OXFORDSHIRE COUNTY COUNCIL

Bicester Transport Modelling

Peripheral Routes Assessment Technical Note
Cherwell Local Plan Main Modifications to Growth for Bicester

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1 Introduction

BACKGROUND

1.1 WYG were commissioned by Oxfordshire County Council to complete a quantitative assessment of the five options for peripheral route improvements at Bicester. The results were presented in the report: Bicester Peripheral Route Assessment Report (A084107-02 Rev3 Jan14). OCC have since commissioned WYG to provide information from the Bicester SATURN model to assess the impact of the increased growth proposals being considered for the Local Plan Main Modifications. The headline traffic impact and broad brush economic assessment of the development and link options is required to enable County Council officers to feedback to Cherwell District Council on whether there are any transport reasons why the growth should not happen at this speed and, if it is to happen, what would be the highway network impacts of this level of growth, what improvements will be required to the peripheral routes to keep these functioning in the intended way, and would this level of growth trigger the need for a new link road. Initial results were included in the report: Cherwell Local Plan Revised Growth for Bicester Peripheral Routes Assessment Technical Note (A084107-07 rev2 Aug14). This report updates the assessment using the final numbers for the Main Modifications to the Local Plan.

2 Revised Development Details

2.1 Cherwell District Council submitted its Local Plan in January this year which included 16,750 new homes. The Local Plan Examination was suspended as the Inspector ruled that the Plan should have taken into account Cherwell's unmet need as identified through the Strategic Market Housing Assessment, which should allow for 22,800 new homes. The District Council therefore needs to assess how to deliver the additional 6,000 homes within the District, including the transport impact of this growth within Modifications to the Local Plan. These results are required to be presented to the Inspector in order to meet the deadlines for consultation and approvals prior to the Examination re-opening in December 2014.

2.2 Bicester is likely to take an additional 2,000 homes by increasing the rate of delivery at North West Bicester, small increases in the development at South West Bicester and tripling the size of housing growth at South East Bicester. In addition there are proposals for increased employment growth.

2.3 Due to the nature and location of the Upper Heyford development, assessment is being carried out using the Central Oxfordshire Transport Model in order to fully assess its impact over the wider area. As such, it will be included in this report as part of the sensitivity testing only.

2.4 Details of the housing and employment sites to be tested are included in **Table 1** below:

Table 1: Final Housing and Employment Figures for the Main Modifications to the Local Plan

Plan Period Total Supply 2011 - 2031	Housing	Employment	
	Dwellings	Hectares (unless otherwise stated)	Jobs Estimate
NW Bicester (Bicester 1)	3293	10	3000
Graven Hill (Bicester 2)	2100	26	2000
SW Bicester Phase 1 (Bicester 3)	1742	-	-
SW Bicester Phase 2 (Bicester 3)	726	-	-
Bic Business Park (Bicester 4)	-	29.5	6000
Bicester Gateway (Bicester 10)	-	18	3500
Land at NE Bicester (Bicester 11)	-	15	1000
SE Bicester (Bicester 12)	1500	40	3000
Gavray Drive (Bicester 13)	300	-	-
Talisman Road (approved site)	125	-	-
Upper Heyford	2361	120,000 sqm	1500

3 Network and Matrix Development

3.1 Saturn networks and matrices were updated from the existing 2012 Bicester Saturn model in order to provide traffic forecasts for the North West Bicester Eco Development. Further model runs were required by the Highways Agency in order to provide traffic forecasts for the M40 Junction 9 in a number of forecast scenarios. Details of this work are included in the report: Bicester M40J9 Scenarios Technical Note (A084107-05 May14).

3.2 The matrices produced for the NW Bicester development were updated to include the revised development assumptions detailed in **Table 1**. These matrices did not include the figures outlined for Upper Heyford. However, additional matrices including the Upper Heyford development were constructed to allow a sensitivity test of the route options to be assessed to be carried out.

3.3 The matrices were assigned to the networks produced for the NW Bicester assessments with the amendment of the addition of zone connectors for the Upper Heyford Development. The infrastructure changes included to update the network from the 2012 base are given below:

i. Vendee Drive (the south west link road);

ii. M40 Junction 9 phase 1;

iii. Town centre access improvements;

iv. Changes implemented as part of the town centre redevelopment;

v. Traffic calming and 30mph speed limit on Middleton Stoney Road;

vi. Changes at the Pingle Drive junction, A41 / Oxford Road (ESSO) junction and along the A41 corridor (as part of the mitigation measures from Tesco's move and Bicester Village phase 4);

vii. Park & ride entrance / exit at the junction of Vendee Drive and the A41;

viii. A4095 / B4100 junction alterations(as part of NW Bicester exemplar site);

ix. Alterations to the A41 / London Road (Rodney House) junction(as part of Graven Hill mitigation);

x. M40 Junction 9 phase 2.

xi. Development access and infrastructure associated with North West Bicester (BICESTER 1), Graven Hill (BICESTER 2), South West Bicester phase 2 (BICESTER 3), Bicester Business Park (BICESTER 4), Town centre redevelopment phase 2 (BICESTER 6), RAF Bicester (BICESTER 8), Bicester Gateway (BICESTER 10), North East Bicester Business Park (BICESTER 11) including the care home and business park adjacent to this site with existing planning permission and South East Bicester (BICESTER 12);

xii. London Road crossing closed permanently to through traffic[1];

xiii. Charbridge Lane level crossing replaced by an overbridge;

xiv. Inclusion of the M40 Junction 10 pinch point scheme; and

xv. Results from an Arcady junction assessment for the A4095/ B4100 Banbury Road roundabout junction were input into the SATURN network in order to accurately reflect traffic conditions at the junction.

3.4 Minor amendments were also made in the networks to the traffic signal timings at M40 junction 9 and M40 Junction 10 in reaction to the revised traffic flows through these junctions. Matrices and networks were produced for the AM and PM peak periods. Assignments were carried out using the above matrices to provide the reference case options for comparing the peripheral routes scenarios.

3.5 The networks were updated to include the three route options to be tested: Route 1b, Route 2c and Route 3 as detailed in the Bicester Peripheral Route Assessment Report.

3.6 Where the NW Bicester development has been included in more detail since the initial peripheral routes assessments, Route 1b would now cross the development. This would not be a desirable route. As such, based on discussion with OCC, the southern tie in of Route 1b has been realigned to the west of the NW Bicester development on the B4030 rather than connecting into the A4095 Howes Lane/Middleton Stoney Road Roundabout. A network plot showing the realigned route is given in **Figure 1**.

[1] The worst case scenario has therefore been modelled i.e. full closure of the crossing.

3.7 The modelled scenarios (for each peak period) are therefore:

Main Scenarios:

1. 2031 Final Main Modification Local Plan Growth;
2. 2031 Final Main Modification Local Plan Growth with Route 1b;
3. 2031 Final Main Modification Local Plan Growth with Route 2c;
4. 2031 Final Main Modification Local Plan Growth with Route 3;

Additional Sensitivity Testing Scenarios (See Section 7):

5. 2031 Final Main Modification Local Plan Growth including Upper Heyford;
6. 2031 Final Main Modification Local Plan Growth with Route 1b including Upper Heyford;
7. 2031 Final Main Modification Local Plan Growth with Route 2c including Upper Heyford; and
8. 2031 Final Main Modification Local Plan Growth with Route 3 including Upper Heyford.

4 Forecast Growth Implications

4.1 As discussed above, the local plan growth represents a significant increase in housing and employment in the Bicester area. As such, it is recognised that this will have a corresponding increase in person trips once the developments are in place.

4.2 **Table 2** below gives the modelled Saturn network summary statistics for the AM and PM peak hours for the 2012 base model and Scenario 1: 2031 Final Main Modification Local Plan Growth.

Table 2: AM Peak Model Network Summary Statistics

Peak Hour:	**AM**		**PM**	
Option:	**2012**	**Scenario 1 No New Link Road**	**2012**	**Scenario 1 No New Link Road**
Trip Matrix Total (PCU)	24930	32817	26150	36136
Total Travel Time (PCU Hrs)	3,085	3,939	3,164	4,761
Total Travel Distance (PCU Kms)	237,565	268,447	243,630	294,787
Average Speed (Kph)	77.0	68.1	77.0	61.9
Over Capacity Queues PCU (Hrs)	220	369	186	688

4.3 As can be clearly seen from **Table 2**, there are significant increases in number of trips in Scenario 1. This leads to an increase in total travel time, total travel distance and over capacity queues and a decrease in average speed.

4.3.1 Comparisons have been made for the demand flow differences between the 2012 base model and Scenario 1 for each peak. These comparisons show a general increase in traffic across the modelled area with Scenario 1. Some decreases in traffic are also seen are due to rerouting of vehicles in response to changes in the network such as starvation of vehicles to downstream

junctions where congestion has increased or changes in the road network e.g. the closure of the London Road level crossing.

4.4 The number of links and turns at junctions with Volume over Capacity (V/C) ratios of 85% or over and 100% or over are summarised in the **Table 3** below for 2012 and Scenario 1.

Table 3: **No of Modelled Links and Turns with V/C 85% or Over & 100% or Over**

Option		85%		100%	
		Link	Turns	Link	Turns
AM	2012	15	20	7	13
	Scenario 1 No New Link Road	48	83	18	43
PM	2012	19	22	9	15
	Scenario 1 No New Link Road	72	125	37	84

4.5 As would be expected, the increased number of PCU trips in the network leads to an increase in the number of links and turns that become congested in Scenario 1.

4.6 The inclusion of the North West Bicester development leads to no junction or links flagged as over 85% (and hence 100%) on the western corridor in Scenario 1. The exception to this is the junction of A4095 Lords Lane/B4100 Banbury Road. This junction is being investigated separately as part of the North West Bicester Transport Assessment and, as such, no improvements to this junction have currently been included in the models.

4.7 The over capacity links and turns at junctions within the Bicester area itself are therefore on the southern, northern and eastern corridors around the town. It would not be prudent to try to enhance central areas of Bicester town in order to improve congestion conditions for vehicular traffic as this would likely lead to an additional increase in traffic through areas where a decrease in traffic is considered more desirable. Therefore, further study into possible improvements to the southern, northern and eastern corridors such as Boundary Way can be considered advisable.

5 Model Comparisons

5.1 This section details the results of the comparisons between the potential peripheral route link options being assessed. **Tables 4 and 5** give the summary network statistics for each option by peak period.

Table 4: **AM Peak Model Network Summary Statistics**

Option:	**2012**	**Scenario 1 No New Link Road**	**Scenario 2 R1b**	**Scenario 3 R2c**	**Scenario 4 R3**
Total Travel Time (PCU Hrs)	3,085	3,939	3,891	3,800	3,726
Total Travel Distance (PCU Kms)	237,565	268,447	268,661	266,905	267,033
Average Speed (Kph)	77.0	68.1	69.0	70.2	71.7
Over Capacity Queues PCU (Hrs)	220	369	334	267	204

Table 5: **PM Peak Model Network Summary Statistics**

Option:	**2012**	**Scenario 1 No New Link Road**	**Scenario 2 R1b**	**Scenario 3 R2c**	**Scenario 4 R3**
Total Travel Time (PCU Hrs)	3,164	4,761	4,693	4,725	4,461
Total Travel Distance (PCU Kms)	243,630	294,787	295,168	293,150	293,732
Average Speed (Kph)	77.0	61.9	62.9	62.0	65.8
Over Capacity Queues PCU (Hrs)	186	688	629	696	440

5.2 As can be seen from **Tables 4 and 5** above, the main modification to the local plan growth with no route option is generally the worst performing option in terms of both over capacity queuing, average speed and travel time. As discussed in the previous section, this is a significant increase over the 2012 levels.

5.3 Of the Peripheral Route options, Route 3 for both peaks performs best in these same three areas.

5.4 Route 2c has the lowest total travel distance of the peripheral routes options.

5.5 **Tables 6 and 7** give link flows in PCUs on key links across the network for each of the main scenarios:

Table 6: **AM Peak Modelled Scenario Link Demand Flows (PCUs)**

Link	Scenario:	Scenario 1 No New Link Road	Scenario 2 R1b	Scenario 3 R2c	Scenario 4 R3
A41 Between M40 and Wendlebury Road	NEB	2056	2084	2489	2577
	SWB	890	867	962	1180
Vendee Drive	NWB	245	202	282	270
	SEB	202	202	294	256
Middleton Stoney Road (East of Vendee Drive)	EB	641	568	512	382
	WB	491	472	478	502
NW Bicester Development Link Road	NEB	418	382	264	242
	SWB	454	384	421	400
A4095 (West of Banbury Road)	EB	637	570	489	427
	WB	412	406	388	361
A4095 (West of A4421)	EB	969	826	903	886
	WB	814	469	742	669
A4421 Skimmingdish Lane	SEB	1598	1577	1572	1569
	WB	622	614	560	531
A4421 Wretchwick Way	NEB	541	503	621	585
	SWB	499	469	507	507
A41 (East of Oxford Road)	EB	2089	2059	1514	1358
	WB	1948	1926	1142	1321
Kings End	NB	1012	963	1305	1410
	SB	1072	1081	1063	1052
Field Street	NB	1300	1239	1368	1357
	SB	1000	985	966	961
Banbury Road (North of Field Street)	NB	340	349	337	336
	SB	314	323	328	305
Buckingham Road (North of Field Street)	NB	964	893	1035	1027
	SB	690	666	642	662
Route 1b North West Link (South of Bucknell Rd)	NEB	NA	296	NA	NA
	SWB	NA	237	NA	NA
Route 2c (South of Graven Hill)	EB	NA	NA	670	NA
	WB	NA	NA	732	NA
Route 3 (South of Graven Hill)	EB	NA	NA	NA	1043
	WB	NA	NA	NA	768

Table 7: **PM Peak Modelled Scenario Link Demand Flows (PCUs)**

Link	Scenario:	Scenario 1 No New Link Road	Scenario 2 R1b	Scenario 3 R2c	Scenario 4 R3
A41 Between M40 and Wendlebury Road	NEB	1288	1263	1574	1590
	SWB	2170	2152	2358	2307
Vendee Drive	NWB	569	588	780	786
	SEB	428	435	961	672
Middleton Stoney Road (East of Vendee Drive)	EB	1106	1037	1025	1007
	WB	546	517	574	514
NW Bicester Development Link Road	NEB	657	531	425	409
	SWB	362	338	384	312
A4095 (West of Banbury Road)	EB	621	414	400	397
	WB	438	481	382	340
A4095 (West of A4421)	EB	445	175	333	334
	WB	1511	1558	1415	1397
A4421 Skimmingdish Lane	SEB	996	984	842	829
	WB	1635	1633	1501	1501
A4421 Wretchwick Way	NEB	723	670	670	639
	SWB	458	474	595	585
A41 (East of Oxford Road)	EB	2127	2078	1122	1242
	WB	1973	1938	1176	1091
Kings End	NB	1131	1040	1527	1470
	SB	1132	1109	1061	1069
Field Street	NB	1369	1333	1396	1372
	SB	1259	1163	946	1034
Banbury Road (North of Field Street)	NB	653	606	657	652
	SB	449	495	450	463
Buckingham Road (North of Field Street)	NB	943	902	941	922
	SB	1037	844	699	773
Route 1b North West Link (South of Bucknell Rd)	NEB	NA	341	NA	NA
	SWB	NA	198	NA	NA
Route 2c (South of Graven Hill)	EB	NA	NA	1023	NA
	WB	NA	NA	685	NA
Route 3 (South of Graven Hill)	EB	NA	NA	NA	959
	WB	NA	NA	NA	874

5.6 The demand flow differences between scenarios for each peripheral route option have been studied. In all cases, these show a general decrease in traffic within the Bicester urban area doe to rerouting of traffic onto the peripheral route included.

5.7 Routes 2c and 3 give significant reductions on the A41 (East of Oxford Road). Routes 2c and 3 give the largest increases on Kings End northbound, although the southbound flows on this link remains largely static in all options.

5.8 Field Street remains largely unchanged in all options. This is likely due to the vehicles using this link having a trip end near to the link thus limiting the routing alternatives.

5.9 The number of links and turns at junctions with Volume over Capacity (V/C) ratios of 85% or over and 100% or over are given in **Tables 8 and 9** below for each scenario. A green shaded cell indicates the best performing option:

Table 8: **No of Modelled Links and Turns with V/C 85% or Over & 100% or Over (AM Peak)**

Option	85%		100%	
	Link	Turns	Link	Turns
2012	15	20	7	13
Scenario 1 No New Link Road	48	83	18	43
Scenario 2 R1b	47	78	19	45
Scenario 3 R2c	47	82	18	45
Scenario 4 R3	42	72	17	37

Table 9: **No of Modelled Links and Turns with V/C 85% or Over & 100% or Over (PM Peak)**

Option	85%		100%	
	Link	Turns	Link	Turns
2012	19	22	9	15
Scenario 1 No New Link Road	72	125	37	84
Scenario 2 R1b	62	113	32	75
Scenario 3 R2c	62	117	32	75
Scenario 4 R3	63	110	33	77

5.10 As can be seen from **Tables 8 and 9**, Route 3 performs the best in the AM peak across all scenarios having the least amount of links and junctions over 85% & 100% V/C for all scenarios. For the PM peak Routes 1b and 2c perform better although the increase between routes 1b/2c and 3 is small.

5.11 The above tables illustrate that, although the peripheral route options help to mitigate some of the congestion caused by the increase in growth, they do not solve all of the problems. Therefore, it is considered advisable that additional assessment is made of mitigation measures that could be feasible in order to further reduce the predicted levels of congestion.

6 Economic Assessment

6.1 The Transport User Benefit Appraisal program, TUBA, (version 1.9.2) has been used to estimate the benefits derived from a scheme in terms of time and vehicle operating cost savings. TUBA assesses the whole life costs and benefits of transport schemes using matrices of costs, in terms of distance and time, and trips from the transport model. The program calculates user benefits and changes in revenues and produces indicators of a project worth.

TUBA Inputs

6.2 There are three main inputs to the TUBA process:

- Economic parameters
- Scheme specific control data
- Matrix data from the traffic model

Economic Parameters

6.3 In accordance with WebTAG guidance, the standard TUBA economics file has been used. This file provides details of tax rates, Values Of Time (VOT) and Vehicle Operating Cost (VOC) parameters and growth forecasts for VOT and VOC.

Scheme Specific Control Data

6.4 The control data file used by TUBA is scheme specific and defines the appraisal period, sets out the scheme costs, provides details of model specific data (e.g. time slices and user classes) and defines the annualisation factors (i.e. to convert model time periods to their annual equivalent).

6.5 For the purposes of the TUBA assessment the current year has been taken as 2014 and, with an opening year of 2017, the horizon year is 2076, thus providing a 60 year assessment period in accordance with WebTAG guidance (TAG Unit 3.5.2). A second year of 2031 is also defined within TUBA for assessment. However, as only one modelled 'year' scenario is available from the SATURN model but TUBA requires a minimum of two modelled years, the same model outputs have been used for both of the scheme appraisal years (2017 and 2031) input to TUBA. This means there is an assumption that all growth and infrastructure occurs, and is complete, by the first assessment year of 2017 and stays the same until 2031. This means that

the economic assessment could be potentially over or underestimating the benefits of any scheme dependant on when the infrastructure or the development growth would actually occur. Were the scheme completed before some of the proposed developments, it could likely operate within capacity more easily and hence provide additional benefits to the network. However, few trips in the network without the development could mean lower levels of benefits as there would be fewer trips in the network to benefit from the presence of the scheme. As such, it must be reiterated that these assessments are for comparative assessments between the route options only.

6.6 The time periods from the transport model were:

i) 0800 – 0900 (AM peak); and

ii) 1700 – 1800 (PM peak).

6.7 A simplistic approach for the calculation of annualisation factors has been taken where the factors are assumed to be the number of weekdays in a year (253) for each peak period.

6.8 The total annual hours assessed therefore are 506 (out of an annual total of 8760 hours). This is considered to be a robust assessment as no benefits from the peak shoulders, interpeak, off peak or weekend periods are being claimed. It is recommended that further assessment of the hours to be assessed should be made in order to refine these factors post the model revalidation work based on survey data.

6.9 The following vehicle mode types have been used in the TUBA assessment:

- Cars
- Light Goods Vehicles (LGV)
- Medium Goods Vehicles (OGV1); and
- Heavy Goods (OGV2)

6.10 Although only 2 vehicle classes were available from the model ('Lights' and 'Heavies'), it was deemed appropriate to split the model outputs into the four classes for assessment with TUBA. As such the 'Lights' vehicle class is assumed to consist of 90% car and 10% light goods vehicles and the 'Heavies' vehicle class is assumed to consist of 60% OGV1 and 40% OGV2. The percentage splits have been based on classified counts collected as part of the model revalidation work. This allows TUBA to take account of different vehicle type impacts in the

assessment. Separate vehicle matrices for each class or factors derived from count information as a minimum should be used for the post model revalidation economic assessments.

6.11 All scheme costs have been entered as Factor Costs to allow TUBA to convert to Market Prices.

6.12 All scheme costs have been assumed to occur in 2016.

6.13 The Retail Price Index (RPI) value of 246.8 has been used in all assessments. This is equivalent to the December 2012 figure which was the latest available at the time of carrying out the assessments.

6.14 All costs have been assumed to be attributable to TUBA Mode 1 (i.e. Private Mode).

6.15 Costs for construction were not available for input to the TUBA assessments. Therefore, a generic figure of £1,000 has been assumed for all options as a proxy for real values. As such, the resultant Present Value Costs (PVC) from the TUBA assessment should not be used. Furthermore, as the Benefit Cost Ratio (BCR) uses the PVC in its calculation, the BCR should also be disregarded in the assessment. Only the Present Value Benefits should be used for analysis of the results and as only one modelled year is available for input to the TUBA, the PVB should only be used to provide a ranking of the options compared to the reference case.

Matrix Data from the Transport Model

6.16 Forecast flows from the Bicester route scenario models, as detailed in the previous sections have been used in the economic assessments.

6.17 Trip Matrices have been skimmed from the SATURN assignments for each vehicle type ('Lights' and 'Heavies') for the revised Main Modifications to the Local Plan growth matrices.

6.18 Each model has then been skimmed to produce time and distance matrices by origin destination pair. In accordance with TUBA guidance, a factor of 0.00028 has been used to convert the time matrices from seconds to hours and a factor of 0.001 has been used to convert the distance matrices from metres to kilometres.

6.19 The following TUBA assessments have been carried out with the no peripheral route scenario (Main Modifications = MM) being taken as the reference case for all assessments:

- MM versus MM +R1b

- MM versus MM +R2c
- MM versus MM +R3

6.20 Checks have been carried out to ensure the correct matrices have been input into the TUBA assessment process.

TUBA Results

6.21 Again, it should be noted that the Benefit Cost Ratio cannot be used directly as no costs for construction have been supplied. Furthermore, as only one modelled year is available, the Present Value Benefits (PVB) can only be used as an indicator as to whether the scheme to be tested is an improvement over the reference case and *the absolute value should not be used*.

6.22 Final Main Modification additional growth versus Route 1b: Route 1b shows a positive PVB and can be considered an improvement in terms of travel time for vehicular journeys when compared to no peripheral route.

6.23 Final Main Modification additional growth versus Route 2c: Route 2c shows a positive PVB and can be considered an improvement in terms of travel time for vehicular journeys when compared to no peripheral route. The quantity of the PVB indicates more of a positive benefit than that shown by Route 1b versus no peripheral route.

6.24 Final Main Modification additional growth versus Route 3: Route 3 shows a positive PVB and can be considered an improvement in terms of travel time for vehicular journeys when compared to no peripheral route. The quantity of the PVB indicates more of a positive benefit than that shown by Route 1b or Route 2c versus no peripheral route.

Order of Ranking

6.25 In summary, the routes increase in benefit compared to no peripheral route in the following order:

- Route 1b
- Route 2c
- Route 3

Least benefit

↓

Most benefit

6.26 This is consistent with the conclusions of the previous peripheral route assessments.

7 Assessments Including Upper Heyford

7.1 **Tables 10 and 11** summarise statistics for the Main Modification to the Local Plan scenarios but include the Upper Heyford Development. As stated previously, Upper Heyford is being assessed in more detail using the Central Oxfordshire Transport Model in order to fully assess its impact over the wider area. These assessments are to confirm that the inclusion of Upper Heyford does not materially affect the assessment of the peripheral routes as detailed in the previous sections. The assessments have been carried out without inclusion of any associated Upper Heyford mitigation and hence can be considered a worst case scenario.

Table 10: AM Peak Model Network Summary Statistics (With Upper Heyford)

Option:	2012	Scenario 5 No New Link Road	Scenario 6 R1b	Scenario 7 R2c	Scenario 8 R3
Total Travel Time (PCU Hrs)	3,085	5,427	5,269	5,104	5,094
Total Travel Distance (PCU Kms)	237,565	311,816	311,815	310,813	310,813
Average Speed (Kph)	77.0	57.5	59.2	59.7	61.0
Over Capacity Queues PCU (Hrs)	220	998	879	830	735

Table 11: PM Peak Model Network Summary Statistics (With Upper Heyford)

Option:	2012	Scenario 5 No New Link Road	Scenario 6 R1b	Scenario 7 R2c	Scenario 8 R3
Total Travel Time (PCU Hrs)	3,164	5,625	5,589	5,590	5,288
Total Travel Distance (PCU Kms)	243,630	318,085	318,554	316,115	316,698
Average Speed (Kph)	77.0	56.5	57.0	56.5	59.9
Over Capacity Queues PCU (Hrs)	186	1096	1085	1109	816

7.2 Of the Peripheral Route options, Route 3 again performs best for total travel time, average speed and over capacity queues with Upper Heyford included.

7.3 Again, Route 2c has the lowest total travel distance for all but the AM with Upper Heyford scenario where Route 2c and 3 both have the lowest.

7.4 **Tables 12 and 13** summarise the link flows in PCUs on key links across the networks for each of the main scenarios including the proposed Upper Heyford development.

Table 12: AM Peak Modelled Scenario Link Flows: With Upper Heyford Demand (PCUs)

Link	Scenario:	Scenario 5 No New Link Road	Scenario 6 R1b	Scenario 7 R2c	Scenario 8 R3
A41 Between M40 and Wendlebury Road	NEB	2111	2109	2525	2855
	SWB	1260	1181	1436	1649
Vendee Drive	NWB	284	289	371	389
	SEB	189	186	321	315
Middleton Stoney Road (East of Vendee Drive)	EB	1030	914	774	581
	WB	802	756	719	732
NW Bicester Development Link Road	NEB	557	528	365	327
	SWB	554	509	479	467
A4095 (West of Banbury Road)	EB	878	748	809	747
	WB	386	463	337	271
A4095 (West of A4421)	EB	1360	996	1135	1046
	WB	1096	757	948	889
A4421 Skimmingdish Lane	SEB	1796	1806	1731	1659
	WB	757	705	541	540
A4421 Wretchwick Way	NEB	509	511	601	528
	SWB	539	465	413	431
A41 (East of Oxford Road)	EB	2395	2302	1742	1584
	WB	2274	2135	1409	1403
Kings End	NB	994	949	1284	1420
	SB	1174	1157	1137	1154
Field Street	NB	1430	1301	1463	1433
	SB	1357	1332	1361	1256
Banbury Road (North of Field Street)	NB	381	394	358	379
	SB	588	568	611	514
Buckingham Road (North of Field Street)	NB	1028	885	1043	1072
	SB	748	742	688	759
Route 1b North West Link (South of Bucknell Rd)	NEB	NA	235	NA	NA
	SWB	NA	168	NA	NA
Route 2c (South of Graven Hill)	EB	NA	NA	980	NA
	WB	NA	NA	917	NA
Route 3 (South of Graven Hill)	EB	NA	NA	NA	1385
	WB	NA	NA	NA	1083

Table 13: PM Peak Modelled Scenario Link Flows: With Upper Heyford Demand (PCUs)

Link	Scenario:	Scenario 5 No New Link Road	Scenario 6 R1b	Scenario 7 R2c	Scenario 8 R3
A41 Between M40 and Wendlebury Road	NEB	1359	1429	1603	1612
	SWB	2597	2883	2845	2531
Vendee Drive	NWB	617	494	762	791
	SEB	385	426	1237	699
Middleton Stoney Road (East of Vendee Drive)	EB	1151	1064	987	968
	WB	853	830	889	726
NW Bicester Development Link Road	NEB	592	471	388	382
	SWB	457	419	623	346
A4095 (West of Banbury Road)	EB	635	380	513	481
	WB	438	552	500	288
A4095 (West of A4421)	EB	440	166	311	292
	WB	1584	1753	1491	1451
A4421 Skimmingdish Lane	SEB	971	1025	829	825
	WB	1980	1940	1752	1748
A4421 Wretchwick Way	NEB	798	746	722	631
	SWB	364	357	526	571
A41 (East of Oxford Road)	EB	2131	2039	1074	1244
	WB	2385	2278	1497	1516
Kings End	NB	1093	1058	1506	1435
	SB	1279	1250	1159	1193
Field Street	NB	1271	1332	1414	1382
	SB	1308	1314	1145	1267
Banbury Road (North of Field Street)	NB	726	730	850	780
	SB	419	544	462	499
Buckingham Road (North of Field Street)	NB	861	895	876	865
	SB	1204	1063	995	1031
Route 1b North West Link (South of Bucknell Rd)	NEB	NA	242	NA	NA
	SWB	NA	200	NA	NA
Route 2c (South of Graven Hill)	EB	NA	NA	1063	NA
	WB	NA	NA	823	NA
Route 3 (South of Graven Hill)	EB	NA	NA	NA	901
	WB	NA	NA	NA	1037

7.5 Again, reductions are seen on links within the Bicester urban area for all scenarios which include a peripheral route due to rerouting of traffic onto the new links.

7.6 Routes 2c and 3 give significant reductions on the A41 (East of Oxford Road). Routes 2c and 3 give the largest increases on Kings End northbound although the southbound flows on this link remains largely static in all options.

7.7 Field Street remains largely unchanged in all options. This is likely due to the vehicles using this link having a trip end near to the link limiting the routing alternatives.

7.8 These results are consistent with Scenarios 1-4.

7.9 The number of links and turns at junctions with Volume over Capacity (V/C) ratios of 85% or over and 100% or over are given in **Tables 14 and 15** for each scenario. A green shaded cell indicates the best performing option:

Table 14: No of Modelled Links and Turns with V/C 85% or Over & 100% or Over (AM Peak with Upper Heyford)

Option	85%		100%	
	Link	Turns	Link	Turns
2012	15	20	7	13
Scenario 5 No New Link Road	94	189	51	130
Scenario 6 R1b	89	169	43	107
Scenario 7 R2c	93	172	43	111
Scenario 8 R3	88	165	42	101

Table 15: No of Modelled Links and Turns with V/C 85% or Over & 100% or Over (PM Peak with Upper Heyford)

Option	85%		100%	
	Link	Turns	Link	Turns
2012	19	22	9	15
Scenario 5 No New Link Road	94	182	55	133
Scenario 6 R1b	88	157	45	102
Scenario 7 R2c	82	163	45	110
Scenario 8 R3	87	161	45	109

7.10 As can be seen from **Tables 14 and 15**, Route 3 again performs the best in the AM peak across all scenarios having the least amount of links and junctions over 85% and over and 100% and over V/C for all scenarios. For the PM peak Routes 1b and 2c perform better.

7.11 Route 1b performs comparatively better in the with Upper Heyford scenarios. This is likely due to the proximity of the R1b scheme to both the Upper Heyford and NW Bicester developments.

7.12 Overall it is considered that these results are consistent with Scenarios 1-4 (No Upper Heyford).

8 Conclusions

8.1 The inclusion of the predicted growth for the Bicester area results in significant increases in over capacity queuing, average speed and total travel time from the 2012 base.

8.2 Of the peripheral routes, Route 3 generally performs best in all areas for both peak periods for overall network statistics. Route 3 performs best for the AM peak period for volume over capacity ratios. Routes 1b and 2c perform best for the PM peak period for volume over capacity ratios although the differences are marginal.

8.3 TUBA indicates that the routes increase in benefit compared to no peripheral route in the following order:

- Route 1b — Least benefit
- Route 2c — ↓
- Route 3 — Most benefit

8.4 The inclusion of the proposed Upper Heyford development as a sensitivity test does not materially change the results of the peripheral route assessments.

8.5 Although the peripheral route options help to mitigate some of the congestion caused by the increase in growth, they do not solve all of the problems.

8.6 Further assessment of mitigation measures that could be feasible for the southern, eastern and northern corridors would be considered advisable to support the peripheral route option assessments.