South Oxfordshire District Council Local Plan

Evaluation of Transport Impacts: Stage 3 - Development Scenarios and Mitigation Testing

Oxfordshire County Council

02 January 2019

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1. Introduction

Atkins has been commissioned by Oxfordshire County Council (OCC) and South Oxfordshire District Council (SODC) to undertake an additional preliminary Evaluation of Transport Impacts (ETI) in relation to the emerging SODC Local Plan. The Local Plan sets out a policy framework for the delivery of sustainable development across the District up to 2034. It sets out the spatial strategy and strategic policies for the District to deliver sustainable development. It identifies the number of new homes and employment land to be provided in the area and makes provision for retail, leisure and commercial development and the infrastructure needed to support them.

One of the main purposes of the ETI is to inform the selection of strategic development sites to be allocated in the Local Plan 2034 and to help identify a package of transport mitigation measures to ensure that the plan contributes towards the delivery of sustainable development. The ETI forms part of the evidence base to inform the Local Plan 2034 alongside other evidence, including: Landscape Capacity Study, Strategic Flood Risk Assessment, Sustainability Appraisal, Green Belt Review, and others.

This is Stage 3 of the work associated with the ETI commission. The first stage considered the suitability of the Oxfordshire Strategic Model (OSM) to assess Local Plan impacts. The subsequent part of the first stage evaluated the transport impacts of five Local Plan scenarios. The second stage of the work looked in more detail at the impacts of the emerging development scenario, and prospective mitigation measures to support the Local Plan. Stage 3 includes additional mitigation measures for increased development, as well as alternative infrastructure options, compared with the Do Minimum.

The base model performance check undertaken during the Stage 1 (Network and Model Performance Review) of this work determined the areas where the OSM is suitable for the assessment of transport impacts in the District. In general, the areas where the model was found to be more suitable align well with the spatial distribution of proposed additional growth within the scenarios tested.

Atkins has undertaken a technical modelling assessment of the Local Plan to understand likely transport impacts on the strategic highway network. The modelling assessment is part of a staged process to inform decision-making. More detailed work is on-going between the District Council, County Council and others to review local impacts of proposed developments and potential mitigation measures associated with growth.

1.1. Previous Work

1.1.1. Previous Local Plan Assessments

Transport modelling of previous versions of the Local Plan (prior to 2016) has been undertaken. At the time, these models were calibrated and validated using transport surveys collected locally. The calibration and validation of these models was within acceptable limits of modelling guidance at the time and they were deemed suitable for assessment of the Local Plan. These previous models, alongside their accompanying reports have now been superseded.

Since this previous round of work, the base model has been updated significantly and the 2031 forecast model planning data has also been updated. Comparing the most recent forecasts presented in this report against model runs from 2015 is not a fair comparison; the older modelling has marked differences to the latest modelling which, in turn, includes improvements to the model, such as updating to the latest version of TEMPro: therefore, the two rounds of modelling are not directly comparable.

Specifically, around Watlington, differences in model performance have been identified between the models prepared in 2007 and used for testing in 2015 and the most recent work undertaken in 2017 and 2018 which used the updated Oxfordshire Strategic Model (OSM) which was calibrated and validated to a base year of 2013. Identified differences are likely to be as a result of changes to demand and supply (network), different model coding practices and application of new versions of the modelling software. The analysis undertaken during Stage 1 gives comfort that results from the most up to date base year model are generally robust in those areas where significant growth has been tested.

This report should be considered in the context of SODC ETI modelling work undertaken in previous stages and summarised in Table 1 recognising the evolution of the models and inherent differences between them.

Table 1 Summary of Previous ETI Stages

ETI and Local Plan Stage	Growth and Infrastructure Tested	Summary of Conclusions
South Oxfordshire ETI technical note, January 2015 (which used previous version of the Oxfordshire transport model)	The land use assumptions tested and summarised are Core Strategy – 9,100 houses apportioned with 55% of houses in Didcot and the remainder split 60% to Market Towns and 40% to the larger villages; Scenario A – Additional 6,000 homes apportioned as per the Core Strategy distribution; Scenario B – Additional 6,000 homes focussed on Science Vale (60%) with remainder spread across 'sustainable settlements'; Scenario C – Additional 6,000 homes all in Science Vale; Scenario D – Additional 6,000 homes all in a single new settlement (in this case around Milton Common); Scenario E – Additional 6,000 homes dispersed evenly across all settlements (in this case 143 in each site); Scenario F – Additional 6,000 homes next to neighbouring major urban areas (in this case split 3,000 near Reading and 3,000 near Oxford near Grenoble Road).	Overall, there was limited difference between scenarios in terms of resulting impacts on the highway network during either time period, although differences were more prominent between scenarios during the morning peak than the evening peak. Bearing this in mind, Scenario C results in the greatest negative impact upon the South Oxfordshire highway network during both time periods. This is closely followed by Scenario D, whilst the impacts of Scenarios A and B could be considered identical and again very similar to Scenario E. Scenario F has the least impact upon the highway network during both time periods; however, the trips generated by the proposed development are not accurately represented in the model due to the location of the development sites being on the periphery of the study area.
Evaluation of Transport Impacts: Stage 1: Network and Model Performance Review, October 2016	Undertook an assessment of planned growth locations and recently observed traffic surveys against 2013 base year modelled flows to determine the suitability of using the OSM highway assignment model to assess the potential impacts of identified developments in the forthcoming South Oxfordshire Local Plan.	OSM was developed as a strategic model to provide evidence base for planning and development mitigation as well as the appraisal of major transport schemes. Analysis suggested that some refinements might be required to ensure the model reflects recent observations. Model network coverage generally relates well to the development locations within the Local Plan. It was concluded that the model is generally suitable for testing strategic transport impacts, particularly in the central/ northern part of the District around Didcot, Chalgrove, Wheatley, Watlington and Stadhampton.

ETI and Local Plan Stage	Growth and Infrastructure Tested	Summary of Conclusions
Evaluation of Transport Impacts: Stage 1: Development Scenarios (to support Local Plan preferred options consultation), March 2017	In addition to the Do Minimum assumptions, the quantum of growth for each development scenario is presented in Table **2**. There are no differences between the Do Minimum and the modelled scenario tests in terms of transport supply assumptions (highway, park and ride and public transport).	Impacts of the Local Plan scenarios are compared considering speeds along the key corridors against the Do Minimum scenario, specifically for the morning peak hour: **Scenario 1**, with dwellings around the B480 and the A4074, average speed is forecast to reduce by 54% along the B480 and by 7% along the A4074; **Scenario 2**, with dwellings around the A4074 and A415, is forecast to reduce speeds by 10% along the A4074 and 1% along A415; **Mitigation (b1)**, with dwellings around the B480 and the A4074, is forecast to have a minor impact along the corridors considered; **Mitigation (b2)**, with dwellings around the A40 and the A329, is forecast to reduce speeds on the A329 by 7% and to reduce speeds on the A40 by 3%; **Scenario 5**, with dwellings around the B480, A4074, A415 and the A329, is forecast to reduce speeds by 54% on the B480, 10 % on the A4074, 1% on the A415 and 5% on the A329.

ETI and Local Plan Stage	Growth and Infrastructure Tested	Summary of Conclusions
Evaluation of Transport Impacts: Stage 2: Mitigation Scenarios (to support LP consultation), October 2017	In addition to the Do Minimum assumptions, the quantum of growth for development scenario in Local Plan and its mitigation scenarios are presented in Table 3. There are no differences between the Do Minimum and the Local Plan modelled scenario test in terms of transport supply assumptions (highway, park and ride and public transport). However, the transport supply assumptions for the mitigation scenarios would change with respect to the removal of non-funded highway schemes from the local plan transport supply network in Mitigation Scenario (a) and addition of highway schemes to the local plan transport supply network in Mitigation (b1) and (b2) scenarios.	Impact of the Local Plan Scenario is compared considering speeds along the key corridors against the Do Minimum Scenario, and for the Mitigation Scenarios against the Local Plan Scenario specifically for the morning peak hour: **Local Plan**, with dwellings around the A415 and the B480, average speed is forecast to reduce by 55% along the A415 and by 23% along the B480, compared to Do Minimum Scenario; **Mitigation (a)**, with dwellings around the A415 and the B480, average speed is forecast to increase by 27% along the A415, by 3% along B480 and A329 and by 3% along the A34 compared to the Local Plan; **Mitigation (b1)**, with dwellings around the A415, A4074 and the B480, average speed is forecast to reduce by 5% along the A415, by 6% along the A4074, by 4% along the B480, and increase by 3% along the A329 compared to the Local Plan; **Mitigation (b2)**, with dwellings around the A415, A4074 and the B480, average speed is forecast to reduce by 5% along the A415, by 4% along the A4074, 2% along the B480, by 3% along the B4009 and increase by 3% along the A329 compared to the Local Plan;

Table 2 Summary of land use assumptions - Stage 1

	Do Minimum	Scenario 1	Scenario 2	Scenario 4	Scenario 5
Do Minimum	11079	11079	11079	11079	11079
Preferred Options	-	8732	8732	8732	12232
Windfall Allowance	-	683	683	683	683
Total dwellings	11079	20494	20494	20494	23994

Table 3 Summary of land use assumptions - Stage 2

	Do Minimum	Local Plan	Mitigation (a)	Mitigation (b1)	Mitigation (b2)
Do Minimum	11079	11079	11079	11079	11079
Strategic Development	-	11301	11301	11301	11301
Total Dwellings	11079	22380	22380	22380	22380

Table 4 Summary of land use assumptions - Stage 3

	Scenario								
	Do Minimum	**1**	**2**	**3A**	**3B**	**3C**	**4A**	**4B**	**5A & 5B**
Do Minimum	11079	11079	11079	11079	11079	11079	11079	11079	11079
Strategic Development	-	8500	9911	8500	8375	8411	11200	8200	15236
Total Dwellings	11079	19579	20990	19579	19454	19490	22279	19279	26315

1.1.2. Network Changes

The transport supply assumptions (highway, park and ride and public transport) are consistent between the Do Minimum and Local Plan Scenarios. A number of highway network changes were made to the Mitigation Scenarios in Stage 3 and these are outlined in Table 10 and in Figure 4.

1.1.3. Model Output Summary

Table 5 and Table 7 shows the highway network performance for the South Oxfordshire District for the morning and evening peak conditions respectively, while Table 6 and Table 8 show the respective percentage differences compared with the Do Minimum.

In Scenario 1 for both the morning and evening peaks the model forecasts an increase in delay, travel time and travel distance, and a reduction in average speed compared to the Do Minimum scenario. The forecast increase in travel distance, could be attributed to traffic using alternative routes, and additional congestion forecast along the A40.

In Scenario 2 in the morning peak the model forecasts a small increase in delay, travel time and travel distance and a small decrease in average speed compared to the Do Minimum scenario. In the evening peak the model forecasts a greater increase in delay, travel time, travel distance, as well as a reduction in average speed.

In Scenarios 3A, 3B and 3C both morning and evening peaks show an increase in delay, travel time and travel distance, alongside a reduction in average speed compared to the Do Minimum scenario. The models forecast an increase in congestion along the A415. There is a small increase in travel distance for all three scenarios.

In Scenario 4A, in both morning and evening peaks, the model forecasts an increase in delay, travel time, and travel distance, especially along the A40 and B480 corridors. This scenario forecasts additional congestion along the A40. There is also a reduction in average speed compared to the Do-Minimum scenario.

Forecasts suggest that Scenario 4B has a minimal impact on average speed in South Oxfordshire, especially during the evening peak. In both the morning and evening peaks there are moderate increases in total time and distance, and minimal increases in delay. There is a low impact on the performance of the A40 in this scenario. The addition of mitigation measures reduces delay in South Oxfordshire compared to other scenarios; however, there is likely to be additional congestion along the A4074 at the Golden Balls Roundabout and at Wallingford associated with increased flows at Crowmarsh Roundabout and other Wallingford junctions.

Scenario 5A has an impact on average speeds across South Oxfordshire compared to the Do Minimum (6-10% decrease). There are forecast delays and increases in travel time for both peaks, but a lower impact on travel distances compared to other scenarios.

In Scenario 5B during the morning and evening peaks there is a moderate increase in delays, travel time and travel distance. The addition of mitigation measures reduces delays in South Oxfordshire compared to other mitigation scenarios; however, there is likely to be additional congestion along the A4074 at Golden Balls Roundabout during the evening peak, and along the A34 corridor at Milton associated with increased demand at Milton Roundabout during the morning peak. Overall, the impact on average speeds is moderate during both peaks (4-6% reduction compared with the do-min).

Table 5 Oxfordshire Highway Network Performance – Morning Peak Hour

Performance Parameters	Full Oxfordshire Network									
	2031 DM	Scenario 1	Scenario 2	Scenario 3A	Scenario 3B	Scenario 3C	Scenario 4A	Scenario 4B	Scenario 5A	Scenario 5B
Delay (pcu hr)	3,027.2	3,131.2	3,124.4	3,080.2	3,112.4	3,085.8	3,177.4	3,161.6	3,209.0	3,310.3
Total Time (pcu hr)	42,845.3	44,002.3	43,919.2	43,803.7	44,725.4	43,880.0	44,229.1	43,908.9	45,394.2	45,525.9
Total Distance (pcu km)	2,352,241	2,382,974	2,382,625	2,371,903	2,384,414	2,373,059	2,396,366	2,390,077	2,408,226	2,419,847
Average Speed (km/h)	54.9	54.2	54.3	54.1	53.3	54.1	54.2	54.4	53.1	53.2

Table 6 Oxfordshire Highway Network Performance - Morning Peak Difference

Performance Parameters	Full Oxfordshire Network									
	2031 DM	Scenario 1	Scenario 2	Scenario 3A	Scenario 3B	Scenario 3C	Scenario 4A	Scenario 4B	Scenario 5A	Scenario 5B*
Delay (pcu hr)	-	104.0	97.2	53.0	85.2	58.6	150.2	134.4	181.8	101.3
Total Time (pcu hr)	-	1,157.0	1,073.9	958.4	1,880.1	1,034.7	1,383.8	1,063.6	2,548.9	131.7
Total Distance (pcu km)	-	30,733	30,384	19,663	32,173	20,818	44,125	37,836	55,985	11,621
Average Speed (km/h)	-	-0.7	-0.6	-0.8	-1.6	-0.8	-0.7	-0.5	-1.8	0.1

* Compared with Scenario 5A

Table 7 Oxfordshire Highway Network Performance - Evening Peak Hour

Performance Parameters	Full Oxfordshire Network									
	2031 DM	Scenario 1	Scenario 2	Scenario 3A	Scenario 3B	Scenario 3C	Scenario 4A	Scenario 4B	Scenario 5A	Scenario 5B
Delay (pcu hr)	3,514.7	3,605.0	3,615.9	3,551.6	3,561.0	3,572.6	3,678.6	3,650.7	3,660.7	3,826.9
Total Time (pcu hr)	49,498.8	50,827.7	50,746.9	50,650.1	50,697.9	50,728.1	51,056.1	50,709.7	51,349.3	51,624.7
Total Distance (pcu km)	2,521,135	2,555,574	2,550,413	2,543,331	2,545,919	2,544,623	2,567,895	2,558,451	2,569,683	2,591,090
Average Speed (km/h)	50.9	50.3	50.3	50.2	50.2	50.2	50.3	50.5	50.0	50.2

Table 8 Oxfordshire Highway Network Performance - Evening Peak Difference

Performance Parameters	Full Oxfordshire Network									
	2031 DM	Scenario 1	Scenario 2	Scenario 3A	Scenario 3B	Scenario 3C	Scenario 4A	Scenario 4B	Scenario 5A	Scenario 5B*
Delay (pcu hr)	-	90.3	101.2	36.9	46.3	57.9	163.9	136.0	146.0	166.2
Total Time (pcu hr)	-	1,328.9	1,248.1	1,151.3	1,199.1	1,229.3	1,557.3	1,210.9	1,850.5	275.4
Total Distance (pcu km)	-	34,440	29,278	22,197	24,784	23,488	46,760	37,316	48,548	21,407
Average Speed (km/h)	-	-0.6	-0.6	-0.7	-0.7	-0.7	-0.6	-0.4	-0.9	0.2

* Compared with Scenario 5A

2. Modelling Approach

2.1. Background

The ETI work is being undertaken to inform the preparation of the preferred South Oxfordshire Local Plan 2034 and has been completed in stages with the agreement of SODC, following the agreed methodological proposal.

2.2. Description of the model

The work is based on the Oxfordshire Strategic Model (OSM) developed by Atkins for Oxfordshire County Council (OCC). The OSM modelling system was developed to represent travel conditions in the 2013 base year and consists of three key elements:

- a Highway Assignment Model (HAM) representing vehicle-based movements within and across the Oxfordshire County for a 2013 October weekday morning peak hour (08:00 – 09:00), an average inter-peak hour (10:00 – 16:00) and an evening peak hour (17:00 – 18:00);
- a Public Transport Assignment Model (PTAM) representing bus and rail-based movements across the same area and for the same time periods; and
- a five-stage multi-modal Demand Model (MMDM) that estimates frequency choice, main mode choice, time period choice, destination choice, and sub mode choice in response to changes in generalised costs of travel across the 24-hour period (07:00 – 07:00). It does this incrementally from the Base Year.

The entire OSM model covers the whole of Great Britain with different degrees of detail.

The OSM covers the strategic links in Oxfordshire and has a detailed modelled area and a fully modelled area as shown in Figure 1.

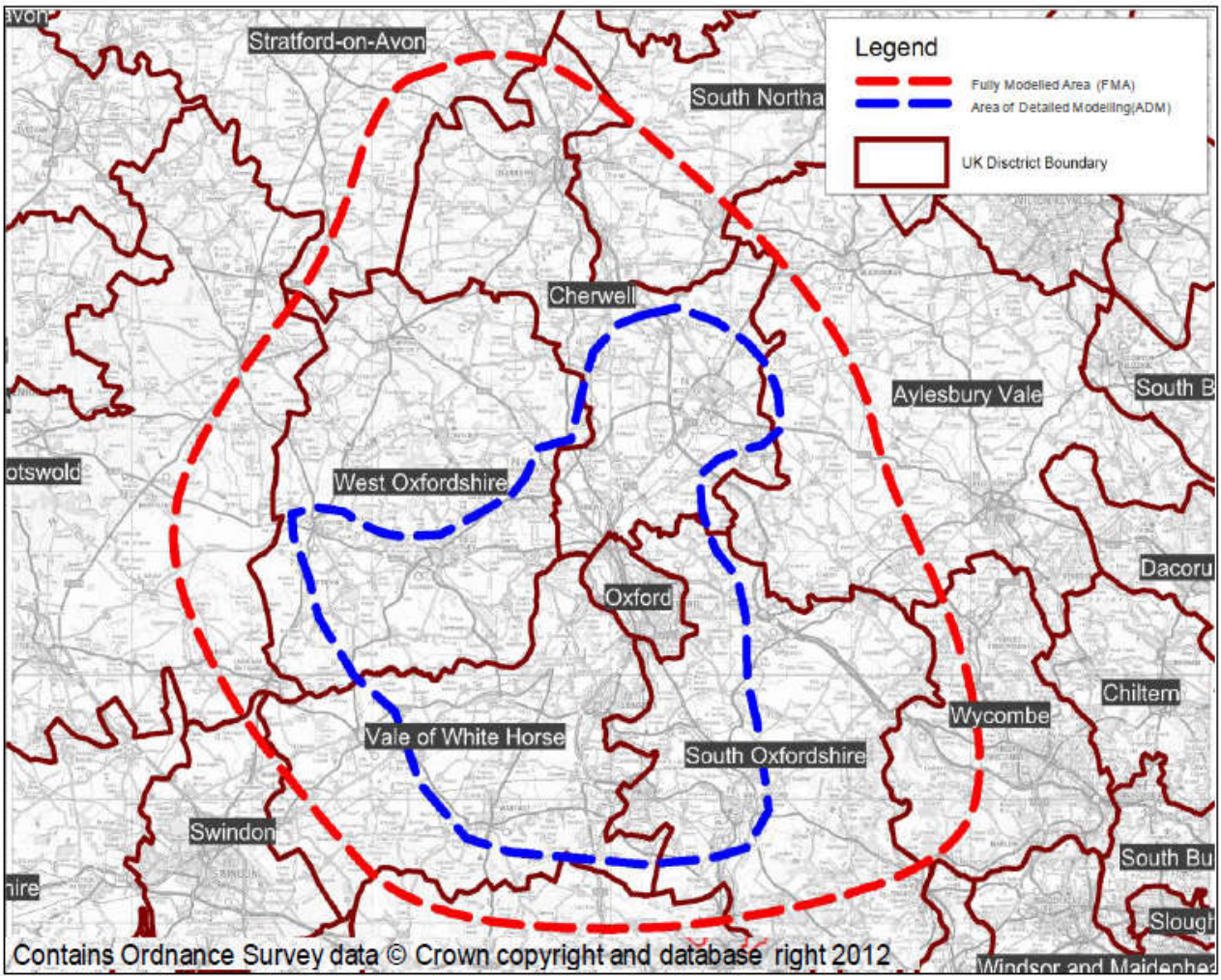
The level of detail varies as follows:

- **Fully Modelled Area:** the area over which proposed interventions have influence, and in which junctions are in SATURN simulation, is further subdivided as:
  - **Area of Detailed Modelling** – the area over which significant impacts of interventions are certain and the modelling detail in this area would be characterised by: representation of all trip movements; small zones; very detailed networks; and junction modelling (including flow metering and blocking back).
  - **Rest of the Fully Modelled Area** – the area outside the detailed modelling area would be characterised by: representation of all trip movements; larger zones and less network detail compared to the Area of Detailed Modelling; and speed/flow modelling (primarily link-based including a representation of strategically important junctions).
- **External Area:** the area where impacts of interventions would be so small as to be reasonably assumed to be negligible and would be characterised by: a SATURN buffer network representing a large proportion of the rest of Great Britain, a partial representation of demand (trips to, from and across the Fully Modelled Area); large zones; skeletal networks and simple speed/flow relationships or fixed speed modelling.

South Oxfordshire is partially situated inside the area of detailed modelling (ADM), which has been subject to full calibration and validation exercises. This includes the area in and around Didcot, and the areas around Oxford. In the fully modelled area, where some of the strategic growth for South Oxfordshire is planned, model validation checks have been undertaken using the latest available transport and traffic data. This assessment is summarised in the Stage 1 'Network and Model Performance Review Report', October 2016.

The model does not cover walking and cycling travel demand specifically. This is something that would be expected to be picked up when undertaking more detailed transport assessments to support the planning application process for specific development sites.

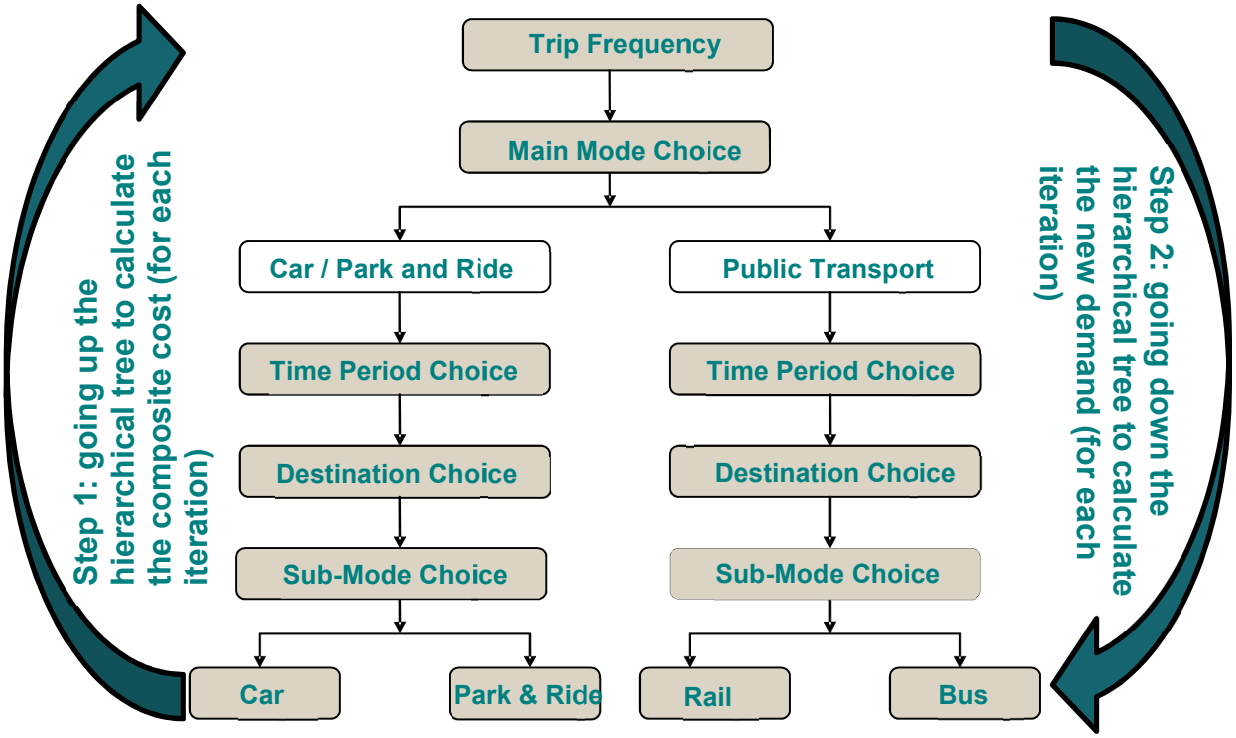
Figure 1 Detailed Modelled Area



2.3. Description of the Demand Model

The MMDM has a hierarchical logit choice structure as shown in Figure 2. Following WebTAG[1], it has an incremental demand modelling approach which responds to changes in travel 'cost' between the 2013 Base Year and the 2031 future year scenario. The process passes through different iterations until it converges.

Figure 2 Demand Model Hierarchy



2.4. Approach

Figure 3 summarises the approach taken for every scenario that is tested in OSM. The model allows changes both in terms of supply and/or demand for each scenario. These inputs enter the Demand model, which estimates how these changes will impact on the distribution of the demand over different time periods, different modes and different routes.

Once a demand model run has finished, a set of checks is performed to confirm the suitability of the results:

- Check that the additional demand is assigned to the expected zones and the level of modelled demand is consistent with the inputs;
- Check convergence of the demand model;
- Check convergence of the highway model;
- Check performance of the network near the added schemes; and
- Check delays on the highway network.

As a result of this process, it might be necessary to implement some improvements in the network:

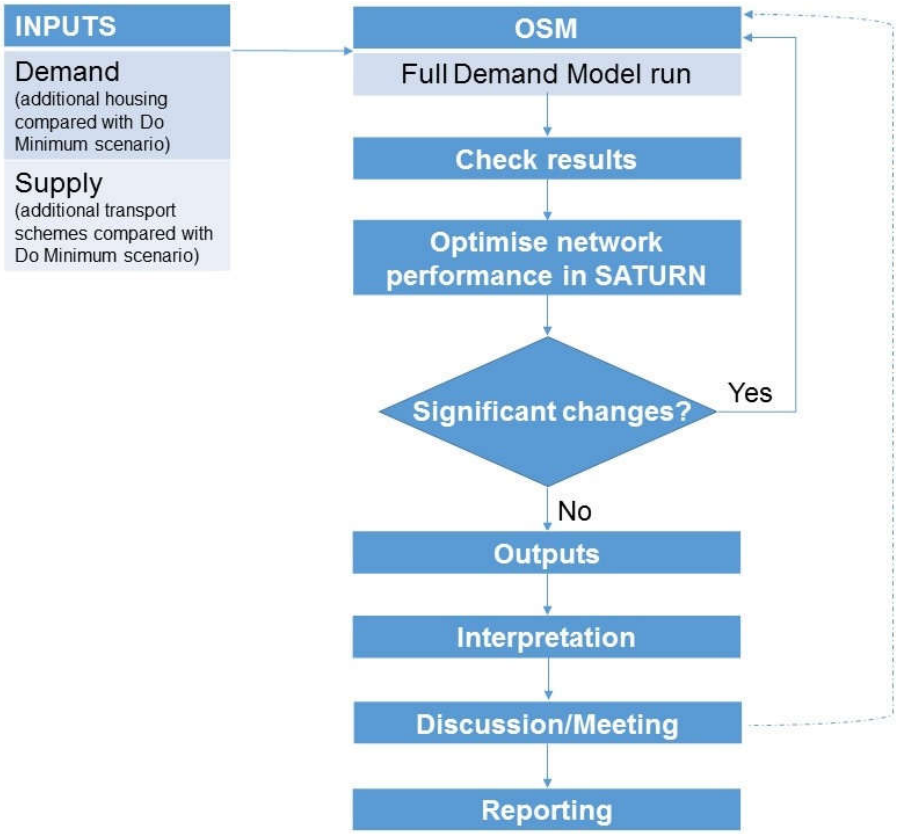
- Review of centroid connectors; and
- Optimisation of signal timings.

[1] Department for Transport (DfT) Transport analysis guidance, WebTAG, provides information on the role of transport modelling and appraisal. https://www.gov.uk/guidance/transport-analysis-guidance-webtag

If the changes are significant (e.g. changed centroid connectors or change of a number of signal timings on main routes), the demand model is rerun with the new inputs.

Once the performance of the model is satisfactory, the results are analysed and the necessary outputs are prepared.

Figure 3 Approach taken for this work



2.5. Modelled Scenarios and Land-use assumptions

For the purpose of the Local Plan ETI, the emerging Local Plan scenarios are evaluated with respect to the Do Minimum scenario. It should be noted that the Local Plan year (2034) is different to the model future reference case year (2031) and that under current projections, the strategic sites will be building out for some years after this time. The results for each scenario present a situation in which the SODC Local Plan sites are built out in full, effectively showing the 'worst case scenario' once all local plan sites have been completed.

The Local Plan scenarios provided by SODC contain additional dwellings, when compared with the Do Minimum scenario, to meet the SODC assessed housing need. The scenarios also include changes in the supply side of the highway network.

Table 9 is a summary of the development assumptions for each scenario tested and Table 10 shows the local plan development distribution and proposed mitigation (above that included at Do Minimum stage). Figure 4 shows the local plan development sites location and highway scheme mitigation measures under each mitigation scenario.

It is important to note that the highway schemes identified are in varying stages of development and design, and therefore the coding of these schemes in the model is based on current information available, and could change in any future modelling as detail of schemes becomes more known. In addition, the capacity of sites used was based on information available at the start of the modelling process, and it is acknowledged that this has changed for certain sites (particularly Lower Elsfield/ Wick Farm and Northfield) in the final consultation version of the local plan following more detailed work. The proposed development area in the Lower Elsfield/ Wick Farm area is also now called Land North of Bayswater Brook.

Table 9 Summary of tested land use assumptions

Developments 2031	**Scenario**								
	Do Minimum	**1**	**2**	**3a**	**3b**	**3c**	**4a**	**4b**	**5**
Total Dwellings	11079	19579	20990	19579	19454	19490	22279	19279	26315
Jobs	4282	4282	4282	4282	4282	4282	4282	4282	4282

Table 10 Local Plan Development Distribution and Network Schemes

Scenario	Proposed development Site Allocations (above those in the Do Minimum)	**Mitigation Included** (above that in the Do Minimum)
1	Culham (3500), Chalgrove (3000), Wheatley (300), Berinsfield (1700), Neighbourhood Plan commitments and targets	Stadhampton Bypass, Chiselhampton Bypass, Watlington Bypass, Benson Bypass, Golden Balls Junction with additional eastbound filter lane
2	Thornhill (875), Northfield (2000), Grenoble Road (3000), Berinsfield (1700), Wick Farm/Lower Elsfield (2036), Neighbourhood Plan commitments and targets	Watlington Bypass, Benson Bypass, Golden Balls Junction with additional eastbound filter lane
3A	Grenoble Road (3000), Culham (3500), Wheatley (300), Berinsfield (1700), Neighbourhood Plan commitments and targets	Watlington Bypass, Benson Bypass, Golden Balls Junction with additional eastbound filter lane
3B	Thornhill (875), Northfield (2000), Culham (3500), Wheatley (300), Berinsfield (1700), Neighbourhood Plan commitments and targets	Watlington Bypass, Benson Bypass, Golden Balls Junction with additional eastbound filter lane

Scenario	Proposed development Site Allocations (above those in the Do Minimum)	**Mitigation Included** (above that in the Do Minimum)
3C	Thornhill (875), Wick Farm/Lower Elsfield (2036), Culham (3500), Wheatley (300), Berinsfield (1700), Neighbourhood Plan commitments and targets	Watlington Bypass, Benson Bypass, Golden Balls Junction with additional eastbound filter lane
4A	Harrington (6500), Chalgrove (3000), Berinsfield (1700), Neighbourhood Plan commitments and targets	Stadhampton Bypass, Chiselhampton Bypass, Watlington Bypass, Benson Bypass, Golden Balls Junction with additional eastbound filter lane, Harrington Site Access Links
4B	Harrington (3500), Chalgrove (3000), Berinsfield (1700), Neighbourhood Plan commitments and targets	Stadhampton Bypass, Chiselhampton Bypass, Watlington Bypass, Benson Bypass, Golden Balls Junction with additional eastbound filter lane, Harrington Site Access Links
5A	Northfield (2000), Grenoble Road (3000), Chalgrove (3000), Culham (3500), Wick Farm/Lower Elsfield (2036), Berinsfield (1700), Wheatley (300), Neighbourhood Plan commitments and targets	Stadhampton Bypass, Chiselhampton Bypass, Watlington Bypass, Benson Bypass, Golden Balls Junction with additional eastbound filter lane from the B4015 to the A4074.
5B	Northfield (2000), Grenoble Road (3000), Chalgrove (3000), Culham (3500), Wick Farm/Lower Elsfield (2036), Berinsfield (1700), Wheatley (300), Neighbourhood Plan commitments and targets	Benson Bypass, Chiselhampton Bypass, Stadhampton Bypass, Watlington Bypass, Culham Didcot Thames River Crossing, western alignment, Culham Site Access Links, Culham Didcot Thames River Crossing alternative (Western alignment), A40 Link Road (40mph single carriageway), Berinsfield northern access, Speed reductions to Dorchester/Stadhampton Road to 20mph, Golden Balls roundabout enlargement, capacity increase for north- and southbound movements and additional filter lane from Clifton Hampden bypass to A4074 northbound, Accesses to Culham site improved

2.6. Transport Network Assumptions

A number of different highway network improvement schemes have been added in the various scenarios being tested. Table 10 shows in which scenarios each network scheme is included. Figure 4 and Figure 5 show where the schemes and development sites are located.

Figure 4 Proposed Highway Scheme Locations

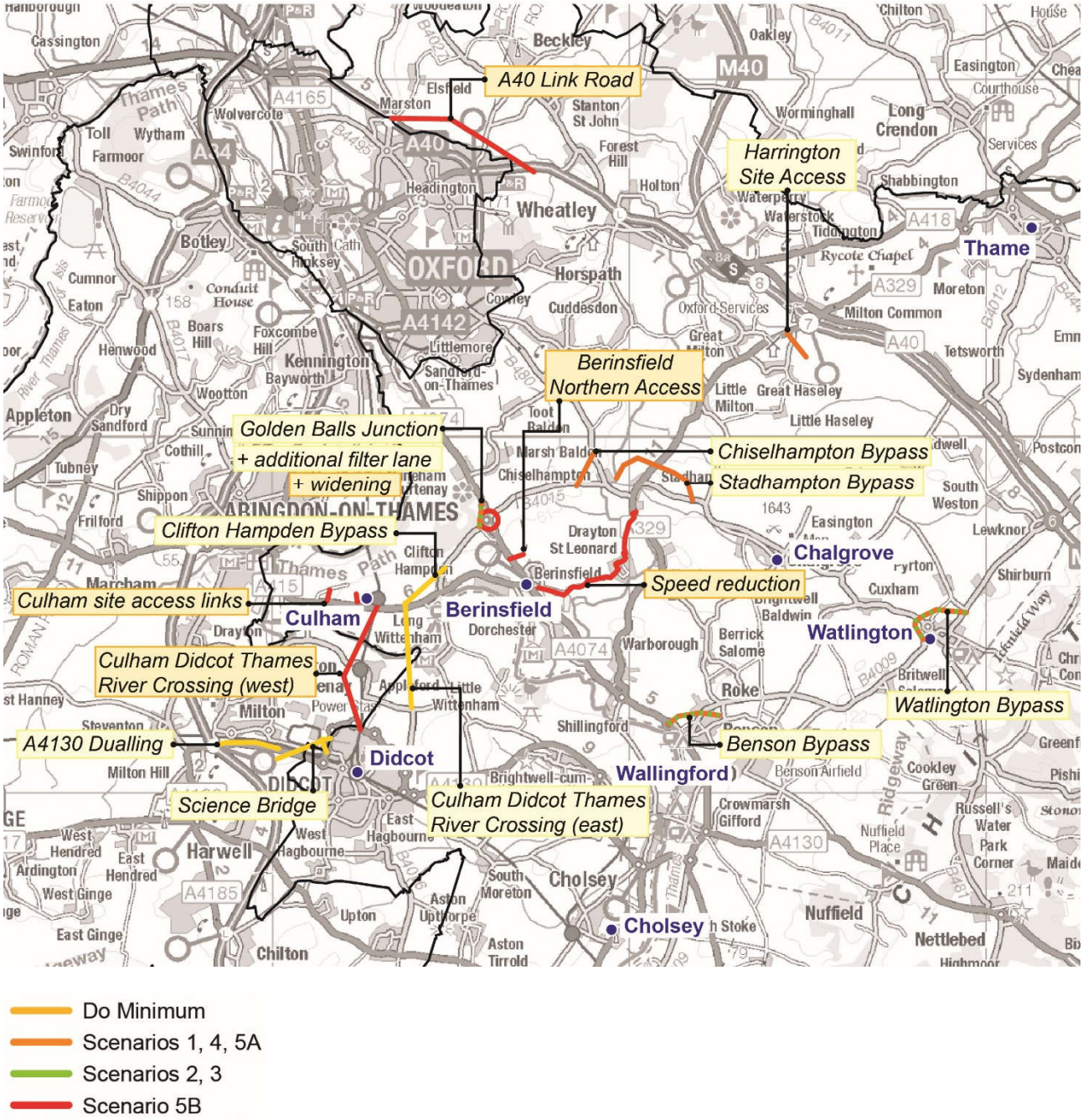
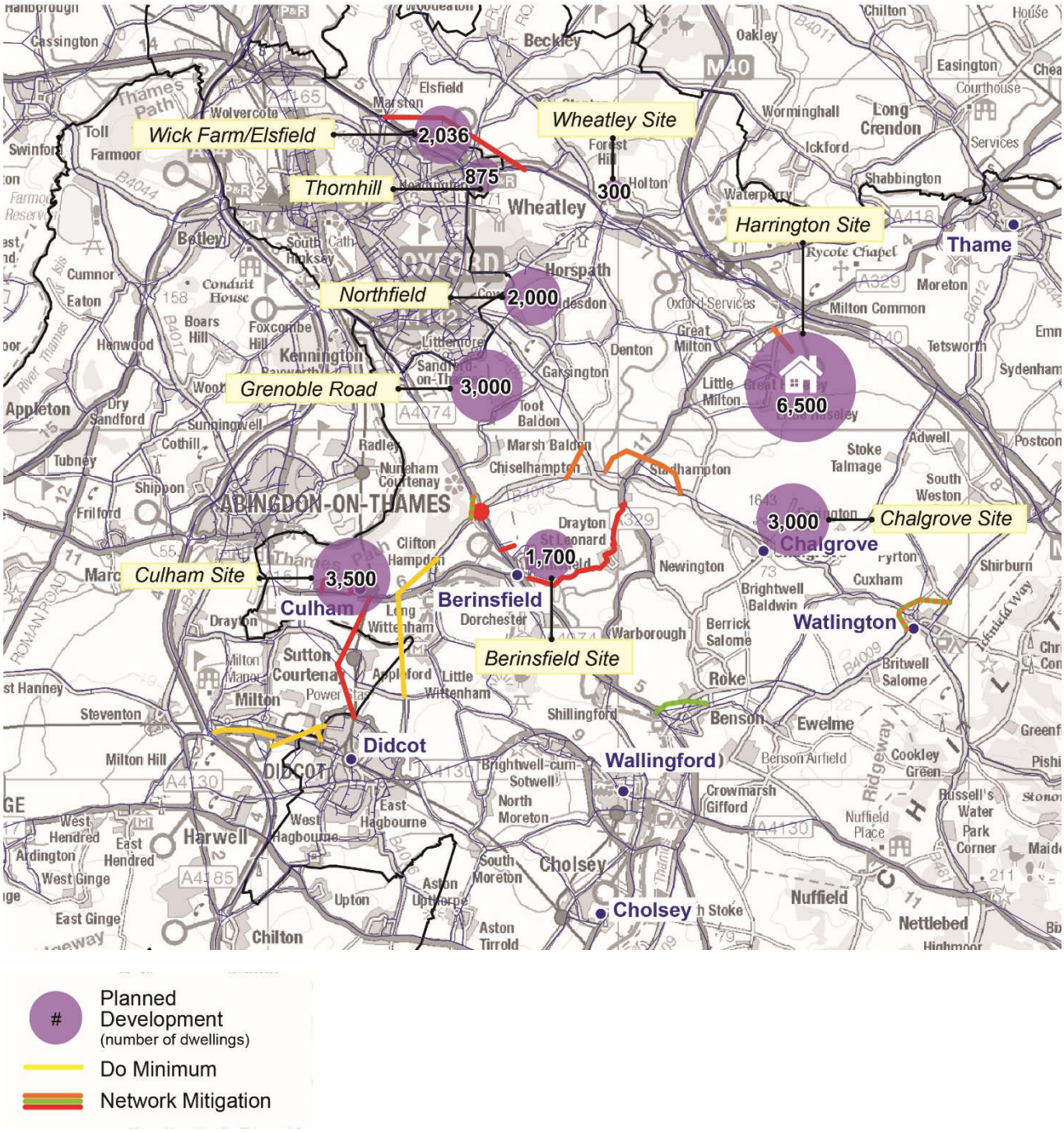


Figure 5 Proposed Development Scheme Locations



3. Demand Model results

This chapter presents the travel demand results for the Base Year 2013, Forecast Year 2031 and each development scenario.

3.1. Convergence

The convergence of the Demand Model is checked for all scenarios before preparing the results/outputs. WebTAG guidance suggests a convergence level of 0.22 within 30 iterations, which was achieved for the Do Minimum scenario and all development scenarios.

3.2. Growth in demand

Table 11 summarises the growth in travel demand between the 2013 Base Year, the 2031 Do Minimum scenario and all development scenarios across the model area. Between the 2013 Base Year and the 2031 Do Minimum scenario, overall travel demand for all districts in Oxfordshire is forecast to grow by 43% over a 12 hour-period. Between the 2031 Do Minimum scenario and the proposed development scenarios, overall travel demand is estimated to increase by a further 2% for Scenarios 1, 2, 3 and 4B, and 3% for Scenarios 4A, 5A, and 5B. The table does not include LGV and HGV demand.

In the development Scenarios compared to the Do Minimum, Table 11 shows a forecast increase of around 48,000 total person trips on average and also an increase of around 25,000 trips by cars and around 4,600 trips across Public Transport (Bus and Rail).

Table 11 Summary of Demand Model results for the entire model – 12 hour period

Entire Model	Car (veh.)	P&R (veh.)	Bus only (pax)	Rail (pax)	TOTAL (persons)
Base Year (BY)	974,474	6,477	102,649	30,238	1,431,020
Do Minimum (DM)	1,380,871	9,396	167,224	40,353	2,036,182
Scenario 1	1,409,096	9,500	167,207	43,287	2,076,617
Scenario 2	1,409,246	9,487	173,246	43,101	2,082,527
Scenario 3A	1,405,849	9,341	170,973	44,003	2,076,596
Scenario 3B	1,407,225	9,433	169,217	43,186	2,075,866
Scenario 3C	1,408,821	9,595	167,499	42,929	2,076,292
Scenario 4A	1,418,153	9,559	167,467	42,664	2,088,220
Scenario 4B	1,409,832	9,549	167,076	42,242	2,076,410
Scenario 5A	1,423,040	9,409	174,132	45,143	2,103,613
Scenario 5B	1,431,879	8,803	159,119	47,659	2,102,424

The car and public transport mode share for all the scenarios are consistent when compared to Do Minimum scenario, since there were no changes to the transport supply with respect to the public transport and the results are presented in Table 12.

Table 12 Mode share – 12 hour period

Entire Model	CAR	Public Transport share
Base Year (BY)	90.7 %	9.3 %
Do Minimum (DM)	89.8 %	10.2 %
Scenario 1	89.9 %	10.1 %
Scenario 2	89.6 %	10.4 %
Scenario 3A	90.5 %	9.5 %
Scenario 3B	89.8 %	10.2 %
Scenario 3C	89.9 %	10.1 %
Scenario 4A	89.9 %	10.1 %
Scenario 4B	89.9 %	10.1 %
Scenario 5A	89.6 %	10.4 %
Scenario 5B	90.2 %	9.8 %

Table 13 and Table 14 summarise travel demand across South Oxfordshire. The growth in travel demand between the 2013 base year and the 2031 Do Minimum scenario shows an increase of around 17% for the SODC area as an origin and destination when considering the trips to/from other districts over a 12-hour period. The growth in travel demand between the 2031 Do Minimum scenario and development scenarios shows an additional increase of around 15% on average for the SODC area.

For the development scenarios compared to the Local Plan, Table 13 shows a forecast increase of 14% total persons trips originating in the South Oxfordshire area and also an increase in car trips (around 26,000) and bus trips (around 1,200), and Table 14 shows forecast increase of around 12% total person trips destined for South Oxfordshire and also an increase in car trips (around 21,000) and bus trips (around 1,000).

In the modelling, the trips are constrained to their origins or destinations. The OSM demand model is constrained to trips originating from dwellings (origins), which would include all the trips from the housing developments enabling the impacts from the proposed housing developments to be identified.

Table 13 Summary of Demand Model results for SODC - Origins 12 hour

SODC as Origin	Reg car (veh.)	P&R (veh.)	Bus only (pax)	Rail (pax)	TOTAL (persons)
Base Year (BY)	159,453	385	4,185	3,801	219,867
Do Minimum (DM)	186,563	588	7,288	5,180	258,340
Scenario 1	211,562	676	7,207	6,700	292,988
Scenario 2	205,276	589	10,604	6,462	287,729
Scenario 3A	209,172	608	9,700	7,169	292,742
Scenario 3B	208,418	631	8,013	6,749	289,650
Scenario 3C	204,657	619	6,914	6,450	283,253
Scenario 4A	219,167	732	7,123	6,242	302,529
Scenario 4B	211,823	706	6,976	6,013	292,434
Scenario 5A	220,177	653	11,166	7,749	309,402
Scenario 5B	222,677	502	9,364	7,295	310,380

Table 14 Summary of Demand Model results for SODC - Destinations 12 hour

SODC as Destination	Reg car (veh.)	P&R (veh.)	Bus only (pax)	Rail (pax)	TOTAL (persons)
Base Year (BY)	157,434	300	3,526	3,608	216,098
Do Minimum (DM)	182,627	449	6,705	4,961	252,190
Scenario 1	206,438	513	6,329	6,028	284,483
Scenario 2	200,833	449	11,005	6,356	282,030
Scenario 3A	204,238	465	9,610	6,717	285,541
Scenario 3B	203,961	479	7,751	6,040	282,662
Scenario 3C	199,992	467	6,124	5,839	275,529
Scenario 4A	214,536	567	6,367	5,947	295,227
Scenario 4B	207,258	543	6,196	5,725	285,177
Scenario 5A	214,983	498	11,495	7,157	302,147
Scenario 5B	218,454	394	9,938	6,968	305,043

4. Do Minimum Highway Network Performance - 2031

4.1. Introduction

Highway network performance is measured in a number of ways: at a high level using network wide statistics and specific statistics and journey times along identified corridors. The metrics used to measure the performance of the highway network are delay (pcu-hours), total time (pcu-hours), total distance (pcu-km) and average speed (km/hr), as defined:

- Delay (pcu-hours) – Delay in the modelled hour experienced by the vehicles on the highway network.
- Total Travel Time (pcu-hours) – Total time spent travelling in the modelled hour by vehicles on the highway network.
- Travel Distance (pcu-km) – Total distance travelled in the modelled hour by vehicles on the highway network.
- Overall Average Speed (km/h) – Average speed of vehicles on the highway network in the modelled hour.

A Passenger Car Unit (PCU) is a means of converting the various types of vehicles including cars, LGV (Light Goods Vehicle) and HGV (Heavy Goods Vehicle) into a single class (equivalent to car) in the model. Cars and LGVs have been modelled as 1 PCU, while HGVs have been modelled as 2.3 PCUs, which is consistent with previous stages of the modelling work.

The outputs from the model can be used to create graphics showing traffic flow on the highway network, link and junction volume to capacity ratios and changes in flow between different scenarios. These have been focussed primarily on the district of South Oxfordshire.

Understanding the impacts of the tested development scenarios on the highway sections in the region enables an assessment of modelled responses of committed and planned transport infrastructure in relation to increased levels of demand and begins to identify where highway mitigation and infrastructure interventions may need to be considered.

The volume to capacity ratio represents the level of congestion on the network and is represented by the ratio of traffic volume to the maximum capacity available at a given point on the highway network. It is given as a percentage, with volume to capacity between 0% - 85% indicating that the network is performing within operational capacity, between 85% - 95% indicating that the network is performing at or near operational capacity, and at 95% and above indicating that the network is performing above operational capacity.

Analysis of performance across the network has been undertaken to compare the Do Minimum and the development scenarios for the modelled morning and evening peak hours. Plots have been produced to show the overall picture of network performance, with highway links and junctions coloured in the following way:

- Green: Link, or junction is performing within operational capacity, with a volume to capacity ratio of between 0% and 85%
- Yellow: Link, or junction is performing near operational capacity, with a volume to capacity ratio of between 85% and 95%
- Red: Link, or junction is performing above operational capacity, with a volume to capacity ratio of over 95%

The colour of a link or node does not represent the length of a queue at a point in the network, although a higher volume to capacity ratio does suggest a higher likelihood of queues developing at that point.

4.2. Highway assumptions

Table 15 summarises all the highway schemes that have been included in the Do Minimum scenario as an addition to the Base Year network, i.e. those schemes assumed to have been delivered across Oxfordshire by 2031.

Table 15 Highway schemes included in the Do Minimum scenario (additional to 2013 Base Year network)

District	Highway scheme description
Cherwell	A41 / Neunkirchen Way roundabout (Rodney House)
Cherwell	A41 Oxford Road / Boundary Way roundabout improvement scheme
Cherwell	Bicester Town Centre changes
Cherwell	M40 J10 Improvements
Cherwell	M40 J9 Phase 2
Cherwell	Oxford Road / Pingle Drive junction
Cherwell	Bucknell Road/A4095 Howes Lane new priority junction
Cherwell	Pioneer Roundabout
Cherwell	Upper Heyford improvement
Cherwell	Updated Bicester SE Perimeter Road as indicated by OCC, Langford Lane is not included in the model for being only a local access
Cherwell	Spine Road through SE Bicester – modelled at a speed of 40 mph (64 km/h) as indicated by OCC
Cherwell	Upgrade of the SE Segment of the A4421
Cherwell	Improvements to Skimmingdish Lane
Cherwell	Tunnel under the rail line – Howes Lane Realignment and the off-site mitigation at Lords Lane
Cherwell	London Road is not available as a through route in the model to reflect the severe restrictions of the level crossing by 2031
Cherwell	Charbridge Lane – dualled
Cherwell	Banbury schemes (Banbury East of M40 J11 Link Road, Banbury Hennef Way Corridor improvements, Banbury Salt Way, Banbury Bridge Street Junction (and other town centre)) were not modelled as Banbury is just outside the simulation area.
Cherwell	Recent changes to the road design of A40-A44 link to the west of A34
Cherwell	Realignment and signalisation of the A4260/ A4095 junctions as part of the Shipton Quarry permitted use
City	Becket Street extension and new junction with Oxpens Road – New site access and link road through Oxpens site
City	Botley interchange – Capacity improvements on circulatory and approaches
City	Cutteslowe and Wolvercote Roundabouts
City	Eastern Arc
City	Frideswide Square including changes to Beckett Street
City	Hinksey Hill – A423 to A34 southbound
City	Hinksey Hill – Science Transit
City	Kennington Roundabout Improvements
City	The Plain and Longwall Street junction – Signal retiming at Longwall Street and cycle improvements
City	West Way / Botley Road Junction
City	Worcester Street/George Street junction
City	Infrastructure around Northern Gateway, which includes the internal link road open to through traffic, the A40-A44 link and improvements to Peartree Interchange
City	Updated Barton site access and bus link
City	Headington roundabout - phase 1 (completed)

District	Highway scheme description
City	Horspath Driftway (being completed as part of Access to Headington Package)
City	Access to Headington Package.
City	2031 Oxford's transport mitigation packages – in this context, this refers to the latest layout around Northern Gateway development, given that the original Do Minimum scenario only included the layout as defined in the spring of 2016. A new layout has been approved in November 2016 and this version is included in the amended Do Minimum. This new version includes: • Updated layout along A40 and A44; • Updated signal timings at Peartree Interchange and Wolvercote Roundabout • Updated layout and signal timings at Cutteslowe Roundabout; • Decrease of penalty on Banbury Road, north of Cutteslowe Roundabout; • Include penalty on Godstow Road to avoid re-routing from A34.
West	A4095/B4022 Staple Hall - Two mini-roundabouts connected by a short connecting link (2014 situation)
West	A415 Ducklington Lane/Station Lane junction improvement - Capacity increase on the Station Lane approach.
West	Brize Norton Village Traffic Calming - Capacity constraint on Minster Road between Elm Grove and Manor Road to reflect link layout change.
West	Downs Road/A40 new junction - At grade roundabout access for Downs Road connecting onto the A40.
West	B4477 Capacity Enhancement through widening (although still single carriageway)
West	Straightening of the existing road between the A40 at Minster Lovell south to the roundabout junction north of Brize Norton
West	Includes bus lane eastbound between Eynsham and Duke's Cut Bridge and the related improvements to Eynsham and Cassington junction to accommodate the bus lane
West	Shilton Link Road from B4020 to Elmhurst Way
Vale/South	Harwell Link Road Section 1 (B4493 to A417)
Vale/South	Didcot Northern Perimeter Road Stage 3
Vale/South	Wantage Eastern Link Road (WELR)
Vale/South	A34 Milton Interchange Hamburger
Vale/South	A34 Chilton Northern Slip Roads
Vale/South	Foxhall Bridge Widening
Vale/South	Access to Harwell Section 2 (Hagbourne Hill)
Vale/South	Grove Northern Link Rd
Vale/South	Rowstock Roundabout improvements
Vale/South	Featherbed/Steventon Lights junction improvements
Vale/South	Great Western Park access
Vale/South	Valley Park spine road (A4130 – B4493)
Vale/South	Coding to reflect traffic management measures in villages (Harwell)
Vale/South	Harwell Oxford all access points junction improvements
Vale/South	Improvements to traffic signals at Frilford Junction (A415/A336)
Vale/South	Junctions on A4130
Vale/South	A420 Western Vale infrastructure (Faringdon – access to The Steeds development)
Vale/South	Lodge Hill Interchange (South facing slip roads onto the A34)
Vale/South	Clifton Hampden Bypass
Vale/South	Culham to Didcot Thames River Crossing (eastern alignment)
Vale/South	Science Bridge modelled with two roundabouts as in the OCC layout & A4130 Capacity Improvements
Vale/South	South Access to Valley Park Spine Road modelled according to the layout provided by Brookbanks (5 arm roundabout).
Vale/South	A420-Highworth Road, Shrivenham

4.3. Park and Ride assumptions

The six proposed peripheral Park and Ride sites were not included in the updated Do Minimum scenario with the exception of Eynsham (OCC, May 2016). The location and accesses of Eynsham P&R site have been provided by WODC when defining the scope of this work. All the existing P&R sites will be kept open and the catchment areas will be the ones defined for the A40 Corridor Study (October 2015).

4.4. Public Transport assumptions

Table 16 and Table 17 summarise all the public transport schemes that have been included in the Do Minimum scenario as additions to the Base Year network. The scheme details have been provided by OCC.

Table 16 Public Transport Schemes included in the scenarios - Bus

District	Bus scheme description
Cherwell	2 new buses per hour to Banbury via Bankside plus enhancement of service S4 between Deddington and Banbury via main road
Cherwell	Create additional services between Upper Heyford and Bicester, also Upper Heyford with Oxford with an additional frequency of 1 bph for all time periods. (new frequency 2 buses per hour)
Cherwell	Create new bus service from NW Bicester to Bicester Town Centre with a frequency of 6 buses per hour in each direction
Cherwell	Create new bus service between Bicester Town Centre and Oxford going through Graven Hill (using Spine Road through SE Bicester and Bicester SE Perimeter Road) with a frequency of 2 buses per hour in each direction
Cherwell	Update of the bus service S5 to stop at Graven Hill;
Cherwell	S5 has two additional variants: • S5a with 2 buses per hour and the following route: Glory Farm – Manorsfield Road – A41 – A34 – Bicester Road – Banbury Road – Headley Way – Brookes University • S5b with 2 buses per hour and the following route: Manorsfield Road – Launton Road – Charbridge Lane – South East Bicester link Road – A41 – A34 – Bicester Road – Banbury Road – Oxford (City Centre)
Cherwell	As a consequence of the ban on London Road, all the buses using this segment previously were re-routed via Charbridge Lane.
Cherwell	Route 25A Oxford-Kirtlington-Upper Heyford-Bicester, now operating with a frequency of 2 bph; Remove Route 25 Woodstock-Kirtlington-Wendlebury-Bicester
City/Cherwell	S4 service Banbury-Deddington-Kidlington-Oxford now operating with a frequency of 2 bph
City/Cherwell	Bus service 500 became 4 buses per hour with the following route: Woodstock/Airport P&R – Bladon – Langford Lane – A44 – Water Eaton P&R – Oxford
City/Cherwell	Bus service 700 became 4 buses per hour with the following route: Woodstock/Airport P&R – Bladon – Langford Lane – A44 – Water Eaton P&R – Headington
City	Remove Route 17 Cutteslowe - Oxford
City	Frequency update for services 800 and 900
City	Bus services serving Barton development (re-routing of bus service 8 and new shuttle service between Barton and John Radcliffe Hosp. with a frequency of 2bph);
City	There are 2 new bus stops and a signalised pedestrian crossing on the A4165 (Oxford Road) adjacent to Oxford Parkway rail station. These are served by: • Service 2 (and all its variations) serve these stops • Service S5 (and all its variants) serve these stops • Service S4 serves these stops • Service 25A served these stops • Services 500 and 700 serve both the Park & Ride site and also the stops on the A4165.
City/West	S7 service for Northern Gateway now operating all day with a frequency of 4 bph;
City/West	S2 service now operating with a frequency of 4 bph to serve Eynsham P&R, topped up by an additional 4 buses per hour Eynsham-Wolvercote-Oxford (new service S2a)

District	Bus scheme description
City/West	S1 service now operating via B4044 with a frequency of 4 bph
City/West	Remove Route 18 Oxford-Woodstock Road-A40-Eynsham-Bampton
West	2 buses per hour (Chipping Norton – Banbury) (currently one bus per hour)
Vale/South	Faringdon - Increase 66 service (Swindon-Oxford) to 3 buses/hour
Vale/South	Wallingford - Increase X39 service (Wallingford-Oxford) to 3 buses/hour
Vale/South	Thame - Increase 280 (Thame - Oxford) to 4 buses/hour
Vale/South	2 buses per hour Harwell-Crab Hill-Grove Airfield-Milton Park-Didcot (service 36) plus diversion of 2 buses per hour Wantage-Oxford through site (either x30 or 31)
Vale/South	"North East Didcot, 4 buses per hour to Didcot Town Centre and Station and then 2 of these extended to Milton Park and on to Harwell"
Vale/South	"Valley Park, 2 buses per hour Didcot-Wantage Road-Valley Park-Milton Park plus 2 buses per hour Didcot - main road - Valley Park – Harwell"
Vale/South	"Great Western Park, same pattern as at Valley Park, 4 per hour to Didcot Town Centre, 2 to Milton Park, 2 to Harwell"

Table 17 Public Transport Schemes included in the scenarios - Rail

Line	Rail scheme description
East West Rail	East West Rail comprises four new services:
	• Reading – Bedford with a headway of 60 minutes all day;
	• Reading – Milton Keynes with a headway of 60 minutes all day;
	• Bletchley – Milton Keynes with a headway of 60 minutes all day;
	• Milton Keynes – Marylebone with a headway of 60 minutes all day.
Evergreen 3	Evergreen3 from Chiltern Railway consists in the creation of a new service between Oxford and London Marylebone, with a headway of 30 minutes all day.
North Cotswolds Line	The services inherited from the Base Year have been substituted by the following (for all time periods):
	• Worcester to/from London Paddington – 1 tph
	• Hanborough to/from London Paddington – 1 tph
	• Hanborough to/from Oxford – 1 tph
Culham Station	The following services now stop at Culham and Radley (in all time periods):
	• Reading to/from Bedford – 1 tph
	• Reading to/from Milton Keynes – 1 tph
Oxford to Didcot	Additionally, two more trains per hour stop at Radley and 1 train per hour stops at Appleford (in all time periods).
Didcot Parkway	For the service between Swindon and London Paddington, 1 more train per hour was added to the ones inherited from the Base Year, making a total of 3 tph (only morning and evening).
Henley-on-Thames	Shuttle service between Henley and Twyford with a frequency of 2 tph, allowing the transfer to the services to London and Oxford.
Banbury to Oxford	The direct service between Banbury and London Paddington was substituted by a shuttle between Banbury and Didcot (in morning and evening) and Banbury and Oxford (in IP) with a frequency of 1 tph.
Oxford to Heathrow	A service with 2 tph already exists between Oxford – Didcot Parkway – Reading – Heathrow – London Paddington. Updated journey time.
Oxford - Swindon/Bristol	New regional service between (Nottingham – Loughborough - Leicester – Kettering - Wellingborough -) Bedford – Bletchley – Bicester Village – Oxford Parkway – Oxford – Didcot – Swindon – Chippenham - Bath – Bristol with 1 tph.
Cowley Branch	New service between Bicester and Oxford Retail Park with a frequency of 1 tph. The line and service are coded but not currently used in the PT model as it creates instability.

4.5. Do Minimum Housing Scenario 2031

4.5.1. Network Performance

The modelled highway network performance within the District for the Do Minimum Scenario for 2031 is shown in the Table 18. Comparisons against these statistics will provide a high-level summary of how the model has responded to the changes in land use assumptions associated with the scenarios. As identified during Stage 1, while some of the District is outside the detailed simulation area, these statistics are an average for the District as a whole and include all links (simulation and buffer) and all links (motorways, A-roads, B-roads and minor roads). Hence, the average speed may be higher than expected since the detailed junction modelling is not included in the buffer network.

Table 18 South Oxfordshire District modelled network performance – 2031 Do Minimum

Do Minimum	South Oxfordshire	
	Morning Peak	Evening Peak
Delay (pcu-hr)	522	611.2
Total Time (pcu-hr)	6060.4	6719.4
Total Distance (pcu-km)	378301.7	408409.9
Average Speed (km/hr)	62.4	60.8

4.5.2. Corridor Performance

The key corridors for highway network performance are described in Section 4.1. This section describes the corridor performance in the Do Minimum scenario for the morning and evening peak hours based on the volume to capacity ratios on the highway network. The volume-capacity plots are presented for the Do Minimum in Figure 6 and Figure 7.

4.5.2.1. A40

The A40 connects multiple settlements within Oxfordshire; in South Oxfordshire, it connects Oxford, Wheatley, and Tetsworth.

The Do Minimum scenario shows that the A40 is forecast to be operating below operational capacity in the northbound and southbound directions between Wheatley and the M40 Junction for both the morning and evening peak hours.

The eastbound and westbound approaches at Headington roundabout are forecast to be operating above operational capacity.

4.5.2.2. A4074

The A4074 provides one of three north-south routes through the District, in this case between Shillingford and the Oxford Eastern By-pass. The route consists of traffic travelling from / to Oxford, Sandford- on-Thames, Nuneham Courtenay, Berinsfield, Burcot, Dorchester and Shillingford.

The Do Minimum forecast suggests that the A4074 is operating at or above operational capacity in the morning peak hour in the northbound direction between Berinsfield roundabout and the Golden Balls roundabout and above capacity in the northbound direction between Heigh View and Lower Farm Lane, Benson Lane and Church Road, Golden Balls roundabout and Baldon Lane. In the evening peak hour, the Do Minimum modelling suggests that the A4074 is operating at or above operational capacity in the northbound direction between Baldon Lane and Lower Farm and above capacity between the Golden Balls roundabout, on Baldon Lane in both directions and southbound between Church Road and Crowmarsh roundabout.

4.5.2.3. B480

The B480 caters for north-south movements between Oxford, Stadhampton, Chalgrove, Cuxham and Watlington.

The Do Minimum forecast shows that the B480 is forecast to be below operational capacity in both morning and evening peak hours.

4.5.2.4. A34

The A34 caters for north-south movements between Oxford, Abingdon, Didcot, and Milton. The Do Minimum forecast shows that the A34 is forecast to be above operational capacity in some areas, in both morning and evening peak hours – notably near Abingdon.

Figure 6 SODC volume-capacity ratio (%) – 2031 Do Minimum morning peak hour

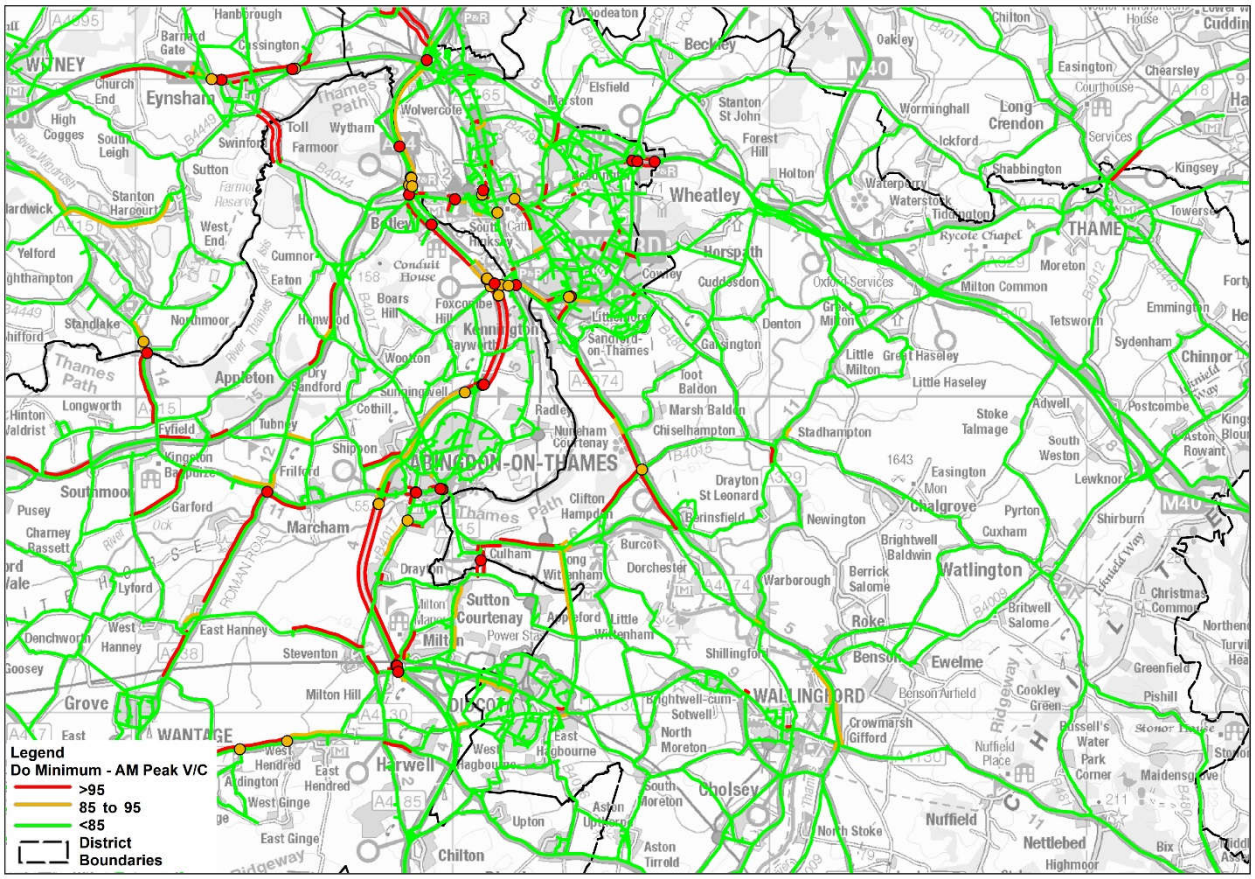
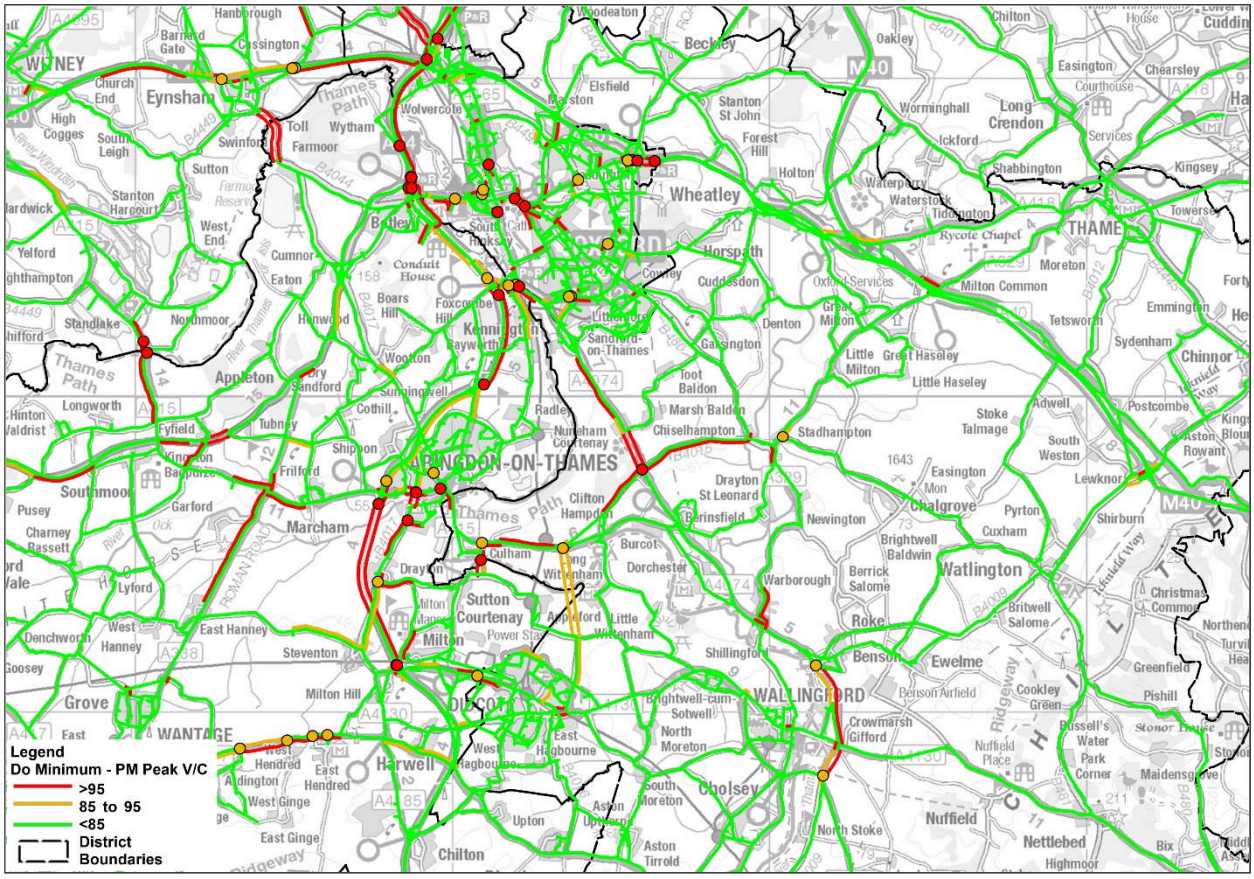


Figure 7 SODC volume-capacity ratio (%) – 2031 Do Minimum evening peak hour



5. Scenarios Highway Network Performance

5.1. Introduction

The highway network performance of the different scenarios is measured using the metrics discussed in section 4.1. This section presents, for each mitigation scenario, the forecast impact of the development on those corridors and describes the modelled changes in flow and volume to capacity ratio between different scenarios compared to the Do Minimum Scenario.

5.2. Scenario 1

Scenario	Proposed development Site Allocations (above those in the Do Minimum)	Mitigation Included (above that in the Do Minimum)
1	Culham (3500), Chalgrove (3000), Wheatley (300), Berinsfield (1700), Neighbourhood Plan commitments and targets	Stadhampton Bypass, Chiselhampton Bypass, Watlington Bypass, Benson Bypass, Golden Balls Junction with additional eastbound filter lane (between B4015 and A4074)

5.2.1. Network Performance

The modelled highway network performance within the District for the Local Plan and Scenario 1 are shown in the Table 19 and Table 20. These statistics give a high-level summary of how the model has responded to the changes in highway network.

Table 19 South Oxfordshire District modelled network performance - morning peak 2031

	South Oxfordshire		
	Do Minimum	Scenario 1	Difference (S1-DM)
Delay (pcu-hr)	522	896	374.6
Total Time (pcu-hr)	6060.4	6862.7	802.3
Total Distance (pcu-km)	78301.7	396807.0	18505.3
Average Speed (km/hr)	62.4	57.8	-4.6

Table 20 South Oxfordshire District modelled network performance - evening peak 2031

	South Oxfordshire		
	Do Minimum	Scenario 1	Difference (S1-DM)
Delay (pcu-hr)	611.2	828.6	217.4
Total Time (pcu-hr)	6719.4	7405.9	686.5
Total Distance (pcu-km)	408409.9	430043.9	21634.0
Average Speed (km/hr)	60.8	58.1	-2.7

5.2.2. Flow and Capacity Impacts

The forecast flow difference between Scenario 1 and the Do Minimum modelled across the District is shown in Figure 8 and Figure 9. The forecast volume to capacity plots for Scenario 1 are shown in Figure 10 and Figure 11.

- Additional morning demand at Culham (3,500 new dwellings) is forecast to result in increased network stress on the A415 in both directions leading away from the development site, and Abingdon Road is forecast to operate near capacity.
- Culham growth is forecast to lead to pinch points in the adjoining network. The proposed Thames River crossing and junction with the A415 are forecast to be over capacity during both the morning and evening peaks. This is related to the design tested which may require further investigation.
- In the Do Minimum Scenario a bottleneck is forecast on the B4015 eastbound approach to Golden Balls Roundabout, northbound traffic volumes are likely to lead to these delays, as B4015 vehicles are unable to consistently join the circulatory. In Scenario 1, congestion is relieved from the B4015 and Golden Balls, but is forecast to shift downstream and onto the A4074 northbound where additional demand is likely to cause delays and speed reductions along the corridor.
- At Chalgrove (3,000 new dwellings), the development access link is near or at capacity during both morning and evening peaks, but the adjoining network appears to accommodate increased demand as the Stadhampton bypass is forecast to relieve congestion at the Thame Road roundabouts at Stadhampton.
- There is a forecast decrease in congestion along the A4074 section from Berinsfield Roundabout to Golden Balls Roundabout, with Golden Balls now forecast to operate below capacity during the morning peak. Overall, the A4074 shows increased northbound demand from Wallingford, resulting in reduced speeds throughout the corridor (Figure 10).
- Morning peak northbound flows appear to route via the Chiselhampton Bypass and onto the B480, where there is spare capacity, but this is likely to result in forecast speed reductions and increased delays (Figure 8).
- In both the morning and evening peaks traffic is drawn towards Watlington and Stadhampton Bypasses. This may lead to instances of over-capacity links along the B480 southbound towards Stadhampton during the evening peak.

Figure 8 South Oxfordshire flow difference (Scenario 1 - Do Minimum) (PCU/hr) – 2031 morning peak

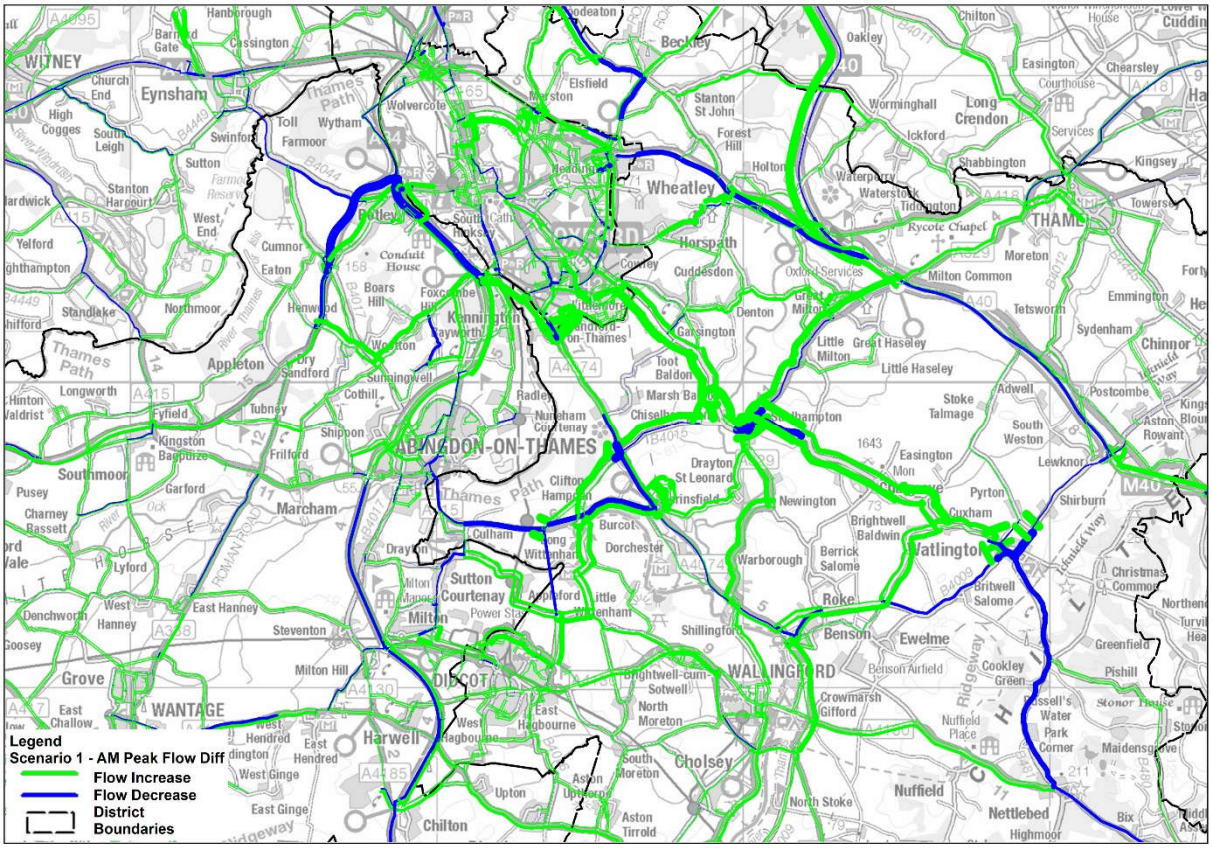


Figure 9 South Oxfordshire flow difference (Scenario 1 - Do Minimum) (PCU/hr) – 2031 evening peak

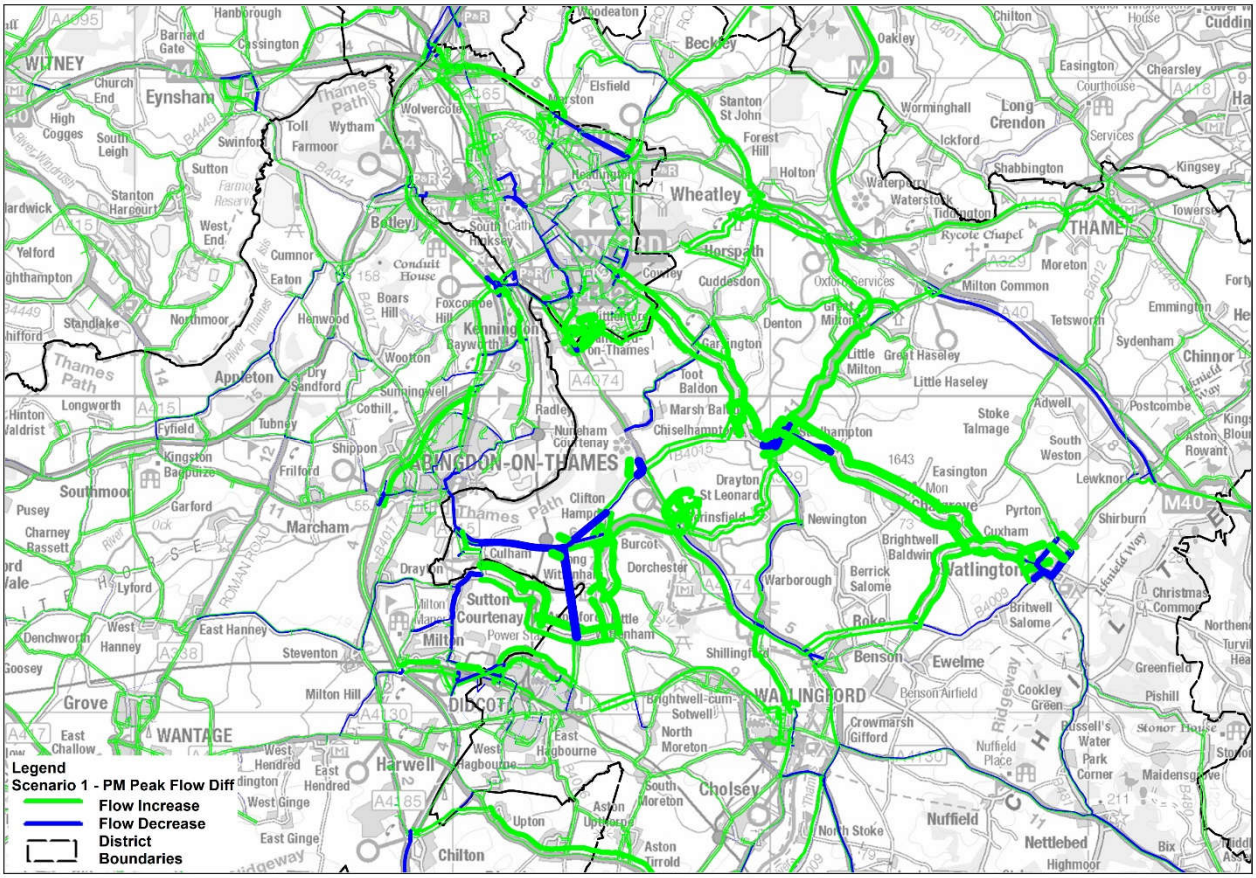


Figure 10 South Oxfordshire V/C for links and junctions – 2031 Scenario 1 morning peak hour

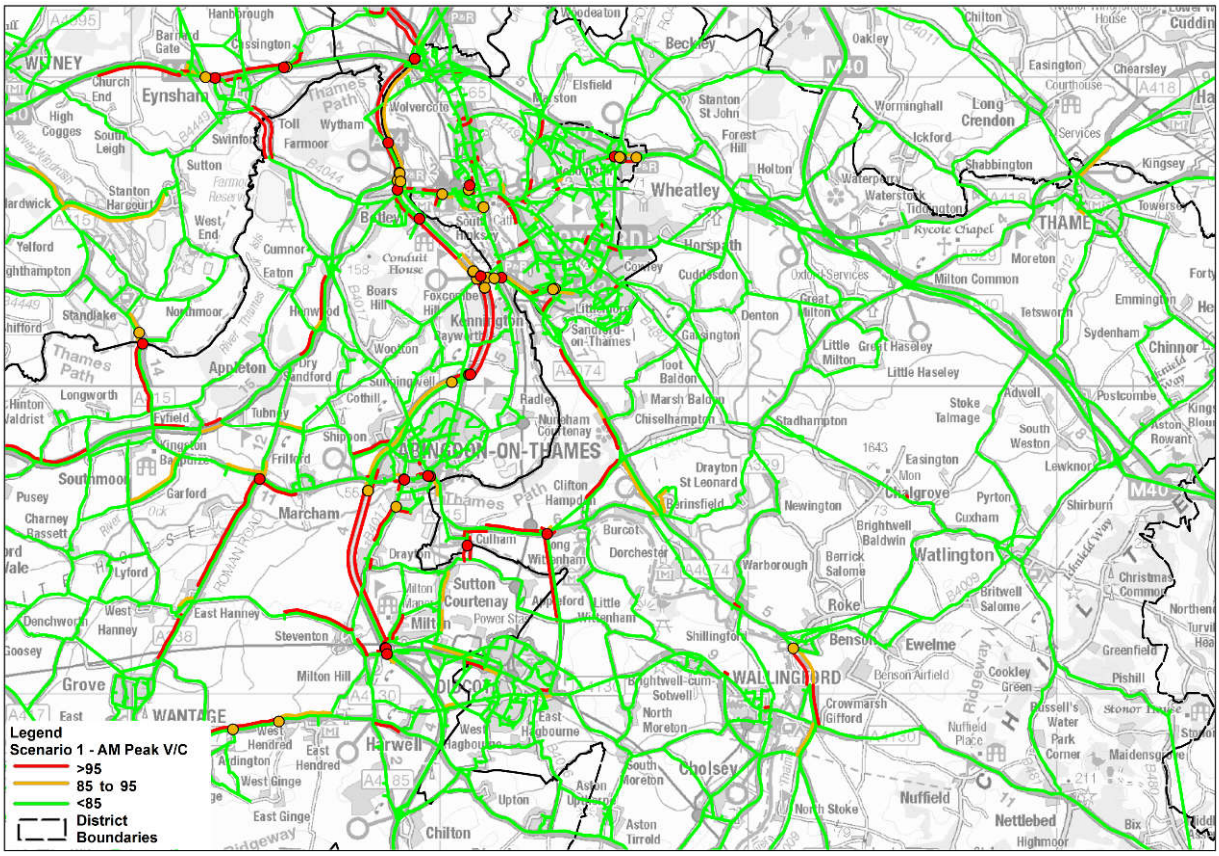
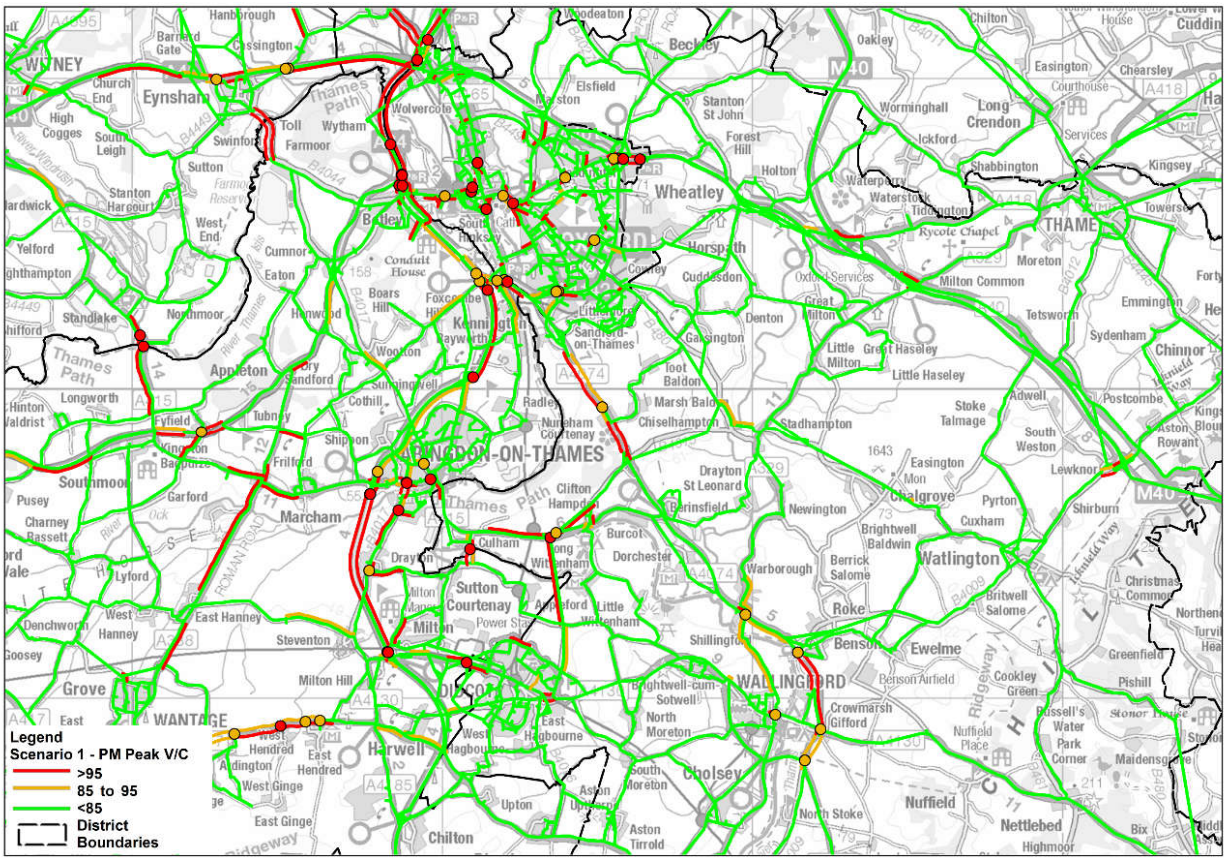


Figure 11 South Oxfordshire V/C for links and junctions – 2031Scenario 1 evening peak hour



5.3. Scenario 2

Scenario	Proposed development Site Allocations (above those in the Do Minimum)	Mitigation Included (above that in the Do Minimum)
2	Thornhill (875), Northfield (2000), Grenoble Road (3000), Berinsfield (1700), Wick Farm/Lower Elsfield (2036), Neighbourhood Plan commitments and targets	Watlington Bypass, Benson Bypass, Golden Balls Junction with additional eastbound filter lane (between B4015 and A4074)

5.3.1. Network Performance

The modelled highway network performance within the District for the Do Minimum and Scenario 2 are shown in Table 21 and Table 22.

These statistics give a high-level summary of how the model has responded to the changes in land use assumptions and network changes.

Table 21 South Oxfordshire District modelled network performance - morning peak 2031

	South Oxfordshire		
	Do Minimum	Scenario 2	Difference (S2-DM)
Delay (pcu-hr)	522	616	94.6
Total Time (pcu-hr)	6060.4	6375.6	315.2
Total Distance (pcu-km)	378301.7	386872.1	8570.4
Average Speed (km/hr)	62.4	60.7	-1.7

Table 22 South Oxfordshire District modelled network performance - evening peak 2031

	South Oxfordshire		
	Do Minimum	Scenario 2	Difference (S2-DM)
Delay (pcu-hr)	611.2	832.2	221.0
Total Time (pcu-hr)	6719.4	7184.0	464.6
Total Distance (pcu-km)	408409.9	421633.8	13223.9
Average Speed (km/hr)	60.8	58.7	-2.1

5.3.2. Flow and Capacity Impacts

The forecast flow difference between Scenario 2 and the Do Minimum modelled across the District is shown in Figure 12 and Figure 13. The forecast volume to capacity plots for Scenario 2 are shown in Figure 14 and Figure 15.

- The flow difference plots (Figure 12 and Figure 13) suggest reduced demand along the A415, but both the corridor and Thames River Crossing continue to operate at or near capacity during the morning and evening peaks.
- Accesses to the Wick Farm/Flower Elsfield Development (2,036 new dwellings) are forecast to distribute to demand into different corridors but are likely to result in increased congestion along the links leading to the A40. There is also a forecast increase to network stress at the Headington Roundabout.
- At Grenoble Road development in Sandford-on-Thames (3,000 new dwellings) demand is directed toward the A4074, which is likely to lead to an increase in northbound demand during the morning peak, with potential for increased congestion towards the Heyford Hill Roundabout.
- The Northfield and Wheatley development sites are not forecast to have noticeable network impacts.

Figure 12 South Oxfordshire flow difference (Scenario 2 – Do Minimum) (PCU/hr) – 2031 morning peak

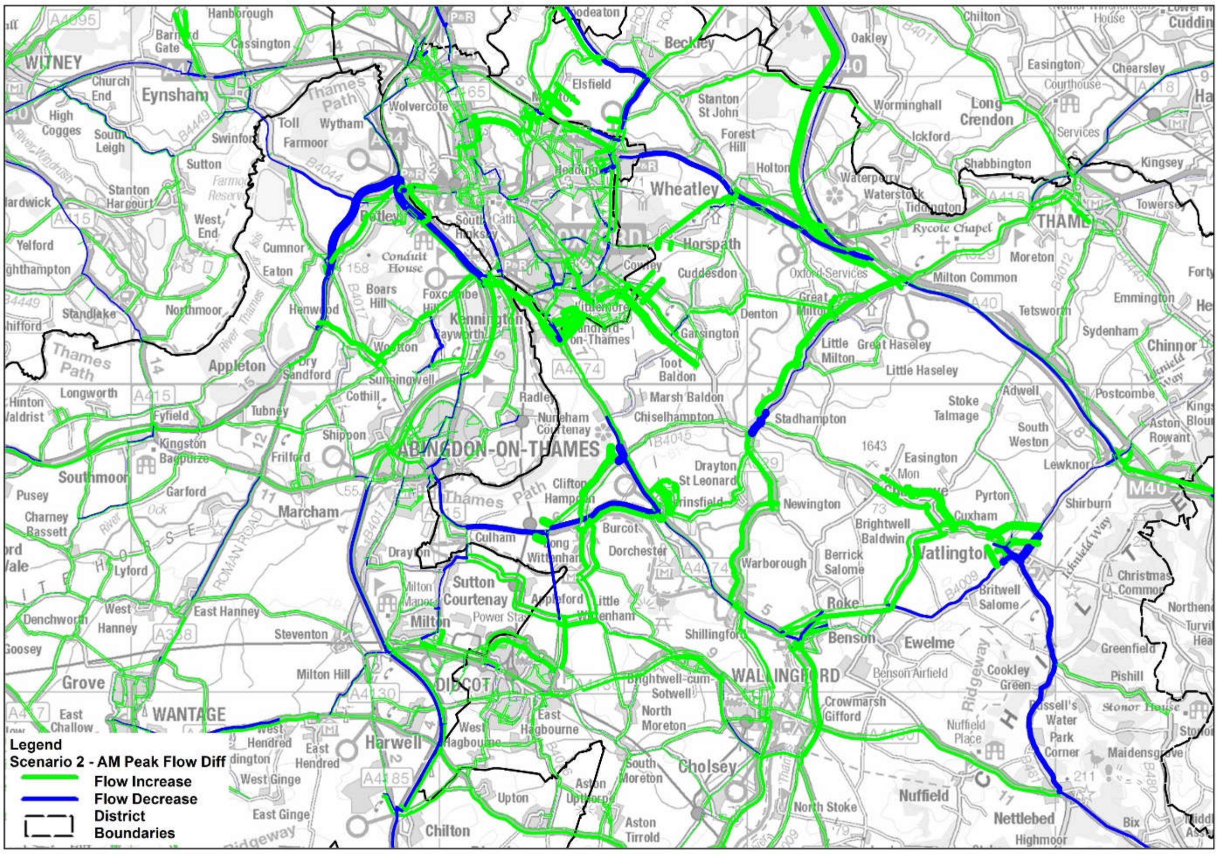


Figure 13 South Oxfordshire flow difference (Scenario 2 – Do Minimum) (PCU/hr) – 2031 evening peak

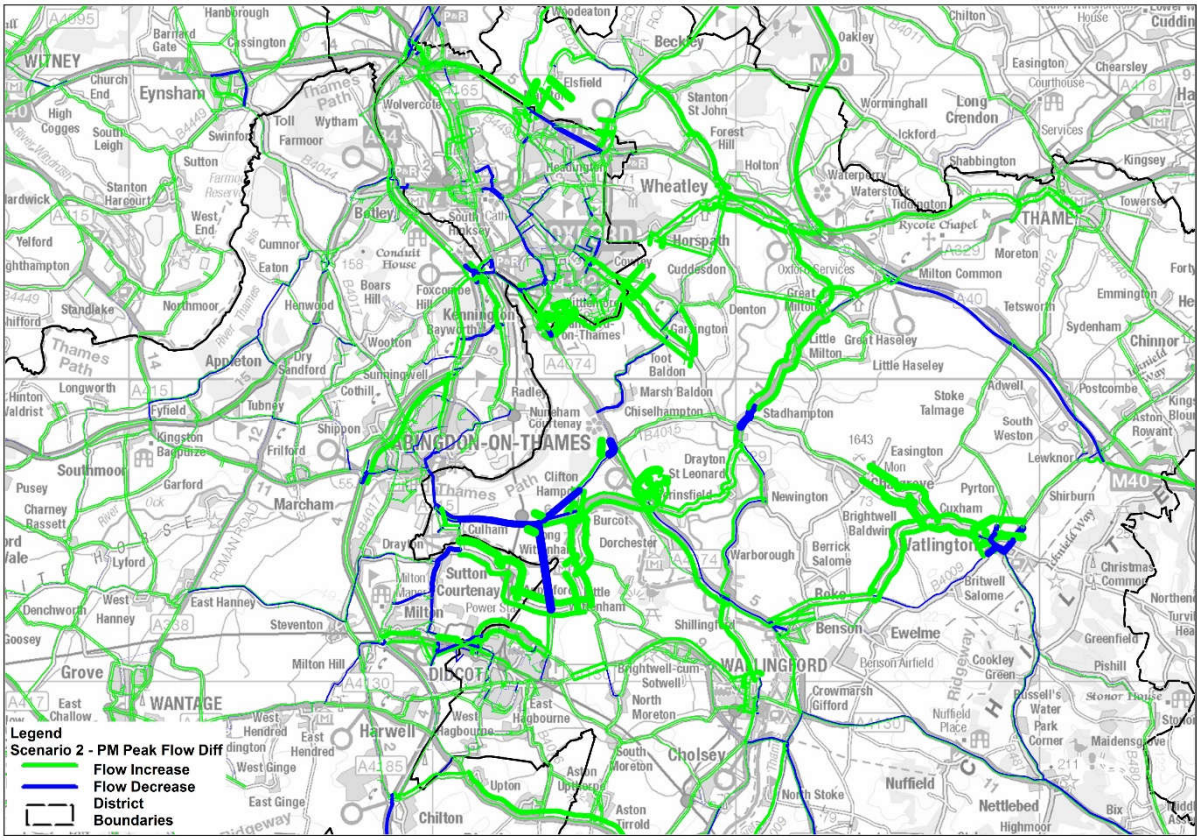


Figure 14 South Oxfordshire V/C for links and junctions – 2031 Scenario 2 morning peak hour

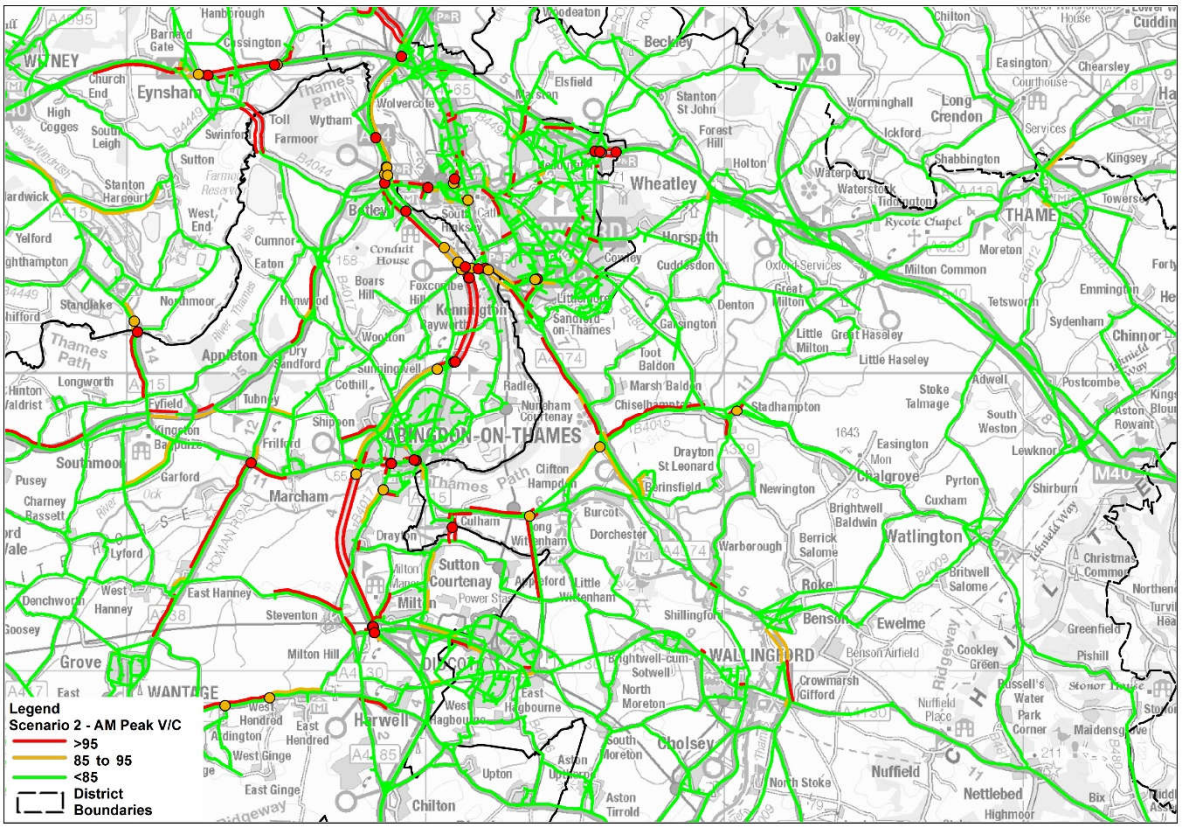
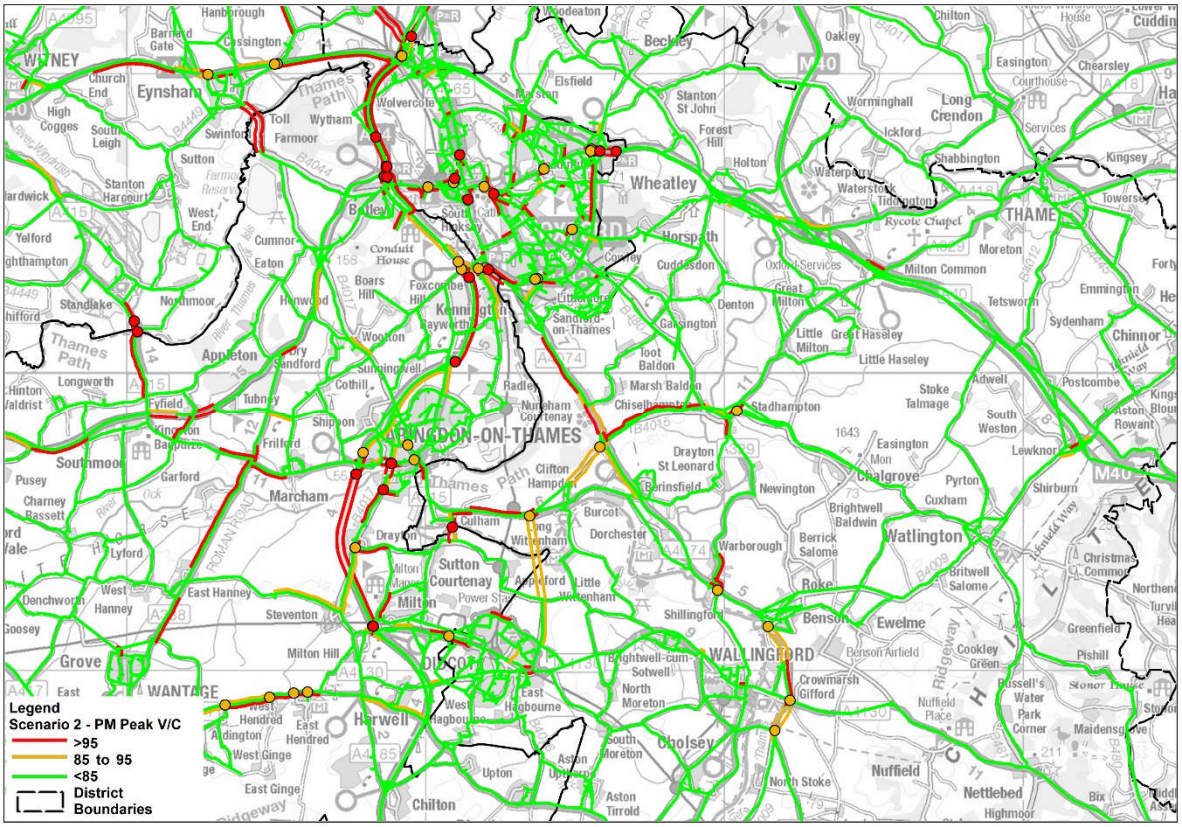


Figure 15 South Oxfordshire V/C for links and junctions – 2031 Scenario 2 evening peak hour



5.4. Scenario 3A

Scenario	Proposed development Site Allocations (above those in the Do Minimum)	Mitigation Included (above that in the Do Minimum)
3A	Grenoble Road (3000), Culham (3500), Wheatley (300), Berinsfield (1700), Neighbourhood Plan commitments and targets	Watlington Bypass, Benson Bypass, Golden Balls Junction with additional eastbound filter lane (between B4015 and A4074)

5.4.1. Network Performance

The modelled highway network performance within the District for the Do Minimum and Scenario 3A are shown in Table 23 and Table 24.

These statistics give a high-level summary of how the model has responded to the changes in land use assumptions and network changes.

Table 23 South Oxfordshire District modelled network performance - morning peak 2031

	South Oxfordshire		
	Do Minimum	Scenario 3A	Difference (S3A-DM)
Delay (pcu-hr)	522	920	398.2
Total Time (pcu-hr)	6060.4	6669.5	609.1
Total Distance (pcu-km)	378301.7	386912.5	8610.8
Average Speed (km/hr)	62.4	58.0	-4.4

Table 24 South Oxfordshire District modelled network performance - evening peak 2031

	South Oxfordshire		
	Do Minimum	Scenario 3A	Difference (S3A-DM)
Delay (pcu-hr)	611.2	903.3	292.1
Total Time (pcu-hr)	6719.4	7247.8	528.4
Total Distance (pcu-km)	408409.9	418793.2	10383.3
Average Speed (km/hr)	60.8	57.8	-3.0

5.4.2. Flow and Capacity Impacts

The forecast flow difference between Scenario 3A and the Do Minimum across the District are shown in Figure 16 and Figure 17. The forecast volume to capacity plots for Scenario 3A are shown in Figure 18 and Figure 19. Additional demand is at Culham, Berinsfield, Wheatley and Grenoble Road.

- Additional demand at Culham (3,500 new dwellings) is forecast to lead to increased network stress on the A415 in both directions away from the development site in the morning peak, with these links forecast to operate near or at capacity. The Culham demand growth is forecast to increase junction v/c in the surrounding network. Tollgate Road/Abingdon Road, an existing Thames crossing, is forecast to be heavily congested. The proposed Thames River crossing and junction with the A415 are also likely to be affected by growth, with the link and junction forecast to operate over capacity during both morning and evening peaks.
- At Grenoble Road (3,000 new dwellings) demand is directed toward the A4074, resulting in northbound traffic during the morning peak experiencing high levels of congestion towards Heyford Hill Roundabout.
- Some demand relief is forecast to the A4074 from Berinsfield Roundabout to Golden Balls during the morning peak despite additional demand (1,700 new dwellings) at Berinsfield, some of the additional demand is forecast to route via Drayton St Leonard, which may result in additional congestion at Stadhampton.

Figure 16 South Oxfordshire flow difference (Scenario 3A – Do Minimum) (PCU/hr) – 2031 morning peak

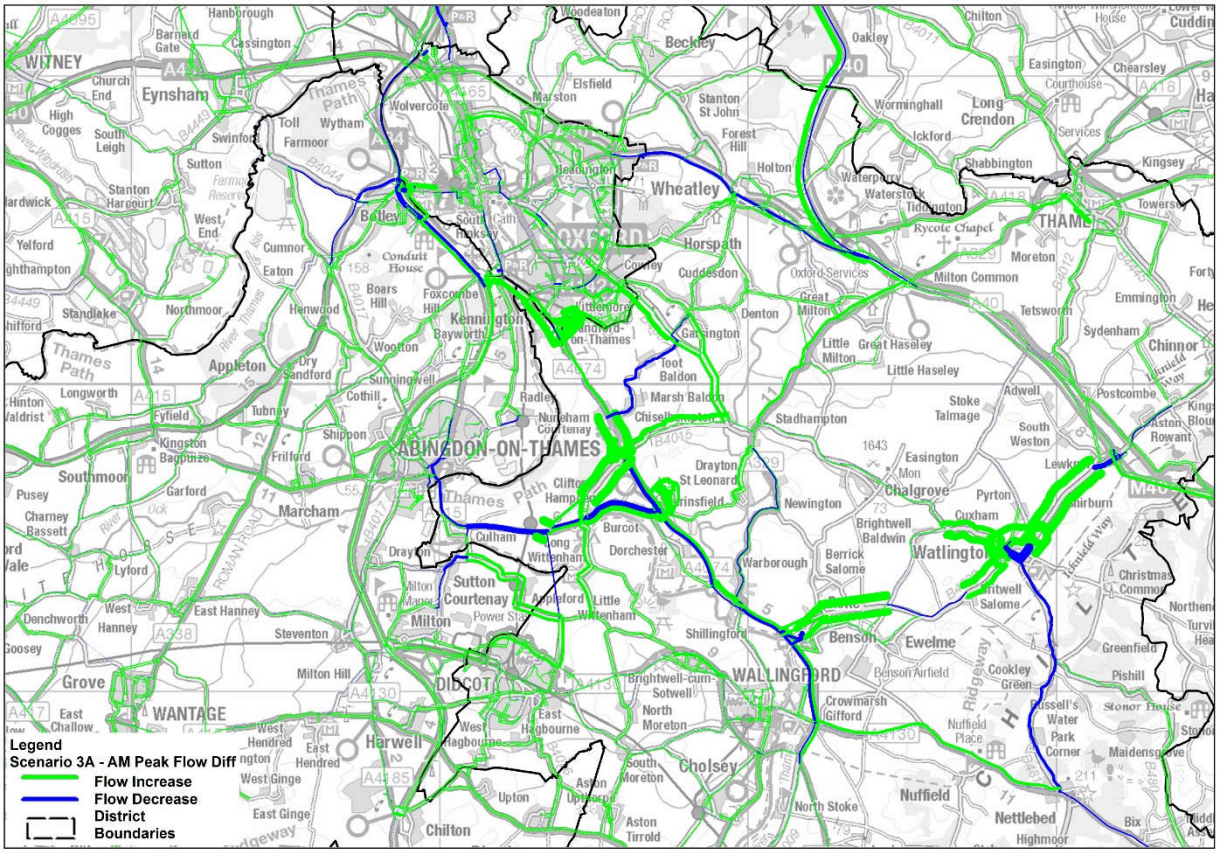


Figure 17 South Oxfordshire flow difference (Scenario 3A – Do Minimum) (PCU/hr) – 2031 evening peak

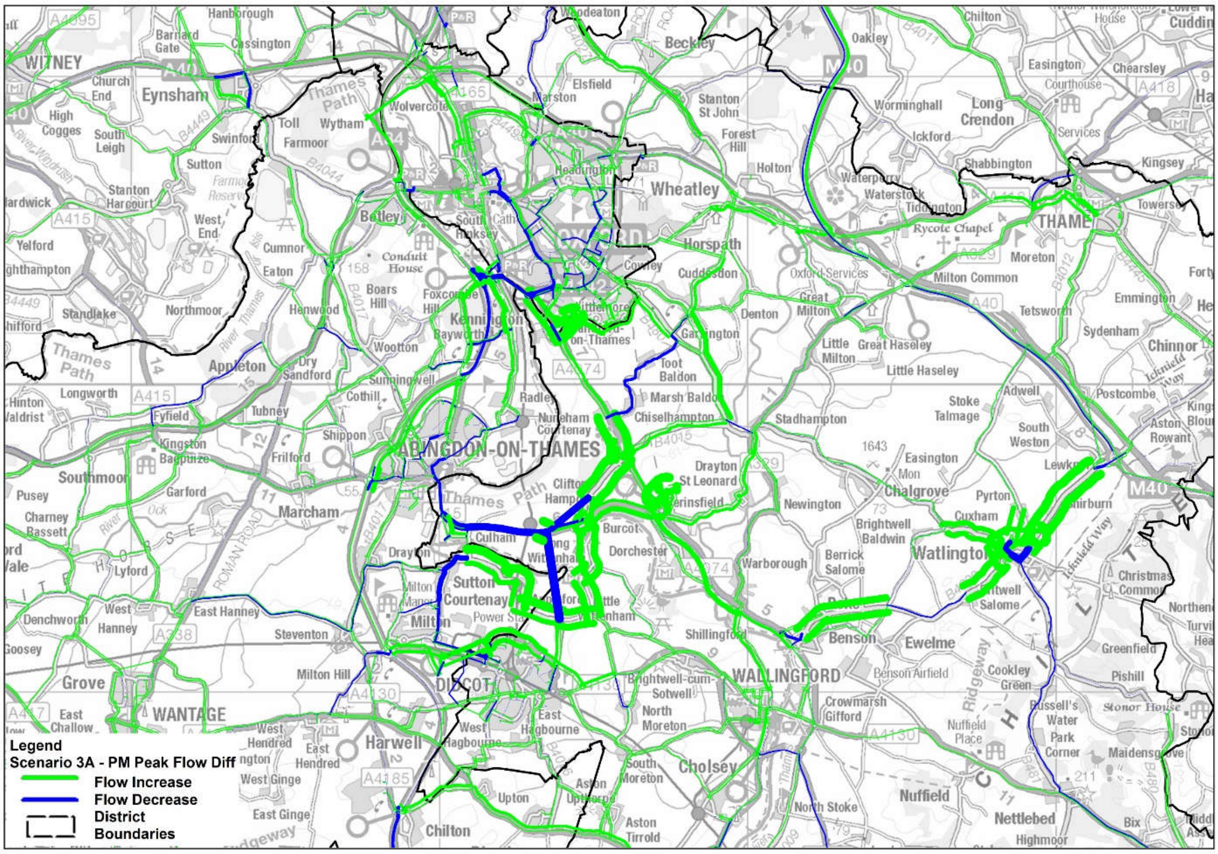


Figure 18 South Oxfordshire V/C for links and junctions – 2031 Scenario 3A morning peak hour

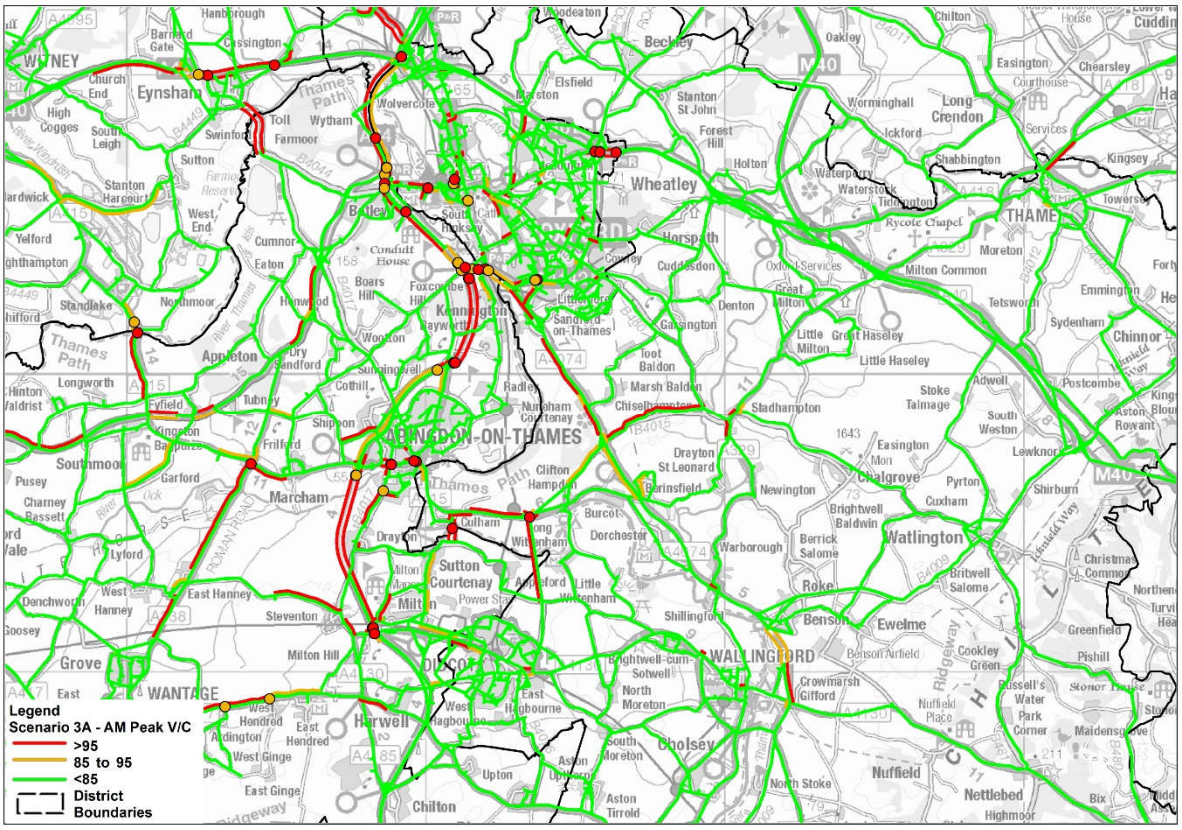
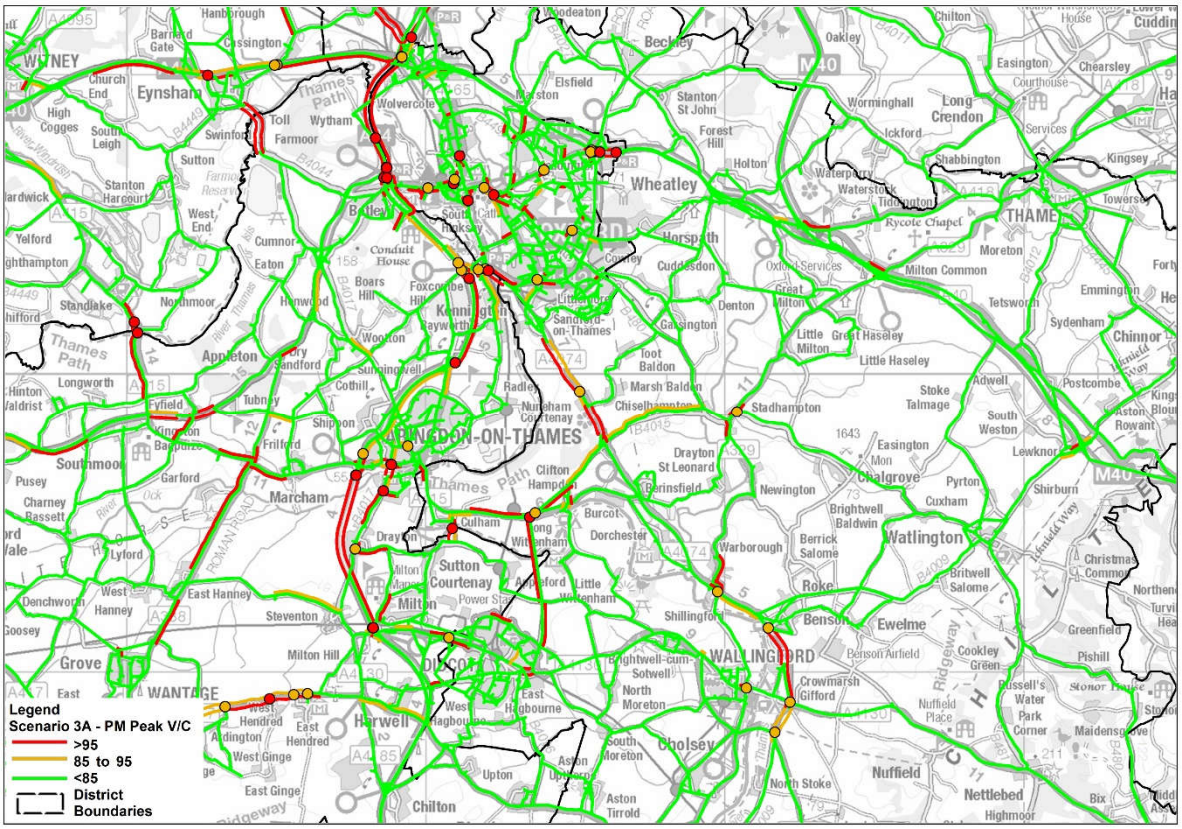


Figure 19 South Oxfordshire V/C for links and junctions – 2031 Scenario 3A evening peak hour



5.5. Scenario 3B

Scenario	Proposed development Site Allocations (above those in the Do Minimum)	Mitigation Included (above that in the Do Minimum)
3B	Thornhill (875), Northfield (2000), Culham (3500), Wheatley (300), Berinsfield (1700), Neighbourhood Plan commitments and targets	Watlington Bypass, Benson Bypass, Golden Balls Junction with additional eastbound filter lane (between B4015 and A4074)

5.5.1. Network Performance

The modelled highway network performance within the District for the Do Minimum and Scenario 3B are shown in Table 25 and Table 26.

These statistics give a high-level summary of how the model has responded to the changes in land use assumptions and network changes.

Table 25 South Oxfordshire District modelled network performance - morning peak 2031

	South Oxfordshire		
	Do Minimum	Scenario 3B	Difference (S3B-DM)
Delay (pcu-hr)	522	972	450.6
Total Time (pcu-hr)	6060.4	6750.8	690.4
Total Distance (pcu-km)	378301.7	388004.3	9702.6
Average Speed (km/hr)	62.4	57.5	-4.9

Table 26 South Oxfordshire District modelled network performance - evening peak 2031

	South Oxfordshire		
	Do Minimum	Scenario 3B	Difference (S3B-DM)
Delay (pcu-hr)	611.2	858.8	247.6
Total Time (pcu-hr)	6719.4	7238.9	519.5
Total Distance (pcu-km)	408409.9	420640.6	12230.7
Average Speed (km/hr)	60.8	58.1	-2.7

5.5.2. Flow and Capacity Impacts

The forecast flow difference between Scenario 3B and Do Minimum modelled across the District are shown in Figure 20 and Figure 21. The forecast volume to capacity plots for Scenario 3B are shown in Figure 22 and Figure 23.

- The Culham development (3,500 new dwellings) is forecast to increase network stress on the A415 in both directions leading away from the development site, with these movements forecast to operate near or at capacity. The Culham development is also forecast to lead to increased network stress on the surrounding network. Tollgate Road/Abingdon Road, is forecast to be heavily congested. The proposed Thames River crossing and junction with the A415 are also likely to be impacted upon, with the link and junction forecast to operate over capacity during both the morning and evening peaks.
- The Clifton Hampden Bypass is forecast to accommodate demand during the evening peak. Access to and junction layout around the Culham Didcot Thames River Crossing may need to be reviewed at an operational level to ensure that forecast demand can be accommodated.
- The additional eastbound filter lane at Golden Balls (between B4015 and A4074) is likely to relieve congestion along the A4074 from Berinsfield Roundabout to Golden Balls as northbound vehicles travel via Clifton Hampden.
- Forecast increases in demand are predicted to result in capacity constraints at Watlington and Stadhampton during the morning peak.
- Additional demand at the Northfield Development (2,000 new dwellings) is likely to result in increased congestion along the adjacent A40 link. There is also likely to be increased network stress at Headington Roundabout potentially related to additional flows at Wheatley.

Figure 20 South Oxfordshire flow difference (Scenario 3B – Do Minimum) (PCU/hr) – 2031 morning peak

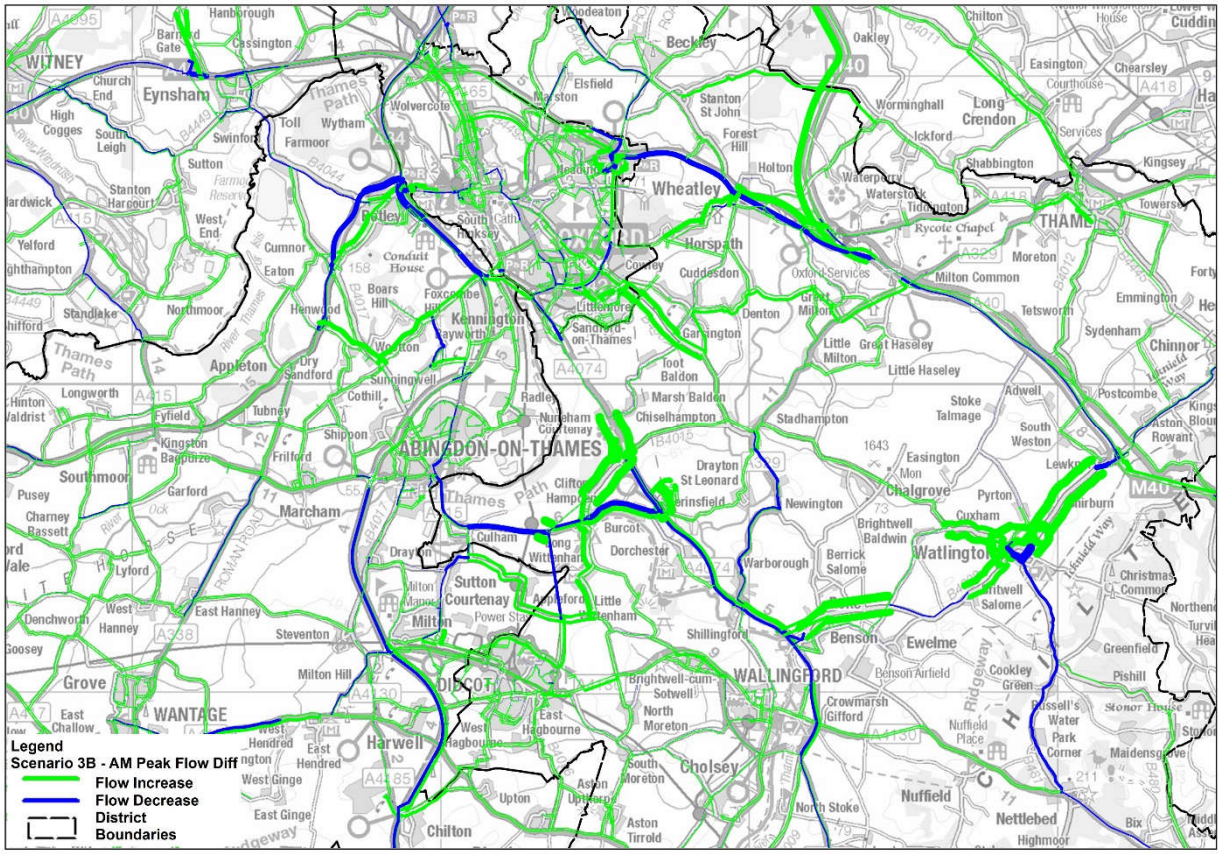


Figure 21 South Oxfordshire flow difference (Scenario 3B – Do Minimum) (PCU/hr) – 2031 evening peak

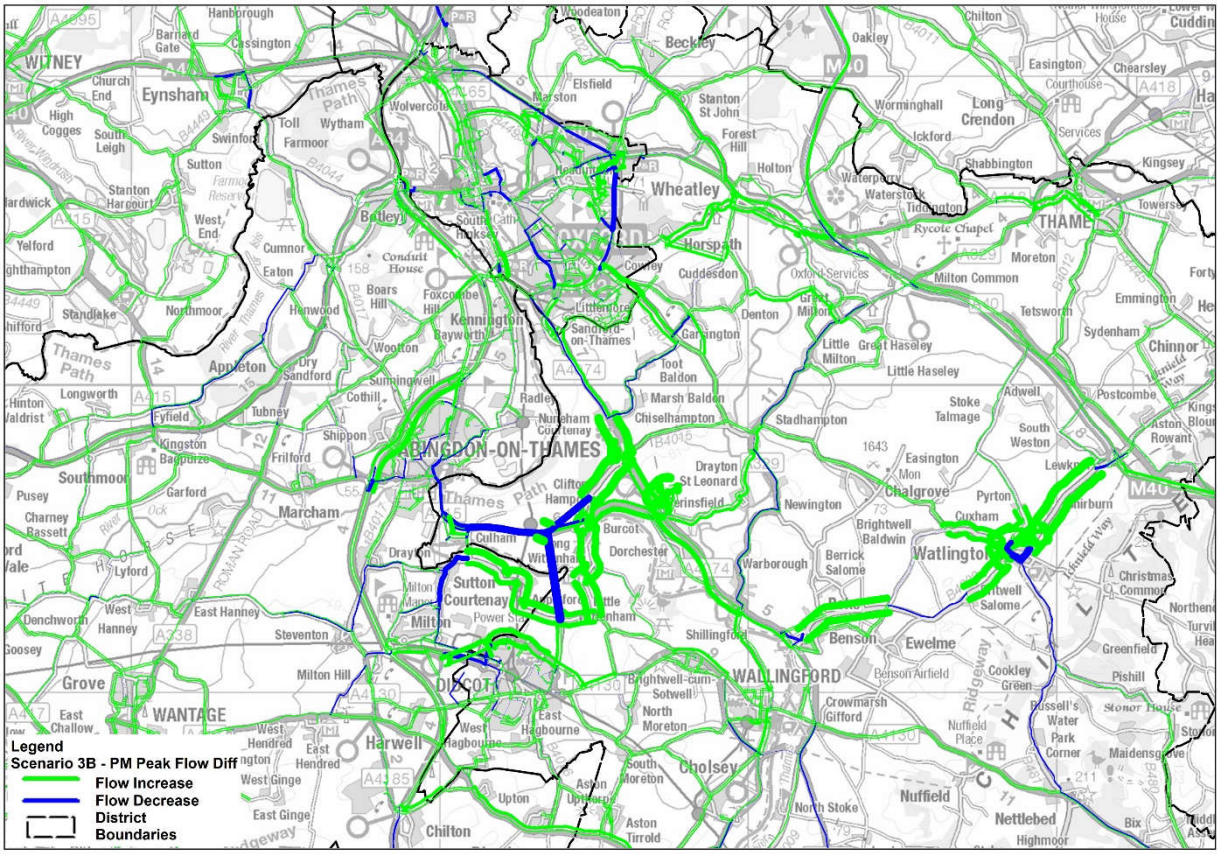


Figure 22 South Oxfordshire V/C for links and junctions – 2031 Scenario 3B morning peak hour

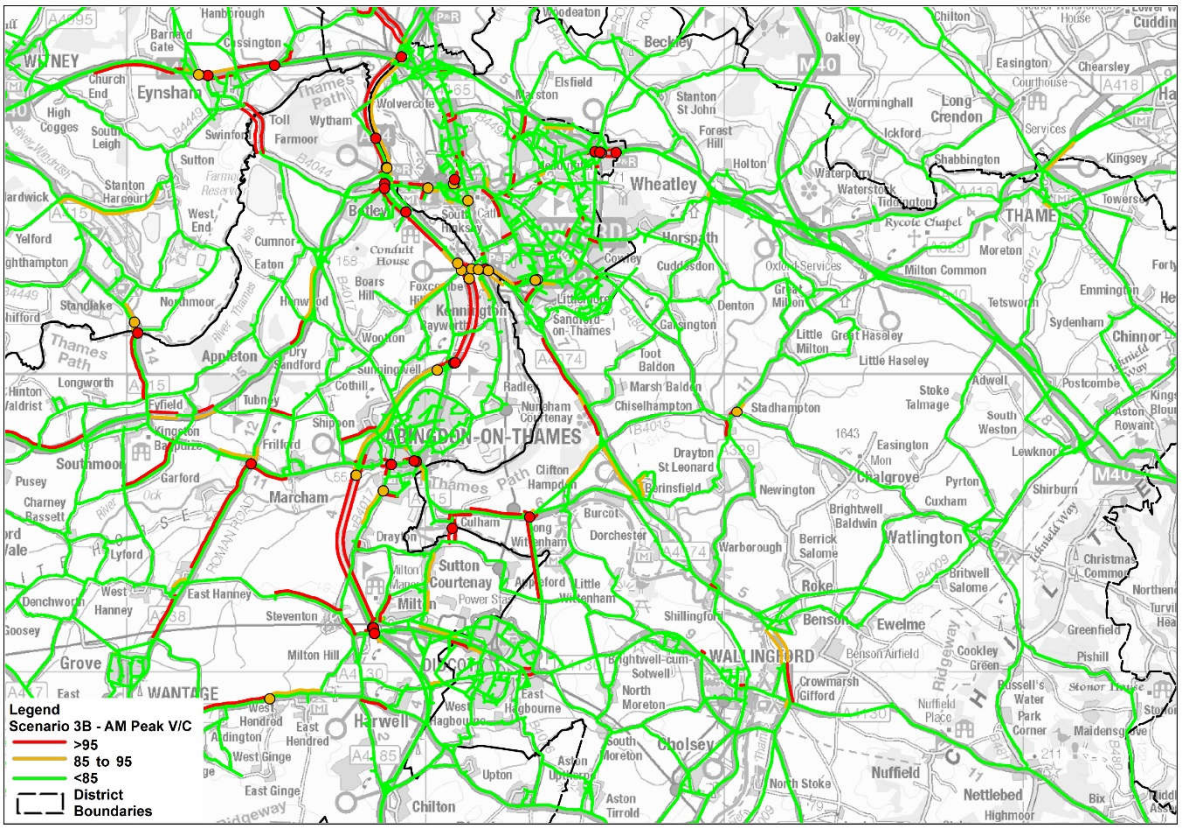
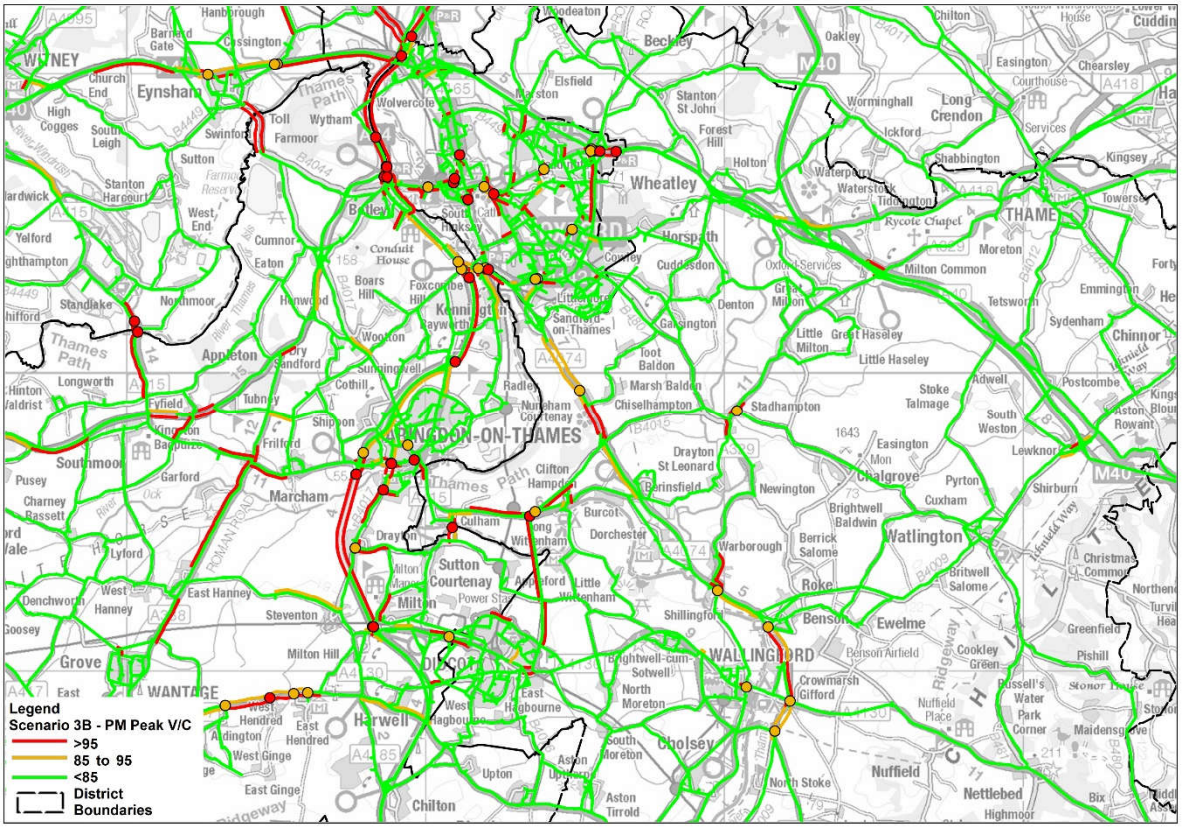


Figure 23 South Oxfordshire V/C for links and junctions – 2031 Scenario 3B evening peak hour



5.6. Scenario 3C

Scenario	Proposed development Site Allocations (above those in the Do Minimum)	Mitigation Included (above that in the Do Minimum)
3C	Thornhill (875), Wick Farm/Lower Elsfield (2036), Culham (3500), Wheatley (300), Berinsfield (1700), Neighbourhood Plan commitments and targets	Watlington Bypass, Benson Bypass, Golden Balls Junction with additional eastbound filter lane (between B4015 and A4074)

5.6.1. Network Performance

The modelled highway network performance within the District for the Do Minimum and Scenario 3C are shown in Table 27 and Table 28.

These statistics give a high-level summary of how the model has responded to the changes in land use assumptions and network changes.

Table 27 South Oxfordshire District modelled network performance - morning peak 2031

	South Oxfordshire		
	Do Minimum	Scenario 3C	Difference (S3C-DM)
Delay (pcu-hr)	522	906	384.2
Total Time (pcu-hr)	6060.4	6645.2	584.8
Total Distance (pcu-km)	378301.7	386395.9	8094.2
Average Speed (km/hr)	62.4	58.1	-4.3

Table 28 South Oxfordshire District modelled network performance - evening peak 2031

	South Oxfordshire		
	Do Minimum	Scenario 3C	Difference (S3C-DM)
Delay (pcu-hr)	611.2	842	230.8
Total Time (pcu-hr)	6719.4	7200.3	480.9
Total Distance (pcu-km)	408409.9	419537.8	11127.9
Average Speed (km/hr)	60.8	58.3	-2.5

5.6.2. Flow and Capacity Impacts

The forecast flow difference between Scenario 3C and Do Minimum modelled across the District is shown in Figure 24 and Figure 25. The forecast volume to capacity plots for Scenario 3C are shown in Figure 26 and Figure 27.

- Additional morning peak demand at Culham (3,500 new dwellings) is likely to result in increased network stress on the A415 in both directions leading away from the development site, with these movements forecast to operate near or at capacity. The Culham demand growth is also likely to lead to additional junctions operating over capacity in the surrounding network. Tollgate Road/Abingdon Road is forecast to be heavily congested. The proposed Thames River crossing and junction with A415 are forecast to operate over capacity during both morning and evening peaks.
- The Chiselhampton Bypass is forecast to accommodate demand during the evening peak, access to and junction layout around the Culham Didcot Thames River Crossing may need to be reviewed at an operational level to ensure that forecast demand can be accommodated.
- The additional eastbound filter lane at Golden Balls is likely to relieve congestion along the A4074 between Berinsfield Roundabout and Golden Balls as northbound vehicles travel via Clifton Hampden. This is also likely to accommodate demand on the A4074 associated with planned dwellings at Berinsfield.
- Forecast increases in demand are predicted to result in capacity constraints at Wallingford and Stadhampton during the morning peak.
- Additional demand at Wick Farm/Lower Elsfield Development (2,036 new dwellings) is likely to result in increased congestion along the adjacent A40 link. There is also likely to be increased network stress at Headington Roundabout which can be associated with increased demand around Wheatley.

Figure 24 South Oxfordshire flow difference (Scenario 3C – Do Minimum) (PCU/hr) – 2031 morning peak

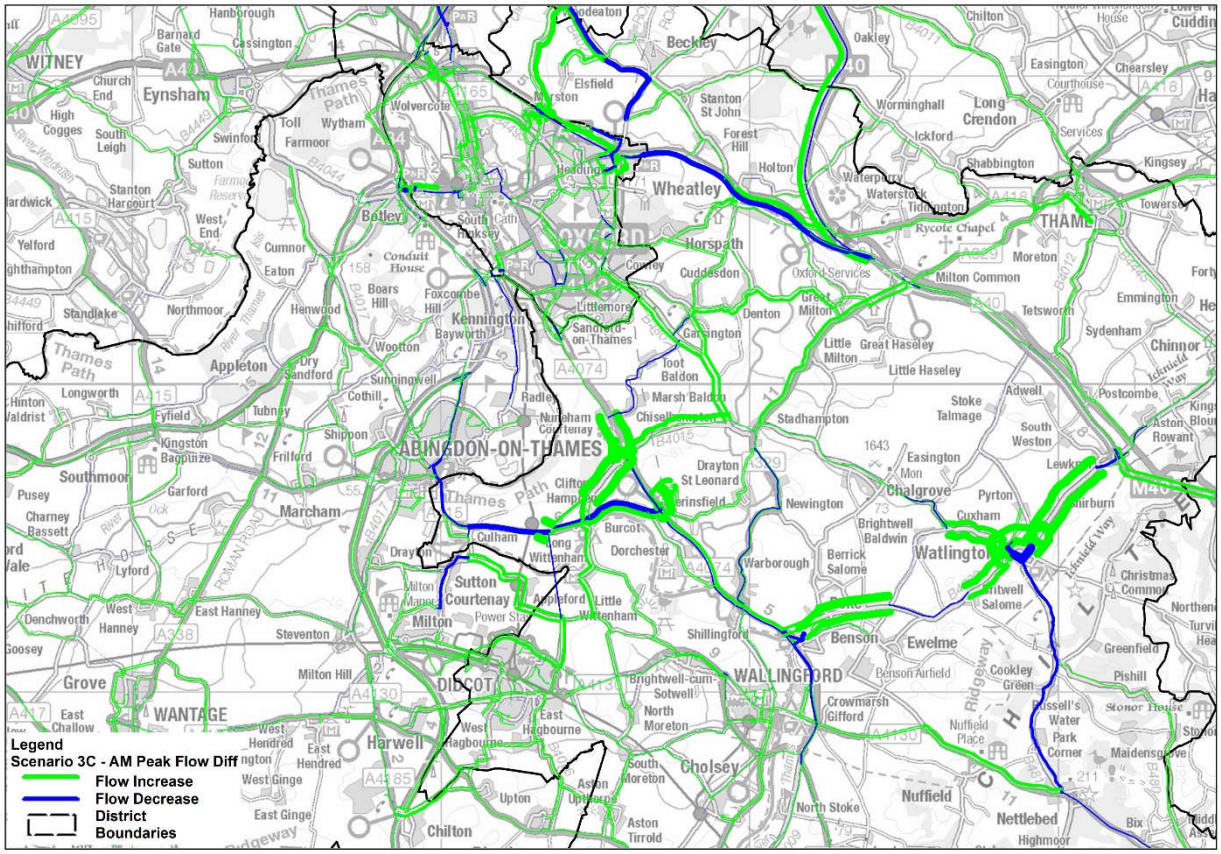


Figure 25 South Oxfordshire flow difference (Scenario 3C – Do Minimum) (PCU/hr) – 2031 evening peak

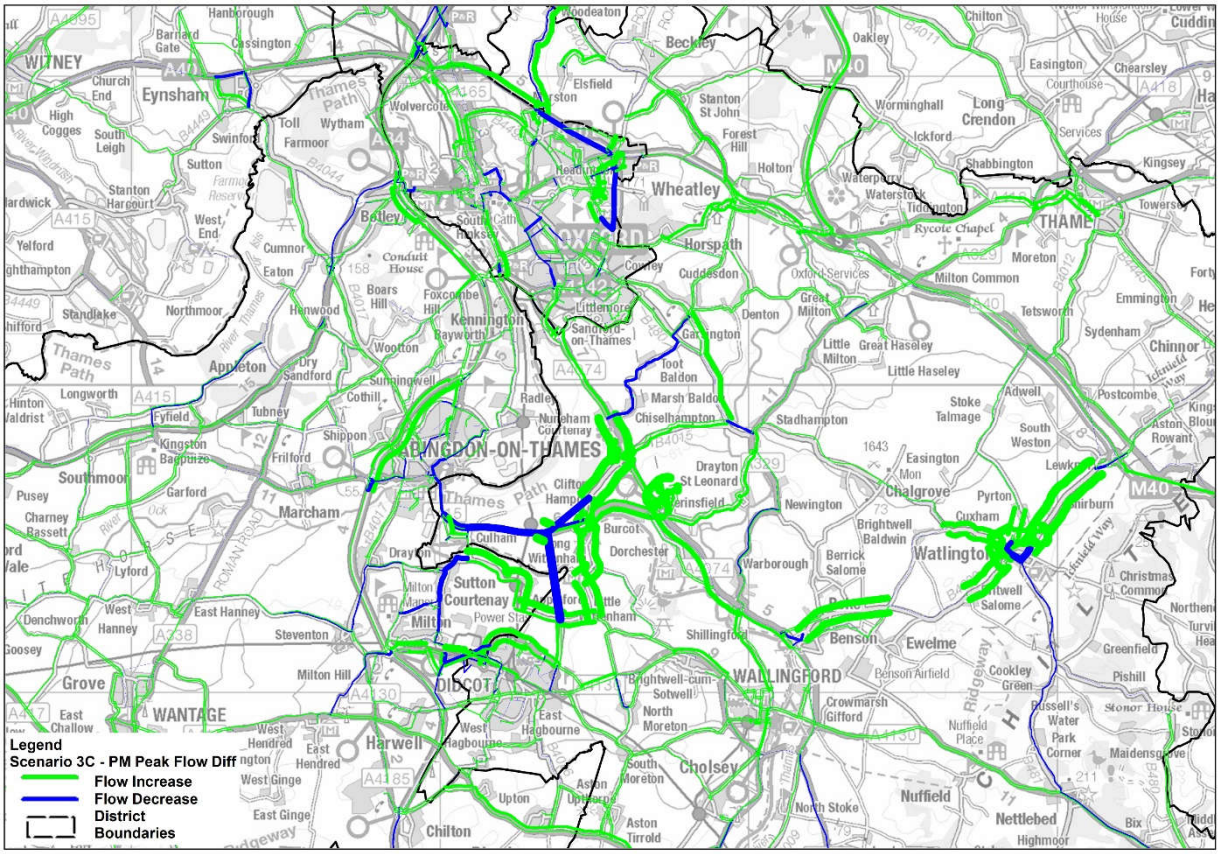


Figure 26 South Oxfordshire V/C for links and junctions – 2031 Scenario 3C morning peak hour

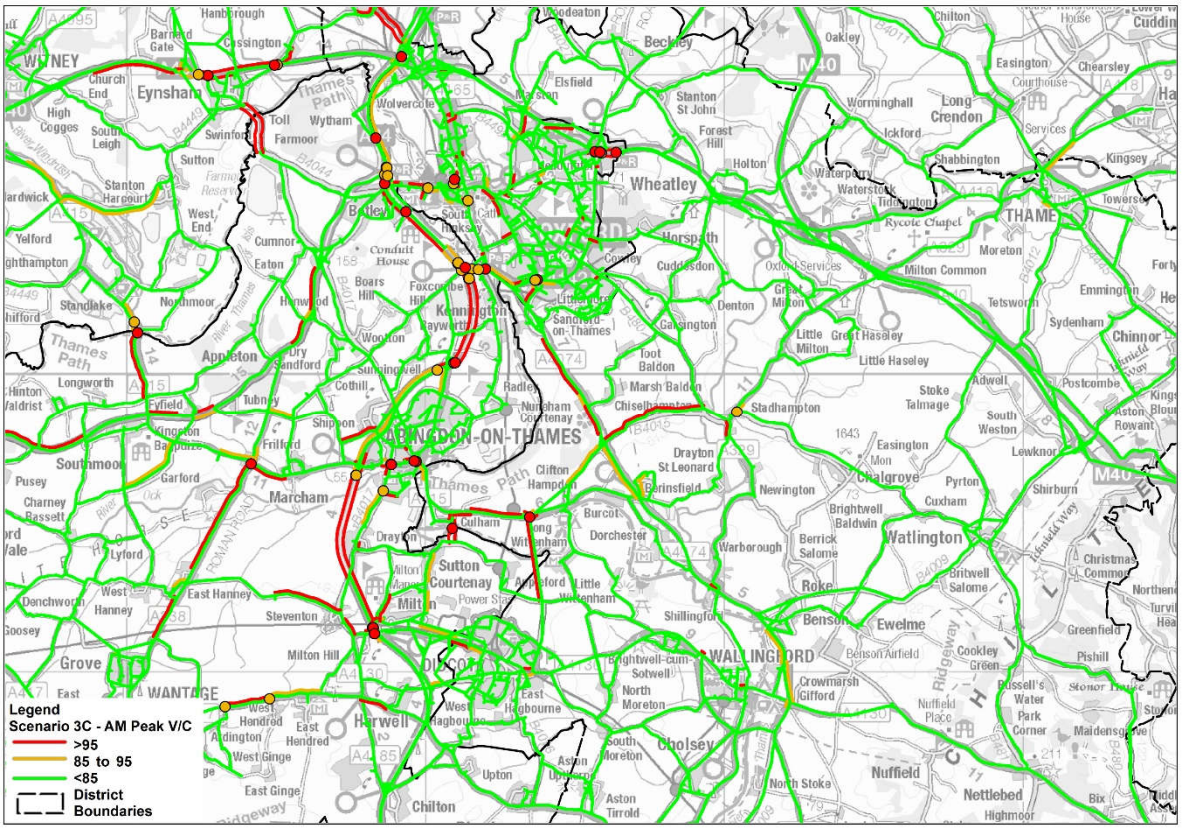
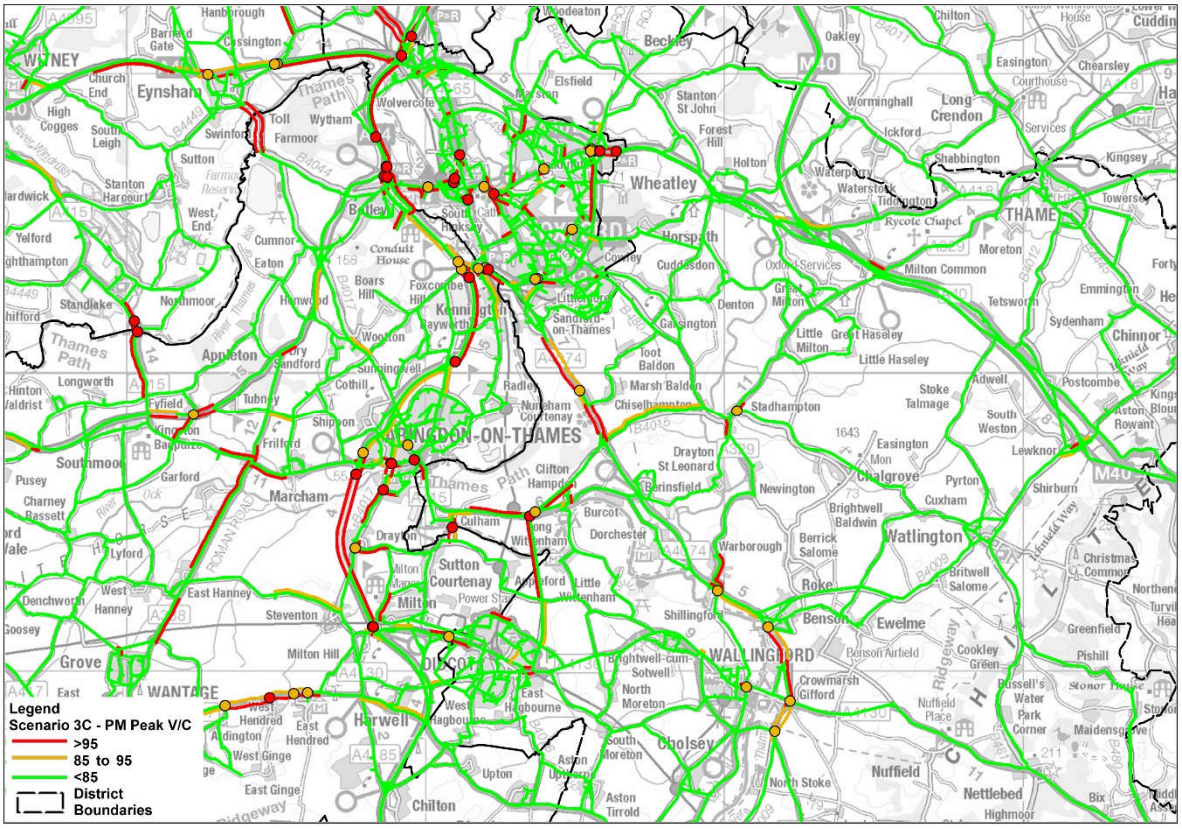


Figure 27 South Oxfordshire V/C for links and junctions – 2031 Scenario 3C evening peak hour



5.7. Scenario 4A

Scenario	Proposed development Site Allocations (above those in the Do Minimum)	Mitigation Included (above that in the Do Minimum)
4A	Harrington (6500), Chalgrove (3000), Berinsfield (1700), Neighbourhood Plan commitments and targets	Stadhampton Bypass, Chiselhampton Bypass, Watlington Bypass, Benson Bypass, Golden Balls Junction with additional eastbound filter lane (between B4015 and A4074), Harrington Site Access Links

5.7.1. Network Performance

The modelled highway network performance within the District for the Do Minimum and Scenario 4A are shown in Table 29 and Table 30.

These statistics give a high-level summary of how the model has responded to the changes in land use assumptions and network changes.

Table 29 South Oxfordshire District modelled network performance - morning peak 2031

	South Oxfordshire		
	Do Minimum	**Scenario 4A**	**Difference (S4A-DM)**
Delay (pcu-hr)	522	829	307.2
Total Time (pcu-hr)	6060.4	6977.8	917.4
Total Distance (pcu-km)	378301.7	406569.8	28268.1
Average Speed (km/hr)	62.4	58.3	-4.1

Table 30 South Oxfordshire District modelled network performance - evening peak 2031

	South Oxfordshire		
	Do Minimum	**Scenario 4A**	**Difference (S4A-DM)**
Delay (pcu-hr)	611.2	795.8	184.6
Total Time (pcu-hr)	6719.4	7596.7	877.3
Total Distance (pcu-km)	408409.9	440893.6	32483.7
Average Speed (km/hr)	60.8	58.0	-2.8

5.7.2. Flow and Capacity Impacts

The forecast flow difference between Scenario 4A and Do Minimum modelled across the District is shown in Figure 28 and Figure 29. The forecast volume to capacity plots for Scenario 4A are shown in Figure 30 and Figure 31

- A major source of highway demand in this scenario is the Harrington development, with 6,500 new dwellings at Great Haseley. Access links to the development from the A329 show stress during the morning and evening peaks and they are forecast to operate over design capacity. During the evening peak, there is likely to be further stress on minor approach routes to the development, as vehicles route from the A40 to Lower End Road at Great Milton, which may lead to congestion on more minor links such as Church Lane and Thame Road, which are forecast to operate over their design capacity.
- The Stadhampton bypass is forecast to relieve stress at Stadhampton, but may lead to pinch points transferring downstream in the morning peak to the B480 Thame River Crossing at Chiselhampton. The reverse movement and resulting congestion are also forecast to be present during the evening peak.
- Development at Chalgrove (3,000 new dwellings) may add demand to the network at Watlington.
- Overall the Harrington, Chalgrove, and Berinsfield developments are forecast to increase demand on the Chiselhampton-Stadhampton links

Figure 28 South Oxfordshire flow difference (Scenario 4A – Do Minimum) (PCU/hr) – 2031 morning peak

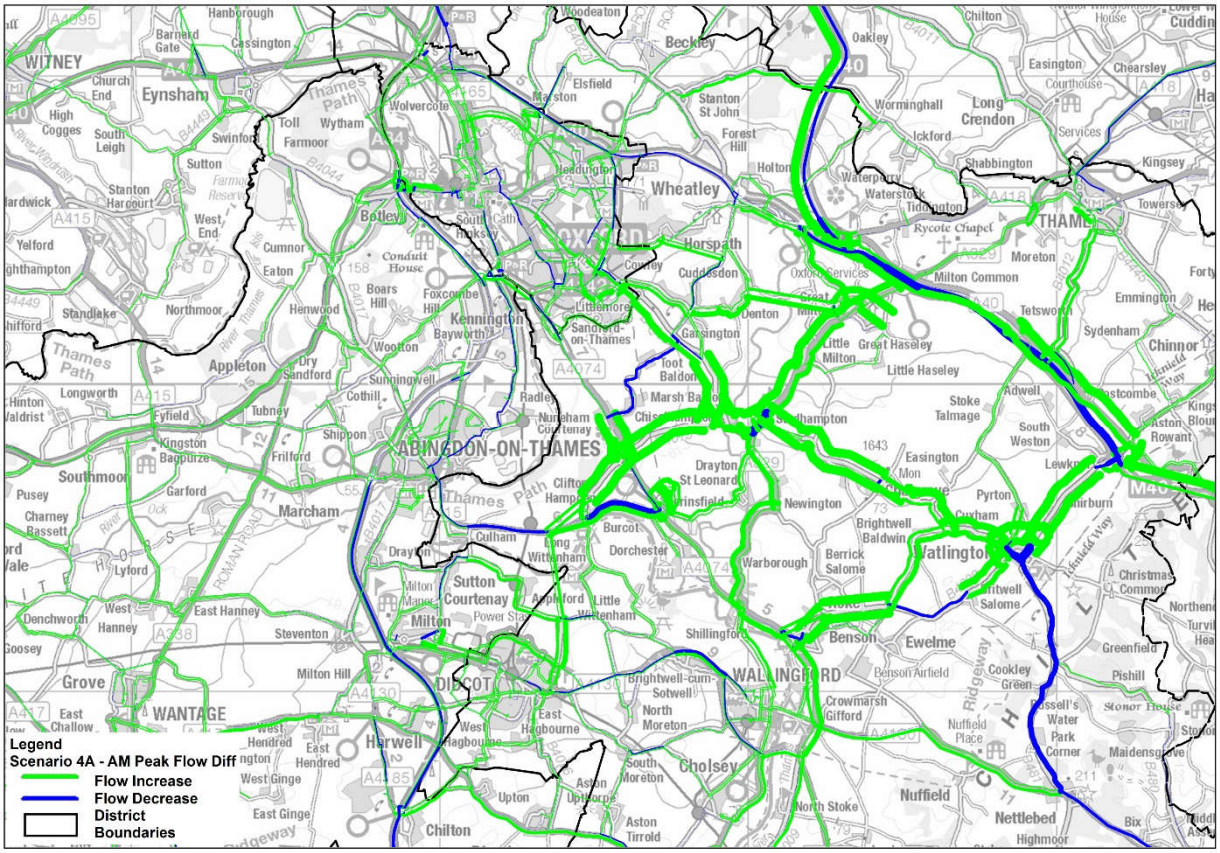


Figure 29 South Oxfordshire flow difference (Scenario 4A – Do Minimum) (PCU/hr) – 2031 evening peak

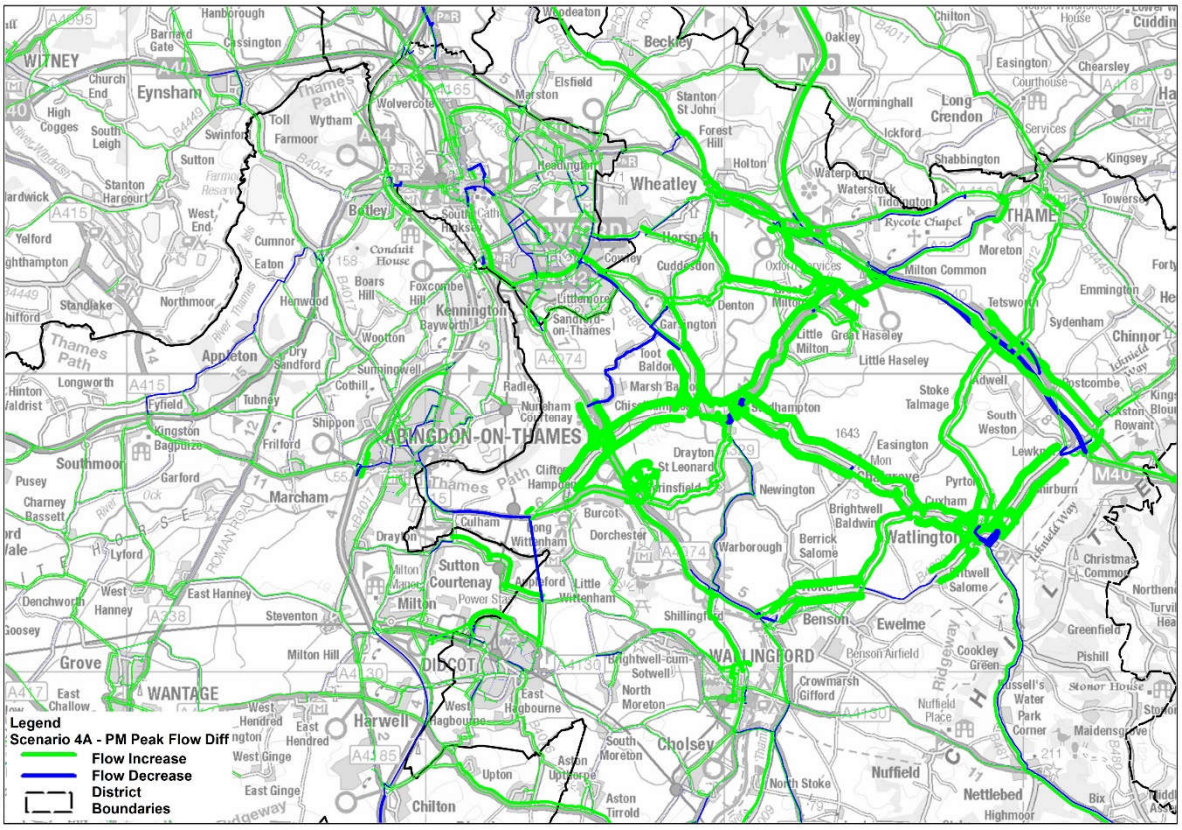


Figure 30 South Oxfordshire V/C for links and junctions – 2031 Scenario 4A morning peak hour

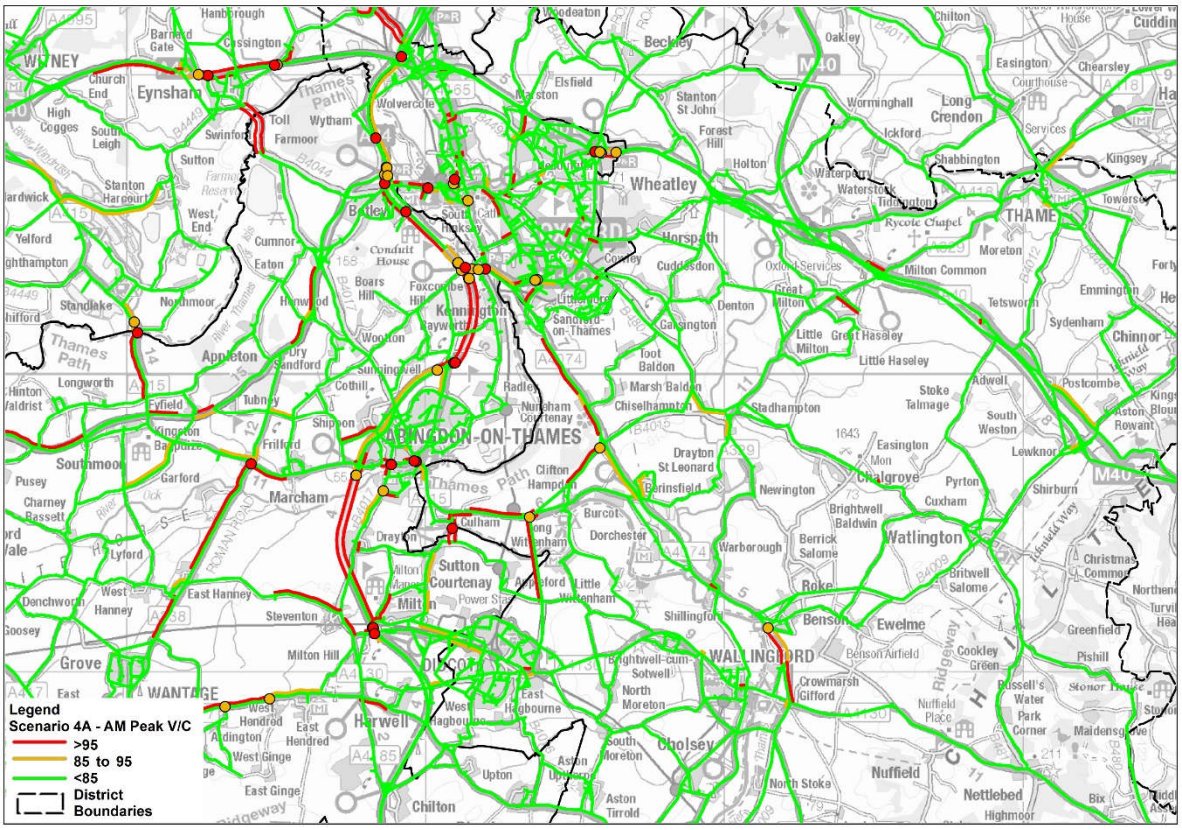
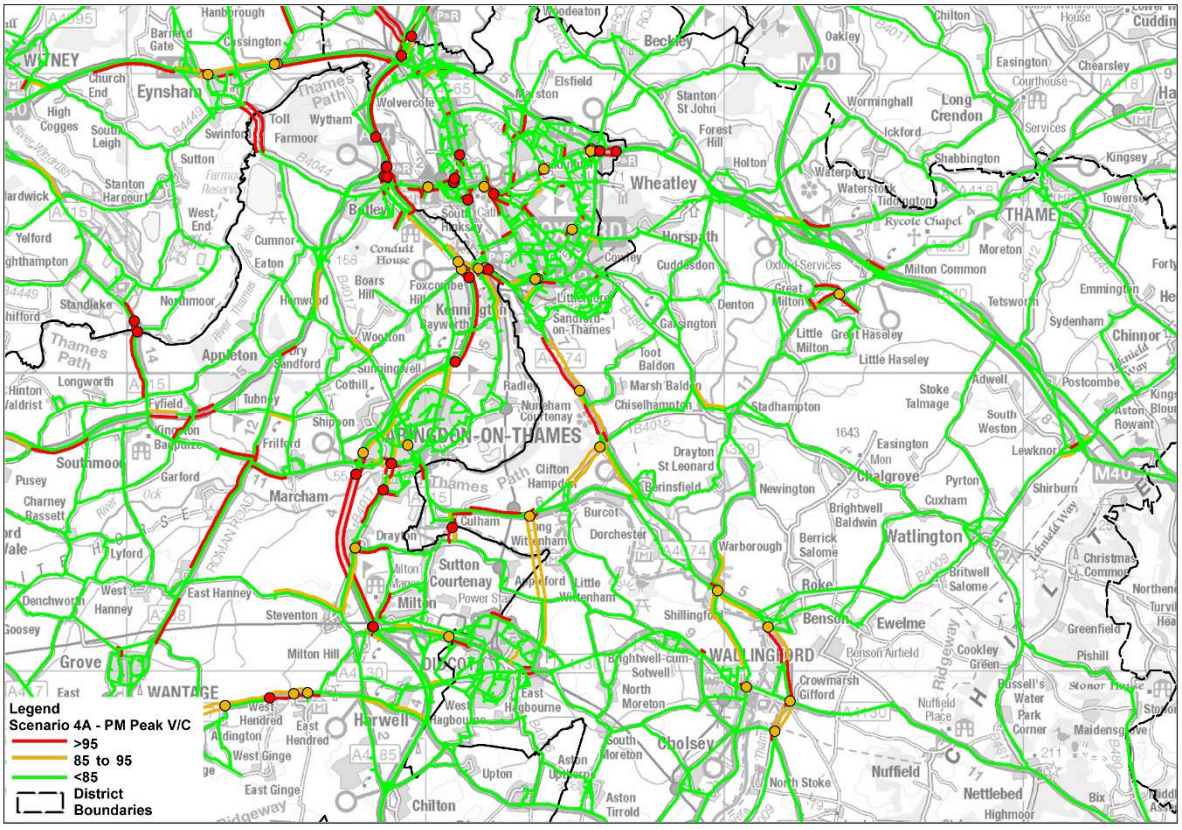


Figure 31 South Oxfordshire V/C for links and junctions – 2031 Scenario 4A evening peak hour



5.8. Scenario 4B

Scenario	Proposed development Site Allocations (above those in the Do Minimum)	Mitigation Included (above that in the Do Minimum)
4B	Harrington (3500), Chalgrove (3000), Berinsfield (1700), Neighbourhood Plan commitments and targets	Stadhampton Bypass, Chiselhampton Bypass, Watlington Bypass, Benson Bypass, Golden Balls Junction with additional eastbound filter lane (between B4015 and A4074), Harrington Site Access Links

5.8.1. Network Performance

The modelled highway network performance within the District for the Do Minimum and Scenario 4B are shown in Table 31 and Table 32.

These statistics give a high-level summary of how the model has responded to the changes in land use assumptions and network changes.

Table 31 South Oxfordshire District modelled network performance - morning peak 2031

	South Oxfordshire		
	Do Minimum	Scenario 4B	Difference (S4B-DM)
Delay (pcu-hr)	522	620	98.6
Total Time (pcu-hr)	6060.4	6653.7	593.3
Total Distance (pcu-km)	378301.7	400022.2	21720.5
Average Speed (km/hr)	62.4	60.1	-2.3

Table 32 South Oxfordshire District modelled network performance - evening peak 2031

	South Oxfordshire		
	Do Minimum	Scenario 4B	Difference (S4B-DM)
Delay (pcu-hr)	611.2	685.9	74.7
Total Time (pcu-hr)	6719.4	7353.9	634.5
Total Distance (pcu-km)	408409.9	433810.8	25400.9
Average Speed (km/hr)	60.8	59.0	-1.8

5.8.2. Flow and Capacity Impacts

The forecast flow difference between Scenario 4B and Do Minimum modelled across the District is shown in Figure 32 and Figure 33. The forecast volume to capacity plots for Scenario 4B are shown Figure 34 and Figure 35.

- Access links to the Harrington development (3,500 new dwellings) from the A329 are forecast to show some stress during the morning and evening peaks as they operate near design capacity. During the evening peak, the model forecasts decreased stress on the minor approach routes towards the development compared to Scenario 4A, as fewer vehicles are predicted to route from the A40 to Lower End Road at Great Milton.
- The Stadhampton bypass is predicted to relieve stress at Stadhampton, but network stress is forecast to transfer to the B480 Thame River Crossing at Chiselhampton. The reverse movement and resulting congestion are also forecast during the evening peak.
- Development at Chalgrove (3,000 new dwellings) is likely to add demand to the network at Watlington, which may in turn result in congestion at the M40, J6 and Golden Balls, which is forecast to operate near capacity during both peaks.

Figure 32 South Oxfordshire flow difference (Scenario 4B – Do Minimum) (PCU/hr) – 2031 morning peak

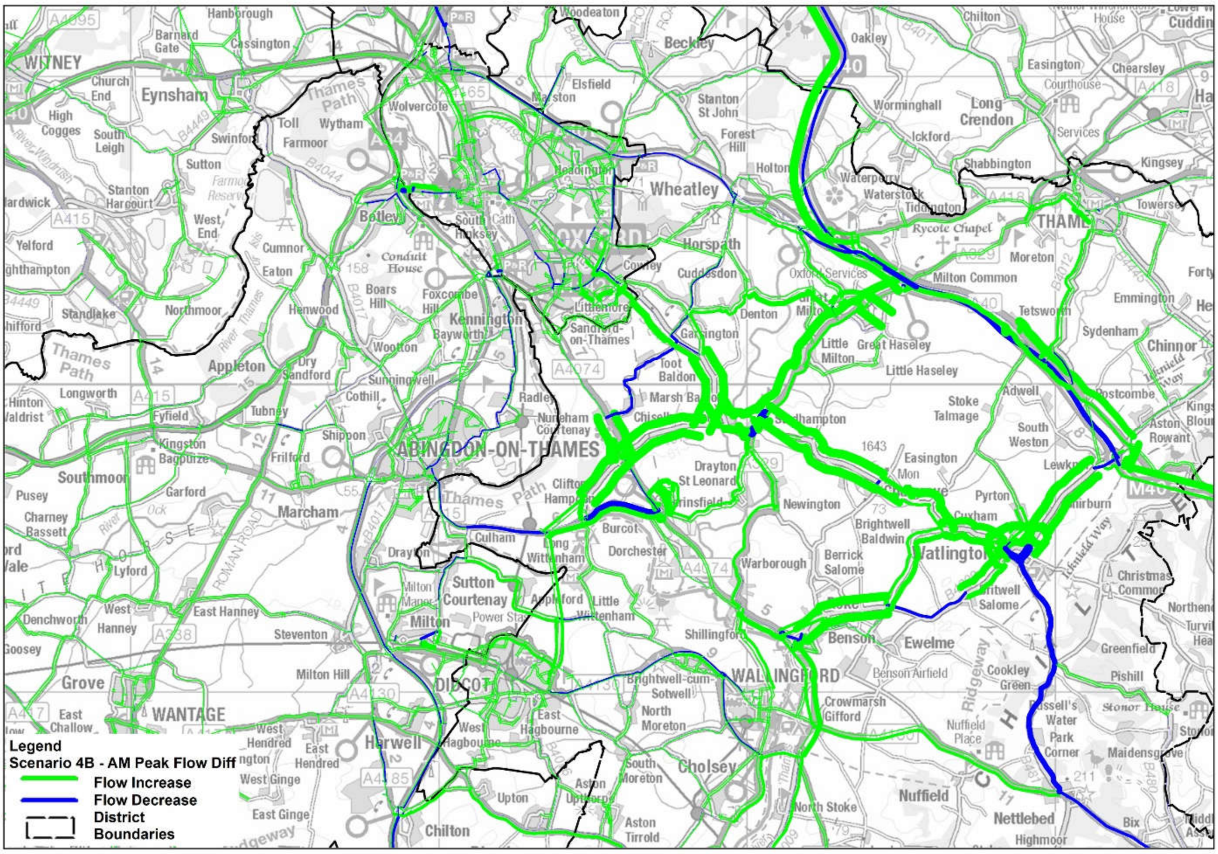


Figure 33 South Oxfordshire flow difference (Scenario 4B – Do Minimum) (PCU/hr) – 2031 evening peak

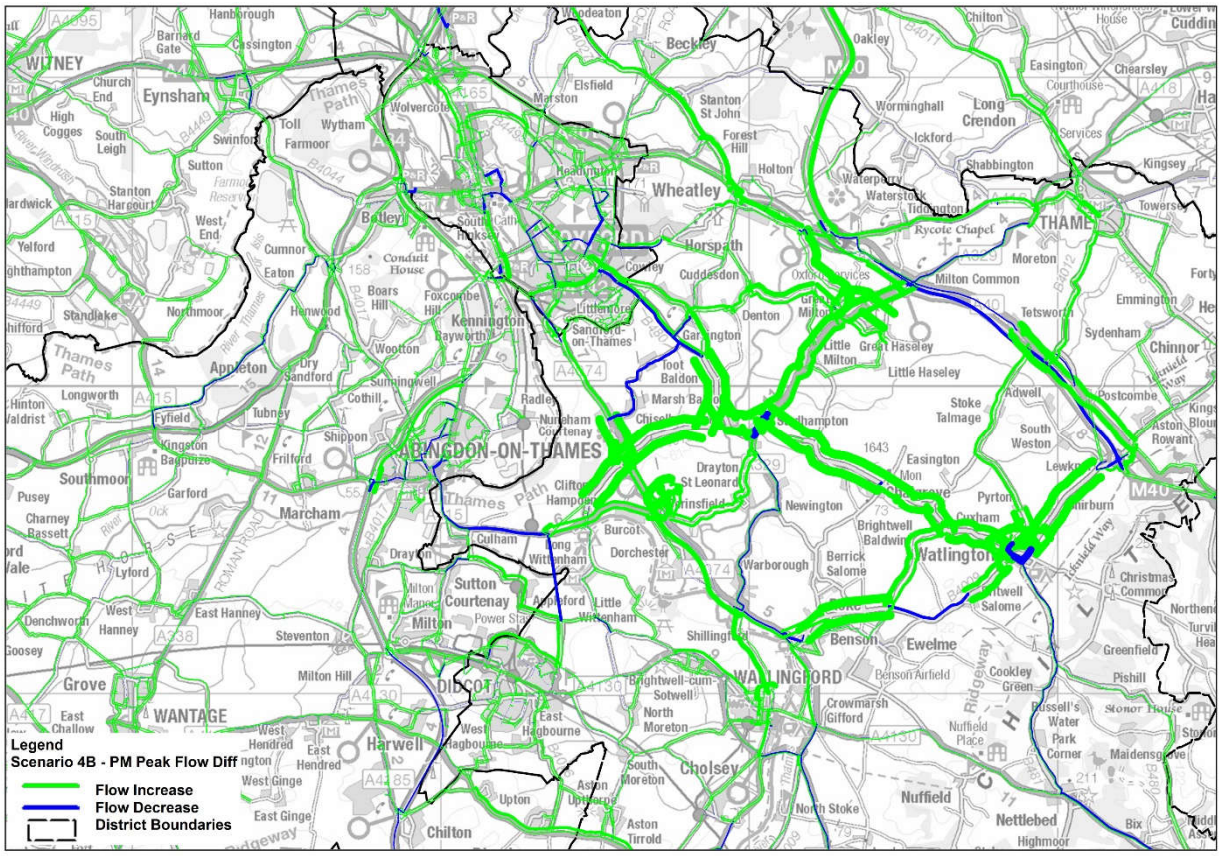


Figure 34 South Oxfordshire V/C for links and junctions – 2031 Scenario 4B morning peak hour

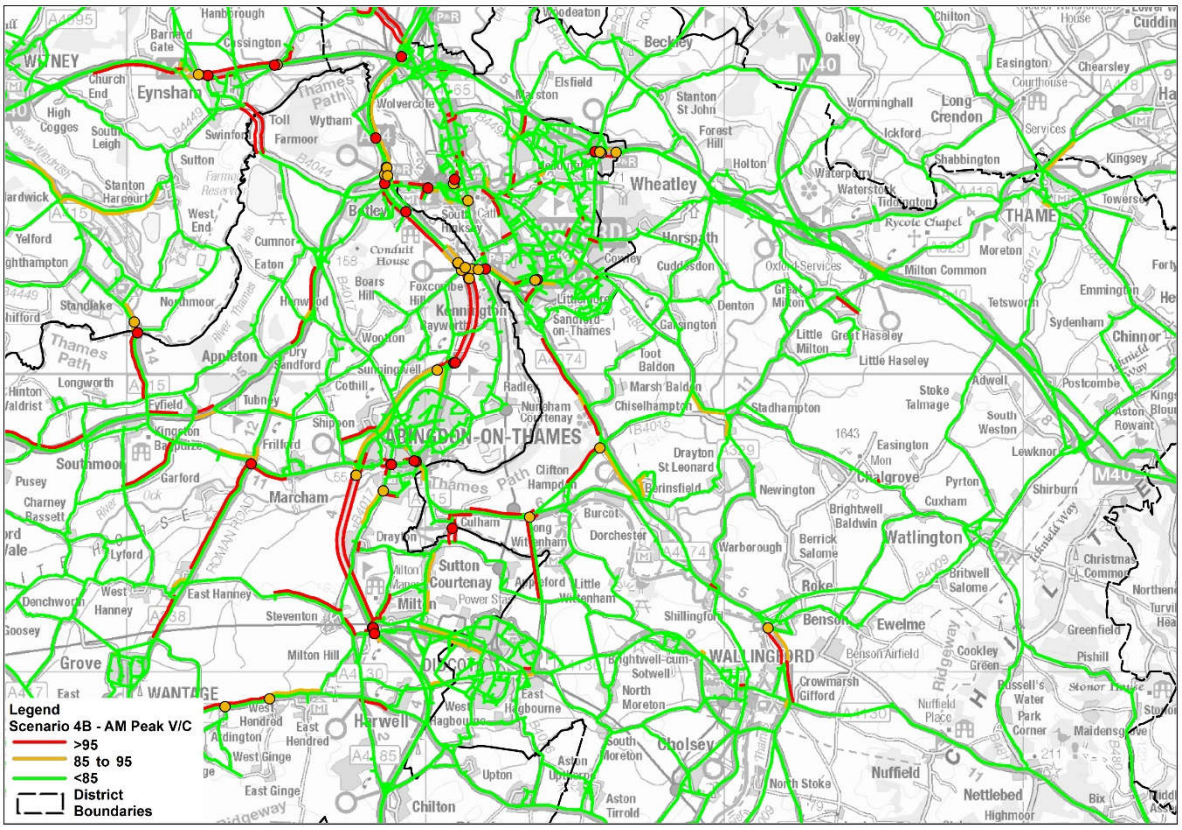
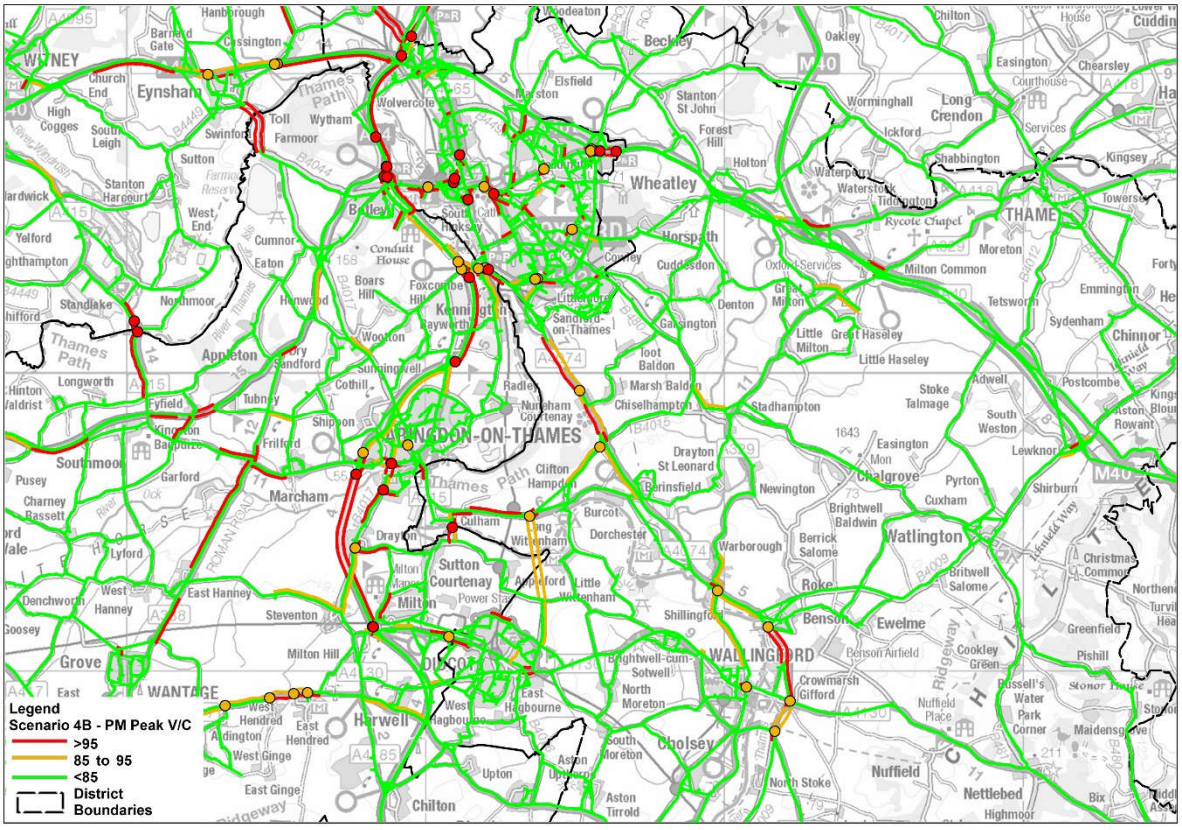


Figure 35 South Oxfordshire V/C for links and junctions – 2031 Scenario 4B evening peak hour



5.9. Scenario 5A

Scenario	Proposed development Site Allocations (above those in the Do Minimum)	Mitigation Included (above that in the Do Minimum)
5A	Northfield (2000), Grenoble Road (3000), Chalgrove (3000), Culham (3500), Wick Farm/Lower Elsfield (2036), Berinsfield (1700), Wheatley (300), Neighbourhood Plan commitments and targets	Stadhampton Bypass, Chiselhampton Bypass, Watlington Bypass, Benson Bypass, Golden Balls Junction with additional eastbound filter lane (between B4015 and A4074)

- .

5.9.1. Network Performance

The modelled highway network performance within the District for the Do Minimum and Scenario 5A are shown in Table 33 and Table 34.

These statistics give a high-level summary of how the model has responded to the changes in land use assumptions and network changes.

Table 33 South Oxfordshire District modelled network performance - morning peak 2031

	South Oxfordshire		
	Do Minimum	Scenario 5A	Difference (S5A-DM)
Delay (pcu-hr)	522	965	443.2
Total Time (pcu-hr)	6060.4	6825.1	764.7
Total Distance (pcu-km)	378301.7	388629.5	10327.8
Average Speed (km/hr)	62.4	56.9	-5.5

Table 34 South Oxfordshire District modelled network performance - evening peak 2031

	South Oxfordshire		
	Do Minimum	Scenario 5A	Difference (S5A-DM)
Delay (pcu-hr)	611.2	855.2	244.0
Total Time (pcu-hr)	6719.4	7337.4	618.0
Total Distance (pcu-km)	408409.9	422382.4	13972.5
Average Speed (km/hr)	60.8	57.6	-3.2

5.9.2. Flow and Capacity Impacts

The forecast flow difference between Scenario 5A and Do Minimum modelled across the District is shown in Figure 36 and Figure 37. The forecast volume to capacity plots for Scenario 5A are shown in Figure 38 and Figure 39.

- In the morning peak development demand at Culham (3,500 new dwellings) is forecast to result in increased network stress on the A415 in both directions leading away from the development site, with these movements forecast to operate near or at capacity. Culham demand growth is also likely to lead to additional network stress on the surrounding network. Tollgate Road/Abingdon Road is forecast to be congested. With increased demand, the Culham Didcot Thames River Crossing is forecast to operate above capacity during the morning and evening peaks, the operational layout of the Culham site access junctions may require review.
- At Golden Balls roundabout during the morning peak the additional eastbound filter lane relieves congestion along the A4074 section from Berinsfield Roundabout to Golden Balls as northbound vehicles from Culham travel via Clifton Hampden. Other approaches to Golden Ball are forecast to operate below capacity.
- Additional demand at Wick Farm/Lower Elsfield Development (2,036 new dwellings) is likely to result in increased congestion along the adjacent A40 link. Increased network stress is also forecast at Headington which may be related to the Wheatley development. The Headington interchange is forecast to remain over capacity under Scenario 5A.

Figure 36 South Oxfordshire flow difference (Scenario 5A – Do Minimum) (PCU/hr) – 2031 morning peak

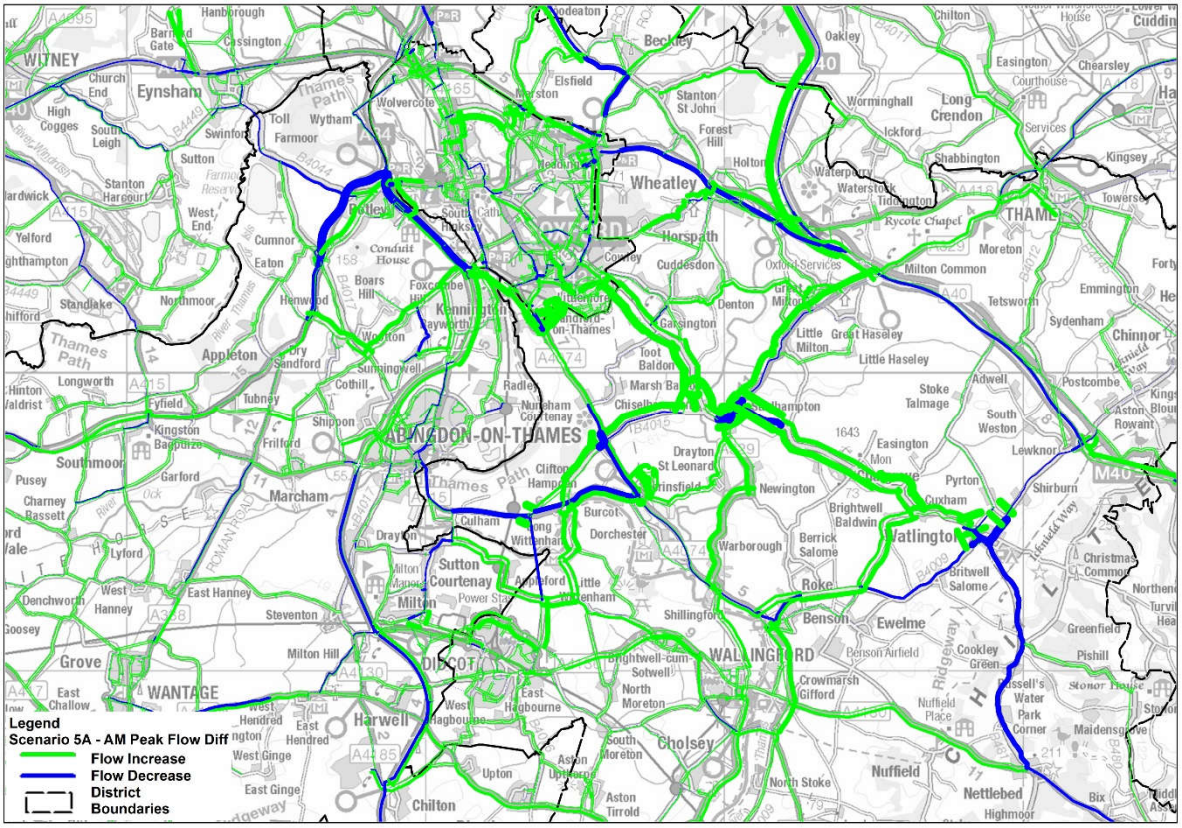


Figure 37 South Oxfordshire flow difference (Scenario 5A – Do Minimum) (PCU/hr) – 2031 evening peak

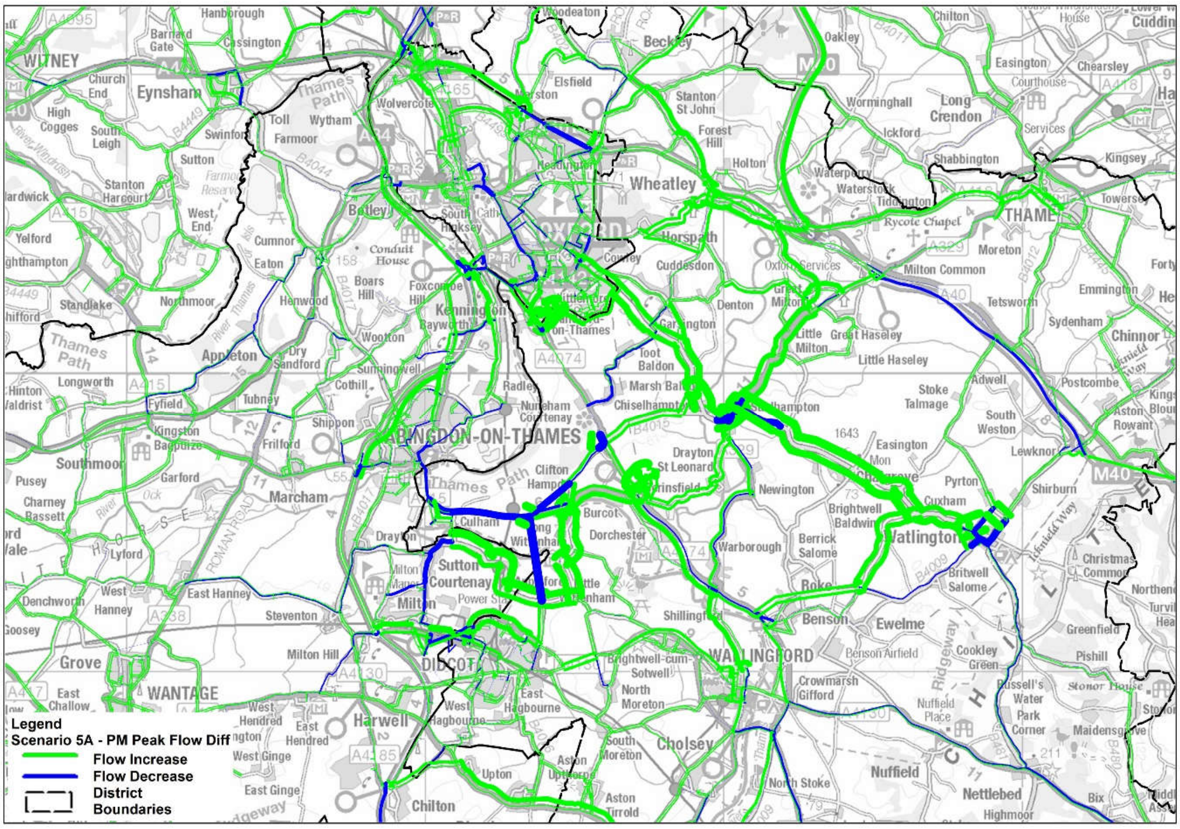


Figure 38 South Oxfordshire V/C for links and junctions – 2031 Scenario 5A morning peak hour

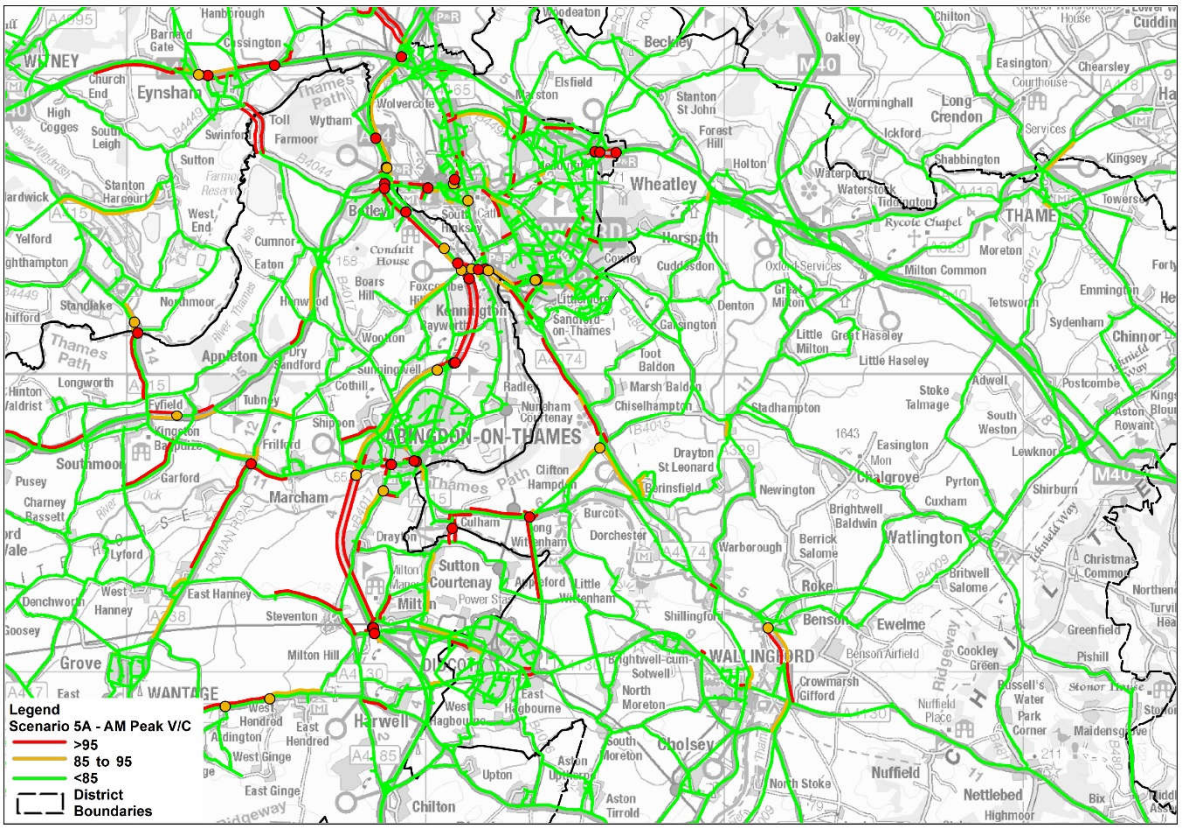
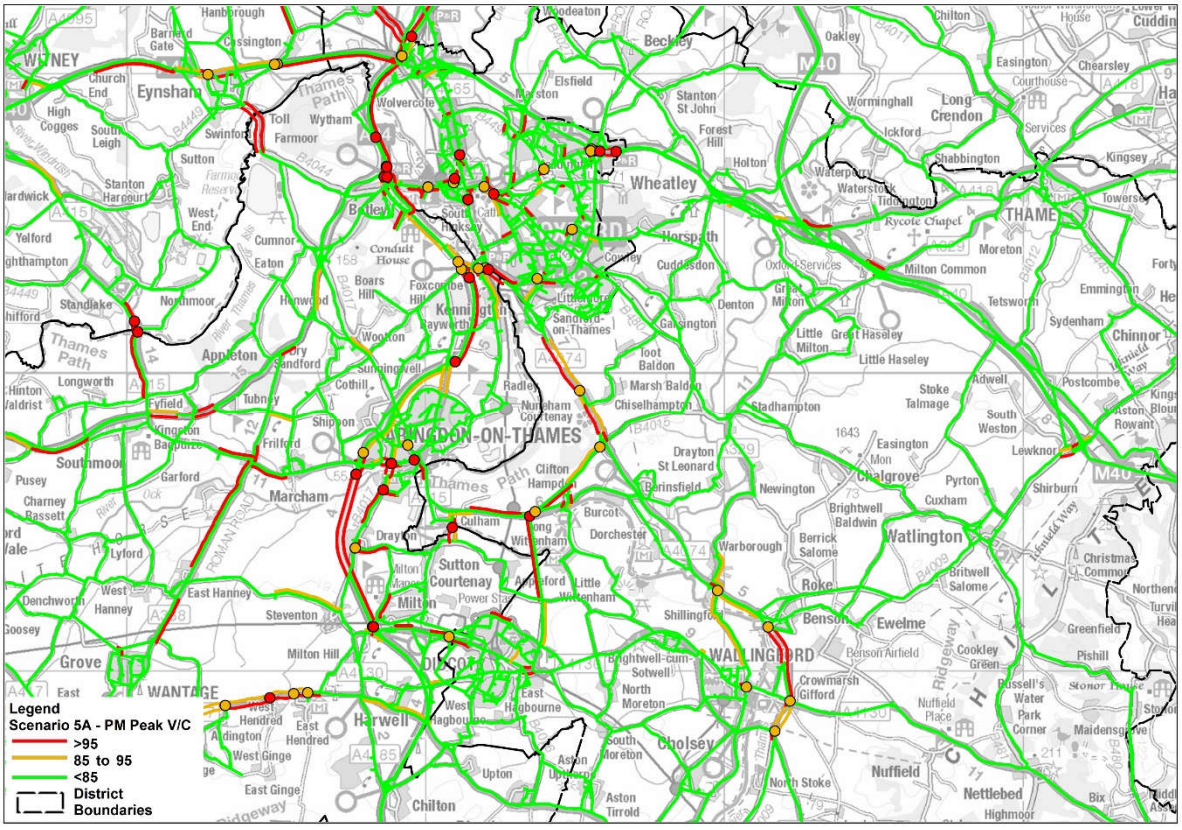


Figure 39 South Oxfordshire V/C for links and junctions – 2031 Scenario 5A evening peak hour



5.10. Scenario 5B

Scenario	Proposed development Site Allocations (above those in the Do Minimum)	Mitigation Included (above that in the Do Minimum)
5B	Northfield (2000), Grenoble Road (3000), Chalgrove (3000), Culham (3500), Wick Farm/Lower Elsfield (2036), Berinsfield (1700), Wheatley (300), Neighbourhood Plan commitments and targets	Benson Bypass, Chiselhampton Bypass, Stadhampton Bypass, Watlington Bypass, Culham Didcot Thames River Crossing, western alignment, Culham Site Access Links, A40 Link Road, Culham Didcot Thames River Crossing alternative (Western alignment), A40 Link Road, 40mph single carriageway, Berinsfield northern access, Speed reductions to Dorchester/Stadhampton Road to 20mph, Golden Balls roundabout enlargement, capacity increase for north- and southbound movements and additional filter lane from Clifton Hampden bypass to A4074 northbound, Accesses to Culham site improved

5.10.1. Network Performance

The modelled highway network performance within the District for the Do Minimum and Scenario 5B are shown in Table 35 and Table 36.

These statistics give a high-level summary of how the model has responded to the changes in land use assumptions and network changes.

Table 35 South Oxfordshire District modelled network performance - morning peak 2031

	South Oxfordshire		
	Do Minimum	Scenario 5B	Difference (S5B-DM)
Delay (pcu-hr)	522	698	176.2
Total Time (pcu-hr)	6060.4	6776.4	716.0
Total Distance (pcu-km)	378301.7	400806.2	22504.5
Average Speed (km/hr)	62.4	59.1	-3.3

Table 36 South Oxfordshire District modelled network performance - evening peak 2031

	South Oxfordshire		
	Do Minimum	Scenario 5B	Difference (S5B-DM)
Delay (pcu-hr)	611.2	692.7	81.5
Total Time (pcu-hr)	6719.4	7546.5	827.1
Total Distance (pcu-km)	408409.9	441992.5	33582.6
Average Speed (km/hr)	60.8	58.6	-2.2

5.10.2. Flow and Capacity Impacts

The forecast flow difference between Scenario 5B and Do Minimum modelled across the District is shown in Figure 40 and Figure 41. The forecast volume to capacity plots for Scenario 5B are shown Figure 42 and Figure 43.

- Junctions along the A40 at Headington are forecast to experience some relief from congestion, as the A40 link road is forecast to attract general traffic away from Headington roundabout. This is likely to result in an increase in average speeds along this corridor during both morning and evening peaks compared to the Do Minimum scenario.
- Scenario 5B includes a western alignment of the Thames River Crossing. This alignment allows for a more even distribution of demand along the proposed link. The layout of Culham access junctions has also been refined in this assessment to accommodate improved operational performance. The refined design and consideration of the Culham Didcot Thames River Crossing western alignment is forecast to operate below capacity during the evening peak. Dual access points to the development at Culham are also forecast to relieve congestion along the A415. Refinement of the detailed design of the Culham Crossing may be required to ensure the planned scheme operates as intended.
- Changes in mitigation compared to 5a (increased capacity at Golden Balls and a western alignment of the Thames River crossing) are likely to result in a reduction in stress on the A34 between Marcham Interchange and Lodge Hill. There is a forecast decrease in flows in this section during the PM peak, and it is predicted to be below capacity during both peaks.
- The B4015/Oxford Road is generally less congested in Scenario 5B compared to 5A, with the exception of the evening peak, as higher traffic volumes approach Golden Balls Roundabout from the north, and whilst the proposed filter lane is likely to ease left-turning movements from Oxford Road onto the A4074, the reverse flows reach a pinch point on the right-turn at Golden Balls due to bottlenecking at Oxford Road Westbound.
- There is a reduction in traffic flow at Drayton-St Leonard related to speed reductions on this link. Lower flows are likely to relieve pressure on the A329 northbound at Stadhampton compared to the Do Minimum.
- Additional demand at Grenoble Road is likely to increase network stress along the A4074. Overall, development traffic is likely to be attracted to less congested corridors such as the B4015 and A329/Milton Road, and the B480 northbound link. These can be potentially used by traffic originating from the Culham, Berinsfield, and Chalgrove developments.

Figure 40 South Oxfordshire flow difference (Scenario 5B – Do Minimum) (PCU/hr) – 2031 morning peak

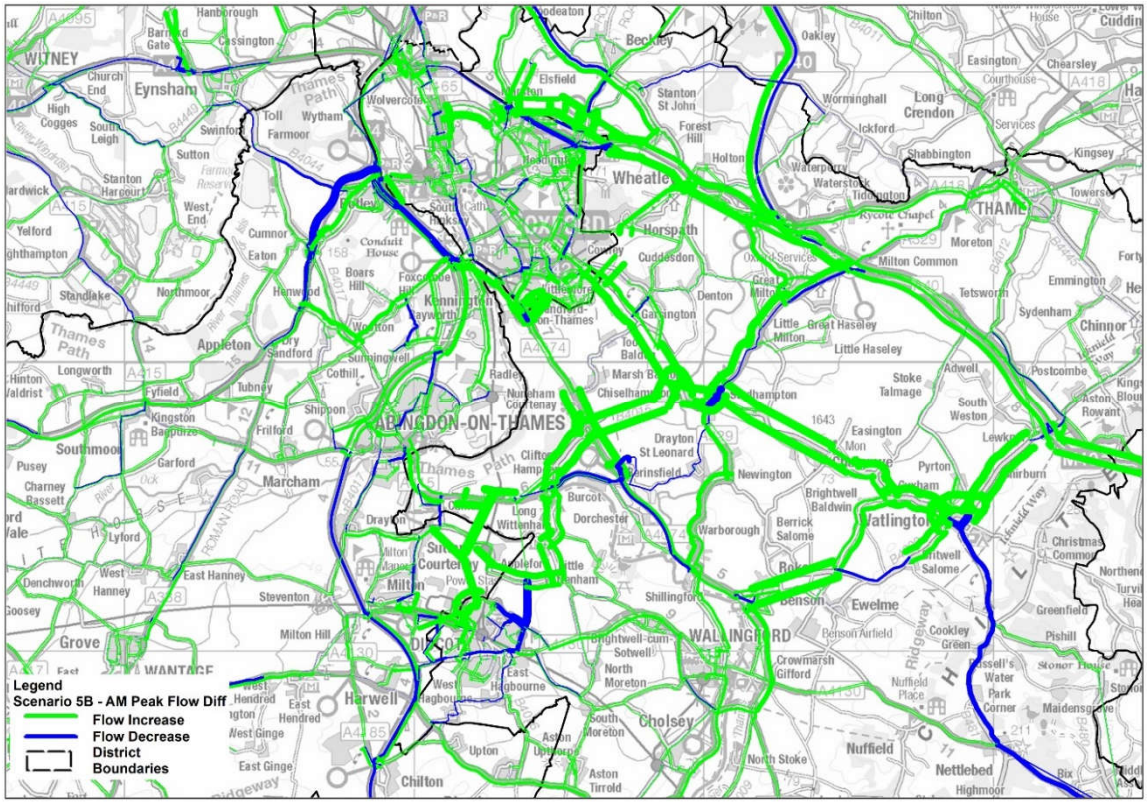


Figure 41 South Oxfordshire flow difference (Scenario 5B – Do Minimum) (PCU/hr) – 2031 evening peak

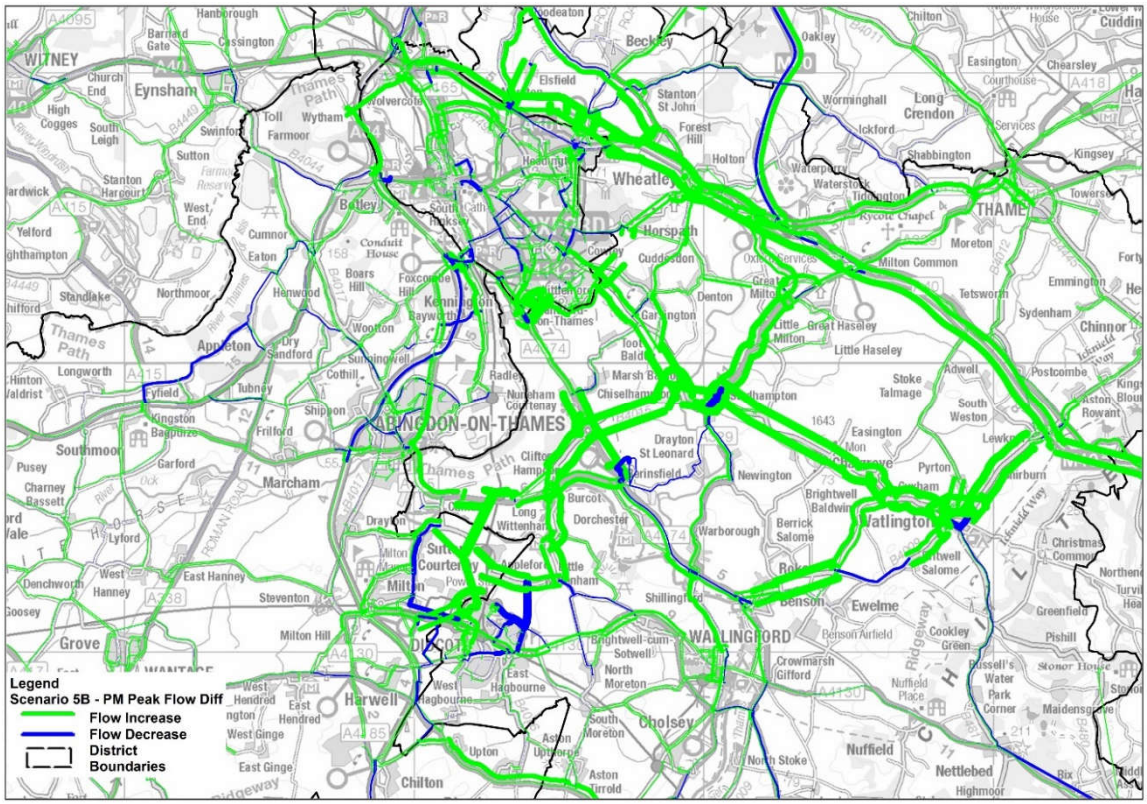


Figure 42 South Oxfordshire V/C for links and junctions – 2031 Scenario 5B morning peak hour

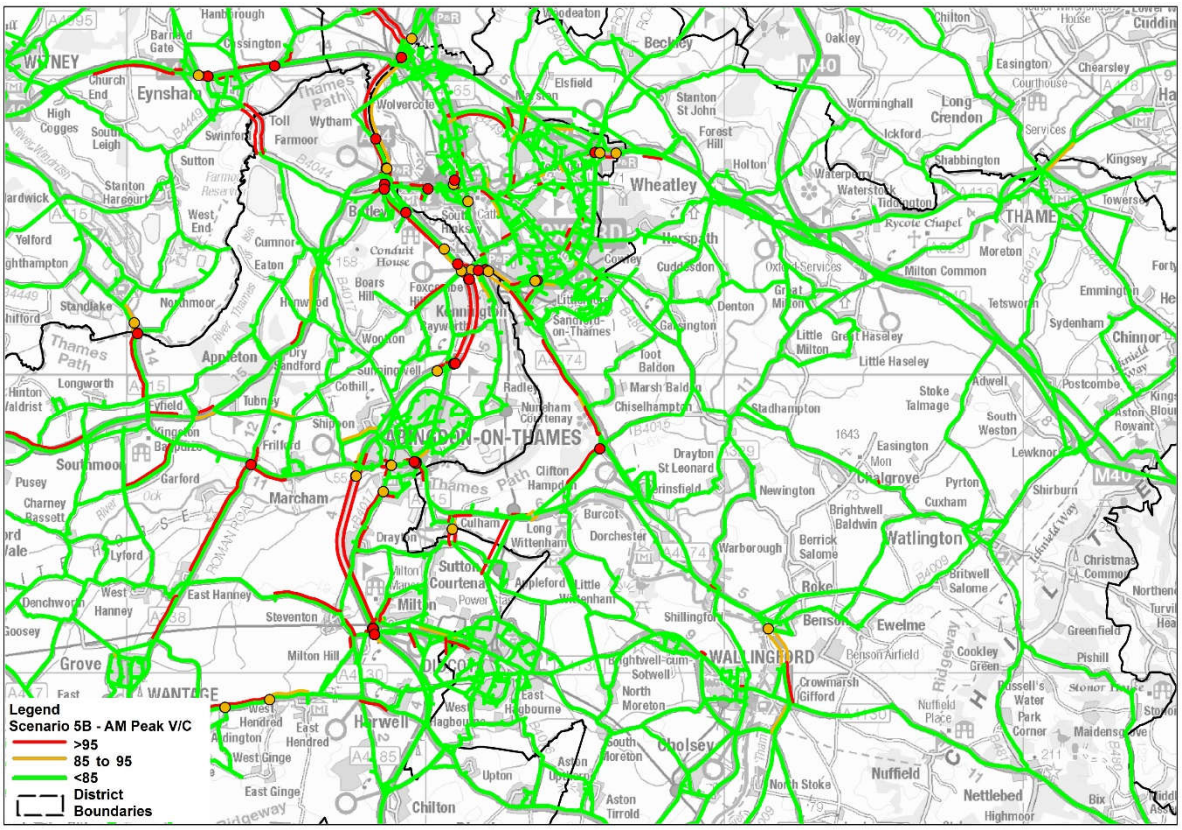
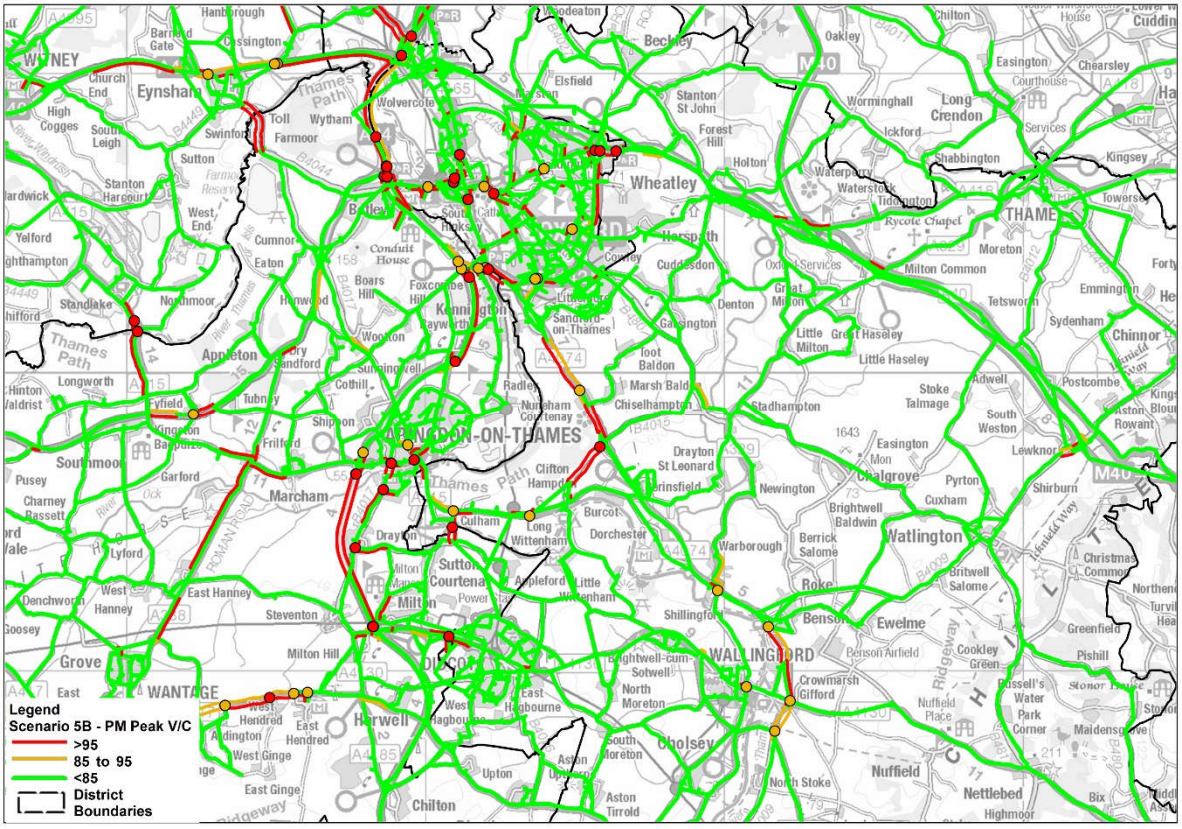


Figure 43 South Oxfordshire V/C for links and junctions – 2031 Scenario 5B evening peak hour



6. Summary

One of the main purposes of the ETI is to inform the selection of strategic development sites to be allocated in the Local Plan 2031 and to help identify a package of highway mitigation measures that ensures that the plan contributes towards the delivery of sustainable development. The ETI forms part of the evidence base to inform the Local Plan 2031 alongside other evidence, including Landscape Capacity Study, Strategic Flood Risk Assessment, Sustainability Appraisal, Green Belt Review, and others.

This is the third stage of work associated with the ETI commission for the South Oxfordshire Local Plan using the Oxfordshire Strategy Model (OSM). This technical note reports on the results of OSM model testing related to the transport impacts of five scenarios and related variants.

Table 37 shows the number of dwellings and the other variations between each of the scenarios, including the Do Minimum scenario and the final mitigation scenario in this set of tests, Scenario 5B.

Table 37 Summary of Scenario housing allocation and network variation

Number	Proposed Development Site Allocations	Description
Do Minimum	11079	• 2013 as Base Year and 2031 as Future Year. • Includes homes delivered since 2013 (base year of OSM), current commitments (homes with planning approval) and 2012 Core Strategy sites.
Scenario 1 In line with the proposed October 2017 submission Local Plan	19579	• Developments in Chalgrove, Culham, Wheatley and Berinsfield • Network mitigation - Stadhampton Bypass, Chiselhampton Bypass, Watlington Bypass, Benson Bypass, Golden Balls Junction with additional eastbound filter lane • In line with October 2017 Plan
Scenario 2 Maximising edge of Oxford Sites and regeneration	20990	• Developments in Thornhill, Northfield, Grenoble Road, Wick Farm/Lower Elsfield, Wheatley and Berinsfield • Network mitigation - Watlington Bypass, Benson Bypass, Golden Balls Junction with additional eastbound filter lane
Scenario 3A Science Vale and Oxford unmet need meet on specific sites adjacent to Oxford (a)	19579	• Developments in Grenoble Road, Culham, Wheatley and Berinsfield • Network mitigation - Watlington Bypass, Benson Bypass, Golden Balls Junction with additional eastbound filter lane

Number	Proposed Development Site Allocations	Description
Scenario 3B Science Vale and Oxford unmet need meet on specific sites adjacent to Oxford (b)	19454	• Developments in Thornhill, Northfield, Culham, Wheatley and Berinsfield • Network mitigation - Watlington Bypass, Benson Bypass, Golden Balls Junction with additional eastbound filter lane between B4015 and A4074
Scenario 3C Science Vale and Oxford unmet need meet on specific sites adjacent to Oxford (c)	19490	• Developments in Thornhill, Wick Farm/Lower Elsfield, Culham, Wheatley and Berinsfield • Network mitigation - Watlington Bypass, Benson Bypass, Golden Balls Junction with additional eastbound filter lane between B4015 and A4074
Scenario 4A Maximising non-green belt sites and regeneration – full delivery	22279	• Developments in Harrington, Chalgrove and Berinsfield • Network mitigation - Stadhampton Bypass, Chiselhampton Bypass, Watlington Bypass, Benson Bypass, Golden Balls Junction with additional eastbound filter lane, Harrington Site Access links
Scenario 4B Maximising non-green belt sites and regeneration – Local Plan delivery	19279	• Developments in Harrington, Chalgrove and Berinsfield • Network mitigation - Stadhampton Bypass, Chiselhampton Bypass, Watlington Bypass, Benson Bypass, Golden Balls Junction with additional eastbound filter lane between B4015 and A4074, Harrington Site Access links
Scenario 5A Preferred Development Locations Scenario	26315	• Developments in Northfield, Wheatley, Grenoble Road, Wick Farm/Lower Elsfield, Chalgrove, Culham and Berinsfield • Network mitigation - Stadhampton Bypass, Chiselhampton Bypass, Watlington Bypass, Benson Bypass, Golden Balls Junction with additional eastbound filter lane between B4015 and A4074

Number	Proposed Development Site Allocations	Description
Scenario 5B Preferred Development Locations Scenario with additional mitigation	26315	• Developments in Northfield, Wheatley, Grenoble Road, Wick Farm/Lower Elsfield, Chalgrove, Culham and Berinsfield • Network mitigation - Stadhampton Bypass, Chiselhampton Bypass, Watlington Bypass, Benson Bypass, Golden Balls Junction with additional eastbound filter lane between B4015 and A4074, Culham Didcot Thames River Crossing (western alignment), Culham Site Access, A40 Link Road, Berinsfield Northern Access, Speed reductions - Dorchester/Stadhampton Road • Benefits compared to Scenario 5A include lower congestion at Headington Roundabout, fewer pinch points on the A415, a less congested Thames River Crossing, and lower traffic impacts at Drayton-St Leonard.

To ascertain the extent to which the proposed dwellings impact on different scenarios, Table 38 shows the impact of each scenario on delay in South Oxfordshire. The total delay in the Do Minimum scenario in pcu hours is given, along with the percentage increase in delay forecast in each scenario with respect to the Do Minimum value. At the district level, delay is forecast to increase the most in Scenario 3B in the morning peak, and in Scenario 3A in the evening peak. The mitigation Scenario 5B is forecast to experience reduced delay relative to Scenario 5A with the same level of development.

Table 38 Forecast changes in delay in South Oxfordshire by scenario compared with the Do Minimum Scenario (pcu hrs)

Model	Morning Peak	Evening Peak
2031 DM	522	611
Scenario 1	72%	36%
Scenario 2	18%	36%
Scenario 3A	76%	48%
Scenario 3B	86%	41%
Scenario 3C	74%	38%
Scenario 4A	59%	30%
Scenario 4B	19%	12%
Scenario 5A	85%	40%
Scenario 5B	34%	13%

An assessment of forecast development growth scenarios and associated transport impacts has been undertaken. The analysis summarised in this report will be used as an evidence base to support the Local Plan, helping to determine a final package of mitigation measure requirements. There will be further, more detailed work to help refine the package of highway and sustainable transport mitigation measures to support future housing and employment growth in the area to ensure the plan contributes towards the

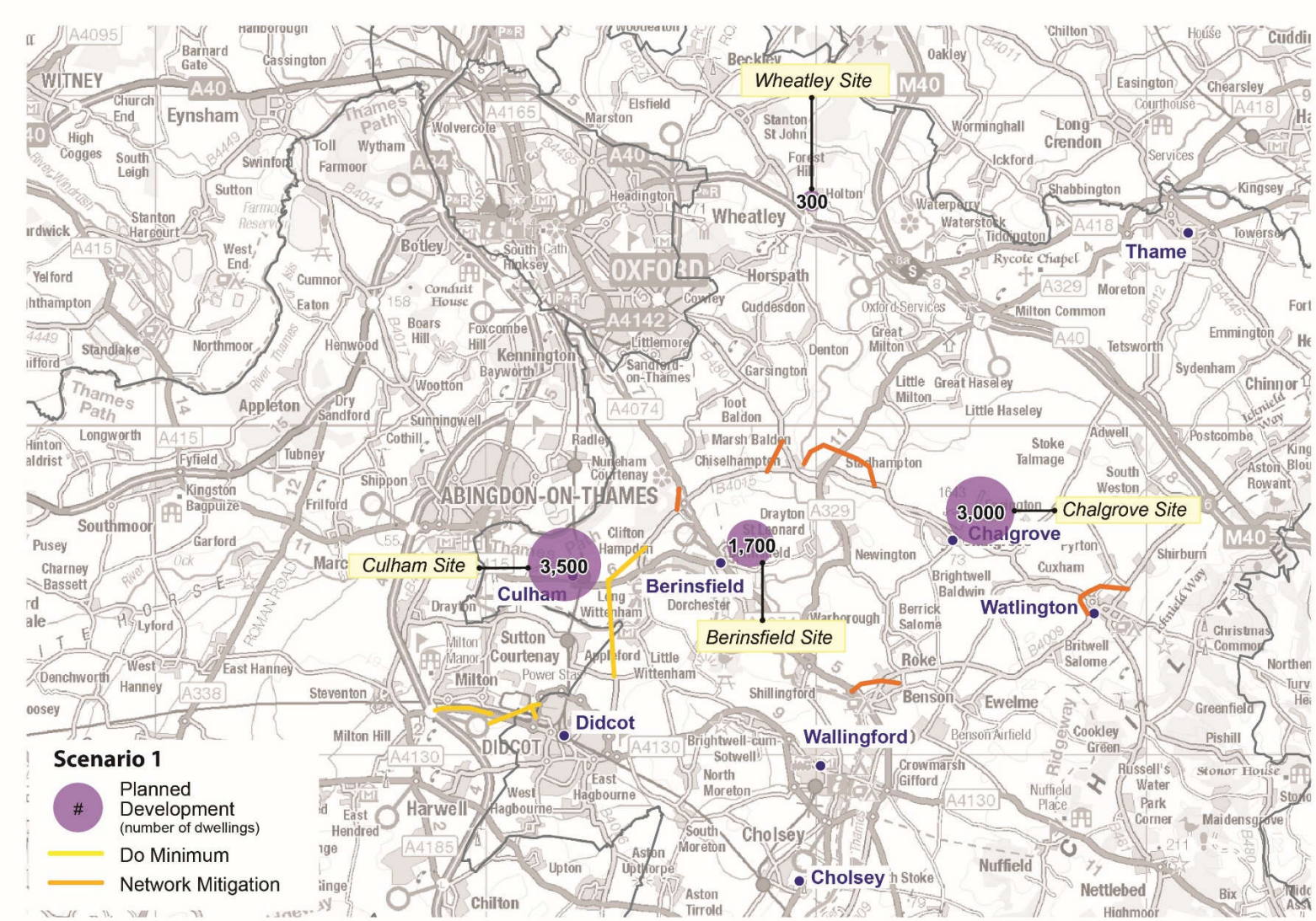
delivery of sustainable development. The further work will include on-going partnership work between the County Council, District Council and other partners including south Oxfordshire communities and developers of the proposed strategic sites.

Appendix

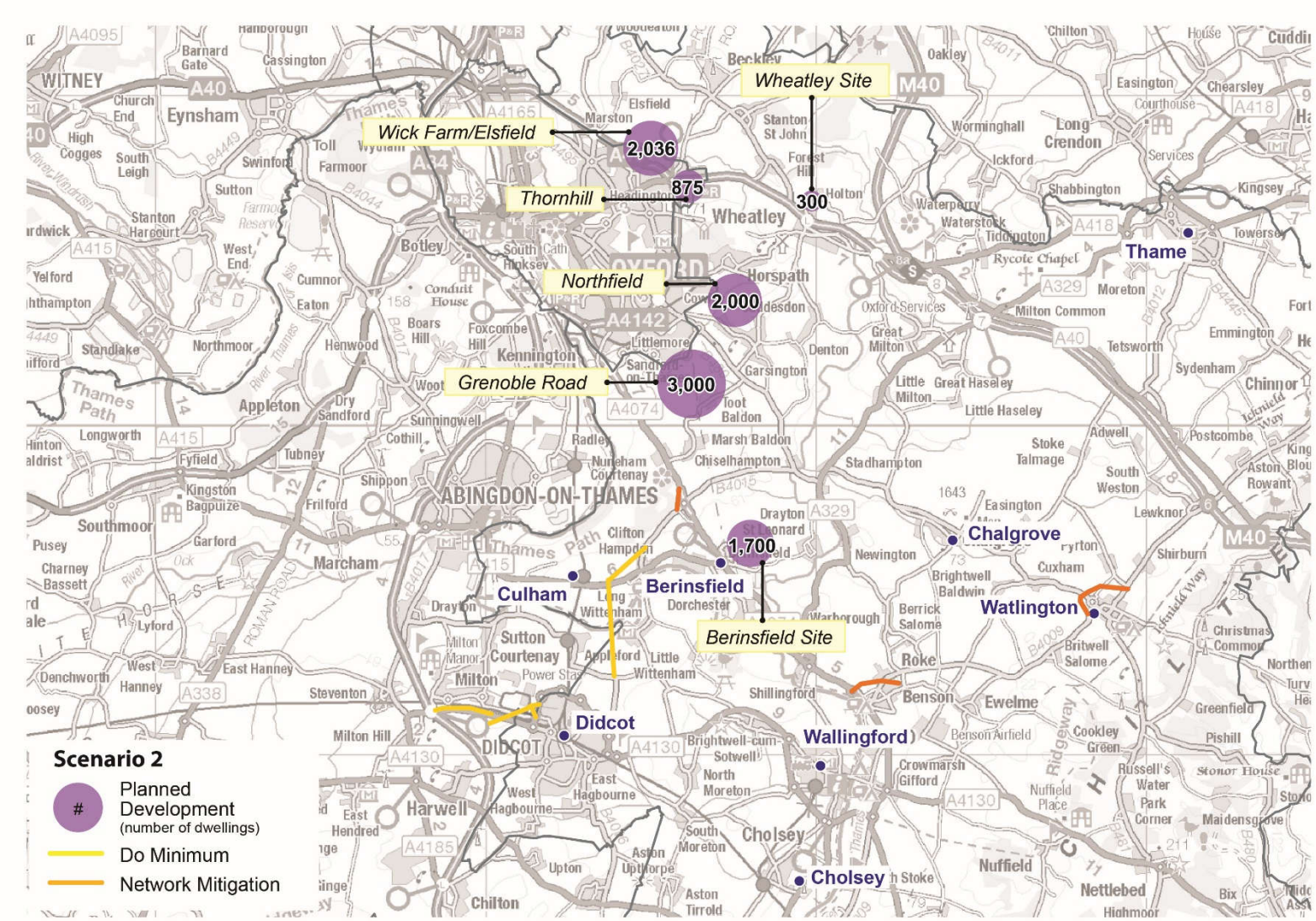
Appendix A.

A.1. Planned Development and Highway Infrastructure Locations

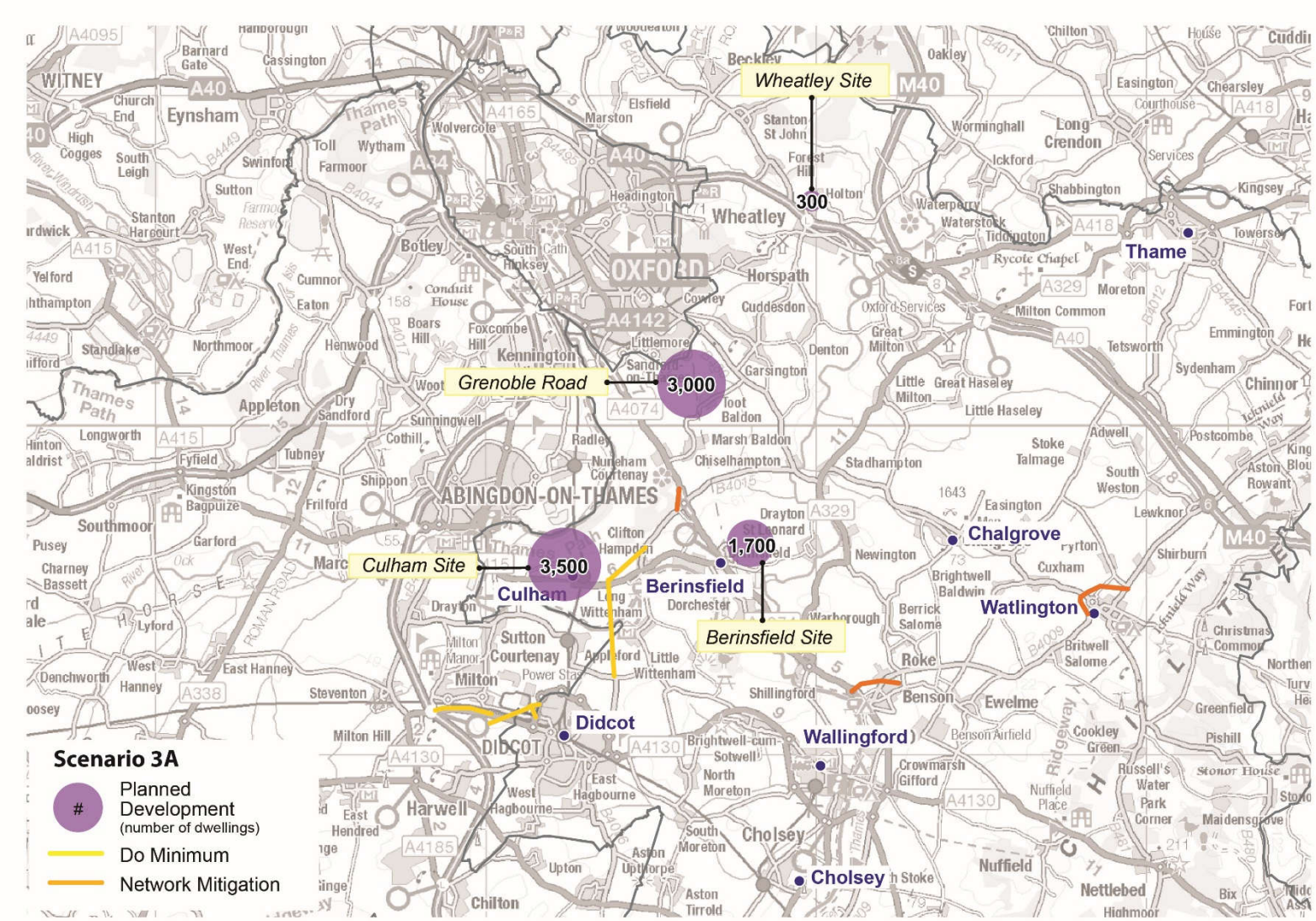
A.1.1. Scenario 1



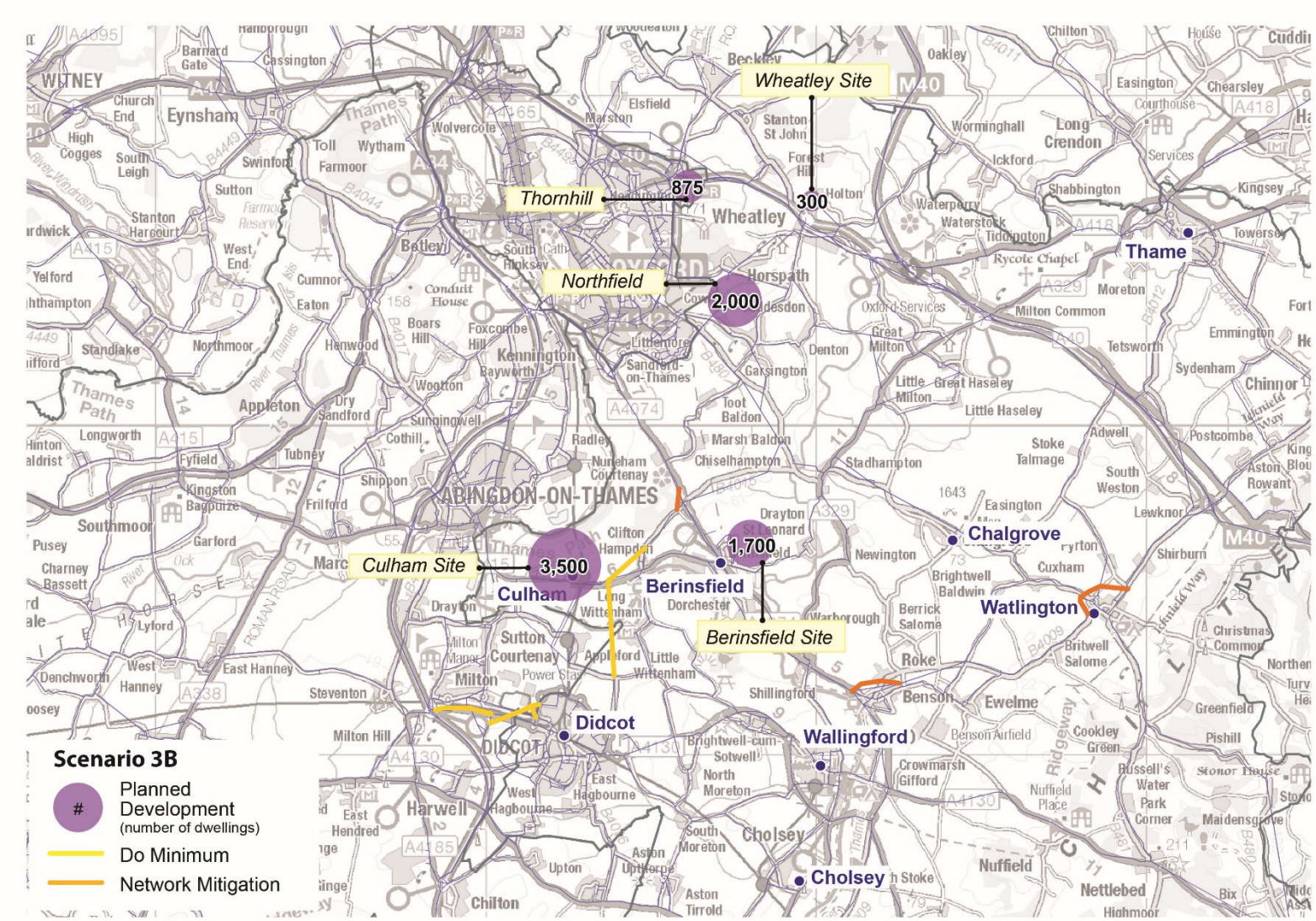
A.1.2. Scenario 2



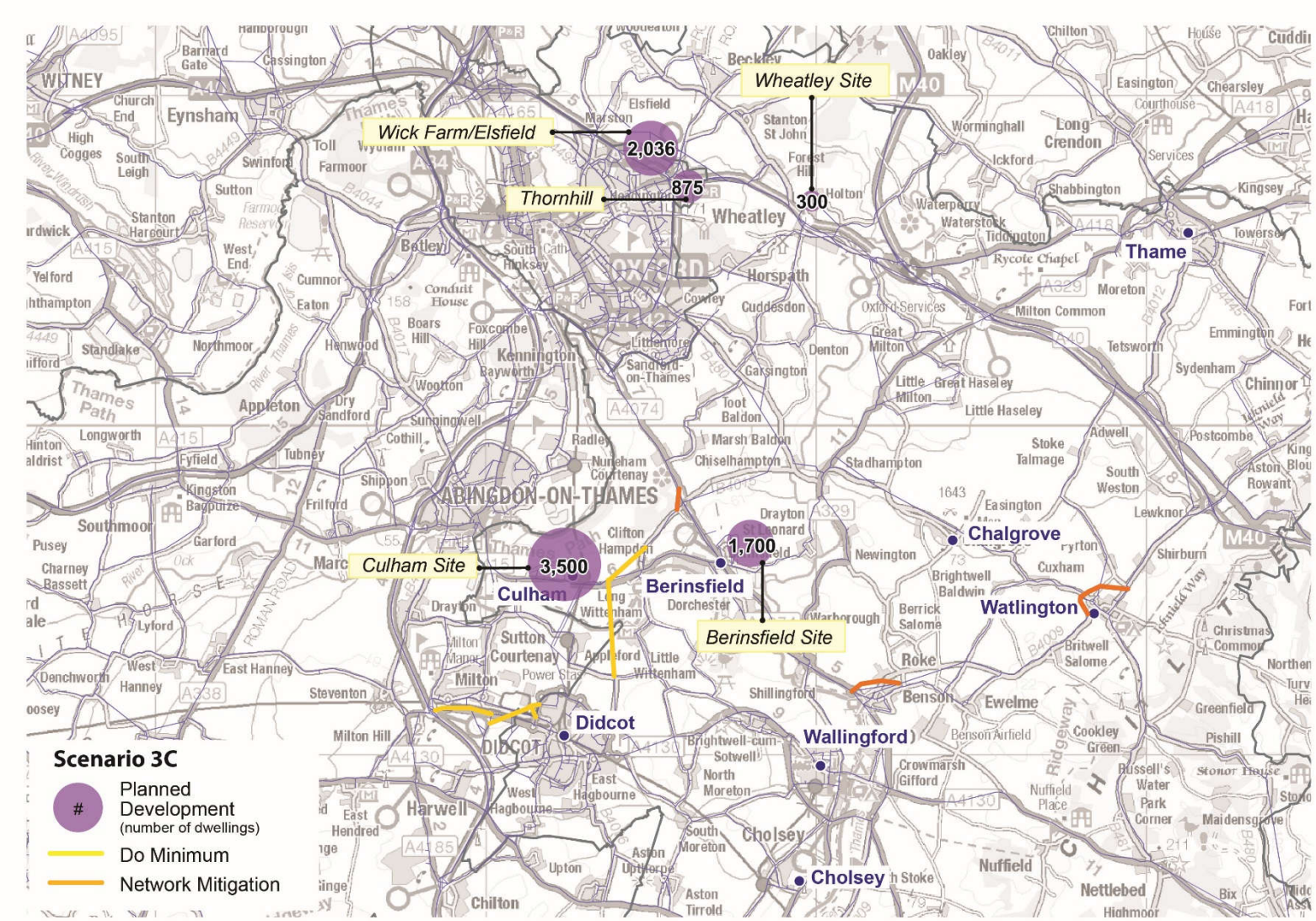
A.1.3. Scenario 3A



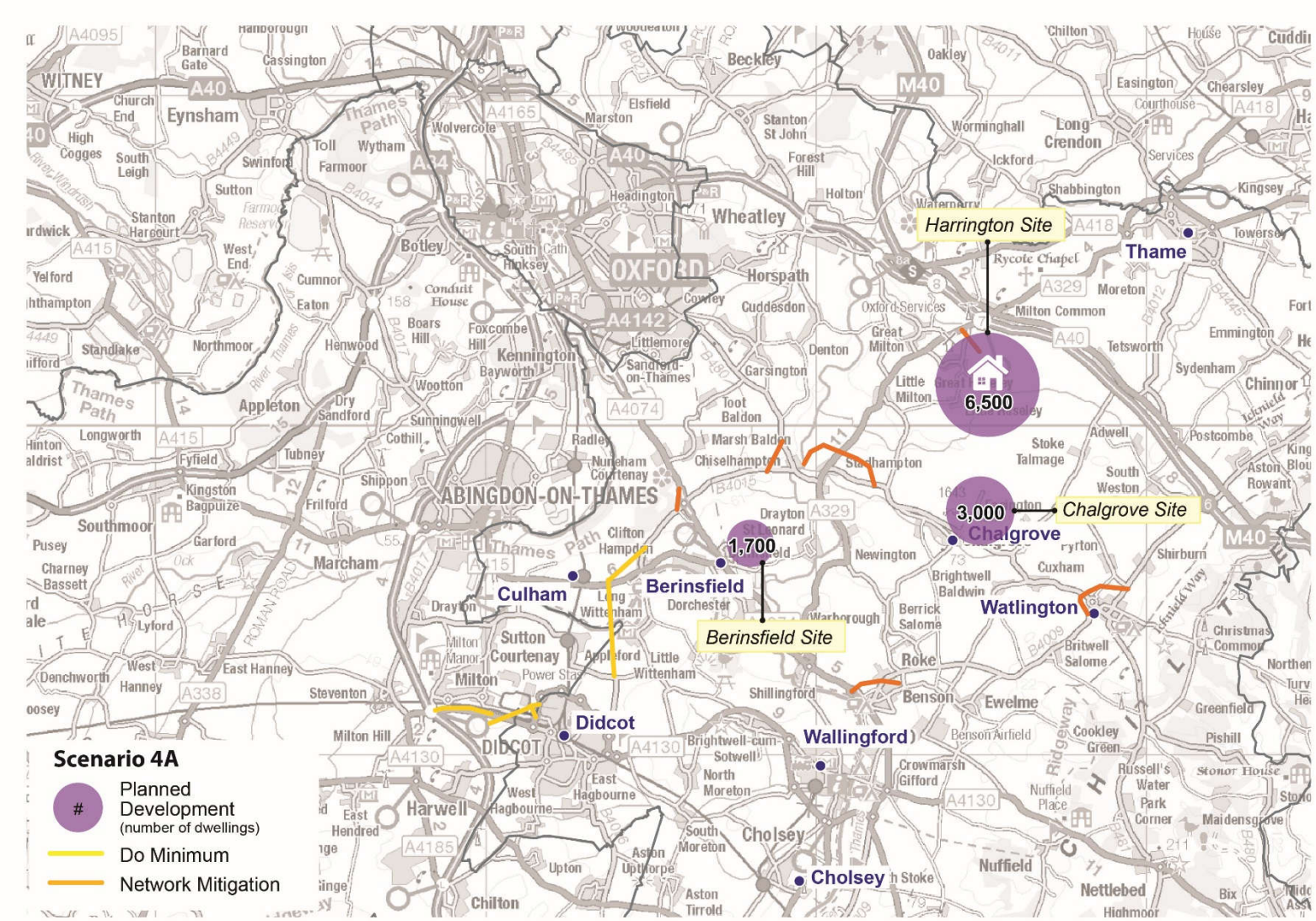
A.1.4. Scenario 3B



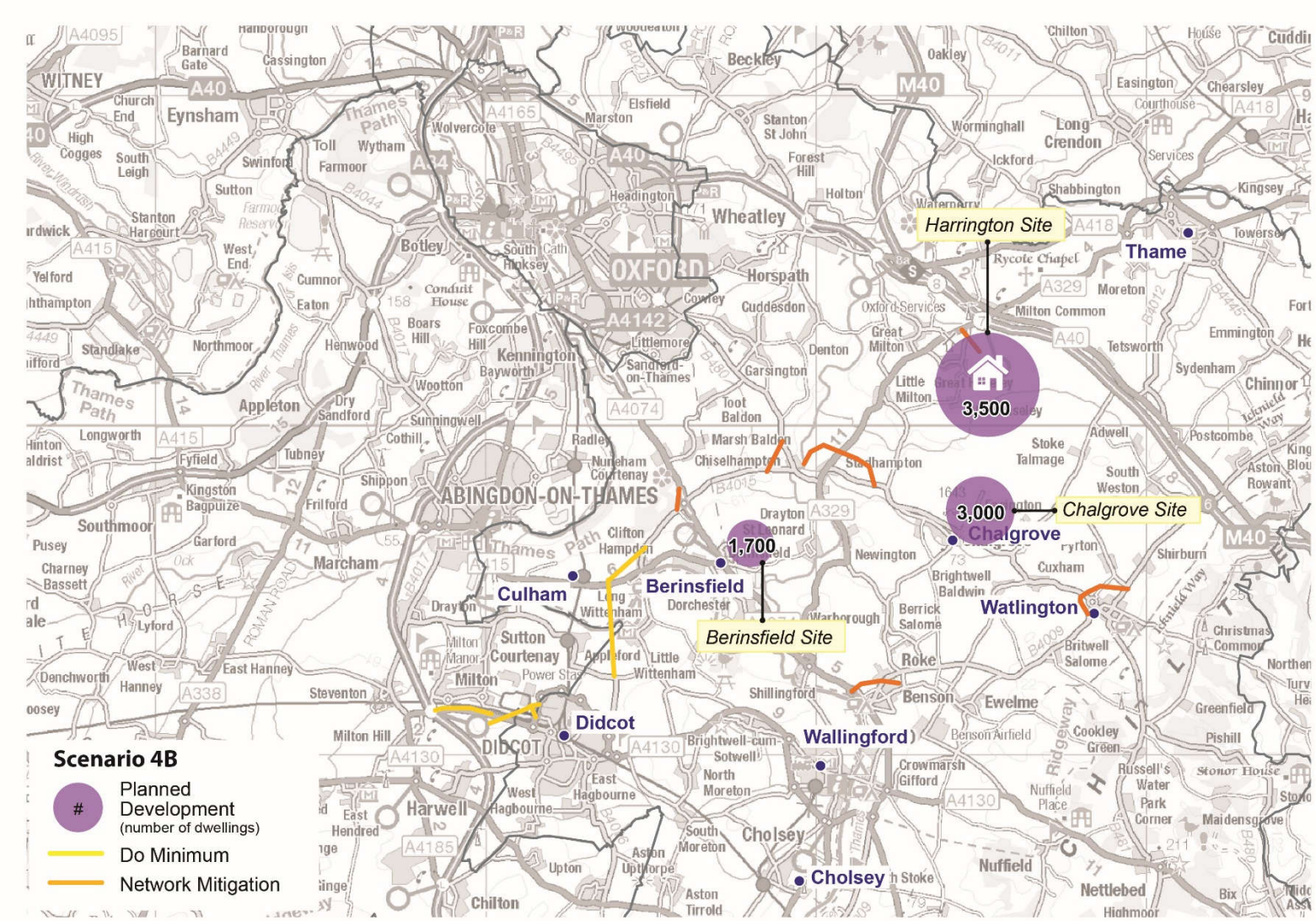
A.1.5. Scenario 3C



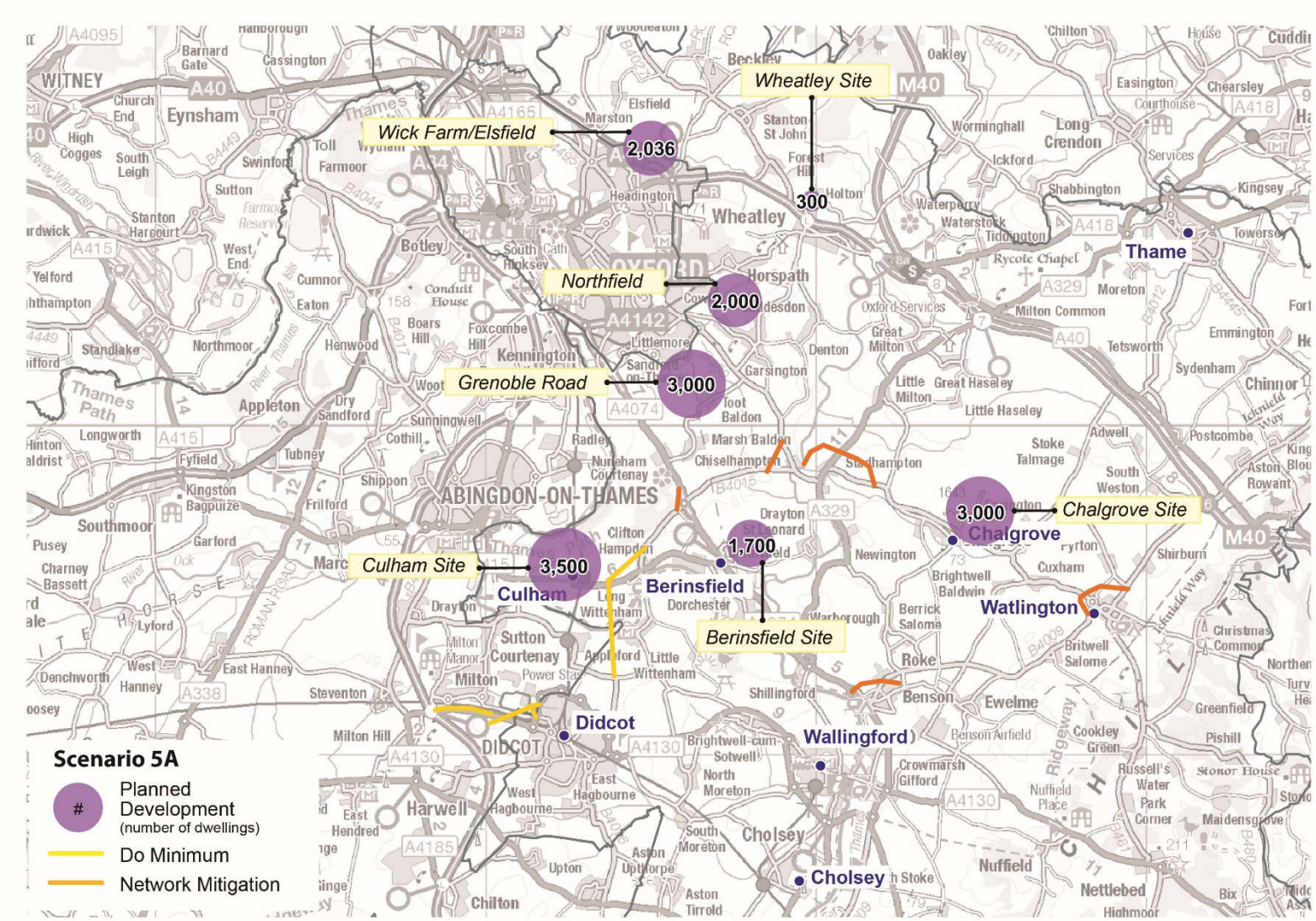
A.1.6. Scenario 4A



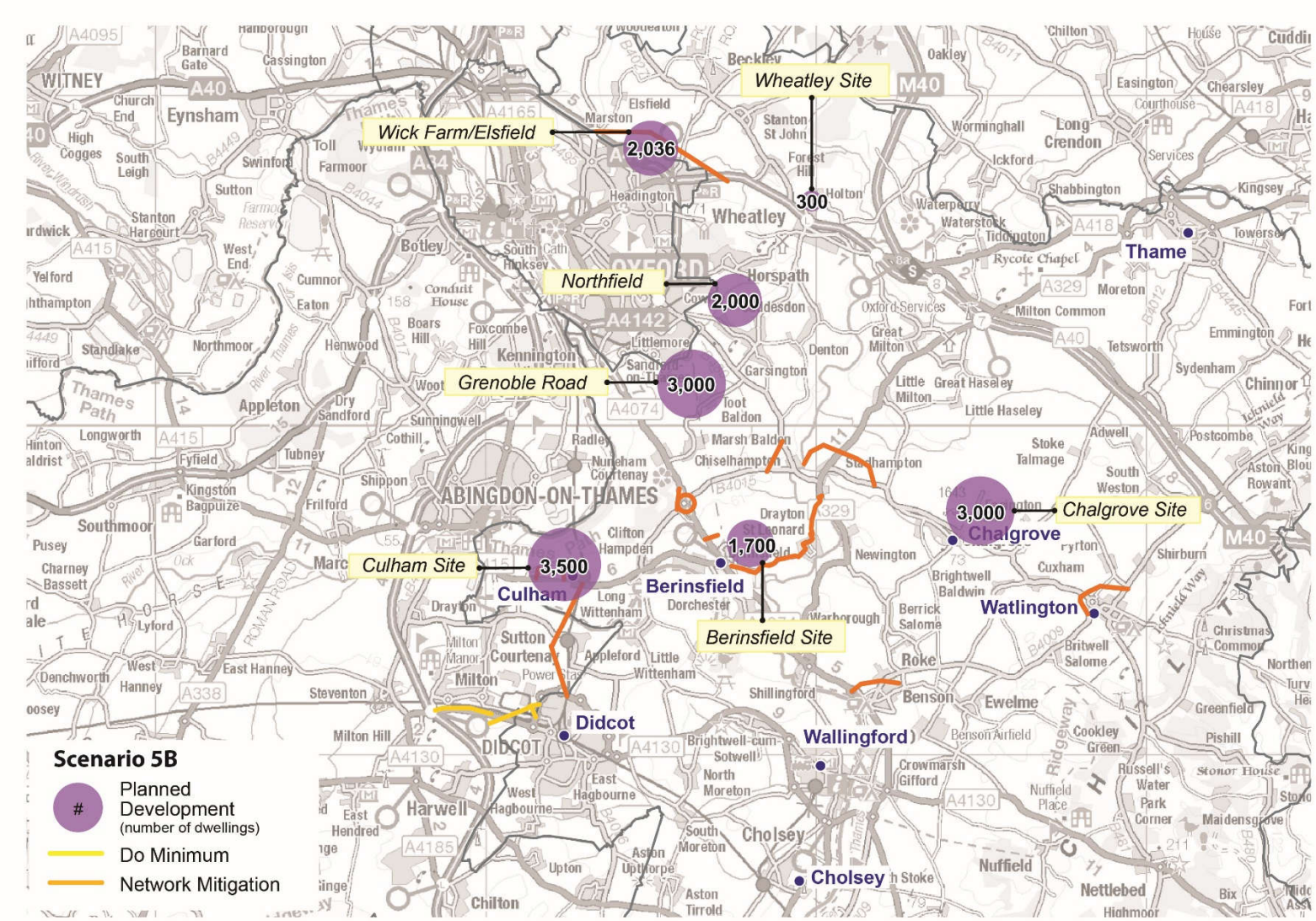
A.1.7. Scenario 4B



A.1.8. Scenario 5A



A.1.9. Scenario 5B



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