A96 Dualling Inverness to Nairn (including Nairn Bypass)

DMRB Stage 2 Scheme Assessment Report

Volume 1 – Main Report

Part 4 – Traffic and Economic Assessment

October 2014

Contents:

Volume 1 – Main Report and Appendices

18 Modelling

18.1 Introduction

18.1.1 The traffic and economic assessment has been undertaken using the Moray Firth Transport Model (MFTM). This is a regional, four-stage, multi-modal forecasting model with a 2009 base year that produces forecasts of travel demand on both the road and public transport networks. The MFTM model years used in the assessment are 2016, 2031 and 2036.

18.1.2 The MFTM was used to compare the route options in terms of performance indicators such as changes to traffic flows, speeds, journey times and travel distances. These outputs are then input to the Transport Users Benefit Appraisal (TUBA, v1.9) software to identify the economic benefits of each option compared to the Do-Minimum scenario, as described in Part 1, Chapter 3 (The Scheme), Section 3.5 of this report. The model outputs were also input into Cost and Benefit to Accidents – Light Touch (COBALT) software to identify the likely impact the alternative options would have on accidents. The impact on the number and severity of accidents is monetised and included in the economic assessment. Output from the MFTM was also used in the environmental appraisal of options as discussed in Part 3, Chapter 8 (Air Quality) and Part 3, Chapter 9 (Traffic Noise and Vibration) of this report.

18.1.3 This chapter of the report describes the operation of the transport model. Chapter 19 (Effects of Route Options) summarises the primary traffic effects of the options considered. The economic performance of the various route options are presented in Chapter 20 (Economic Performance of Route Options) and for the purposes of the economic assessment, construction is assumed to commence in 2017 and be completed in 2019.

18.2 Moray Firth Transport Model

18.2.1 The MFTM has a base year of 2009, and covers a geographical area that broadly encompasses the Inverness Travel to Work area. It includes all Trunk Roads and non-Trunk principal roads as well as important local roads. The model has been developed and maintained by AECOM for The Highland Council, for use as a planning and forecasting tool for projects in the Inverness area.

18.2.2 Road based travel demand is assigned to the highway network using a volume averaged equilibrium assignment, in vehicles, for each of the following five vehicle classes:

- Cars (travelling in work time: on business);
- Cars (travelling to work: commuters);
- Cars (travelling for other purposes in non-work time);
- Light Goods Vehicles (LGV); and
- Other Goods Vehicles (OGV).

18.2.3 In addition, scheduled rail, bus and coach services are coded to follow predefined routes based on operator timetables.

18.2.4 Public transport based travel demand within the model is assigned to the public transport network for each of the bus, rail and walking networks. This travel demand is assigned in units of people rather than vehicles.

18.2.5 Model vehicle speeds are derived from speed-flow curves for each link type in the MFTM model. Delays are calculated for each movement at each modelled junction.

18.2.6 Two distinct one hour time periods are modelled. These are:

- 08:00 – 09:00 (AM); and

- 17:00 – 18:00 (PM).

18.2.7 To assess traffic flows over other time periods (for example 18 hour average weekday and Annual Average Daily Traffic (AADT)), AM and PM flows are combined and multiplied by a factor to calculate the 12 hour flow. The 12 hour flows are then factored to 18 hour Annual Average Weekday Traffic (AAWT) and 24 hour AADT respectively. The factors used are:

- Car 18hr AAWT = (((AM flow + PM flow) x 5.180) x 1.171);
- LGV 18hr AAWT = (((AM flow + PM flow) x 5.788) x 1.128);
- HGV 18hr AAWT = (((AM flow + PM flow) x 6.134) x 1.189);
- Car 24hr AADT = (((AM flow + PM flow) x 5.665) x 1.195);
- LGV 24hr AADT = (((AM flow + PM flow) x 5.904) x 1.201); and
- HGV 24hr AADT = (((AM flow + PM flow) x 6.146) x 1.351).

18.2.8 The factored traffic flows were used in the environmental appraisal. The factors were derived from analysis of Automatic Traffic Count (ATC) data.

18.3 Proxy Inter-Peak Model Development

18.3.1 The MFTM does not represent the Inter-Peak (IP) period. To rectify this, a proxy Inter-Peak model was developed based on the calibrated and validated AM and PM peak models. To do this, factors were derived from ATC data.

18.3.2 There are 43 permanent ATC count sites in the model area, 17 of which are in the detailed model area. It is necessary to utilise traffic data from the detailed modelled area when deriving factors for the Inter-Peak model as traffic flows along the A96 corridor are influenced by traffic movements outside of the corridor, with key routes influencing traffic volumes, such as the Kessock Bridge, the A82 and the A9. Using data from a larger area provides a better representation of traffic flows across the model, making the Inter-Peak model more robust. As these counters are maintained by Transport Scotland, they are located on the trunk road network (A82, the A9 and the A96). The locations of the 17 counters are shown on Drawing B1557601/TRA/0001 (Volume 2).

18.3.3 A calibration and validation check was undertaken on the Base model (2009) at the 17 locations identified in Drawing B1557601/TRA/0001 (Volume 2) to establish how closely the modelled flows matched the 2009 observed data. This was undertaken in both peaks, and it was discovered that, whilst within acceptability criteria, the modelled flows were overall slightly higher than the observed data. To rectify this, an AM and PM factor was derived to reduce the number of trips in each matrix. These factors are:

- AM Peak = 0.93; and
- PM Peak = 0.96.

18.3.4 The 2009 ATC data was used to calculate a factor to take the average adjusted AM and PM peak flow to an average Inter-Peak flow at each of the 17 counter locations. From this, a flow weighted factor of 0.87 was calculated for the detailed modelled area. This is:

- IP = 0.87 x ((0.93 x AM Peak) + (0.96 x PM Peak))

18.3.5 The majority of the ATCs are not disaggregated by vehicle classification. As the MFTM model has 5 different user classes, the matrices were combined into an all vehicle matrix before the factors were applied. To maintain consistency between models, once the Inter-Peak all vehicle matrix has been calculated, it was divided into the same vehicle classifications as the AM and PM Peak models. This was undertaken by first dividing the matrix into Car, LGV and HGV matrices based on the average vehicle category proportions across all road types from the Cost Benefit Analysis (COBA) Manual Table 8/1, but adjusted for the fact that buses are not assigned. The proportions used are:

- Car = 0.825;
- LGV = 0.115; and
- HGV = 0.060.

18.3.6 The car vehicle class was then subdivided into 3 further user classes, Car Work Commute, Car In Work and Car other. The COBA Manual doesn't disaggregate vehicle classes by journey purpose, so these factors were taken from WebTAG Table A 1.3.4 May 2014:

- Car Work Commute = 0.116;
- Car In Work = 0.083; and
- Car Other = 0.801.

18.3.7 Once calculated, the matrices were assigned to the detailed network and checked against the observed 2009 Inter-Peak data from the 17 ATC counters. This showed that the assigned traffic flows were within the thresholds set out in DMRB for acceptable assignment validation. This process was only undertaken for the road matrices. As the public transport matrices are assigned in units of people and not vehicles, the same process could not be followed for public transport. As a result the Inter-Peak model is a road only model.

18.3.8 As a proxy Inter-Peak model was developed for economic purposes, the AADT factor has been changed from those quoted in section 18.2. The AADT Factors used for the economic assessment are:

- All Vehicle AADT = (((AM flow x 2.61) + (IP flow x 6) + (PM flow x 2.77)) x 1.20)

18.3.9 The economic appraisal of options is discussed in Chapter 20 (Economic Performance of Route Options).

18.4 Future Year Demand Matrices

18.4.1 Highway model assignment matrices for the AM and PM Peak in 2016, 2031 and 2036 were derived for each option from full model runs of MFTM. The full model run reflects changes in the choice of destination, travel mode, trip frequency, and route travelled. Consequently, each of the options discussed in Chapter 19 (Effects of Route Options) was appraised using highway matrices in the years 2016 and 2031 that reflect the changes in travel patterns and demand that may be expected to occur as a result of the proposed Do-Something option being tested. The future year Inter-Peak demand matrices were derived in the same way as the base year matrices, applying the same factors to the 2016, 2031 and 2036 AM and PM peak demand matrices.

18.5 Do-Minimum Network

18.5.1 The MFTM is intended to assess the impact of interventions by comparing the intervention scenario (Do-Something) with a Do-Minimum scenario, such that the difference between the two identifies the likely impacts.

18.5.2 It is therefore necessary to define the committed and most likely changes that will be made to the transport network between 2009 and each of the appraisal years (2016, 2031 and 2036) to obtain the most representative appraisal results. These committed and likely interventions form the MFTM Do-Minimum scenario.

18.5.3 The Do-Minimum interventions included within MFTM are listed below.

- Modifications to B9006 Millburn Roundabout – Culcabock – Castle Hill – Culloden Moor – Croy – Gollanfield – Fort George Road associated with the new Beechwood Campus. This includes a new arm at the junction of the B9006 with the A9 southbound slip road at the A9 Inshes junction to serve the new Beechwood Campus;
- New Dalcross railway station;
- A new circular bus service linking Dalcross railway station and Inverness airport;
- A new Inverness to Nairn rail service (serving Dalcross Railway station);
- The replacement of Inshes roundabout with a signal controlled junction including left turn bypass lanes;
- Full signalisation of Longman Roundabout including associated works on the A82; and
- Completion of the western end of the B8082 Inverness Southern Distributor Road, with a crossing of the River Ness and Caledonian Canal.

18.6 Do-Minimum Forecasts

18.6.1 Drawings B1557601/TRA/0002 to 0005 (Volume 2) show AADT flows on the wider road network in 2016 (the first modelled future year), and 2031 (15 years after the first modelled future year) respectively under the High Growth scenario.

18.7 Summary

18.7.1 The Moray Firth Transport Model (MFTM) has been used to provide existing and future forecast traffic flows. Details of the model development, operation, calibration and validation of the model are set out in the Local Model Validation Report prepared by Aecom in 2010.

18.7.2 Future proposed changes in land use were provided by The Highland Council for the period until 2036 for three different development scenarios: Low, Medium and High. This was then used within the MFTM to create travel demand forecasts for 2016 (the first modelled future year), 2031 (15 years after first modelled future year) and 2036 (an additional future year for economic purposes only). The high growth traffic forecasts for 15 years after the first modelled future year (2031) have been used for engineering design purposes and environmental appraisal. The low growth forecasts for 2016, 2031 and 2036 have only been used for the economic assessment.

18.7.3 Do-Minimum infrastructure was defined by The Highland Council and incorporated in MFTM by AECOM. There are no Trunk Road interventions included within the study area of the MFTM.

19 Effects of Route Options

19.1 Introduction

19.1.1 For the purposes of appraisal of route options, the scheme has been considered as two discrete sections broadly representing an upgrade of the existing A96 between Inverness and Gollanfield and an offline bypass to the south of Nairn.

19.1.2 As described in Chapter 3 (Description of Route Options), eight route options were selected between Inverness and Gollanfield and nine Nairn Bypass route options were selected for assessment at DMRB Stage 2.

19.1.3 The route options for the Inverness to Gollanfield section are referred to as Options 1A to 1D, with the Morayston variants referred to as Options 1A (MV) to 1D (MV). The Nairn Bypass options are referred to as Options 2A to 2I.

19.1.4 For traffic and economic appraisal, it was necessary to combine the route option alternatives that are subject to more detailed appraisal to create a series of Do-Something scenarios that comprise one of the Inverness to Gollanfield route options with one of the Nairn Bypass route options. In total, there are therefore 72 potential options for the entire scheme.

19.1.5 However, it is unlikely that relatively minor variations to the design of the upgrade between Inverness and Gollanfield would significantly influence the level of traffic likely to use the various Nairn Bypass route options and vice versa. As such, the appraisal of the two sections of the Inverness to Nairn (including Nairn Bypass) scheme has been undertaken separately.

19.1.6 For the appraisal of the Inverness to Gollanfield section, each option has assumed construction of Nairn Bypass Option 2B. The appraisal of these route options is discussed further in Section 19.2.

19.1.7 For the appraisal of the Nairn Bypass route options, each option has been assessed in conjunction with Inverness to Gollanfield Option 1A. The appraisal of these route options is discussed further in Section 19.3.

19.2 Inverness to Gollanfield Route Options

19.2.1 Drawings B1557601/TRA/0002 and 0003 (Volume 2) indicate forecast AADT flows on key links in the network between Inverness and Gollanfield in both 2016 and 2031, respectively.

19.2.2 Inverness to Gollanfield Options 1A and 1D (MV) were identified as being the two options that differed most in terms of route alignment and junction location. Comparing the AADT flows from drawing B1557601/TRA/0003 indicates that there is little or no difference between the 2031 modelled year traffic flows on the upgraded sections of the A96 under each option; however there are slightly larger differences in traffic levels on the existing A96. The AADT on the existing A96 between the Smithton Junction and the Newton Junction are forecast to be a minimum of 6,200 in Option 1B (MV), and 11,600 in Option 1D (MV). This is a reduction of 23,700 AADT for Option 1B (MV) and a reduction of 18,300 for Option 1D (MV). Similarly, the AADT on the existing A96 between the Newton Junction to the Mid-Coul Junction are forecast to be 1,300 in Option 1B (MV) and 4,300 in Option 1A (MV). This is a reduction of 19,000 AADT for Option 1B (MV) and 16,000 for Option 1A (MV). The AADT forecast to use the new section of the A96 in each option are considered to be broadly similar.

19.2.3 Table 19.1 to Table 19.3 show the modelled journey times for the Inverness to Gollanfield section in the Do-Minimum and each of the options in the AM Peak, Inter Peak and PM Peak. The tables indicate that all of the route options reduce the journey time by approximately two and a half to three minutes when compared to the Do-Minimum in all three time periods. The differences in journey times between the options are considered to be broadly similar and, as such, there is little differentiation between the options in terms of journey times.

Table 19.1 Inverness to Gollanfield - 2031 AM Peak Journey Times

2031 AM Peak (min:sec)	Do-Min	1A	1A (MV)	1B	1B (MV)	1C	1C (MV)	1D	1D (MV)
Smithton to Gollanfield	10:57	08:00	08:07	07:49	07:57	07:51	08:00	07:43	07:50
Gollanfield to Smithton	11:58	08:38	08:18	08:11	08:19	08:14	08:21	08:05	08:11

Table 19.2 Inverness to Gollanfield - 2031 Inter Peak Journey Times

2031 Inter-Peak (min:sec)	Do-Min	1A	1A (MV)	1B	1B (MV)	1C	1C (MV)	1D	1D (MV)
Smithton to Gollanfield	10:57	08:02	08:07	07:50	07:58	07:54	08:02	07:45	07:51
Gollanfield to Smithton	10:37	08:01	07:57	07:52	08:00	07:56	08:03	07:47	07:54

Table 19.3 Inverness to Gollanfield - 2031 PM Peak Journey Times

2031 PM Peak (min:sec)	Do-Min	1A	1A (MV)	1B	1B (MV)	1C	1C (MV)	1D	1D (MV)
Smithton to Gollanfield	12:14	08:26	08:30	08:14	08:30	08:16	08:22	08:06	08:12
Gollanfield to Smithton	10:29	07:59	07:54	07:49	08:09	07:52	08:00	07:44	07:50

19.3 Nairn Bypass Route Options

19.3.1 Drawings B1557601/TRA/0004 and 0005 (Volume 2) indicate forecast AADT flows on key links around Nairn and on the proposed Nairn Bypass in both 2016 and 2031.

19.3.2 The alignment of Nairn Bypass Options 2A and 2I were identified as being the two route options that differed most: Option 2A follows the most northerly extent of the study area, while Option 2I follows the most southerly extent of the study area. Whilst to the west of the River Nairn, each of the remaining options follows the same alignment as one or other of these options, to the east of the River Nairn, four distinct corridors are considered.

19.3.3 Comparing the flows in Drawing B1557601/TRA/0005 indicates that there is little or no difference between the 2031 modelled year AADT on the upgraded sections of the A96 and the Nairn Bypass under each option; however there are slightly larger differences in AADT on the existing A96 in and around Nairn. The forecast AADT on the existing A96 to the west of Nairn (between the B9092 junction and Nairn) is lowest in Option 2G (7,700) and highest in Option 2D (9,500). This is a reduction of 10,400 AADT for Option 2G and a reduction of 8,600 for Option 2D.

19.3.4 Similarly, forecast AADT on the A96 in the centre of Nairn is lowest in Option 2G (6,300) and highest in Option 2D (7,600). This is a reduction of 11,100 AADT for Option 2G and a reduction of 9,800 for Option 2D. The A96 to the east of Nairn experiences a similar effect, with Option 2D forecasting the lowest flow (3,300) and Option 2H forecasting the highest flow (4,700). This is a reduction of 9,700 AADT for Option 2D and a reduction of 8,300 for Option 2H.

19.3.5 Table 19.4 to Table 19.6 show the modelled journey times for the Nairn Bypass section in the Do-Minimum and each of the options in the AM Peak, Inter Peak and PM Peak. This section of the existing A96 passes through Nairn, and is subsequently bypassed in the route options. As such, journey times on the existing route and the bypass have been extracted from the model. The tables indicate that all of the options reduce the journey time through Nairn by approximately one and a half to two minutes when compared to the Do-Minimum in all three peaks. The journey time using the bypass is approximately five to six minutes quicker than travelling through Nairn in the Do-Minimum scenario. The differences in journey times between the options are considered to be broadly similar and, as such, there is little differentiation between the options in terms of journey times.

Table 19.4 Nairn Bypass - 2031 AM Peak Journey Times

2031 AM Peak (mm:ss)	Do-Min	2A	2B	2C	2D	2E	2F	2G	2H	2I
Gollanfield to Hardmuir via Bypass	-	08:35	08:37	08:32	08:50	08:22	08:24	08:19	08:40	08:28
Hardmuir to Gollanfield via Bypass	-	08:37	08:39	08:37	08:54	08:36	08:26	08:24	08:42	08:33
Gollanfield to Hardmuir via Nairn	13:56	12:15	12:26	12:12	12:09	12:25	12:23	12:22	12:18	12:24
Hardmuir to Gollanfield via Nairn	14:10	12:52	13:16	12:29	12:26	13:11	13:13	12:37	12:43	12:39

Table 19.5 Nairn Bypass - 2031 Inter Peak Journey Times

2031 Inter-Peak (mm:ss)	Do-Min	2A	2B	2C	2D	2E	2F	2G	2H	2I
Gollanfield to Hardmuir via Bypass	-	08:35	08:37	08:32	08:51	08:22	08:23	08:19	08:40	08:28
Hardmuir to Gollanfield via Bypass	-	08:32	08:34	08:31	08:49	08:32	08:22	08:19	08:38	08:27
Gollanfield to Hardmuir via Nairn	13:50	12:16	12:27	12:13	12:09	12:26	12:24	12:23	12:19	12:24
Hardmuir to Gollanfield via Nairn	13:33	12:42	13:05	12:22	12:18	13:00	13:03	12:29	12:32	12:30

Table 19.6 Nairn Bypass - 2031 PM Peak Journey Times

2031 PM Peak (mm:ss)	Do-Min	2A	2B	2C	2D	2E	2F	2G	2H	2I
Gollanfield to Hardmuir via Bypass	-	08:42	08:44	08:40	08:58	08:29	08:30	08:26	08:46	08:35
Hardmuir to Gollanfield via Bypass	-	08:37	08:39	08:35	08:52	08:36	08:26	08:22	08:42	08:30
Gollanfield to Hardmuir via Nairn	14:40	12:36	12:38	12:22	12:22	12:26	12:35	12:30	12:35	12:32
Hardmuir to Gollanfield via Nairn	13:47	12:48	13:06	12:23	12:23	12:56	13:03	12:30	12:41	12:30

19.3.6 The forecast traffic flows and journey times on the upgraded A96 and the Nairn Bypass are considered to be broadly similar in each option. As such, there is little differentiation between the options in terms of traffic usage.

19.4 Summary

19.4.1 This chapter has set out the forecast traffic flows using each element of the route options for both the Inverness to Gollanfield and Nairn Bypass sections and the expected journey times for each section. The typical end to end journey time, between the Smithton Junction and Hardmuir to the east of Nairn, is likely to be approximately 25 minutes in the Do-Minimum Scenario by 2031. This is anticipated to reduce to approximately 16 to 17 minutes with an upgraded A96 and a Nairn Bypass in place.

20 Economic Performance of Route Options

20.1 Introduction

20.1.1 The economic evaluation of the route options has been carried out using a program developed by the Department for Transport (DfT), called TUBA version 1.9. This software was developed for the appraisal of transport schemes. The impact each of the options has on accidents in the area has been assessed using the COBALT 2012 software. The economic impacts of delays during construction have been assessed using the Queues And Delays at Roadworks (QUADRO) version 4.11 software.

20.2 Method of Appraisal

20.2.1 Inputs to TUBA are zone-to-zone trips, time, distance and tolls for the Do-Minimum and Do-Something options. This data was obtained from the MFTM. The scheme benefits are calculated by comparing, for each pair of zones, the total costs of travel (including travel time, fares, vehicle operating costs and tolls) for the Do-Minimum and Do-Something scenarios.

20.2.2 The transport modelling used for the economic appraisal was slightly different to that used for engineering design purposes and environmental appraisal. Option 1A was modelled using the full demand assignment. The full model run reflects changes in the choice of destination, travel mode, trip frequency, and route travelled. Consequently, Option 1A was appraised using highway matrices in the years 2016, 2031 and 2036 that reflect the changes in travel patterns and demand that may be expected to occur as a result of the proposed Do-Something option being tested. As the routes are relatively similar, it was considered appropriate at this stage that all of the Inverness to Gollanfield options would be modelled using the demand matrices from Option 1A, resulting in the demand for each of the options being consistent.

20.2.3 Similarly, the Nairn Bypass Option 2C was modelled using the full demand assignment. This demand was then used in the assessment of the other Nairn Bypass Options, with the option assessment being undertaken using a road only assignment. This approach was adopted to ensure that small changes in the AM and PM models did not alter the Inter-Peak matrices, which were derived from the AM and PM periods as set out in section 18.3 (Proxy Inter-Peak model Development).

20.2.4 In accordance with Her Majesty's Treasury 'Green Book' guidance and DMRB guidance, the benefit stream is calculated for a 60 year period. In instances where the assumed opening year (2019) is later than the first modelled year (2016), in line with the TUBA: Frequently Asked Questions document version 1.9.3, a 63 year appraisal period has to be used, with the first modelled year of 2016. TUBA calculates the benefits for the period 2016 to 2078 (inclusive) and the benefits for the years 2016 to 2018 are removed from the Transport Economic Efficiency (TEE) table. This is the equivalent of calculating the benefits for a 60 year appraisal period from an assumed opening year of 2019. The summed monetised units of final TEE benefit are expressed in 2010 prices which are discounted to 2010 at 3.5 per cent per annum for the first 30 years from the date of the appraisal and at 3.0 per cent per annum thereafter.

20.2.5 To ensure that only the benefits from trips that travelled along the route corridor were included in the assessment, a 'masking' process was undertaken. The area was divided into seven sectors, these are shown in Figure 20.1. Sector to Sector movements and internal sector movements that do not travel in the scheme area have been removed from the assessment. In Table 20.1 the shaded cells identify the sector to sector movements that have been included within the economic assessment.

Figure 20.1 Sectors used in TUBA Analysis

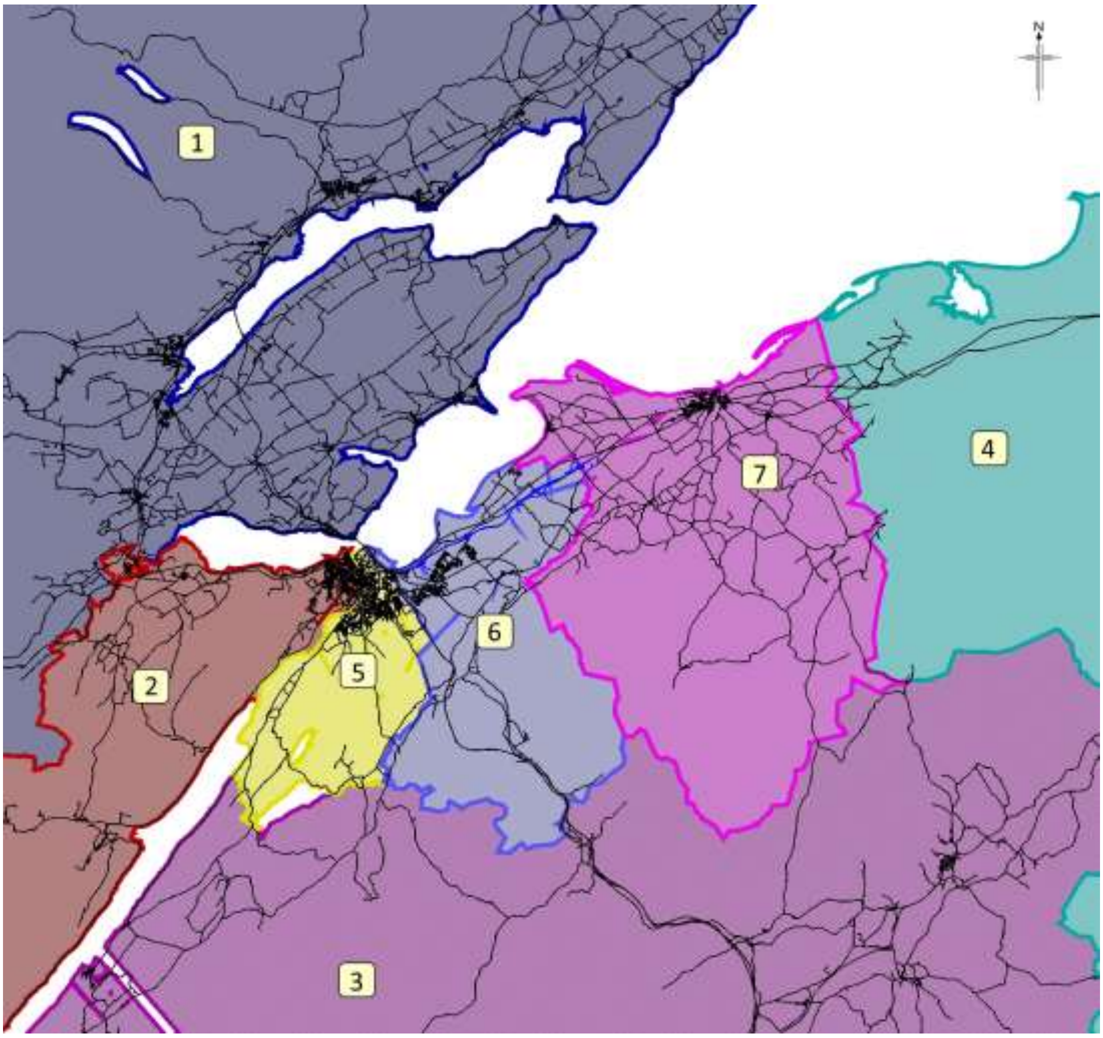

Table 20.1 Sector to Sector Movements Included in Economic Assessment

Sector	1	2	3	4	5	6	7
1				✓		✓	✓
2				✓		✓	✓
3				✓		✓	✓
4	✓	✓	✓		✓	✓	✓
5				✓		✓	✓
6	✓	✓	✓	✓	✓	✓	✓
7	✓	✓	✓	✓	✓	✓	✓

20.2.6 Inputs to COBALT are link based, with each link being assigned a distance, type, speed limit and AADT flow. There is a limit on the maximum number of links that COBALT can assess; therefore the MFTM model was cordoned to reduce the number of links in the dataset for input to COBALT. The cordon area was defined to encompass the area that is likely to be affected by the upgrade of the A96 between Inverness and Nairn to dual carriageway standard and the introduction of the Nairn Bypass.

20.2.7 For the purpose of the economic assessment, the scheme was assessed as two individual sections, Inverness to Gollanfield and the Nairn Bypass, in order to report the economic benefits of each option. Each Inverness to Gollanfield route option was modelled and compared to the Do-Minimum Model. For the Nairn Bypass, each option was modelled with Option 1A included in the Do-Something and Do-Minimum models. This removed the benefits accrued by Option 1A from the assessment of the Nairn Bypass options.

20.2.8 The economic impacts of delays during construction have been assessed using the QUADRO software. The software calculates the road user costs associated with traffic management during construction. The QUADRO assessment was developed using a simple assessment of traffic management required to construct online sections of new dual carriageway and a cost per kilometre was calculated. This cost was then multiplied by the length of online traffic management associated with each route option. In all instances, delays during construction reduce the overall benefits of each option.

20.2.9 The summed benefits (TUBA + COBALT + QUADRO) and costs are denoted by PVB (Present Value of Benefits) and PVC (Present Value of Costs) respectively; from these the NPV (Net Present Value = PVB - PVC) and the BCR (Benefit to Cost Ratio = PVB / PVC) are calculated. Where an option produces a positive NPV (i.e. a future stream of forecast benefits in excess of scheme costs) and a BCR greater than one, then is considered to provide value for money.

20.3 Scheme Specific Data

20.3.1 The MFTM was run for both the AM Peak, Inter-Peak and PM Peak periods for the appraisal years 2016, 2031 and 2036. For intermediate years, benefits are obtained by interpolation. No traffic growth is assumed to occur after 2036. Consequently, travel costs and, hence, route corridor choices remain unchanged. However, economic parameters, and therefore scheme benefits, are assumed to continue to change beyond 2036, as set out in WebTAG[1]. These parameters include;

- Value of Time;
- Cost of Fuel; and
- Proportion of transport fleet using diesel or petrol engines.

20.3.2 Whilst this approach offers a conservative valuation of scheme benefits, it was considered that this was a suitable basis for comparison of route options.

20.3.3 The Scottish household survey contains a travel diary section which provides for various aspects of travel for the previous day. The survey contains data from 1999 to 2006. For the HITRANS area, the observed number of trips in each of the time periods was then used to estimate the following ratios:

- AM Peak hour to annual = AM flow x 554;
- PM Peak hour to annual = PM flow x 600; and
- Inter-Peak hour to annual = IP flow x 3456[2].

These factors were used to factor road traffic demand outputs from the three modelled time periods to annual benefits as output by TUBA.

[1] WebTAG Unit 3.5.6 October 2012, www.webtag.org.uk

[2] MVA Information Note 'Regional Annualisation Factors', number 1 version 3, 01 April 2008

20.4 Construction Costs

20.4.1 As set out in Chapter 19 (Effects of Route Options), there are 72 possible combinations of options for Inverness to Gollanfield and Nairn Bypass. However, for appraisal purposes, the two sections have been assessed independently, such that there are eight options for the Inverness to Gollanfield section and nine options for the Nairn Bypass. The estimated cost of each option is described in Part 1, Chapter 3 (Description of Route Options), Section 3.6 (Cost Estimates) of this report.

20.4.2 For the purposes of this Stage 2 assessment, construction is assumed to commence in 2017 and be completed in 2019. The annual expenditure for all options was assumed to be :

- 2014 – 1.5%;
- 2015 – 1.5%;
- 2016 – 2.0%;
- 2017 – 20.0%;
- 2018 – 45.0%; and
- 2019 – 30.0%.

20.4.3 The construction cost estimates (£M, 2014 Q1 prices) are as presented in Table 20.2 and Table 20.3. These cost estimates exclude VAT; costs are input to TUBA in the factor cost unit of account, which does not include indirect taxation. Costs of the Do-Minimum scenario have been taken as zero.

Table 20.2 Construction Cost Estimates (Inverness to Gollanfield)

Option	1A	1A (MV)	1B	1B (MV)	1C	1C (MV)	1D	1D (MV)
Construction Cost:	£206.6m	£200.4m	£212.5m	£216.1m	£198.4m	£192.0m	£201.8m	£208.3m

Table 20.3 Construction Cost Estimates (Nairn Bypass)

Option	2A	2B	2C	2D	2E	2F	2G	2H	2I
Construction Cost:	£224.8m	£224.8m	£237.0m	£240.2m	£202.4m	£204.3m	£214.4m	£239.1m	£225.8m

20.5 Accidents

20.5.1 The cost of accidents has been assessed for each of the options using the COBALT software. Each of the Inverness to Gollanfield route options were compared against the Do-Minimum Scenario. As the Nairn Bypass route options were modelled alongside Options 1A, this option has been included as the Do-Minimum scenario for the Nairn Bypass options. This removes the accident benefits accrued from upgrading the A96 between Inverness and Gollanfield.

20.5.2 COBALT calculates the number of accidents that would occur in the Do-Minimum and Do-Something scenarios using default accident rates for different road classes. The default accident rate is a national UK rate and is not specific to the area. This may result in an over or under estimation in the number of casualties saved and therefore the accident benefits. The software calculates the number of fatal, serious and slight casualties that would occur on each link using the default accident rate and the traffic flows in each scenario. The difference between each scenario is calculated and presented as the accident benefit. The software also outputs the number of casualties in each severity class that will be saved over the 60 year assessment period. This has been divided by 60 to give a yearly saving for the entire COBALT network. Table 20.4 and Table 20.5 show the Low and High Growth scenarios for the Inverness to Gollanfield route options, and Tables 20.5.3 and 20.5.4 show the same for the Nairn Bypass section.

Table 20.4 Average number of casualties saved per year - Inverness to Gollanfield: Low Growth scenario

Option	1A	1A (MV)	1B	1B (MV)	1C	1C (MV)	1D	1D (MV)
Fatal	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Serious	3.0	3.0	3.1	2.9	3.0	2.9	3.0	3.0
Slight	15.3	13.7	16.9	14.2	15.1	14.5	16.0	15.6

Table 20.5 Average number of casualties saved per year - Inverness to Gollanfield: High Growth scenario

Option	1A	1A (MV)	1B	1B (MV)	1C	1C (MV)	1D	1D (MV)
Fatal	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Serious	3.2	3.0	3.3	3.0	3.1	3.0	3.2	3.1
Slight	16.7	14.0	18.7	14.7	16.3	15.5	17.6	16.9

Table 20.6 Average number of casualties saved per year - Nairn Bypass: Low Growth scenario

Option	2A	2B	2C	2D	2E	2F	2G	2H	2I
Fatal	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Serious	2.1	2.0	2.3	2.2	1.8	1.8	2.0	1.8	2.1
Slight	14.3	14.1	16.3	15.2	12.9	12.4	14.3	12.2	14.5

Table 20.7 Average number of casualties saved per year - Nairn Bypass: High Growth scenario

Option	2A	2B	2C	2D	2E	2F	2G	2H	2I
Fatal	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Serious	2.1	2.1	2.4	2.4	1.8	1.8	2.1	1.8	2.1
Slight	14.9	14.7	16.9	16.5	13.1	12.9	14.4	13.0	15.0

20.6 Results

20.6.1 A comparison of Economic Performance for each Inverness to Gollanfield route option is set out in Table 20.8 for the Low Growth scenario, while Table 20.9 presents the same comparison under the High Growth scenario. A comparison of Economic Performance for each Nairn Bypass route option is set out in Table 20.10 for the Low Growth scenario, while Table 20.11 presents the same comparison under the High Growth scenario. All figures are expressed in 2010 prices and values, discounted to 2010 at 3.5% for the first 30 years and 3% thereafter.

20.6.2 The majority of the route options presented in Table 20.8 and Table 20.9 have a Benefit to Cost Ratio (BCR) at or above 1, indicating these options are likely to provide value for money. Option 1A (MV) and 1B (MV) have a BCR below one indicating that the costs of the Do-Something exceeds the benefits that are forecast to arise from construction of the proposed scheme.

20.6.3 Similarly the majority of the route options presented in Table 20.10 and Table 20.11 have a BCR at or above 1, indicating these options are likely to provide value for money. Option 2B and 2H have a BCR below one for the Low Growth scenario. The BCR for Option 2B increases to 1.0 under the High Growth scenario.

Table 20.8 Economic Performance - Inverness to Gollanfield: Low Growth scenario

	1A	1A (MV)	1B	1B (MV)	1C	1C (MV	1D	1D (MV)
Present Value of Benefits (TUBA)	£99.7m	£87.6m	£109.3m	£87.6m	£107.4m	£98.8m	£119.4m	£111.0m
Accident Benefits (COBA–LT)	£66.7m	£61.9m	£70.2m	£64.1m	£66.0m	£64.1m	£67.5m	£66.3m
Construction Impacts (QUADRO)	-£1.4m	-£1.4m	-£1.5m	-£1.5m	-£1.1m	-£1.1m	-£1.2m	-£1.3m
Total Present Value Benefits	£165.0m	£148.1m	£178.0m	£150.2m	£172.3m	£161.8m	£185.7m	£176.0m
Present Value of Costs	£164.8m	£159.8m	£169.5m	£172.3m	£158.2m	£153.1m	£160.9m	£166.1m
Net Present Value (NPV)	£0.2m	-£11.7m	£8.5m	-£22.1m	£14.1m	£8.7m	£24.8m	£9.9m
Benefit to Cost Ratio (BCR)	1.0	0.9	1.1	0.9	1.1	1.1	1.2	1.1

Table 20.9 Economic Performance - Inverness to Gollanfield: High Growth scenario

	1A	1A (MV)	1B	1B (MV)	1C	1C (MV	1D	1D (MV)
Present Value of Benefits (TUBA)	£100.5m	£86.7 m	£102.1m	£91.6m	£109.1m	£101.2m	£123.4m	£116.4m
Accident Benefits (COBA–LT)	£70.5m	£64.3m	£74.8m	£65.6m	£69.2m	£66.5m	£71.7m	£69.6m
Construction Impacts (QUADRO)	-£1.4m	-£1.4m	-£1.5m	-£1.5m	-£1.1m	-£1.1m	-£1.2m	-£1.3m
Total Present Value Benefits	£169.6m	£149.6m	£175.4m	£155.7m	£177.2m	£166.6m	£193.9m	£184.7m
Present Value of Costs	£164.8m	£159.8m	£169.5m	£172.3m	£158.2m	£153.1m	£160.9m	£166.1m
Net Present Value (NPV)	£4.8m	-£10.2m	£5.9m	-£16.6m	£19.0m	£13.5m	£33.0m	£18.6m
Benefit to Cost Ratio (BCR)	1.0	0.9	1.0	0.9	1.1	1.1	1.2	1.1

Table 20.10 Economic Performance - Nairn Bypass: Low Growth scenario

	2A	2B	2C	2D	2E	2F	2G	2H	2I
Present Value of Benefits (TUBA)	£123.4m	£119.1m	£143.7m	£139.0m	£122.6m	£117.9m	£145.5m	£117.4m	£145.7m
Accident Benefits (COBA–LT)	£51.1m	£50.7m	£56.7m	£52.4m	£46.1m	£42.3m	£50.7m	£43.7m	£50.5m
Construction Impacts (QUADRO)	-£1.6m	-£2.5m	-£1.8m	-£1.9m	-£1.5m	-£2.2m	-£1.6m	-£1.5m	-£1.6m
Total Present Value Benefits	£172.9m	£167.3m	£198.6m	£189.5m	£167.2m	£158.0m	£194.6m	£159.6m	£194.6m
Present Value of Costs	£179.3m	£179.3m	£189.0m	£191.6m	£161.4m	£162.9m	£171.0m	£190.7m	£180.1m
Net Present Value (NPV)	-£6.4m	-£12.0m	£9.6m	-£2.1m	£5.8m	-£4.9m	£23.6m	-£31.1m	£14.5m
Benefit to Cost Ratio (BCR)	1.0	0.9	1.1	1.0	1.0	1.0	1.1	0.8	1.1

Table 20.11 Economic Performance - Nairn Bypass: High Growth scenario

	2A	2B	2C	2D	2E	2F	2G	2H	2I
Present Value of Benefits (TUBA)	£126.9m	£121.4m	£147.2m	£143.0m	£123.9m	£117.6m	£147.2m	£117.5m	£148.4m
Accident Benefits (COBA–LT)	£52.4m	£52.2m	£58.6m	£58.1m	£46.3m	£41.3m	£51.1m	£46.2m	£52.6m
Construction Impacts (QUADRO)	-£1.6m	-£2.5m	-£1.8m	-£1.9m	-£1.5m	-£2.2m	-£1.6m	-£1.5m	-£1.6m
Total Present Value Benefits	£177.7m	£171.1m	£204.0m	£199.2m	£168.7m	£156.7m	£196.7m	£162.2m	£199.4m
Present Value of Costs	£179.3m	£179.3m	£189.0m	£191.6m	£161.4m	£162.9m	£171.0m	£190.7m	£180.1m
Net Present Value (NPV)	-£1.6m	-£8.2m	£15.0m	£7.6m	£7.3m	-£6.2m	£25.7m	-£28.5m	£19.3m
Benefit to Cost Ratio (BCR)	1.0	1.0	1.1	1.0	1.1	1.0	1.2	0.9	1.1

20.7 Summary

20.7.1 This section reports an evaluation of the economic costs and benefits of the route options for both the Inverness to Gollanfield and Nairn Bypass sections.

20.7.2 The economic evaluation program TUBA was used for the evaluation, as it is able to assess the economic effects of redistribution of trips due to journey cost changes resulting from the introduction of a road scheme. Traffic data for input to TUBA was derived from the MFTM. COBALT was used to assess the impact each option has on accidents, and QUADRO has been used to assess the impact of delays during construction.

20.7.3 A summary of the NPV and BCR for each option is presented in Tables 20.8 to 20.11.

20.7.4 For the Inverness to Gollanfield section, the majority of the route options present a positive NPV. Option 1D presents the strongest business case as it has a NPV of £24.8m and a BCR of 1.2 under the Low Growth scenario. This is a result of Option 1D having the highest level of present value benefits (£185.7m) and one of the lowest costs (£160.9m).

20.7.5 For the Nairn Bypass section, the majority of the route options present a positive NPV. Option 2G presents the strongest business case as it has a NPV of £23.6m and a BCR of 1.1 under the Low Growth scenario. Option 2G has one of the highest levels of present value benefits (£194.6m) and one of the lowest costs (£171.0m). However the uncertainties in traffic modelling and forecasting make it more difficult to differentiate between the options when the economic performance of all the options is so similar as set out in Tables 20.8 to 20.11.

A96 DUALLING
INVERNESS TO NAIRN
(incl. Nairn Bypass)

TRANSPORT SCOTLAND
CÒMHDHAIL ALBA