4 The Proposed Scheme

4.1 Introduction

4.1.1 This chapter provides a description of the proposed scheme, including information on the procurement process, design of the route, layout of the proposed scheme, methods and programme of construction.

4.1.2 This ES reports on the proposed scheme at the Stage 3 level of engineering design as defined in DMRB.

4.2 Scheme Procurement

4.2.1 As announced to Parliament by the Minister for Transport, Infrastructure and Climate Change on 10 December 2008, the Forth Replacement Crossing Project is to be procured by means of a Design and Build (D&B) Contract. Under the terms of this contract, the Contractor will undertake both the detailed design and construction of the project.

4.2.2 The terms of the contract and contract management arrangements will ensure that the detailed design of the proposed scheme, including environmental mitigation, will be implemented in compliance with this ES.

4.3 Scheme Design

4.3.1 As detailed in Chapter 3 (Alternatives Considered), the preferred route corridor for the proposed scheme was identified following the DMRB Stage 2 assessment.

4.3.2 Following the refinement of the proposed scheme definition to include the Forth Road Bridge as a public transport crossing as part of a managed crossing strategy, the Stage 3 design has been informed by a number of factors.

4.3.3 Throughout the development of the proposed scheme described in this chapter, consultations have been held with statutory consultees and non-statutory consultees, including landowners that would be affected by the proposals. The feedback received from these consultations has been used to inform the Stage 3 design, with reasonable and practical measures implemented, where appropriate, to address specific areas of concern. A summary of the consultation process is provided in Chapter 6 (Consultation and Scoping).

4.3.4 The environmental constraints and issues identified within the study area of the proposed scheme have significantly informed route development, including the location and form of proposed junctions. The Stage 3 design has been developed iteratively, taking into account the recommendations of environmental specialists, information sourced from the consultation process, and the results from the traffic, structural, geotechnical and drainage studies undertaken.

4.4 Sustainable Development Policy

4.4.1 Consideration of sustainable development issues has informed the development of the proposed scheme, with a key scheme objective being “to support sustainable development and economic growth”.

4.4.2 Transport Scotland has developed a sustainable development policy, the Forth Replacement Crossing Sustainable Development Policy. This policy was published in January 2009, and outlines the following vision for the proposed scheme:

> *“To deliver an iconic project that respects the environment, contributes to sustainable economic growth at both regional and Scottish levels and facilitates efficient public transport*

whilst minimising disruption to the community and reducing the use of non-renewable resources during its construction and throughout it life."

4.4.3 Beneath this vision lies a set of sustainable development objectives, which embrace sustainable economic growth, equality and social inclusion, environmental quality, resources and protection of the natural and cultural heritage.

4.4.4 Consideration of sustainable development has, and shall continue to, formed a core thread of all activities undertaken in the projects life cycle including:

- project design and appraisal;
- tender evaluation;
- construction;
- maintenance; and
- operation (and decommissioning).

4.5 Summary of the Proposed Scheme

4.5.1 The following paragraphs, read in conjunction with Figure 4.1, provide a detailed overview of the main works elements associated with the proposed scheme. The main features of the proposed scheme can be broken down into the following three sections:

- the Main Crossing and the Forth Road Bridge;
- north of the Firth of Forth: Main Crossing to Admiralty Junction (M90 Junction 1); and
- south of the Firth of Forth: Scotstoun Junction (A90/M9 Spur) to the Main Crossing, and M9 Junction 1A and associated improvements.

The Main Crossing and the Forth Road Bridge

Main Crossing

4.5.2 Sited upstream of the Forth Road Bridge, the Main Crossing will consist of a 3-tower cable stayed bridge and approach viaducts. The total length of the Main Crossing is approximately 2.7km.

4.5.3 The proposed cross-section of the Main Crossing will be to dual two lane motorway (D2M) standard with widened hard shoulders. The provision of widened hard shoulders will give flexibility in the use of the Main Crossing. Hard shoulder running may be required during times of maintenance or congestion, or where the Forth Road Bridge is unable to fulfil its role as a public transport crossing. The provision of a sufficient width of deck on the Main Crossing will also allow for possible future rearrangement of the bridge's functions, with possibilities to adapt the cross-section to encompass a multi-modal corridor and dual two lane carriageway, or a pedestrian and cycleway with a dual two lane carriageway.

4.5.4 It is anticipated that two electricity substations will be required, the indicative locations of which are shown adjacent to the northern and southern bridgeheads.

4.5.5 The alignment of the Main Crossing is straight and at a skew of approximately 18° to the Forth Road Bridge. The twin corridor deck arrangement passes either side of the mono-towers, with the central mono-tower sited upon Beamer Rock. Wind barriers are proposed as part of the parapet structure to reduce the effect of cross-winds on traffic.

4.5.6 Situated on a navigable waterway where approximately 5,500 vessel transits occur per year, the Main Crossing will provide a sufficient navigational clearance envelope for shipping using the Forth Deep Water Navigation Channel (situated beneath the southern 650m main span and providing

access to upstream ports such as Grangemouth) and the Rosyth Navigation Channel (situated beneath the northern 650m main span and serving Rosyth Dockyard).

Forth Road Bridge

4.5.7 As detailed in Chapter 3 (Alternatives Considered), the Forth Road Bridge would be adopted within the proposed scheme as a public transport crossing. It will cater for bus and taxi services, and pedestrians and cyclists, with possibilities for future adaption to accommodate a Light Rapid Transit (LRT) system in the form of a high quality bus network, guided bus way or tram system.

4.5.8 To make best use of the Forth Road Bridge in this new role, new road connections are proposed, as described below.

4.5.9 North of the Firth of Forth, traffic will leave the existing A90 and travel on new carriageway to the Main Crossing. Through the reconstruction of Ferrytoll Junction, the existing bridge and redundant section of the A90 will be reconnected to the road network, via a new slip road dedicated to public transport access between the Forth Road Bridge and the new junction arrangement. This functionality also supporting the development of Ferrytoll Park and Ride and other public transport initiatives which may be considered by Fife Council.

4.5.10 South of the Firth of Forth, traffic will leave the existing A90 and travel on new carriageway to the Main Crossing, with a new dedicated slip road created between the A90 at Scotstoun Junction and the A8000, to cater for public transport crossing the Firth of Forth. Southbound, a dedicated public transport lane will be provided from Echline Junction, the redundant section of the A90 being utilised in part to provide a direct access to Edinburgh through Scotstoun Junction.

North of the Main Crossing (to Admiralty Junction)

4.5.11 Departing the Main Crossing, the mainline cross-section continues as D2M with widened hard shoulders to the intersection with the north facing slip roads at Ferrytoll Junction.

4.5.12 Given the orientation of the Main Crossing relative to the existing road network, a section of offline carriageway is required to the south of Ferrytoll Junction. Connecting to the main crossing at St. Margaret's Hill, the route descends, clipping the eastern perimeter of St. Margaret's Marsh Site of Special Scientific Interest (SSSI), south of Dunfermline Waste Water Treatment Works (WWTW).

4.5.13 A significant structural requirement exists in the provision of the mainline carriageway between the Main Crossing and Ferrytoll Junction, and in the provision of the south facing slip roads to Ferrytoll Junction itself. This is as a result of the topography of the area, and the level difference associated with the Main Crossing and the existing road network.

4.5.14 North of Ferrytoll Junction, the vertical geometry of the mainline carriageway matches that of the existing A90, the physical improvements to the carriageway terminating at Admiralty Junction.

4.5.15 To improve the operational efficiency of the northbound carriageway between Ferrytoll and Admiralty, the proposed scheme provides three traffic lanes and a discontinuous hard shoulder through this section, assisting traffic interaction between the junctions taking into account their close proximity.

4.5.16 Southbound, the A90 will continue to operate in its current form through this section, with lanes two and three providing access to the Main Crossing. Lane one will continue to provide a dedicated lane to Ferrytoll Junction and access to Inverkeithing, North Queensferry, Rosyth Dockyard and Ferrytoll Park and Ride.

4.5.17 Ferrytoll Junction itself will be fully reconstructed. Sited north of the existing junction, the new grade separated arrangement will be larger than its predecessor, the junction being sited beneath the mainline which will be carried on structure above. Operationally, the junction will cater for all

traffic movements between the strategic and local road network, whilst also providing access to the Forth Road Bridge. As part of the improvements, the junction approaches from the B981 (Inverkeithing) and Ferry Toll Road will be improved.

4.5.18 To maintain access to North Queensferry during the construction period and to improve the operational effectiveness and safety of Ferrytoll Junction, the B981 will be realigned over part of its length. A new section of carriageway will be provided from the northern extents of St. Margaret's Hill to a new junction with Ferry Toll Road, west of Dunfermline WWTW.

4.5.19 Similarly, Castlandhill Road will be realigned to the west at its southern end, a new junction being provided to Ferry Toll Road. The realignment of this local route will remove the current interaction between local traffic travelling to Rosyth and strategic traffic wishing to access the A90 northbound.

South of the Main Crossing (Scotstoun Junction to A90/M9 Spur, and M9 Junction 1A)

4.5.20 The connection of the Main Crossing to the existing road network is achieved through the provision of a new 3.1km section of carriageway between the A90 Scotstoun Junction and the Main Crossing approach structure located to the west of South Queensferry.

4.5.21 The proposed carriageway cross-section to be implemented throughout this section will be to motorway standard.

4.5.22 Between Scotstoun Junction and the proposed Queensferry Junction, located to the southwest of Echline, the mainline carriageway will be constructed to dual three lane motorway (D3M) standard. This section, passing through the fields north of Dundas Home Farm and the northern extents of Dundas Estate will be constructed on embankment, accommodating strategic utilities with the provision of new structures, and the drainage system to be implemented as a part of the proposed scheme.

4.5.23 The orientation of the new mainline carriageway, and the implementation of a D3M cross-section when departing the A90, requires the structure carrying the A8000 to be replaced. The new structure, sited parallel to the existing structure, will be of sufficient width to accommodate the proposed D3M mainline cross-section and a dedicated public transport lane from the Forth Road Bridge to Edinburgh via the A90.

4.5.24 From the proposed Queensferry Junction, the mainline cross-section will be D2M, with widened hard shoulders, complementing the cross-section of the Main Crossing. The cross-section transition from D3M to D2M is facilitated through a lane drop/lane gain arrangement to the east facing slip roads at the new junction.

4.5.25 On approach to the new junction, the vertical profile of the mainline design transitions from embankment to cutting, passing beneath the junction, which is carried on bridge structures to facilitate connection to the A904. On approach to the Main Crossing, the existing topography of the land tends towards the Firth of Forth. At this point, the mainline exits cutting to intersect the bridge approach structure.

4.5.26 The Stage 3 design for the proposed Queensferry Junction takes the form of a grade separated roundabout which provides access in all directions between the Main Crossing and the strategic and local road networks. Situated south of the line of the A904, this existing road will be re-routed to the east and west to form appropriate tie-ins with the new junction. The diversion of this route, offline, will require the realignment of subsidiary local roads including the B924 and Builyeon Road.

4.5.27 The B924 access to Echline Estate and South Queensferry will be realigned to a new junction with the A904 east of the proposed Queensferry Junction. As a part of these works, a new maintenance access road to the Main Crossing will be constructed, a new junction to the B924 being provided in proximity to the A904. The access road will run parallel to and east of the mainline carriageway, through the fields at Echline.

4.5.28 Builyeon Road, severed by the new road network proposed to complement the main crossing, will be realigned on approach to its intersection with the A904, a new junction being formed with the A904 west of the proposed Queensferry Junction.

M9 Junction 1A

4.5.29 The Stage 3 design for M9 Junction 1A comprises a grade separated junction arrangement, which is capable of facilitating all movement access between the M9 and the M9 Spur. Located on the site of the existing junction, the new arrangement makes best use of existing infrastructure whilst minimising the amount of new land-take required in its implementation. The east facing functionality provided by the existing junction is enhanced through revisions to both the existing loop arrangement, from the M9 westbound to the M9 Spur, and the slip road from the M9 Spur to the M9 eastbound. Each of these links will provide two general traffic lanes, assisting traffic flow through the junction area.

4.5.30 To better serve West Lothian traffic, the re-design of M9 Junction 1A will incorporate west facing slip roads, a feature not encompassed within the existing junction design. The provision of these slip roads will remove the current requirement for traffic to navigate Newbridge Roundabout when making this movement.

4.5.31 In the provision of the revised M9 Junction 1A, whilst new structures will be required to carry new sections of road and realigned watercourses, where possible, existing structures will be utilised or widened.

M9 Junction 1A Associated Improvements

4.5.32 To complement the improvements to the junction, the section of the M9 between Newbridge Roundabout (M9 Junction 1) and M9 Junction 1A is to be widened to provide four lanes of traffic in the southbound direction and an auxiliary slip road lane as far as the River Almond underbridge northbound. The interaction of traffic between these junctions is a known constraint on the operation of the strategic network, weaving being a particular issue. The southbound widening of the M9 in tandem with the provision of two lane merge and diverge slip roads at Newbridge Roundabout and M9 Junction 1A will improve the connectivity and operational performance of the network through this section.

4.6 Details of the Proposed Scheme

Road Geometry

4.6.1 In the provision of the Stage 3 design, the horizontal and vertical geometry associated with the new sections of mainline carriageway have been designed to current DMRB standards. As indicated in Section 4.4, the cross-section implemented on the new mainline carriageway varies from D2M, with widened hard shoulders, to D3M. Elsewhere on the strategic road network, existing carriageways have been enhanced to provide additional functionality.

4.6.2 In the consideration of regional roads, the design work undertaken as part of the Stage 3 design has been to DMRB standards. Subsidiary side roads and accesses have been designed in accordance with local road authority standards.

4.6.3 The standard carriageway cross-sections utilised within the Stage 3 design are summarised in Table 4.1 and further detailed in the Stage 3 Engineering Report (Jacobs Arup, 2009).

Table 4.1: Standard Carriageway Cross-Sections

Element	D2M (widened hard shoulder)	D3M	Single carriageway – Rural	Single carriageway – Urban
Verge	1.5m	1.5m	2.5m	2m
Hard Shoulder	4.2m	3.3m	n/a	n/a
Carriageway	7.3m	11.0m	7.3m	7.3m
Hard Strip	0.7m	0.7m	1m	n/a
Central Reserve	3.1m	3.1m	n/a	n/a
Hard Strip	0.7m	0.7m	n/a	n/a
Carriageway	7.3m	11.0m	n/a	n/a
Hard Shoulder	4.2m	3.3m	n/a	n/a
Verge	1.5m	1.5m	2.5m	2m
Total Width	**30.5m**	**36.1m**	**14.3m**	**11.3m**

Note: Footways/cycleways required in some locations in addition to standard cross-section.

4.6.4 In the provision of new and improved sections of carriageway, a requirement exists to provide sections of widening to central reservations and carriageway verges. Such widening is necessary to maintain visibility and stopping site distance, and to accommodate carriageway features such as safety barriers, traffic signs and gantries.

Pedestrian and Cyclist Provision

4.6.5 Facilities for pedestrians and cyclists will be a feature of the proposed scheme, with various links and accesses being provided to assist such movements. The Main Crossing will not provide pedestrian and cyclist access, as this will be retained on the Forth Road Bridge as part of the managed crossing strategy.

4.6.6 As a part of the proposed scheme, the Forth Road Bridge will continue to form a part of the National Cycle Network, providing cross-Forth access for both cyclists and pedestrians. In maintaining cycle facilities to the north and south of the Main Crossing, the new junctions at Ferrytoll and South Queensferry will encompass such functionality, sustaining the national cycle routes associated with Ferry Toll Road and the A904. Cycle routes will be designed in accordance with the Scottish Government's 'Cycling by Design' guidance document, published in 2000.

4.6.7 Pedestrians will also be catered for through the junction areas and on the local road network where appropriate.

Earthworks

North of the Firth of Forth

4.6.8 The Stage 3 design for the mainline carriageway north of the Firth of Forth and its associated network connections will require the construction of several cuttings and embankments. Rock cuts are proposed north of the Queensferry Hotel for the northbound diverge slip road and to the east of Ferrytoll Junction in the provision of the new southbound merge and diverge slip roads. Rock slopes are likely to be formed at angles of between 50 and 70 degrees, incorporating appropriate rock traps. Higher rock slopes will generally be benched. It is envisaged that the Contractor may be able to avoid these rock cuts through detailed design refinement, but they are included in this Stage 3 design to illustrate a reasonable worst case for cost and environmental impacts.

4.6.9 Notable soil cuts include the realigned section of Castlandhill Road and the A90 northbound diverge slip road to Admiralty Junction. Soil cuttings are likely to be formed at gradients of between 1:1 and 1:4.5 (vertical:horizontal) with the steeper slopes incorporating stabilisation measures such as soil nailing.

4.6.10 Significant embankments to the north of the Firth of Forth include the proposed B981 realignment between St. Margaret's Hill and Ferry Toll Road, the proposed southbound slip road to the Forth Road Bridge and the proposed northbound merge slip road to the A90. Required embankment slope angles generally vary from 1:2 to 1:3. These gradients will be locally steeper where constrained by features such as existing local roads. Castlandhill Road and its proximity to the northbound merge to the A90 presents such a situation and embankment reinforcement measures for steeper slops will be incorporated where appropriate.

South of the Firth of Forth

4.6.11 The Stage 3 design for the mainline carriageway as it leaves the existing A90 at the A8000, south of the Firth of Forth, climbs onto moderate height embankment as it passes through the fields north of Dundas Home Farm. The outer slopes of the embankment will be of variable slope to accommodate noise bunds and the return of the surrounding land to agriculture. On approach to the curve to the southwest of South Queensferry, the mainline descends into cutting, which will be partly formed in soil, and partly in rock beneath the A904 junction. The route then emerges from cutting to climb a minor embankment and onto the main crossing approach viaduct.

4.6.12 The alignment improvements between Newbridge Roundabout (M9 Junction 1) and M9 Junction 1A will largely comprise relatively minor widening of the existing carriageway extending no further east than the River Almond, requiring re-profiling of the existing embankment and cutting slopes. These will generally be formed at similar angles to the existing earthworks. At M9 Junction 1A, the new slip roads will require the construction of a number of new embankments, while the realignment of the Swine Burn as it approaches the M9 Spur will require the formation of a new soil and rock cutting at the toe of the new embankment.

Fencing and Environmental Barriers

Fencing

4.6.13 To secure the land area acquired for the implementation of the proposed scheme, temporary fencing will be erected prior to the commencement of construction where appropriate. Whilst much of the agricultural land bounding the proposed scheme is arable in nature, a requirement for stock proofing may be required in some areas.

4.6.14 Upon completion of the works, the proposed scheme boundary will typically take the form of a permanent fence, with a timber post and rail fence commonly being used to indicate a motorway boundary and a post and wire fence being used in other instances. Alternative methods of signifying property boundaries may include the planting of hedgerows or the construction of walls.

Environmental Barriers

4.6.15 Environmental barriers may be required to reduce the impact of the proposed scheme in specific locations. Where the requirement has been identified within this ES, environmental barriers to provide visual screening or mammal mitigation (including badger fencing and otter fencing), will be incorporated. These are shown on Figure 12.4.

4.6.16 To counteract noise effects associated with the proposed scheme, suitable noise mitigation measures will be provided. The requirements for noise mitigation are detailed in Chapter 16 (Noise and Vibration)

Flooding Provision and Drainage

4.6.17 The drainage design for the proposed scheme has been developed in accordance with Sustainable Drainage Systems (SUDS) guidance and through consultation with SEPA. The drainage system makes use of combined surface and groundwater filter drains to provide most of the carriageway

drainage. Exceptions to this include the use of swales on the mainline and kerbed areas such as junctions and bridge decks where gullies will be used to collect surface water.

4.6.18 It is anticipated that the Main Crossing drainage will comprise surface water channels and gullies incorporated within the bridge deck. Over the Firth of Forth, surface water runoff from the Main Crossing will be collected in closely spaced gullies, and discharged directly through the main deck to the estuary below. Where above land or the mudflats situated to the southern end of the Main Crossing, surface runoff will be collected in gullies and discharged through a closed pipe system to the nearest manhole associated with the land based drainage system.

4.6.19 Pre-earthworks drainage consisting of shallow filter drains or lined ditches will be used to collect run-off from adjacent land and field drains. A number of likely outfall locations have been identified. These are described in more detail in Chapter 9 (Water Environment). This chapter also defines potential impacts to the water environment and defines the mitigation measures required to prevent, reduce or offset these effects in accordance with the EIA Regulations.

4.6.20 Wherever possible, watercourses will be maintained along their existing line. However, the requirement for a watercourse realignment of the Swine Burn, northwest of M9 Junction 1A, has been identified. Where such works are required, the length of realignment will be minimised.

4.6.21 New culverts for watercourse crossings will be provided and existing structures lengthened where required, to take watercourses under upgraded existing roads, new roads and access tracks. The locations of proposed watercourse crossing structures considered in the EIA are shown on Figure 1.1. The form of these crossings was selected based on achieving a balance between environmental, engineering and economic factors and are as follows:

- Swine Burn – one new depressed invert box culvert (ch245 Interchange Link) under the 'M9 Eastbound to M9 Spur Northbound Link' (ch2055 M9 to ch490 M9 Spur) (50m) and one culvert extension of approximately 20m to the existing 144m double-barrel concrete culvert upstream of the M9 Spur (ch730 M9 Spur).
- Niddry Burn – one culvert extension of approximately 14m (7m on each side of the carriageway) to the existing 81.6m culvert under the M9 (ch1120 M9).
- Tributary of Niddry Burn – one culvert extension of approximately 10m (5m on each side of the carriageway) to the existing 52m pipe culvert under the M9 (ch880).

4.6.22 The detailed design of these watercourse crossing structures will be developed by the Contractor subject to suitable provision being made for flood flows and ecological and geomorphological mitigation, and compliance with the environmental commitments detailed within this ES. Specific reference should be made to Chapter 9 (Water Environment), Chapter 10 (Terrestrial and Freshwater Ecology) and Chapter 11 (Estuarine Ecology).

4.6.23 The proposed scheme design for both watercourse crossings and drainage design takes consideration of the Water Environment (Controlled Activities) Regulations 2005 which requires licenses to be sought for all design and construction activities affecting watercourses, including engineering works (culverts and bridges) and discharges (outfalls, attenuation and treatment).

Traffic Signs and Lighting

Traffic Signs

4.6.24 The traffic signs required in the provision of the proposed scheme will be designed to the relevant design standards. The detailed design of this element of the works will be the responsibility of the Contractor, and will be subject to compliance with the contract documents. As a part of the design process, the Contractor will consult with Transport Scotland and local roads authorities.

Lighting

4.6.25 For the purposes of the EIA it has been assumed that the whole of the proposed scheme would be lit at night, which is a conservative "worst-case" scenario in terms of potential environmental impacts. Design development indicates that road lighting will be required as a minimum on the mainline between the Scotstoun Interchange and the Main Crossing in the south and between the Main Crossing and Admiralty Junction in the north. In addition, it is considered that the side roads in the vicinity of Ferrytoll and South Queensferry junctions will require to be lit. The functionality of the installed lighting will allow for dimming and remote control for future energy reduction to support government objectives to reduce carbon emissions, pollution of the night sky and to reduce impacts on the rural landscape where this can be achieved safely and effectively.

Intelligent Transport System (ITS)

4.6.26 The operational management of the proposed scheme will be supported through the use of an Intelligent Transport System (ITS), which will assist in delivering optimum capacity within a safe, efficient and reliable environment and provide local and strategic information to road and public transport users during normal and abnormal conditions.

4.6.27 To maximise the benefits of the Main Crossing and its connecting roads, ITS will be provided over a corridor extending from the Halbeath Interchange (M90 Junction 3) in the north to Newbridge Roundabout (M9 Junction 1) in the south, with additional provision on main road approaches.

4.6.28 Overhead gantry mounted signalling and signage will be the principal method of presenting information on network conditions to the road user, with verge mounted signage being utilised on main road approaches where appropriate.

4.6.29 An outline ITS design has been produced for the purposes of this EIA. The ITS design continues to be refined as the proposed scheme is developed. The ITS components which will assist in the operational management of the network are detailed in Table 4.2.

Table 4.2: Operational Management Components of ITS

Component	Description
Bridge Control	• Main Crossing – Management of scheme corridor and hard shoulder bus lane running during Forth Road Bridge closures. • Forth Road Bridge – Management of bi-directional bus corridor.
Lane Signalling	Used in the control of each lane, displaying road sign aspects and other aspects for managing lane use.
Mandatory Speed Signalling	Used for displaying variable mandatory speed limits incorporating an appropriate enforcement system
Variable Message Signs	Used in the display of strategy and tactical text messages and/or multicoloured pictograms to drivers
Incident Management	Real-time detection of traffic to identify incidents/events occurring on the network, so that operators can implement strategies to mitigate the effects and manage safely.
CCTV Surveillance	For visual monitoring of the motorway and the provision of travel information
Access Control	Regulation of traffic entering/exiting the main carriageway to prevent flow breakdown. Also used to close an entry point when a motorway downstream is closed. Sometimes referred to as Ramp Metering.
Traffic monitoring and Measurement System	For the gathering of traffic data Journey Time information for real-time application and statistical purposes.
Emergency Telephone System	To provide roadside assistance on the approach roads to the Main Crossing through direct connection of the roadside telephones
Meteorological Outstation	Used to establish road and weather conditions
Communications Network	Used to collect and disseminate real-time travel information through a variety of medium and applications.

Traffic Conditions

4.6.30 The traffic flows associated with the existing road network are discussed in Chapter 2 (Need for the Proposed Scheme). The Transport Model for Scotland (TMfS:05A) has been used to provide existing and future year flows. TMfS is a multi-purpose forecasting toolkit developed by Transport Scotland to assist in the investigation and assessment of different policies and strategies on land-use and transport provision. Details of model development, operation, calibration and validation of the model are set out in the reports available on the Land Use And Transport Integration in Scotland (LATIS) website, www.latis.org.uk. The predicted traffic volumes for opening year (2017) and design year (2032) are shown on Figure 4.3.

4.6.31 TMfS:05A was judged to be the best available modelling platform for the DMRB Stages 2 and 3 strategic transport modelling work. At the time of undertaking the Stage 2 modelling, it was noted that TMfS:07 was under development. However, this was not completed to a stage where it could be used for the Stage 3 strategic modelling work.

4.6.32 Do-minimum and reference case infrastructure as defined by Transport Scotland in August 2007 is incorporated with TMfS:05A. For the purposes of the detailed assessment reported in this ES, the reference case has been taken as the do-minimum, and reflects the continued operation of the existing road network in tandem with the Forth Road Bridge. However, as Chapter 5, Section 5.3 explains, a supplementary assessment, to be read in conjunction with the reference case, has also been undertaken of the environmental impacts relating to a partial closure of the Forth Road Bridge for an extended period to allow for cable replacement. An additional assessment has also been made of an alternative Do-Minimum relating to a full closure of the Forth Road Bridge.

4.7 Construction Methods and Programme

4.7.1 This section provides a brief outline of the envisaged construction programme and typical construction activities. Typical construction methods for these activities, and the construction assumptions made for the purposes of this ES are provided in Appendix A4.1 (Construction Information).

4.7.2 The following details a possible construction sequence for the proposed scheme; however, the design and construction process adopted by the Contractor may vary from that described in this outline methodology. The Contractor will be permitted to change the construction process and duration of each works element provided that any environmental impacts are no greater than those described in the ES and that commitments given in the ES are adhered to (or measures providing equivalent mitigation subject to agreement with Transport Scotland).

4.7.3 Construction will not commence before July 2011 at the earliest. The overall construction period is anticipated to be over five years.

Outline Construction Programme

4.7.4 In order to assist the EIA process the approximate duration of construction activities has been estimated. A timescale for each element of the works is difficult to determine precisely as this will be determined by the date of commencement for the works as well as the construction methods employed by the Contractor. An outline of the possible timing for the works is indicated in Table 4.3.

Table 4.3: Works Timescales

Main Crossing	Timescale
Construction of Main Crossing and South Approach Viaduct	July 2011 – July 2016
Network Connections North	
Advanced Works *	July 2011 – March 2013
Ferrytoll Junction & Mainline North	April 2012 – July 2016
Network Connections South	
M9 Junction 1A	July 2011 – October 2014
Queensferry Junction and Mainline South	April 2013 – July 2016

* Advanced works are activities required before construction can start – often seasonally dependant.

Typical Construction Activities

4.7.5 The key elements of the construction works have been broken down to facilitate the assessment of environmental impacts.

4.7.6 The construction activities associated with the provision of the Main Crossing are detailed in Table 4.4.

Table 4.4: Main Crossing Construction Activities

Section	Construction Activities
Access and enabling works	• Temporary earth bund at south shore • South access trestle • North access trestle and skid track • Haul roads
Marine foundation works	• Dry dock • Central tower foundation • South tower foundation • North tower foundation • Dredging • Marine piers
Towers	• Central tower • South flanking tower • North flanking tower
Deck fabrication	• List materials and order plans • Produce fabrication drawings • Receive materials • Fabricate steelwork • Deliver steelwork to assembly yard
Deck fabrication	• List materials and order plans • Produce fabrication drawings • Receive materials • Fabricate steelwork • Deliver steelwork to assembly yard
Deck assembly	• Mobilise assembly yard • Assembly deck units • Clear assembly building • Deliver erection units • Operate storage for units • Clear assembly yard

Section	Construction Activities	
Deck erection	Main span – Central/South/North tower fans • Erect deck segmentation • Connections between deck and tower • Weld longitudinal seam • Mobilise stay erection equipment and erect stay • Commission erection gantries • Erect deck segments	Main span closure • Central to south fan • Central to north fan
Land piers and abutments	Land piers • Excavation for pier bases • Construct pier bases • Backfill around pier bases • Construct pier legs	Abutments • Excavation base for abutment • Construct base for abutment • Construct abutment wall up to breaking shelf level for abutment • Construct wing walls and ballast walls for abutment
South approach span	Deck construction • Prepare launch area • Assemble and launch east and then west launch box • Remove launch equipment • Cast deck slab for west and then east carriageway • Finishes	
Site clearance	• Remove earth bund and sheet piling at south shore • Remove south and then north access trestles	

4.7.7 The construction activities associated with the provision of the connecting road network associated with the Main Crossing are detailed in Table 4.5.

Table 4.5: Proposed Scheme and Junction Construction Activities

Section	Construction Activities
Ferrytoll Junction	
Phase 1	• Main crossing approach structure • Temporary diversion of B981 • FRC N/B Diverge Slip Structure • A90 N/B Diverge slip road (part) • Railway Bridge and access to Dunfermline WWTW • Widen west side of existing roundabout bridges • Construct temporary northbound carriageway • Temporary S/B diverge slip road • Construct Castlandhill Road (B980)
Phase 2	• New structure under A90 (Gyratory) East Side • FRC S/B diverge slip road • Rock cutting Ch 7500-7700 • Temporary A90 S/B merge slip road • Realign Ferry Toll Road • B980 temporary link to N/B merge slip road • FRC N/B merge slip road • A90 Northbound on-line widening • Temporarily re-align B981
Phase 3	• New structure under A90 (Gyratory) west side • Complete FRC/A90 N/B diverge slip to new Gyratory • Complete B981 link up to new Gyratory • Complete B981(E) and access to Park and Ride

Section	Construction Activities	
	• Complete Gyratory • Open Gyratory	
Phase 4	<u>Stage 1</u> • Infill south bridge on roundabout • Extend FRC tie-in up to A90	<u>Stage 2</u> • Complete N/B tie-in and temporary ramp
Phase 5	• Complete S/B Main tie-in • Complete FRC S/B Merge and retaining wall • Finishes • Open Main Crossing • Finishes • Complete A90 S/B Merge Slip Road • Complete A90 N/B Diverge Slip Road	
Queensferry Junction		
Phase 1	<u>Mainline & Interchange (inc. Southside Bus Lane):</u> • Earthworks and drainage • Interchange Overbridges • Pipeline protection works	<u>A8000</u> • Bridgeworks • Earthworks • Roadworks
Phase 2	<u>Mainline & Interchange (inc. Southside Bus Lane)</u> • Roadworks • Comms/Lighting/Signing	<u>A8000</u> • Demolish A8000 bridge • A90 Online widening (S/B Hard Shoulder) • A90 Temporary 2+2 Diversion
Phase 3	• A90 online widening (N/B Hard Shoulder) • Complete tie-in works at A8000 • Northside bus lane • Finishes	
M9 Junction 1A		
Phase 1 - South of M9	<u>M9 Westbound to M9 Spur Northbound Link</u> • Earthworks & Drainage • Roadworks • New M9 Bridge Substructure <u>M9 Spur Southbound to M9 Westbound Link</u> • Earthworks and drainage • Roadworks • Underbridge widening (Overton Rd)	<u>Motorway Widening Westbound Carriageway</u> • Earthworks and drainage • Roadworks
Phase 1 - North of M9	<u>M9 Westbound to M9 Spur Northbound Link</u> • Earthworks and drainage • Roadworks • New M9 Bridge substructure • New M9 Bridge superstructure	<u>M9 Eastbound to M9 Spur Northbound Link</u> • Earthworks and Drainage • Roadworks • Swine Burn Culvert • B9080 Bridge Widening
Phase 2	• M9 Junction 1A tie-ins <u>Motorway Widening Eastbound Carriageway</u> • Earthworks & drainage • Roadworks • M9 Junction 1A finishes • M9 Junction 1A road markings	
Phase 3	• Ancillary works finishes	

Construction Compounds

4.7.8 Potential locations for the Contractor's site compounds will be included within the land to be acquired as a part of the proposed scheme, and the environmental impacts associated with these sites have been considered as a part of the EIA. Anticipated construction compounds are described in Chapter 19 (Disruption Due to Construction) and their indicative locations shown on Figure 19.1.

4.7.9 The compound locations will be situated in proximity to the principal works areas, namely Ferrytoll Junction, South Queensferry/Echline and M9 Junction 1A.

4.7.10 A potential location for the main compound for the principal works, including the construction of the Main Crossing and its approach roads, has been identified within Echline Field, west of South Queensferry with an approximate area of 8 hectares (ha), laid out in a manner to minimise the impact of the compound activities on the local community. However, ongoing community liaison over the course of the design development and assessment revealed local concerns regarding this site. To address these, a potential alternative location for the main compound, further to the west, has been identified and also assessed. Both locations offer good connections to the proposed site, the existing road network and utility supplies. Echline Field East is owned by Scottish Ministers and would provide operational advantages, the alternative, Echline Field West, would involve new land acquisition but further reduces the impact on local communities. Echline Field West is now the preferred site location, subject to securing approval of Parliament as part of the Bill for powers to compulsory purchase the land.

4.7.11 The main compound will provide toilet facilities, messing facilities, and parking for office based staff and site operatives. In addition, stores, workshop areas and a visitor centre (located within or near the compound) will be provided for the construction phase. The visitor centre is expected to comprise a single storey temporary building with approximately 40 car parking spaces. A temporary haul road will link the A904 to Society Road and will provide access from the main compound to the works on the Firth of Forth via the Port Edgar Barracks (refer to Figure 19.1).

4.7.12 It is envisaged that the main compound will be supported by a satellite compound to the north of the Firth of Forth, adjacent to the Rosyth Strategic Link Road with an area of approximately 3ha. The satellite compound will remain in operation for the duration of the construction of the Main Crossings north approach viaduct and Ferrytoll Junction and will provide welfare, parking and stores facilities. Access to works on the northern shore of the Firth of Forth would be provided primarily along the line of the existing driveway to Admiralty House. A construction platform will be created to allow plant and materials to be lowered down to the foreshore.

4.7.13 A further compound will be provided in proximity to M9 Junction 1A, given that the improvements proposed to the junction and its approaches are remote from the main works associated with the proposed scheme. The envisaged location for this compound is to the south of the B9080, northwest of the junction area with an estimated area of approximately 3ha. This will provide direct access and egress to site for construction vehicles, avoiding the motorway network.

Main Crossing

4.7.14 The construction of the Main Crossing is almost entirely independent of the permanent connecting roads element of the project. The only tie-ins required early in the programme relate to access for construction, with access roads to be provided both north and south of the Firth of Forth. The progress made in the construction of the Main Crossing will be the subject of weather events however. Within the 5+ year construction timescale for the Main Crossing, allowance has been made for loss of time due to weather events both in the undertaking of general construction activities and marine based activities.

Roadworks and Structures

4.7.15 Physical improvements to the existing road network will commence in 2011 with the construction commencement at M9 Junction 1A. In advance of the main works, site compounds may be established and site clearance may be undertaken to enable operations to commence. Through a phased construction of the necessary improvements, it is envisaged that the connecting roads infrastructure to the main crossing will be delivered by July 2016 with the completion of Ferrytoll Junction, Queensferry Junction, and the south mainline carriageway respectively. In some areas it should be noted that constraints may be imposed on construction operations, with environmental conditions being applied to works being undertaken in particularly sensitive areas.

4.7.16 Works such as service diversions, bridges and culverts will be undertaken in accordance with the Contractor's overall programme. Factors that may influence the timing of these other works include the rate that haul-routes and earthworks are constructed to provide access to proposed bridge and culvert locations. Ecological seasonal constraints will also affect the construction programme for these works.

Material Requirements

4.7.17 A summary of the estimated earthworks quantities for construction of the proposed scheme is provided in Table 4.6. These estimates indicate that there is an import requirement at each junction. The export quantity is material that is unsuitable to be re-used as engineering fill.

Table 4.6: Estimated Earthworks

	M9 Junction 1A	Queensferry Junction	Ferrytoll Junction
Estimated import (m^3)	155,000	105,000	85,000
Estimated disposal (m^3)	20,000	55,000	40,000

Environmental Mitigation

4.7.18 The Contractor will be required to implement all relevant environmental mitigation measures at the appropriate time. These will include a range of measures to avoid or reduce construction and operational impacts.

4.7.19 Where possible, physical environmental mitigation features such as earthworks will be constructed soon after the completion of main engineering elements. Earthworks side slopes and verges will be topsoiled and seeded/planted as early as possible to minimise the risk of sediment run off which may affect the carriageway drainage system and create a potential pollution risk to watercourses. Planting works and ecological habitat creation areas are seasonally dependent and these may be left until later in the construction period occurring in 2016 or 2017 following completion of the main works. Noise barriers may be constructed early to mitigate construction noise impacts, otherwise they will be constructed later in the construction period.

Land Acquisition

4.7.20 All construction work will take place within the limit of the land made available to the Contractor as defined within the contract documents. This land will include the land acquired under the Parliamentary Bill together with any land to which the Scottish Ministers already have ownership of or access to, and any other areas the Contractor has acquired by agreement to facilitate construction of the works. The land acquired for the proposed scheme includes land necessary to construct the proposed scheme and associated infrastructure and to undertake essential environmental mitigation measures. Certain areas of the land acquired through the Parliamentary Bill process may not be made available to the Contractor – for example where severance has made a small parcel of land unviable, this area of land may be purchased, but will not require any construction work on it.

4.7.21 The Contractor may wish to utilise other areas of land not covered by the Parliamentary Bill. In such an instance, the Contractor will have to secure the use of these areas by agreement and through separate planning applications, where appropriate. As the location of these areas is currently unknown, it has not been possible to include an assessment of the impact of them within this ES.

4.8 Ongoing Design Development

4.8.1 The proposed scheme design as assessed in this chapter includes significant rock cuts to the north and south of Ferrytoll Junction. Detailed design may allow these rock cuts to be avoided or reduced. Design development indicates that there is potential for a westward shift of the proposed scheme alignment of up to approximately 15m between approximate chainages 7500 - 7800 (south west of Jameston) and 8150 – 8500 (west of the cemetery) to allow the rock cuts to be avoided.

4.8.2 Environmental review of this refinement indicates that this could reduce adverse impacts associated with the rock cuts without materially increasing other environmental effects. More information on this design refinement is provided in the DMRB Stage 3 Scheme Assessment Report.

4.9 References

Environmental Impact Assessment (Scotland) Regulations 1999 (as amended).

Jacobs Arup (2009). Forth Replacement Crossing - DMRB Stage 3 Scheme Assessment Report.

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