

Forth Replacement Crossing

Route Corridor Options Review

Report on Scheme Development: January to May 2008

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Bibliography and Workstream Timeline

This report, as highlighted below, is one of a series of reports on project development work carried out during 2008. It reports on the assessment of the nine identified mainline connecting road corridors and recommends the corridor options to be taken forward for further (Stage 2) assessment.

1. *Forth Replacement Crossing Study Report 5: Final Report*

Work pre-June 2007.

Report on work undertaken by Jacobs and Faber Maunsell to June 2007 to assess the options for a replacement crossing which recommended that a cable stayed bridge in 'Corridor D' – a crossing point immediately upstream of the Forth Road Bridge - be taken forward as the best overall performing option.
2. *Forth Replacement Crossing Route Corridor Options Review:*

Work carried out by Jacobs Arup, January to May 2008.

Report to assess 9 mainline connecting road corridors: three in the Northern Study Area and six in the Southern Study Area. It recommended that two of the northern and two of the southern corridor options be taken forward for further assessment.
3. *Forth Replacement Crossing DMRB Stage 2 Corridor Report:*

Work carried out by Jacobs Arup, May to August 2008.

Report on the assessment of the shortlisted corridor options and a supplementary assessment of a variant version of a connecting road corridor in the Southern Study Area. The report recommended that work continue to identify in detail the optimum road improvement within North Corridor Option 1 and South Corridor Option 1.
4. *Forth Replacement Crossing, Main Crossing (Bridge) Scheme Assessment Report, Development of Options:*

Work carried out by Jacobs Arup, January to August 2008.

Report on the assessment of options for the outline design of the replacement crossing.
5. *Forth Road Bridge – Feasibility of Multi-Modal Corridor:*

Work carried out by Jacobs Arup, August to October 2008.

Report on the feasibility of utilising the existing Forth Road Bridge for non motorised and public transport/light road traffic, including for a potential future guided bus/tram/ light rail facility. The report concluded that this would be a feasible option.
6. *Forth Road Bridge – Audit of Feasibility of Future Multi-Modal Use – Summary Report*

Independent summary of review on the Jacobs Arup assessment of the feasibility of utilising the existing Forth Road Bridge for non motorised and public transport/light

*Work carried out by Faber
Maunsell to November 2008*

road traffic, including for a potential future guided bus/tram/light rail facility. The report concluded that the Forth Road Bridge could, in principle, be adapted for future LRT.

7. *Forth Replacement Crossing, Main
Crossing (Bridge) Scheme
Assessment Report, Development
of D2M Alternatives:*

Report on the assessment of options for a narrower replacement crossing to carry a dual carriageway road with hard shoulders.

*Work carried out by Jacobs Arup,
October to November 2008.*

*Forth Replacement Crossing,
Scheme Definition Report.*

The final report on the project planning work carried out during 2008 which provides recommendations of the road connections and the incorporation of the Forth Road Bridge as an integral element of the proposals for use by pedestrians, cyclists, public transport and any future multi-modal facility.

*Work carried out by Jacobs Arup,
July to November 2008*

1 Introduction

1.1 Background

Following the Scottish Government's decision of December 2007 to construct a multi-modal Cable Stayed Bridge west of the existing Forth Road Bridge, Jacobs Arup have been engaged in the assessment and review of the roads' infrastructure route corridor options identified for consideration at the initial project workshops of January 2008.

Nine mainline route corridor options were identified for consideration in the provision of connections between the proposed replacement bridge and existing roads' infrastructure. Of these options, three were identified to the north of the Firth of Forth, providing connections to the A90/M90, and six were identified to the south, providing a connection to the A90, M9 Spur and M9.

The assessment was undertaken in two stages. First, an initial assessment was undertaken between January and March 2008 with the recommendations being presented at a sifting workshop on 5 March 2008. Following acceptance of these recommendations, the remaining route corridor options were subject to further design development and assessment and the results reported to Transport Scotland in May 2008.

It was recognised that the preferred corridors identified need not be improved over their full length. It was specified that a later stage of project development would be to give further consideration to the form and function of the junctions required and the extent of the road infrastructure improvements to be provided.

The route corridor options to be assessed are as follows:

Northern Route Corridor Options

- North Corridor Option 1 – An online upgrade of the existing A90/M90 route corridor between Ferrytoll Junction and Halbeath Interchange.
- North Corridor Option 2 – An offline scheme providing a new mainline carriageway between the proposed replacement bridge and Halbeath Interchange.
- North Corridor Option 3 – A combined option requiring the online upgrade of the A90 between Ferrytoll Junction and Admiralty Junction with a new section of offline carriageway being provided between Admiralty Junction and Halbeath Interchange.

Southern Route Corridor Options

- South Corridor Option 1 – A short offline section of new carriageway connecting the proposed replacement bridge to the A90 south of Echline Junction.
- South Corridor Option 2 – A new offline carriageway connecting the proposed replacement bridge to the M9 north of Winchburgh.
- South Corridor Option 3 – A new offline carriageway connecting the proposed replacement bridge to the M9 Spur northeast of M9 Junction 1a.

- South Corridor Option 4 - A new offline carriageway connecting the proposed replacement bridge to the M9 northwest of Winchburgh.
- South Corridor Option 5 – A new offline carriageway connecting the proposed replacement bridge to the M9 northwest of Winchburgh and to the M9 Spur northeast of M9 Junction 1a.
- South Corridor Option 6 - Similar to South Corridor Option 4 but with the alignment located slightly further west.
- The assessment of certain combinations of southern corridor options was also undertaken where it was considered practicable.

1.2 Purpose of Route Corridor Options Review

The purpose of this Route Corridor Options Review is to demonstrate the process of assessment undertaken, with respect to each of the mainline route corridor options, whilst taking into consideration the scheme objectives of the Forth Replacement Crossing Project:

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

In the initial assessment of the nine mainline route corridor options consideration was given to engineering and transportation issues and environmental impact. Comparative scheme costs were also taken into consideration in the assessment. A plan of the indicative layouts of the route corridor options is contained within Appendix 1. Junction areas were not reviewed in detail during the initial assessment. It was assumed that all existing traffic movements would be catered for. All corridor options were considered on the basis of provision of a dual two lane motorway but no consideration was given to the impact of provision of multi-modal or multiple occupancy transport strategies.

The initial assessment stage was focused on the consideration of options that had significant differences from each other, rather than minor differences.

The further assessment stage took account of the further design development and assessment that was undertaken in the period between the sifting workshop in March and May 2008.

Through comparative assessment, the number of route corridor options to be taken forward to DMRB Stage 2 Corridor Assessment was reduced with appropriate justification being provided for those options not deemed favourable.

2 Initial Assessment Stage

The initial assessment stage covers the work undertaken in the period from January to March 2008.

The assessment matrices included in Appendix 2 identify the significant environmental, engineering, relative scheme cost and economic factors assessed during this period in relation to each of the route corridor options considered. These tables provided the rationale for the decisions on route corridor option removal at the initial assessment stage and are discussed below.

2.1 Rationale for Southern Route Corridor Options Removal

2.1.1 South Corridor Option 4

The reasons why South Corridor Option 4 is significantly less advantageous than other corridors are as follows:

- In traffic economic terms the vehicle kilometres are significantly higher than Route Corridor Options 1 to 3. This is as a result of the majority of traffic movements coming from the east on the A90 or south east on the M9.
- Presence of collapsed mine workings and large number of shafts within corridor area, which would impact on the programme and cost of the works.
- Comparative cost is some 65% higher than the base South Corridor Option 1 and was not considered to provide value for money as it did not provide a significantly greater level of service for traffic (e.g. M9 West traffic) or provide for a reduction in vehicle kilometres travelled.

As a consequence of the above it was recommended that South Corridor Option 4 should not be taken forward for further consideration.

2.1.2 South Corridor Option 5

The reasons why South Corridor Option 5 is significantly less advantageous than other corridors are as follows:

- Cost is some 86% higher than the base South Corridor Option 1.
- The cost of providing the new M9 links was not proportional to the levels of traffic anticipated and was not considered to provide value for money.
- Overall, the environmental impact was considered likely to be higher than the other corridors under consideration, for example land take and severance.
- The western section of the corridor passes along the edge of a known mine workings area and additional investigation and treatment would impact on the costs and programme.

As a consequence of the above it was recommended that South Corridor Option 5 should not be taken forward for further consideration.

2.1.3 South Corridor Option 6

The reasons why South Corridor Option 6 is significantly less advantageous than other corridors are as follows:

- In traffic economic terms the vehicle kilometres are significantly higher than South Corridor Options 1 to 3. This is as a result of the majority of traffic movements coming from the east on the A90 or south east on the M9.
- Presence of collapsed mine workings and large number of shafts within corridor area, which would impact on the programme and cost of the works.
- Comparative cost is some 63% higher than the base South Corridor Option 1 and was not considered to provide value for money as it did not provide a significantly greater level of service for traffic (e.g. M9 West traffic) or provide for a reduction in vehicle kilometres travelled.

As a consequence of the above it was recommended that South Corridor Option 6 should not be taken forward for further consideration.

2.1.4 Combination of Corridor Options

To provide direct vehicular access from both the A90 and M9 the following combinations of corridor options were also considered:

- South Corridor Options 1 and 2.
- South Corridor Options 1 and 4.
- South Corridor Options 1 and 6.

No further combinations of corridor options were considered feasible.

2.1.5 Combination of South Corridor Options 1 and 4

The reasons why the combination of South Corridor Options 1 and 4 is significantly less advantageous than other corridors are as follows:

- Presence of collapsed mine workings and large number of shafts within corridor area, which would impact on the programme and cost of the works.
- Comparative cost is some 165% higher than the base South Corridor Option 1 and was not considered to provide value for money as it did not provide a significantly greater level of service for traffic (e.g. M9 West traffic).

As a consequence of the above it was recommended that the Combination of South Corridor Options 1 and 4 should not be taken forward for further consideration.

2.1.6 Combination of South Corridor Options 1 and 6

The reasons why the combination of South Corridor Options 1 and 6 is significantly less advantageous than other corridors are as follows:

- Presence of collapsed mine workings and large number of shafts within corridor area, which would impact on the programme and cost of the works.
- Comparative cost is some 163% higher than the base South Corridor Option 1 and was not considered to provide value for money as it did not provide a significantly greater level of service for traffic (e.g. M9 West traffic).

As a consequence of the above it was recommended that the Combination of South Corridor Options 1 and 6 should not be taken forward for further consideration.

2.2 Northern Route Corridor Options

The level of overall differentiation between North Corridor Options 1, 2 and 3 were not considered to be significant enough to rule any of the corridors out at the initial assessment stage. The corridors were reviewed and, although there are higher costs with some corridors and buildability issues with others, it was recommended that all three are taken forward for further consideration.

3

Recommendations for Further Assessment**3.1 Recommendation**

The rationale described in the previous chapter and the resultant recommendations were presented to Transport Scotland at a workshop on 5 March 2008. Transport Scotland accepted all of the recommendations at the conclusion of the workshop.

Following the initial assessment stage, the corridor options noted below were therefore taken forward for further consideration at the next stage of assessment.

3.2 Southern Route Corridor Options

- South Corridor Option 1.
- South Corridor Option 2.
- South Corridor Option 3.
- Combination of South Corridor Options 1 and 2 (known as South Corridor Option 4A moving forward).

3.3 Northern Route Corridor Options

- North Corridor Option 1.
- North Corridor Option 2.
- North Corridor Option 3.

4

Further Assessment Stage

The following chapters of the report summarise the design development and assessment that was undertaken in the period from the sifting workshop in March to May 2008.

Following the sifting workshop, the route corridor options carried forward for further assessment are as follows:

Northern Route Corridor Options

- North Corridor Option 1 – An online upgrade of the existing A90/M90 route corridor between Ferrytoll Junction and Halbeath Interchange.
- North Corridor Option 2 – An offline scheme providing a new mainline carriageway between the proposed replacement bridge and Halbeath Interchange.
- North Corridor Option 3 – A combined option requiring the online upgrade of the A90 between Ferrytoll Junction and Admiralty Junction with a new section of offline carriageway being provided between Admiralty Junction and Halbeath Interchange.

Southern Route Corridor Options

- South Corridor Option 1 – A short offline section of new carriageway connecting the proposed replacement bridge to the A90 south of Echline Junction.
- South Corridor Option 2 – A new offline carriageway connecting the proposed replacement bridge to the M9 north of Winchburgh.
- South Corridor Option 3 – A new offline carriageway connecting the proposed replacement bridge to the M9 Spur northeast of M9 Junction 1a.
- South Corridor Option 4A – A combination of South Corridor Options 1 and 2 providing direct connections to the A90 and the M9.

In the assessment of the seven mainline route corridor options consideration was given to engineering and transportation issues and environmental impact. The further design development enabled the corridors to be described and assessed in more detail. Indicative junction layouts were also considered to ensure that access can be provided/maintained/improved between the proposed mainline and local/national routes.

5

North Corridor Option 1**5.1 Description**

At 7.1km in length, North Corridor Option 1 covers much of the existing A90/M90 route corridor between Ferrytoll Junction and Halbeath Interchange. An indicative layout of this option is provided in Appendix 3.

As a substantially on-line corridor, it was recognised that this corridor option had significant potential for optimising the extent of its improvement over its overall extent.

Connection to the proposed replacement bridge is achieved through the provision of a new section of carriageway between the northern bridgehead and Ferrytoll Junction. Descending on viaduct in a north easterly direction towards Ferrytoll Junction, the new section of carriageway clips the eastern edge of St Margaret's Marsh, a Site of Special Scientific Interest (SSSI), before crossing the B981 east of Dunfermline Waste Water Treatment Works.

The change in bearing associated with the approach to the proposed replacement bridge necessitates the reconstruction of Ferrytoll Junction. In the provision of a new junction at this location, all traffic movements associated with the existing arrangement will need to be maintained, new connections being required between the mainline carriageway, the B980, B981 and Ferrytoll Road.

North of Ferrytoll, the new mainline, retaining the horizontal and vertical geometry of the existing A90/M90, is required to interact with junctions at Admiralty and Masterton where access is provided to the A985, A921 and A823(M). A range of proposals are available for implementation at these junctions ranging from do nothing to full reconstruction. Continuing north, the corridor passes to the east of the properties at Middlebank, before passing beneath Masterton Road and the B981 on approach to Halbeath Interchange where the scheme terminates.

For the purpose of assessment, it was assumed that the carriageway cross section existing A90/M90 route corridor would be upgraded to full motorway standard. A dual two lane motorway (D2M) or dual three lane motorway (D3M) was considered.

5.2 Engineering Issues

A number of engineering constraints were identified which require assessment to allow further development should this option be progressed. Principally these are:

- Carriageway Cross Section.
- A90/M90 Route Corridor and Structural Requirements.
- Junction Provision and Future Transport Developments.
- Geotechnical Assessment.

5.2.1 Carriageway Cross Section

In considering the most appropriate cross section for implementation, the scheme objectives dictate that two lanes of general traffic in each direction are required. It was recognised that there may be an opportunity to consider additional High Occupancy Vehicle (HOV) lanes in the early years following construction, prior to a possible future introduction of a public transport multi-modal facility.

In light of this opportunity, a dual three lane motorway (D3M) was therefore taken as the working assumption over the extent of North Corridor Option 1 with a design speed of 120kph, with the flexibility to scale back the scope of the upgrade as necessary during scheme development.

5.2.2 A90/M90 Route Corridor and Structural Requirements

Using the existing A90/M90 route corridor and replicating its existing horizontal and vertical geometry imposes a number of substandard design elements. Where economically practicable, these would be removed through design development, but a number of substandard elements are likely to remain due to topography, existing structures and existing junction positions.

Existing structures will be adopted for use, where possible. A number of structures may be retained in their current form but many would require widening to accommodate a dual three lane motorway. A number of new structures will also be required, particularly in the junction areas and in connecting Ferrytoll Junction and the proposed replacement bridge.

5.2.3 Junction Provision and Future Transport Developments

North Corridor Option 1 being an online upgrade of the A90/M90 intersects the existing junctions at Ferrytoll, Admiralty and Masterton.

(a) Ferrytoll Junction

The bearing of the proposed replacement bridge dictates that Ferrytoll Junction must be reconstructed. The junction will, as a minimum, replicate the movements of the existing layout.

In future-proofing the scheme for future transport modes such as Light Rapid Transit (LRT), an appropriate entry/exit point must be considered. North of the Firth of Forth, it was determined that Ferrytoll Junction is the most practical place to terminate the multi-modal aspect of the project. Termination at this point will enable connections to be established to a number of local destinations.

Connectivity to the Forth Road Bridge must also be considered in the development of this junction, thus catering for any future role for which the existing bridge might have.

(b) Admiralty Junction

The existing junction layout at Admiralty provides a typical grade separated junction facilitating all movements. In the provision of the North Corridor Option 1, the following proposals could be implemented:

- provision of minor improvements to all slip road tapers and nosings to enable implementation of D3M motorway cross section;
- provision of minor improvements to south facing slip roads and provision of north facing auxiliary lanes to alleviate weaving issue on mainline carriageway between Admiralty and Masterton;
- provision of minor improvements to south facing slip road tapers and nosings and provision of parallel running lanes between Admiralty and Masterton, removing north facing slip roads; and

- full improvement, encompassing minor improvements to south facing slip roads and closure of north facing slip roads, existing north facing functionality being catered for by a new junction arrangement at Masterton.

(c) Masterton Junction

The existing layout of Masterton provides a free flow junction arrangement between the M90 and the A823(M) both northbound and southbound. In the provision of North Corridor Option 1 the following proposals could be implemented:

- provision of minor improvements to all slip road tapers and nosings to enable implementation of D3M cross section;
- partial reconstruction as a free flow junction with south facing auxiliary lanes to Admiralty Junction;
- provision of a new grade separated dumbbell junction arrangement facilitating all movements with the addition of south facing parallel running lanes to Admiralty Junction; and
- full reconstruction as a free flow junction with new links to the A921 catering for the functionality lost at Admiralty Junction through the closure of the north facing slip roads.

5.2.4 Geotechnical Assessment

The recent ground investigation found that North Corridor Option 1 is mostly situated on variably weathered glacial till overlying dolerite bedrock at St. Margaret's Hope and in the vicinity of Ferrytoll and Admiralty Junctions, with sedimentary bedrock comprising sandstone, siltstone, mudstone, limestone and coal seams elsewhere. Based on the available information there would appear to be no significant geotechnical issues.

5.3 Environmental Considerations

North Corridor Option 1 is mainly on-line and has the lowest land take of all northern route corridor options. It is anticipated to have the lowest overall impact on watercourses, designated sites of geological importance, ecological impact on habitats and species, landscape, visual, footpaths and community severance.

An increase in the carriageway cross section to D3M would potentially increase the landscape and visual impacts of the corridor. There may also be changes in the air quality, traffic noise and vibration impacts due to the increase in the carriageway width.

With regards to cultural heritage, North Corridor Option 1 has the least potential for impacts on unrecorded archaeology but has the potential to impact on Middlebank Souterrain Scheduled Ancient Monument (SAM), which is located adjacent to the existing M90 at Masterton Junction.

5.4 Transportation Considerations

The provision of a D3M cross section, encompassing two lanes of general traffic and the potential for an HOV lane, in tandem with the continued provision of junction arrangements at Ferrytoll, Admiralty and Masterton is expected to provide the following benefits:

- increased levels of service for private, road based modes of transport;

- improved performance to the wider road network through improved connectivity;
- improved journey time reliability;
- improved accessibility and social exclusion through the provision of complementary transport measures; and
- minimal impact on the effective operation of the transport network during times of maintenance.

5.5 North Corridor Option 1 Recommendation

An indicative layout of North Corridor Option 1 is contained within Appendix 3. If carried forward to DMRB Stage 2 Corridor Assessment this option could encompass the following:

- a dual D2m or D3M mainline cross section; and
- a reconstructed Ferrytoll Junction, providing:
 - connectivity between the new mainline and existing local roads; and
 - connectivity for future transport modes.

In addition, the following junction improvements could also be considered:

- a full improvement to Admiralty Junction;
- a full reconstruction of Masterton Junction; and
- connectivity to the Forth Road Bridge.

6

North Corridor Option 2**6.1 Description**

At 7.0km in length, North Corridor Option 2 is an offline solution which enables much of the existing A90/M90 between Ferrytoll Junction and Masterton Junction to be left in situ, allowing it to act as a local distributor road. An indicative layout of this option is provided in Appendix 4.

As a substantially off-line corridor, it was recognised that this corridor option had little potential for optimising the extent of its improvement within its overall extent.

The North Corridor Option 2 mainline is to be constructed to motorway standard. The mainline carriageway descends on viaduct from the northern bridgehead, passing through the eastern extents of St Margaret's Marsh (SSSI) before crossing the B981 southeast of Dunfermline Waste Water Treatment Works.

Located to the west of the existing corridor through Ferrytoll, North Corridor Option 2 requires a new junction to be constructed at this location maintaining access to the B980, B981 Ferrytoll Road and the existing A90.

North of Ferrytoll Junction, the corridor climbs Castlandhill before sweeping northeast. The topography of the area requires the provision of a cut and cover solution in the vicinity of Castlandhill Steadings, masking the corridor's presence. Upon exiting the cut and cover section, the corridor crosses the A90 on structure, south of Admiralty Junction, and continues on a north easterly bearing towards Belleknowes Industrial Estate. Continuing north, the corridor climbs out of the valley containing Belleknowes Industrial Estate, intersecting the M90 north of Masterton Junction. The tie in to the existing M90 is achieved east of Duloch Farm. The scheme terminates at Halbeath Interchange.

In the consideration of North Corridor Option 2, two mainline motorway cross sections were considered, D2M and D3M.

6.2 Engineering Issues

A number of engineering constraints were identified which require assessment to allow further development should this option be progressed. Principally these are:

- Carriageway Cross Section.
- Route Corridor, Structural Requirements and Topographical Effects.
- Junction Provision and Future Transport Developments.
- Geotechnical Assessment.

6.2.1 Carriageway Cross Section

In considering the most appropriate cross section for implementation, the scheme objectives dictate that two lanes of general traffic in each direction are required. It was recognised that there may be an opportunity to consider additional High Occupancy Vehicle (HOV) lanes in the early years following construction, prior to a possible future introduction of a public transport multi-modal facility.

Whilst effective in dealing with all means of transport provision, it was considered that the provision of a D3M cross section in tandem with the retention of the existing

A90/M90 as a local distributor road would be unnecessary. Future traffic growth and the potential for HOV provision could be catered for through the use of the existing A90/M90 and the new mainline carriageway at D2M standard with effective junction provision. Given this, it is thought that the additional costs and impacts associated with the D3M cross section outweigh any benefits.

A dual two lane motorway (D2M) was therefore taken as the working assumption over the extent of North Corridor Option 2 with a design speed of 120kph.

6.2.2 Route Corridor, Structural Requirements and Topographical Effects

Situated offline, North Corridor Option 2 has a greater effect on the coastal landscape than North Corridor Option 1. Situated west of the existing A90/M90 route corridor, it further impacts the existing landscape through its assent of Castlandhill, with a complex cut and cover solution likely to be required in the establishment of the corridor through this section. Sweeping northeast across the A90/M90 route corridor, further new structures will be required to support the corridor with a sizable structure being required in the vicinity of Belleknowes Industrial estate, carrying the mainline over the A921 and the Fife Circle Railway Line. Continuing north the mainline carriageway connects to the M90 north of Masterton Junction.

In contrast to North Corridor Option 1, the new offline mainline carriageway allows a fully DMRB compliant horizontal and vertical geometry design to be considered, subject to the topographical constraints detailed and junction design. However, the provision of this option would still encompass Departures from Standard through the retention of the existing A90/M90.

6.2.3 Junction Provision and Future Transport Developments

The provision of an offline mainline carriageway and the retention of the existing A90/M90 only requires a new junction at Ferrytoll with the existing arrangements at Admiralty and Masterton being retained for local access.

(a) Ferrytoll Junction

The provision of a new offline mainline carriageway dictates that Ferrytoll Junction must be reconstructed. The junction will, as a minimum, replicate the movements of the existing layout.

As with North Corridor Option 1, Ferrytoll Junction is considered the most practical place to terminate the multi-modal aspect of the project.

Connectivity to the Forth Road Bridge must also be considered in the development of this junction, thus catering for any future role for which the existing bridge might have.

(b) Local Access Provision

To satisfy the scheme objectives, it is necessary that connectivity be maintained to both local and national routes. Therefore, the retention of the existing A90/M90 and the junctions at Admiralty and Masterton is necessary to facilitate access to Rosyth, Inverkeithing and Dunfermline.

A set of north facing slip roads are proposed between Masterton Junction and Halbeath Interchange to facilitate access between the proposed mainline and the existing M90.

6.2.4 Geotechnical Assessment

The recent ground investigation found that the ground conditions associated with North Corridor Option 2 predominantly comprise variably weathered glacial till overlying bedrock consisting of dolerite or sedimentary rocks including sandstone, siltstone, mudstone, limestone and coal seams. Based on the available information there would appear to be no significant geotechnical issues.

6.3 Environmental Considerations

North Corridor Option 2 being predominantly offline has the greatest land take of the northern route corridor options. Therefore, this option is anticipated to have the greatest potential for overall land use impacts. The significance of impacts on watercourses, designated sites of geological importance, ecological impact to habitats and species, landscape, visual and effects, footpaths and community severance are also likely to be increased compared to all other northern route corridor options.

North Corridor Option 2 is also considered to be less compliant with policy objectives than North Corridor Option 1 due to potential impacts on policies protecting Belleknowes Industrial Estate, which is designated for brownfield development.

6.4 Transportation Considerations

The provision of a D2M cross section encompassing two lanes of general traffic in tandem with the continued use of the existing A90/M90 route corridor as a local distributor road and potential HOV corridor is expected to provide the following benefits:

- increased levels of service for private, road based modes of transport;
- improved performance to the wider road network through improved connectivity;
- improved journey time reliability;
- improved accessibility and social exclusion through the provision of complementary transport measures; and
- minimal impact on the effective operation of the transport network during times of maintenance.

6.5 North Corridor Option 2 Recommendation

An indicative layout of North Corridor Option 2 is contained within Appendix 4. If carried forward to DMRB Stage 2 Corridor Assessment this option could encompass the following:

- a dual two lane motorway (D2M) mainline cross section;
- a reconstructed Ferrytoll Junction, providing:
 - connectivity between the new mainline, local roads and the existing A90/M90; and
 - connectivity for future transport modes;
- provision of north facing connectivity between the proposed mainline and the existing A90/M90 north of Masterton Junction.

In addition, the following junction improvements could also be considered:

- connectivity to the Forth Road Bridge.

7

North Corridor Option 3**7.1 Description**

At 7.0km in length, North Corridor Option 3 is a combined option requiring the upgrade of the existing A90 between Ferrytoll Junction and Admiralty Junction and the provision a new offline section of carriageway north of Admiralty. An indicative layout of this option is provided in Appendix 5.

As with North Corridor Option 2, the off-line nature of the northern end of the corridor means that this corridor option also has limited potential for optimising the extent of its improvement within its full extent.

The North Corridor Option 3 mainline would be constructed to motorway standard. Connection to the proposed replacement bridge is achieved through the provision of a new section of carriageway between the northern bridgehead and Ferrytoll Junction. Descending on viaduct in a north easterly direction towards Ferrytoll Junction, the new section of carriageway clips the eastern edge of St Margaret's Marsh (SSSI) before crossing the B981 east of Dunfermline Waste Water Treatment Works.

The change in bearing associated with the approach to the proposed replacement bridge necessitates the reconstruction of Ferrytoll Junction. In the provision of a new junction at this location, all traffic movements associated with the existing arrangement will need to be maintained, new connections being required between the mainline carriageway, the B980, B981 and Ferrytoll Road.

North of Ferrytoll the new mainline, retaining the horizontal and vertical geometry of the existing A90/M90 to a point just south of Admiralty Junction, turns on a north easterly bearing towards Belleknowes Industrial Estate. Continuing north, the corridor climbs out of the valley containing Belleknowes Industrial Estate intersecting the M90 north of Masterton Junction. The tie in to the existing M90 is achieved east of Duloch Farm. The scheme terminates at Halbeath Interchange.

In the consideration of North Corridor Option 3, two mainline motorway cross sections were considered, D2M and D3M.

7.2 Engineering Issues

A number of engineering constraints were identified which require assessment to allow further development should this option be progressed. Principally these are:

- Carriageway Cross Section.
- Route Corridor, Structural Requirements and Topographical Effects.
- Junction Provision and Future Transport Developments.
- Geotechnical Assessment.

7.2.1 Carriageway Cross Section

In considering the most appropriate cross section for implementation, the scheme objectives dictate that two lanes of general traffic in each direction are required. It was recognised that there may be an opportunity to consider additional High Occupancy Vehicle (HOV) lanes in the early years following construction, prior to a possible future introduction of a public transport multi-modal facility. The existing

A90/M90 between Admiralty and Masterton could be utilised as a local distributor road, similar to Route Corridor Option 2.

In light of this opportunity, a dual three lane motorway (D3M) was therefore taken as the working assumption over the extent of North Corridor Option 3 with a design speed of 120kph, with the flexibility to scale back the scope of the upgrade as necessary during scheme development.

7.2.2 Route Corridor, Structural Requirements and Topographical Effects

Using the existing A90/M90 route corridor and replicating its existing horizontal and vertical geometry imposes a number of substandard design elements have been inherited. Where economically practicable, these would be removed through design development but a number of substandard elements are likely to remain due to topography, existing structures and existing junction positions.

North of Admiralty Junction, the provision of an offline mainline carriageway has allowed a fully DMRB compliant horizontal and vertical geometry to be considered, subject to topographical constraints and junction design.

Existing structures will be adopted for use, where possible. However, the reconstruction of Ferrytoll Junction and the provision of a widened cross section would require a number of structures to be widened or replaced. New structures of substantial length will be required in the provision of the mainline carriageway, carrying the corridor over existing local roads and railway lines whilst also providing connectivity to the proposed replacement bridge.

7.2.3 Junction Provision and Future Transport Developments

The provision of an offline mainline carriageway from north of Ferrytoll and the retention of the existing A90/M90 only requires a new junction at Ferrytoll with the existing arrangements at Admiralty and Masterton being retained for local access.

(a) Ferrytoll Junction

The bearing of the proposed replacement bridge dictates that Ferrytoll Junction must be reconstructed. The junction will, as a minimum, replicate the movements of the existing layout.

As with North Corridor Option 1, Ferrytoll Junction is considered the most practical place to terminate the multi-modal aspect of the project.

Connectivity to the Forth Road Bridge must also be considered in the development of this junction, thus catering for any future role for which the existing bridge might have.

(b) Local Access Provision

To satisfy the scheme objectives, it is necessary that connectivity be maintained to both local and national routes. Therefore, the retention of the existing A90/M90 and the junctions at Admiralty and Masterton is necessary to facilitate access to Rosyth, Inverkeithing and Dunfermline. The south facing slips at Admiralty will require to be extended to connect to the proposed mainline.

North facing slip roads are proposed between Masterton Junction and Halbeath Interchange to facilitate access between the proposed mainline and the existing M90.

7.2.4 Geotechnical Assessment

The recent ground investigation found that the ground conditions associated with North Corridor Option 3 predominantly comprise variably weathered glacial till overlying bedrock consisting of dolerite or sedimentary rocks including sandstone, siltstone, mudstone, limestone and coal seams. Based on the available information there would appear to be no significant geotechnical issues.

7.3 Environmental Considerations

North Corridor Option 3 is an intermediate option for a number of environmental impacts. With regards to air quality, this corridor has the highest number of properties that may experience a deterioration in local air quality.

7.4 Transportation Considerations

The provision of a D3M cross section encompassing two lanes of general traffic and the potential for an HOV lane in tandem with the provision of a new junction at Ferrytoll and the limited use of Admiralty Junction and Masterton Junction is expected to provide the following benefits:

- increased levels of service for private, road based modes of transport on the mainline carriageway
- a reduction in the performance to the wider road network through reduced connectivity
- improved journey time reliability on the mainline carriageway only, with detrimental effects to journey time reliability on local roads with reduced connectivity
- limited improvement to accessibility and social exclusion through the provision of complementary transport measures
- disruption to the effective operation of the transport network during times of maintenance through a reduction in junction connectivity.

7.5 North Corridor Option 3 Recommendation

An indicative layout of North Corridor Option 3 is contained within Appendix 5. This option is the least favoured of the northern route corridor options. However, if carried forward to DMRB Stage 2 Corridor Assessment this corridor option could encompass the following:

- a dual three lane motorway (D3M) mainline cross section;
- a reconstructed Ferrytoll Junction, providing:
 - connectivity between the new mainline and existing local roads; and
 - connectivity for future transport modes;
- provision of north facing connectivity between the proposed mainline and the existing A90/M90 north of Masterton facilitating limited local access; and.
- extension of south facing slips at Admiralty to provided connectivity between the proposed mainline and the existing A90/M90.

In addition, the following junction improvements could also be considered:

- connectivity to the Forth Road Bridge.

8

South Corridor Option 1**8.1 Description**

At 2.75km in length, South Corridor Option 1 provides a direct link between the proposed replacement bridge and the existing A90 southeast of Echline Junction. In the provision of this route corridor option, best use is made of the existing roads' infrastructure associated with the Forth Road Bridge including the A90 and the recently completed M9 Spur Extension. An indicative layout of this option is provided in Appendix 6.

The proposed mainline, commencing approximately 250m east of the A8000 overbridge, departs the existing A90 into the fields of Dundas Home Farm to the west where a new junction to the A904 is proposed. Continuing west, the mainline enters Dundas Estate before swinging north and crossing beneath the A904 to the west of South Queensferry. On approach to the proposed replacement bridge, the vertical geometry of the corridor rises to meet the southern bridgehead.

In the provision of this option, further connectivity enhancements are proposed to the existing road network with a sliding scale of improvements available at M9 Junction 1a and Scotstoun Junction. The construction of a new junction to the A904 is also proposed to provide access to the proposed replacement crossing for non-motorway traffic and local traffic.

A major consideration to be taken into account when assessing South Corridor Option 1 was the position of an oil pipeline which runs to the south of the existing A90 and continues west across the fields to the south of Echline and South Queensferry. Protection measures are required where the proposed corridor crosses the pipeline, a major diversion of the pipeline costing an estimated £200 million per day to implement. The interaction between the new carriageway and the oil pipeline was therefore a key consideration in the identification of the preferred South Corridor Option 1 alignment.

In the consideration of South Corridor Option 1, two mainline motorway cross sections were considered, D2M and D3M.

8.2 Engineering Issues

A number of engineering constraints were identified which require assessment to allow further development should this option be progressed. Principally these are:

- Carriageway Cross Section
- Route Corridor, Structural Requirements and Topographical Effects
- Junction Provision and Future Transport Developments
- Geotechnical Assessment

8.2.1 Carriageway Cross Section

In considering the most appropriate cross section for implementation, the scheme objectives dictate that two lanes of general traffic in each direction are required. It was recognised that there may be an opportunity to consider additional High Occupancy Vehicle (HOV) lanes in the early years following construction, prior to a possible future introduction of a public transport multi-modal facility.

In light of this opportunity, a dual three lane motorway (D3M) was therefore taken as the working assumption over the extent of South Corridor Option 1 with a design speed of 120kph, with the flexibility to scale back the scope of the upgrade as necessary during scheme development.

8.2.2 Route Corridor, Structural Requirements and Topographical Effects

Due to its close proximity to South Queensferry, a number of measures were considered in the provision of South Corridor Option 1.

To provide protection to the oil pipeline in the fields to the south of the A904, the corridor must be constructed above ground level. In order to provide suitable mitigation and to limit the number of structural crossings of the pipeline, initial consultations have been held with BP Oil UK Ltd to discuss the horizontal and vertical geometry of the corridor. Further consultations shall be held if this option is progressed to DMRB Stage 2 Corridor Assessment.

The provision of a new offline carriageway allows a fully DMRB compliant horizontal and vertical geometry design to be considered, subject to existing topographical constraints and the requirement to cross the A904 on approach to the proposed replacement bridge. Through the utilisation of the existing A90 and the M9 Spur, a number of substandard design elements are likely to be inherited. Where economically practicable, these would be removed through design development. However a number of substandard elements are likely to remain due to topography, existing structures and existing junctions.

In the provision of the South Corridor Option 1, the requirement exists for the reconstruction of the A8000 overbridge. A new structure will also be required to carry the A904 over the proposed mainline carriageway. Any improvement considered at M9 Junction 1a will also generate significant modifications to enhance the functionality of the existing arrangement.

In future-proofing the scheme for future transport modes such as Light Rapid Transit (LRT), an appropriate entry/exit point must be considered. South of the Firth of Forth, it was determined that the A904 is the most practical place to terminate the multi-modal aspect of the project. Termination at this point will enable connections to be established to a number of local destinations.

8.2.3 Junction Provision and Future Transport Developments

In the provision of South Corridor Option 1, a new junction is required at Echline to maintain access to local communities and as an access for non-motorway traffic. In addition, improvements can be made to M9 Junction 1a and the recently completed Scotstoun Junction, optimising existing infrastructure for use with the proposed replacement bridge.

(a) Echline Junction

The provision of a new junction at Echline is required in order to connect the proposed mainline to the A904 to provide access to the proposed replacement crossing for non-motorway and local traffic.

Connectivity to the Forth Road Bridge must also be considered in the development of this junction, thus catering for any future role for which the existing bridge might have.

In the provision of South Corridor Option 1, the following proposals could be implemented:

- a standard grade separated junction utilising a roundabout to maintain all movements between the proposed mainline and the A904
- a free flow junction arrangement, incorporating improvements to Scotstoun Junction and the use of the existing Echline Junction, providing access between the proposed mainline, the A904 and the A8000.

Should South Corridor Option 1 be taken forward for further assessment, it is deemed appropriate that the design should consider the optimum junction arrangement at Echline and Scotstoun.

(b) M9 Junction 1a

The existing layout of M9 Junction 1a provides partial free flow junction movements between the M9 and the M9 Spur. No west facing functionality is offered by the existing junction arrangement. In the provision of improvements, the following options could be implemented:

- provision of minor improvements.
- full reconstruction of the existing junction arrangement providing a change in traffic priority, the M9 to M9 Spur link becoming the mainline carriageway.
- full reconstruction of the existing junction arrangement, providing full functionality between the M9 and the M9 Spur.

8.2.4 Geotechnical Assessment

The ground conditions in the area of South Corridor Option 1 essentially comprise variably weathered glacial till overlying bedrock. The bedrock comprises mainly sedimentary deposits of sandstones, mudstones and siltstones, with dolerite located at depth beneath the A904 crossing. Based on the available information there would appear to be no significant geotechnical issues, with the exception of any alterations to Scotstoun Junction, which would necessitate construction of links and structures over an area of recorded oil shale workings.

8.3 Environmental Considerations

South Corridor Option 1 is the shortest of the southern route corridor options under consideration and is therefore expected to have the lowest overall land use impacts in terms of potential land loss, severance and building demolitions. It is likely to cross the least number of watercourses and terrestrial habitats of all of the southern route corridor options and is therefore expected to have the lowest impacts on ecology and the water environment. Landscape and visual impacts are likely to be the lowest as South Corridor Option 1 uses less of the rural landscape.

With regards to traffic noise and vibration, South Corridor Option 1 is likely to affect the greatest number of properties (due to its proximity to South Queensferry), although most are already affected by the A904 traffic.

South Corridor Option 1 may result in significant cultural heritage and landscape impacts on Designed Landscape Area of Dundas Estate and may result in changes to the area's cultural heritage.

Whilst South Corridor Option 1 breaches the Green Belt, this option is expected to have the lowest impact on policy objectives as all other southern options affect the Green Belt and also have potential impacts on a Designated Area of Outstanding

Landscape Quality. It does propose the lowest level of new road / junction construction and has the least properties within 200m and is therefore anticipated to result in the least construction disruption.

8.4 Transportation Considerations

The provision of a D3M cross section encompassing two lanes of general traffic and the possibility of an HOV lane in tandem with the provision of a new junction at Echline and improvements to the existing junctions at Scotstoun and M9 Junction 1a is expected to provide the following benefits:

- increased levels of service for private, road based modes of transport
- improved performance to the wider road network through improved connectivity.
- improved journey time reliability
- improved accessibility and social exclusion through the provision of complementary transport measures.
- minimal impact on the effective operation of the transport network during times of maintenance.

8.5 South Corridor Option 1 Recommendation

An indicative layout of South Corridor Option 1 is contained within Appendix 6. If carried forward to DMRB Stage 2 Corridor Assessment this route corridor option could encompass the following:

- a dual D2M or D3M mainline cross section;
- a new Echline Junction encompassing improvements to Scotstoun Junction providing:
 - connectivity between the new mainline and existing local roads .

In addition, the following junction improvements could also be considered:

- an enhancement of M9 Junction 1a to provide all ways movements; and
- connectivity to the Forth Road Bridge.

9.1 Description

At 5.1km in length, South Corridor Option 2 provides a direct link between the proposed replacement bridge and the M9 north of Winchburgh. An indicative layout of this option is provided in Appendix 7.

Departing a new junction with the M9 situated west of Junction 1a, the proposed South Corridor Option 2 mainline climbs on embankment crossing the B9080 and the Falkirk-Fife Railway Line. Cresting on approach to Swine Burn, the mainline carriageway descends into cutting passing to the east of Westmuir Riding Centre.

Continuing north along the boundary of Dundas Estate the mainline remains in cutting, passing beneath Builyeon Road, on approach to the A904. It is proposed that the mainline passes beneath the A904 to mask the corridor's presence, the A904 being carried on structure above. To provide access to the proposed replacement crossing for non-motorway traffic and local traffic, a new junction is proposed at this location.

On approach to the proposed replacement bridge, the earthworks associated with the vertical geometry of the mainline transition from cutting to embankment, facilitating a connection with the proposed replacement bridge.

South Corridor Option 2 has an impact on the oil pipeline, with a crossing required within the grounds of Dundas Estate, south of the A904.

In the provision of this option, connectivity enhancements can be considered to existing roads' infrastructure with the reconstruction of Scotstoun Junction facilitating traffic movements in all directions between the A90 and M9 Spur.

In the consideration of South Corridor Option 2, two mainline motorway cross sections were considered, D2M and D3M.

9.2 Engineering Issues

A number of engineering constraints were identified which require assessment to allow further development should this option be progressed. Principally these are:

- Carriageway Cross Section
- Route Corridor, Structural Requirements and Topographical Effects
- Junction Provision and Future Transport Developments
- Geotechnical Assessment

9.2.1 Carriageway Cross Section

In considering the most appropriate cross section for implementation, the scheme objectives dictate that two lanes of general traffic in each direction are required. It was recognised that there may be an opportunity to consider additional High Occupancy Vehicle (HOV) lanes in the early years following construction, prior to a possible future introduction of a public transport multi-modal facility.

In light of this opportunity, a dual three lane motorway (D3M) was therefore taken as the working assumption over the extent of South Corridor Option 2 with a design

speed of 120kph, with the flexibility to scale back the scope of the upgrade as necessary during scheme development.

9.2.2 Route Corridor, Structural Requirements and Topographical Effects

Situated offline and at a length of 5.1km, South Corridor Option 2 has a greater effect on existing topography than South Corridor Option 1. Situated for the most part along the western boundary of Dundas Estate, the corridor has been placed in cutting to mask its presence to the surrounding area.

The provision of a new offline carriageway allows a fully DMRB compliant horizontal and vertical geometry design to be considered, subject to existing topographical constraints, junction provision and the requirement for crossings of Builteon Road and the A904 on approach to the proposed replacement bridge.

The implementation of South Corridor Option 2 will require a number of significant structures to be constructed in the provision of junctions to existing routes. The provision of these structures will require careful planning and significant traffic management during the construction period. New structures will also be required where the corridor crosses the Falkirk-Fife Railway Line and local access roads. A single structural crossing of the oil pipeline will be necessary, south of the A904.

As with South Corridor Option 1, initial consultations have been held with BP Oil UK Ltd over the position of the pipeline. Further consultations shall be held if this option is progressed to DMRB Stage 2 Corridor Assessment.

9.2.3 Junction Provision and Future Transport Developments

In the provision of South Corridor Option 2, a new junction to the M9 is required to facilitate access between the proposed replacement bridge and the central Scotland motorway network. In addition, the reconstruction of Scotstoun Junction can be considered, which would provide full connectivity between the A90 and the M9 Spur. In the provision of non-motorway access/egress to the proposed replacement bridge, a new junction to the A904 would be provided.

(a) M9 Junction

The provision of a new junction on the M9 is required to maintain cross-Forth links between central Scotland and the north. Encompassing the existing M9 Junction 1a, the new junction would provide connectivity between the proposed mainline, M9 and M9 Spur.

In maintaining access to the M9 Spur, any future proposals for the use of the Forth Road Bridge can be realised, through the use of this existing route, Scotstoun Junction and the A90.

West facing connectivity to the M9 would be a feature of the junction, providing access to the proposed mainline and the M9 Spur, a movement which is not available within the existing M9 Junction 1a arrangement.

The proximity of the M9, M9 Spur, B9080 and Falkirk-Fife Railway Line to South Corridor Option 2 requires a significant number of structures to be considered in the provision of a junction at this location. Multiple crossings of the M9 will be required, providing full connectivity between the M9, M9 Spur and proposed mainline. As such a significant period of traffic management will be required on both the trunk road and local road networks during the construction period.

(b) Scotstoun Junction

In the provision of South Corridor Option 2, Scotstoun Junction could be utilised in its current form, providing limited functionality between the M9 Spur and A90. Alternatively, it could be upgraded to provide full connectivity.

If reconstruction was to be considered, the new free flow, all movements junction would provide the following:

- a priority routing of traffic between the M9 Spur and the A90 to the east
- a new slip road arrangements between the M9 Spur and the A90 to the west
- new slip road arrangements maintaining A90 through traffic connectivity between Edinburgh and local destinations via the A904/A8000.

The provision of such measures would also cater for any future proposals for the use of the Forth Road Bridge.

(c) A904 Junction

In the provision of non-motorway connectivity and to maintain local access to the proposed replacement bridge, a new junction is required to the A904 west of South Queensferry. The form of this junction would be simplistic with only north facing slip roads being provided to the proposed mainline.

As with South Corridor Option 1, the A904 is considered the most practical place to terminate the multi-modal aspect of the project.

9.2.4 Geotechnical Assessment

The ground conditions in this area comprise glacial till overlying bedrock. Rockhead is within 5m of surface close to where the corridor coincides with the South Corridor Option 1 alignment, however it deepens to the south, resulting in between 10m and 20m of drift deposits. Based on the available information there would appear to be no significant geotechnical issues, with the exception of any alterations to Scotstoun Junction, which would necessitate construction of links and structures over an area of recorded oil shale workings.

9.3 Environmental Considerations

South Corridor Option 2 provides a predominantly offline mainline carriageway which would have the greatest land take in relation to agricultural land of all southern route corridor options. South Corridor Option 2 would cross the most watercourses and footpaths and is therefore considered to have the greatest potential for impacts on the water environment and on non-motorised users.

South Corridor Option 2 diverts traffic away from the A90 at South Queensferry which would be expected to result in large noise reductions to a large number of properties in this area. However, the alignment between the M9 and A904 would likely result in large noise increases affecting a small number of rural properties.

Cultural Heritage impacts for South Corridor Option 2 are envisaged to be comparatively less than for other southern route corridor options due to lower impacts on designated landscapes.

Ecology, landscape and visual impacts are also expected to be greater for South Corridor Option 2. This is because the mainline is offline for a comparatively longer length than South Corridor Option 1 and therefore has greater potential to impact on

habitats. In addition, South Corridor Option 2 would cross between the Swineburn, Muiriehall and Carmelhill woodland complex, resulting in the fragmentation of ecological habitats. With regard to landscape, the mainline carriageway cuts through existing woodland and fields near Dundas Estate, isolating this character area. The significant cuttings through the landscape as well as extensive earthworks required in the implementation of the mainline carriageway would also increase visual impacts.

The provision of a reconstructed Scotstoun Junction would require land take and thus, potentially, give rise to additional environmental impacts. Consequently, impacts on land use, geology, the water environment, ecology, landscape, visual impacts, traffic noise and vibration, air quality are expected to be slightly increased for the area to the southeast of South Queensferry.

9.4 Transportation Considerations

The provision of a D3M cross section encompassing two lanes of general traffic and the possibility of an HOV lane in tandem with the provision of new junctions with the M9 and A904 and the possible reconstruction of Scotstoun Junction is expected to provide the following benefits:

- an increase in the cross-Forth levels of service provided for private, road-based modes of travel to/from the central Scotland motorway network.
- a deterioration in network performance at locations across West Edinburgh (e.g. M9 Junction 1, Newbridge Roundabout)
- an improvement in network performance for cross-Forth traffic to/from Falkirk/Linlithgow
- improved journey time reliability between central Scotland and Fife (excluding the Edinburgh area)
- possible detrimental effects to journey time reliability to/from north Edinburgh along the A8/A90.
- improved accessibility and social inclusion through the provision of complementary transport measures.
- minimal impact on the effective operation of the transport network during times of maintenance.

9.5 South Corridor Option 2 Recommendation

An indicative layout of South Corridor Option 2 is contained within Appendix 7. If carried forward to DMRB Stage 2 Corridor Assessment this route corridor option could encompass the following:

- a dual three lane motorway (D3M) mainline cross section;
- a new M9 Junction providing full interconnectivity between the M9, M9 Spur and proposed mainline; and
- a new junction to the A904.

In addition, the following junction improvements could also be considered:

- the reconstruction of Scotstoun Junction

10.1 Description

At 4.6km in length, South Corridor Option 3 provides a direct link between the proposed replacement bridge and the existing M9 Spur north of M9 Junction 1a. An indicative layout of this option is provided in Appendix 8.

Departing a new junction with the M9/M9 Spur, the proposed corridor follows the line of the M9 Spur before departing northwest into the fields of Humbie Farm, crossing the Falkirk-Fife Railway on embankment. To the north of Humbie Farm, the vertical alignment of the mainline transitions from embankment to cutting, following existing ground topography as closely as possible.

Sweeping north, the mainline continues in cutting, intersecting the south west corner of Dundas Estate, west of Barrencraig Wood, before passing beneath Builyeon Road to the west of Dundas Mains. The corridor, continuing north along the boundary of Dundas Estate, remains in cutting, masking its presence on approach to the A904. It is proposed that the mainline passes beneath the A904, the A904 being carried on structure above. To provide access to the proposed replacement bridge for non-motorway traffic and local traffic, a new junction is proposed at this location.

On approach to the proposed replacement bridge, the earthworks associated with the vertical geometry of the mainline transition from cutting to embankment, facilitating a connection with the proposed replacement bridge.

South Corridor Option 3 has an impact on the oil pipeline, with a crossing required within the grounds of Dundas Estate, south of the A904.

In the provision of this option, connectivity enhancements can be considered to the existing roads' infrastructure with the reconstruction of Scotstoun Junction, which would facilitate traffic movements in all directions between the A90 and M9 Spur.

In the consideration of South Corridor Option 3, two mainline motorway cross sections were considered, D2M and D3M.

10.2 Engineering Issues

A number of engineering constraints were identified which require assessment to allow further development should this option be progressed. Principally these are:

- Carriageway Cross Section
- Route Corridor, Structural Requirements and Topographical Effects
- Junction Provision and Future Transport Developments
- Geotechnical Assessment

10.2.1 Carriageway Cross Section

In considering the most appropriate cross section for implementation, the scheme objectives dictate that two lanes of general traffic in each direction are required. It was recognised that there may be an opportunity to consider additional High Occupancy Vehicle (HOV) lanes in the early years following construction, prior to a possible future introduction of a public transport multi-modal facility.

In light of this opportunity, a dual three lane motorway (D3M) was therefore taken as the working assumption over the extent of South Corridor Option 3 with a design speed of 120kph, with the flexibility to scale back the scope of the upgrade as necessary during scheme development.

10.2.2 Route Corridor, Structural Requirements and Topographical Effects

South Corridor Option 3 has a similar effect on existing topography to South Corridor Option 2. Situated for the most part along the western boundary of Dundas Estate, the corridor has been placed in cutting to mask its presence to the surrounding area.

The provision of a new offline carriageway allows a fully DMRB compliant horizontal and vertical geometry design to be considered, subject to existing topographical constraints, junction provision and the requirement for crossings of Builyeon Road and the A904 on approach to the proposed replacement bridge.

The implementation of South Corridor Option 3 will require a number of significant structures to be constructed in the provision of junctions to existing routes. The provision of these structures will require careful planning and significant traffic management during the construction period. New structures will also be required where the corridor crosses the Falkirk-Fife Railway Line and local access roads. A single structural crossing of the oil pipeline will be necessary, south of the A904.

Similar to South Corridor Options 1 and 2, initial consultations have been held with BP Oil UK Ltd over the position of the pipeline. Further consultations shall be held if this option is progressed to DMRB Stage 2 Corridor Assessment.

10.2.3 Junction Provision and Future Transport Developments

In the provision of South Corridor Option 3, a new junction to the M9 Spur is required to facilitate access between the proposed replacement bridge and the central Scotland motorway network. In addition, the reconstruction of Scotstoun Junction can be considered to provide full connectivity between the A90 and the M9 Spur. In the provision of non-motorway access to the proposed replacement bridge and the central Scotland motorway network, a new junction to the A904 will be required.

(a) M9 Junction 1a/M9 Spur Junction

The provision of a new junction to the M9 Spur is required to maintain cross-Forth links between central Scotland and the north. Encompassing the existing M9 Junction 1a, the new junction would provide connectivity between the proposed mainline, M9 and M9 Spur.

Full west facing connectivity to the M9 would be a feature of the junction, providing access/egress to the M9 Spur, a movement which is not available within the existing M9 Junction 1a arrangement.

The proximity of the M9, M9 Spur, B9080 and Falkirk-Fife Railway Line to the corridor requires a significant number of structures to be considered in the provision of a junction at this location. Multiple crossings of the Falkirk-Fife Railway Line, M9, and proposed mainline will be required in order to provide full connectivity. As such, a significant period of traffic management will be required on both the trunk road and local road networks during the construction period.

Any junction considered at this location is like to be extremely complex and difficult to construct. The provision of a junction at this location is likely to require significant

Departures from Standard in its implementation, reducing its operational effectiveness.

(b) Scotstoun Junction

In the provision of South Corridor Option 3, Scotstoun Junction could be utilised in its current form, which provides limited functionality between the M9 Spur and A90. Alternatively, it could be upgraded to provide full connectivity.

If upgrading was to be considered, the new free flow, all movements junction would provide the following:

- a priority routing of traffic between the M9 Spur and the A90 to the east
- a new slip road arrangement between the M9 Spur and the A90 to the west
- new slip road arrangements maintaining A90 through traffic connectivity between Edinburgh and local destinations via the A904/A8000.

The provision of such measures would also cater for any future proposals for the use of the Forth Road Bridge.

(c) A904 Junction

In the provision of non-motorway connectivity and to maintain local access, a new junction is required to the A904 west of South Queensferry. The form of this junction would be simplistic, providing north and south facing slip roads to the proposed mainline.

As with South Corridor Option 1, the A904 is considered the most practical place to terminate the multi-modal aspect of the project.

10.2.4 Geotechnical Assessment

The ground conditions in this area comprise glacial till overlying bedrock. Based on the available information there would appear to be no significant geotechnical issues, with the exception of any alterations to Scotstoun Junction, which would necessitate construction of links and structures over an area of recorded oil shale workings.

10.3 Environmental Considerations

South Corridor Option 3 is predominantly offline and is expected to have the greatest impacts, compared to the other southern options, in relation to residential property demolitions.

South Corridor Option 3 is an intermediate option for a number of environmental impacts. Ecology, landscape and visual impacts are likely to be greater than for South Corridor Option 1 but less than for South Corridor Option 2.

The construction of the M9 Junction 1a/M9 Spur Junction and A904 Junction could result in land use, landscape, visual, air quality, traffic noise and vibration impacts.

The provision of a reconstructed Scotstoun Junction would require land take and thus potentially give rise to additional environmental impacts. Consequently, impacts on land use, geology, the water environment, ecology, landscape, visual impacts, traffic noise and vibration, air quality are expected to be slightly increased for the area to the southeast of South Queensferry.

10.4 Transportation Considerations

South Corridor Option 3 is deemed to provide similar benefits and disbenefits to that experienced with South Corridor Option 2. The provision of a D3M cross section encompassing two lanes of general traffic and the possibility of an HOV lane in tandem with the provision of new junctions with the M9 and A904 and the possible reconstruction of Scotstoun Junction is expected to provide the following benefits:

- an increase in the cross-Forth levels of service provided for private, road-based modes of travel to/from the central Scotland motorway network.
- a deterioration in network performance at locations across West Edinburgh (e.g. M9 Junction 1, Newbridge Roundabout)
- an improvement in network performance for cross-Forth traffic to/from Falkirk/Linlithgow
- improved journey time reliability between central Scotland and Fife (excluding the Edinburgh area)
- possible detrimental effects to journey time reliability to/from north Edinburgh along the A8/A90.
- improved accessibility and social inclusion through the provision of complementary transport measures.
- minimal impact on the effective operation of the transport network during times of maintenance.

10.5 South Corridor Option 3 Recommendation

An indicative layout of South Corridor Option 3 is contained within Appendix 8. This option is the least favoured of the southern route corridor options. However, if carried forward to DMRB Stage 2 Corridor Assessment this route corridor option could encompass the following:

- a dual three lane motorway (D3M) mainline cross section;
- a new M9 Junction 1a/M9 Spur Junction providing full interconnectivity between the M9, M9 Spur and proposed mainline; and
- a new junction to the A904.

In addition, the following junction improvements could also be considered:

- the reconstruction of Scotstoun Junction

11

South Corridor Option 4A

11.1 Description

South Corridor Option 4A is a combination of South Corridor Options 1 and 2, providing connectivity to the proposed replacement bridge from the A90 and the M9. An indicative layout of this option is provided in Appendix 9.

The connection to the A90 would be used to facilitate direct access to the north of Edinburgh from the proposed replacement bridge, relieving some of the traffic pressures which may build up on the existing road network through the implementation of South Corridor Option 2 in isolation.

Operating as a single motorway on approach to the proposed replacement bridge, a divergence of carriageways is required southwest of South Queensferry. A new junction would be provided to the A904 from the South Corridor Option 1 mainline, maintaining cross-Forth connectivity and access to Edinburgh and the central Scotland motorway network for local communities.

In the provision of access to the M9 through the South Corridor Option 2, a new junction would be provided encompassing the existing M9 Junction 1a.

Through the implementation of this option, benefits to road based cross-Forth public transport may also be realised, connection to the A90 providing a direct link to central Edinburgh via Barnton Junction and Queensferry Road (A90).

No consideration is made for HOV traffic with South Corridor Option 4A.

The provision of South Corridor Option 1 and South Corridor Option 2 in combination would impact the oil pipeline, with multiple crossings required within the grounds of Dundas Home Farm and Dundas Estate.

Due to the increased mainline functionality offered, a carriageway cross section to D2M standard would be implemented on both corridors.

11.2 Engineering Issues

A number of engineering constraints were identified which require assessment to allow further development should this option be progressed. Principally these are:

- Route Corridor, Structural Requirements and Topographical Effects
- Geotechnical Assessment

This section shall focus on Junction Provision and Future Transport Developments.

11.2.1 Junction Provision and Future Transport Developments

In the provision of South Corridor Option 4A, new junctions are required to the M9 and the A904. To facilitate access between the two corridors, as a minimum, simple north facing connections are also required. The reconstruction of Scotstoun Junction can also be considered in the provision of this option.

(a) M9 Junction

The provision of a new junction on the M9 is required to maintain cross-Forth links between central Scotland and the north. Full connectivity would be provided between the M9 and the South Corridor Option 4A (South Corridor Option 2) mainline. Unlike South Corridor Option 2, the junction provided need not encompass the existing M9 Junction 1a. However, given the operational concerns associated with M9 Junction 1a, improvements to the existing layout can be incorporated, the new arrangement being capable of providing west facing connectivity from the M9 Spur to the M9 and an alternative connection from the M9 to the M9 Spur, replacing the existing loop arrangement.

(b) South Corridor Option 1 – South Corridor Option 2 Connectivity

The connection between South Corridor Option 1 and South Corridor Option 2 is made in proximity to the A904, providing route choice to traffic departing the proposed replacement bridge. The South Corridor Option 2 mainline forms the priority route to the proposed replacement bridge. The junction connecting the corridors may take the form of the following:

- A simple north facing slip road arrangement providing access to and from the proposed replacement bridge.
- A grade separated junction arrangement providing northbound access to the proposed replacement bridge, southbound access to the South Corridor Option 2 mainline and limited access to the A904.

(c) Echline Junction

In the provision of non-motorway connectivity and to maintain local access to the proposed replacement bridge, a new junction is required to the A904 west of South Queensferry.

Connectivity to the Forth Road Bridge must also be considered in the development of this junction, thus catering for any future role for which the existing bridge might have.

In the provision of South Corridor Option 4A, the following proposals could be implemented:

- a grade separated junction utilising a roundabout to maintain all movements between the proposed mainline and the A904.
- a free flow junction arrangement, incorporating improvements to Scotstoun Junction and the use of the existing Echline Junction, providing access between the proposed mainline, the A904 and the A8000.

The development of either arrangement shall be the subject of further traffic analysis should South Corridor Option 4A be taken forward to DMRB Stage 2 Corridor Assessment.

(d) Scotstoun Junction

In the provision of South Corridor Option 4A, Scotstoun could be utilised in its current form, providing limited functionality between the M9 Spur and A90 or upgraded to provide full connectivity.

If reconstruction was to be considered, the new free flow, all movements junction would provide the following:

- a priority routing of traffic between the M9 Spur and the A90 to the east

- a new slip road arrangements between the M9 Spur and the A90 to the west
- new slip road arrangements maintaining A90 through traffic connectivity between Edinburgh and local destinations via the A904/A8000.

11.3 Environmental Considerations

Land take for Route Corridor Option 4A is high; however, the land use impacts are not expected to be as great as for Options 2 or 3 which have higher impacts in relation to agricultural land or property demolitions.

South Corridor Option 4A is considered to have the greatest potential ecological impacts due to habitat loss and fragmentation. Similar to South Corridor Option 2, it would be likely to have the greatest impact on the water environment with a high number of watercourse crossings required.

South Corridor Option 4A is also considered to have the greatest potential landscape and visual impacts. In particular, South Corridor Option 4A would be likely to be most visible and disruptive in terms of use of the rural landscape and would require significant cuttings and earthworks.

11.4 Transportation Considerations

As a combination of South Corridor Options 1 and 2, through the provision of a D2M cross section in tandem with new junctions to the M9 and A904 and the possible reconstruction of Scotstoun Junction is expected to provide the following benefits:

- improved existing levels of service for private, road-based modes of travel
- improved network performance.
- improved journey time reliability through the provision of new route corridor options for some journeys between central Scotland and Fife.
- minimum change to land-based travel choices and integration.
- improved general accessibility for those with access to private transport.
- minimal impact on the effective operation of the transport network during times of maintenance.
- reduced sustainable development, but increase economic growth.

11.5 South Corridor Option 4A Recommendation

An indicative layout of South Corridor Option 4A is contained within Appendix 9. If carried forward to DMRB Stage 2 Corridor Assessment this route corridor option could encompass the following:

- a dual two lane motorway (D2M) mainline cross section;
- a new M9 Junction providing partial connectivity between the M9 and the M9 Spur and full connectivity between the M9 and the South Corridor Option 4A mainline; and
- a new junction to the A904 providing full connectivity.

In addition, the following junction improvements could also be considered:

- the reconstruction of Scotstoun Junction

12

Recommendations for Further Development

12.1 Rationale for Route Corridor Option Removal**12.1.1 North Corridor Option 3**

North Corridor Option 3 does not provide any benefits over North Corridor Option 1 or North Corridor Option 2. It is the least effective in meeting the scheme objectives and of the options available provides the least amount of junction functionality, limiting local access connectivity. In addition, of the northern route corridor options available, this corridor is expected to generate a deterioration of local air quality to the highest number of properties.

12.1.2 South Corridor Option 3

Whilst the South Corridor Option 3 mainline can be implemented fully in association with the proposed replacement bridge, the junction arrangement required to the M9 and M9 Spur is complex, requiring multiple structures to implement. The proximity of existing roads' infrastructure and the Falkirk-Fife Railway Line to the proposed junction location makes the provision of connections to all routes extremely difficult, with a substantial number of Departures from Standard likely to be required.

The provision of South Corridor Option 3 would also be likely to require the greatest number of residential property demolitions when compared to the other southern route corridor options available.

12.1.3 South Corridor Option 4A

Whilst South Corridor Option 4A is capable of providing direct access to the A90 and the M9, the land take associated with the implementation of such a scheme is far higher than that of South Corridor Option 1 or South Corridor Option 2 in isolation. This corridor is also expected to have the greatest ecological, visual and landscape impacts of the southern route corridor options and would require a high number of water crossings.

Further to this, the anticipated cost associated with the implementation of this option is far greater than that associated with South Corridor Option 1 or South Corridor Option 2 in isolation.

12.2 Recommendation

Having discarded the above corridor options as above, the following northern and southern route corridor options were recommended for DMRB Stage 2 Corridor Assessment:

Northern Route Corridor Options	Southern Route Corridor Options
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- | | |
|---------------------------|---------------------------|
| ▪ North Corridor Option 1 | ▪ South Corridor Option 1 |
| ▪ North Corridor Option 2 | ▪ South Corridor Option 2 |