A9/A96 Inshes to Smithton

DMRB Stage 2 Scheme Assessment Report

Volume 1 – Main Report and Appendices

Part 4 – Traffic and Economic Assessment

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TRANSPORT SCOTLAND
CÒMHDHAIL ALBA

Contents

19. Traffic Assessment

19.1 Introduction

19.1.1 This chapter of the Design Manual for Roads and Bridges (DMRB) Stage 2 Scheme Assessment report provides an overview of the transport model development, traffic forecasting and potential impacts of the proposed options for the scheme, compared to a Do-Minimum scenario. The economic appraisal of all proposed options and the economic results are presented in Chapter 20.

19.1.2 The traffic and economic assessment of the proposed options have been undertaken using an updated version of the Moray Firth Transport Model (MFTM). This is a regional, four-stage, multi-modal forecasting model with an original base year of 2009 developed for The Highland Council (THC), that was calibrated and validated to represent 2009 operating conditions.

19.1.3 The preceding STAG based assessment, A9/A96 Connections Study Transport Appraisal (Jacobs 2016), was undertaken using the original MFTM model. In preparation for the DMRB Stage 3 assessment for the A96 Dualling Inverness to Nairn (including Nairn Bypass) scheme, and the DMRB Stage 2 assessment for the A9/A96 Inshes to Smithton scheme, the MFTM Base model was updated using additional traffic data collected in 2014 along the A96 corridor. The MFTM update also utilised existing traffic date collected in and around Inverness.

19.1.4 As a further refinement to the MFTM, a specific Inter peak model was also developed to provide a more detailed assessment of the proposed options based on the representation of the AM peak, PM peak and Inter peak periods in the traffic modelling.

19.1.5 Figure 19.1 shows the relevant area of the MFTM Base transport model that was used to produce forecasts of multi-modal travel demand. The model was used to determine the effect of the proposed options compared to the Do-Minimum scenario, for the future years of 2021, as the assumed opening year, and 2036, as the assumed design year (15 years post-opening year).

19.1.6 Key performance indicators for the proposed options, such as changes to traffic flows, speeds, journey times and travel distances, have been assessed using the MFTM. The outputs from the MFTM were then input into the Department for Transport's (DfT) Transport Users Benefits Appraisal (TUBA) Version 1.9.7 software to identify the economic benefits for each of the proposed options compared to the Do-Minimum scenario. The infrastructure included in the agreed Do-Minimum scenario is described in section 19.5 of this chapter. The MFTM outputs have also been provided for the respective air quality, and traffic noise and vibration assessments as part of the Environmental Impact Assessment.

19.1.7 The following sections of this chapter describe the structure of the modelling system, including an overview for the models, inputs and forecasting assumptions. It also contains an assessment of the proposed options in order to determine the effect they have on the road network within the study area.

19.2 Model Inputs and Assumptions

Base Model Update

19.2.1 As noted previously, the MFTM Base Model was updated to include additional traffic count data collected along the A96 corridor, in combination with the existing data for Inverness. The data was used as part of a targeted process to update the MFTM Base Model and refine the representation of traffic within the corridor, particularly on the secondary road network. In order to provide Transport Scotland with the required level of technical assurance, the work undertaken to update the Base Model was subject to an independent audit.

19.2.2 The additional data collection consisted of an additional 38 Automatic Traffic Counters (ATC) located along the A96 corridor as shown in Figure 19.2.

19.2.3 Journey Time surveys were also undertaken as part of the data collection programme, and comprised a series of key routes between Inverness and Nairn, and key arterial/radial routes around Nairn as shown in Figure 19.3.

19.2.4 In addition to this data collection programme, use was also made of the existing 43 permanent ATC sites located throughout the model area, that are installed on the Trunk Road network and maintained by Transport Scotland. The ATC counters that lie within the study area are identified in Figure 19.4. The MFTM Base Model update was mainly focused on the A96 Corridor and Inverness, however it also covers all major commuting catchments to the city and strategic movements from the rest of Scotland. The model has been recalibrated to a base year of 2014 across the A96 corridor. Elsewhere the MFTM is largely unchanged as analysis of observed traffic growth across the trunk road network has shown that little-to-no growth occurred between 2009 and 2014. The forecast years that have been developed for the proposed options are 2021, as the assumed Year of Opening, and 2036, as the assumed Design Year.

19.2.5 The model has been developed to represent the following time periods:

- Morning peak 08:00-09:00 hours
- Inter peak average hour 10:00-16:00 hours
- Evening peak 17:00-18:00 hours

19.3 Existing Traffic Conditions

19.3.1 The study area incorporates the A9 and A96 trunk roads connecting via a roundabout at Raigmore Interchange. The existing A96 is a 60 mph speed limit rural single carriageway on approach to the A96 Smithton junction, where the speed limit reduces to 50 mph east of Smithton junction and applies on this section of the A96 route through to Raigmore Interchange. The A96 remains single carriageway until the Inverness Retail and Business Park junction, where it changes to a dual carriageway standard between the retail park junction and Raigmore Interchange.

19.3.2 The A9 is a dual carriageway where it passes through the study area and operates under a 70 mph national speed limit, until a point approximately 500m south of the A9/A82 Longman Junction. From this point the A9 operates under a 50mph speed limit north as it crosses the Kessock Bridge.

19.3.3 On the local road network, the B9006 Culloden Road is a key single carriageway distributor route for traffic accessing Inverness from the East and the Smithton, Culloden and Balloch areas, and is subject to a national 60 mph speed limit to a point just to the east of Viewmount Brae. From Viewmount Brae eastwards, the B9006 Culloden Road operates under a 40 mph speed limit until a point just to the east of the junction with the C1058 Caulfield Road North where a 30 mph speed limit applies as the route enters the Inshes urban area.

19.3.4 The C1032 Barn Church Road is a key local distributor road and provides a key access route for the Smithton, Culloden and Balloch areas to the A96. The route is subject to a 40 mph speed limit along the section that passes the main Balloch and Culloden residential areas between Upper Cullernie Court and the U1124 Caulfield Road. The eastern and western sections of the C1032 Barn Church Road approaching the A96 Balloch and A96 Smithton junctions are subject to a 60 mph speed limit.

19.3.5 A summary of the observed 2014 two-way Annual Average Daily Traffic flows at key locations on the trunk and local road network are shown in Table 19.1. The observed traffic information has been obtained from the permanent Automatic Traffic Counters (ATC) maintained by the National Traffic Database System (NTDS) and from the additional ATCs that were installed during September 2014, as a representative (neutral) month in terms of traffic volumes. The source of the traffic data has also been included within Table 19.1.

19.3.6 In 2014, the 2-way Annual Average Daily Traffic (AADT) flow on the A96 between the A96 Smithton junction and Raigmore Interchange was approximately 30,000 vehicles, based on the ATC data analysis. The 2-way AADT flow on the A9 north of Raigmore Interchange was approximately 35,000 vehicles, and on the A9 south of Raigmore Interchange was approximately 24,000 vehicles. The 2-way AADT flows at key locations on the local road network are also shown in Table 19.1, with the C1032 Barn Church Road and the B9006 Culloden Road having the highest traffic flows of approximately 11,900 vehicles and 12,600 vehicles respectively.

Table 19.1: Observed 2-way Annual Average Daily Traffic (AADT) Flows

Location	Source	2-Way AADT (2014)
A9 North of Raigmore	ATC01008	35,200
A96 Raigmore to West Seafield	ATCNE011	30,400
A96 West Seafield to Smithton	ATC01065	26,000
A96 East of Smithton	ATC01066	14,500
A9 South of Raigmore	ATCNW001	24,000
U1058 Caulfield Road North	Additional ATC1	3,500
B1977	Additional ATC3	2,400
U1124 Caulfield Road	Additional ATC4	5,100
Tower Road	Additional ATC6	9,900
C1032 Barn Church Road east of Tower Road	Additional ATC9	7,200
B9006 Culloden Road west of B1977	Additional ATC2	12,600
C1032 Barn Church Road west of Tower Road	Additional ATC5	11,900

19.3.7 Observed journey time information was also obtained for key routes in the study area. The observed journey time information was obtained for the key routes between the following points:

- A96 East of Smithton;
- A9 North of Kessock Bridge;
- Millburn Road;
- B9006 west of Inshes;
- Sir Walter Scott Drive;
- A9 South;
- B9006 Culloden Road East of Tower Road; and
- C1032 Barn Church Road.

19.3.8 The journey time routes are shown in Figure 19.6.

19.3.9 The observed data was used to establish existing journey time information within the study area in both the AM and PM peak periods. The observed journey time data for traffic movements passing through Raigmore Interchange and along the B9006 Culloden Road corridor are of particular interest for the proposed option assessment and the data analysed for the key movements is shown in Table 19.2 and Table 19.3 for the AM peak and PM peak respectively.

Table 19.2: Observed AM Peak Journey Times

Start Point	End Point	Direction	Peak	Journey Time (mm:ss)
A96 East of Smithton	A9 Kessock Bridge	WB	AM	10:49
A96 East of Smithton	Millburn Road	WB	AM	06:44
A96 East of Smithton	B9006 West of Inshes	WB	AM	10:05
A96 East of Smithton	Walter Scott Drive	WB	AM	10:16
A96 East of Smithton	A9 South	WB	AM	08:32
B9006 Culloden Road East of Tower Road	B9006 West of Inshes	WB	AM	08:02
B9006 West of Inshes	B9006 Culloden Road East of Tower Road	EB	AM	07:08
B9006 Culloden Road East of Tower Road	Walter Scott Drive	WB	AM	08:12
Walter Scott Drive	B9006 Culloden Road East of Tower Road	EB	AM	08:42

Table 19.3: Observed PM Peak Journey Times

Start Point	End Point	Direction	Peak	Journey Time (mm:ss)
A96 East of Smithton	A9 Kessock Bridge	WB	PM	10:24
A96 East of Smithton	Millburn Road	WB	PM	06:39
A96 East of Smithton	B9006 West of Inshes	WB	PM	10:12
A96 East of Smithton	Walter Scott Drive	WB	PM	10:31
A96 East of Smithton	A9 South	WB	PM	08:22
B9006 Culloden Road East of Tower Road	B9006 West of Inshes	WB	PM	07:46
B9006 West of Inshes	B9006 Culloden Road East of Tower Road	EB	PM	07:23
B9006 Culloden Road East of Tower Road	Walter Scott Drive	WB	PM	08:05
Walter Scott Drive	B9006 Culloden Road East of Tower Road	EB	PM	07:50

19.4 Accident Summary

Accident History

19.4.1 Recorded accident data for the A9 and A96 within the study area, for the five-year period from 2012 to 2016, was supplied by Transport Scotland in the form of STATS 19 Data in June 2017, and extracted from the Integrated Roads Information System (IRIS).

19.4.2 Road Casualties Scotland 2015 indicates that of the total accidents that have occurred on non-built-up A-Class roads, 3% were recorded as Fatal accidents and 22% as Serious accidents. Of the total accidents recorded on the A9 and A96 within the Inshes to Smithton study area, 0% were recorded as Fatal accidents and 15% recorded as Serious accidents. The proportions of Fatal and Serious accidents that have occurred on these sections of the A9 and A96 are therefore lower than the national average.

19.4.3 In total there were 27 recorded accidents between 2012 and 2016 within the study area, with an

average of five accidents occurring each year. The number and severity of accidents that occurred in each of the five years are shown in Table 19.4.

Table 19.4: Recorded Accidents by Year and Severity

Year	Slight	Serious	Fatal	Total
2012	7	0	0	7
2013	3	2	0	5
2014	5	1	0	6
2015	4	1	0	5
2016	4	0	0	4
Total	23	4	0	27

19.4.4 In summary there are several key points associated with the recorded accidents that have occurred on these sections of the A96 and the A9, as follows:

- There is no evidence to indicate that the A9 or A96 has a higher occurrence of fatal accidents compared to the national average.
- Approximately 15% of the recorded accidents were serious, which is lower than the overall national average for A-Class roads.
- Approximately 70% (17 accidents) of the accidents appear to have occurred at or in close proximity to junctions, based on the co-ordinates that were recorded, with:
    - Ten accidents recorded at Raigmore Interchange;
    - Four accidents recorded at the Inverness Retail and Business Park junction, and
    - Two accidents recorded at the A9/A82 Longman roundabout.

19.4.5 Figure 19.7 shows the recorded accident locations on the trunk road network by severity type.

19.5 Traffic Modelling

Introduction

19.5.1 This section provides an overview of the transport model methodology, including the development of the Base Model and the future year traffic forecasting. As noted previously, the Moray Firth Transport Model (MFTM) was the primary tool that has been used to assess the proposed options. To support the wider traffic modelling and economic assessment undertaken using the MFTM, a micro-simulation model was developed using the S-Paramics software to assess the detailed operational performance of the proposed options in the future forecast year of 2036.

19.5.2 The following sections present details of the traffic, operational and economic assessment of the proposed options.

19.5.3 The relevant transport modelling and economic appraisal aspects have been subject to a separate independent audit process.

Moray Firth Transport Model

19.5.4 Traffic modelling for the initial assessment of the options, undertaken following STAG principles, was undertaken using the original version of the MFTM that was developed on behalf of THC.

19.5.5 The original version of the MFTM had a base year of 2009, and covered a geographical area that broadly encompasses the Inverness Travel to Work area. It included all Trunk Roads and non-Trunk Principal Roads, as well as a significant part of the key local road network. The model was developed and maintained for THC by their transport modelling consultants, for use as a planning and forecasting tool for developments in the Inverness area including the West Link project.

19.5.6 As noted in Section 19.2 a targeted process to update the MFTM Base Model and refine the representation of traffic within the corridor and on the secondary road network was undertaken. To provide Transport Scotland with the required level of technical assurance, the work undertaken to update the Base Model has been subject to independent audit.

19.5.7 Further details on the MFTM Base model update process, and the model calibration and validation results are presented in the MFTM Base Model Uplift Calibration Report (Jacobs 2016).

Base Model

19.5.8 The updated MFTM Base year (2014) AADT flows on the A9 and A96, and key locations on the local road network, are shown in Table 19.5.

Table 19.5: MFTM Base Year Model 2-way Annual Average Daily Traffic Flows

Location	2-Way AADT (2014)
A9 North of Longman Roundabout	34,300
A9 South of Longman Roundabout	38,600
A82 at Longman Roundabout	33,200
Stadium Road	1,700
A9 Southbound Merge at Raigmore	4,400
A9 Northbound Diverge at Raigmore	6,500
A9 between Raigmore and Inshes	31,900
A96 East of Raigmore Interchange	38,400
A96 Raigmore Interchange to Retail Park	39,000
A96 Retail Park to Smithton	31,500
A96 East of A96 Smithton Junction	19,075
C1032 Barn Church Road west of Smithton Road	11,800
Tower Road	8,700
B9006 Culloden Road West of A9	19,800
B9006 Culloden Road East of A9	11,200
Sir Walter Scott Drive	12,700
Milburn Road	26,800

19.5.9 The Base Model traffic flows generally compare well to the observed flows on the A96, and during the AM peak, Inter peak and PM peak periods.

Consideration of the Do-Minimum Scenario

19.5.10 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.

19.5.11 It was therefore necessary to define the committed and most likely changes that will be made to the transport network between 2014 and each of the future appraisal years (2021 and 2036) to obtain the most representative appraisal results. The Do-Minimum scenario represents the likely future

conditions if the proposed options were not constructed. The Do-Minimum scenario includes other infrastructure improvements that have the required level of commitment to be included, and was agreed with Transport Scotland and THC.

19.5.12 The Do-Minimum interventions included within the MFTM are listed below:

- Two lane southbound diverge slip road from the A9 at Inshes, and signal adjustments at the junction on the B9006 Culloden Road;
- New access junction arrangements at the A9 Diverge/Culloden Road/UHI Campus Junction;
- Improvements at Longman Roundabout, including signalisation;
- Rail upgrades between Inverness and Aberdeen (permitting an hourly service between the two cities);
- New Rail Station at Dalcross;
- The Inverness West Link Road;
- Inshes Junction Improvements Phase 2;
- Raigmore Interchange Signalisation;
- C1032 Barn Church Road widened to 2 lanes;
- Kinnairdie Link Road, Dingwall; and
- The A96 Dualling Inverness to Nairn (including Nairn Bypass) scheme.

Planning Scenarios

19.5.13 In recent years the local and regional economy has been affected in the same way as the rest of the UK, with house building and the employment market slowing. As a result, the development forecasts previously set out by THC are not likely to be fully realised over the same timescale, particularly in zones that have been designated as large areas of employment. The renewables sector has however continued to grow, with jobs being created on the Cromarty Firth, around Nigg and to a lesser extent in Ardersier.

19.5.14 In response to this, three revised planning scenarios that better reflect forecasts following the economic downturn were developed to reflect the emerging Housing Needs and Demand Assessment (HNDA) being undertaken by THC. The scenarios allowed the proposed options to be tested with varying levels of growth and provide an understanding of how the network would operate under each growth scenario.

19.5.15 Full details of the planning scenarios are contained in the Moray Firth Transport Model Traffic Forecast Report (Jacobs 2016). The basis of each of the planning scenarios is summarised in the following sub-sections.

Low Growth Demand Scenario

19.5.16 The low demand scenario assumes the same annual level of house build-out rate in the period between 2011 and 2016 as has been observed during the period 2009-2013. The build-out rate is expected to increase between 2016 and 2021 to take account of growth associated with Inverness College (University of the Highlands and Islands Campus) and the renewables industry in Nigg. Post 2021, it is assumed that there will be a gradual decline in house build-out rates reflecting the general trend reported in the Highland Council HNDA.

19.5.17 In each scenario the growth in employment associated with the renewables industry at Nigg, the Port at Invergordon and Inverness College (UHI Campus) have been accounted for. Over the next 20 years, the low growth scenario assumes an increase in jobs in Nigg, Invergordon and Inverness

College (UHI Campus). For assessment purposes, it is also assumed that there is marginal growth in employment at most of the existing industrial, commercial and business sites in the area over the same period.

High Growth Demand Scenario

19.5.18 The high demand scenario is based on the high migration scenario in the HNDA, modified to include an increase in employment and housing associated with the renewables industry in Nigg and a corresponding decrease at the development sites along the A96. This decrease has been included to balance the overall employment and housing in the Highland Wide Plan.

19.5.19 The employment in Invergordon and the UHI remains the same as the low growth scenario. There are additional employment opportunities allocated to existing industrial, commercial and business sites in the area as well as expansion areas such as the Inverness Airport Business Park.

19.6 Proposed Options

19.6.1 The proposed options developed for the A9/A96 Inshes to Smithton scheme were appraised using the MFTM for the future years of 2021 as the Opening Year, and 2036 as the Design Year (Year of Opening plus 15 years).

19.6.2 As described in Chapter 3 two variants have been developed for each of the proposed options, defined as the A variant and the B variant. The difference between these variants is a change in alignment with the B variant developed to avoid the Ashton Farm Ring Ditch and Pit Circles Scheduled Monument. From a traffic modelling perspective, the difference in length of the alignments, of approximately 30m between the proposed Cradlehall roundabout and the proposed grade separated junction at the A96 Smithton junction (as points common to both the A and B variants), was not sufficient to result in a significant change to the modelled traffic flows.

19.6.3 As a result, B variant for each option has not been specifically modelled.

19.6.4 The estimated scheme costs for the two variants do however differ, and the economic assessment of the proposed options has therefore been undertaken for both variants. The results of the economic assessment are presented in Chapter 20.

19.7 A9/A96 Inshes to Smithton Option 1

19.7.1 Option 1 is shown in Figure 7.3 and consists of a single carriageway road connecting to the proposed arrangement for the Inshes Retail Park roundabout as part of THC's Inshes Phase 2 Outline Proposals to the west of the A9. The option crosses the A9 and the B9006 Culloden Road to connect to the local road network via the proposed Cradlehall roundabout on the C1058 Caulfield Road North, and continues northeast to connect to the southern dumbbell roundabout of the grade separated A96 Smithton junction, as part of the A96 Dualling Inverness to Nairn (including Nairn Bypass) scheme. The option includes for an intermediate junction between the Cradlehall roundabout and the A96 Smithton junction that provides an additional connection to the Inverness Retail and Business Park, and would provide a connection to the planned development area. The option also includes provision of a lane gain/drop on the southbound A9 between Raigmore Interchange and the A9 Southbound Inshes junction. Under Option 1 the existing A9 southbound merge and diverge slip roads would be retained.

19.8 A9/A96 Inshes to Smithton Option 2

19.8.1 Option 2 is shown in Figure 7.4 and is as per Option 1 with the additional provision of new A9 southbound slip roads at the A9 Southbound Inshes Junction, that connect to a new signalised junction on the option to the east of the proposed A9 overbridge. Option 2 again includes the provision of a lane gain/drop on the southbound A9 between Raigmore Interchange and the A9 Southbound Inshes junction.

19.9 A9/A96 Inshes to Smithton Option 3

19.9.1 Option 3 is shown in Figure 7.5 and consists of a single carriageway road connecting to the B9006 Culloden Road via the C1058 Caulfield Road North. Under this option the C1058 Caulfield Road North would be widened to provide two lanes southbound on the approach to the junction with the B9006 Culloden Road, and it is realigned to connect to the proposed roundabout at Cradlehall. The single carriageway road would then continue northeast to connect to the southern dumbbell roundabout of the grade separated A96 Smithton junction. The option includes for an intermediate junction between the Cradlehall roundabout and the A96 Smithton junction that provides an additional connection to the Inverness Retail and Business Park, and a connection to the planned development area. Option 3 provides for two lanes in each direction on the B9006 Culloden Road as it crosses the A9 via a parallel structure adjacent to the existing overbridge. Option 3 also includes provision of a lane gain/drop on the southbound A9 between Raigmore Interchange and the A9 Southbound Inshes junction.

19.10 Traffic Forecasts

19.10.1 The forecasting of future traffic demand was derived from the MFTM model. This 4-stage model represents the following responses and procedures in the order given below:

- Trip generation;
- Mode choice;
- Trip distribution; and
- Route choice (assignment).

19.10.2 The model makes use of the planning scenario data that was provided by THC and projected changes in population, households and employment levels.

19.10.3 The traffic demand for the assessment of the proposed options was developed for the following years:

- Proposed Option Opening Year of 2021; and
- Proposed Option Design Year of 2036 (15 years after the Opening Year).

19.10.4 The traffic growth forecasts in term of the matrix totals by journey purpose derived from the MFTM are shown in Table 19.6, Table 19.7 and Table 19.8 respectively for the modelled AM peak, Inter peak and PM peak time periods.

Table 19.6: Do-Minimum High Growth AM Peak

AM Peak	Base	DM 2021	DM 2036	Base ↗ 2021	2021 ↗ 2036
Car Commute	15725	18090	20265	15.04%	12.02%
Car In Work	2014	2153	2502	6.90%	16.21%
Car Others	6295	7706	9067	22.41%	17.66%
LGV	1375	2045	2819	48.72%	37.85%
HGV	649	775	1000	19.41%	29.03%

Table 19.7: Do-Minimum High Growth Inter Peak

Inter Peak	Base	DM 2021	DM 2036	Base ↗ 2021	2021 ↗ 2036
Car Commute	3858	4292	4624	11.2%	7.74%
Car In Work	1219	1368	1566	12.2%	14.47%
Car Others	14347	17830	21361	24.2%	19.80%
LGV	1440	2027	2535	40.69%	25.06%
HGV	438	408	492	-7.08%	20.59%

Table 19.8: Do-Minimum High Growth PM Peak

PM Peak	Base	DM 2021	DM 2036	Base ↗ 2021	2021 ↗ 2036
Car Commute	10445	12042	13474	15.29%	11.89%
Car In Work	1805	1893	2205	4.88%	16.48%
Car Others	13361	16403	19221	22.77%	17.18%
LGV	1307	1825	2331	39.63%	27.78%
HGV	418	467	701	11.72%	50.11%

19.11 Operational Model Traffic Forecasts

19.11.1 Following on from the completion of the MFTM future year 2021 and 2036 forecast models, output data was extracted from the MFTM forecast models to develop 2036 traffic data for input to the detailed operational models that were developed using the S-Paramics micro-simulation software.

19.11.2 As the MFTM is a strategic model covering a large area, a cordon was applied that allowed the extraction of traffic data from the MFTM for the smaller area modelled in the detailed operational model. The exact boundary of the cordon was defined based upon the location of zones within the detailed operational model and the representation of the road networks in the MFTM. The links included in the MFTM cordon area are shown in Figure 19.8.

19.11.3 The road network represented in the detailed operational model covers the A9 from the Kessock Bridge to south of the A9 Milton of Leys junction, and the A96 from Raigmore Interchange to east of the A96 Smithton junction. The local road network within the B9006 Culloden Road corridor, the Dell of Inshes and the C1032 Barn Church Road have also been included.

19.11.4 Further details of the development of forecast traffic demand for the operational model are contained in the A9/A96 Inshes to Smithton Future Year Demand Generation: Methodology (Jacobs 2017).

19.12 Effects of Options

Option 1

19.12.1 The two-way AADTs from the MFTM for the Do-Minimum and Option 1 high growth scenario, in the design year 2036, are shown in Table 19.9, and on Figures 19.9 and 19.10 respectively for the Do-Minimum and Option 1 scenarios.

Table 19.9: AADTs for the Do-Minimum and Option 1

Location	DM 2036	Option 1 2036	Difference	%Difference
A96 east of Raigmore Interchange	68,100	53,900	-14,200	-21%
A96 Raigmore Interchange to Retail Park	69,200	54,600	-14,600	-21%
A96 Retail Park to Smithton	58,300	46,900	-11,400	-20%
A96 east of A96 Smithton Junction	34,900	39,400	4,500	13%
C1032 Barn Church Road at Smithton	21,600	28,200	6,600	31%
C1032 Barn Church Road west of Tower Road	15,800	17,200	1,400	9%
C1058 Caulfield Road North	3,600	5,200	1,600	44%
B9006 Culloden Road between A9 Diverge/Culloden Road/UHI Campus Junction and U1124 Caulfield Road	14,300	10,500	-3,800	-27%
B9006 Culloden Road Overbridge	28,800	20,600	-8,200	-28%
B8082 Sir Walter Scott Drive	18,000	11,600	-6,400	-36%
B9006 west of Inshes	14,600	15,600	1,000	7%
A9 Raigmore to Inshes	45,400	35,300	-10,100	-22%
A9 Raigmore NB Diverge	9,700	3,900	-5,800	-60%
A9 Raigmore SB Merge	9,000	2,800	-6,200	-69%
A9 South of Longman Roundabout	45,200	46,400	1,200	3%
A9 North of Longman Roundabout	45,100	45,200	100	0%
Stadium Road	4,700	4,900	200	4%
A82 West of Longman Roundabout	37,800	36,400	-1,400	-4%
Tower Road	12,100	5,800	6,300	-52%
B9006 Culloden Road West of B9177	12,600	8,300	4,300	-34%
B9006 Culloden Road West of Tower Road	12,300	8,300	4,000	-33%
B9006 Culloden Road East of Tower Road	3,800	2,700	1,100	-29%
Millburn Road	45,600	44,300	1,300	-3%
Option 1 - South of Smithton	-	22,200	-	-
Option 1 - South of Retail Park	-	28,800	-	-
Option 1 - East of A9	-	21,900	-	-
Option 1 - West of A9	-	21,900	-	-
Option 1 - Retail Park Access	-	4,000	-	-

19.12.2 In terms of the key traffic flow changes Table 19.9 shows that compared to the Do-Minimum scenario, Option 1 would reduce the number of vehicles on the A96 approach to Raigmore Interchange by 21%, with a forecast reduction in the 2-way AADT traffic flow of approximately 14,000 vehicles. Option 1 would also result in a reduction in traffic on the A9 between Raigmore Interchange and A9 Inshes Junction, with forecast traffic levels reducing by approximately 22% (or 10,100 vehicles), as traffic travelling via the A96 and the A9 under the Do-Minimum transfers to travel via the proposed Option.

19.12.3 The introduction of Option 1 and the provision of an additional crossing of the A9 would reduce traffic travelling via the existing B9006 Culloden Road overbridge, with a forecast reduction in traffic volumes of approximately 28% (or 8,200 vehicles) compared to the Do-Minimum. Traffic flows would also be forecast to reduce on Sir Walter Scott Drive, on the approach to the Inshes junction by approximately 36% (or 6,400 vehicles) at the AADT level.

19.12.4 The forecast traffic flows travelling via the proposed option overbridge crossing the A9 would be 21,900 vehicles under Option 1.

19.12.5 The proposed option would also provide benefits to the local road network as a proportion of traffic that travels through the Smithton and Westhill residential areas in the Do-Minimum transfers to travelling via the Inshes to Smithton scheme. From Table 19.9 it is evident that traffic levels on Tower Road would reduce by approximately 50% (or 6,300 vehicles), and on the B9006 Culloden Road to the west of the junction with Tower Road by approximately 30% (or 4,000 vehicles). This transfer of traffic would contribute to an increase in traffic travelling via the C1032 Barn Church Road to the A96 Smithton Junction, with traffic forecast to increase by approximately 30% (or 6,600 vehicles) in the 2-way AADT flow.

19.12.6 The forecast changes in journey times for key movements under Option 1 compared to the Do Minimum are shown in Table 19.10 and Table 19.11 for the AM peak and PM peak periods respectively.

Table 19.10: AM Peak High Growth Journey Time Comparison

High Growth Journey Time AM Peak		DM 2036 (mm:ss)	Opt 1 2036 (mm:ss)	Difference (mm:ss)
A96 East of Smithton to Kessock Bridge	EB	11:46	11:21	-00:26
	WB	15:51	9:17	+03:26
A96 East of Smithton to Inshes	EB	09:12	07:53	-01:19
	WB	12:58	09:34	-03:23
A96 East of Smithton to A9 South via Option 1	EB	07:11	08:07	+00:56
	WB	09:39	08:28	-01:11
A96 East of Smithton to A9 South	EB	07:11	08:29	+01:18
	WB	09:39	07:16	-02:23
A96 East of Smithton to Millburn Road	EB	05:49	05:48	-00:01
	WB	09:05	06:38	-02:28
B9006 Culloden Road west of B9177 to B9006 west of Inshes	EB	04:20	04:10	-00:10
	WB	05:00	04:19	-00:40
B9006 Culloden Road west of B9177 to Sir Walter Scott Drive	EB	05:17	04:01	-01:16
	WB	04:19	03:38	-00:41

Table 19.11: PM Peak High Growth Journey Time Comparison

High Growth Journey Time PM Peak		DM 2036 (mm:ss)	Opt 1 2036 (mm:ss)	Difference (mm:ss)
A96 East of Smithton to Kessock Bridge	EB	00:08:11	00:07:59	-00:00:12
	WB	00:13:11	00:12:27	-00:00:44
A96 East of Smithton to Inshes	EB	00:09:58	00:08:20	-00:01:38
	WB	00:09:06	00:08:25	-00:00:41
A96 East of Smithton to A9 South via Option 1	EB	00:07:49	00:08:31	+00:00:42
	WB	00:06:28	00:07:33	+00:01:05
A96 East of Smithton to A9 South	EB	00:07:49	00:07:16	-00:00:33
	WB	00:06:28	00:05:41	-00:00:47
A96 East of Smithton to Millburn Road	EB	00:06:41	00:05:28	-00:01:14
	WB	00:05:12	00:04:19	-00:00:53
B9006 Culloden Road west of B9177 to B9006 west of Inshes	EB	00:05:07	00:04:34	-00:00:33
	WB	00:04:39	00:03:59	-00:00:39
B9006 Culloden Road west of B9177 to Sir Walter Scott Drive	EB	00:04:46	00:04:15	-00:00:31
	WB	00:04:25	00:03:29	-00:00:56

19.12.7 From the tables it is evident that the journey time on the A96 approach to Raigmore Interchange would reduce, with journey times for the A96 East of Smithton to Millburn Road route exhibiting a reduction of approximately two and a half minutes in the AM peak and approximately one minute in the PM peak for Option 1 compared to the Do-Minimum. Similarly, the journey times between the A96 East of Smithton and the A9 South travelling through Raigmore Interchange, would reduce by approximately two and a half minutes in the AM peak period and a reduction of approximately one minute in the PM peak.

19.12.8 The reduction in traffic leads to journey time savings for the movements from the B9006 Culloden Road (West of the B9177) to West of Inshes Junction of approximately 40 seconds in both the AM and PM peak periods. There is a similar level of journey time savings when travelling between the B9006 Culloden Road and Sir Walter Scott Drive.

19.12.9 The constraint posed by the A9/A82 Longman junction as a result of the at-grade arrangement, does appear to have an impact on selected movements for example movements from the A96 to the A9 Kessock Bridge. This is also affected by the increase in traffic travelling northbound on the A9 between Raigmore Interchange and the A9/A82 Longman junction under Option 1, as the improved operation of Raigmore Interchange allows a higher level of traffic throughput compared to the Do-Minimum.

19.12.10 The more complex traffic interactions have also been assessed using the detailed operational models that were developed using the S-Paramics micro-simulation software. As would be expected with the level of traffic forecast in 2036, which includes the traffic from the planned land-use developments for the area, the road network is under significant pressure.

19.12.11 In the Do-Minimum scenario this is largely focussed on the A9 Diverge/Culloden Road/UHI Campus Junction. In the AM peak period extensive and persistent queuing is apparent for traffic travelling

westbound on the B9006 Culloden Road that extends back from the A9 Diverge/Culloden Road/UHI Campus Junction to beyond the Inshes Wood area (approximately 1.4km from the junction). A persistent queue simultaneously develops on the A9 Southbound diverge slip road at Inshes that blocks-back on to the A9 Southbound carriageway and extends northwards towards Raigmore Interchange.

19.12.12 During the PM peak period, the A9 Diverge/Culloden Road/UHI Campus Junction is again subject to significant pressure. The forecast traffic levels result in a significant and persistent queue building up on the eastbound B9006 Culloden Road approach to the A9 Diverge/Culloden Road/UHI Campus Junction, sufficient to block-back across the new access to the Inshes Retail Park that would be formed on the B9006 Culloden Road as part of THC's Inshes Phase 2 proposals. This in turn would also have a significant impact on traffic entering and leaving the petrol filling station. Extensive queuing would again be apparent on the A9 Southbound Diverge slip road at the A9 Southbound Inshes Junction extending back onto the A9 southbound carriageway and northwards towards Raigmore Interchange.

19.12.13 There is also a substantial volume of traffic forecast to exit Inverness College (UHI Campus) during the PM peak, that places further pressure on the A9 Diverge/Culloden Road/UHI Campus Junction. This would likely cause significant and persistent queuing on the internal Inverness College (UHI Campus) road network for a significant duration throughout the PM peak period.

19.12.14 When compared to the Do-Minimum, one of the key effects of Option 1 is the reduction in traffic travelling from the east via the A96, Raigmore Interchange, the A9 Southbound Inshes Junction Diverge and onto the B9006 Culloden Road to continue westbound towards Inshes. The reduction in the number of vehicles on the A9 southbound diverge approach to the A9 Diverge/Culloden Road/UHI Campus Junction allows more flexibility to improve the optimisation of the signals for example to provide additional green time to the B9006 Culloden Road westbound approach.

19.12.15 From the detailed operational modelling during the AM peak period this would result in significant reductions in both the length and duration of the queues on the Culloden Road westbound approach, and the A9 Southbound Diverge slip road compared to the Do-Minimum. In particular, the extent of the queue on the A9 Southbound Diverge would not block-back on to the main A9 southbound carriageway.

19.12.16 During the PM peak, the performance of the B9006 Culloden Road would also improve under Option 1 compared to the Do-Minimum. The level of queuing on the Culloden Road eastbound approach to the A9 Diverge/Culloden Road/UHI Campus Junction reduced such that it would not block-back to the new Inshes Retail Park access.

19.12.17 However, in the PM peak under Option 1 there would be operational impacts at the extended Inshes Retail Park roundabout where the option is proposed to connect via the upgraded U1267 Dell of Inshes Road. The increased traffic levels travelling through the roundabout under Option 1 and crossing the A9 would have priority over the egress from the retail park car parks serving the Aldi and Tesco food stores. As a result, the operation of the internal road networks would be impacted with persistent queues developing on the car park exits throughout the PM peak.

Option 2

19.12.18 The two-way AADTs from the MFTM for the Do-Minimum and Option 2 high growth scenario, in the design year 2036, are shown in Table 19.12 and on Figure 19.9 and Figure 19.11 respectively for the Do-Minimum and Option 2 scenarios.

Table 19.12: AADTs for the Do-Minimum and Option 2

Location	DM 2036	Option 2 2036	Difference	%Difference
A96 east of Raigmore Interchange	68,100	52,500	-15,600	-23%
A96 Raigmore Interchange to Retail Park	69,200	53,200	-16,000	-23%
A96 Retail Park to Smithton	58,300	45,600	-12,700	-22%
A96 east of A96 Smithton Junction	34,900	39,100	4,200	12%
C1032 Barn Church Road at Smithton	21,600	27,900	6,300	29%
C1032 Barn Church Road west of Tower Road	15,800	17,100	1,300	8%
C1058 Caulfield Road North west of the Inshes to Smithton scheme	3,600	7,400	3,800	106%
B9006 Culloden Road between A9 Diverge/Culloden Road/UHI Campus Junction and U1124 Caulfield Road	14,300	11,700	-2,600	-18%
B9006 Culloden Road Overbridge	28,800	14,800	-14,000	-49%
B8082 Sir Walter Scott Drive	18,000	9,800	-8,200	-46%
B9006 west of Inshes	14,600	14,900	300	2%
A9 Raigmore to Inshes	45,400	33,400	-12,000	-26%
A9 Raigmore NB Diverge	9,700	3,800	-5,900	-61%
A9 Raigmore SB Merge	9,000	2,400	-6,600	-73%
A9 South of Longman Roundabout	45,200	46,200	1,000	2%
A9 North of Longman Roundabout	45,100	44,900	-200	0%
Stadium Road	4,700	4,400	-300	-6%
A82 West of Longman Roundabout	37,800	37,200	-600	-2%
Tower Road	12,100	5,300	6,800	-56%
B9006 Culloden Road West of B9177	12,600	8,500	4,100	-33%
B9006 Culloden Road West of Tower Road	12,300	8,400	3,900	-32%
B9006 Culloden Road East of Tower Road	3,800	3,100	700	-18%
Millburn Road	45,600	43,800	1,800	-4%
Option 2 - South of Smithton	-	22,700	-	-
Option 2 - South of Retail Park	-	29,100	-	-
Option 2 - East of A9	-	23,800	-	-
Option 2 - West of A9	-	27,800	-	-
Option 2 - Retail Park Access	-	3,400	-	-
Option 2 – A9 Southbound Diverge	-	14,400	-	-
Option 2 – A9 Southbound Merge	-	5,000	-	-

19.12.19 Option 2 would have a similar impact on traffic flows as Option 1, although there are some differences due to the provision of the new A9 Southbound merge and diverge slip roads at the A9 Southbound Inshes junction. This would mainly result in a higher reduction in traffic levels on the A96 approach to Raigmore Interchange.

19.12.20 In terms of the key traffic flow changes, Table 19.12 shows that compared to the Do-Minimum scenario, Option 2 would reduce the number of vehicles on the A96 approach to Raigmore Interchange by 23%, with a forecast reduction in the 2-way AADT traffic flow of approximately 15,600

vehicles. Option 2 would also result in a reduction in traffic on the A9 between Raigmore Interchange and the A9 Inshes junction, with forecast traffic levels reducing by approximately 26% (or 12,000 vehicles), as traffic travelling via the A96 and the A9 under the Do-Minimum transfers to travel via the proposed Option.

19.12.21 The introduction of Option 2 and the provision of an additional crossing of the A9 would reduce traffic travelling via the existing B9006 Culloden Road Overbridge, with a forecast reduction in traffic volumes of approximately 50% (or 14,000 vehicles) compared to the Do-Minimum. Traffic flows would also be forecast to reduce on Sir Walter Scott Drive on the approach to the Inshes junction by approximately 50% (or 8,200 vehicles) at the AADT level.

19.12.22 The forecast traffic flows travelling via the proposed option overbridge crossing the A9 would be 27,800 vehicles under Option 2.

19.12.23 The proposed option would also provide benefits to the local road network as a proportion of traffic that travels through the Smithton and Westhill residential areas in the Do-Minimum transfers to travelling via the new connection between the C1058 Caulfield Road North and the A96 Smithton Junction. From Table 19.12 it is evident that traffic levels on Tower Road would reduce by approximately 55% (or 6,800 vehicles), and on the B9006 Culloden Road to the west of the junction with Tower Road by approximately 30% (or 3,900 vehicles). This transfer of traffic would contribute to an increase in traffic travelling via the C1032 Barn Church Road to the A96 Smithton junction, with traffic forecast to increase by approximately 29% (or 6,300 vehicles) in the 2-way AADT flow.

19.12.24 The forecast changes in journey times for key movements under Option 2 compared to the Do-Minimum are shown in Table 19.13 and Table 19.14 for the AM peak and PM peak periods respectively.

Table 19.13: AM Peak High Growth Journey Time Comparison

High Growth Journey Time AM Peak		DM 2036	Opt 2 2036	Difference
A96 East of Smithton to Kessock Bridge	EB	00:11:46	00:11:37	-00:00:09
	WB	00:15:51	00:19:05	+00:03:14
A96 East of Smithton to Inshes	EB	00:09:12	00:07:56	-00:01:16
	WB	00:12:58	00:09:13	-00:03:45
A96 East of Smithton to A9 South via Option 2	EB	00:07:11	00:08:08	+00:00:58
	WB	00:09:39	00:07:03	-00:02:36
A96 East of Smithton to A9 South	EB	00:07:11	00:09:23	+00:02:12
	WB	00:09:39	00:07:02	-00:02:37
A96 East of Smithton to Millburn Road	EB	00:05:49	00:06:22	+00:00:33
	WB	00:09:05	00:06:37	-00:02:28
B9006 Culloden Road west of B9177 to B9006 west of Inshes	EB	00:04:20	00:04:16	-00:00:05
	WB	00:05:00	00:04:05	-00:00:55
B9006 Culloden Road west of B9177 to Sir Walter Scott Drive	EB	00:05:17	00:04:01	-00:01:16
	WB	00:04:19	00:03:24	-00:00:54

Table 19.14: PM Peak High Growth Journey Time Comparison

High Growth Journey Time AM Peak		DM 2036	Opt 2 2036	Difference
A96 East of Smithton to Kessock Bridge	EB	00:08:11	00:07:46	-00:00:25
	WB	00:13:11	00:12:33	-00:00:38
A96 East of Smithton to Inshes	EB	00:09:58	00:08:13	-00:01:45
	WB	00:09:06	00:08:19	-00:00:47
A96 East of Smithton to A9 South via Option 2	EB	00:07:49	00:08:22	+00:00:33
	WB	00:06:28	00:06:06	-00:00:22
A96 East of Smithton to A9 South	EB	00:07:49	00:07:00	-00:00:49
	WB	00:06:28	00:05:41	-00:00:47
A96 East of Smithton to Millburn Road	EB	00:06:41	00:05:48	-00:00:54
	WB	00:05:12	00:04:18	-00:00:54
B9006 Culloden Road west of B9177 to B9006 west of Inshes	EB	00:05:07	00:04:28	-00:00:39
	WB	00:04:39	00:03:44	-00:00:55
B9006 Culloden Road west of B9177 to Sir Walter Scott Drive	EB	00:04:46	00:04:06	-00:00:40
	WB	00:04:25	00:03:09	-00:01:16

19.12.25 From the tables it is evident that the journey time on the A96 approach to Raigmore Interchange would reduce, with journey times for the A96 East of Smithton to Millburn Road route exhibiting a reduction of approximately two and a half minutes in the AM peak and approximately one minute in the PM peak for Option 2 compared to the Do-Minimum. Similarly, the journey times between the A96 East of Smithton and the A9 South travelling through Raigmore Interchange, would reduce by approximately two and a half minutes in the AM peak period and by approximately 50 seconds in the PM peak.

19.12.26 The reduction in traffic leads to journey time savings for the movements from B9006 Culloden Road (West of the B9177) to West of Inshes Junction of approximately 50 seconds in both the AM and PM peak periods. There is a similar level of journey time savings when travelling between B9006 Culloden Road and Sir Walter Scott Drive.

19.12.27 The constraint posed by the A9/A82 Longman Junction as a result of the at-grade arrangement, does appear to have an impact on selected movements, for example movements from the A96 to the A9 Kessock Bridge. This is also affected by the increase in traffic travelling northbound on the A9 between Raigmore Interchange and the A9/A82 Longman Junction under Option 2, as the improved operation of Raigmore Interchange allows a higher level of traffic throughput compared to the Do-Minimum.

19.12.28 In terms of the detailed operational performance, in Option 2 the provision of the new A9 Southbound Merge and Diverge slip roads introduces a major change to the operation of the A9 Diverge/Culloden Road/UHI Campus Junction. Under Option 2 the new slip road design effectively removes one approach arm and hence the traffic flows from this key junction, significantly reducing the number of conflicting traffic streams and allows the signals design to be reconfigured accordingly.

19.12.29 As a result, during the AM peak period the road network would accommodate the forecast traffic levels particularly westbound traffic on the B9006 Culloden Road with a lower degree of queuing developing for a shorter duration. The higher traffic flows that would travel on the connection between the C1058

Caulfield Road North and the A96 Smithton Junction under Option 2 would result in queuing developing on the U5096 Castlehill Road approach to the proposed roundabout at Cradlehall, and on the C1058 Caulfield Road North approach to the junction with the B9006 Culloden Road. The extent of the queues is not of sufficient length to cause any blocking-back issues to upstream junctions and are of a relatively short duration and dissipate quickly.

19.12.30 At the proposed signalised junction connecting the A9 southbound diverge and merge slip roads to the proposed overbridge crossing the A9, the queue on the southbound diverge approach extends to a maximum length of approximately 100m.

19.12.31 During the PM peak, the B9006 Culloden Road corridor operates well compared to the Do-Minimum situation with minimal queuing in the eastbound direction. Again, as a result of the reconfiguration of the A9 Diverge/Culloden Road/UHI Campus Junction, the PM peak eastbound traffic on the B9006 Culloden Road and the high volumes of traffic exiting Inverness College (UHI Campus) would be accommodated with minimal queuing.

19.12.32 However, during the PM peak period Option 2 would have significant operational impacts on the local road network in the Inshes area. At the Inshes Retail Park, there would be significant operational impacts at the extended Inshes Retail Park roundabout where the option is proposed to connect via the upgraded U1267 Dell of Inshes Road. The higher traffic levels travelling through the roundabout from the proposed overbridge crossing the A9 to access Culloden Road, and accessing the proposed overbridge from Sir Walter Scott Drive and Inshes Road, would have priority over the egress from the retail park car parks serving the Aldi and Tesco food stores. This would result in the rapid development of queues on the car park approaches to the roundabout, and would persist for the duration of the PM peak period. The duration of the queuing would lead to a significant amount of unmet demand from the car parks, with a large proportion of the forecast traffic being unable to exit by the end of the modelled period.

19.12.33 As a result of the higher traffic levels using Option 2, during the PM peak period the proposed junction connecting to the A9 Southbound slip roads would also come under pressure with queues forming on the eastbound approach and extending back to the extended retail park roundabout. The Option 2 approach via the upgraded U1267 Dell of Inshes Road to the extended Inshes Retail Park roundabout would also exhibit persistent queuing throughout the PM peak period.

19.12.34 Under Option 2, as a result of the increased traffic levels routing through the Inshes area, the section of Inshes Road approaching the junction with Sir Walter Scott Drive would see a persistent queue develop quickly and block-back to the adjacent roundabout on Inshes Road. This would further impact the operation of the road network serving the southern part of the retail park.

Option 3 - Assessment

19.12.35 The two-way AADTs from the MFTM for the Do-Minimum and Option 3 high growth scenario, in the design year 2036, are shown in Table 19.15 and on Figure 19.9 and Figure 19.12 respectively for the Do-Minimum and Option 3 scenarios.

Table 19.15: AADTs for the Do-Minimum and Option 3

Location	DM 2036	Option 3 2036	Difference	%Difference
A96 east of Raigmore Interchange	68,100	58,800	-9,300	-14%
A96 Raigmore Interchange to Retail Park	69,200	59,600	-9,600	-14%
A96 Retail Park to Smithton	58,300	50,400	-7,900	-14%
A96 east of A96 Smithton Junction	34,900	37,900	3,000	9%
C1032 Barn Church Road at Smithton	21,600	27,300	5,700	26%
C1032 Barn Church Road west of Tower Road	15,800	16,600	800	5%
C1058 Caulfield Road North west of the Inshes to Smithton scheme	3,600	15,600	12,000	333%
B9006 Culloden Road between A9 Diverge/Culloden Road/UHI Campus Junction and U1124 Caulfield Road	14,300	21,700	7,400	52%
B9006 Culloden Road Overbridge	28,800	33,300	4,500	16%
B8082 Sir Walter Scott Drive	18,000	16,800	-1,200	-7%
B9006 west of Inshes	14,600	15,100	500	3%
A9 Raigmore to Inshes	45,400	36,900	-8,500	-19%
A9 Raigmore NB Diverge	9,700	5,000	-4,700	-48%
A9 Raigmore SB Merge	9,000	4,100	-4,900	-54%
A9 South of Longman Roundabout	45,200	45,900	700	2%
A9 North of Longman Roundabout	45,100	45,100	0	0%
Stadium Road	4,700	4,700	0	0%
A82 West of Longman Roundabout	37,800	37,400	-400	-1%
Tower Road	12,100	5,800	-6,300	-52%
B9006 Culloden Road West of B9177	12,600	10,500	-2,100	-17%
B9006 Culloden Road West of Tower Road	12,300	9,600	-2,700	-22%
B9006 Culloden Road East of Tower Road	3,800	3,000	-800	-21%
Millburn Road	44,300	45,600	1,300	3%
Option - South of Smithton	-	16,200	-	-
Option - South of Retail Park	-	20,900	-	-
Option - Retail Park Access	-	2,600	-	-

19.12.36 Option 3 would result in a similar pattern of traffic as Options 1 and 2 in terms of the A96 approach to Raigmore Interchange and the A9 between Raigmore Interchange and the A9 Inshes Junction. The arrangement of the connection with the B9006 Culloden Road at the southern end of Option 3 would produce differences when compared with the other two options.

19.12.37 In terms of the key traffic flow changes Table 19.15 shows that compared to the Do-Minimum scenario, Option 3 would reduce the number of vehicles on the A96 approach to Raigmore Interchange by 14%, with a forecast reduction in the 2-way AADT traffic flow of approximately 9,000 vehicles. Option 3 would also result in a reduction in traffic on the A9 between Raigmore Interchange and the A9 Inshes junction, with forecast traffic levels reducing by approximately 19% (or 8,500 vehicles), as traffic travelling via the A96 and the A9 under the Do-Minimum transfers to travel via the proposed Option.

19.12.38 In Option 3 the provision of the additional structure parallel to the existing B9006 Culloden Road overbridge to provide two lanes in each direction, would result in an increase in traffic at this location of approximately 16% (or 4,500 vehicles) compared to the Do-Minimum. Due to the Option 3 connection to the B9006 Culloden Road via the upgraded C1058 Caulfield Road North under Option 3, traffic flows on this upgraded section of the U1124 Caulfield Road would increase significantly, by approximately 12,000 vehicles compared with the Do-Minimum.

19.12.39 Traffic flows would reduce on Sir Walter Scott Drive, on the approach to the Inshes junction by approximately 7% (or 1,200 vehicles) at the AADT level.

19.12.40 The proposed option would also provide benefits to the local road network as a proportion of traffic that travels through the Smithton and Westhill residential areas in the Do-Minimum transfers to travelling via Option 3. From Table 19.12 it is evident that traffic levels on Tower Road would reduce by approximately 52% (or 6,300 vehicles), and on the B9006 Culloden Road to the west of the junction with Tower Road by approximately 22% (or 2,700 vehicles). This transfer of traffic would contribute to an increase in traffic travelling via the C1032 Barn Church Road to the proposed A96 Smithton junction, with traffic forecast to increase by approximately 26% (or 5,700 vehicles) in the 2-way AADT flow.

19.12.41 The forecast changes in journey times for key movements under Option 3 compared to the Do-Minimum are shown in Table 19.16 and Table 19.17 for the AM peak and PM peak periods respectively.

Table 19.16: AM Peak High Growth Journey Time Comparison

High Growth Journey Time AM Peak		DM 2036	Opt 3 2036	Difference
A96 East of Smithton to Kessock Bridge	EB	00:11:46	00:11:32	-00:00:15
	WB	00:15:51	00:20:03	+00:04:11
A96 East of Smithton to Inshes	EB	00:09:12	00:08:08	-00:01:04
	WB	00:12:58	00:10:36	-00:02:21
A96 East of Smithton to A9 South via Inshes to Smithton scheme	EB		00:08:18	
	WB		00:09:32	
A96 East of Smithton to A9 South	EB	00:07:11	00:09:31	+00:02:20
	WB	00:09:39	00:08:00	-00:01:39
A96 East of Smithton to Millburn Road	EB	00:05:49	00:06:27	+00:00:38
	WB	00:09:05	00:07:35	-00:01:30
B9006 Culloden Road west of B9177 to B9006 west of Inshes	EB	00:04:20	00:04:18	-00:00:03
	WB	00:05:00	00:04:36	-00:00:24
B9006 Culloden Road west of B9177 to Sir Walter Scott Drive	EB	00:05:17	00:04:39	-00:00:38
	WB	00:04:19	00:04:04	-00:00:15

Table 19.17: PM Peak High Growth Journey Time Comparison

High Growth Journey Time AM Peak		DM 2036	Opt 3 2036	Difference
A96 East of Smithton to Kessock Bridge	EB	00:08:11	00:08:23	+00:00:12
	WB	00:13:11	00:12:08	-00:01:04
A96 East of Smithton to Inshes	EB	00:09:58	00:08:14	-00:01:44
	WB	00:09:06	00:09:16	+00:00:10
A96 East of Smithton to A9 South via Inshes to Smithton scheme	EB		00:08:22	
	WB		00:08:18	
A96 East of Smithton to A9 South	EB	00:07:49	00:07:14	-00:00:35
	WB	00:06:28	00:05:44	-00:00:44
A96 East of Smithton to Millburn Road	EB	00:06:41	00:06:01	-00:00:40
	WB	00:05:12	00:04:26	-00:00:46
B9006 Culloden Road west of B9177 to B9006 west of Inshes	EB	00:05:07	00:05:00	-00:00:07
	WB	00:04:39	00:04:15	-00:00:24
B9006 Culloden Road west of B9177 to Sir Walter Scott Drive	EB	00:04:46	00:06:03	+00:01:16
	WB	00:04:25	00:04:05	-00:00:20

19.12.42 From the tables it is evident that the journey time on the A96 approach to Raigmore Interchange would reduce, with journey times for the A96 East of Smithton to Millburn Road route exhibiting a reduction of approximately one and a half minutes in the AM peak and approximately 50 seconds in the PM for Option 3 compared to the Do-Minimum. Similarly, the journey times between the A96 East of Smithton and the A9 South travelling through Raigmore Interchange, would reduce by approximately one and a half minutes in the AM peak period and by approximately 40 seconds in the PM Peak.

19.12.43 The option would provide a lower degree of journey time savings compared to Option 1 and 2 for the movements from the B9006 Culloden Road (West of the B9177) to West of Inshes Junction of approximately 30 seconds in both the AM and PM peak periods. There is a similar level of journey time savings when travelling between the B9006 Culloden Road and Sir Walter Scott Drive, with the exception of the eastbound direction during the PM peak period.

19.12.44 The constraint posed by the A9/A82 Longman Junction as a result of the at-grade arrangement, does appear to have an impact on selected movements for example movements from the A96 to the A9 Kessock Bridge. This is also affected to a lesser extent by the slight increase in traffic travelling northbound on the A9 between Raigmore Interchange and the A9/A2 Longman junction under Option 3, as the improved operation of Raigmore Interchange allows a higher level of traffic throughput compared to the Do-Minimum.

19.12.45 The operational performance of Option 3 exhibits some key some differences to the performance of the other options in the B9006 Culloden Road and Inshes areas. The provision of two lanes in each direction on the B9006 Culloden Road where it crosses the A9 due to the additional parallel structure, allows for greater flexibility in optimising the signals at the key A9 Diverge/Culloden Road/UHI Campus junction. This is made possible as the additional structure provides two lanes eastbound approaching the junction.

19.12.46 Nevertheless, during the AM peak period a persistent queue is apparent for traffic travelling westbound on the B9006 Culloden Road that extends back from the A9 Diverge/Culloden Road/UHI Campus junction. The level of queuing is slightly improved in terms of the extent and duration compared to the Do-Minimum situation, such that there would be no net detriment to the B9006 Culloden Road westbound traffic under Option 3.

19.12.47 The queuing on the A9 Southbound diverge slip road is carefully managed by the traffic signals at the A9 Diverge/Culloden Road/UHI Campus Junction under Option 3 such that it is accommodated within the length of the slip road itself for the majority of the AM peak period. At the height of the peak period under the maximum traffic levels the queue would extend to just beyond the full length of the slip road for very short instances.

19.12.48 Although the B9006 Culloden Road corridor would be under significant traffic pressures, the operational performance of Option 3 during the AM peak is well balanced across the remainder of the road network. A degree of queuing would occur on the Inshes Retail Park access northbound approach to the new junction on the B9006 Culloden Road as part of THC's Inshes Phase 2 proposals, although this would not be sufficient to adversely impact on access/egress to the petrol filling station.

19.12.49 During the PM peak period overall the road network has a sufficient level of operational performance to accommodate the forecast levels of traffic. In a similar manner to Option 1 there is a degree of persistent queuing evident on the Inverness College (UHI Campus) approach to the junction with B9006 Culloden Road in Option 3. There is also queuing evident on the Sir Walter Scott Drive approach to the upgraded Inshes Junction throughout the PM peak period, although it does not extend far enough to for a sufficient duration to impact on the relocated access to the Police headquarters.

19.12.50 Option 3 again would exhibit a degree of queuing on the Inshes Retail Park access northbound approach to the new junction on the B9006 Culloden Road as part of THC's Inshes Phase 2 proposals in the PM peak period, although it would not be of sufficient duration to have a significant impact on the petrol filling station access.

19.13 Summary of Performance Against Objectives

19.13.1 This section provides a summary of the performance of the proposed options against the relevant scheme objectives, based primarily on quantitative outputs extracted from the traffic models. The objectives for the scheme are:

1. To encourage more effective use of the road network hierarchy and thereby improve the operation of the network for longer distance and local journeys.

2. To contribute to The Highland Council's Development Plan aims for development east of the A9, and to complement the benefits arising from the dualling of the A96.

3. To improve safety for motorised and non-motorised users where the trunk and local road network interact.

4. To maximise opportunities for active travel and public transport connections arising from the road infrastructure improvements.

19.14 Objective 1

19.14.1 Objective 1 is to encourage more effective use of the road network hierarchy and thereby improve the operation of the network for longer distance and local journeys.

19.14.2 Under all of the Options, the road network hierarchy would be improved through the provision of the proposed option between the A9 and A96.

19.14.3 Option 1 would meet this objective as in both the AM and PM peak hours the secondary road network through the Smithton area would experience a reduction in traffic flows as local trips transfer onto the new connection between Inshes and Smithton to access South Inverness and the A9. As a result, the transport modelling assessment indicates that local traffic levels on the A96 passing through Raigmore Interchange would reduce in the westbound direction during the AM peak by 7%, and in the eastbound direction in the PM peak by 21%. Part of the reduction in traffic at this location would be through the removal of local traffic passing through the trunk road junctions at Raigmore Interchange, which would see a net decrease of 17% of local trips in the AM peak for westbound traffic, and 23% in the PM peak for eastbound traffic. Westbound traffic levels would also reduce on the B9006 Culloden Road overbridge of approximately 34% in both the AM and PM peaks.

19.14.4 Journey times between the A96 East of Smithton and the Milburn Road / Harbour Road junction would reduce by 27% in the AM peak and 17% in the PM peak in Option 1. In the opposite direction, journey times are anticipated to remain the same as the Do-Minimum in the AM peak and reduce by 18% in the PM peak. Option 1 would improve the operational performance of the local road network through the provision of an alternative route for local traffic travelling between Smithton and Culloden, Inshes and the areas to the South of Inverness, with improved operational performance anticipated on the B9006 Culloden Road, Harbour Road, Milburn Road and Sir Walter Scott Drive, and forecast reductions in traffic levels passing through the local Inshes junction. The forecast reduction of traffic on the Milburn Road and A96 approaches to Raigmore Interchange would contribute to an improvement in the operation of the junction itself by reducing the level of conflicting longer distance and local movements, leading to reductions in journey times for movements passing through the interchange.

19.14.5 The reduction in general traffic, local traffic and journey times through Raigmore Interchange would all contribute to Option 1 meeting Objective 1. However, the additional crossing of the A9 would lead to increases in conflicts on the local road network within the Inshes Retail Park area, particularly in the PM peak. There would be an increase in the level of traffic crossing the A9 to tie in to the proposed Inshes Phase 2 roundabout to access the retail park (Tesco/Aldi), with an increase in right turning vehicles taking priority over those exiting the retail park and Tesco, resulting in a persistent queue and a degree of unreleased vehicles (unmet demand from the car park). Option 1 would therefore impact on the operation of the local road network, with significant localised traffic impacts on the Dell of Inshes area and the U1267 Dell of Inshes Road. The option would also exhibit queuing at key pressure points during the AM peak period on the B9006 Culloden Road (WB) and the C1058 Caulfield Road North, with a degree of queuing also expected to occur on the B9006 Culloden Road (EB) approach to the A9 Diverge/Culloden Road/UHI Campus Junction.

19.14.6 Option 1 would have a similar impact during the PM peak period with a persistent queue at the Inverness College (UHI Campus) egress developing and a degree of unreleased vehicles (unmet demand) expected to build up within Inverness College (UHI Campus). A persistent queue is also anticipated to occur at the exit from the Tesco car park within the Inshes Retail Park with a degree of unreleased vehicles (unmet demand) evident within the Operational Models.

19.14.7 Similarly, Option 2 would meet this objective as in both the AM and PM peak hours the secondary road network through Smithton would experience a reduction in traffic flows as local trips transfer onto the new connection between Inshes and Smithton to access South Inverness and the A9. As a result, the transport modelling assessment indicates that local traffic levels on the A96 passing through Raigmore Interchange would reduce in the westbound direction during the AM peak by 10%, and in the eastbound direction in the PM peak by 21%. Part of the reduction in traffic at this location would be the result of the removal of local traffic passing through the trunk road junctions at Raigmore Interchange, which would see a net decrease of 24% of local trips in the AM peak for westbound traffic, and 24% in the PM peak for eastbound traffic. Westbound traffic levels would also reduce through the A9 Inshes junction, with a reduction on the B9006 Culloden Road overbridge of approximately 46% in the AM peak and 55% in the PM peak.

19.14.8 Option 2 would also reduce journey times between the A96 East of Smithton and the Milburn Road / Harbour Road junction by 27% in the AM peak and 17% in the PM peak. In the opposite direction, journey times would reduce by 9% in the AM peak and by 13% in the PM peak. This option would provide an alternative route for local traffic travelling between Smithton and Culloden, Inshes and the areas to the South of Inverness. This would lead to an improvement in the operational performance of the local road network through the reductions in traffic on B9006 Culloden Road, Harbour Road, Milburn Road and Sir Walter Scott Drive, and would reduce traffic levels passing through the local Inshes junction. These traffic reductions would be further enhanced by the introduction of the replacement slip roads at the A9 Southbound Inshes Junction, providing a connection from Option 2 onto the A9. The reduction in traffic on the Milburn Road and A96 approaches to Raigmore Interchange would contribute to an improvement in the operation of the junction itself by reducing the level of conflicting longer distance and local movements, leading to reductions in journey times for movements passing through the interchange.

19.14.9 Option 2 would impact the operation of the local road network, with significant localised traffic impacts on the Dell of Inshes area and the U1267 Dell of Inshes Road. The reduction in general traffic, local traffic and journey times through Raigmore Interchange all help this option to meet Objective 1, however, the additional crossing of the A9 would increase vehicle conflicts on the local road network within the Inshes Retail Park area, particularly in the PM peak. There would be an increase in the level of traffic crossing the A9 to tie in to the proposed Inshes Phase 2 roundabout to access the retail park (Tesco/Aldi), with an increase in right turning vehicles taking priority over those exiting the retail park and Tesco, resulting in a persistent queue and a significant level of unreleased vehicles (unmet demand from the car park). There would also be queuing on the proposed overbridge crossing the A9 as it approaches the Inshes Retail Park roundabout due to the high volumes of traffic travelling westbound in this option. This would increase the delay experienced by vehicles attempting to exit Tesco when compared to Option 1.

19.14.10 The connection to the slip roads, at the A9 Southbound Inshes junction, provided by Option 2 would increase the number of vehicles using the Inshes to Smithton scheme, putting pressure on the new signalised junction where the slip roads tie into the new connection between Inshes Retail Park and the B9006 Culloden Road. This would result in a degree of queuing on the southbound diverge. There would also be delays experienced by traffic travelling both east and westbound on the new connection between Inshes Retail Park and the B9006 Culloden Road as they approach the junction. The eastbound traffic would be primarily delayed due to traffic turning right onto the southbound merge from the new connection between Inshes Retail Park and the B9006 Culloden Road. As the eastbound approach to the junction is a single lane, vehicles turning right, which have to give way to westbound traffic, obstruct the straight through traffic, resulting in a queue. Westbound traffic would be delayed at the junction due to high volumes of traffic travelling in this direction. All of these impacts negatively affect how Option 2 performs against Objective 1.

19.14.11 The introduction of the new southbound slips would encourage traffic travelling via the A9 to use the southbound diverge to access Inverness College (UHI Campus), and the Inshes area and may increase conflicts with local traffic on B9006 Culloden Road and the C1058 Caulfield Road North. During the PM peak period, within the Inshes Retail Park a persistent queue is anticipated to develop at the exit from the Tesco car park with significant unmet demand evident.

19.14.12 Option 3 would also meet this objective as in both the AM and PM peak hours, the secondary road network through Smithton would experience a reduction in traffic flows as local trips transfer onto the new connection between the C1058 Caulfield Road North and the A96 Smithton Junction to access South Inverness and the A9. As a result, the transport modelling assessment indicates that local traffic levels on the A96 passing through Raigmore Interchange would reduce in the westbound direction during the AM peak by 5%, and in the eastbound direction in the PM peak by 13%. Part of the reduction in traffic at this location would be through the removal of local traffic passing through the trunk road junctions at Raigmore Interchange, which would experience a net decrease of 14% in the AM peak (westbound) and in the PM peak (eastbound).

19.14.13 Unlike the other two options, there would be a slight increase in the level of westbound traffic passing through the A9 Inshes Junction (via the B9006 Culloden Road overbridge) in Option 3. Traffic levels would increase by 4% in the AM peak and 5% in the PM peak, and by widening of the overbridge to provide 2 lanes in the eastbound direction the forecast increase in eastbound traffic of 51% in the AM peak and 30% in the PM peak would be accommodated.

19.14.14 Journey times between the A96 East of Smithton and the Milburn Road / Harbour Road junction would also reduce in Option 3, where a reduction of approximately 17% in the AM peak and 15% in the PM peak is anticipated. In the opposite direction, journey times would reduce by 10% in both the AM and PM peaks. This option would provide an alternative route for local traffic travelling between Smithton and Culloden, Inshes and the areas to the South of Inverness through the provision of the new connection between the C1058 Caulfield Road North and the A96 Smithton Junction. This would lead to an improvement in the operational performance of the local road network through the reduction in traffic on the B9006 Culloden Road, Tower Road and Millburn Road, although this option would increase traffic levels travelling to and from Culloden Road passing through the Inshes junction. The reduction in traffic on the Milburn Road and A96 approaches to Raigmore Interchange would contribute to an improvement in the operation of the junction itself by reducing the level of conflicting longer distance and local movements, leading to reductions in journey times for movements passing through the interchange.

19.14.15 However, as Option 3 does not provide an additional crossing of the A9 to the south of the existing overbridge, there would be increased traffic flows on the local road network around the southern tie in at the C1058 Caulfield Road North. Traffic levels would increase at this location in all three options, however the largest impact is evident in Option 3. The increased traffic levels on the C1058 Caulfield Road North and on the B9006 Culloden Road overbridge would put additional pressure on the local road junctions at the B9006 Culloden Road and the U1124 Caulfield Road junction, the A9 Diverge/Culloden Road/UHI Campus Junction and Inshes junction. During the PM peak period there would be a persistent queue at the Inverness College (UHI Campus) egress due to the high volumes of traffic on the B9006 Culloden Road. There would be some localised issues around the Inshes Phase 2 scheme, with some queuing on the Tesco Access Road and into the Tesco Petrol Station.

19.15 Objective 2

19.15.1 Objective 2 is to contribute to THC's Development Plan aims for development east of the A9, and to complement the benefits arising from the dualling of the A96.

19.15.2 THC have plans to develop land in Inverness to the East of the A9. The East Inverness development comprises a mix of commercial, industrial & residential properties as well as amenity land and greenspace.

19.15.3 Option 1 would contribute to THC's development aims as it would enable access to the proposed development to the East of the A9, connecting the development areas to local amenities within Inverness and areas further afield by linking the development area to the A9 and the A96. The new connection between Inshes and Smithton would provide an alternative route to the local road network for vehicles travelling from the east of Smithton to the Culloden and Inshes area, attracting traffic away from less appropriate residential routes within Smithton and Culloden.

19.15.4 Option 1 also complements the benefits that arise from the dualling of the A96 as it would have a positive impact on A96 journey times through the traffic reductions gained between the A96 Smithton Junction and Raigmore Interchange, and therefore contributes to the wider journey time benefits accrued as a result of the dualling of the A96. The new connection between Inshes and Smithton would improve the operation of Raigmore Interchange, and reduce the congestion on the eastern approach to the junction, reducing the journey time by approximately two minutes in the AM peak and 15 seconds in the PM peak, complementing the benefits arising from the dualling as it is anticipated to further improves the journey time into Inverness from the East.

19.15.5 Similarly, Option 2 would also contribute to THC's development aims as it would enable access to the proposed development to the East of the A9, providing a similar connection and benefits as those discussed above. The journey time savings experienced under Option 2 would also be very similar to those in Option 1, with reductions on the A96 Eastern approach to Raigmore Interchange of approximately two minutes in the in the AM peak and 15 seconds in the PM peak, complementing the benefits arising from the dualling as it further improves the journey time into Inverness from the East.

19.15.6 Option 3 would also contribute to THC's development aims as it would enable access to the proposed development to the East of the A9, providing a similar connection and benefits as those discussed above. The journey time savings experienced under Option 3 would again be very similar to those in Options 1 and 2, with anticipated reductions on the A96 Eastern approach to Raigmore Interchange of approximately one and a half minutes in the in the AM peak and 45 seconds in the PM peak. This would complement the benefits arising from the dualling as it further improves the journey time into Inverness from the East.

19.16 Objective 3

19.16.1 The main outcome of Objective 3 is to improve safety for motorised and non-motorised users where the trunk and local road network interact.

19.16.2 Option 1 would improve the operation of the secondary network along the B9006 Culloden Road corridor, with the anticipated reduction in traffic levels passing through the A9 Diverge/Culloden Road/UHI Campus Junction reducing the risk of queues extending along the A9 Southbound diverge slip road and on to the A9 itself. The safety concerns related to this queuing would be further alleviated through the provision of the additional auxiliary lane on the A9 Southbound carriageway between Raigmore Interchange and Inshes, which is common to all options. Option 1 would also reduce traffic levels crossing the A9 via the existing B9006 Culloden Road overbridge at Inshes which will also serve to reduce accident numbers and provide a safer environment for non-motorised users.

19.16.3 The traffic attracted to Option 1 would also result in a reduction in traffic levels on the local road network within the Smithton and Culloden residential areas, and this would be expected to reduce potential NMU conflicts with traffic and thus improve the safety environment for NMUs.

19.16.4 These benefits may be partly offset as the new connection between Inshes and Smithton may lead to a slight overall increase in vehicle kilometres travelled and therefore increase the opportunities for accidents to occur. The new connection between the C1058 Caulfield Road North and the A96 Smithton Junction in this option would also result in a route with a higher speed limit of 40 mph, and may be relatively free-flowing. This may therefore lead to the new route being perceived as less attractive than the existing corridor via the B9006 Culloden Road for NMUs.

19.16.5 Option 2 performs in exactly the same manner as Option 1, however the addition of the replacement slip roads at the A9 Southbound Inshes Junction would reduce the risk of queues extending along the A9 Southbound diverge and onto the A9 itself. The safety concerns related to this queuing would be further alleviated through the provision of the additional auxiliary lane on the A9 Southbound carriageway between Raigmore Interchange and Inshes.

19.16.6 As in Options 1 and 2, the traffic attracted to the new connection between the C1058 Caulfield Road North and the A96 Smithton Junction in Option 3 would result in a reduction in traffic levels on the local road network within the Smithton and Culloden residential areas, and this would reduce potential NMU conflicts with traffic and thus improve the safety environment for NMUs.

19.16.7 Again, the new connection between the C1058 Caulfield Road North and the A96 Smithton Junction in this option would result in a route with a higher speed limit of 40 mph, and be relatively free-flowing. This may therefore lead to the new route being perceived as a less attractive than the existing corridor via the B9006 Culloden Road that has well established NMU facilities.

19.16.8 Option 3 is however the only option to return an accident benefit for the COBA-LT assessment. As this option does not cross the A9 to the south of the existing overbridge, the additional vehicles-kilometres associated with the new road space are not as high as the other options, which has resulted in accident dis-benefits in Options 1 and 2. The benefits associated with the reduced traffic levels on the A96 approach to Raigmore Interchange and the A9 between Raigmore Interchange and the A9 Inshes Junction, which have observed accident rates that are lower than the national average for A Class roads only marginally outweighs the dis-benefits generated by the proposed option, and therefore only results in a marginal accident benefit.

19.17 Objective 4

19.17.1 The main outcome for Objective 4 is to maximise opportunities for active travel and public transport connections arising from the road infrastructure improvements.

19.17.2 An NMU strategy will not be completed until Stage 3 and therefore specific opportunities for active travel have not yet been finalised. However, it is anticipated that the reduction in traffic passing through Raigmore as a result of the implementation of all three options would result in an improvement in bus journey times travelling to and from Inverness via the A96, and would have a positive impact on opportunities for public transport services connecting Inverness and the growth area to the East.

19.17.3 All options provide a single carriageway connection between Inshes and Smithton that would provide opportunities for new public transport routes, and opportunities to expand active travel links between Inverness and the growth area to the East including Inverness College (UHI Campus). The connection between Inshes and Smithton would also provide access to the planned areas of development in Inverness East, and provide additional opportunities for enhanced public transport connections and active travel links to the development area.

19.17.4 The Inshes to Smithton scheme would sever a core path and a national cycle route in the area, although this could be mitigated (at least partly) through the provision of crossing facilities between the areas lying either side of the new connection between the C1058 Caulfield Road North and the A96 Smithton Junction. Options 1 and 2 would also cause increased traffic and disruption on a popular active travel route, along the U1267 Dell of Inshes Road, which is a dis-benefit to these options. Option 3 would increase traffic on the B9006 Culloden Road corridor, including the B9006 Culloden Road overbridge and this may detract from the attractiveness of the corridor to active travel modes.or public transport.

19.18 References

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Moray Firth Transport Model Traffic Forecast Report, Jacobs UK (On behalf of Transport Scotland), 2016

20. Economic Assessment

20.1 Introduction

20.1.1 This chapter presents details of the economic appraisal for the three proposed options. It is based on the comparison of the Do-Minimum (i.e. without a proposed option) and each of the three proposed options as the Do-Something scenarios, including changes in traffic flows, average journey times, vehicle speeds and travel distance. A road-based assessment has been undertaken that comprises Cars, Light Goods Vehicles (LGV's), Medium Goods Vehicles (MGV's) and Heavy Goods Vehicles (HGV's) vehicle types.

20.1.2 The economic evaluation of each of the proposed options has been carried out using the Department for Transport's (DfT) Transport User Benefit Appraisal (TUBA) software version 1.9.7. The TUBA software has been used to calculate the user benefits for the proposed options based on travel time savings and vehicle operating costs savings. The necessary inputs to the TUBA software were generated from the Moray Firth Transport Model (MFTM) for the Do-Minimum and the three Do-Something option scenarios.

20.1.3 The impact that the proposed options have on accident benefits in the study area has been assessed using the DfT's COst and Benefit to Accidents – Light Touch (COBALT) software version 2013.02, in conjunction with the July 2016.1 WebTAG parameters file.

20.1.4 In accordance with Her Majesty's Treasury 'Green Book' guidance and DMRB guidance, the benefits stream is calculated over a 60-year appraisal period. The summed monetised units of the final Transport Economic Efficiency (TEE) benefits calculated are expressed in 2010 prices and values, and for each appraisal year are discounted to 2010 at 3.5 per cent per annum for the first 30 years, and at 3.0 per cent per annum thereafter.

20.2 Proposed Option Costs

20.2.1 The target construction cost estimates for the proposed options are detailed in Table 20.1 and were based on 2015 Q2 prices. It should be noted that spot costs only have been used for the purposes of the economic appraisal, however in line with standard practice for this stage of assessment, cost ranges are used as set out in Chapter 3.

20.2.2 The cost estimates exclude VAT and construction inflation, as the costs are input to TUBA in the 'factor cost unit of account' that does not include indirect taxation. The capital costs of the Do-Minimum scenario have been assumed to be zero at this stage of the assessment process.

20.2.3 The construction period was assumed to commence in 2019 and end in 2021.

20.2.4 As noted previously in Chapter 19, the cost estimates differ for the A variant and the B variant. Although the overall impact in traffic modelling terms was not significant enough to warrant specifically modelling both variants, the economic assessment was undertaken for both variants due to the difference in estimated costs. It should be noted that the benefits in the economic assessments for both the A variant and the B variant presented in the following sections were derived from the traffic modelling undertaken for the A variant only.

Table 20.1: Option Cost Estimates

Option	A variant Cost (£000s)	B variant Cost (£000s)
Option 1	£34,662.2	£37,361.6
Option 2	£42,865.7	£45,531.3
Option 3	£24,521.3	£27,232.2

20.3 Accident Benefits

20.3.1 As noted in Section 20.1 the accident assessment has been undertaken using the COBALT software, with the potential accidents benefits of each of the three proposed options evaluated against the Do-Minimum scenario.

20.3.2 The COBALT software calculates the number of accidents that would occur in the Do-Minimum and each option using either a set of default accident rates for different road classes applied to both scenarios, or using a set of locally derived accident rates to apply to the Do-Minimum scenario. The default accident rates are national rates derived for the different road classes using UK wide accident data records, and are not specific to the area. This could result in an over or under estimation in the number of casualties saved and therefore the accident benefits.

20.3.3 As a result, the accident benefits for the proposed options have been evaluated using both default rates and a set of locally derived rates applied to the existing A9 and A96 routes. It should be noted that the Do-Minimum includes the proposed A96 Dualling Inverness to Nairn (including Nairn Bypass) scheme, which would provide a dual carriageway route from the Inverness Business and Retail Park Roundabout to the east of Nairn. As this scheme has not yet been constructed, the links that comprise the upgraded section of the A96 have been assessed using a default accident rates in both the local accident and default accident assessment.

20.3.4 The software calculates the number of Fatal, Serious and Slight casualties that would occur on each link using the defined accident rates, in conjunction with the traffic flows contained in the Do-Minimum and the proposed options. The difference between each scenario is calculated and presented as the accident benefit. The software also outputs the difference in the number of casualties compared to the Do-Minimum over the 60-year appraisal period. This has been divided by 60 to give an annual difference across all links included in the COBALT assessment.

20.3.5 Table 20.2 and Table 20.3 show the number of casualties predicted to occur in the Do-Minimum and the three proposed options, and difference in the number of casualties compared to the Do-Minimum, under Low traffic growth and High traffic growth respectively. This assessment was based on applying the locally derived accident rates to the existing A9 and existing sections of the A96 route.

Table 20.2: Average number of casualties saved per year – Inshes to Smithton - Low Growth – Local Accident Assessment

Low Growth	Option 1			Option 2			Option 3		
	Fatal	Serious	Slight	Fatal	Serious	Slight	Fatal	Serious	Slight
DM Casualties (60 Years)	70	942	8,877	70	942	8,877	70	942	8,877
Option Casualties (60 Years)	70	952	8,972	70	953	8,983	70	939	8,845
Casualties Saved (60 Years)	-0.4	-9	-96	-0.8	-11.1	-106.3	0.3	3.2	32
Average Casualties Saved	-0.01	-0.15	-1.60	-0.01	-0.19	-1.77	0.01	0.05	0.53

Table 20.3: Average number of casualties saved per year – Inshes to Smithton - High Growth – Local Accident Assessment

High Growth	Option 1			Option 2			Option 3		
	Fatal	Serious	Slight	Fatal	Serious	Slight	Fatal	Serious	Slight
DM Casualties (60 Years)	73	987	9,274	73	987	9,274	73	987	9,274
Option Casualties (60 Years)	74	1,001	9,413	74	1,002	9,409	73	985	9,248
Casualties Saved (60 Years)	-0.7	-14	-139	-1	-14	-135	0.3	2.4	26
Average Casualties Saved	-0.01	-0.23	-2.32	-0.02	-0.23	-2.25	0.01	0.04	0.43

20.3.6 The monetised cost of accidents and the resulting benefits based on the number of accident casualties saved from the accident appraisal for the Low and High traffic growth scenarios for the three options are shown in Table 20.4 and Table 20.5 respectively.

Table 20.4: Accident Benefits (60 Years) Inshes to Smithton - Low Growth– Local Accident Assessment

Low Growth	Option 1 (£000)	Option 2 (£000)	Option 3 (£000)
Total DM Accident Cost	£356,967	£356,967	£356,967
Total Option Accident Cost	£360,427	£361,150	£355,476
Accident Benefit	-£3,460	-£4,183	£1,491

Table 20.5: Accident Benefits (60 Years) Inshes to Smithton - High Growth– Local Accident Assessment

High Growth	Option 1 (£000)	Option 2 (£000)	Option 3 (£000)
Total DM Accident Cost	£372,992	£372.992	£372,992
Total Option Accident Cost	£378,102	£378,264	£371,751
Accident Benefit	-£5,110	-£5,272	£1,241

20.3.7 The results for both Options 1 and 2 show slight dis-benefits from the accident assessment that has been undertaken. In both options this is driven by the additional length of road space that the options provide, and with the traffic volumes that are forecast to use the options, increases the total vehicle-kilometres for the Option 1 and Option 2 assessments. This additional increase in vehicle-kilometres travelled is sufficient to offset the accident savings that, for example, would be generated from the reduction in traffic levels on the A96 approach to Raigmore Interchange under each of the options.

20.3.8 Tables 20.4 and 20.5 show that Option 3 provides a positive level of accident benefits. In contrast to Options 1 and 2, the shorter length of Option 3 results in a lower level of additional vehicle-kilometres that would be travelled. The accident benefits that would arise from the reduction in traffic for example on the A96 approach to Raigmore Interchange therefore remain sufficient to produce positive accident benefits overall for Option 3.

20.3.9 As noted previously, an accident assessment using default accident rates applied to the existing A9 and A96 has also been undertaken. As the default accident rate is higher than the locally derived accident rates, this assessment produces a higher level of accident benefits. The difference in the number of casualties compared to the Do-Minimum for the assessment using default accident rates under both Low and High traffic growth are shown below in Table 20.6 and Table 20.7 respectively.

Table 20.6: Average number of casualties saved per year – Inshes to Smithton - Low Growth – Default Accident Assessment

Low Growth	Option 1			Option 2			Option 3		
	Fatal	Serious	Slight	Fatal	Serious	Slight	Fatal	Serious	Slight
DM Casualties (60 Years)	73	966	9,034	73	966	9,034	73	966	9,034
Option Casualties (60 Years)	74	974	9,118	74	975	9,126	73	961	8,992
Casualties Saved (60 Years)	-0.2	-8	-84	-0.6	-9	-93	0.5	4.8	42
Average Casualties Saved	0.00	-0.13	-1.40	-0.01	-1.52	-1.55	0.01	0.08	0.70

Table 20.7: Average number of casualties saved per year – Inshes to Smithton - High Growth – Default Accident Assessment

High Growth	Option 1			Option 2			Option 3		
	Fatal	Serious	Slight	Fatal	Serious	Slight	Fatal	Serious	Slight
DM Casualties (60 Years)	77	1,014	9450	77	1,014	9,450	77	1,014	9,450
Option Casualties (60 Years)	77	1,026	9,574	77	1,026	9,565	76	1,010	9,414
Casualties Saved (60 Years)	-0.4	-12	-124	-0.6	-11	-115	0.5	4	36
Average Casualties Saved	-0.01	-0.20	-2.05	-0.01	-0.18	-1.92	0.01	0.07	0.60

20.3.10 The monetised cost of accidents and the resultant benefits derived from the number of accident casualties saved using the default accident rates for the Low and High traffic growth scenarios for the three options are shown in Table 20.8 and Table 20.9 respectively.

Table 20.8: Accident Benefits (60 Years) Inshes to Smithton - Low Growth– Default Accident Assessment

Low Growth	Option 1 (£000)	Option 2 (£000)	Option 3 (£000)
Total DM Accident Cost	£365,140	£365,140	£365,140
Total Option Accident Cost	£368,020	£368,617	£363,136
Accident Benefit	-£2,878	-£3,477	£2,004

Table 20.9: Accident Benefits (60 Years) Inshes to Smithton - High Growth– Default Accident Assessment

High Growth	Option 1 (£000)	Option 2 (£000)	Option 3 (£000)
Total DM Accident Cost	£382,130	£382,130	£382,130
Total Option Accident Cost	£386,441	£386,361	£380,381
Accident Benefit	-£4,310	-£4,231	£1,749

20.3.11 The accident benefits differ from the assessment using locally derived accident rates, as the default accident rate applied to the existing A9 and A96 in the Do-Minimum scenario is higher than the local accident rates. This results in a higher set of casualty numbers being calculated for the Do-Minimum scenario and hence a higher accident cost.

20.4 TUBA Assessment

20.4.1 The required inputs to the TUBA software comprise traffic demand matrices, and time and distance (and if relevant toll) 'skim' matrices for the Do-Minimum and proposed Options that were extracted from the MFTM. The scheme benefits are calculated by comparing, for each pair of transport model zones, the total costs of travel (including travel time, vehicle operating costs and tolls) for the Do-Minimum and the proposed option scenarios.

20.4.2 The calculated TUBA benefits from the Low and High traffic growth scenarios are summarised in Table 20.10 and Table 20.11 respectively.

Table 20.10: TUBA Results – Low Growth

TUBA Benefits	Option 1 £000s	Option 2 £000s	Option 3 £000s
Travel Time	£140,641	£140,360	£60,510
Vehicles Operating Costs	£9,990	£9,392	£7,954
Indirect Tax	-£2,359	-£2,023	-£1,852
Greenhouse Gases	£1,064	£939	£787
Present Value Benefits	£149,336	£148,668	£67,399

Table 20.11: TUBA Results – High Growth

TUBA Benefits	Option 1 £000s	Option 2 £000s	Option 3 £000s
Travel Time	£200,906	£187,812	£92,475
Vehicles Operating Costs	£11,376	£11,445	£8,853
Indirect Tax	-£2,399	-£2,467	-£1,846
Greenhouse Gases	£1,085	£1,175	£786
Present Value Benefits	£210,968	£197,966	£100,268

20.4.3 The tables show that all three options would produce positive levels of travel benefits. Options 1 and 2 would provide higher benefits than Option 3, as both these options would result in higher reductions in traffic on the key sections of the A96 and A9 at Raigmore Interchange. Although Option 2 would reduce traffic on the A96 approach to and passing through Raigmore Interchange by the higher amount, the constraint posed by the A9/A82 Longman Junction would serve to erode more of the potential benefits accruing under Option 2. As Option 2 would improve the operation of Raigmore Interchange and allow for a greater level of traffic throughput, this would also increase pressure on the A9 Northbound approach to the A9/A82 Longman Junction and thus a higher level of traffic would be affected by the A9/A82 Longman Junction acting as a constraint and the additional delays that would result.

20.4.4 A further economic sensitivity test has been undertaken to improve the operation of the A9/A82 Longman Junction as discussed in section 20.6 below.

20.5 Key Economic Assessment Results

20.5.1 The results of the economic assessment are summarised in Table 20.12 and Table 20.13 respectively for the Low and High traffic growth scenarios.

Table 20.12: Economic Assessment Results – Local Accident Rates - Low Growth

Impact	Monetary Value in 2010 prices A variant Costs			Monetary Value in 2010 prices B variant Costs		
	Option 1 £000s	Option 2 £000s	Option 3 £000s	Option 1 £000s	Option 2 £000s	Option 3 £000s
Present Value of Benefits (TUBA)	£149,336	£148,668	£67,399	£149,336	£148,668	£67,399
Local Accident Benefits (COBALT)	-£3,460	-£4,182.5	£1,491	-£3,460	-£4,182.5	£1,491
Total Present Value of Benefits	£145,876	£144,485.5	£68,890	£145,876	£144,485.5	£68,890
Present Value of Costs	£27,555	£34,076	£19,493	£29,701	£36,195	£21,648
Net Present Value	£118,321	£110,409.5	£49,397	£116,175	£108,290.5	£47,242
Benefit to Cost Ratio	5.3	4.2	3.5	4.9	4.0	3.2

Table 20.13: Economic Assessment Results – Local Accident Rates - High Growth

Impact	Monetary Value in 2010 prices A variant Costs			Monetary Value in 2010 prices B variant Costs		
	Option 1 £000s	Option 2 £000s	Option 3 £000s	Option 1 £000s	Option 2 £000s	Option 3 £000s
Present Value of Benefits (TUBA)	£210,968	£197,966	£100,268	£210,968	£197,966	£100,268
Local Accident Benefits (COBALT)	-£5,110	-£5,271.7	£1,241	-£5,110	-£5,271.7	£1,241
Total Present Value of Benefits	£205,858	£192,694.3	£101,509	£205,858	£192,694.3	£101,509
Present Value of Costs	£27,555	£34,076	£19,493	£29,701	£36,195	£21,648
Net Present Value	£178,303	£158,618.3	£82,016	£176,157	£156,499.3	£79,861
Benefit to Cost Ratio	7.5	5.7	5.2	6.9	5.3	4.7

20.5.2 The tables show that the proposed options would all generate a positive Net Present Value, even under the low traffic growth scenario. The overall Benefit to Cost Ratio (BCR) would be positive for all options in both the low and high growth scenario, with Option 1 ranging between 4.9 and 7.5, Option 2 between 4.0 and 5.7 and Option 3 between 3.2 and 5.2.

20.5.3 Based on the results in Tables 20.12 and 20.13, it is evident that all options would provide high value for money outcomes, with the level of benefits that would accrue being significantly higher than the estimated costs.