmental problem; by requiring competent authorities in Member States to draw up "strategic noise maps" for major roads, railways, airports and agglomerations, using harmonised noise indicators. ▪ Informing and consulting the public about noise exposure, its effects, and the measures considered to address noise, in line with the principles of the Aarhus Convention ▪ Addressing local noise issues by requiring competent authorities to draw up action plans to reduce noise where necessary and maintain environmental noise quality where it is good. The directive does not set any limit value, nor does it prescribe the measures to be used in the action plans, which remain at the discretion of the competent authorities. ▪ Developing a long-term EU strategy, which includes objectives to reduce the number of people affected by noise in the longer term, and provides a framework for developing existing Community policy on noise reduction from source.	Construction and operation of a new crossing would generate noise pollution in areas which are currently not affected. Noise would decrease in some areas currently affected by the existing Forth Road Bridge.
Air Quality Directive (1996/62/EC)	▪ To protect the environment as a whole and human health. ▪ To maintain ambient air quality where it is good and to improve it in other cases using limit values and/or alert threshold set for ambient air pollution levels. ▪ Preserve best ambient air quality compatible with sustainable development.	A new crossing would affect levels of air pollutants in the area of a new crossing, and in the vicinity of the existing Forth Road Bridge. There is also the potential for the FRC to influence levels of pollutants in the Air Quality Management Areas in Edinburgh.

Biofuels Directive (2003/30/EC)	▪ Calls for the dependence on oil in the transport sector to be reduced by using alternative fuels such as biofuels. ▪ Member States should ensure that a minimum proportion of biofuels and other renewable fuels is placed on their markets, and, to that effect, shall set national indicative targets. A reference value for these targets shall be 5,75 %, calculated on the basis of energy content, of all petrol and diesel for transport purposes placed on their markets by 31 December 2010.	Although the FRC and this Directive are both related to transport and climate change issues, there is no direct relationship between the two.
National		
Wildlife and Countryside Act 1981	▪ Protection of wildlife (birds, animals and plants), countryside, national parks, public rights of way and the designation of protected areas such as sites of special scientific interest or limestone pavement orders.	The FRC has the potential to adversely affect biodiversity. An Appropriate Assessment of the potential effects on the SPAs within the Forth and mitigation is set out in the associated report.
The Conservation (Natural Habitats & c) Regulations 1994	▪ Measures relating to the conservation of natural habitats and of wild fauna and flora. ▪ Provides for the designation and protection of 'European Sites'. (SCIs, SACs, SPAs and RAMSAR sites) ▪ Protection of European protected species (e.g. bats, otters, great crested newts)	
Nature Conservation (Scotland) Act 2004	▪ Conservation of biodiversity ▪ Increases protection for Sites of Special Scientific Interest (SSSI) ▪ Amends legislation on Nature Conservation Orders ▪ Provides for Land Management Orders for SSSIs and associated land ▪ Strengthens wildlife enforcement legislation	
Ancient Monuments and Archaeological Areas Act 1979	▪ To consolidate law relating to ancient monuments and to provide for the inspection and recording of matters of archaeological interest and to regulate such activities. ▪ Provides for nationally important archaeological sites to be statutorily protected as Scheduled Ancient Monuments. ▪ Requires authorisation in the form of Scheduled Monument Consent, for the undertaking of certain works.	The FRC has the potential for adverse effects on the historic environment, for example by physically affecting historic features or by affecting the setting of such features. Historic features include Scheduled Ancient Monuments (SAM), Listed Buildings, Archaeology (known and unknown) and Conservation Areas. When a preferred option is chosen, it may be necessary to apply for consent to carry out works which affect SAMs or Listed Buildings.
Planning (Listed Buildings and Conservation Areas) (Scotland) Act 1997	▪ Listing of buildings of special architectural or historic interest ▪ 'Building preservation notice' Temporary listing ▪ Restriction on work affecting listed buildings ▪ Authorisation of works listed building consent ▪ Applications for listed building consent ▪ Power to impose conditions on grant of listed building consent ▪ Revocation and modification of listed building consent ▪ Rights of owners compensation ▪ Prevention of deterioration and damage ▪ Conservation Areas designation ▪ Preservation and enhancement of conservation areas	
Creating Our Future… Minding Our Past. Scotland's National Cultural Strategy, Scottish Executive, 1999	▪ Promote creativity, the arts, and other cultural activity; ▪ Celebrate Scotland's cultural heritage in its full diversity; ▪ Realise culture's potential contribution to education, promoting inclusion and enhancing people's quality of life; and ▪ Assure an effective national support framework for culture.	
Scotland's Historic Environment Policy (SHEP 1): Scotland's Historic Environment, March 2006	Overarching aim is the protection of the historic environment and realisation of its potential as a resource.	
Scotland's Historic Environment Policy (SHEP 2): Scheduling: protecting Scotland's nationally important monuments, 2006	Sets out policy for the identification and designation of nationally important ancient monuments.	
Air Quality Strategy for England, Scotland, Wales and Northern Ireland (2000)	▪ Plans to improve and protect ambient air quality in the UK, to protect people's health and the environment without unacceptable economic or social costs. ▪ Details of national air quality standards and objectives for nine pollutants.	A new crossing would affect levels of air pollutants in the area of a new crossing, and in the vicinity of the existing Forth Road Bridge. There is also the potential for the FRC to influence levels of pollutants in the Air Quality Management Areas in Edinburgh.
The Air Quality Limit Values (Scotland) Regulations 2003	▪ Transpose into national legislation the requirements of Directive 2002/3/EC ▪ Duty to ensure compliance with limit values of relevant pollutants in ambient air ▪ Sets target values and long term objectives for levels of ozone in ambient air ▪ Assess ambient air quality ▪ Production of action plans where there is a risk of exceeding limit values for any of the relevant pollutants	
Water Environment and Water Services (Scotland) Act 2003	Implements the Water Framework Directive in Scotland and requires: ▪ Protection of water environment ▪ Production of river basin management plans	The FRC has the potential for adverse effects on water quality. The SEA assesses effects in relation to the objectives of the Water Framework Directive i.e. if the ability to achieve the objectives.
The Pollution Prevention and Control (Scotland) Regulations 2000	Aims to control pollution from industrial sources. It requires the prevention or reduction of emissions from installations and promotes techniques that reduce the amount of waste and releases overall.	Legislation applies to measures which will be employed to mitigate impacts during construction.
Road Traffic Reduction Act 1997	▪ Requires local Authorities to create "an assessment of the levels of local road traffic in their area, and a forecast of the growth of these levels"; and ▪ To specify targets for "a reduction in the levels of local road traffic in the area or a reduction in the rate of growth on the level of such traffic".	The FRC is unlikely to contribute to a reduction in traffic levels, although there is the opportunity to take forward complementary measures such as park and ride.

National Planning Framework 2004	▪ Offers perspective on Scotland's long term spatial development and highlights the important role transport plays in this development. ▪ As part of taking the Framework forward there will be investment in transport infrastructure and recognises the need to 'effect a shift to more sustainable modes of transport'	The FRC supports the existing pattern of development in the east of central Scotland.
Environmental Assessment (Scotland) Act 2005	Extends Scottish legislation for SEA beyond the requirements of the 'SEA Directive'.	Requires this SEA to be undertaken.
Environmental Impact Assessment (Scotland) Regulations 1999	Sets out the requirements for some projects to be subject to Environmental Impact Assessment (EIA).	The regulations require that an EIA of the preferred crossing option is carried out.
Transport (Scotland) Act 2005	▪ Requires the development of Regional Transport Partnerships, Regional and National Transport Strategies	The National Transport Strategy has been published and Regional Transport Strategies (RTS) are due to be adopted imminently. RTSs support the development of a replacement crossing.
UK Climate Change Programme (2006)	To deliver the UK's commitment of a 12.5% reduction in greenhouse gas emissions from 1990 levels by 2008 - 2012. The programme sets out a strategic, far reaching package of policies and measures across all sectors of the economy to achieve the targets set. These are also designed to move the UK towards its domestic target of 20% reduction in 1990 levels of CO2 emissions by 2010.	Transport is a significant contributor of CO2 emissions and the FRC will influence traffic levels and congestion on one the busiest routes in Scotland.
Our Energy Future – Creating a Low Carbon Economy 2003	To cut the UK's carbon dioxide emissions - the main contributor to global warming - by some 60% by about 2050, as recommended by the RCEP, with real progress by 2020.	
Scottish Climate Change Programme (2006)	▪ Establish an analysts' network to assess and present the carbon impact of policies in a consistent and routine manner, and Consider how climate factors are being addressed at policy, plan and programme level as part of the SEA process and contribute to strengthening guidance if necessary.	
UK Biodiversity Action Plan (1994)	Includes action plans for the conservation of 391 species, 45 habitats and local biodiversity action plan targets.	The FRC has the potential to adversely affect biodiversity.
Scotland's Biodiversity: It's in Your Hands - A strategy for the conservation and enhancement of biodiversity in Scotland	Outlines a number of actions with the overall aim of conserving biodiversity for the health, enjoyment and well being of the people of Scotland now and in the future	
Scotland's Transport Future – Transport White Paper 2004	▪ Promote economic growth by building, enhancing, managing and maintaining transport services, infrastructure and networks to maximise their efficiency. ▪ Promote social inclusion by connecting remote and disadvantaged communities and increasing the accessibility of the transport network. ▪ Protect out environment and improve health by building and investing in public transport and other types of sustainable transport which minimise emissions and consumption or resources and energy. ▪ Reduce accidents and enhance personal safety of pedestrians, drivers, passengers and staff. ▪ Improve integration and ensure smooth connections between different forms of transport.	The options under consideration for the FRC have been assessed against objectives which are based on these national transport objectives
Choosing our Future: Scotland's Sustainable Development Strategy	▪ Sets out Scotland's framework for sustainable development for a number of SE's emerging and new strategies on climate change, transport, renewable energy, energy efficiency, green jobs and biodiversity. Notes the need for urgent action in response to growing problems and pressures.	Through the protection of the environment the FRC should seek to contribute to sustainability.
National Transport Strategy	The Strategy is based on the Scottish Executive's 5 transport objectives: ▪ To promote economic growth by building, enhancing, managing and maintaining transport services, infrastructure and networks to maximise their efficiency ▪ To protect our environment and improve health by building and investing in public transport and other types of efficient and sustainable transport which minimise emissions and consumption of resources and energy ▪ To promote social inclusion by connecting remote and disadvantaged communities and increasing the accessibility of the transport network ▪ To improve safety of journeys by reducing accidents and enhancing the personal safety of pedestrians, drivers, passengers and staff ▪ To improve integration by making journey planning and ticketing easier and working to ensure smooth connection between different forms of transport. The aims of the NTS are: ▪ Cover all modes ▪ Cover all travellers ▪ Be medium to long-term in nature ▪ Provide the context for the Strategic Projects Review ▪ Be based on wide-ranging public consultation - which is underway	The options under consideration have been appraised against the 5 national transport objectives.
National Waste Strategy	The aim is to encourage more effective use of natural resources through greater efficiency, waste minimisation, recycling and increased value recovery from waste. The main objectives include; ▪ Ensuring that waste is recovered or disposed of without endangering human health and without using processes or methods which could harm the environment and, in particular, without causing nuisance through noise or odours. ▪ Establishing an integrated and adequate network of waste disposal installations, taking account of the best available technology not involving excessive costs. ▪ Encouraging the prevention or reduction of waste production and its harmfulness, in particular by the development of clean technologies more sparing in their use of natural resources.	All options for fixed links have the potential to generate significant quantities of waste materials, particularly options for bored tunnels. In line with the strategy, waste should be kept to a practical minimum and reused or recycled wherever possible. Where not possible, materials should be disposed of without endangering human health. Due to the quantities of raw materials likely to be produced, environmental effects are likely from disposal.

National Cycling Strategy (Department for Transport) (1996)	▪ Increase cycle use. ▪ Achieve convenient cycle access to key and major destinations and provide cycle parking facilities at these destinations. ▪ Improve cycle safety and reduce cycle theft by improving security and recovery. ▪ Provide increased cycle use within all local highways and traffic management schemes. ▪ Design safe and convenient cycle use of the road network. ▪ Reallocate road spacing to cycling. ▪ Raise awareness, expertise and status amongst transport providers, service providers, employers, potential cyclists and other road users. ▪ Encourage and enable cycling amongst school children, and encourage cycle use for business trips. ▪ Unlock financial resources to meet the strategy objectives. ▪ To make the best use of existing infrastructure and resources and to integrate cycling into other programmes. ▪ Progress the national cycling strategy and monitor the results of the strategy.	The option for a replacement bridge would have access for cyclists and pedestrians.
Memorandum of Guidance on Listed Buildings and Conservation Areas 1998	Provides information on procedures for activities which may affect listed buildings, conservation areas and gardens and designed landscapes.	The FRC has the potential for adverse effects on the historic environment, for example by physically affecting historic features or by affecting the setting of such features. Historic features include Scheduled Ancient Monuments (SAM), Listed Buildings, Archaeology (known and unknown) and Conservation Areas. When a preferred option is chosen, it may be necessary to apply for consent to carry out works which affect SAMs or Listed Buildings.
Passed to the Future (Historic Scotland's policy for the sustainable management of the historic environment)	▪ Recognising Value. ▪ All actions should include long-term strategies for management, conservation, use, maintenance and monitoring, and good stewardship of the historic environment should have regard to its capacity for change as well as to the sustainable use of resources. Assessing impact on the historic environment. ▪ Sustainable management should involve everyone.	
Securing the Future (2005) UK Government Sustainable Development Strategy	The new objectives included within the strategy are: ▪ Living within environmental limits; ▪ Ensuring a strong, healthy and just society; ▪ Achieving a sustainable economy; ▪ Promoting good governance; and ▪ Using sound science responsibly.	Through the protection of the environment the FRC should seek to contribute to sustainability.
Towards a Transport Strategy for Scotland (2006) - rail consultation paper	Seeks to gather views from stakeholders on what the strategic priorities for Scotland's Rail should be. It specifically seeks views on: ▪ How rail can contribute to the economy and society of Scotland; ▪ Encouraging modal shift; and ▪ Priorities on assignment of scarce capacity.	The FRC has the potential to influence rail usage by encouraging/discouraging car use.
Choosing our Future (2005) Scotland's Sustainable Development Strategy	▪ Respecting the limits of the planet's environment, resources and biodiversity – to improve our environment and ensure that the natural resources needed for life are unimpaired and remain so for future generations. ▪ Meeting the diverse needs of all people in existing and future communities, promoting personal well-being, social cohesion and inclusion, and creating equal opportunity for all. ▪ Building a strong, stable and sustainable economy which provides prosperity and opportunities for all, and in which environmental and social costs fall on those who impose them (Polluter Pays) and efficient resource use is incentivised. ▪ Promoting good governance ▪ Using sound science responsibly.	The FRC should seek to contribute to sustainability through the protection of the natural environment and by meeting the needs of people in existing and future communities.
Scottish Energy Efficiency Strategy (forthcoming)	Sets out how measures to be more energy efficient in all sectors can make a measurable difference to greenhouse gas emissions.	Both transport and energy are significant sources of greenhouse gas emissions. Beyond this there are no direct links of relevance to this SEA.
Securing a Renewable Future: Scotland's Renewable Energy (2003)	Outlines renewable energy commitments as part of Scotland's efforts to tackle climate change.	
Lets Make Scotland More Active (2003)	▪ Aims to ensure that the Scottish population becomes more active, setting the target of all adults accumulating at least 30 minutes of moderate activity on most days of the week, and an hour for children. ▪ By achieving improved rates of activity, levels of chronic heart disease, high blood pressure, diabetes, obesity, colon cancer could be substantially reduced.	The option for a new bridge across the Forth would have the potential for pedestrian and cyclist access whereas a tunnel would not.
The Planning etc (Scotland) Act 2006 (formerly Modernising the Planning System -Planning White Paper)	▪ Sets out arrangements for the preparation and publication of the National Planning Framework, a spatial plan for Scotland. ▪ It sets out provisions for the preparation, examination and publication of strategic development plans and local development plans, which will replace the existing structure plans and local plans. It also defines a new duty on planning authorities to exercise their development planning functions with the objective of contributing to sustainable development.	The FRC will have to follow the procedures set out in this Act and the National Planning Framework as the development is progressed.
Scotland's Transport, Delivering Improvements, Scottish Executive, March 2002	Sets out the Executive's transport vision for Scotland including ▪ A number of transport improvements across Scotland and across all modes of transport ▪ Outlines the Executive's vision for the future focusing on the key transport challenges tackling congestion, ensuring greater integration and completing the vital missing links.	The FRC could influence traffic congestion in and around the Firth of Forth. The FRC could also be integrated with complementary measures such as HOV/public transport lanes and park and rides etc.

SEPA Groundwater Protection Policy	Provide a sustainable future for Scotland's groundwater resources by protecting legitimate uses of groundwater and providing a common SEPA framework to: ▪ 'Protect groundwater quality by minimising the risks posed by point and diffuse sources of pollution' and; ▪ 'Maintain the groundwater resource by influencing the design of abstractions and developments, which could affect groundwater quantity'	Construction works for a new crossing would have the potential for adverse effects on groundwater quality. Mitigation measures include a commitment to applying good practice which is highlighted in this policy (see Section 6).
SEPA Policy on the Culverting of Watercourses	Policy to minimise the impacts of culverting on the environment through for example encouraging bridging rather than culverting where it is necessary for transport links to cross watercourses.	There is the potential for watercourses to be culverted in the construction of infrastructure associated with a new crossing. Culverting issues are referred to in the mitigation section of this report and this SEPA policy should be considered in the design of the preferred option.
Scottish Transport Appraisal Guidance (STAG) 2000	Appraisal framework to aid transport planners and decision-makers in the development of transport policies, plans, programmes and projects in Scotland. Five criteria form the basis of STAG assessments: ▪ Environment, ▪ Safety, ▪ Economy, ▪ Integration; and ▪ Accessibility	STAG Parts 1 and 2 were used to appraise options for a replacement Forth crossing.
Scottish Natural Heritage Policy Summary: Environmental Justice and the Natural Heritage, August 2004	Sets out SNH's vision for environmental justice including access to local greenspace, involvement in environmental decisions and access to environmental information.	The construction of a new Forth crossing has the potential to result in environmental injustice for some residents in the vicinity. New major infrastructure close to residential could adversely affect the quality of life of residents, caused by for example increased noise from construction and major increases in traffic volumes. However, without a replacement crossing, access from Edinburgh and other areas south of the Forth to Fife and the surrounding area would be severely limited, with transport options being limited to train crossing and buses and cars having to travel via the Kincardine Bridge.
Regional and Local		
Tayside and Central Scotland Regional Transport Partnership, Regional Transport Strategy, Finalised Strategy March 2007	The objectives set out are: ▪ to ensure transport helps to deliver regional prosperity; ▪ to improve accessibility for all, particularly for those suffering from social exclusion; ▪ to ensure that the transport system contributes to safeguarding the environment and promotes opportunities for improvement; ▪ to promote the health and well-being of communities; ▪ to improve the real and perceived safety and security of the transport network; and ▪ to improve integration, both within transport and between transport and other policy areas.	The FRC has long-term implications for transport on both sides of the Forth which are covered by these two Regional Transport Strategies. Any changes in road capacity across the Forth will affect traffic levels on either side of the Firth of Forth. It will also affect the potential for residential, commercial and industrial development in these areas, which will in turn have an additional effect on the requirement for transport in these areas.
South-East of Scotland Transport Partnership, Regional Transport Strategy, Finalised Strategy, March 2007	The objectives set out are: ▪ to ensure transport facilities encourage economic growth, regional prosperity and vitality in a sustainable manner ▪ to improve accessibility for those with limited transport choice or no access to a car, particularly those who live in rural areas ▪ to ensure that development is achieved in an environmentally sustainable manner ▪ to promote a healthier and more active SEStrans area population	
Edinburgh and Lothian Structure Plan	The objectives set out are to: ▪ ensure that the location and design of new development, especially major new development, reduces the need to travel by car and encourages the use of public transport, walking and cycling; ▪ maximise accessibility for all in the community by foot, cycle and public transport; ▪ manage car use through parking policies, particularly by applying development control maximum parking standards, in conjunction with public transport improvements; ▪ encourage the movement of freight by rail and sea or, where road freight is dominant, along the strategic road network; ▪ support transport strategies by safeguarding land for improvements to transport networks and prioritising the provision of new transport infrastructure required to support the development strategy; ▪ ensure that development caters for its transport needs	Any changes in road capacity across the Forth will affect traffic levels on either side of the Firth of Forth. It will also affect the potential for residential, commercial and industrial development in these areas. Increased development opportunities can result in greater pressures land use.
Fife Structure Plan 2006	The plan aims to: ▪ Guide new development, where possible, to locations that reduce the need to travel by private car. ▪ Encourage the use of more sustainable modes of transport. ▪ Improve accessibility and transport choice for all sectors of the community. ▪ Encourage the movement of freight by rail and water. ▪ Safeguard land for potential improvements to the transport network.	
Perth and Kinross Structure Plan	The plan aims to: ▪ enhance the economic performance of Perth & Kinross ▪ offer travel choices to all while reducing the dependence on the car ▪ reduce social exclusion by promoting accessibility ▪ maintain and enhance the high quality environment of Perth & Kinross.	

The Central Edinburgh Local Plan (adopted 29 May 1997, reviewed in 2000)	The strategy aims to: ▪ minimise car use and dependency ▪ reduce the amount of car traffic in the city centre; and ▪ develop the public transport system as the main means of enhancing the city centre's accessibility.	
The South East Edinburgh Local Plan (adopted 18 August 2005)	The objectives set out are: ▪ To ensure that development takes place in locations which encourage the use of public transport, walking and cycling in preference to the car ▪ To minimise the incentive to use the car, in particular in areas where the adverse impacts are most severe ▪ To minimise the detrimental effects of traffic and parking on communities and the environment ▪ To ensure that development takes account of user and community safety, having regard in particular to vulnerable groups such as children and cyclists ▪ To facilitate the improvement of the transport system in ways which provide accessibility for all	
The North East Edinburgh Local Plan (adopted 30 April 1998 and incorporating an alteration on 22 January 2004)	The plan aims to: ▪ Reduce the adverse impact of traffic and parking on the environment ▪ Promote convenient and efficient public transport services and facilities ▪ Encourage improvements to the road network only where they bring environmental and safety benefits and support the development strategy ▪ Improve environmental conditions and safety for pedestrians and cyclists and support a greater reliance on walking and cycling as alternatives to car use. ▪ Identify opportunities for private sector involvement in transport infrastructure provision ▪ Achieve energy saving and environmental benefits by encouraging the switch of freight from road to rail.	
Draft West Edinburgh Local Plan (supersedes North West Edinburgh Local Plan (adopted 23 January 1992) and South West Edinburgh Local Plan (adopted 11 March 1993))	The plan aims to: ▪ To protect and enhance the Green Belt and establish long term defensible boundaries that meet Green Belt objectives. ▪ To protect and enhance the landscape, natural habitats, biodiversity and open spaces of West Edinburgh. ▪ To encourage the expansion of recreational opportunities, including the continued expansion of footpaths and cycleways throughout the Local Plan area. ▪ To ensure that development takes place in locations which encourage the use of public transport, walking and cycling in preference to the private car. ▪ To minimise the incentive to use the car, particularly in areas where the direct adverse impacts of this are most severe. ▪ To minimise the detrimental effects of traffic and parking on communities and the environment. ▪ To ensure that development takes account of user and community safety, having regard in particular to vulnerable groups such as children and cyclists. ▪ To facilitate the improvement of the transport system in ways which provide accessibility for all.	
The Rural West Edinburgh Local Plan (adopted 1 June 2006)	The objectives set out in the plan are: ▪ to reduce reliance and use of the private car and maximise accessibility for all, through careful location and design of new development and the provision of dedicated infrastructure to encourage walking, cycling and public transport use; ▪ to improve road safety and enhance the quality of the environment, particularly for pedestrians and cyclists through the introduction of appropriate traffic management measures and provision of dedicated infrastructure; ▪ to improve public transport linkages between the city and the major traffic generators in Rural West Edinburgh; ▪ to encourage the movement of freight by, rail wherever possible; ▪ to safeguard land for new transport infrastructure, where this can be fully justified in strategic terms, while ensuring that adverse environmental impacts will be minimised.	
West Lothian Local Plan 2005	The plan aims to: ▪ contribute to meeting national and local road traffic reduction and environmental targets; ▪ maximise accessibility for all and minimise the need for travel, especially by car; ▪ ensure adequate means of access, especially by public transport, to existing and proposed strategic employment locations, major public attractions and key development sites; ▪ enhance the convenience and attractiveness of non-private car travel, whether by public transport, cycling or on foot; ▪ improve road and pedestrian safety; ▪ reduce the adverse effects of traffic in residential areas, in town and village main streets, and in the countryside; and ▪ sustain the viability of commercial centres.	

Appendix C - Environmental Baseline

ECOLOGY AND NATURE CONSERVATION

The Firth of Forth supports habitats and species which are designated at a national and international level in recognition of their contribution to the UK and European biodiversity resource. The highest level of protection is afforded to the Natura 2000 sites, which are legislated by the Conservation (Natural Habitats &c.) Regulations 1994, and comprise Special Protected Areas (SPAs), Special Areas for Conservation (SACs) and Ramsar sites. The latter are designated under the RAMSAR Convention as opposed to the Habitats Directive, under which SACs and SPAs are designated. RAMSAR[7] sites have been adopted as part of the Natura 2000 network by the UK government. The Firth of Forth supports sites belonging to all these types of Natura 2000 sites.

At a national level, areas are protected by being designated as Sites of Special Scientific Interest (SSSIs) under the Wildlife and Countryside Act (1981) as amended by the Nature Conservation (Scotland) Act 2004. Other areas are protected by the local planning system, such as Local Nature Reserves, Ancient Woodland, and areas of local nature conservation importance. The Firth of Forth also has several nature reserves owned/managed by non governmental organisations. The ecological designations discussed in this section are illustrated in Figure C.1.

In addition to the site designations described there are species of international and national importance. Of international importance are the European Protected Species (EPS) legislated for by the Conservation (Natural Habitats &c.) regulations 1994. At a national level, there are species protected under the Wildlife and Countryside Act 1981 (as amended).

INTERNATIONAL PROTECTION OF SITES

There are three Natura 2000 sites that are situated in the Firth of Forth, or have connectivity with the Firth of Forth:

Firth of Forth SPA

This 6,313 hectare estuarine SPA supports intertidal mud flats, rocky outcrops, sand and shingle flats, saltmarsh and sand dunes. This SPA is also designated as a RAMSAR site. The site supports 27 species of Annex I birds in winter and qualifies under Article 4.1 (for Annex 1 species requiring special measures) and Article 4.2 (for regularly occurring migratory species) of the Birds Directive (79/409/EEC) as shown in Table C.1:

Table C.1 Firth of Forth SPA – Annex 1 Species

Qualifying Features under Article 4.1	Percentage (%) of UK population
Gavia stellata (Red throated diver)	2
Limosa lapponica (Bar tailed godwit)	4
Pluvialis apricaria (Golden plover)	1
Sternus sandvicensis (Sandwich Tern)	6
Qualifying Features under Article 4.2	**Percentage of UK population**

[7] Ramsar sites are designated under the Convention of Wetlands of International Importance. The Convention was adopted in Ramsar, Iran, in 1971 and ratified by the UK Government in 1976.

Qualifying Features under Article 4.1	Percentage (%) of UK population
Anser brachyrynchus (Pink footed goose)	6
Arenaria interpres (Turnstone)	1
Caladris canutus (Knot)	3
Tadorna tadorna (Shelduck)	2
Tringa toteanus (Redshank)	3

The area also qualifies under Article 4.2 of the Directive by regularly supporting 95,000 (at least 20,000 to qualify) seabirds in the breeding season.

Forth Islands SPA

This SPA comprises islands in the inner Firth (Long Craig, Inchmickery, Fidra, Lamb, Craigleith, Cow and Calves) and the outer Firth (Bass Rock, Isle of May). The inner isles are relatively low lying while the outer isles are considerably higher and rocky. Some of these islands are famous for their seabird colonies, particularly the breeding gannet colony at Bass Rock and the seabirds of the Isle of May. The species supported are shown in Table C.2.

Table C.2 Forth Islands SPA Qualifying Features

Qualifying Features under Article 4.1	Percentage (%) of UK population
Sterna paradisaea (Arctic Tern)	1.2
Sterna hirundo (Common Tern)	6.5
Sterna dougallii (Roseate Tern)	15.0
Sterna sandvicensis (Sandwich Tern)	0.2
During the breeding season	**Percentage of UK population**
Morus bassanus Gannet	13.1
Larus fuscus (Lesser Black-backed Gull)	2.4
Fratercula arctica (Puffin)	2.3
Phalacrocorax aristotelis (Shag)	2.3

This site also qualifies under Article 4.2 of the Birds Directive by supporting populations of European importance of the following migratory species:

During the breeding season:

- Gannet *Morus bassanus*, 34,400 pairs representing at least 13.1 per cent of the breeding North Atlantic population (Count, as at 1994);
- Lesser Black-backed Gull *Larus fuscus*, 2,920 pairs representing at least 2.4 per cent of the breeding Western Europe/Mediterranean/Western Africa population (Count, as at 1994);
- Puffin *Fratercula arctica*, 21,000 pairs representing at least 2.3 per cent of the breeding population (Count, as at 1992); and

- Shag *Phalacrocorax aristotelis*, 2,887 pairs representing at least 2.3 per cent of the breeding Northern Europe population (Count as at 1987).

The area also qualifies under Article 4.2 of the Birds Directive by regularly supporting 90,000 (at least 20,000 to qualify) seabirds in the breeding season.

River Teith SAC

This 1,312 hectare site comprising the river and riparian habitats lies to the north west of Stirling and is designated for its populations of sea lamprey (*Petromyzon marinus*), brook lamprey (*Lampetra planeri*) and river lamprey (*Lampetra fluviatilis*). Atlantic salmon (*Salmo salar*) are also present as a qualifying feature, but are not a primary reason for its designation. It is this latter migratory species that links this site with the Forth which it relies on as its migration route to the North Sea.

INTERNATIONAL PROTECTION OF SPECIES

Four of the thirteen animal species (species groups) of European Protected Species (EPS) are associated with the Firth of Forth:

- otter, ubiquitous in the Forth catchment;
- bats, roosts and foraging habitat associated with rivers and riverside structures;
- cetaceans, regularly reported in the Firth of Forth; and
- great crested newts, recorded in the Forth catchment.

The EPS designation ensures protection of the long term status of these species by requiring any disruption to them to be covered by a stringent licensing procedure that is administered by the Scottish Executive Environment and Rural Affairs Department (SEERAD).

NATIONAL PROTECTION OF SITES

The Wildlife and Countryside act (1981) as amended by the Nature Conservation (Scotland) Act 2004 affords rigorous protection to SSSIs. Many SSSIs are found along the Firth of Forth. Some of these, such as St Margaret's Marsh adjacent to North Queensferry, are protected by this status alone, whereas many sites have additional protection as a Natura 2000 site.

NATIONAL PROTECTION OF SPECIES

Otter, bat Cetaceans and great crested newts are protected under Schedule 5 of the Wildlife and Countryside Act (1981) as amended, in additional to their EPS status. However there are many species protected under schedule 5 (animals), schedule 1 (birds) and schedule 8 (plants). Examples of these that occur along the Firth of Forth include divers, kingfisher, barn owl, roseate tern, water vole and red squirrel (north of Forth).

OTHER ECOLOGICAL DESIGNATIONS

Ancient Woodland

Ancient Woodland is not a statutory designation, although the importance of some ancient woodlands is recognised by designated status. Ancient woodland is defined as land that has been continuously wooded since AD1750. An inventory was produced by the Nature Conservancy Council which lists all areas of woodlands over 2 hectares that are ancient. These areas were identified by looking at historical maps. Areas of ancient woodland that have never been cleared or replanted are known as semi-natural ancient woodland (SNAW). The irreplaceable nature of these woodlands is recognised in most local plans, the UK Biodiversity Action Plan (BAP) and most local BAPs. In the Firth of Forth area, the distribution of ancient woodland is strongly linked to river valleys and includes various stretches of woodland around Hopetoun House and at Limekilns to the west of Rosyth.

Local Nature Reserves

Local Nature Reserve (LNR) is a statutory designation made under Section 21 of the National Parks and Access to the Countryside Act 1949 by principal local authorities. They are designated not only for their local conservation importance, but also as an outdoor recreational resource for the local population. They are protected in the local planning system.

In the Firth of Forth area Torry Bay LNR is part of a larger area of inter-tidal mud flats between Longannet Point and Crombie Point. The Torry Bay LNR encompasses areas of tidal mudflats and is administered by Fife Council.

Nature Reserves Owned/Managed by Non Governmental Organisations (NGO)

The RSPB have a bird reserve at Skinflats, while the Scottish Wildlife Trust have Bo'mains Meadow at Bo'ness, Pepperwood at Kirkliston and Carlingnose Point near north Queensferry. The Woodland Trust own Inzievar Woods at Oakley.

Some of the areas within these reserves have one or more statutory designation in addition to the protection afforded by administration of the NGO.

Country Parks

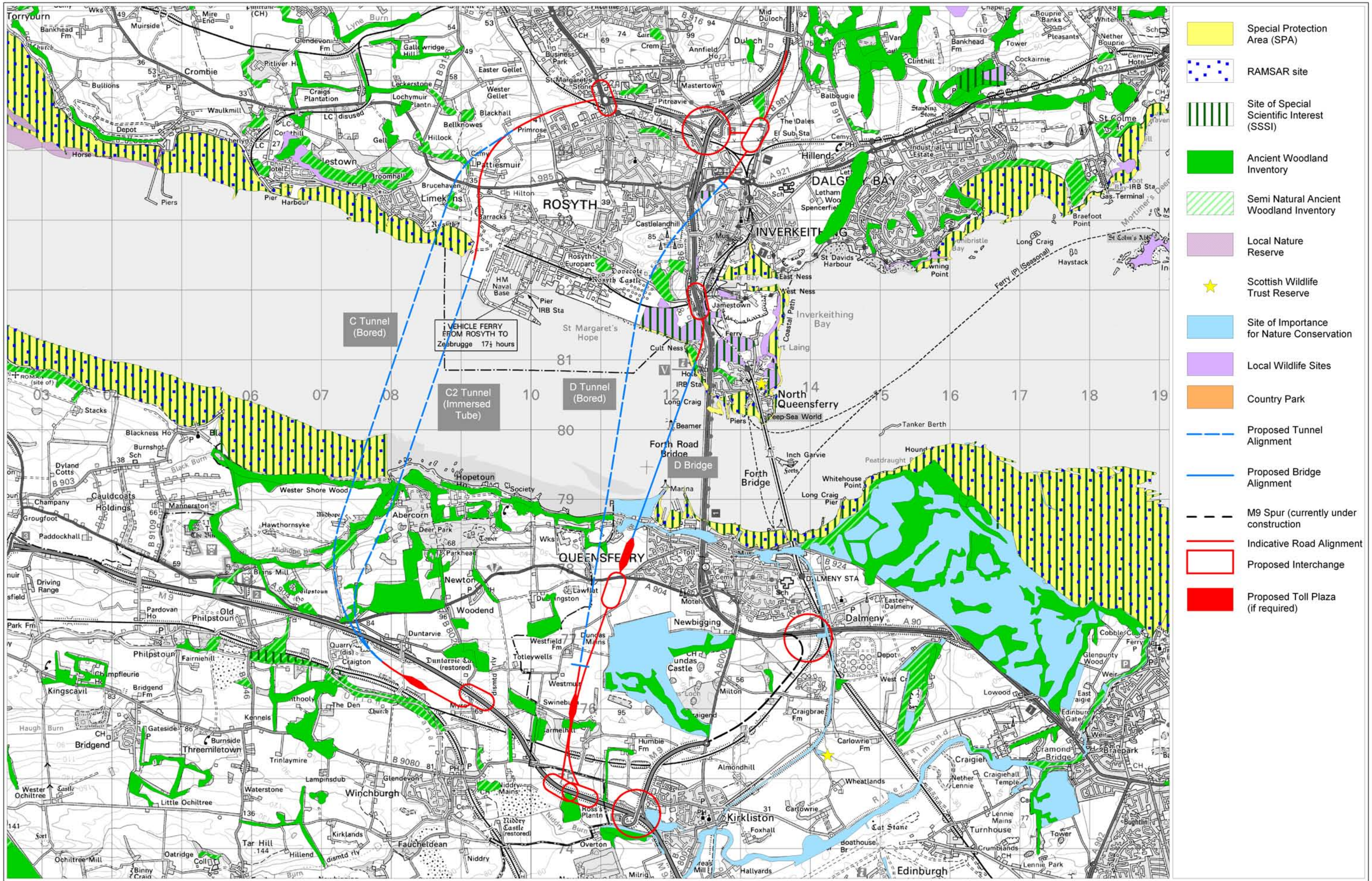
These are areas of land usually owned and/or managed by the local authority for countryside recreation, and include Beecraigs Country Park located approximately 1.5km to the south of Linlithgow. They are supported by a ranger service and hold events. They are established by Local Authorities under Section 48 of the Countryside (Scotland) Act 1967.

Biodiversity Species and Habitats

There is now a duty for all statutory bodies to maintain biodiversity, as stated in the Nature Conservation (Scotland) Act 2004. Many habitats and species in the Firth of Forth are listed in strategies that reflect their importance and vulnerability at different levels:

- priority species and habitats listed in the UK Biodiversity Action Plan;
- species and habitats listed in local Biodiversity Action Plans (normally at a regional level);

- species listed on the Scottish Biodiversity List; and
- bird species classed as ‘red’ on the RSPB’s list of Species of Conservation Concern (UK level).



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Title: FIG C.1 SEA ENVIRONMENTAL REPORT ECOLOGICAL DESIGNATIONS

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LANDSCAPE

This section considers the landscape character and value of the area within and around the Firth of Forth. The level of protection afforded to sites of landscape value and importance varies according to their designation, with the most protected being National Scenic Areas of which, it should be noted, there are none within the study area.

The sites afforded the greatest level of protection within the area of interest are those included on the Inventory of Gardens and Designed Landscapes, however, in the main, landscape designations within the study area are non-statutory. These comprise Areas of Great Landscape Value (AGLVs) within Falkirk, Fife and West Lothian, Areas of Outstanding Landscape Quality (AOLQs) within Edinburgh, and greenbelt within Edinburgh and Falkirk. These designations are on a local basis and have emerged as a result of the respective local plans. Landscape designations are illustrated in Figure C.2

NATIONALLY PROTECTED SITES

Inventory of Gardens and Designed Landscapes

Within the study area there are a number of sites included on the Inventory of Gardens and Designed Landscapes (GDLs). Sites on the Inventory are designated by Historic Scotland, but are not afforded the same level of protection as Listed Buildings or Scheduled Ancient Monuments. Instead sites are protected under the Town and Country Planning (General Development Procedure) (Scotland) Order 1992 (GDPO) and circular 6/1992, revised March 2007. This requires planning authorities to consult with Historic Scotland on development proposals affecting Inventory sites. It should be noted that the Inventory is a growing record of sites, and new gardens and landscapes may be added regularly. GDLs may be included on the Inventory as a result of their:

- Importance as individual works of art in their own right;
- Historic interest;
- Architectural interest;
- Archaeological interest;
- Horticultural interest;
- Scientific interest; and
- Scenic interest.

The GDLs located on or close to the fringes of the Firth of Forth are outlined below:

- Tulliallan;
- Dunimarle Castle;
- Culross Abbey House;

- Valleyfield;
- Fordell Castle;
- Donibristle;
- St Colme house;
- Aberdour Castle and House;
- House of Binns;
- Hopetoun House;
- Dundas Castle; and
- Dalmeny.

LOCALLY PROTECTED SITES

Areas of Great Landscape Value / Areas of Outstanding Landscape Quality

AGLVs and AOLQs may be designated by planning authorities for the purpose of safeguarding locally important areas of outstanding scenic character or quality from inappropriate development. The difference in name reflects the inconsistent approaches local authorities in Scotland have adopted with regards to sub-national landscape designation. In essence AGLVs and AOLQs are the same sub-national level of designation and as such are afforded the same level of protection through local plans and policies.

There are three AGLVs within the study area that are located on the fringes of the Firth of Forth. These are Hopetoun AGLV to the west of South Queensferry, the Broomhall/Belleknowes AGLV to the southwest of Dunfermline, and the Culalloe Hills/The Binn AGLV extending north east from Dalgety Bay. Within a wider context there are further AGLVs at Slamannan, Riccarton Hills and the Cleish Hills.

Within the study area there are two AOLQs within close proximity to the Firth of Forth, Dalmeny to the east of the Forth Rail Bridge and on the southern fringe of the Forth, and Dundas Castle on the A8000 en route to the existing crossing. Within the wider area there are further AOLQs at Carmelhill, Newliston and Turnhouse.

Green Belt

Green belt is a planning designation that is included with the various Local Plans for the area. The intended function of the green belt is to limit and control the urban sprawl and to enhance the setting and amenity of towns or cities in the long-term. However, such areas of green belt are under considerable pressure as economic growth demands more land to be released for housing and out of town office and business park developments. Within the area of interest there are areas currently designated as green belt within Falkirk and Edinburgh Council districts. In Falkirk, areas located to the south of Bo'ness and Grangemouth, and between Kincardine Bridge and the River Carron are designated as green belt. In Edinburgh green belt stretches from the Forth in the north and extends; southwards beyond Edinburgh airport, east to Dalmeny and Cramond and west as far as Dundas Mains.

LANDSCAPE CHARACTER ASSESSMENT

Scottish Natural Heritage, in conjunction with partner Councils, has undertaken a detailed review and classification of various landscape areas and types across Scotland. Within the Firth of Forth there are four individual Character Assessments. These cover Edinburgh, Falkirk and West Lothian on the south of the estuary and Fife on the north of the estuary. To the south of the estuary land is principally characterised as coastal margins while on the northern side land character is a mixture of coastal braes, coastal flats, coastal hills and urban areas. The Landscape Character Areas are illustrated in Figure C.3.

North of the Firth of Forth

The north section of the study area is covered by Fife Landscape Character Assessment, dated 1999 (Review Number 113) and the southern section by the Lothians Landscape Character Assessment, dated 1998 (Review Number 91).

The Fife Landscape Character Assessment divides Fife into nineteen distinctive Landscape Character Types. The key features and characteristics which make each of the landscape types distinctive are identified and described. The study area includes six different landscape character types, identified below[8] .

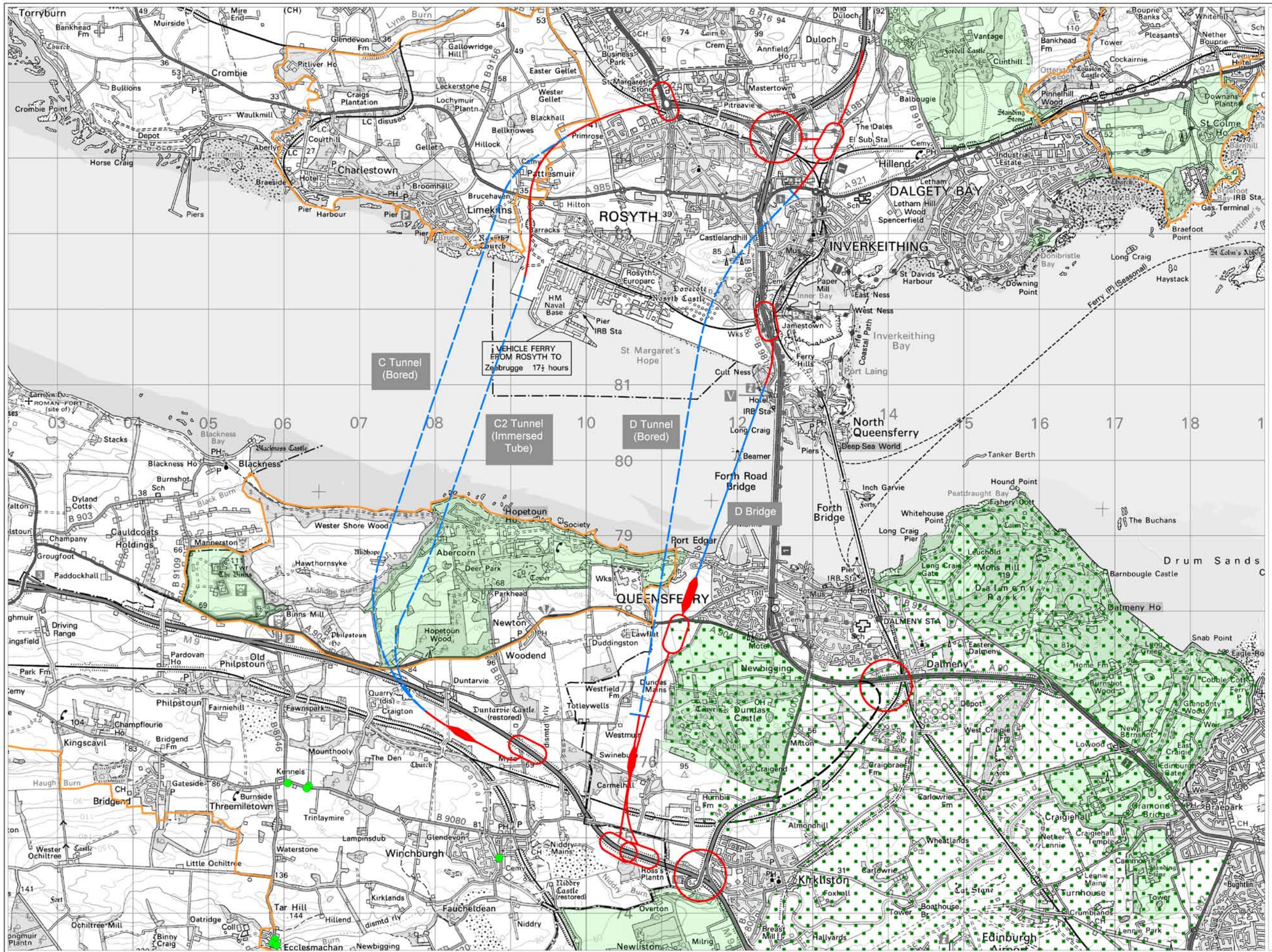
- Pronounced Volcanic Hills and Craigs
- Lowland Hills and Valleys
- Coastal Hills
- Coastal Braes
- Coastal Flats
- The Firth of Forth

[8] D.Tyldesley and Associates (1999). Fife landscape character assessment. Scottish Natural Heritage Review. No 113.

South of the Firth of Forth

The Lothians Landscape Character Assessment divides the Lothians into seven broad landscape character types within which a further twenty six detailed Landscape Character Areas are identified. The two landscape character types adjacent to the Firth are Coastal Margins and Lowland Plains. The Coastal Margins landscape type is characterised primarily by its close proximity to the Firth of Forth. The landscape is generally flat with slight undulations although raised beaches and dunes may feature.

Arable farmland, including Class 1 Agricultural Land dominates the landcover, however, this is interrupted by an urban strip stretching from Silverknowes in North West Edinburgh to Prestonpans in the East. The Lowland Plains landscape type is characterised also by the predominance of arable farmland forming plains in the heart of the region which is divided into sections by the Pentland Hills and Edinburgh City.



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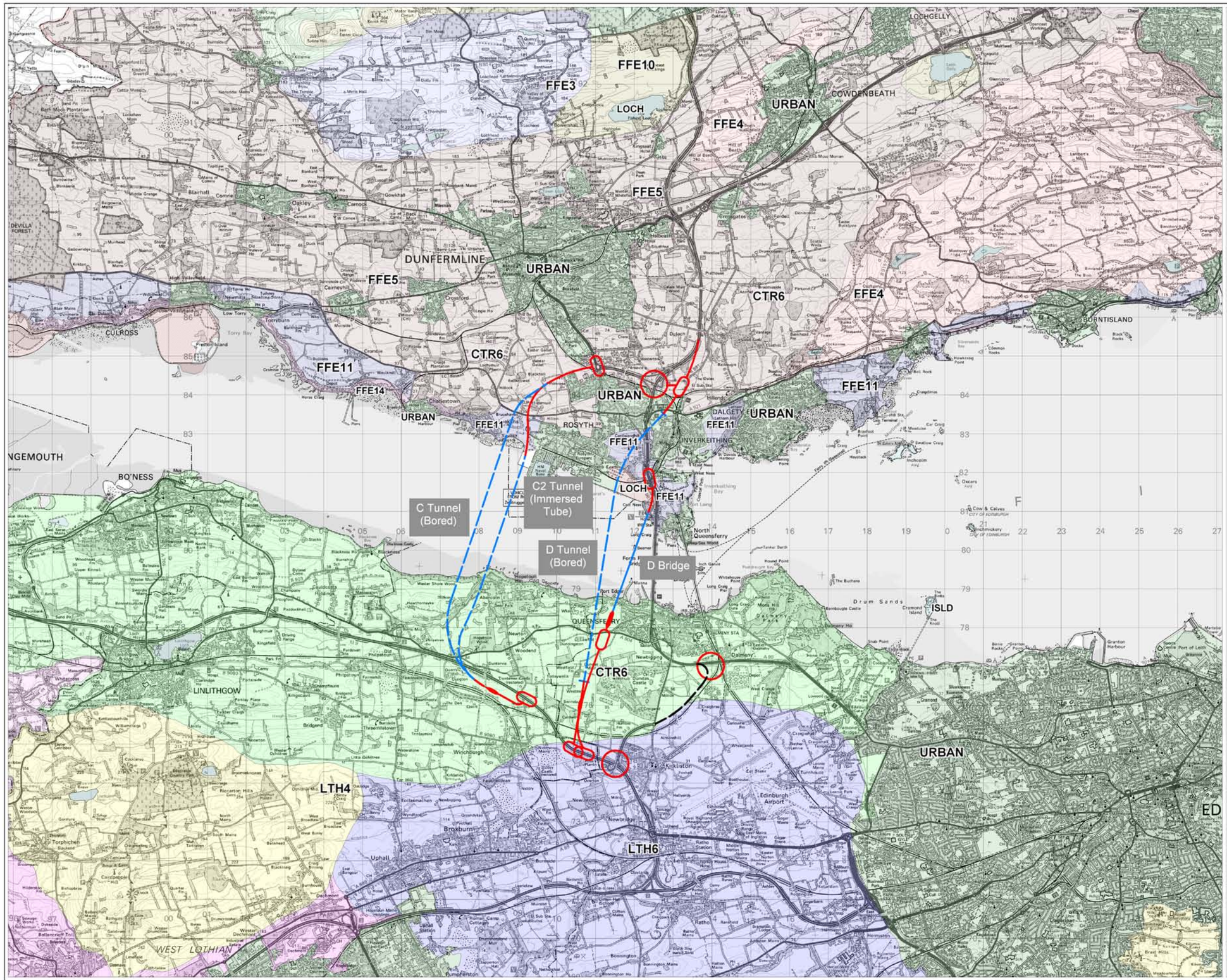

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ARCHAEOLOGY AND CULTURAL HERITAGE

Archaeology is the study of the past through the material remains of human activities left behind, be they visible monuments, buried sites or portable antiquities. Cultural heritage is a broader concept and was recently defined by the Faro Convention[9] as:

"…*a group of resources inherited from the past which people identify, independently of ownership, as a reflection and expression of their constantly evolving values, beliefs, knowledge and traditions. It includes all aspects of the environment resulting from the interaction between people and places through time*."

Heritage resources potentially include features dating from the earliest Holocene human occupation, approximately 10,000 years ago, through to 21st century buildings and townscapes.

Baseline data was collected for an area covering the various options and the surrounding area, from the sources listed below:

- City of Edinburgh Sites and Monuments Records held on the Canmore[10] database.
- Fife Sites and Monuments Records held on the Canmore database.
- West of Scotland Archaeology Service for West Lothian.
- The Statutory List of Buildings of Special Architectural or Historic Interest.
- The National Monuments Record of Scotland.
- The Inventory of Gardens and Designed Landscapes in Scotland.
- Local Plans.

Figure C.4 illustrates the cultural heritage designations around the Firth of Forth.

WORLD HERITAGE SITES

There are no World Heritage Sites (WHS) within the study area, however, it has been noted that the Forth Bridge has been included on the UK Tentative List of WHS's which is currently under review.

SCHEDULED ANCIENT MONUMENTS

A Scheduled Ancient Monument (SAM) is a protected archaeological site or historic building considered to be of national importance, and is the highest level of cultural heritage designation present within the study area.

[9] Council of Europe Framework Convention on the Value of Cultural Heritage for Society
[10] Canmore – The Royal commission for the Ancient and Historic Monuments of Scotland (RCAHMS) database of archaeological sites, monuments, buildings and maritime sites in Scotland.

In Scotland, Scheduled Ancient Monuments are defined in the Ancient Monuments and Archaeological Areas Act 1979. Work relating to SAMs is undertaken by Historic Scotland on behalf of Scottish Ministers. The table below lists the some of the main SAMs which are close to Firth of Forth. These include prehistoric sites such as various hill forts and enclosures to more recent structures such as the defensive installations on the island of Inch Garvie in the Firth of Forth itself. Table C.3 highlights some of the SAMs in the study area.

Table C.3 Scheduled Ancient Monuments

Council Area	Name
Fife	Rosyth, Old Kirk
Fife	Aberdour Lodge, standing stone 110m SW of
Fife	Inverkeithing Market Cross, Bank Street
Fife	Charlestown, Limekilns & associated features
Fife	Carlingnose Battery
Fife	Crombie Old Parish Church, Craigflower Estate, Torryburn
Fife	Charles Hill, Monks' Cave storehouse, military camp and battery
Fife	North Queensferry, St James' Chapel
Fife	Middlebank House, souterrain 370m ENE of
Fife	Balbougie, enclosed settlement 310m NNE of
Fife	Braefoot Point, battery
Fife	Aberdour Castle
Fife	Rosyth Castle
Fife	St Bridget's Kirk
Fife	North Wood, Dunfermline, cairn 140m NNW of crematorium
Fife	Rosyth Castle Dovecot
Fife	Inchcolm, Abbey, hog-backed stone, hermit's cell, WWI & WWII defences
Fife	Pitreavie House dovecote
City of Edinburgh	Craigie Hill, fort
City of Edinburgh	Earl Cairnie or Harlow Cairn, cairn, The Warrens
City of Edinburgh	Cramond, old bridge
City of Edinburgh	Old Dundas Castle, castle, sundial and dovecot
City of Edinburgh	Inchmickery, fortifications
City of Edinburgh	Cramond, Roman fort & civil settlement
City of Edinburgh	Inch Garvie, Firth of Forth, defensive installations
City of Edinburgh	Dalmeny Park, enclosures 420m N of Mansion Hill
City of Edinburgh	Hunter's Craig or Eagle Rock
West Lothian	Duntarvie Castle
West Lothian	Midhope Castle
West Lothian	Staneyhill Tower
West Lothian	Auldcathie Church
West Lothian	Abercorn, fort 450m SW of West Lodge
West Lothian	Abercorn Church, carved stones in Session House
West Lothian	Abercorn Castle, remains of

Council Area	Name
West Lothian	Union Canal, River Almond to River Avon
Falkirk	Antonine Wall, Carriden House, Roman fort
Falkirk	Burnshot, settlement & field system 443m NW of
Falkirk	Stacks, enclosure 300m N of
Falkirk	Antonine Wall,Carriden,Roman & native settlement
Falkirk	Carriden House, church and burial ground 20m SW of
Falkirk	Walton, enclosure 650m NE of
Falkirk	Carriden House, mound 300m SSW of
Falkirk	Stacks, enclosure 250m ESE of
Falkirk	Stacks, enclosure 250m WSW of
Falkirk	Blackness Castle

Listed Buildings

Historic Buildings are an important part of Scotland's heritage, providing a link to the history and culture of the country. Certain historic buildings, which are of special architectural or historic interest, can be designated as Listed Buildings and receive statutory protection under Section 6 of the Planning (Listed Buildings and Conservation Areas) (Scotland) Act 1997. Listed buildings in Scotland are defined by Historic Scotland in three categories: A, B and C(S) according to merit and provisions for alteration or removal of such buildings are included in the act. Category A listed buildings are of national or international importance while Category B listed buildings are of regional or more than local importance. Category C(S) listed buildings are of local importance.

Within the study area there are numerous listed buildings most of which most are within urban centres, however, there are a considerable number spread throughout the countryside. Table C.4 identifies some of the Category A listed buildings in the study area.

Table C.4 Category A Listed buildings

Council Area	Name
Fife	DONIBRISTLE HOUSE, CHAPEL AND FAMILY VAULTS
Fife	FORDELL CASTLE AND FORDELL CHAPEL
Fife	INVERKEITHING, TOWNHALL STREET, TOWN HOUSE
Fife	CHARLESTOWN, HARBOUR ROAD, LIMEKILNS
Fife	FORTH ROAD BRIDGE
Fife	THE FORTH BRIDGE
Fife	ROSYTH CASTLE
Fife	LIMEKILNS, 8 ACADEMY SQUARE, THE KING'S CELLAR
Fife	DONIBRISTLE HOUSE
Fife	OLD DULOCH
Fife	OLD DULOCH, WALLED GARDEN
Fife	OLD DULOCH, BOUNDARY WALLS AND GATE PIERS
Fife	PITREAVIE CASTLE
Fife	NORTH QUEENSFERRY, PILOT BOAT SLIPWAY

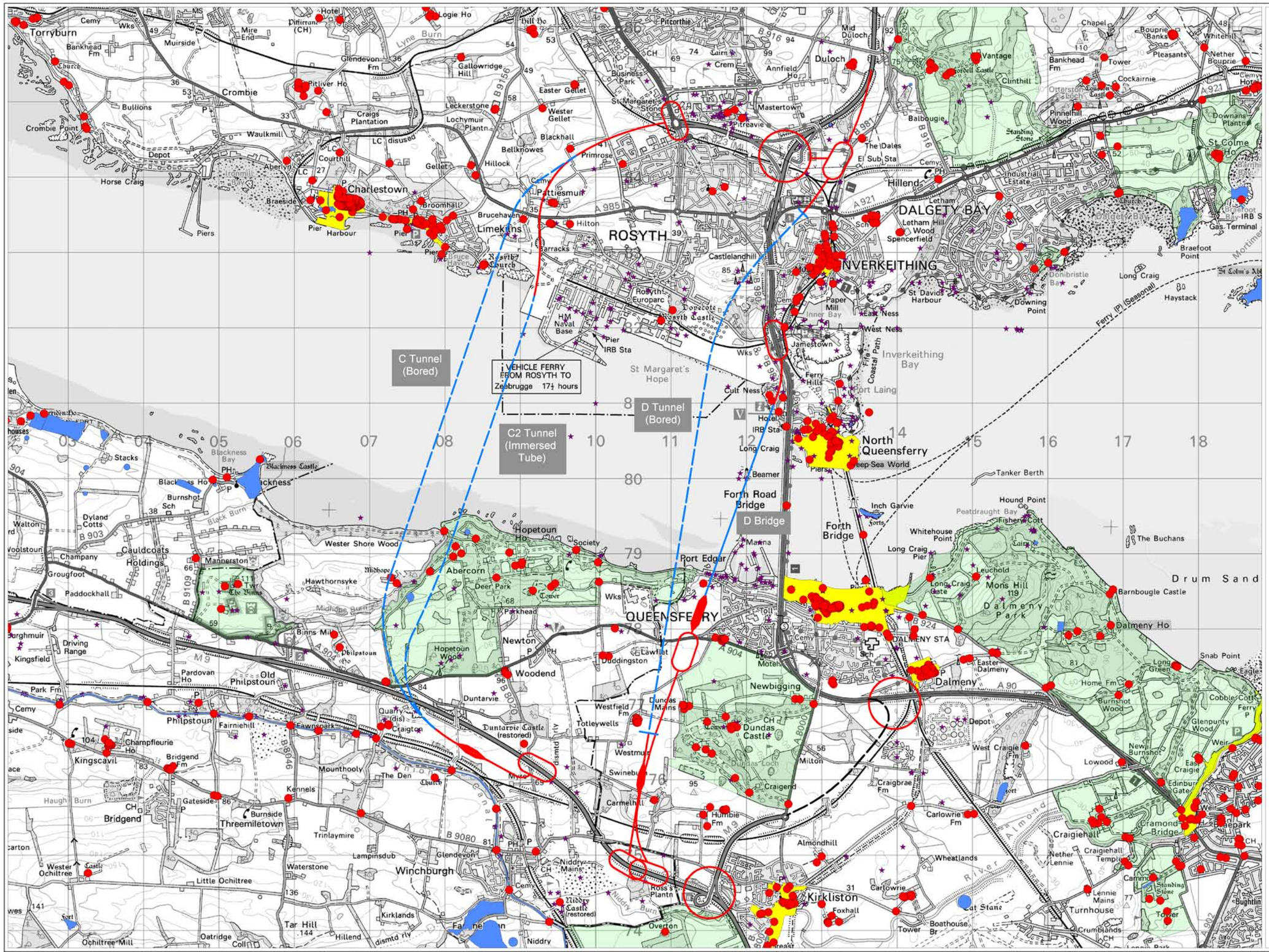
Council Area	Name
Fife	INVERKEITHING, QUEEN STREET, MUSEUM
Fife	NORTH QUEENSFERRY, TOWN PIER
City of Edinburgh	EDINBURGH, DALMENY HOUSE
City of Edinburgh	CARLOWRIE, WALLED GARDEN
City of Edinburgh	SOUTH QUEENSFERRY, HIGH STREET, TOLBOOTH
City of Edinburgh	EDINBURGH, CRAIGIEHALL HOUSE, WALLED GARDEN
City of Edinburgh	DUNDAS CASTLE, DUNDAS CASTLE KEEP
City of Edinburgh	EDINBURGH, BARNBOUGLE CASTLE, SUNDIAL
City of Edinburgh	EDINBURGH, BARNBOUGLE CASTLE
City of Edinburgh	SOUTH QUEENSFERRY, 1 – 7 HOPETOUN ROAD, PLEWLANDS HOUSE
City of Edinburgh	FORTH ROAD BRIDGE
City of Edinburgh	THE FORTH BRIDGE
City of Edinburgh	DUNDAS CASTLE
City of Edinburgh	DUNDAS CASTLE, STABLE COURT
City of Edinburgh	DUNDAS CASTLE, FOUNTAIN AND SUNDIAL
City of Edinburgh	DALMENY, MAIN STREET, DALMENY PARISH CHURCH
City of Edinburgh	DALMENY, MAIN STREET, DALMENY PARISH CHURCH, CHURCHYARD
City of Edinburgh	NEWLISTON HOUSE
City of Edinburgh	SOUTH QUEENSFERRY, 8 HOPETOUN ROAD, EPISCOPAL CHURCH
City of Edinburgh	EDINBURGH, CRAIGIEHALL HOUSE
City of Edinburgh	EDINBURGH, CRAIGIEHALL HOUSE, EAST SUNDIAL
City of Edinburgh	EDINBURGH, CRAIGIEHALL HOUSE, WESTERN SUNDIAL
City of Edinburgh	EDINBURGH, BRAE PARK ROAD, RIVER ALMOND, CRAMOND OLD BRIDGE
West Lothian	HOPETOUN HOUSE, ESTATE BUILDINGS, STEADING
West Lothian	HOPETOUN HOUSE, ESTATE BUILDINGS, SQUASH COURT
West Lothian	HOPETOUN HOUSE, ESTATE BUILDINGS, WORKSHOP
West Lothian	ABERCORN CHURCH AND ANGLIAN MONASTERY
West Lothian	MIDHOPE CASTLE
West Lothian	LINLITHGOW, EDINBURGH ROAD, 2-3 KINGSCAVIL COTTAGES
West Lothian	NIDDRY CASTLE
West Lothian	HOPETOUN HOUSE
West Lothian	HOUSE OF THE BINNS
West Lothian	HOUSE OF THE BINNS, COTTAGES AND STABLE BUILDINGS
Falkirk	BLACKNESS CASTLE
Falkirk	BO'NESS, CARRIDEN HOUSE

Conservation/Heritage Areas

Provision for Conservation Areas is also defined by the Planning (Listed Buildings and Conservation Areas) (Scotland) Act 1997. Conservation areas are shown on Council Local Plans and within the study area include much of Linlithgow, South Queensferry and parts of Edinburgh on the southern shore and on the north Inverkeithing, Charlestown, Limekilns and Pattiesmuir in Fife.

Sites and Monuments Record

The Sites and Monuments Record (SMR) comprises records of archaeological sites, ancient monuments, buildings and maritime sites. The SMRs relevant to the study area have been consulted with and the available data is mapped on Figure C.4



Scheduled Ancient Monuments (SAM)

Listed Buildings

Conservation Area

Gardens & Designed Landscapes

Known Heritage

Proposed Tunnel Alignment

Proposed Bridge Alignment

M9 Spur (currently under construction)

Indicative Road Alignment

Proposed Interchange

Proposed Toll Plaza (if required)

Note:
Known heritage comprises data held on the:
- City of Edinburgh Sites and Monuments Record;
- Fife Sites and Monuments Record; and
- Data held by the West of Scotland Archaeological Service.

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AIR QUALITY & CLIMATIC FACTORS

AIR QUALITY

Transport schemes can have a major impact on local air quality. Petrol and diesel engine motor vehicles emit a number of pollutants including carbon monoxide (CO), nitrogen oxides (NO_x) and particulate matter (PM_{10}), all of which can negatively impact upon urban air quality. The emission of these pollutants is increased by high traffic flows in particular rush hour traffic associated with commuting and congestion.

The Air Quality Strategy provides a framework for air quality control through air quality management and air quality standards. These and other air quality standards and their objectives have been enacted in Scotland through the Air Quality (Scotland) Regulations 1997, as amended, most recently in 2002. The Environment Act 1995 requires Local Authorities to undertake air quality reviews. Air quality objectives exist for the following pollutants:

- Benzene
- 1,3-Butadiene
- Carbon Monoxide
- Lead
- Nitrogen Dioxide
- Particles (PM_{10})
- Sulphur Dioxide

In areas where an air quality objective is not anticipated to be met, Local Authorities are required to establish Air Quality Management Areas (AQMA) and to develop and implement Air Quality Action Plans that detail the measures to be taken to work towards reducing pollution levels to below the objective targets.

The nearest AQMAs with respect to the Firth of Forth are located in Edinburgh. City of Edinburgh Council have identified two AQMAs; the first at St John's Road to west of the city centre and on a main approach to the city centre; and the second encompassing the city centre and roads approaching it including areas at Roseburn, Haymarket and Gorgie.

Traffic modelling data will inform assessments of effects on emissions. No baseline information regarding emissions was identified.

CLIMATIC FACTORS

Transportation is one of the main contributors to climate change due to emissions of carbon dioxide (CO_2). High levels of CO_2 and other 'greenhouse gases' in the atmosphere are thought to accelerate the earth's natural warming. This warming is predicted to have a variety of environmental consequences including increased frequency and severity of storm events, as well as rises in sea level. Changes in rainfall patterns could lead to increased erosion and pollution associated with surface run-off.

The UK government published its Climate Change Programme in 2000, setting out targets to reduce carbon emissions by 20% by 2010, a target higher than that set by Kyoto protocol of 12.5%. In the Energy White Paper (2003) target cuts of 60% by 2050 of carbon emissions are set by the government.

WATER QUALITY AND FLOODING

WATER FRAMEWORK DIRECTIVE

The Water Framework Directive was transposed into Scottish law by the Water Environment and Water Services Act (Scotland) 2003 (WEWS) and Water Environment (Controlled Activities) (Scotland) Regulations 2005 (CAR).

The overall objective of the Water Framework Directive (WFD) is the 'protection of the water environment' which is transposed into s.1(2) a) of the WEWS Act) as meaning preventing further deterioration of, and protecting and enhancing, the 'status' of aquatic ecosystems and, with regard to their water needs, terrestrial ecosystems and wetlands directly depending on those aquatic ecosystems'. The WFD goes on to define "Surface water status" as the general expression of the status of a body of surface water, determined by the poorer of its ecological status and its chemical status, Article 2(17).

The ongoing implementation of the WFD has resulted in the identification and characterisation of River Basin Districts (RBDs); the Firth of Forth being located in the Scotland RBD. A key consideration in the characterisation is assessing if the waterbody is at is risk of not achieving the WFD target of "good status" by 2015. A risk based approach, rather than the qualitative approach used for water quality classifications, is used to determine WFD characterisations. The risk status is determined taking into account pressures and impacts including; point source and diffuse pollution, abstractions, impoundments and hydromorphological change. Four reporting categories are used to describe all types of surface waterbodies:

- 1a definitely at risk of not achieving "good status" by 2015;
- 1b probably at risk of not achieving "good status" by 2015;
- 2a probably not at risk of not achieving "good status" by 2015; and
- 2b definitely not at risk of not achieving "good status" by 2015.

It should be noted that the characterisation takes into account factors not previously considered in the assessment of river quality. This coupled with the more stringent quality objectives of the WFD mean that the many surface waterbodies are deemed to be in categories 1a or 1b, at risk of not achieving "good status" when they may have higher quality rating under water quality classification regime.

The Controlled Activities Regulations (CAR) have also resulted from the implementation of the WFD. CAR covers engineering works in or adjacent to waterbodies and aims to control the impacts of development on the water environment. There are three levels of CAR, General Binding Rules (GBRs), Registration and Licence. The control and authorisation conditions applied under these levels will be dependent on the risks a particular development poses to the water environment.

WATER QUALITY CLASSIFICATION

Water quality classifications have been determined taking into account biological, chemical and aesthetic elements of surface waters and a single classification has resulted. Class ranges are:

- A1 Excellent;
- A2 Good;
- B Moderate;
- C Poor; and
- D Seriously polluted.

It is the intention of SEPA that the above classifications will continue to be used for reporting until at least 2007 when they will be replaced by the WFD reporting categories. Where such information on water quality exists, this assessment has taken into account both the water quality classification, based on the sampling year 2005, and the results of the WFD characterisation.

Table C.4 below summarises the water quality of a number of surface waters within the study area.

Table C.4 Surface Water Quality Monitoring

Potentially Affected Surface Water	WFD Reporting Category	Water Quality Classification
Brankholm Burn	1a	C, poor
Keithing Burn	1a	C, poor
Firth of Forth	1a	n/a
Midhope Burn	1b	B, moderate
Swine Burn	1a	A2, good
Dolphinton Burn	1a	C, poor
Union Canal	1a	C, poor
Niddry Burn	1b	Not monitored

The Indicative River and Coastal Flood Map for Scotland has been reviewed in order to identify parts of the study area at risk from coastal and river flooding. It is noted that the flood map is indicative only and does not take into account small burns with catchments less than 3km^2, flood defences, urban areas with complex drainage systems or structures such as bridges or culverts.

Areas at risk from coastal flooding or sea level change include:

- Islands in the Firth of Forth including Beamer Rock and Inch Garvie;
- Piers and ports on both the north and south shores including the docks and naval base at Rosyth and Port Edgar; and

- An area at St Margaret's Marsh on the north shore.

Inland surface waters identified as being a flood risk include:

- The Keithing Burn and Brankholm Burn on the north shore; and
- The Dolphinton Burn, Swine Burn and Midhope Burn on the south shore.

POPULATION & HUMAN HEALTH

No information sources have been identified which provide accurate information regarding physical activity of the population, in relation to transport. This data gap will be addressed in the Environmental Report as information is obtained.

Table C.5 below contains information on health data in the TACTRANS and SESTRANS regions[11]. This captures health data for council regions both north and south of the Firth of Forth including East, West and Midlothian Lothian Councils, City of Edinburgh Council, Falkirk Council, Fife Council and Perth and Kinross Council.

Table C.5 Health Data

Region	% with Perceived Health: Good	% with Perceived Health: Not Good	% with Limiting Long Term Illness
SESTRANS	68.8	9.22	19.30
TACTRANS	69.92	8.82	19.30
Scotland	67.91	10.15	20.31

No baseline information regarding noise and vibration has been identified. Traffic modelling data will inform assessments of effects on noise and vibration.

[11] www.sestran.gov.uk, www.tactran.gov.uk

Appendix D - Option Generation and Sifting

Please note that more detail on the option selection process including the reasons for rejection are contained in Forth Replacement Crossing Study Reports 3: Option Generation and Sifting and 4: Appraisal Report.

Table E.1 STAG Initial Option Generation and Sifting

No	Solution Option	Taken forward (✓) or Rejected (✖)	Reason for Rejection (where applicable)
1	Bridge at Queensferry for vehicular traffic	✓	-
2	Bridge at Queensferry for light rail/ road	✓	-
3	Bridge at Queensferry for heavy rail/ road	✖	More effective ways of providing additional heavy rail capacity using the existing rail bridge and rail network.
4	Bridge with hard shoulder for vehicles at Queensferry	✓	-
5	Bridge east of existing rail bridge	✓	-
6	Bridge west of Rosyth	✓	-
7	Bridge at Grangemouth	✓	-
8	Viaduct at west of Rosyth	✓	-
9	Bridge east of Bo'ness	✓	-
10	Swing bridge at various locations	✖	Largest existing swing bridge, El Ferdan crossing the Suez Canal provides an opening of 340m. Time required to open the bridge is approximately 30 minutes leading to excessive closure of bridge. Longest existing vertical lift bridge is 170m span and unlikely to provide sufficient navigational clearance.
11	Bridge at Leith/ Portobello to Kirkcaldy	✖	Bridge too long and uneconomical.
12	Bridge at Burntisland to Leith/ Portobello	✖	Bridge too long and uneconomical.
13	Cable stayed bridge at various locations	✓	-
14	Strengthen existing rail bridge to carry road traffic	✓	-
15	Suspension bridge at various locations	✓	-
16	Balanced cantilever bridge	✓	-
17	Single deck bridge options	✓	-
18	Double deck bridge options	✓	-
19	Dual carriageway bridge deck	✓	-
20	Dual 2 lane bridge carriageway	✓	-
21	Dual 2 lane Motorway Standard	✓	-
22	Dual 3 lane bridge carriageway	✓	-

No	Solution Option	Taken forward (✓) or Rejected (✖)	Reason for Rejection (where applicable)
23	Dual 3 lane Motorway Standard	✓	-
24	Provision for Non-Motorised Units	✓	-
25	Bus way	✓	-
26	Light rail	✓	-
27	Heavy rail	✖	More effective ways of providing additional heavy rail capacity using the existing rail bridge and rail network
28	Building in maintenance access facilities to bridge	✓	-
29	Build new capacity onto existing bridge	✖	Insufficient capacity in deteriorating main cable. It is not possible to repeat the Tamar Bridge solution as the main span deck is already an orthotropic deck.
30	Close and replace/ repair existing bridge	✓	-
31	Build new bridge and repair existing	✓	-
32	Build new bridge and increase capacity of existing rail bridge	✓	-
33	Build new road bridge and use existing bridge as light rail	✓	-
34	New rail bridge and adapt existing rail bridge for road	✖	Insufficient width to existing rail structure. High complexity of widening the bridge.
35	Build new road bridge and use existing road bridge for heavy rail	✖	Insufficient strength and probably insufficient stiffness to limit deformation under rail traffic.
36	Build new road bridge and use existing bridge for guided busway	✓	-
37	Build new road bridge and use existing bridge for Non-Motorised Units	✖	Uneconomical and inefficient use of the existing road bridge.
38	Arch bridge at various locations	✖	Not as economical as cable stayed bridges.
39	Build new bridge for non road modes and use existing road bridge	✖	This does not relieve loading on the existing road bridge.
40	Build new bridge for Heavy Goods Vehicles and use existing road bridge for light traffic	✓	-
41	Utilise new bridge to generate energy source	✖	High cost, wide environmental impact and effect on traffic capacity.
42	High Occupancy Vehicle lanes	✓	-
43	Dedicated bus lanes	✓	-
44	Variable tolls	✓	-
45	No tolling	✓	-
46	Multi lane free flow tolling	✓	-
47	Active Traffic Management	✓	-
48	Tidal working - vehicle movements	✓	-

No	Solution Option	Taken forward (✓) or Rejected (✖)	Reason for Rejection (where applicable)
49	Twin bridge strategy - using one bridge south and one northbound	✓	-
50	Twin bridge strategy - using one bridge strategic and one local	✓	-
51	Do nothing	✖	Does not satisfy objectives.
52	Twin bridge strategy - using one bridge toll and one not tolled	✓	-
53	Use existing bridge as Non-Motorised Unit crossing and use upgraded Kincardine bridge with upgraded road links back to M90	✖	Does not satisfy the travel pattern demands on the existing road bridge.
54	Maximise use of infrastructure at Kincardine bridge to create a new strategic north - south corridor	✖	Does not satisfy objectives.
55	Future proofing new bridge for light or heavy rail	✓	-
56	Immersed tunnels - covering ideas 1- 55	✓	-
57	Bored tunnels - covering ideas 1- 55	✓	-
58	Combination of tunnel and bridges - covered in options 1-57	✓	-
59	Ferry crossing	✖	This alone will not provide sufficient capacity.
60	Hovercraft	✖	This alone will not provide sufficient capacity.
61	Road ferry	✖	Unproven and requires strengthening of the Forth Road Bridge
62	Maximise use of retail/ commerce options with crossing	✓	-
63	Rail shuttle	✖	More effective ways of providing additional heavy rail capacity using the existing rail bridge and rail network
64	Double decker rolling stock	✓	-
65	Travelator	✖	This alone will not satisfy the objectives.

The Initial Sifting saw 46 options taken forward for further consideration. These options fall into seven broad categories:

- Crossing location;
- Bridge crossings;
- Tunnel crossings;
- Capacity/operational configuration;
- Multi modal capability;
- Operational options; and

- Miscellaneous others.

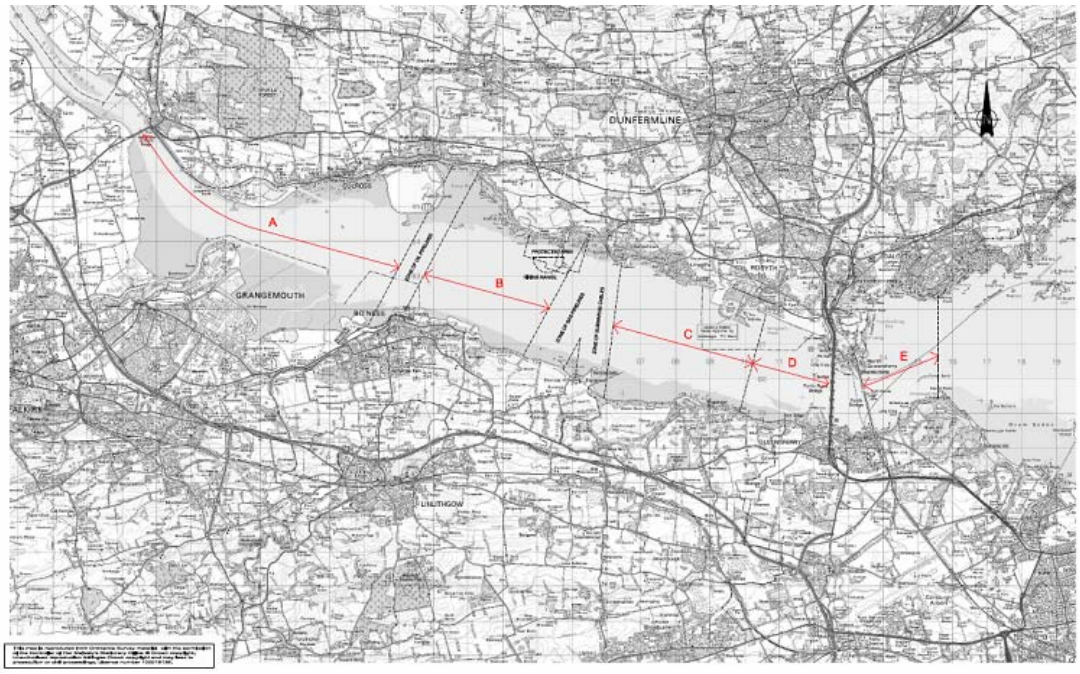
A hierarchical approach to the appraisal was followed to ensure that the major issues were dealt with adequately before turning to the more detailed considerations.

The approach adopted was to consider the first three categories above; namely crossing location, bridge crossings and tunnel crossings. All other issues would be considered once a clear view on the primary issues was developed.

The remainder the option appraisal process therefore considered bridge and tunnel options in the following five corridors:

- A – Grangemouth (West of Bo'ness);
- B – East of Bo'ness;
- C – West of Rosyth;
- D - East of Rosyth/West of South Queensferry; and
- E – East of South Queensferry.

Each corridor has been determined by the environmental and physical constraints in and around the Firth of Forth and is illustrated below.



Each of these corridors, containing either a bridge or tunnel, was then assessed against the planning objectives, described below, and the Government's five key objectives of Environment, Economy, Safety, Accessibility/Social Inclusion and Integration.

- **Maintain cross Forth transport links for all modes to at least the level of service offered in 2006**

The corridors have been assessed on the basis of how well each assists in reducing future traffic levels in 2012, 2017 and 2022 on the existing Forth Road Bridge to 2006 levels. The Transport Model for Scotland has been used to predict the likely usage of a crossing in the new corridor and the existing Forth Road Bridge.

- **Connect to the strategic transport network to aid optimisation of the network as a whole**

The corridors have been assessed in terms of the opportunities they can provide to improve the overall efficiency of the transport networks.

- **Improve the reliability of journey times for all modes**

This examines how well a crossing in the corridor will assist in reducing congestion on the road network and therefore increase the reliability of road based journey times. It also examines the opportunities to improve the reliability of public transport journey times through the corridors ability to provide enhanced public transport services either directly or indirectly.

- **Increase travel choices and improve integration across modes to encourage modal shift of people and goods**

This explores how well each corridor is likely to improve the choice of public transport services available for journeys which are currently made by private vehicles

- **Improve accessibility and social inclusion**

This examines how each corridor will make it easier for non-car owners to make journeys to access places of employment, educational and healthcare facilities and other vital journeys of this nature.

- **Minimise the impacts of maintenance on the effective operation of the transport network**

This objective is essentially about how the new corridor can operate in conjunction with the existing Forth Road Bridge during periods of planned maintenance to ensure that delays on the network as a whole are minimised. This also extends to operating during periods of unplanned incidents such as accidents and when high wind restrictions are in force on the Forth Road Bridge.

- **Support sustainable development and economic growth**

This looks at the location of the corridor in the context of known development and economic active areas on either side of the Forth

- **Minimise the impact on people, the natural and cultural heritage of the Forth area**

Finally, the corridors were assessed for the likely environmental impact that might incur if a crossing was to be introduced within it. The work undertaken confirmed that Corridors A and B did not meet the objectives of the study and were therefore rejected.

The remote location of Corridor A (in terms of distance from the existing FRB) results in it performing poorly against the objectives. This corridor was dismissed as a consequence. In addition, this crossing is likely to have significant environmental impacts on people and the natural and built environment.

Corridor B, as with A performed poorly in part due to its distance from the existing FRB. Additionally there were significant environmental constraints within Corridor B including the Firth of Forth Special Protection Area (SPA) and the Antonine Wall, a Scheduled Ancient Monument. This corridor was dismissed as it is likely to have significant environmental impacts on people and the natural and built environment.

It was concluded that these corridors would not be considered further within the study. Corridors C, D and E do, however, perform well to varying degrees against the objectives and these were taken forward to the Part 1 Appraisal, with bridge and tunnel options considered for all three corridors. Whilst the majority of the planning objectives were met by each of the proposals, it was evident that the degree to which they were met varied across corridors and crossing types.

Assessment of the performance of the proposals against the appraisal criteria identified that the critical issues related to the STAG environment objective and the study specific planning objective to “minimise the impact on people, the natural and cultural heritage of the Forth area”. The bridge proposals in Corridors C and E performed particularly badly in this regard as both the northern and southern landfalls cross, or come very close to, the Forth Special Protected Areas which may lead to loss of Special Protected Area habitat. Both were considered to have major adverse impacts on a European designated site and are unlikely to be permitted when viable alternatives exist that have less or no adverse impact. The bridge in Corridor D was considered to avoid this impact.

STAG indicates that any proposal which fails to meet the Part 1 appraisal test should be rejected. In this case, given the importance of the Special Protected Area and the likely impact which these bridge proposals would have on it, it was considered that the bridge proposals in Corridors C and E should be set aside and not carried forward to the more detailed STAG Part 2 appraisal.

The outcome of the STAG Part 1 appraisal was that the following proposals were taken forward for further development and the STAG Part 2 Appraisal:

- Corridor C Tunnel;
- Corridor D Bridge;

- Corridor D Tunnel; and
- Corridor E Tunnel.

Appendix E - Assessment Methodology

Effect Magnitude

For the purpose of this SEA, the magnitude of the predicted effect will be identified as negligible, minor, moderate or major. Magnitude is a combined measure of the geographical scale of the effect; the probability of the effect; the duration of the effect; whether changes in the baseline are permanent or temporary; reversible or irreversible; direct or indirect; the frequency of the effects and the rate of change. Direction of change is measured as positive, negative or neutral. The following is a summary of how the magnitude of the predicted effect will be determined:

Table E.1 Criteria for Determining Effect Magnitude

Magnitude	Description
Negligible	No or neutral effect on the baseline. Effects would be one or more of the following: possible, short term, indirect
Low	Slight change in the baseline. Effects would be one or more of the following: likely, short term, direct or indirect
Medium	Identifiable change in the baseline. Effects would be one or more of the following: definite, medium term, direct or indirect, reversible
High	Substantial identifiable change in the baseline. Effects would be one or more of the following: definite, long term, direct, irreversible

The terms used to describe effect magnitude, above, relate to the following descriptions of the predicted effects that interventions may potentially have on the environment.

Table E.2 Types of Predicted Effects

Predicted Effect	Description
Probability	Definite Likely Possible
Geographical Scale	Community or Local Regional National European or International
Frequency	Frequent Rare

Importance of the Receptors

To evaluate the significance of effects, the importance (sometimes referred to as 'sensitivity') of receptors must be identified. The questions in Table 5.1 linked to the SEA objectives, relate to specific receptors. The following criteria have been developed to describe the importance of these receptors.

Table E.3 Receptor Importance

Importance of Receptors	Description
Negligible	No statutory recognition / designation, not vulnerable or sensitive to change
Low	Low environmental value, no statutory recognition / designation, tolerant to change without detriment to character
Medium	Local or regional recognition / designation, sensitive to change
High	International or national statutory recognition / designation, features with legal protection, receptors vulnerable or highly sensitive to change

Significance of Effects

The significance of effects will depend on the magnitude of the effect in relation to the importance of the receptors. The following matrix has been developed to determine the significance of effects.

Table E.4 Determining the Significance of Predicted Effects

Magnitude	Importance of the Receiving Environment			
	High	Medium	Low	Negligible
High:	Major	Moderate	Moderate	Minor
Medium:	Moderate	Moderate	Minor	Negligible
Low:	Moderate	Minor	Negligible	Negligible
Negligible:	Minor	Negligible	Negligible	Negligible

Appendix F - Assessment Matrices

Table F.1 Corridor C Tunnel (bored)

SEA Objective	Questions	Comments on Predicted Residual Impacts (incorporating mitigation set out in section 6)	Importance of Receptor	Magnitude of Impact	Significance of Impact
To protect and conserve biodiversity	Does the FRC affect biodiversity? Does the FRC affect designated sites (for example Special Protection Areas, Special Areas of Conservation, Ramsar sites, Sites of Special Scientific Interest and Sites of Interest for Nature Conservation)? Does the FRC affect protected species?	The proposed tunnel would pass beneath the Firth of Forth SPA, avoiding direct impacts, however, the proposed shaft and site entrance on the northern shore is adjacent to the SPA so the potential exists for indirect impacts, particularly on birds. A bored tunnel, due to the construction techniques involved is likely to have an overall neutral effect on marine ecology i.e. cetaceans, seals, and fish. On both the northern and southern shores the potential exists for road network connections to impact on terrestrial ecology including European Protected Species (EPS) as well as valuable habitats. Impacts could include temporary habitat loss due to construction activities, permanent habitat loss as a result of the landtake associated with road connections and fragmentation of wildlife corridors such as woodland, hedgerows and surface watercourses. With regards to impacts on species, there will be temporary disturbance associated with construction activities which may interfere with breeding seasons and movement of species.	High	Medium	Moderate to Minor Adverse
To safeguard the character and diversity of the Scottish landscape and visual amenity	How will the FRC affect national, regional or local landscape character? Does the FRC affect any areas designated for their landscape value e.g. Gardens and Designed Landscapes? Does the FRC have the potential for adverse effects on visual amenity?	**Landscape Character and Landscape Designations** The proposed junction alignment to the north of the Forth would sever the attractive matrix of rolling arable farmland with boundary hedgerow and tree planting features being lost. It would result in the loss of a swathe of deciduous woodland planting which forms an attractive landscape feature. The portal and newly connecting road infrastructure to the south of the Forth would lie in a relatively contained section of the landscape with the existing M9 motorway corridor to the immediate north and a band of woodland planting around the railway and the Union Canal to the south. No landscape designations are directly affected, however, the tunnel and associated road connections run beneath or adjacent to a number of designated features including the Belleknowes and Forth Shore AGLVs on the northern and southern Forth shores respectively, an AOLQ at Humbie and Hopetoun House GDL. Overall impacts on the landscape character of the area affected by Tunnel Crossing C are considered to be Moderate Adverse. **Visual Amenity** With regards to visual amenity, there will be short term impacts resulting from construction while permanent impacts will be associated with the tunnel portals and the road network connections. Receptors have been identified as being of high importance due to the potential for impacts on the views experienced from residential properties. Dependent on the receptors' proximity to and, angle and direction of view of the tunnel portals and road connections, potential impacts range from Minor to Major Adverse.	High	Medium	Minor to Major Adverse
To safeguard cultural heritage features and their settings	Does the FRC affect any features designated for their cultural heritage value (for example listed buildings, Conservation Areas, Scheduled Ancient Monuments, known or unknown archaeology)? Does the FRC affect the setting of any of the above cultural heritage features?	Road network connections would result in indirect visual impacts on the setting of four sites of national importance including Duntarvie Castle and Aldcathie Church which would experience minor and moderate adverse visual impacts respectively. Local and regional sites, including Blackhall Farm and two military defence sites, could experience direct physical and indirect visual impacts. Overall, the magnitude of the impacts on cultural heritage features is considered to be Moderate Adverse.	High	Medium	Moderate Adverse
To contribute to an improvement in national and local air quality by reducing the level of transport related air pollution emissions	Is the FRC likely to have positive or negative effects on any Air Quality Management Areas? Does the FRC contribute to an increase or decrease of the following pollutants: ▪ Benzene ▪ 1,3-Butadiene ▪ Carbon Monoxide ▪ Lead ▪ Nitrogen Dioxide ▪ Particles (PM10) ▪ Sulphur Dioxide	There are no Air Quality Management Areas (AQMAs) located in close proximity to the Firth of Forth, however, the proposal has the potential to influence pollutant emissions across an extensive geographic area, in particular Edinburgh. Within Edinburgh there are two AQMAs covering arterial routes on the west of the city which could be used by city-bound traffic from the bridge. The traffic model used to assess emissions in 2017, compared with the 'do minimum', predicted reductions in the emissions of NOX (-2.1%) and PM10 (-0.4%). Minor Positive effects are therefore predicted. Please note that these results are traffic model-based and have not been informed by a local level assessment.	Medium	Low	Minor Positive
To contribute towards the reduction of national carbon output from transport	Does the FRC contribute to an increase or decrease in transport related CO2 emissions? Does the FRC have the potential to result in a shift towards more sustainable modes of transport?	The receptor has been defined as of Medium importance due to the influence of transport-related emissions on global CO2 emissions and also as a result of the effects of global climate change on various environmental factors i.e. flooding. The traffic model used to assess emissions in 2017, compared with the 'do minimum', predicted a Minor Positive effect on CO2 emissions of -1.6%. Significant Positive effects are therefore predicted. Limitations to the size of the tunnel bore mean it is unlikely that the tunnel will make provisions for other modes of transport or include High Occupancy Vehicle or public transport dedicated lanes.	Medium	Low	Minor Positive

SEA Objective	Questions	Comments on Predicted Residual Impacts (incorporating mitigation set out in section 6)	Importance of Receptor	Magnitude of Impact	Significance of Impact
To protect surface water and groundwater bodies from the impacts of transport	Does the FRC have the potential to affect water quality?	The most significant effects on the water environment are associated with the construction of the scheme. Construction of the bored tunnel would have a negligible effect on the Firth of Forth as works occur beneath it, however, construction of road network connections could impact on adjacent or nearby surface waters either as a result of culverting, realignment or pollution arising from contaminated surface runoff or spillages. No significant effects on the groundwater regime are predicted. Overall impacts are predicted to be Minor Adverse. The Water Framework Directive (WFD) was transposed into Scottish law by the Water Environment and Water Services Act (Scotland) 2003 (WEWS) and Water Environment (Controlled Activities) (Scotland) Regulations 2005 (CAR). The aim of the legislation is the prevention of further deterioration of, and protection or enhancement of, the 'status' of aquatic ecosystems. The development could potentially prevent the surface waters attaining the target of the WFD of "good status by 2015".	Medium	Low	Minor Adverse
To reduce and manage flood risks from transport infrastructure	Does the FRC have the potential to contribute to flooding? Does the FRC affect vulnerability to flooding?	Poorly designed or blocked culverts could lead to localised flooding. In addition, the increase in impermeable surfaces would increase the volume of surface run-off. Effects can however be adequately mitigated and are therefore predicted to be Minor Adverse.	Medium	Low	Minor Adverse
To safeguard the quality of` Scotland's geomorphological, geological and pedologic (soil) resources	Does the FRC affect geomorphological, geological and pedologic (soil) resources? Does the FRC affect sites designated for geological value?	The designation of the Firth of Forth Site of Special Scientific Interest (SSSI) covers geological as well as biological interests, consequently the receptor is considered to be of High Importance, however, the tunnel and associated road network connections are unlikely to impact on the SSSI. This option would not affect any fields designated under national or local designation, however, loss of agricultural land, including some deemed prime quality agricultural land would occur. The tunnel boring activities would disturb larger quantities of soil, particularly during cut and cover activities, however, the effect is predicted to be Moderate Adverse due to the potential to mitigate impacts through storage of affected soil. No significant impacts on local geology are predicted.	Medium	Medium	Moderate Adverse
To contribute to improving health in Scotland by supporting modes of transport which contribute to a healthier lifestyle and by reducing noise and vibration	Does the FRC promote more active lifestyles? Does the FRC result in increased noise and/or vibration?	Due to the location of residential properties and the potential health effects of noise and vibration, the receptor is defined as being of High importance. Major Adverse temporary effects are predicted from construction activities. Permanent operational effects are likely to vary with Moderate Positive impacts in some locations and Major Adverse impact in others. These impacts are predicted due to changes in traffic flows and are likely to occur across a wide geographic area. The tunnel would not include provision for pedestrians or cyclists.	High	Low to high	Major Adverse to Moderate Positive
To provide sustainable access to employment and essential services, and the countryside	Does the FRC contribute to increased access to services via public transport? Does the FRC contribute to increased access to the natural and historic environment?	This proposal will result in increased accessibility, particularly for car users, in areas such as Rosyth, Dunfermline, Limekilns and Charlestown, however, there will be a loss of cross-Forth accessibility in the South Queensferry and Dalmeny area. Corridor C is currently not well served by the public transport network, however, a crossing in this location could expand the public transport network into areas which are not well served at present. Operating as a replacement, a tunnel would mean that current cross-Forth pedestrian and cycle links would be severed as a tunnel is not able to accommodate these modes.	Medium	Low	Minor Adverse to Minor Positive
To maximise the opportunity for community linkages and reduce severance effects of transport	Does the FRC result in severance?	The introduction of new transport corridors associated with the road connections would result in severance effects for a number of residential properties to the west of Rosyth. There is likely to be community severance between Rosyth and Dunfermline. Operating as a replacement, a tunnel would mean that current cross-Forth pedestrian and cycle links would be severed as a tunnel is not able to accommodate these modes.	Medium	Medium	Moderate Adverse
To promote the sustainable use of natural resources – reduce, reuse, recycle and recover	Does the FRC result in the production of large amounts of waste? Can the FRC be designed to reduce, reuse, recycle or recover waste? Does the FRC affect private property or land?	The construction of the tunnel would generate large amounts of waste and the majority of materials used could not be obtained from renewable sources. There is the opportunity to reuse waste materials generated from the tunnel boring in the construction of new road infrastructure. Private property could be affected as construction of the road network connections may require the demolition of properties as well as the loss of agricultural land.	High	Medium	Moderate Adverse

Table F.2 Corridor C2 Tunnel (immersed tube)

SEA Objective	Questions	Comments on Predicted Residual Impacts (incorporating mitigation set out in section 6)	Importance of Receptor	Magnitude of Impact	Significance of Impact
To protect and conserve biodiversity	Does the FRC affect biodiversity? Does the FRC affect designated sites (for example Special Protection Areas, Special Areas of Conservation, Ramsar sites, Sites of Special Scientific Interest and Sites of Interest for Nature Conservation)? Does the FRC affect protected species?	The proposed alignment for Tunnel C (immersed tube) avoids, though is adjacent to, the intertidal areas of the Forth designated as the Firth of Forth SPA. However, when considering the potential impacts on an SPA the important factor is whether there will be adverse impacts on the qualifying features of the SPA, whether they are actually present within the boundaries of the SPA or not. The construction method and alignment proposed for Tunnel C2 are likely to have significant adverse effects on the SPA through disturbance and loss of feeding habitat during the construction period. As a result of construction activities there will be increased disturbance of marine and bird species in both the open water and in the intertidal areas. Dredging the channel that will take the immersed tube below the low water mark will have impacts on water quality and consequently on related ecology within the Forth during the construction period. The direct impact will be the displacement of sediments from the bed of the Forth which would exacerbate existing water quality problems. This would result in a number of indirect effects including: ▪ A reduction in the depth of light penetration into the water. This effectively decreases rates of photosynthetic activity and thus primary productivity in submerged plants such as eelgrass (Zostera spp.), which is a basic food source for aquatic animals. A reduction in the food source at the primary level may then have a knock-on effect upon higher trophic levels, including birds; ▪ Adverse affects on invertebrate populations, and also interfere with the behaviour, migration, feeding and growth of salmonids and other fish species. It can also cause damage to fish gills by abrasion (hyperplasia), and clogging. This is significant in relation to potential impacts on Atlantic salmon which are a qualifying feature of the River Teith SAC. Note that such effects would not be spatially limited to the construction zone; and ▪ Impacts on cetaceans, protected by the Habitat Regulations, the Wildlife and Countryside Act (1981) as amended by the Nature Conservation (Scotland) Act 2004 do use the Forth. Reductions in the availability of food to them as well as disturbance during construction. The proposed location for the shaft and site entrance for the southern shore is generally screened from the Firth of Forth SPA by linear belts of woodland but the scale and duration of the works may still lead to disturbance issues. Indirect effects relating to the works on the northern shore and in open water areas may also have potential for impact. However, the birds of the SPA may become habituated to the general construction activities, and mitigation measures may be possible to limit specific disturbance events by seasonal timing of certain construction activities and having an enforced buffer zone and screening structures for the SPA on either shore. On both the northern and southern shores the potential exists for road network connections to impact on terrestrial ecology including European Protected Species (EPS) as well as valuable habitats. Impacts could include temporary habitat loss due to construction activities, permanent habitat loss as a result of the landtake associated with road connections and fragmentation of wildlife corridors such as woodland, hedgerows and surface watercourses. With regards to impacts on species, there will be temporary disturbance associated with construction activities which may interfere with breeding seasons and movement of species. In the long term impacts associated with movement of species could be impacted upon.	High	High	Major Adverse
To safeguard the character and diversity of the Scottish landscape and visual amenity	How will the FRC affect national, regional or local landscape character? Does the FRC affect any areas designated for their landscape value e.g. Gardens and Designed Landscapes? Does the FRC have the potential for adverse effects on visual amenity?	**Landscape Character and Landscape Designations** The proposed junction alignment to the north of the Forth would sever the attractive matrix of rolling arable farmland with boundary hedgerow and tree planting features being lost. It would result in the loss of a swathe of deciduous woodland planting which forms an attractive landscape feature. The portal and newly connecting road infrastructure to the south of the Forth would lie in a relatively contained section of the landscape with the existing M9 motorway corridor to the immediate north and a band of woodland planting around the railway and the Union Canal to the south. The Belleknowes AGLV would be directly impacted on by the road network connection alignment. It fringes the western boundary of the AGLV. The tunnel and associated road connections run beneath or adjacent to a number of other designated features including the Forth Shore AGLV and Hopetoun House GDL. Overall impacts on the landscape character of the area affected by Tunnel Crossing C are considered to be Moderate Adverse **Visual Amenity** With regards to visual amenity, there will be short term impacts resulting from construction while permanent impacts will be associated with the tunnel portals and the road network connections. Receptors have been identified as being of high importance due to the potential for impacts on the views experienced from residential properties. Dependent on the receptors' proximity to and, angle and direction of view of the tunnel portals and road connections, potential impacts range from Minor to Major Adverse.	High	Medium	Minor to Major Adverse

SEA Objective	Questions	Comments on Predicted Residual Impacts (incorporating mitigation set out in section 6)	Importance of Receptor	Magnitude of Impact	Significance of Impact
To safeguard cultural heritage features and their settings	Does the FRC affect any features designated for their cultural heritage value (for example listed buildings, Conservation Areas, Scheduled Ancient Monuments, known or unknown archaeology)? Does the FRC affect the setting of any of the above cultural heritage features?	Road network connections would result in indirect visual impacts on the setting of four sites of national importance including Duntarvie Castle and Aldcathie Church which would experience minor and moderate adverse visual impacts respectively. Local and regional sites, including Blackhall Farm and two military defence sites, could experience direct physical and indirect visual impacts. Overall, the magnitude of the impacts on cultural heritage features is considered to be Moderate Adverse.	High	Medium	Moderate Adverse
To contribute to an improvement in national and local air quality by reducing the level of transport related air pollution emissions	Is the FRC likely to have positive or negative effects on any Air Quality Management Areas? Does the FRC contribute to an increase or decrease of the following pollutants: ▪ Benzene ▪ 1,3-Butadiene ▪ Carbon Monoxide ▪ Lead ▪ Nitrogen Dioxide ▪ Particles (PM10) ▪ Sulphur Dioxide	There are no Air Quality Management Areas (AQMAs) located in close proximity to the Firth of Forth, however, the proposal has the potential to influence pollutant emissions across an extensive geographic area, in particular Edinburgh. Within Edinburgh there are two AQMAs covering arterial routes on the west of the city which could be used by city-bound traffic from the bridge. The traffic model used to assess emissions in 2017, compared with the 'do minimum', predicted reductions in the emissions of NOX (-2.1%) and PM10 (-0.4%). Minor Positive effects are therefore predicted. Please note that these results are traffic model-based and have not been informed by a local level assessment.	Medium	Low	Minor Positive
To contribute towards the reduction of national carbon output from transport	Does the FRC contribute to an increase or decrease in transport related CO2 emissions? Does the FRC have the potential to result in a shift towards more sustainable modes of transport?	The receptor has been defined as of Medium importance due to the influence of transport-related emissions on global CO2 emissions and also as a result of the effects of global climate change on various environmental factors i.e. flooding. The traffic model used to assess emissions in 2017, compared with the 'do minimum', predicted a Minor Positive effect on CO2 emissions of -1.6%. Significant Positive effects are therefore predicted. Limitations to the size of the tunnel bore mean it is unlikely that the tunnel will make provisions for other modes of transport or include High Occupancy Vehicle or public transport dedicated lanes.	Medium	Low	Minor Positive
To protect surface water and groundwater bodies from the impacts of transport	Does the FRC have the potential to affect water quality?	The most significant effects on the water environment are associated with the construction of the scheme. Construction of the immersed tube tunnel would involve the dredging of a trench on the sea bed and lowering the pre-fabricated tunnel into it, both of these could have a significant negative effect on the Firth of Forth as a result of the large volumes of displaced sediment. Construction of the bored tunnel would have a negligible effect on the Firth of Forth as works occur beneath it, however, construction of road network connections could impact on adjacent or nearby surface waters either as a result of culverting, realignment or pollution arising from contaminated surface runoff or spillages. No significant effects on the groundwater regime are predicted. Overall impacts are predicted to be Major Adverse. The Water Framework Directive (WFD) was transposed into Scottish law by the Water Environment and Water Services Act (Scotland) 2003 (WEWS) and Water Environment (Controlled Activities) (Scotland) Regulations 2005 (CAR). The aim of the legislation is the prevention of further deterioration of, and protection or enhancement of, the 'status' of aquatic ecosystems. The development could potentially prevent the surface waters attaining the target of the WFD of "good status by 2015".	Medium	High	Major Adverse
To reduce and manage flood risks from transport infrastructure	Does the FRC have the potential to contribute to flooding? Does the FRC affect vulnerability to flooding?	Poorly designed or blocked culverts could lead to localised flooding. In addition, the increase in impermeable surfaces would increase the volume of surface run-off. Effects can however be adequately mitigated and are therefore predicted to be Minor Adverse.	Medium	Low	Minor Adverse
To safeguard the quality of` Scotland's geomorphological, geological and pedologic (soil) resources	Does the FRC affect geomorphological, geological and pedologic (soil) resources? Does the FRC affect sites designated for geological value?	The designation of the Firth of Forth Site of Special Scientific Interest (SSSI) covers geological as well as biological interests, consequently the receptor is considered to be of High Importance, however, the tunnel and associated road network connections are unlikely to impact on the SSSI. This option would not affect any fields designated under national or local designation, however, loss of agricultural land, including some deemed prime quality agricultural land would occur. The tunnel boring activities would disturb larger quantities of soil, particularly during cut and cover activities, however, the effect is predicted to be Moderate Adverse due to the potential to mitigate impacts through storage of affected soil. No significant impacts on local geology are predicted.	High	Medium	Moderate Adverse
To contribute to improving health in Scotland by supporting modes of transport which contribute to a healthier lifestyle and by reducing noise and vibration	Does the FRC promote more active lifestyles? Does the FRC result in increased noise and/or vibration?	Due to the location of residential properties and the potential health effects of noise and vibration, the receptor is defined as being of High importance. Major Adverse temporary effects are predicted from construction activities. Permanent operational effects are likely to vary with Moderate Positive impacts in some locations and Major Adverse impact in others. These impacts are predicted due to changes in traffic flows and are likely to occur across a wide geographic area. The tunnel would not include provision for pedestrians or cyclists.	Medium	Low to high	Major Adverse to Moderate Positive

SEA Objective	Questions	Comments on Predicted Residual Impacts (incorporating mitigation set out in section 6)	Importance of Receptor	Magnitude of Impact	Significance of Impact
To provide sustainable access to employment and essential services, and the countryside	Does the FRC contribute to increased access to services via public transport? Does the FRC contribute to increased access to the natural and historic environment?	This proposal will result in increased accessibility, particularly for car users, in areas such as Rosyth, Dunfermline, Limekilns and Charlestown, however, there will be a loss of cross-Forth accessibility in the South Queensferry and Dalmeny area. Corridor C is currently not well served by the public transport network, however, a crossing in this location could expand the public transport network into areas which are not well served at present. Operating as a replacement, a tunnel would mean that current cross-Forth pedestrian and cycle links would be severed as a tunnel is not able to accommodate these modes.	Medium	Low	Minor Adverse to Minor Positive
To maximise the opportunity for community linkages and reduce severance effects of transport	Does the FRC result in severance?	The introduction of new transport corridors associated with the road connections would result in severance effects for a number of residential properties to the west of Rosyth such as Pattiesmuir. There is likely to be community severance between Rosyth and Dunfermline. Operating as a replacement, a tunnel would mean that current cross-Forth pedestrian and cycle links would be severed as a tunnel is not able to accommodate these modes.	Medium	Medium	Moderate Adverse
To promote the sustainable use of natural resources – reduce, reuse, recycle and recover	Does the FRC result in the production of large amounts of waste? Can the FRC be designed to reduce, reuse, recycle or recover waste? Does the FRC affect private property or land?	The construction of the tunnel would generate large amounts of waste and the majority of materials used could not be obtained from renewable sources. There is the opportunity to reuse waste materials generated from the channel dredging in the construction of new road infrastructure. Private property could be affected as construction of the road network connections may require the demolition of properties as well as the loss of agricultural land.	High	Medium	Moderate Adverse

Table F.3 Corridor D Bridge

SEA Objective	Questions	Comments on Predicted Residual Impacts (incorporating mitigation set out in section 6)	Importance of Receptor	Magnitude of Impact	Significance of Impact
To protect and conserve biodiversity	Does the FRC affect biodiversity? Does the FRC affect designated sites (for example Special Protection Areas, Special Areas of Conservation, Ramsar sites, Sites of Special Scientific Interest and Sites of Interest for Nature Conservation)? Does the FRC affect protected species?	The bridge crossing has the potential for negative impact on all three Natura 2000 sites, however, there are no direct impacts on these sites. The construction of the bridge could potentially cause disturbance to the wintering bird assemblages of the Firth of Forth SPA, both in the intertidal areas and open water. The Forth Islands SPA is designated for its breeding common, roseate, sandwich and arctic tern colonies and breeding seabird assemblages. Most of this SPA is located in the outer Firth of Forth, however, Long Craig Island is situated beneath the Forth Road Bridge and supports important tern colonies. Long Craig Island is approximately 400 metres from the proposed bridge alignment; the impacts of construction on the shore and open water have potential for disturbance to feeding and flight lines to foraging areas and construction activities such as pile driving may cause disturbance to breeding birds. The River Teith SAC relies upon the successful migration through the Forth of salmon, sea lamprey and river lamprey. There is potential for this migration to be interrupted by temporary indirect impacts of construction such as increased turbidity and the acoustic impact of pile driving. Similarly for cetaceans, construction activities, in particular pile driving, could result in disturbance. On both the northern and southern shores the potential exists for road network connections to impact on terrestrial ecology including European Protected Species (EPS), St Margarets Marsh SSSI and other valuable habitats. St Margaret's Marsh SSSI is a 26.4ha area designated for its coastland habitat. The proposed junctions to link the bridge to the motorway will result in loss of habitat in the east of the SSSI. Indirect impacts are also possible such as modification of remaining habitat through disturbance, shading and dust, disturbance to birds from construction and operation, alterations to groundwater conditions. Additional terrestrial impacts on ecology could include temporary habitat loss due to construction activities, permanent habitat loss as a result of the landtake associated with road connections and fragmentation of wildlife corridors such as woodland, hedgerows and surface watercourses. This proposal has the potential to fragment corridors that otters may travel along. Overall this option has Moderate to Major Adverse Effect.	High	Medium	Major to Moderate Adverse
To safeguard the character and diversity of the Scottish landscape and visual amenity	How will the FRC affect national, regional or local landscape character? Does the FRC affect any areas designated for their landscape value e.g. Gardens and Designed Landscapes? Does the FRC have the potential for adverse effects on visual amenity?	**Landscape Character and Landscape Designations** No designated landscapes would be directly affected by this option. GDLs and an AGLV are located approximately 1-2 km from possible highway works to the north of the Forth but the setting of these is unlikely to be affected. Road works are however likely to result in Minor Adverse effects on the setting of designated greenbelt. To the south of the river, new road infrastructure would be located in the vicinity of 2 GDLs (Hopetoun House and Dundas Castle). It is likely that this road infrastructure would result in Moderate Adverse effects on the setting of the Hopetoun House GDL. The proposed bridge crossing options would be taller than both existing bridges. A new bridge could increase the influence of the bridges on the landscape, decreasing the apparent scale of the Forth from closer viewpoints. A new junction to the north of the Forth would result in the loss of a large section of attractive ancient woodland to the east of St Margaret's Hope. The junction and associated roads would create prominent structures within the landscape, further severing the open valley landscape. To the south of the Forth, an extensive area of shoreline woodland which connects various designed landscapes would also be lost. New road infrastructure in this area would further increase the prominence of transport corridors in this open landscape, fragmenting rolling farmland which is typical or this area and resulting in the loss of hedgerows, trees and shelterbelt planting. In addition to these Major Adverse permanent effects, the creation of construction compounds at Port Edgar and South Queensferry would result in Moderate Adverse temporary effects. **Visual Amenity** In terms of visual amenity, receptors have again been identified as being of High importance, due to the potential for impacts on the views experienced from residential properties. Potential impacts would range from Minor to Major Adverse depending on the sensitivity of the receptor and the receptor's proximity, angle and direction of view of the development. In summary, this option would substantially change the character of the Firth of Forth and its hinterland and has the potential for Highly Significant Adverse effects on both landscape character and visual amenity.	High	Medium	Minor to Major Adverse

SEA Objective	Questions	Comments on Predicted Residual Impacts (incorporating mitigation set out in section 6)	Importance of Receptor	Magnitude of Impact	Significance of Impact
To safeguard cultural heritage features and their settings	Does the FRC affect any features designated for their cultural heritage value (for example listed buildings, Conservation Areas, Scheduled Ancient Monuments, known or unknown archaeology)? Does the FRC affect the setting of any of the above cultural heritage features?	Major Adverse effects are predicted due to direct impacts on a Scheduled Ancient Monument; a souterrain at Middlebank House. Major Adverse effects are also predicted as Hopetoun House is listed in Inventory of Gardens and Designed Landscapes. A new bridge is likely to result in Moderate Adverse impacts on the setting of 3 Grade A Listed Buildings. Impacts on the setting of the existing bridges, both of which are Grade A Listed structures, are predicted to result in Moderate Adverse effects. Minor Adverse effects on the setting of Duntarvie Castle, a Scheduled Ancient Monument, are also likely to occur. Moderate Adverse effects are predicted doe to impacts on the setting of 3 GDLs. Those affected would be Dundas Castle, Fordell Castle and Newliston. This option is also likely to result in Moderate Adverse impacts on the Queensferry Conservation Area. The overall impacts on Cultural Heritage are predicted to be Major Adverse.	High	High	Major Adverse
To contribute to an improvement in national and local air quality by reducing the level of transport related air pollution emissions	Is the FRC likely to have positive or negative effects on any Air Quality Management Areas? Does the FRC contribute to an increase or decrease of the following pollutants: ▪ Benzene ▪ 1,3-Butadiene ▪ Carbon Monoxide ▪ Lead ▪ Nitrogen Dioxide ▪ Particles (PM10) ▪ Sulphur Dioxide	There are no Air Quality Management Areas (AQMAs) located in close proximity to the Firth of Forth, however, the proposal has the potential to influence pollutant emissions across an extensive geographic area, in particular Edinburgh. Within Edinburgh there are two AQMAs covering arterial routes on the west of the city which could be used by city-bound traffic from the bridge. The model used to assess emissions in 2017, compared with the 'do minimum', predicted a Minor Positive effect on NOX (-3.2%) and PM10 (-0.4%) emissions. Significant Positive effects are therefore predicted. Please note that these results are model-based and have not been informed by a local level assessment.	Medium	Low	Minor Positive
To contribute towards the reduction of national carbon output from transport	Does the FRC contribute to an increase or decrease in transport related CO2 emissions? Does the FRC have the potential to result in a shift towards more sustainable modes of transport?	The receptor has been defined as of Medium importance due to the influence of transport-related emissions on global CO2 emissions and due to the effects of global climate change on various environmental factors. The model used to assess emissions in 2017, compared with the 'do minimum', predicted a Minor Positive effect on CO2 emissions of -2.2%. Significant Positive effects are predicted. Please note that these results are model-based and have not been informed by a local level assessment. A bridge crossing could operate with a lane dedicated to High Occupancy Vehicles or public transport which may contribute to reducing CO2 emissions.	Medium	Low	Minor Positive
To protect surface water and groundwater bodies from the impacts of transport	Does the FRC have the potential to affect water quality?	The most significant effects on the water environment are associated with the construction of the scheme. Construction of road network connections could impact on adjacent or nearby surface waters either as a result of culverting, realignment or pollution arising from contaminated surface runoff or spillages. Construction of the bridge would have short term effects on the morphology of the Firth of Forth, however, in long term the effect of new tower structures which support the bridge are predicted to be neutral. No significant effects on the groundwater regime are predicted. Overall impacts are predicted to be Minor Adverse. The Water Framework Directive (WFD) was transposed into Scottish law by the Water Environment and Water Services Act (Scotland) 2003 (WEWS) and Water Environment (Controlled Activities) (Scotland) Regulations 2005 (CAR). The aim of the legislation is the prevention of further deterioration of, and protection or enhancement of, the 'status' of aquatic ecosystems. The development could potentially prevent the surface waters attaining the target of the WFD of "good status by 2015".	Medium	Low	Minor Adverse
To reduce and manage flood risks from transport infrastructure	Does the FRC have the potential to contribute to flooding? Does the FRC affect vulnerability to flooding?	Poorly designed or blocked culverts could lead to localised flooding. In addition, the increase in impermeable surfaces would increase the volume of surface run-off. Effects can however be adequately mitigated and are therefore predicted to be Minor Adverse.	Medium	Low	Minor Adverse
To safeguard the quality of` Scotland's geomorphological, geological and pedologic (soil) resources	Does the FRC affect geomorphological, geological and pedologic (soil) resources? Does the FRC affect sites designated for geological value?	The designation of the Firth of Forth Site of Special Scientific Interest (SSSI) covers geological as well as biological interests, consequently the receptor is considered to be of High Importance, however, this proposal is unlikely to impact on the SSSI. This option would not affect any fields designated under national or local designation, however loss of agricultural land, including agricultural land deemed prime quality, would occur. Although a substantial area of agricultural land is predicted to be lost, the effect on soils is only predicted to be Minor Adverse due to the potential to mitigate impacts through storage of affected soil. No significant impacts on local geology are predicted.	Medium	Medium	Moderate Adverse

SEA Objective	Questions	Comments on Predicted Residual Impacts (incorporating mitigation set out in section 6)	Importance of Receptor	Magnitude of Impact	Significance of Impact
To contribute to improving health in Scotland by supporting modes of transport which contribute to a healthier lifestyle and by reducing noise and vibration	Does the FRC promote more active lifestyles? Does the FRC result in increased noise and/or vibration?	Due to the location of residential properties and the potential health effects of noise and vibration, the receptor is defined as being of High importance. Major Adverse temporary effects are predicted from construction activities. Permanent operational effects are likely to vary with Moderate Positive impacts in some locations and Major Adverse impact in others. These impacts are predicted due to changes in traffic flows and are likely to occur across a wide geographic area. Both pedestrians and cyclists would be able to use a replacement bridge.	High	Low to high	Major Adverse to Moderate Positive
To provide sustainable access to employment and essential services, and the countryside	Does the FRC contribute to increased access to services via public transport? Does the FRC contribute to increased access to the natural and historic environment?	Operating as a replacement for the existing FRB, the similarity of this proposal to the existing crossing, on the north shore of the Firth of Forth, would result in minimal impacts upon accessibility depending upon the detail of the network connections. On the southern shore of the Firth of Forth, this proposal would link with South Queensferry and retain existing levels of accessibility in this area, albeit Dalmeny residents may have to travel further to access the new crossing which is likely to entail disproportionate disbenefits for non-car owners. The proximity of the proposal to the existing public transport network, associated infrastructure and developed areas would enable an enhanced public transport network to better serve the needs of its users.	Medium	Low	Minor Positive
To maximise the opportunity for community linkages and reduce severance effects of transport	Does the FRC result in severance?	Due to the potential for direct effects on residents, the receptor is defined as being of high importance. The introduction of new transport corridors would result in severance effects for a number of residential properties in the Totley Wells area.	Medium	Medium	Minor Adverse
To promote the sustainable use of natural resources – reduce, reuse, recycle and recover	Does the FRC result in the production of large amounts of waste? Can the FRC be designed to reduce, reuse, recycle or recover waste? Does the FRC affect private property or land?	The construction of Bridge D would generate large amounts of waste and the majority of materials used could not be obtained from renewable sources. There is the opportunity to reuse waste materials in the construction of new road infrastructure. Private property could be affected as construction of the road network connections may require the demolition of properties as well as the loss of agricultural land.	High	Medium	Moderate Adverse

Table F.4 Corridor D Tunnel (bored)

SEA Objective	Questions	Comments on Predicted Residual Impacts (incorporating mitigation set out in section 6)	Importance of Receptor	Magnitude of Impact	Significance of Impact
To protect and conserve biodiversity	Does the FRC affect biodiversity? Does the FRC affect designated sites (for example Special Protection Areas, Special Areas of Conservation, Ramsar sites, Sites of Special Scientific Interest and Sites of Interest for Nature Conservation)? Does the FRC affect protected species?	This tunnel would pass beneath the Firth of Forth SPA, avoiding direct impacts, but the proposed location of the northern shaft may have indirect impacts on the Firth of Forth SPA and also St Margaret's Marsh SSSI, both which lie adjacent to this shaft site. The potential impacts on both of these sites relate to disturbance of birds, and also indirect effects of construction such as dust and contaminated run off. The site is currently scattered scrub, and bird communities will be using this for breeding in conjunction with St Margaret's Marsh. St Margaret's Marsh, being a coastal water reed bed, is also vulnerable to changes in groundwater conditions. A bored tunnel, due to the construction techniques involved is likely to have an overall neutral effect on marine ecology i.e. cetaceans, seals, and fish. On both the northern and southern shores the potential exists for road network connections to impact on terrestrial ecology including European Protected Species (EPS) as well as valuable habitats. Impacts could include temporary habitat loss due to construction activities, permanent habitat loss as a result of the landtake associated with road connections and fragmentation of wildlife corridors such as woodland, hedgerows and surface watercourses The proposed construction site for the portal lies approximately 400 metres from a pond with an extant great crested newt population. The distribution of great crested newts in other ponds in this area has not fully been studied, although many ponds in the area were surveyed in 1996 and no further ponds were found to be positive for great crested newt. The connecting infrastructure to the M9, the southern connections to the A90 and the linking road to Hillend indicate potential for impacts to otters, particularly in terms of fragmentation as many small burns are crossed.	High	Medium	Moderate to Minor Adverse
To safeguard the character and diversity of the Scottish landscape and visual amenity	How will the FRC affect national, regional or local landscape character? Does the FRC affect any areas designated for their landscape value e.g. Gardens and Designed Landscapes? Does the FRC have the potential for adverse effects on visual amenity?	**Landscape Character and Landscape Designations** The new roads and junction improvements to the north of the Forth would result in the introduction of prominent structures into the open valley landscape to the north of Inverkeithing and further severance of scrub woodland and grassland which currently separates the existing bridge road network from the western edge of Inverkeithing. The tunnel portal construction to the south of the Forth would result in significant earthworks which would appear relatively incongruous with the existing landscape structure. The road network connection would result in the loss of a number of features which contribute to Humbie AOLQ including woodland, boundary planting and watercourses. The Humbie AOLQ would be directly affected by road infrastructure located on southern shore as it would be dissected by the road network connection. New Liston, Dundas Castle and Hopetoun House Gardens and Designed Landscape will experience indirect effects on their settings. The Forth Shore/Hopetoun AGLV will be directly impacted on during construction of the tunnel portal. Overall impacts on the landscape character of the area affected by Tunnel Crossing D are considered to be Major to Moderate Adverse. **Visual Amenity** With regards to visual amenity, there will be short term impacts resulting from construction while permanent impacts will be associated with the tunnel portals and the road network connections. Receptors have been identified as being of high importance due to the potential for impacts on the views experienced from residential properties. Dependent on the receptors' proximity to and, angle and direction of view of the tunnel portals and road connections, potential impacts range from Minor to Major Adverse.	High	Medium	Minor to Major Adverse
To safeguard cultural heritage features and their settings	Does the FRC affect any features designated for their cultural heritage value (for example listed buildings, Conservation Areas, Scheduled Ancient Monuments, known or unknown archaeology)? Does the FRC affect the setting of any of the above cultural heritage features?	Direct physical and indirect visual impacts will be caused by road network connections and tunnel portals. Scheduled Ancient Monuments (SAMs) including a souterrain at Middlebank House and Duntarvie Castle will experience negative indirect effects on their respective setting as will a number of listed buildings and gardens and designed landscapes including Hopetoun House and Dundas Castle. Additionally, a number of archaeological sites of local and regional importance will be directly affected. Overall, the magnitude of the impacts on cultural heritage features is considered to be Moderate adverse.	High	Medium	Moderate Adverse
To contribute to an improvement in national and local air quality by reducing the level of transport related air pollution emissions	Is the FRC likely to have positive or negative effects on any Air Quality Management Areas? Does the FRC contribute to an increase or decrease of the following pollutants: ▪ Benzene ▪ 1,3-Butadiene ▪ Carbon Monoxide ▪ Lead ▪ Nitrogen Dioxide ▪ Particles (PM10) ▪ Sulphur Dioxide	There are no Air Quality Management Areas (AQMAs) located in close proximity to the Firth of Forth, however, the proposal has the potential to influence pollutant emissions across an extensive geographic area, in particular Edinburgh. Within Edinburgh there are two AQMAs covering arterial routes on the west of the city which could be used by city-bound traffic from the bridge. The traffic model used to assess emissions in 2017, compared with the 'do minimum', predicted reductions in the emissions of NOX (-2.0%) and a slight increase in the emission of PM10 (0.8%). Overall Minor Positive effects are likely. Please note that these results are traffic model-based and have not been informed by a local level assessment.	Medium	Low	Minor Positive

SEA Objective	Questions	Comments on Predicted Residual Impacts (incorporating mitigation set out in section 6)	Importance of Receptor	Magnitude of Impact	Significance of Impact
To contribute towards the reduction of national carbon output from transport	Does the FRC contribute to an increase or decrease in transport related CO2 emissions? Does the FRC have the potential to result in a shift towards more sustainable modes of transport?	The receptor has been defined as of Medium importance due to the influence of transport-related emissions on global CO2 emissions and also as a result of the effects of global climate change on various environmental factors i.e. flooding. The traffic model used to assess emissions in 2017, compared with the 'do minimum', predicted a Minor Positive effect i.e. a reduction of CO2 emissions of -1.1%. Significant Positive effects are therefore predicted. Limitations to the size of the tunnel bore mean it is unlikely that the tunnel will make provisions for other modes of transport or include High Occupancy Vehicle or public transport dedicated lanes.	Medium	Low	Minor Positive
To protect surface water and groundwater bodies from the impacts of transport	Does the FRC have the potential to affect water quality?	The most significant effects on the water environment are associated with the construction of the scheme. Construction of the bored tunnel would have a negligible effect on the Firth of Forth as works occur beneath it, however, construction of road network connections could impact on adjacent or nearby surface waters either as a result of culverting, realignment or pollution arising from contaminated surface runoff or spillages. No significant effects on the groundwater regime are predicted. Overall impacts are predicted to be Minor to Moderate Adverse. The Water Framework Directive (WFD) was transposed into Scottish law by the Water Environment and Water Services Act (Scotland) 2003 (WEWS) and Water Environment (Controlled Activities) (Scotland) Regulations 2005 (CAR). The aim of the legislation is the prevention of further deterioration of, and protection or enhancement of, the 'status' of aquatic ecosystems. The development could potentially prevent the surface waters attaining the target of the WFD of "good status by 2015".	Medium	Low	Minor Adverse
To reduce and manage flood risks from transport infrastructure	Does the FRC have the potential to contribute to flooding? Does the FRC affect vulnerability to flooding?	Poorly designed or blocked culverts could lead to localised flooding. In addition, the increase in impermeable surfaces would increase the volume of surface run-off. Effects can however be adequately mitigated and are therefore predicted to be Minor Adverse.	Medium	Low	Minor Adverse
To safeguard the quality of` Scotland's geomorphological, geological and pedologic (soil) resources	Does the FRC affect geomorphological, geological and pedologic (soil) resources? Does the FRC affect sites designated for geological value?	The designation of the Firth of Forth Site of Special Scientific Interest (SSSI) covers geological as well as biological interests, consequently the receptor is considered to be of High Importance, however, the tunnel and associated road network connections are unlikely to impact on the SSSI. Corridor D Tunnel affects agricultural land, classified as prime quality agricultural land, and land that is also within the Countryside Policy Area (Rural West Edinburgh Local Plan). The tunnel boring activities would disturb larger quantities of soil, particularly during cut and cover activities, however, the effect is predicted to be Moderate Adverse due to the potential to mitigate impacts through storage of affected soil. No significant impacts on local geology are predicted.	Medium	Medium	Moderate Adverse
To contribute to improving health in Scotland by supporting modes of transport which contribute to a healthier lifestyle and by reducing noise and vibration	Does the FRC promote more active lifestyles? Does the FRC result in increased noise and/or vibration?	Due to the location of residential properties and the potential health effects of noise and vibration, the receptor is defined as being of High importance. Major Adverse temporary effects are predicted from construction activities. Permanent operational effects are likely to vary with Moderate Positive impacts in some locations and Major Adverse impact in others. These impacts are predicted due to changes in traffic flows and are likely to occur across a wide geographic area. The tunnel would not include provision for pedestrians or cyclists.	High	Low to high	Major Adverse to Moderate Positive
To provide sustainable access to employment and essential services, and the countryside	Does the FRC contribute to increased access to services via public transport? Does the FRC contribute to increased access to the natural and historic environment?	Operating as a Replacement Crossing, and due to its proximity to the existing crossing, Tunnel D would have minimal impacts on the northern shore, However, on the southern shoe the tunnel ties into the M9 as opposed to South Queensferry. The proximity of the proposal to the existing public transport network, associated infrastructure and developed areas would enable an enhanced public transport network to better serve the needs of its users. Operating as a replacement, a tunnel would mean that current cross-Forth pedestrian and cycle links would be severed as a tunnel is not able to accommodate these modes.	Medium	Low	Minor Adverse
To maximise the opportunity for community linkages and reduce severance effects of transport	Does the FRC result in severance?	The road network connections on the southern shore are likely to result in severance in the Carmelhill area and on the northern shore the junctions connecting to the existing road network would lead to severance in the Inverkeithing area.	Medium	Medium	Moderate Adverse
To promote the sustainable use of natural resources – reduce, reuse, recycle and recover	Does the FRC result in the production of large amounts of waste? Can the FRC be designed to reduce, reuse, recycle or recover waste? Does the FRC affect private property or land?	The construction of the tunnel would generate large amounts of waste and the majority of materials used could not be obtained from renewable sources. There is the opportunity to reuse waste materials generated from the tunnel boring in the construction of new road infrastructure. Private property could be affected as construction of the road network connections may require the demolition of properties as well as the loss of agricultural land.	High	Medium	Moderate Adverse

Table F.5 No New Crossing Scenario

SEA Objective	Questions	Comments on Predicted Residual Impacts (incorporating mitigation set out in section 6)	Importance of Receptor	Magnitude of Impact	Significance of Impact
To protect and conserve biodiversity	Does the FRC affect biodiversity? Does the FRC affect designated sites (for example Special Protection Areas, Special Areas of Conservation, Ramsar sites, Sites of Special Scientific Interest and Sites of Interest for Nature Conservation)? Does the FRC affect protected species?	Dependent on the location of public transport infrastructure there should be no effects on the SPA. The dualling of the A985 should also have no effects on the SPAs. This option should have no impacts on the marine environment. The potential exists for the dualling of the A985 and public transport schemes to impact on terrestrial ecology including European Protected Species (EPS) as well as valuable habitats. Impacts could include temporary habitat loss due to construction activities, permanent habitat loss as a result of the landtake associated with road connections and fragmentation of wildlife corridors such as woodland, hedgerows and surface watercourses.	High	Medium	Moderate Adverse
To safeguard the character and diversity of the Scottish landscape and visual amenity	How will the FRC affect national, regional or local landscape character? Does the FRC affect any areas designated for their landscape value e.g. Gardens and Designed Landscapes? Does the FRC have the potential for adverse effects on visual amenity?	**Landscape Character and Landscape Designations** There will be adverse effects on landscape associated with dualling the A985 as the road crosses through the Belleknowes AGLV. The location of public transport infrastructure would, assuming they are sited within an urban environment, have minimal impacts on landscape character. Overall impacts on landscape are likely to be Moderate Adverse. **Visual Amenity** In terms of visual amenity, receptors have again been identified as being of High importance, due to the potential for impacts on the views experienced from residential properties. Potential impacts would range from Negligible to Major Adverse depending on the proposal, i.e. the sensitivity of the receptor and the receptor's proximity, angle and direction of view of the developments; either the dualling of the A985 or the public transport measures.	High	Medium	Minor to Major Adverse
To safeguard cultural heritage features and their settings	Does the FRC affect any features designated for their cultural heritage value (for example listed buildings, Conservation Areas, Scheduled Ancient Monuments, known or unknown archaeology)? Does the FRC affect the setting of any of the above cultural heritage features?	The proposal, in particular the dualling of the A985, has the potential to have direct physical and indirect visual impacts on a number of sites of heritage or archaeological value. The Tuilyies Standing Stone a Schedule Ancient Monument and a number of listed buildings are close to or immediately adjacent to the A985, consequently they may experience adverse impacts on their settings and in some cases direct physical impacts. There may be some impacts on the settings of listed buildings and sites of regional or local importance resulting from the development of public transport related facilities and infrastructure. The overall impacts on Cultural Heritage are considered to be Major Adverse.	High	High	Major Adverse
To contribute to an improvement in national and local air quality by reducing the level of transport related air pollution emissions	Is the FRC likely to have positive or negative effects on any Air Quality Management Areas? Does the FRC contribute to an increase or decrease of the following pollutants: ▪ Benzene ▪ 1,3-Butadiene ▪ Carbon Monoxide ▪ Lead ▪ Nitrogen Dioxide ▪ Particles (PM10) ▪ Sulphur Dioxide	During refurbishment of the existing bridge there will be significant adverse effects on air quality as a result of increased congestion and the diversionary routes that will be in place. The proposal includes a number of measures that aim to promote modal shift including a cross-Forth ferry service, Park and Choose sites and increases in bus and rail services. Should these measures result in reductions in private car use there may be positive effects on air quality as a result of reduced emissions. Following refurbishment, the proposal also includes the provision of High Occupancy Vehicle/public transport lanes on the existing bridge and approach roads to it, while this may encourage some modal shift it will also result in increased traffic congestion. The dualling of the A985, also included within this option, will increase road capacity and may result in increased traffic levels and greater emissions of pollutants. Traffic modelling suggests that, as a result of reduced capacity on the bridge for Heavy Goods Vehicles (HGVs) and Single Occupancy Vehicles (SOVs), traffic flows could be re-distributed and lengthier diversionary routes utilised. There are no Air Quality Management Areas (AQMAs) located in close proximity to the Firth of Forth, however, the proposal has the potential to influence pollutant emissions across an extensive geographic area, in particular Edinburgh. Within Edinburgh there are two AQMAs covering arterial routes on the west of the city which could be used by city-bound traffic from the existing bridge. This option may reduce the volume of Edinburgh-bound traffic and positively impact on the AQMAs. Overall it is likely that option will have a Minor Adverse impact on air quality. It should be noted that no air quality modelling has informed this assessment.	Medium	Low	Minor Adverse
To contribute towards the reduction of national carbon output from transport	Does the FRC contribute to an increase or decrease in transport related CO2 emissions? Does the FRC have the potential to result in a shift towards more sustainable modes of transport?	The receptor has been defined as of Medium importance due to the influence of transport-related emissions on global CO2 emissions and due to the effects of global climate change on various environmental factors. As above, the option comprises measures which could positively and negatively influence the emission of CO2, however, overall it is likely that there will Minor Adverse impacts.	Medium	Low	Minor Adverse

SEA Objective	Questions	Comments on Predicted Residual Impacts (incorporating mitigation set out in section 6)	Importance of Receptor	Magnitude of Impact	Significance of Impact
To protect surface water and groundwater bodies from the impacts of transport	Does the FRC have the potential to affect water quality?	The refurbishment of the bridge is unlikely to result in significant impacts on the Firth of Forth. Dependent on proximity to surface waters, dualling the A985 and construction of public transport infrastructure could impact on adjacent or nearby surface waters either as a result of culverting, realignment or pollution arising from contaminated surface runoff or spillages. No significant effects on the groundwater regime are predicted. Overall impacts are predicted to be Minor Adverse. The Water Framework Directive (WFD) was transposed into Scottish law by the Water Environment and Water Services Act (Scotland) 2003 (WEWS) and Water Environment (Controlled Activities) (Scotland) Regulations 2005 (CAR). The aim of the legislation is the prevention of further deterioration of, and protection or enhancement of, the 'status' of aquatic ecosystems. The development could potentially prevent the surface waters attaining the target of the WFD of "good status by 2015".	Medium	Low	Minor Adverse
To reduce and manage flood risks from transport infrastructure	Does the FRC have the potential to contribute to flooding? Does the FRC affect vulnerability to flooding?	Public transport infrastructure and dualling the A985 will result in an increase in hardstanding surfaces that will increase surface run off and flood risk, however, the proposals could all be mitigated such that the flood risk is minimal. Overall there is likely to be Minor Adverse impacts.	Medium	Low	Minor Adverse
To safeguard the quality of` Scotland's geomorphological, geological and pedologic (soil) resources	Does the FRC affect geomorphological, geological and pedologic (soil) resources? Does the FRC affect sites designated for geological value?	No geological SSSIs or RIGs are affected by this option. Some agricultural land will be lost as a result of dualling the A985 and potentially, dependent on location, new public transport facilities and infrastructure. Overall this effect is likely to be Moderate Adverse	Medium	Medium	Moderate Adverse
To contribute to improving health in Scotland by supporting modes of transport which contribute to a healthier lifestyle and by reducing noise and vibration	Does the FRC promote more active lifestyles? Does the FRC result in increased noise and/or vibration?	Construction of the schemes comprising this option will result in significant adverse noise and vibration related impacts. Major Adverse temporary effects are predicted from construction activities. Permanent operational effects are likely to vary with Minor Positive impacts in some locations and Major Adverse impacts in others. These impacts are predicted due to changes in traffic flows and are likely to occur across a wide geographic area. By refurbishing the existing bridge cross-Forth accessibility for pedestrians and cyclists will be maintained.	High	Low to high	Major Adverse to Moderate Positive
To provide sustainable access to employment and essential services, and the countryside	Does the FRC contribute to increased access to services via public transport? Does the FRC contribute to increased access to the natural and historic environment?	As result of additional public transport services there will be an increase in capacity for cross-Forth person trips which will have a positive impact on public transport accessibility between north Edinburgh and South Fife. However, accessibility for HGVs and SOVs will be significantly reduced.	Medium	Medium	Moderate Adverse
To maximise the opportunity for community linkages and reduce severance effects of transport	Does the FRC result in severance?	This option should not result in transport related severance.	Medium	Negligible	Negligible
To promote the sustainable use of natural resources – reduce, reuse, recycle and recover	Does the FRC result in the production of large amounts of waste? Can the FRC be designed to reduce, reuse, recycle or recover waste? Does the FRC affect private property or land?	The construction of public transport facilities and dualling the A985 would generate significant amounts of waste and the majority of materials used could not be obtained from renewable sources. Some properties and agricultural land could be affected by the development of public transport infrastructure and dualling of the A985.	High	Medium	Moderate Adverse