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Hertfordshire COMET: Local Plan Forecasting Report - LP5

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Quality information

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1. Executive Summary

1.1 Background to the Forecast

1.1.1 Hertfordshire County Council (HCC) commissioned AECOM to produce a 2036 forecast using the COMET multi-modal transport model. The forecast scenario includes the Local Plan aspirations (all employment and dwelling growth, regardless of certainty) of the 10 Hertfordshire districts, as well as the growth aspirations in the following neighbouring areas: Central Bedfordshire, Luton, Buckinghamshire (all districts), part of Essex (i.e. Epping Forest, Harlow, and Uttlesford), part of Cambridgeshire (i.e. South Cambs and Cambridge) and three boroughs of Outer London (Barnet, Enfield and Hillingdon)[1].

1.1.2 The forecast year has been defined by HCC as 2036. This year was chosen as it aligns with the local plan review timescales in south west Hertfordshire, represents the latest date of some districts Local Plans and is the furthest year into the future for which reasonable planning data projections are available. Where planning data did not forecast to 2036, NTEM[2] growth between the end point of the planning data and 2036 was applied. The forecast is based on growth assumptions in Hertfordshire and the surrounding areas (shown in Table 1-1) between 2014 and 2036 (as COMET has a Base Year of 2014).

1.1.3 Local Plan 5 (LP5) is the fifth local plan run that has been undertaken. LP5 includes the proposed transport schemes agreed with Hertfordshire districts in autumn 2019. It aligns with the Infrastructure Delivery Plans and Transport Strategies at the time, such as the growth and transport plans and the A414 strategy. A full list of the 283 transport schemes included in LP5 is detailed in Section 4. It should be noted a number of the schemes are hypothetical at this stage. In addition to highways and public transport schemes, a range of mode shift schemes were included in LP5 and attempts to reduce areas of notable delay from the reference case scenario were made.

1.1.4 LP5 also includes the light and heavy goods vehicle (LGV/HGV) growth projections detailed in the Department for Transport's Road Traffic Forecast 2018 (RTF 2018). Growth projections of LGV/HGV traffic have significantly increased in RTF 2018 compared to those used in previous 2031 Local Plan COMET scenarios (from RTF 2015). Similarly, buffer speed changes in RTF 2018 were implemented in LP5. These speed changes simulate changes in speeds on the wider road network outside of Hertfordshire. Sensitivity tests were undertaken to ensure the correct levels of traffic were observed in the simulation area from the buffer using the revised RTF 2018 projections.

[1] For the rest of Great Britain, the growth in employment and population in the COMET forecast is based on NTEM 7.2 projections.
[2] NTEM is the National Trip-EndTrip-endTrip-end Model produced by the Department for Transport and forecasts the growth in trip origins-destinations for use in transport modelling. These forecasts take into account population, employment, housing, car ownership and trip rates.

1.1.5 Caution should be exercised when comparing the results of LP5 and LP4 (Local Plan Run 4). Although both LP4 and LP5 forecast scenarios have been modelled for the same forecast year (2036) and RTF 2018 was utilised in both, an updated version of the COMET Base Year model (COMET v5) was used in LP5. This is the first time COMET v5 was used to undertake an unconstrained 2036 Local Plan forecast. The COMET v5 model includes significantly enhanced and updated zoning coverage and transport networks compared to COMET v4 which informed LP4. The validation of COMET v5 incorporated significantly more traffic data and screenlines and full v5 Base Year Model performance is detailed in the updated LMVR[3]. The differing performance and validation of the different versions of the COMET Base Year Model informing LP4 and LP5 should be considered when viewing results reported in this report.

1.1.6 With regards to planning data, LP5 includes a number of updates compared to LP4; NTEM projections were assumed for both housing and employment for Central Bedfordshire between the base year and 2036, whilst three boroughs of Outer London were included in the selected neighbouring area, as trips from/to these boroughs greatly impact the transport network within Hertfordshire. In LP4 Local Plan housing and employment data was used in Central Bedfordshire and NTEM projections were used for all Outer London boroughs. Additionally, 283 transport schemes were included in LP5, which were newly coded to ensure compatibility with COMET v5. The spatial distribution of developments are also considerably different between LP5 and LP4.

1.1.7 A direct comparison of the two Local Plan forecasts is therefore not possible and high-level comparisons are made to provide indicative results and analysis. The forecast is a reflection of the total cumulative growth within the county rather than a test of any specific set of developments and/or schemes.

1.1.8 Table 1-1 presents the number of dwellings and jobs in the base year (2014), as well as the growth assumptions for the forecast year (2036) in Hertfordshire and the selected neighbouring districts. The percentage growth in dwellings and jobs between 2014 and 2036 is also provided for the sites included in LP5. A comparison of growth assumptions in LP4 and LP5 is also presented. Whilst total housing growth in Hertfordshire is broadly consistent with LP4, it can be seen that there are variations by Districts and a reduction in the total number of Hertfordshire jobs. In areas bordering Hertfordshire there is a reduction in the number of houses and jobs compared to LP4.

[3] Hertfordshire COMET: Local Model Development and Validation Report v5.2, issued March 2020

Table 1-1: Growth Assumptions in Hertfordshire and selected neighbouring areas (2014-2036)

Area	BY 2014		LP5 2036		LP5 Growth (2014-2036)		Difference in Growth LP4 vs LP5 (2036)	
	Dwellings	Jobs	Dwellings	Jobs	Dwellings	Jobs	Dwellings	Jobs
Broxbourne	38,782	42,914	9,123	14,296	24%	33%	-15%	102%
Dacorum	61,987	71,623	21,183	6,157	34%	9%	7%	312%
East Hertfordshire	58,886	63,318	20,705	2,037	35%	3%	-2%	-38%
Hertsmere	41,222	50,065	17,633	1,185	43%	2%	5%	-81%
North Hertfordshire	55,087	57,010	16,147	3,574	29%	6%	-18%	-53%
St Albans	58,034	67,182	17,663	11,639	30%	17%	0%	87%
Stevenage	35,766	48,422	9,638	4,420	27%	9%	-21%	26%
Three Rivers	36,226	38,144	9,261	5,564	26%	15%	128%	-33%
Watford	38,119	57,602	13,664	2,880	36%	5%	32%	-74%
Welwyn Hatfield	45,114	73,998	16,432	9,896	36%	13%	-12%	-21%
Hertfordshire	**469,222**	**570,277**	**151,449**	**61,648**	**32%**	**11%**	**0%**	**-9%**
Essex (Epping Forest, Harlow, Uttlesford)	119,829	137,257	30,031	21,650	25%	16%	-7%	-6%
Central Bedfordshire	110,218	107,425	33,399	11,672	30%	11%	28%	-78%
Luton	75,883	97,998	7,348	5,340	10%	5%	-17%	0%
Buckinghamshire (Aylesbury Vale, Chiltern, Wycombe, South Bucks)	204,878	249,466	52,604	26,013	26%	10%	-32%	-63%
Outer London (Barnet, Enfield, Hillingdon)	90,125	169,807	10,841	19,839	12%	12%		
Cambridgeshire (Cambridge, South Cambridgeshire)	113,079	181,542	42,273	18,504	37%	10%	-32%	-19%
Total	**1,183,234**	**1,513,771**	**327,945**	**164,666**	**28%**	**11%**	**-8%**	**-32%**

1.1.9 COMET is a multi-modal transport model suite that includes a Highway Assignment Model, Public Transport Model, and Variable Demand Model.

1.2 Highway Network Results

1.2.1 In terms of highway trips originating in Hertfordshire, an increase of approximately 13% (at a 24 hour level) is forecast between 2014 and 2036. This increase is accompanied by a rise in travel distance of between 23% - 36% (depending on time period, longest distances travelled in the IP period), and an increase in travel time of between 44% to 50% (maximum increase in the Inter-peak). The relatively sharp rise in travel time compared to travel distance is indicative of increasing congestion and corroborates the maximum fall in average network speed of approximately -15% in the PM Peak.

Vehicle Flows and Congestion

1.2.2 Model results show significant congestion on key urban and inter-urban roads in 2036 – see section 7.3 for further details:

- Modelling shows the highest levels of congestion in the urban areas of Watford, Hatfield, Welywn Garden City, and Stevenage towns;
- Modelling shows congestion (although to a lower level) in the urban areas of St Albans, Hertford, Ware, Letchworth Garden City, Baldock and Bishop's Stortford;
- Modelling suggests lowest levels of congestion in the urban towns of Cheshunt, Broxbourne, Hoddesdon, Hitchin and Hemel Hempstead;
- Various sections of the M25, A1(M) and M1 suffer from congestion ;
- The M1 and A1(M) are more popular for strategic north-south movements than the A10;
- The A414 broadly operates within capacity, but increased flows are experienced on the A414 corridor between the A10 and A1(M);
- Reduced flows are suggested on the A414 through central Hemel Hempstead, due to a direct access being modelled from M1 junction 8 into eastern Hemel and the modelling of a new link around the northern part of Hemel Hempstead and the reduction of the A414 to one lane for general traffic in each direction;
- There is congestion and delays on key strategic routes entering and exiting Hertfordshire from neighbouring Local Authorities.
- The impact of the A120 bypass can be seen linking to the northern ring road around Bishop's Stortford;
- There is a flow reduction on the A10 in Broxbourne due to the reduced speed limit and localised flow reductions on the A505 between Hitchin and Letchworth;
- Link stress and delays can be seen to increase across the western half of Hertfordshire (west of the A1(M)) ; and
- Increases in delays along the A414 in Hemel may be due to the reduced road capacity, while decrease in delays on the A10 are experienced due to decreased link stress

1.2.3 Figure 1-1 to Figure 1-3 provide a selection of forecast highway model results from the AM peak. Note that "BY" refers to "Base Year", whilst "LP5" refers to the "Local Plan Run 5" (i.e. the current forecast).

Figure 1-1: Flow Difference on Key Corridors (2036 AM Peak minus 2014 AM Peak)

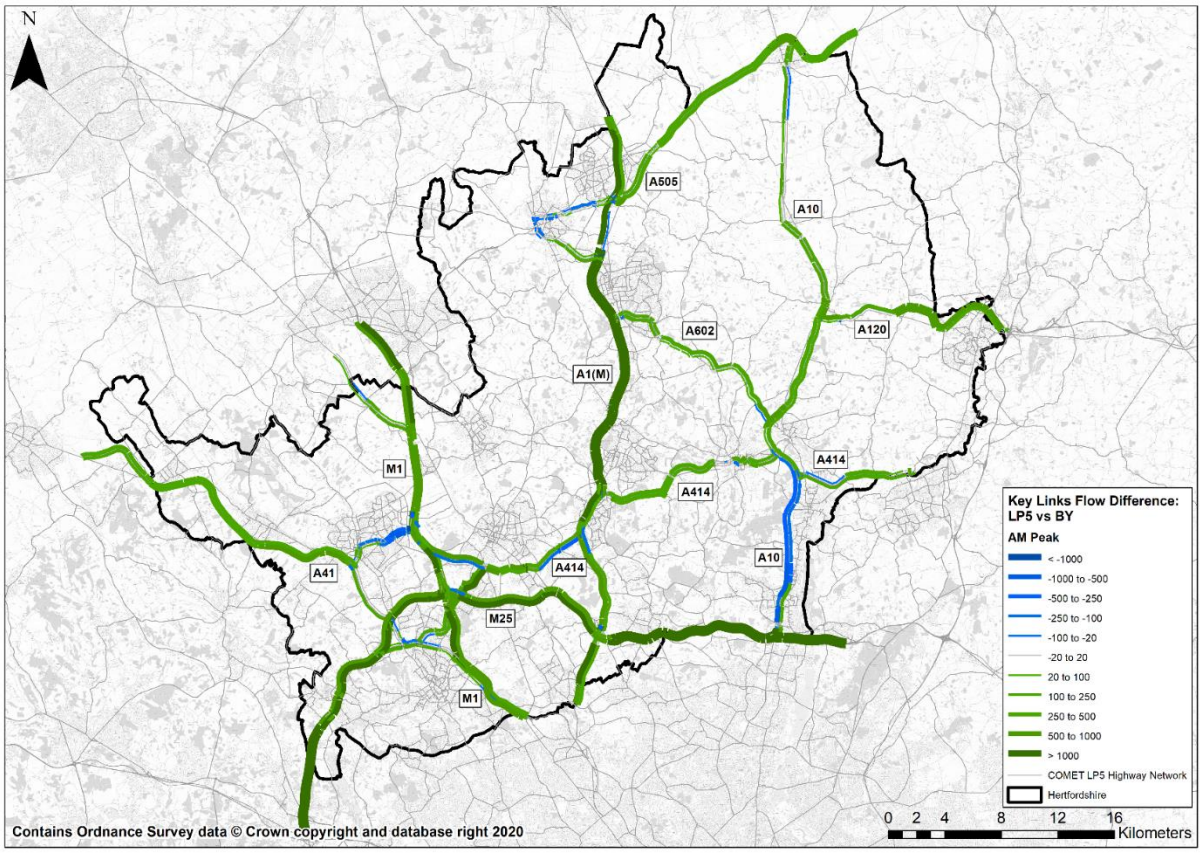


Figure 1-2: Volume over Capacity on Key Links (2036 AM Peak)

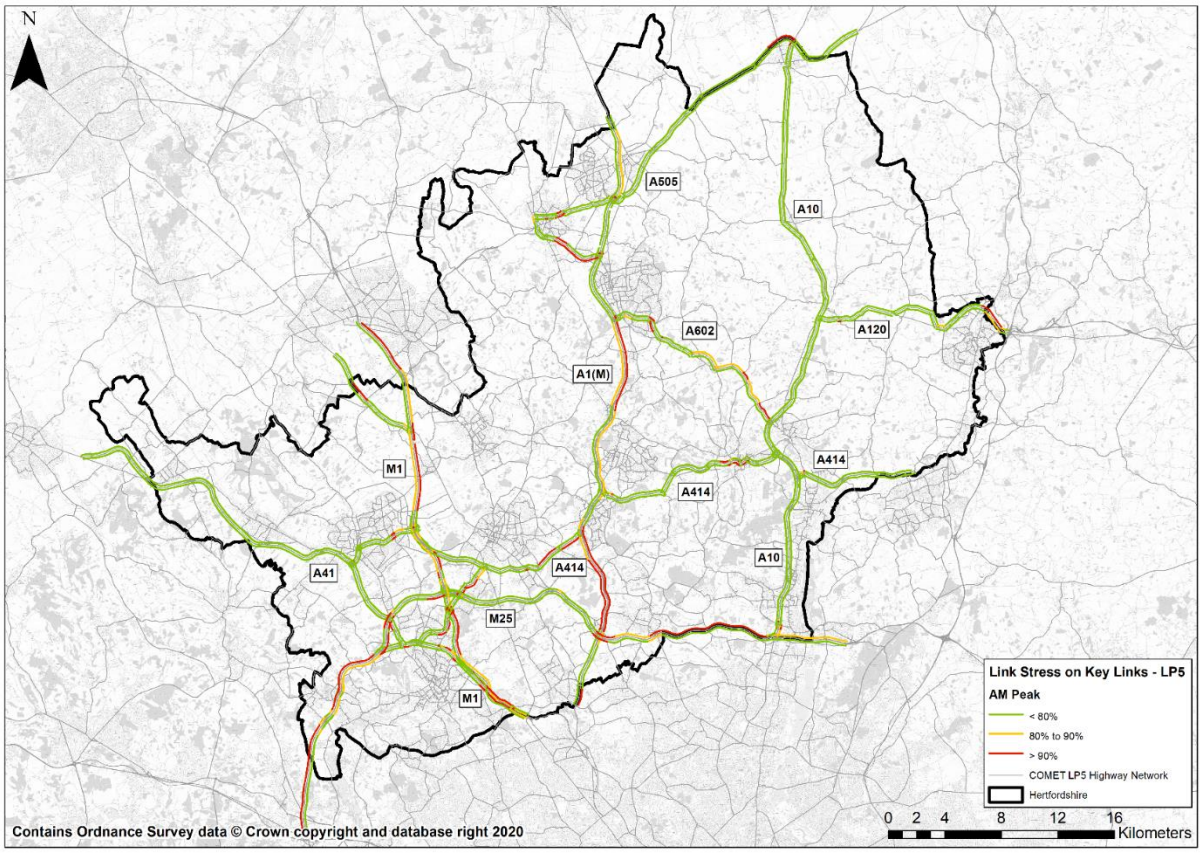
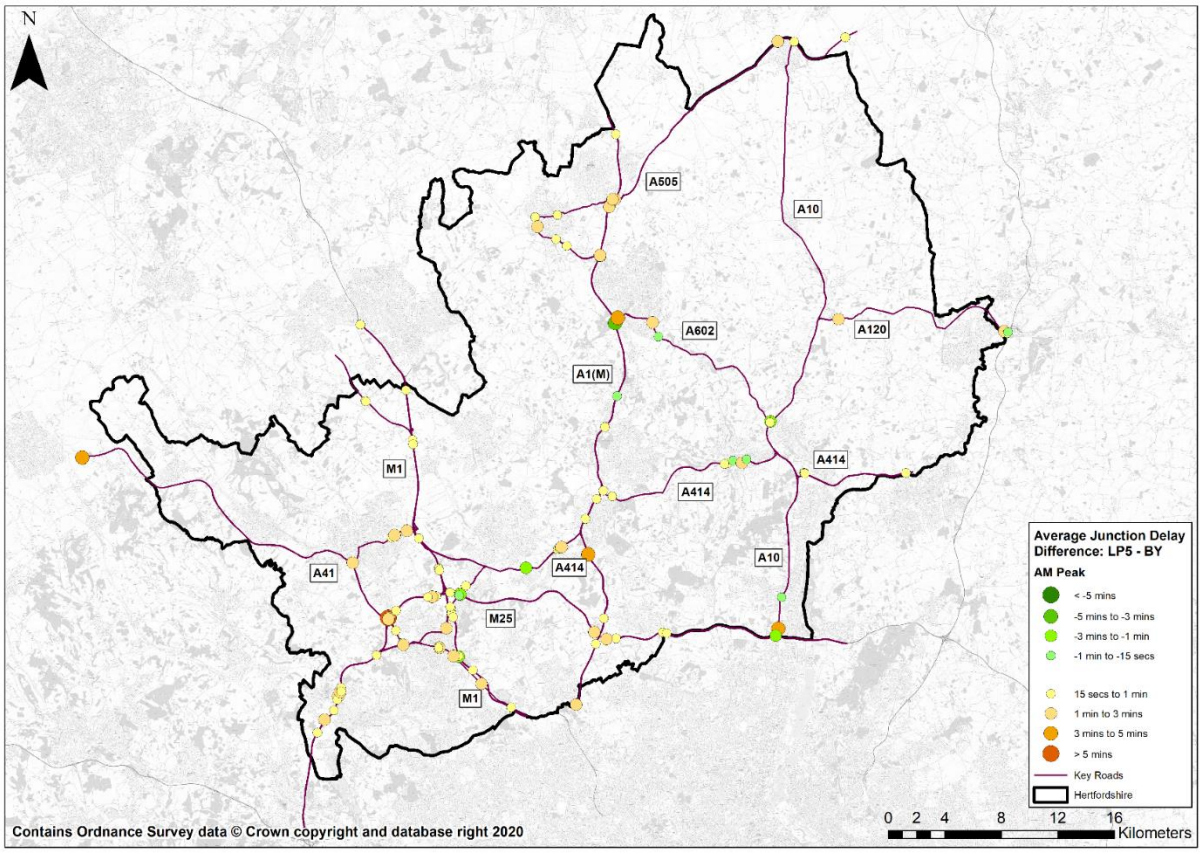


Figure 1-3: Delay at Key Junctions (2036 AM Peak)



Inter-urban Highway Journey Times

1.2.4 Increased vehicle flow and congestion in the Forecast Year cause a rise in the average journey time between urban areas in Hertfordshire. The table below presents the journey time changes between key towns in Hertfordshire in LP5 in the AM peak.

1.2.5 This table shows journey times for the “average route”; therefore, some journeys will be considerably slower than the indicated values.

1.2.6 Towns in the south west of Hertfordshire experience some of the greatest changes in journey times due to the congestion on the network.

Table 1-2: Journey time comparisons between LP5 and Base Year in AM peak (mins)

	2036 LP5 - BY AM (min)										
	Town	Bishop's Stortford	Cheshunt	Borehamwood	Rickmansworth	Watford	Hertford	Welwyn Garden City	Stevenage	Hitchin	St Albans	Hemel Hempstead
LP5 vs BY	Bishop's Stortford	0	5	9	17	16	0	0	1	7	6	17
	Cheshunt	9	0	9	17	16	9	3	11	9	11	18
	Borehamwood	14	17	0	12	15	10	8	10	8	6	11
	Rickmansworth	15	17	2	0	3	11	10	12	8	5	5
	Watford	13	15	10	3	0	9	8	10	7	4	4
	Hertford	1	3	7	14	12	0	0	1	3	4	14
	Welwyn Garden City	3	6	7	14	12	3	0	4	3	3	11
	Stevenage	3	7	6	13	11	5	4	0	5	4	10
	Hitchin	8	10	8	12	12	7	5	5	0	4	9
	St Albans	7	12	3	9	6	7	5	7	3	0	3
	Hemel Hempstead	19	22	9	5	7	11	7	9	6	2	0

1.3 Public Transport Network Results

1.3.1 Forecast results also indicate that the rail network in Hertfordshire will experience an increase in passenger boardings by approximately between 95% and 180% across the AM, IP and PM Peaks between 2014 and 2036. Bus travel, by comparison, is likely to grow at a lower rate (by 19%-50%) over the same period as a result of rising personal incomes that make rail's higher fares relatively more affordable.

1.3.2 Passenger distance bus travel experiences a lower increase compared to rail and rail and bus journeys, as rail becomes a more attractive option. However some local movements by bus increase due to the linkages of new developments to bus routes.

2. Introduction

2.1 Background

2.1.1 The development of the COMET model suite was commissioned by Hertfordshire County Council (HCC) in February 2015 to provide a structured evidence base for assessing transport policies and strategies on a consistent basis across the county. COMET is a multi-modal model with variable demand modelling capability.

2.1.2 The COMET Base Year (2014) model has been regularly updated since 2015 and different versions of the COMET model have informed 4 previous local plan forecast scenarios. The last COMET model Local Plan Run 4 (LP4) forecast (completed in spring 2019) included 2036 dwelling and employment projections (regardless of certainty) for the 10 Hertfordshire districts as well as the growth aspirations in selected neighbouring areas: Central Bedfordshire, Luton, Buckinghamshire (all districts), part of Essex (i.e. Epping Forest, Harlow, and Uttlesford), and part of Cambridgeshire (i.e. South Cambs and Cambridge)[4].,

2.1.3 Since then the South West Hertfordshire Authorities have been identifying additional development sites as part of their local plan reviews and Welwyn Hatfield have also identified additional development sites In light of the updated local plan projections (Local Plan 5), HCC commissioned AECOM to produce a 2036 forecast model, which would include the 2036 dwellings and employment aspirations for the same areas as in LP4.

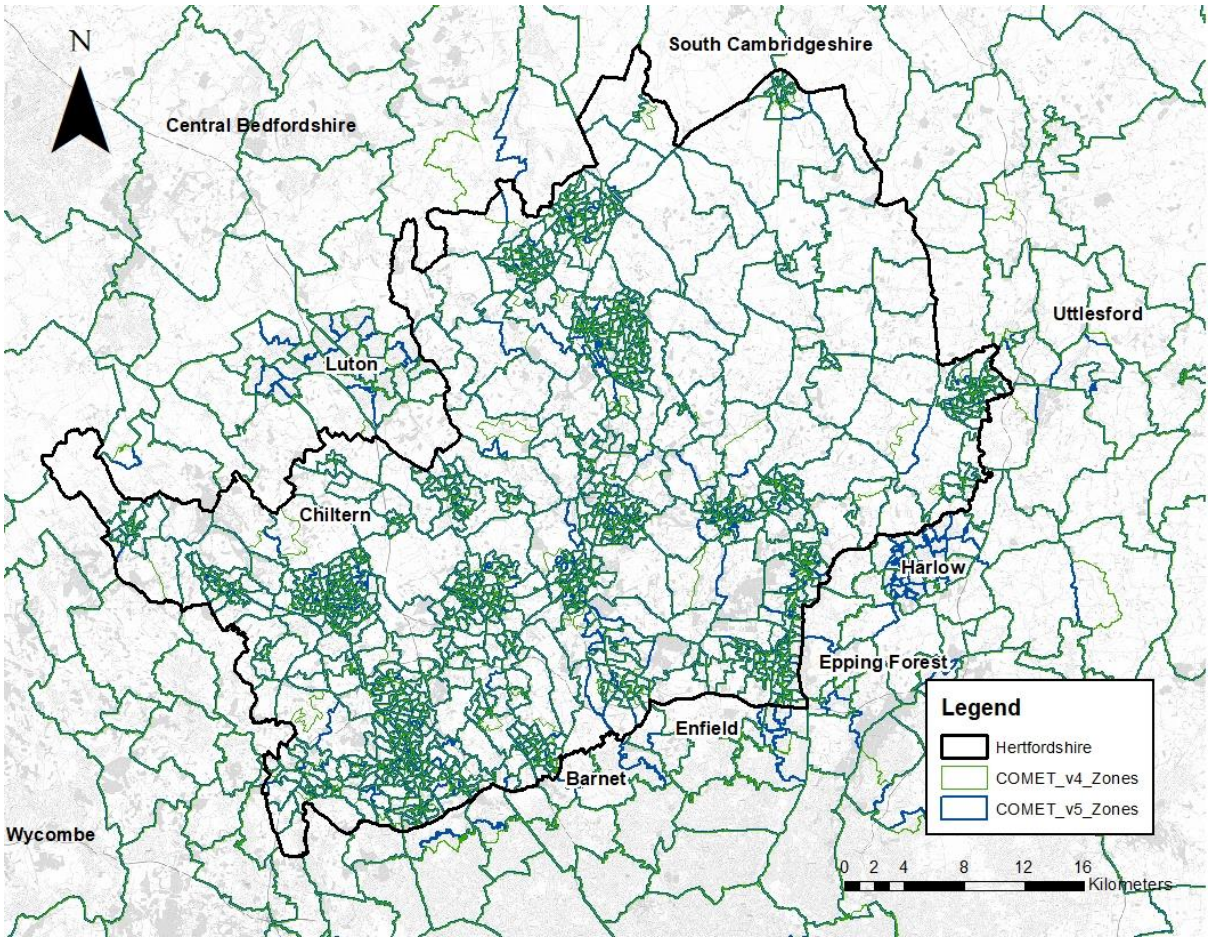
2.1.4 This is the first time COMET v5 was used to undertake an unconstrained 2036 Local Plan forecast. The COMET v5 model includes significantly enhanced and updated zoning coverage and transport networks compared to COMET v4 which informed LP4. The validation of COMET v5 incorporated significantly more traffic data and screenlines and full v5 Base Year Model performance is detailed in the updated LMVR[5]. The differing performance and validation of the different versions of the COMET Base Year Model informing LP4 and LP5 should be considered when viewing results reported in this report.

2.1.5 Three London boroughs, that are considered to have a direct impact on the road network within Hertfordshire, were added to the neighbouring areas: Outer London (i.e. Barnet, Enfield and Hillingdon). Previous versions of local plan scenarios have only assumed NTEM growth in these 3 areas.

2.1.6 The difference between the zoning system in the LP4 and LP5 applications of the COMET model are shown in Figure 2-1.

[4] For the rest of Great Britain, the growth in employment and population in the COMET forecast is based on National Trip-EndTrip-endTrip-end Model (NTEM) 7.2 projections.
[5] Hertfordshire COMET: Local Model Development and Validation Report v5.2, issued March 2020

Figure 2-1: Zoning system in COMET v5 (LP5 application) and its differences to COMET v4 (LP4 application)



2.1.7 LP5 includes the proposed transport schemes agreed with HCC in autumn 2019 and aligns with the Infrastructure Delivery Plans and Transport Strategies at that time. A full list of all transport schemes included in LP5 is detailed in Section 4. Compared to the COMET Base Year model, 283 schemes are included in LP5. In addition to highways and public transport schemes, a range of mode shift schemes (see Figure 4-1) were included in LP5 and attempts to reduce areas of notable delay identified in the reference case scenario were made.

2.1.8 LP5 also includes light and heavy goods vehicle (LGV/HGV) growth projections detailed in the Department for Transport's Road Traffic Forecast 2018 (RTF 2018). Growth projections of LGV/HGV traffic have significantly dropped in RTF 2018 compared to those used in previous 2031 Local Plan COMET scenarios (from RTF 2015). Similarly, buffer speed changes in RTF 2018 were implemented in LP5. These speed changes simulate changes in speeds on the wider road network outside of Hertfordshire. Sensitivity tests were undertaken to ensure the correct levels of traffic were observed in the simulation area from the buffer using the revised RTF 2018 projections.

2.1.9 The forecast is developed to test the cumulative impact of the updated Local Plan development projections and revised set of transport infrastructure measures.

2.2 Purpose of this Document

2.2.1 This document presents the steps taken to produce the forecast scenario and a summary of high level results across Hertfordshire's highway and public transport networks. A user-friendly presentation providing similar analysis was also issued to HCC in March 2020.

2.3 Caveats

2.3.1 Although both LP4 and LP5 forecast scenarios have been modelled for the same forecast year (2036) and RTF 2018 was considered in both, caution should be exercised when comparing the results of LP5 and LP4:

- LP5 was applied on a different COMET version to LP4 (COMET v5 and COMET v4 respectively). The two versions are fundamentally different due to their differences in the zoning system, networks and validation parameters/performance. COMET v5 comprises smaller zones in the area within Hertfordshire and the selected neighbouring areas (Figure 2-1) which results in a higher level of detail across the transport network. Thus, the spatial distribution of developments, as well as their impact to the network, e.g. saturation flows, are considerably different.
- With regards to planning data, LP5 includes a number of updates compared to LP4; planning data for both housing and employment for Central Bedfordshire were replaced with the TEMPro growth between the base year and 2036 (as projections were deemed unrealistic – this was confirmed by HCC), whilst three boroughs of Outer London were included in the selected neighbouring area, as trips from/to these boroughs greatly impact the transport network within Hertfordshire. Growth assumptions for Buckinghamshire and Cambridgeshire were kept consistent with LP4, where national growth projections were used.
- Comparing the transport schemes in consideration, 283 schemes are included in LP5 whereas around 300 schemes were included in LP4.

  A direct comparison of the two Local Plan forecasts is, therefore, not possible and high-level comparisons are made to provide indicative results and analysis.

2.3.2 Analysis focuses on results from the AM peak (0800 to 0900) and PM peak (1700 to 1800), however, results have also be produced for the Inter peak (average hour between 1000 and 1600). Results from the Inter peak will only be reported if they vary considerably from those seen in the AM and PM peaks.

2.4 Previous Local Plan COMET Forecasting

2.4.1 Table 2-1 presents a summary of the previously prepared Local Plan forecasts prepared in COMET for HCC.

Table 2-1: Previous Local Plan COMET Forecasting

Base Year Version	Local Model Development and Validation Report	Summary of COMET Base Year Version	Relevant Previous Forecast Scenarios
COMET v1	May 2016 (v1)	Initial version of COMET	Hertfordshire COMET: **Local Plan** Forecasting Report: June 2016
COMET v2	November 2016 (v2)	Version of COMET based on v1 enhanced in the Watford area: Refinements to the highway matrix build process New intra-urban highway screenlines/cordons Additional highway data collection Enhancement of network detail in the town New bus passenger cordon around Watford Additional bus passenger data collection	Hertfordshire COMET: **Local Plan Do Minimum** Forecasting Report: January 2017 **Local Plan Do Something** Scenario – developed in early 2017. Outputs presented to HCC in February 2017, however, no forecasting report was produced.
COMET v3	No LMVR produced	Version of COMET based on v2 enhanced in St Albans district: New intra-urban highway screenlines/cordons Additional highway data collection Enhancement of highway network detail in the town, including coding of speeds on urban links in St Albans and Harpenden. New bus passenger cordon around St Albans Additional bus passenger data collection in St Albans and Harpenden	**St Albans Local Plan Do Minimum** scenario. Outputs presented to HCC in June 2017, however, no forecasting report was produced.
COMET v4	No LMVR produced	As above for Local Plan v3. Uses the same Base Year version as Local Plan 3 from v2 enhanced in St Albans district.	**Local Plan v3 2031** scenario. Outputs and report provided to HCC June 2018. **Local Plan v4 2036** scenario. Outputs and report provided to HCC June 2019.
COMET v5	LMVR[6] produced	Fundamentally different to LP3 and LP4. The Base Year transport network was updated, and re-zoning was introduced for the areas within Hertfordshire and selected neighbouring areas to provide greater detail. All schemes were coded anew.	**Current forecast** documented in this report – referred to as Local Plan v5 with forecast year of 2036.

[6] Hertfordshire COMET: Local Model Development and Validation Report v5.2, issued March 2020

2.5 Report Structure

2.5.1 This report covers the following areas:

- Forecast Approach
- Forecast Network Development
- Forecast Trip Matrix Development
- Forecast Assignments
- Highway Forecast Results
- Public Transport Forecast Results
- Airport Growth Sensitivity Test
- Appendices

3. Forecast Approach

3.1 Forecast Objectives

3.1.1 The objective of this forecasting exercise is to understand the cumulative effect of all Local Plan growth in Hertfordshire, whilst also considering the impact of growth in neighbouring authorities and the impact of potential transport schemes and strategies (see Table 1-1).

3.1.2 This document does not draw any conclusions for any specific individual development or scheme regarding its effect on the local or wider transport network. Although LP5 and LP4 are not directly comparable, high level comparisons to LP4 are made. The caveats in section 2.3 should be noted.

3.1.3 This forecast takes into consideration changes between 2014 and 2036 including increases in population, number of jobs and dwellings, rising costs of travel, and proposed transport infrastructure schemes. However, there is currently no allowance for factors that may fundamentally alter the nature of travel in Hertfordshire or elsewhere in Great Britain. These factors may include the introduction of new technologies (e.g. autonomous vehicles) or a significant shift in travel patterns relative to the Base Year model as a result of behavioural change.

3.2 Model Years

3.2.1 The forecast year has been defined by HCC as 2036. 2036 was chosen as the date aligning with the Local Plan reviews for the South West Herts planning authorities. In other districts local plan growth was projected forwards using NTEM growth. Where planning data did not forecast to 2036, NTEM growth between the end point of the planning data and 2036 was applied. No other forecasts with alternative model years have been created.

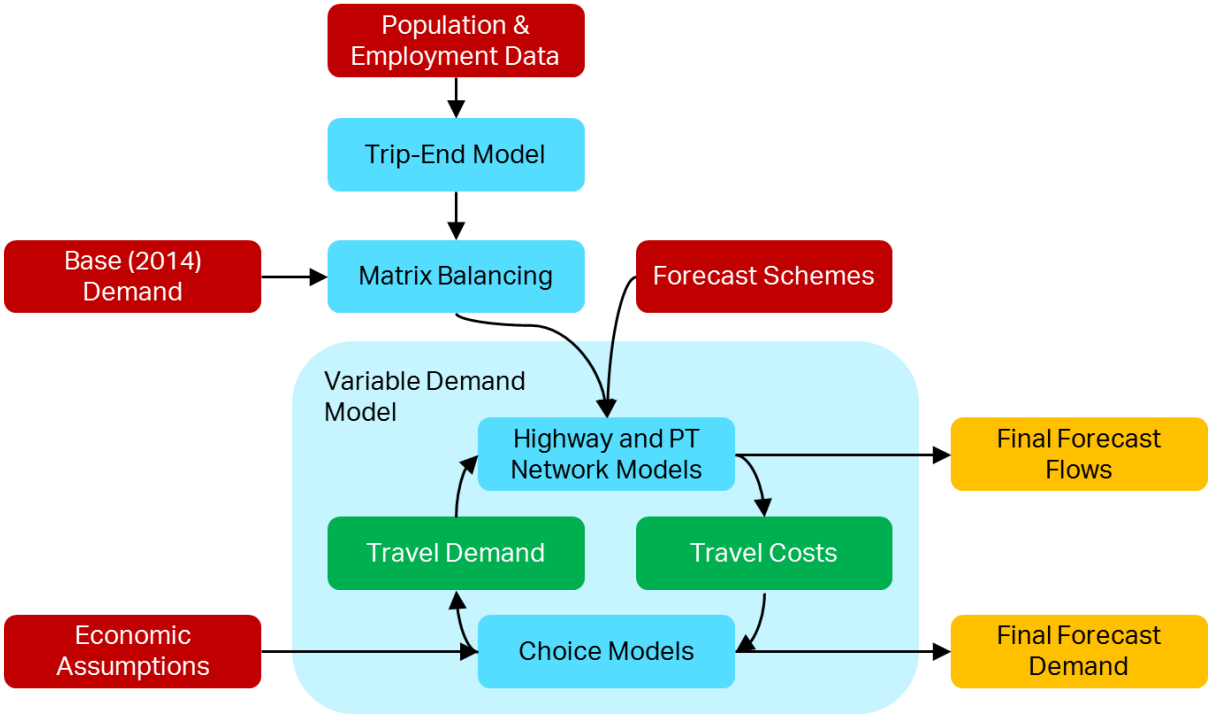
3.3 Treatment of Variable Demand

3.3.1 COMET includes a variable demand model, which has been used in the preparation of forecast scenarios. The variable demand model is designed to estimate the effect of changes in transport infrastructure and travel cost upon patterns of demand. This considers changes in overall travel movements and is separate to modelling the way in which travellers respond to changes by choosing different routes. The latter is forecast by the highway and public transport assignment models. Further details of the treatment of variable demand can be found in Chapter 5.

3.4 Model Structure

3.4.1 COMET is a multi-modal model with a Highway Assignment Model developed in SATURN, a Public Transport Model in Emme and Variable Demand Model in Emme. The structure of the forecasting process, including the interaction between the demand models and assignment models is shown in Figure 3-1.

Figure 3-1: COMET Model Structure



4. Forecast Network Development

4.1 Public Transport Network

4.1.1 As the COMET model was updated, with new coding standards and zoning system, it was necessary for the public transport schemes used in previous applications to be revised. No changes to the public transport network were made and the coding assumptions considered in previous model versions were checked. The new public transport schemes were modelled, using drawings and maps sent by HCC to inform the schemes details and the system was updated to allow for trips that involved bus and rail interchange.

Forecast Public Transport Schemes

4.1.2 HCC provided an updated list of public transport schemes (as part of the infrastructure log) and drawings for each of the schemes. These networks, therefore, formed the basis on which the highway and public transport networks of the 2036 LP5 were created.

4.1.3 Schemes were taken from the district Local Plan IDPs and transport strategies such as the Growth and Transport plans and the A414 Strategy as well as proposed changes to interurban bus services and bus services linked to new developments. Non-tolled measures identified through the Broxbourne Air Quality Local Plan work were also included.

4.1.4 The new public transport schemes and services in Hertfordshire added during the creation of the LP5 2036 forecast network are shown in Table 4-1 and Table 4-2 (schemes outside Hertfordshire).

Table 4-1: Modelled Public Transport Schemes in Hertfordshire

District	Scheme Type	Location	Description	Modelled before?
Broxbourne	Bus Scheme	High Leigh to Broxbourne	New bus service, High Leigh to Broxbourne Station	LP3 and LP4
Broxbourne	Bus Scheme	Hoddesdon to Enfield	New bus service, Hoddesdon to Enfield via Cheshunt (2 buses per hour)	No
Broxbourne	Bus Scheme	Harlow to Hertford	New bus service, Harlow to Hertford (2 services per hour)	No
Broxbourne	Bus Scheme	Hoddesdon to Enfield	New bus service, Hoddesdon to Enfield via A10 (2 buses per hour)	No
Broxbourne	Bus Scheme	Waltham Cross to Hertford Regional College	New bus service, Waltham Cross station to Hertford Regional College	No
Broxbourne	Bus Scheme	Park Plaza to Waltham Cross	New bus service, Park Plaza North to Waltham Cross bus station	LP3 and LP4
Broxbourne	Bus Scheme	Broxbourne	New stations, Turnford and Park Plaza/Lane, on the WAML. Increased services to reflect the 4-tracking	No
Broxbourne	Bus Scheme	Waltham Cross to Potters Bar	New bus service, Waltham Cross to Potters Bar	No
Broxbourne	Bus Scheme	Brookfield	Brookfield bus interchange improvement	LP3 and LP4
Broxbourne	Bus Scheme	Old A10	Bus stop improvement programme at stops on old A10 (A1170 / B176) . High quality bus stops throughout with provision of real time information in appropriate locations	LP3 and LP4
Broxbourne	Bus Scheme	Old A10	Selective Vehicle Detection providing priority for buses on old A10 (A1170 /B176) at Station Road / High Road (Broxbourne), A1170 / Vancouver Road, Church Lane / Turners Hill & Old Pond junction (Cheshunt)	LP3 and LP4
Broxbourne	Sustainable improvements	Broxbourne	New cycle routes & secure cycle parking at stations	No
Broxbourne	Sustainable improvements	Waltham Cross	Multi-modal interchange at Waltham Cross station	No

District	Scheme Type	Location	Description	Modelled before?
Dacorum	Bus Scheme	Hemel Hempstead, Luton	Diversion of bus service 757 into Maylands MMTI and Luton town centre with half hourly frequency during peak periods	LP3 and LP4
East Herts	Bus Scheme	Ware	New circular bus service linking North East Ware development with town centre & station - assume 2 buses running in either direction (1 per direction) with 30min frequency. Runs on new link road which should already be included in the model	LP3 and LP4
East Herts	Bus Scheme	Bishops Stortford	Rerouteing of London Road bus services to station and bus station via new Goods Yard Link	No
East Herts	Rail Scheme	Hertford East to Liverpool St/Stratford	Increased frequency from Hertford East to / from Liverpool Street / Stratford; from roughly 2tph to 3tph	LP3 and LP4
East Herts	Bus Scheme	Bishops Stortford	Diversion of existing bus services through Bishops Stortford South development site running along Spine Road between Whittington Way and St James Way rather than along London Road.	LP4
East Herts	Rail Scheme	Bishops Stortford	Increased frequency to 9 trains per hour off peak	LP3 and LP4
Hertfordshire	Rail Scheme	East Coast Main Line and Hertford Loop services	Timetable changes for Thameslink services on the ECML. New services to St Pancras and on to Brighton	LP3 and LP4
Hertfordshire	Bus Scheme	Heathrow to Harlow	Rationalisation of existing 724 route into route 724, & 302 - splitting it into sections with improved frequency over shorter distances e.g. WGC to Hertford 1bph to 2bph	LP4
Hertfordshire	Bus Scheme	Aylesbury to Watford, and Maple Cross to Watford	Aylesbury to Watford now 20 min frequency on 500 service. 520 retention on section from Maple X to Watford Junction section only (rather than Hemel)	No
Hertfordshire	Bus Scheme	Hemel Hempstead to Stevenage	Route now becomes 300, 301 and 303	No

District	Scheme Type	Location	Description	Modelled before?
Hertfordshire	Bus Scheme	Stevenage	Diversion of existing SB1 service into new east of Stevenage development	LP4
Hertfordshire	Rail Scheme	Euston to Tring	Post-HS2 timetables	No
Hertsmere	Bus Scheme	Potters Bar	Extend current service 298 to Cranbourn Road via Mutton Lane with one hour frequency (previously modelled as 20 min frequency)	LP4
Luton	LTR Scheme	Luton	New LRT connection between Luton Parkway and Luton Airport	LP3 and LP4
North Hertfordshire	Bus Scheme	Letchworth	Bus frequency improvements between Letchworth and Stevenage. Bus 55.	LP3 and LP4
North Hertfordshire	Bus Scheme	Hitchin	Assume a 10% improvement in journey times along 100/101 route	LP3 and LP4
North Hertfordshire	Bus Scheme	Baldock	Bus service 98 to divert into Baldock North development via new spine road. Increased frequency to 20 mins ph and add stops serving development	LP4
North Hertfordshire	Bus Scheme	Hitchin	Eastern access to Hitchin station	LP3 and LP4
St. Albans	Bus Scheme	Hatfield Road, St. Albans	Assume a 10% improvement in journey times along Hatfield Road, St. Albans	LP4
St. Albans	Rail Scheme	Park Street	Park and Rail facility south of the A414 and east of the A405; linked to the existing Park Street rail station	LP4
St. Albans	Rail Scheme	St. Albans to Watford	Abbey Flyer proposal code in a new passing loop to enable a 30 minute frequency on the Abbey Line in each direction (but keep as heavy rail). Further increase frequency to 20 min - linked with Park Street Garden Village	LP4

District	Scheme Type	Location	Description	Modelled before?
Stevenage	Bus Scheme	Stevenage	Hertford Road Speed reduction measures & bus gate	LP3 and LP4
Stevenage	Bus Scheme	Stevenage	Relocation of the existing bus station; to the south of Gordon Craig Theatre	No
Stevenage	Rail Scheme	Stevenage	Provision of a fifth platform to allow for increased frequency on the Hertford loop	LP4
Watford	Sustainable Improvements	Watford	Colne sustainable link (cycle / bus). New link over the River from Tolpits Lane to Hampermill Lane for buses / cycles	LP4
Welwyn Hatfield	Bus Scheme	Welwyn Garden City	New bus only link from Falcon Way to Empire House to allow buses to avoid congestion exiting Shire Park	LP4

Table 4-2: Modelled Public Transport Schemes outside Hertfordshire

District	Scheme Type	Location	Description	Modelled before?
External	Rail Scheme	Bucks, Oxon, Cambs	New rail link connecting Oxford and Cambridge	LP3 and LP4

Bus Services

4.1.5 It is acknowledged that our ability to predict changes in the bus network over a 10-20 year period is very limited. As bus routes tend to change on a commercial basis, it is generally not possible to make specific forecasts about details of bus routes over the next 10-20 years. Accordingly, the model assumes no changes from the model Base Year other than the schemes identified in Table 4-1 and Table 4-2.

4.2 Highway Network

4.2.1 Similar to the PT schemes, the infrastructure log for the highway schemes was also revised by HCC. This was necessary in order for the highway schemes to be coded in the updated COMET suit (COMET v5). These networks, therefore, formed the basis on which the highway and public transport networks of the 2036 LP5 were created. HCC also provided access to an online portal containing updated scheme designs where feasible. Every scheme was reviewed thoroughly to ensure any changes in scheme designs were included where appropriate.

4.2.2 The forecast highway network is coded using the $INCLUDE file facility in SATURN, which allows for greater flexibility in coding and developing the supply network. The facility makes it simpler to update scheme files in the future year, providing greater capability for the model in assessing different infrastructure and development options that may have associated network improvements.

Forecast Highway Schemes

4.2.3 The key forecast highway network schemes included in the forecasts are summarised in Table 4-3 (schemes in Hertfordshire) and Table 4-4 (schemes outside Hertfordshire). The full list of schemes is available in Appendix III Section 11.3.

4.2.4 The proposed transport schemes were agreed with districts in winter 2019 and align with the Infrastructure Delivery Plans and Transport Strategies at that time. One key difference between previous Local Plan forecasts is that LP does not include the Hertford Bypass. Additional schemes were also included in Broxbourne reflecting the non-tolled option for the Air Quality Local Plan.

Table 4-3: Key Modelled Highway Schemes in Hertfordshire

District	Description	No. of Highways Schemes
Broxbourne	Includes speed limit reduction (to 40mph) on A!0 between Hertford and M25. Junction improvements and Turnford Link Road serving Brookfield Centre	27
Dacorum	Includes new access to Maylands from M1 J8, north Hemel link road and Berkhamsted development link road	30
East Herts	Includes the A120 Little Hadham Bypass and development access schemes in Gilston and north/south Bishops Stortford	28
Hertsmere	Includes capacity enhancements, reconfigurations, signalisation and optimisation of key junctions and town centre speed reductions	13
North Herts	Junction and capacity improvements plus sustainable travel provision. Includes cycle routes and traffic calming measures plus a new link road in Baldock	38
St Albans	Includes capacity enhancements, signalisation & optimisation of key junctions and speed reduction in town centres	27
Stevenage	Junction optimisation on A1(M) J7 & J8 and Lytton Way/Swingate. Widening of A1(M)	9
Three Rivers	Junction improvements, signalisation and capacity enhancements	4
Watford	Bus priority speed reductions and traffic calming measures	7
Welwyn Hatfield	Junction signalisation and capacity enhancements on key junctions. Pedestrianisation and cycle improvements plus safe corridors	28
Various	A1(M) J6-J8 widening plus county wide bus and rail service improvements	6

Table 4-4: Modelled Highway Schemes outside Hertfordshire

District	Scheme Type	Location	Description	Modelled before?
Central Beds	Link Road	M1 - A5	New link between M1 and A5 north of Dunstable	LP4
Central Beds	Junction	Biggleswade	A1 Biggleswade Junction improvements – capacity improvements and dedicated left turn	LP4
Luton	Link Road	M1 junction 11a - A6	New link between M1 and A6 around North Luton	LP4
Luton	Infrastructure	Luton	Dualling of Vauxhall Way between Stopsley Way / Hitchin Road and Kimpton Road	LP4
Luton	Infrastructure	Luton	Widening of Gipsy Lane between Kimpton Road to just before link road to New Airport Way to 4 lanes (no central reserve	LP4
Luton	Bypass	Luton	Luton Town Centre Bypass	LP4
Luton	Ban	Luton	Reallocation of lanes on part of town centre ring road	LP4
Luton	Junction	Luton	New grade-separated junction	LP4
Harlow	Roundabout	Harlow	New Roundabout Junction – M11 Junction 7a	LP4
Harlow	Crossing	Harlow	Central Stort crossing (widening of Fifth Avenue between Eastwick Road and Edinburgh Way (Burnt Mill roundabout), Harlow	LP4
Harlow	Junction	Harlow	M11 junction 7 short term capacity enhancements	LP4
Harlow	Crossing	Harlow	Second River Stort crossing	LP3 and LP4
Harlow	Roundabout	Harlow	Replacement of roundabout with signalised junction and provision of new arm to north providing bus access to Gilston development	LP4
Uttlesford	Junction	M11 junction 8	Lane marking amendments & new dedicated free flow LT lane from M11 SB off slip. The M11 J8 no longer includes a direct slip from S/B carriageway, but now has 5 lanes on that approach instead.	LP3 and LP4

District	Scheme Type	Location	Description	Modelled before?
Central Beds	Link Road	M1 - A5	New link between M1 and A5 north of Dunstable	LP4
Central Beds	Junction	Biggleswade	A1 Biggleswade Junction improvements – capacity improvements and dedicated left turn	LP4
Luton	Link Road	M1 junction 11a - A6	New link between M1 and A6 around North Luton	LP4
Luton	Infrastructure	Luton	Dualling of Vauxhall Way between Stopsley Way / Hitchin Road and Kimpton Road	LP4
Luton	Infrastructure	Luton	Widening of Gipsy Lane between Kimpton Road to just before link road to New Airport Way to 4 lanes (no central reserve	LP4
Luton	Bypass	Luton	Luton Town Centre Bypass	LP4
Luton	Ban	Luton	Reallocation of lanes on part of town centre ring road	LP4
Luton	Junction	Luton	New grade-separated junction	LP4
Harlow	Roundabout	Harlow	New Roundabout Junction – M11 Junction 7a	LP4
Harlow	Crossing	Harlow	Central Stort crossing (widening of Fifth Avenue between Eastwick Road and Edinburgh Way (Burnt Mill roundabout), Harlow	LP4
Harlow	Junction	Harlow	M11 junction 7 short term capacity enhancements	LP4
Harlow	Crossing	Harlow	Second River Stort crossing	LP3 and LP4
Harlow	Roundabout	Harlow	Replacement of roundabout with signalised junction and provision of new arm to north providing bus access to Gilston development	LP4
Uttlesford	Junction	M11 junction 8	Lane marking amendments & new dedicated free flow LT lane from M11 SB off slip. The M11 J8 no longer includes a direct slip from S/B carriageway, but now has 5 lanes on that approach instead.	LP3 and LP4

4.3 Road Traffic Forecasts 2018 (RTF 2018)

4.3.1 Road Traffic Forecasts 2018 (RTF 2018) present the latest forecast for traffic demand, congestions and emissions in England and Wales up to 2050. These are produced using the Department for Transport's National Transport Model. Data from the Road Traffic Forecasts is used in COMET to forecast LGV (Light Goods Vehicle) growth, HGV (Heavy Goods Vehicle) growth and buffer speed changes. LP4 also incorporated data from RTF 2018 however previous Local Plan forecasts in COMET used data from RTF 2015, the latest available at the time. It is important to note the changes between RTF 2015 and 2018 are considerable.

4.3.2 The RTF2018 update rebased the model from 2003 to 2015 and considers recent evidence and input data. Since RTF 2015, the National Trip End Model has also been updated. The forecasts consider uncertainty around a number of key drivers of road traffic, including:

- Population growth;
- Trip rates;
- GDP & Income;
- Costs of driving;
- Young people's driving patterns and licence holding;
- Demand for goods: freight; and
- Technology.

4.3.3 RTF 2018 now provides growth rates and speed changes based on the different time periods included in the COMET model. RTF 2015 provided only a single speed regardless of time period.

4.3.4 The changes resulting from the new RTF 2018 traffic forecast assumptions are as follows:

- Expected freight growth for LGV and HGVs have been amended and are significantly lower than previous RTF projections; and
- Buffer speeds reduced relative to the Base Year to simulate the effect of rising congestion outside the simulation area. This speed reduction is based on Scenario 1 of RTF 2018 and is increased 4 fold to achieve forecast traffic growth in the buffer network. These speeds are marginally lower than those in LP3 which used RTF 2015. This approach was applied separately for each time period across the buffer network.

Modal Shift

4.3.5 In addition to the schemes listed in Table 4-1 to Table 4-4, HCC requested that the forecast scenario should include an element of modal shift (from highway to other modes) in selected areas to represent district's proposals to encourage sustainable travel and the impact of emerging Growth and Transport Plan sustainable measures. The areas where this modal shift has been simulated are as follows (also illustrated in Figure 4-1):

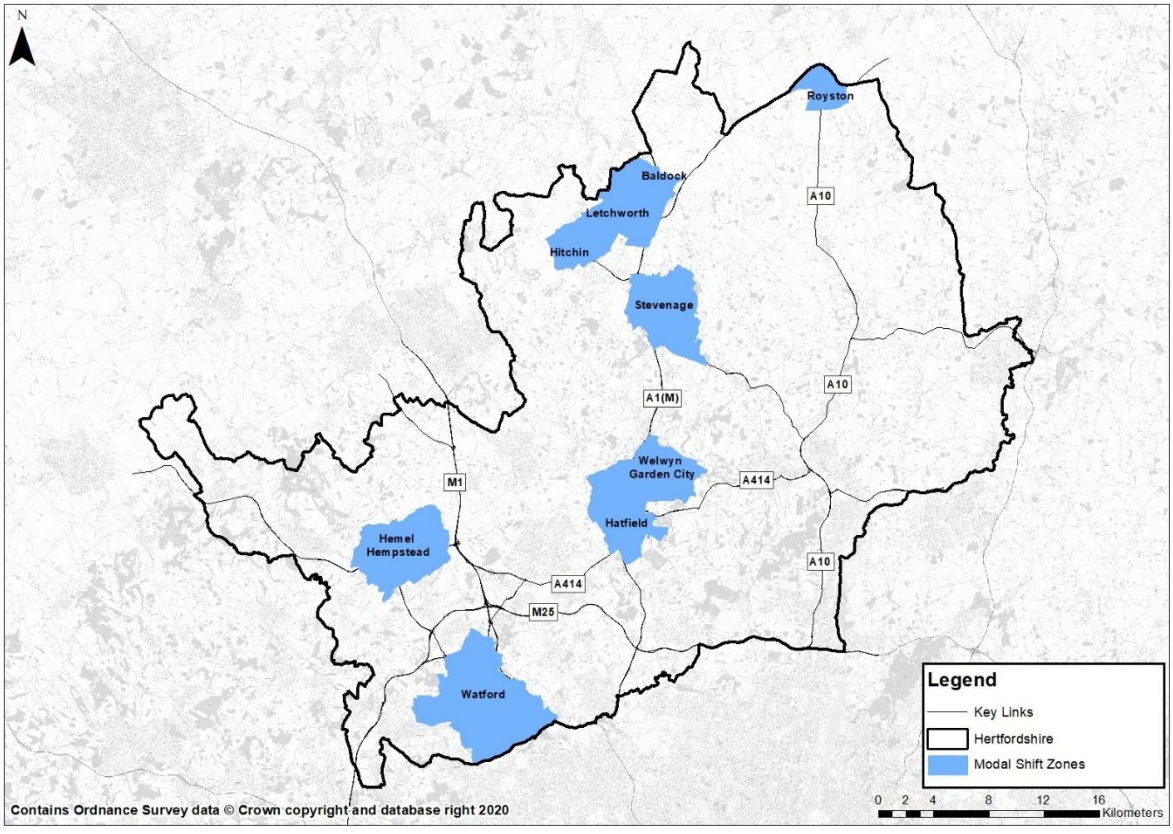
- Hemel Hempstead
- Hitchin
- Letchworth

- Baldock
- Royston
- Stevenage
- Watford
- Welwyn Garden City
- Hatfield

4.3.6 The modal shift in the forecast scenario is achieved by applying a factor (in COMET's Variable Demand Model) to the cost of highway trips originating in the selected zones. By raising the cost of undertaking a journey by car, this factor encourages trips to be made by alternative means (i.e. public transport or sustainable travel). The level of modal shift specified by HCC and achieved for these zones is approximately 5%.

4.3.7 This is not a recommended approach to modelling modal shift in a multi-modal model (such as COMET) as no infrastructure to facilitate such behaviour change has been included in the forecast year network. This modelled modal shift is therefore not a result of COMET's Variable Demand Model representing behavioural change; rather, it is the result of a parameter adjustment that is currently not based on any specific interventions to the transport network. Once more specific scheme assumptions regarding the proposed sustainable travel initiatives are known, these should be coded into COMET as other forecast schemes already are.

Figure 4-1: Modal Shift Zones



Watford and Stevenage Developments – Car Parking Assumptions

4.3.8 There are several proposed residential developments in Watford and Stevenage that have been represented with lower levels of car ownership compared to the standard forecast assumptions. This is implemented in response to developer plans to provide a lower level of car parking at these locations. The sites, where this adjustment has been implemented, are as follows:

- Land to the East of Ascot Road, Watford– 486 dwellings
- Watford Junction, Watford – 1,232 dwellings
- North of Stevenage – 1,105 dwellings
- West of Stevenage – 1,350 dwellings
- South East of Stevenage (1 and 2) – 692 dwellings
- Stevenage Leisure Park – 1,259 dwellings
- Combined phases of SG1 (phases 1, 2 and 3), Stevenage – 2,329 dwellings

4.3.9 The lower level of car ownership has been simulated by shifting 20% of residents in new developments from a “car-owning” category to a “non car-owning” category. This change is made in the IXICarOwn table (this is one of several inputs to the COMET TripEnd model, described in Paragraph 5.2).

Signalised Junctions and Network Checking

4.3.10 Signalised junctions associated with transport schemes have been checked to compare the levels of delay with the base year model. Signal timings have been optimised and adjusted in cases where significant delays were forecasted.

4.3.11 Signal timings and phases have been adjusted by taking into account the location of delays or congestion where significant.

4.3.12 Furthermore, a check has been made of the forecast highway assignment to ensure that the implementation of the schemes has not led to implausible levels of delay, or any unrealistic re-routeing of traffic.

4.3.13 It should be noted that the increased planning assumptions, RTF 2018 changes and additional infrastructure schemes generated significant convergence issues. Every effort was made to optimise signals and reduce delays wherever possible, however this had to be considered alongside creating a stable, reliable forecast model scenario which converged in all time periods.

4.3.14 It is worth noting that the PM time period required more optimisation to achieve acceptable convergence.

5. Forecast Trip Matrix Development

5.1 Overview

5.1.1 The forecast trip matrix is an estimation of future trips in COMET based on the available planning data (i.e. for Hertfordshire and selected neighbouring authorities – see Table 1-1) and growth assumptions for the rest of Great Britain (NTEM v7.2).

5.1.2 The COMET Trip End model is used to forecast future trip ends (total productions and attractions for each model zone). These trip ends are used to build a reference matrix for the forecast year (2036). This reference matrix is then adjusted based on the forecast Highway and Public Transport assignments through the Variable Demand Model (VDM), which further adjusts demand to take into account changes in transport infrastructure, travel times and costs. The resulting matrices constitute the forecast trip matrices.

5.2 COMET Trip End Model

5.2.1 A Trip End model has been built specifically for COMET as part of the COMET Base Year (2014) development. The COMET Trip End model is based on version 7.2 of the National Trip-End Model (NTEM) and its associated CTripEnd software. As part of the COMET Trip End development, NTEM has been re-zoned for COMET zones, and demographic data has been uplifted to 2036 based on TEMPro projections. NTEM v7.2 trip rates remain unchanged, whilst NTEM v7.2 growth is available at 5 year intervals from 2011 to 2051.

5.2.2 NTEM uses its own zoning system (7,700 zones covering England and Scotland, based on 2011 Census MSOAs) which is inconsistent with the COMET zone system. As a preliminary step, the original NTEM zones are converted to COMET zones using aggregation or disaggregation as appropriate.

5.2.3 An updated COMET zoning system was developed for this application (COMET v5), to reflect the greater detail in the traffic network compared to previous COMET versions. The differences are presented in Figure 2-1.

5.2.4 The COMET Trip End model takes in estimates of planning data (population, households and employment) for each COMET zone, and produces “trip ends”, that is, estimates of the number of trips produced by and attracted to each zone in an average weekday, by demand segment and by year.

5.2.5 The model has also been streamlined to enable the software to be run from a command prompt without user intervention, and to export results in Emme format for the variable demand model, but its functionality is otherwise unchanged.

5.2.6 There are three key data tables in the Trip End model:

- Car Ownership: Population segmented by household types and children. Households are distinguished based on the number of adults and car availability;
- Employment: Total number of jobs and households. Employment is segmented by industry; and
- Population: Population segmented by traveller types. These are defined as a combination of person type (age, gender and employment status) and household type.

5.2.7 Table 5-1, Table 5-2 and Table 5-3 present the categories in which the CarOwnership, Employment and Population tables are segmented (See NTEM specification).

Table 5-1: NTEM Car Ownership Categories

NTEM Category	Description
HHT1	One adult household with no car
HHT2	One adult household with one or more cars
HHT3	Two adult households with no car
HHT4	Two adult households with one car
HHT5	Two adult households with two or more cars
HHT6	Two adult households with no car
HHT7	Two adult households with one car
HHT8	Two adult households with two or more cars
S001	Children (0 to 15), in 1 adult household with no car
S002	Children (0 to 15), in 1 adult household with one or more cars
S003	Children (0 to 15), in 2 adult household with no car
S004	Children (0 to 15), in 2 adult household with one car
S005	Children (0 to 15), in 2 adult household with two or more cars
S006	Children (0 to 15), in 3+ adult household with no car
S007	Children (0 to 15), in 3+ adult household with one car
S008	Children (0 to 15), in 3+ adult household with two or more cars
HHT1	One adult household with no car
HHT2	One adult household with one or more cars
HHT3	Two adult households with no car

Table 5-2: NTEM Employment Categories

NTEM Category	Description
E03	Primary & Secondary schools
E04	Higher education
E05	Adult education
E06	Hotel, camp sites, etc.
E07	Retail trade
E08	Health / Medical
E09	Services (business, other, postal / courier) & equipment rental
E10	Industry, construction and transport
E11	Restaurants and bars
E12	Recreation and sport
E13	Agriculture and fishing
E14	Business
E15	Holiday accommodation and second residences

Table 5-3: NTEM Population Categories

NTEM Category	Description
PT01	Children, aged 0 to 15
PT02	Males in full-time employment, aged 16 to 74
PT03	Males in part-time employment, aged 16 to 74
PT04	Male students, aged 16 to 74
PT05	Males not employed / students (i.e. economically inactive), aged 16 to 74
PT06	Males aged 75 or over
PT07	Females in full-time employment, aged 16 to 74
PT08	Females in part-time employment, aged 16 to 74
PT09	Female students, aged 16 to 74
PT10	Females not employed / students (i.e. economically inactive), aged 16 to 74
PT11	Females aged 75 or over
HHT1	Persons in 1 adult households with no car
HHT2	Persons in 1 adult households with one or more cars
HHT3	Persons in 2 adult households with no car
HHT4	Persons in 2 adult households with one car
HHT5	Persons in 2 adult households with two or more cars
HHT6	Persons in 3+ adult households with no car
HHT7	Persons in 3+ adult households with one car
HHT8	Persons in 3+ adult households with two or more cars

5.2.8 Table 5-4 presents demand segments for which the COMET Trip End model outputs are estimated.

Table 5-4: Demand Segment Categories

NTEM Category	Description
HBW	Home-Based Work
HBEB	Home-Based Employer's Business
HBO	Home-Based Other
NHBEB	Non-Home-Based Employer's Business
NHBO	Non-Home-Based Other
LGV	Light Goods Vehicles
HGV	Heavy Goods Vehicles

COMET Trip End Model Forecast Update

5.2.9 The COMET Trip End model was updated to 2036 as part of the COMET v5 Reference Case Forecast Year (2036) development.

5.2.10 Detailed planning data (provided from districts via HCC) was provided for all Hertfordshire Districts and in selected adjoining areas (see Table 5-6 for a list of selected districts). NTEM v7.2 growth is used for the rest of the Great Britain. Growth assumptions can be found in Section 5.3.

5.2.11 The COMET Trip End model was updated by refreshing the three following tables (described in further detail above):

- Car Ownership (classification of Households by car ownership)
- Employment
- Population

5.2.12 HCC planning data provides estimates of dwellings and employment for the forecast year. In the absence of available population projections, it is derived by applying a population per dwelling assumption by NTEM zone from NTEM v7.2. These growth projections are split into the segments defined above for each table using NTEM original forecasts for each year.

5.2.13 In those areas outside Hertfordshire, where no detailed planning data is available, NTEM v7.2 growth is used. Growth is calculated for each table, segment and zone and between NTEM 2014 (this year has been interpolated using 2011 and 2016 data) and the Forecast Year (2036). Since each segment is considered separately, the process accounts for the ageing population trend in UK demography just as NTEM does.

5.2.14 For "model development zones" (see Figure 5-6), population and household segmentation have been applied based on the NTEM zone where it is located geographically. Employment data segmentation is based on the land use provided by HCC for each site.

5.2.15 NTEM v7.2 is based on the 2011 Census, the same as COMET's Trip End Model. Growth between the forecast year and base year is applied to the Trip End model using the formula below:

$$IXI_{FY} = IXI_{BY} * \frac{IXI\_NTEM_{FY}}{IXI\_NTEM_{2014}}$$

5.2.16 For zones and demand segments with no data for NTEM v7.2 in 2014 (value of zero), absolute growth is used following the formula below:

$$IXI_{FY} = IXI_{BY} + (IXI\_NTEM_{FY} - IXI\_NTEM_{2014})$$

Where:

- IXIFY refers to each of the Car Ownership / Employment / Population tables mentioned above for the Forecast Year (2036) in the COMET Forecast Year Trip End model
- IXIBY refers to each of the Car Ownership / Employment / Population tables mentioned above for the Base Year (2014) in the COMET Base Year Trip End model
- IXI_NTEMFY refers to each of the Car Ownership / Employment / Population tables mentioned above for the Forecast Year (2036) in the original NTEM v7.2
- IXI_NTEMBY refers to each of the Car Ownership / Employment / Population tables mentioned above for the interpolated Year (2014) from the original NTEM v7.2

NTEM Interpolated 2014 Year

5.2.17 NTEM v7.2 does not explicitly include 2014, however, this year is needed for the calculations described above. The Car Ownership / Employment / Population tables (mentioned above) have been estimated for 2014 by interpolating the same tables from NTEM between 2011 and 2016 years.

Additional Note on Conversions and Demolitions

5.2.18 The employment projections received from HCC contain a number of planned conversions to residential or other uses/demolitions, which involve the change or loss of certain types of employment land in some zones.

5.2.19 In most zones, the conversions/demolitions are directly accounted for in their COMET zone. For some zones, however, deducting the number of units to be demolished leads to negative values. This is due to discrepancies between the planning data and NTEM v7.2 employment allocations. To address this, where reduction of employment exceeds existing employment in a zone, the remaining reduction of employment has been subtracted from neighbouring zones proportionally to reconcile the data. This addresses planning data and NTEM v7.2 employment allocation discrepancies, respecting the total reduction in employment forecast for each area.

5.3 Forecast Planning Data

5.3.1 The forecast planning data for the following areas was collated and provided by HCC in terms of employment and dwelling growth by COMET zone. It is based on Local Plan information from autumn 2019.

- All 10 Hertfordshire districts;
- Adjoining districts in Essex (Epping Forest, Harlow and Uttlesford); and
- Luton

5.3.2 It should be noted that a key difference between LP4 and LP5 was the exclusion of Central Bedfordshire Local Plan projections and the use of NTEM v7.2 projections instead. This was undertaken in liaison with HCC as the differences between Local Plan and NTEM projections in Central Bedfordshire were significantly different.

5.3.3 Within these areas, all sites (employment and dwellings) are incorporated into the forecast scenario regardless of certainty level. This includes growth categorised according to WebTAG definitions as “near certain”, “more than likely”, “reasonably foreseeable”, and “hypothetical”.

5.3.4 Planning data included for some of the south western Hertfordshire authorities includes some emerging potential sites being identified as part of the Local Plan review process which are less certain as they currently have no planning status..

5.3.5 Outside of Hertfordshire and the selected neighbouring authorities, growth assumptions are based on NTEM v7.2 projections.

5.3.6 Table 5-5 presents the end year up to which planning data were provided by HCC or NTEM data were used. Where planning data did not forecast to 2036, NTEM growth between the end point of the planning data and 2036 was applied. The growth was added in the same way as windfall growth.

5.3.7 Windfall growth refers to growth that is considered to occur within the local plan but has not been attached to specific development sites. Windfall growth is proportionally distributed across all known development sites within the District / area.

Table 5-5: NTEM TEMPro uplifts applied in LP5 to create the 2036 LP5 scenario

District/Area	Planning End Year	TEMPro uplift	Zones to be applied to
Broxbourne	2033	2033-2036	Distribute proportionally to all zones
Dacorum	2036	n/a	n/a
East Herts	2033	2033 – 2036	Distribute proportionally to all zones, excluding Gilston growth for housing (zone: 2066)
Hertsmere	2036	n/a	n/a
North Herts	2031	2031-2036	Distribute proportionally to all zones
St Albans	2036	n/a	n/a
Stevenage	2031	n/a	n/a
Three Rivers	2036	n/a	n/a
Watford	2036	n/a	n/a
Welwyn Hatfield	2036	n/a	n/a
Essex (Epping Forest, Harlow, Uttlesford)	2033	2033-2036	Distribute proportionally to all zones
Central Bedfordshire	2036	n/a	n/a
Luton	2031	2031-2036	Distribute proportionally to all zones
Buckinghamshire (Aylesbury Vale, Chiltern, Wycombe, South Bucks)	2036	n/a	n/a
Outer London (Barnet, Enfield, Hillingdon)	2036	n/a	n/a
Cambridgeshire (Cambridge, South Cambridgeshire)	2036	n/a	n/a

Dwelling Data within Hertfordshire and Selected Neighbouring Districts

5.3.8 Dwelling data provided by HCC is presented in Table 5-6, and is accompanied by a comparison with NTEM v7.2 projections. The data is provided spatially by model zone in Figure 5-1 (bespoke planning data area) and Figure 5-2 (Hertfordshire). The comparison with NTEM is provided for information only and does not inform the development assumptions within Hertfordshire and the selected neighbouring districts of Essex and Luton used in this forecast.

5.3.9 Dwelling growth includes completions since 2014, those currently in the planning system, plus an allowance for windfall sites, as well as Local Plan Allocations.

5.3.10 In some instances, sites have not been allocated by HCC to a specific COMET zone (e.g. where assumptions are made for windfall development). In addition some of the SW Herts authorities have included some development sites which are more uncertain and don't yet have a certainty status allocated within their Local Plans. In these cases, the dwellings have been split proportionately throughout the district according to the HCC dwelling growth assumptions in other zones in the district up to 2036. This applies to a relatively small number of dwellings.

5.3.11 Overall, there is assumed to be a net increase of approximately 159,000 dwellings between 2014 and 2036 in Hertfordshire. This total is significantly higher (by ~70,000 dwellings) than the NTEM projection and is likely to be as such because all developments in the HCC data have been included (regardless of certainty), and because Local Planning Authorities own projections of housing need have increased in recent years.

5.3.12 Especially for Essex and Luton, where bespoke planning data were used, it can be seen that the negative growth is concentrated in specific zones and is not uniform as it is for the other bespoke areas where NTEM growth was considered.

Table 5-6: Dwelling Growth Assumptions in Hertfordshire and selected neighbouring districts (2014-2036)[7]

District	2036 HCC Dwellings	2036 NTEM v7.2 Dwellings	2036 Difference
Broxbourne	9,884	6,311	3,574
Dacorum	21,183	10,719	10,464
East Hertfordshire	21,408	13,856	7,553
Hertsmere	17,633	5,489	12,144
North Hertfordshire	19,824	17,716	2,108
St Albans	17,663	5,075	12,588
Stevenage	12,135	10,675	1,460
Three Rivers	9,261	3,617	5,644
Watford	13,664	5,392	8,272
Welwyn Hatfield	16,432	9,849	6,583
Hertfordshire	**159,088**	**88,700**	**70,388**
Essex (Epping Forest, Harlow, Uttlesford)	32,307	19,635	12,672
Central Bedfordshire	33,399	33,399	0
Luton	7,917	5,828	2,089
Buckinghamshire (Aylesbury Vale, Chiltern, Wycombe, South Bucks)	52,604	52,604	0
Outer London (Barnet, Enfield, Hillingdon)	10,841	10,841	0
Cambridgeshire (Cambridge, South Cambridgeshire)	42,273	42,273	0
Total	**338,428**	**253,279**	**85,149**

[7] Dacorum, Hertsmere and Welwyn Hatfield include some development sites with less certainty.

Figure 5-1: Dwellings growth between 2014 and 2036 by COMET model zone (wider zoom)

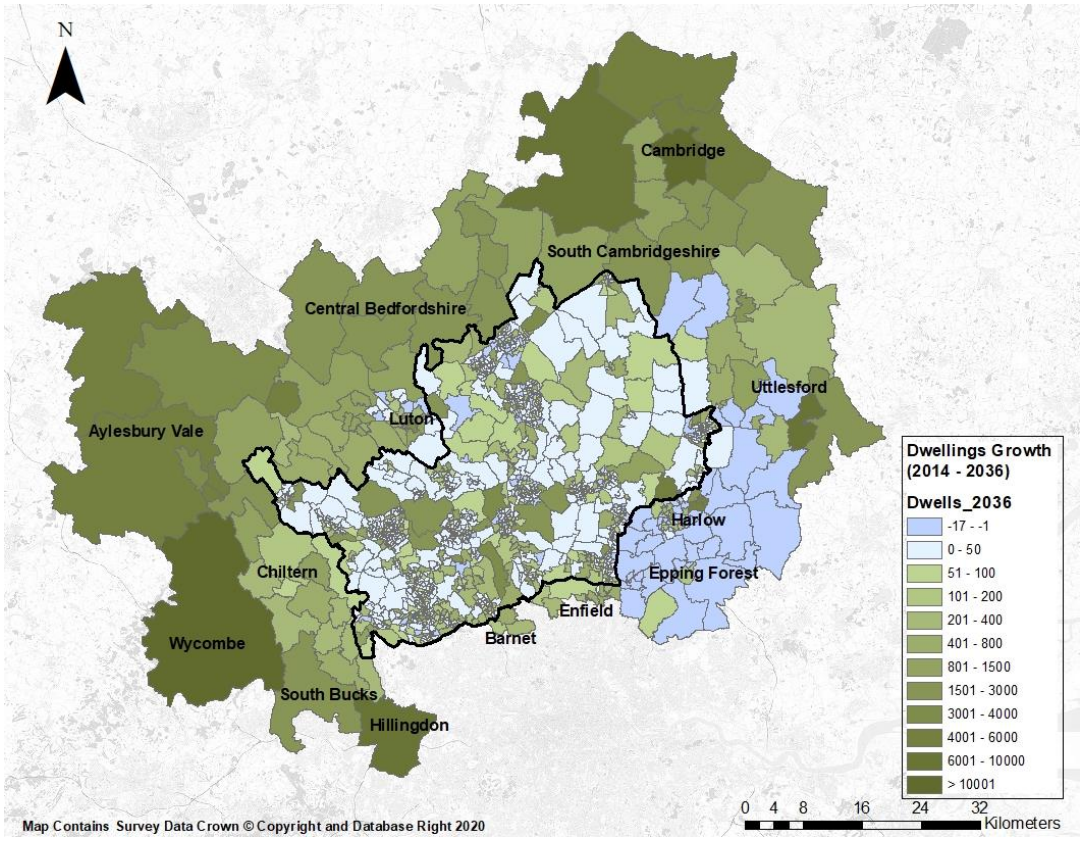
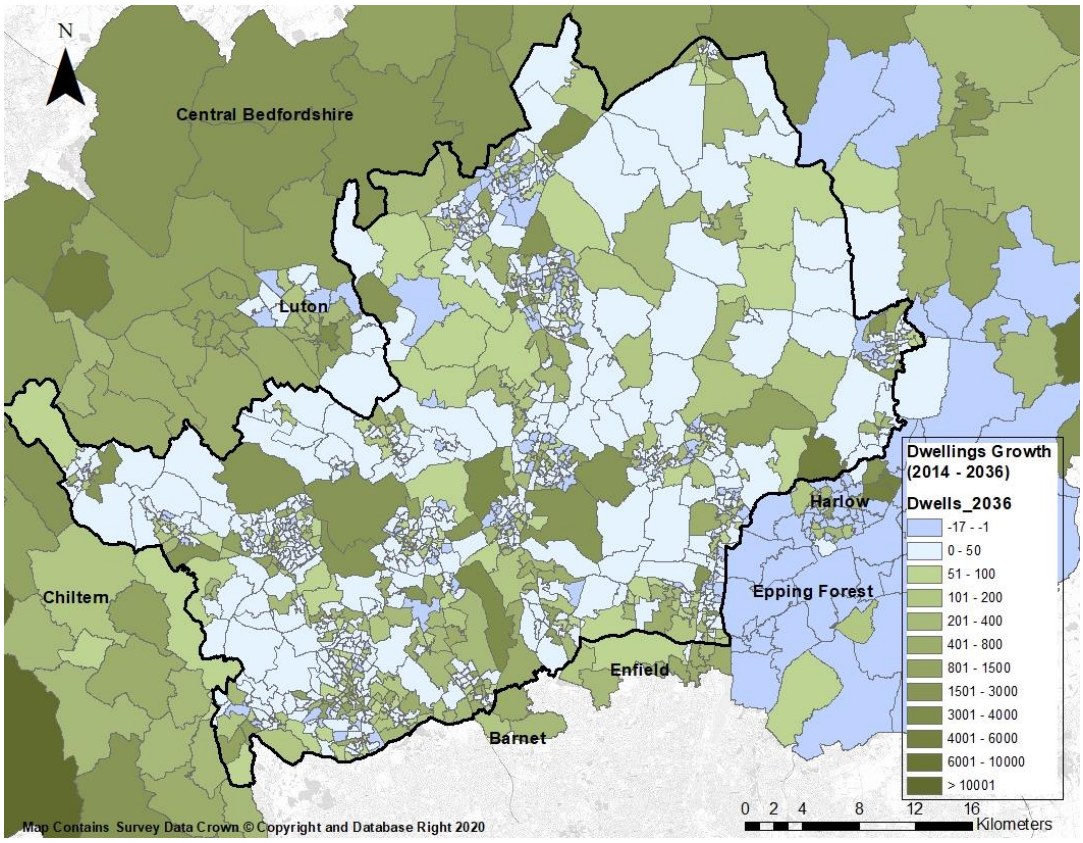


Figure 5-2: Dwellings growth between 2014 and 2036 by COMET model zone (HCC zoom)



Employment Data within Hertfordshire and Selected Neighbouring Districts

5.3.13 Employment data provided by HCC is presented in Table 5-7, and is accompanied by a comparison with NTEM v7.2 projections. The data is provided spatially by model zone in Figure 5-3 and Figure 5-4. As with the dwelling data, the comparison with NTEM is provided for information only and does not inform the development assumptions within Hertfordshire and the selected neighbouring districts of Essex and Luton used in this forecast.

5.3.14 The data also includes permissions for conversion of employment space into residential use, the incidence of which is significant in some areas and shows up as an overall loss in job numbers. The figures below help identify there are targeted areas within Hertfordshire where employment is planned.

5.3.15 Local planning authorities have less control over employment growth and therefore less information on likely growth by location. Much of the employment data provided by the Hertfordshire districts was in terms of employment floor space rather than jobs and has therefore been converted to an estimated number of jobs by AECOM.

5.3.16 This conversion process is based on employment densities as defined in the Employment Densities Guide (November 2015 – Homes and Communities Agency). The employment densities used to calculate jobs are listed in section 11.1. For land use types not included in this guide, site data from TRICS has been used to generate an employment density value. Whilst the employment data used represents the most complete available projection of job growth in Hertfordshire, efforts should be made by HCC and the Local Planning Authorities in the future to minimise the need for the assumptions defined above.

5.3.17 Projected conversions/demolitions which involve the change or loss of a certain land use type have been taken into consideration during the employment data collation process. This reduces the risk of double counting job sites.

5.3.18 Overall, there is assumed to be a net increase of approximately 85,000 jobs between 2014 and 2036 in Hertfordshire. This total is higher (by ~7,000 jobs) than the NTEM projection. As applies to the dwelling data, the reason for this difference is, at least partly, due to the inclusion of all employment sites in the HCC data regardless of certainty, especially for Broxbourne, East Hertfordshire and in Welwyn Hatfield.

Table 5-7: Employment Growth Assumptions in Hertfordshire and selected neighbouring districts (2014-2036)

District	2036 HCC Jobs	2036 NTEM v7.2 Jobs	2036 Difference
Broxbourne	14,714	4,186	10,528
Dacorum	6,157	6,994	-837
East Hertfordshire	2,663	6,257	-3,594
Hertsmere	1,185	4,832	-3,647
North Hertfordshire	4,518	6,117	-1,599
St Albans	11,639	6,807	4,832
Stevenage	5,231	5,005	226
Three Rivers	5,564	3,684	1,879
Watford	2,880	6,253	-3,373
Welwyn Hatfield	9,896	7,204	2,691
Hertfordshire	**64,446**	**57,339**	**7,107**
Essex (Epping Forest, Harlow, Uttlesford)	23,018	13,752	9,266
Central Bedfordshire	11,672	11,672	0
Luton	6,963	10,408	-3,445
Buckinghamshire (Aylesbury Vale, Chiltern, Wycombe, South Bucks)	26,013	26,013	0
Outer London (Barnet, Enfield, Hillingdon)	19,839	19,839	0
Cambridgeshire (Cambridge, South Cambridgeshire)	18,504	18,504	0
Total	**170,455**	**157,527**	**12,928**

Figure 5-3: Jobs growth between 2014 and 2036 by COMET model zone (wider zoom)

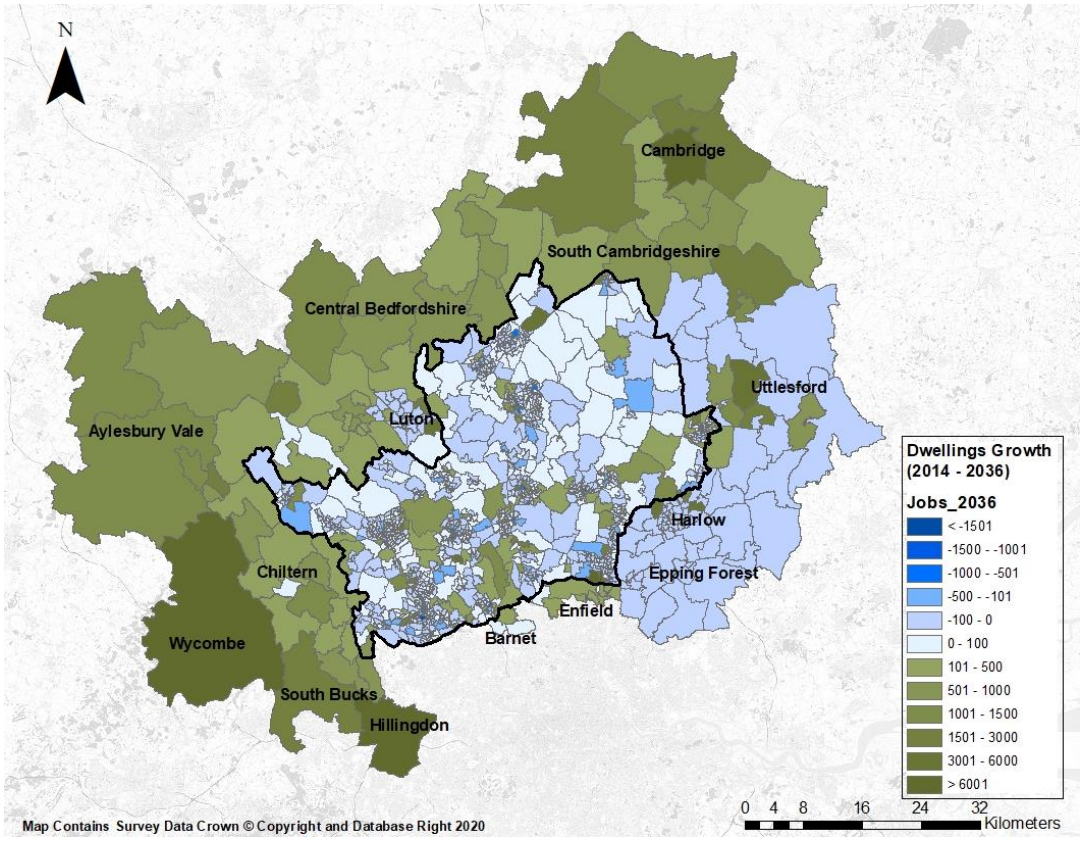
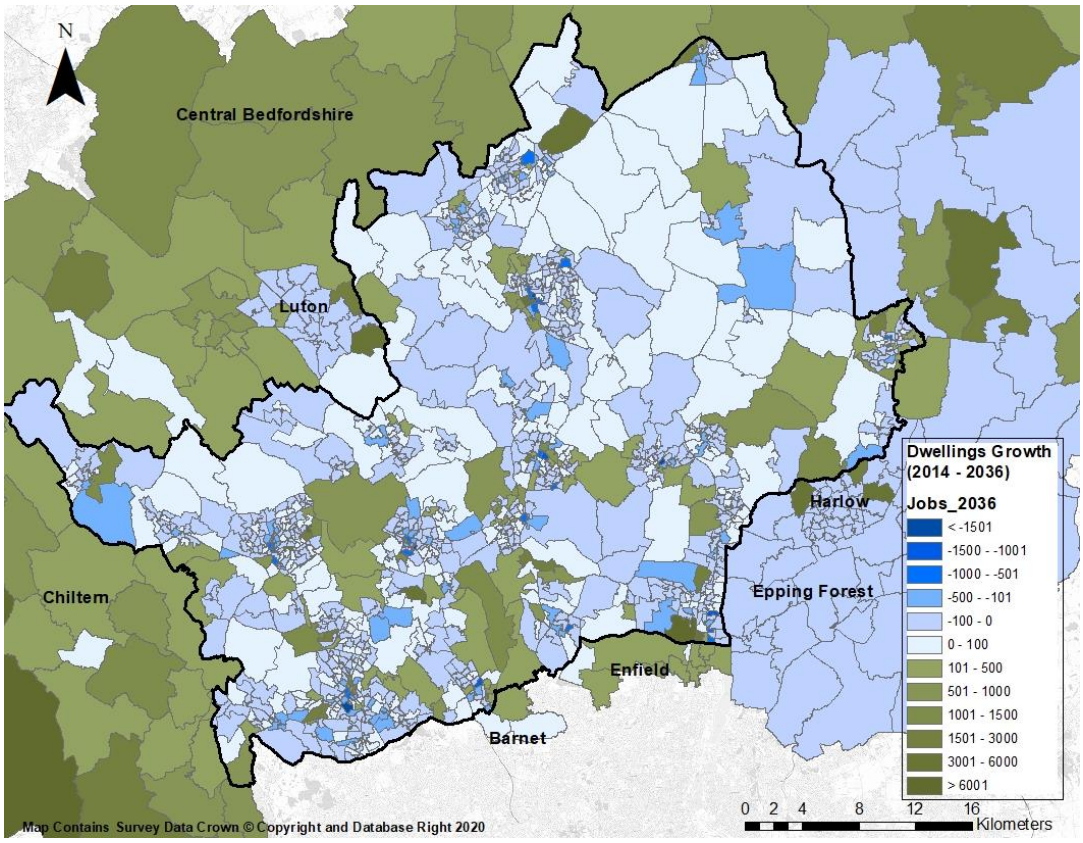


Figure 5-4: Jobs growth between 2014 and 2036 by COMET model zone (HCC zoom)



Planning Data in Selected Neighbouring Districts

5.3.19 The same assumptions and caveats explained for planning data within Hertfordshire also apply to the additional planning data provided for the 6 districts outside Hertfordshire.

5.3.20 HCC had requested for the LP4 housing and employment data to be used in the LP5 application.

5.3.21 HCC had provided housing and employment data at a zone level for Essex and Luton, which were re-zoned to match the COMET v5 zoning system. A value for total jobs and dwellings were provided for 2033 (Essex) and for 2031 (Luton), to which NTEM growth was added (between 2033 and 2036 for Essex and between 2031 and 2036 for Luton). These values were then distributed between COMET zones according to NTEM v7.2 proportions.

5.3.22 Although planning data at a zone level were provided for Central Bedfordshire for the LP4 application, additional checks revealed the inappropriateness of these data, especially for employment, and it was decided for neither the LP4 housing nor the LP4 employment data to be used in the LP5 application. NTEM v7.2 projections were used as totals to inform the distribution of growth. The following assumptions were made in order to prepare zone level growth assumptions for these two counties:

5.3.23 HCC were unable to provide housing and employment data at a zone level for Buckinghamshire, Cambridgeshire and the three Outer London boroughs (Barnet, Enfield and Hillingdon), where NTEM growth projections were used to inform housing and jobs growth.

5.3.24 The above are part of the correspondence between AECOM and HCC (email sent on 31 January 2020 with subject “LP5 Planning Data checks”).

Planning Data outside Hertfordshire and Selected Neighbouring Districts

5.3.25 The availability of planning data outside Hertfordshire beyond the neighbouring districts is limited. Consequently, growth in terms of housing, employment and population in the rest of Great Britain is derived directly from NTEM v7.2.The 2014-2036 growth rates are in Table 5-8. It is worth noting that these growth figures are likely to be lower than growth being proposed through the Local Plan processes in these areas.

Table 5-8: NTEM 7.2 Growth Rates (for areas without bespoke planning data)

	2014-2036
Dwellings	18.51%
Employment	9.25%
Population	12.71%

5.4 Model Development Zones

Background

5.4.1 There are a number of locations in Hertfordshire where significant levels of growth (in terms of housing and/or employment) are anticipated in previously undeveloped areas. The trip patterns of these developments are likely to be materially different to those of the existing land use, and as such require special consideration in terms of forecast demand estimation and loading point(s) onto the network.

5.4.2 As the v5 Base Year model was set up with a limited number of development zones available in the model (50), care has been taken to minimise the number used at this stage (thereby leaving more available for later applications). To this end, developments are allocated to model development zones according to the selection process in Figure 5-5. The developments that meet the requirements are set out in Figure 5-6 with a corresponding table of development zones in Table 5-9. It should be noted HCC also requested some developments which didn't fully satisfy the criteria in Figure 5-5 be included as development zones. This is to future proof the model as it is anticipated that forecasting work may look to assess the impacts of these developments in isolation.

Figure 5-5: Model Development Zone Selection Process

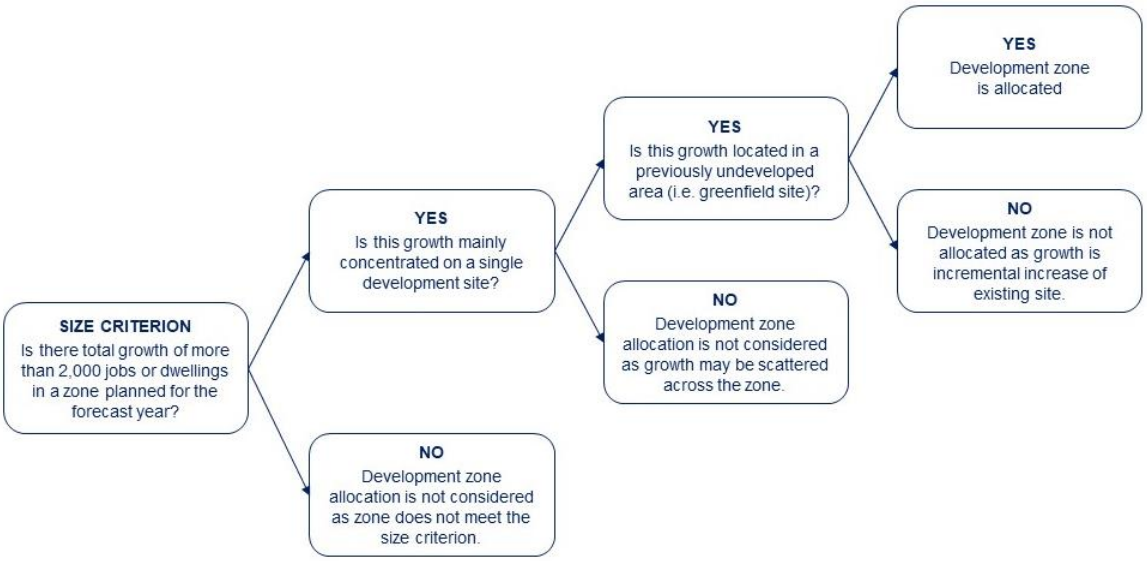


Figure 5-6: Model Development Zones (only shows sites that have a location allocated)

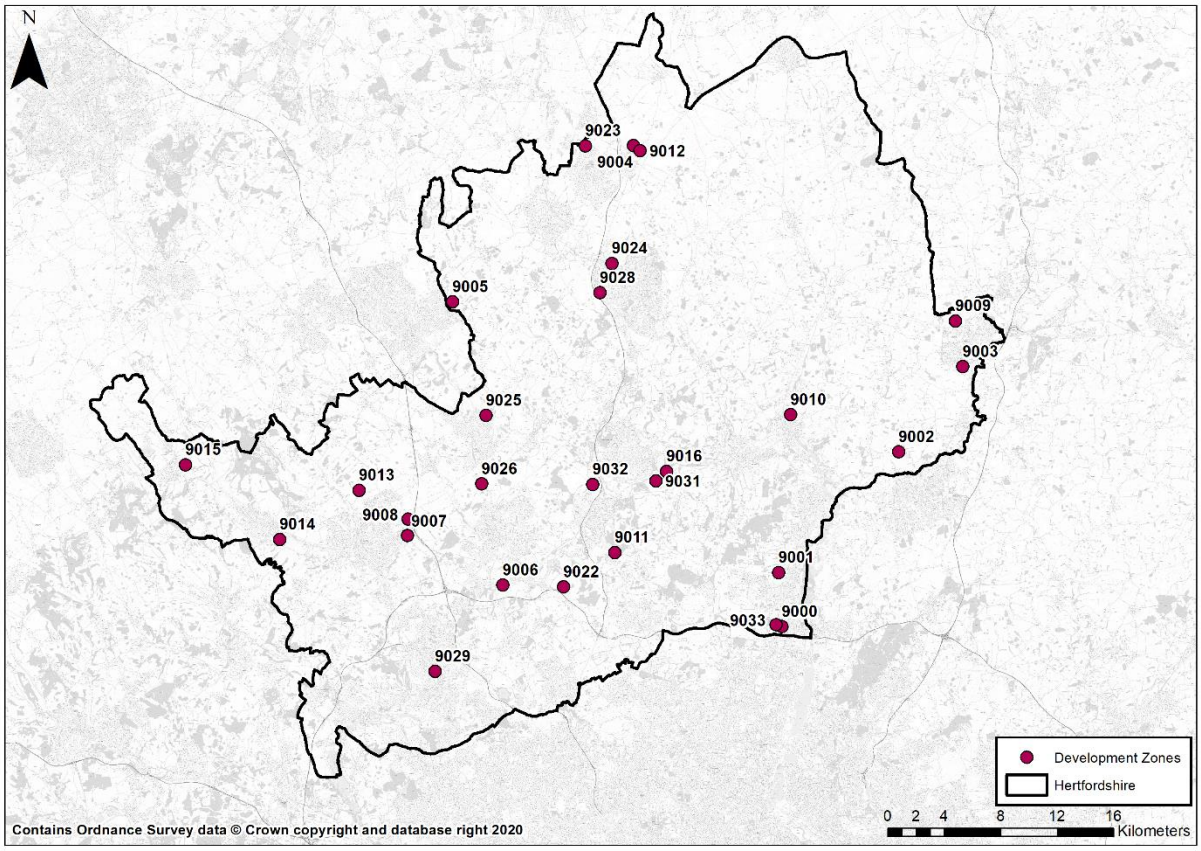


Table 5-9: List of all Development Zones Included in LP5 (shown in Figure 5-6)

Zone Number	Description
9000	Park Plaza North Development, Promotion of small / medium enterprises on existing employment site
9001	Brookfield Garden Village
9002	The Gilston Area, north of A414
9003	Whittington Way, Bishop's Stortford, CM23 4AS
9004	Land north of Baldock
9005	Wandon Park
9006	Park Street Garden Village
9007	East Hemel Hempstead South
9008	East Hemel Hempstead North
9009	Land At Bishops Stortford North, Bishops Stortford 1
9010	Land North and East of Ware
9011	Land at Marshmoor, off Great North Road
9012	Royston Road
9013	North Hemel (Phase 1)
9014	Land south of Berkhamsted GUI land
9015	East of Tring (New Mill, Marshcroft Lane and Harrow Estates) (3 linked sites)
9016	Land North and South of Birchall Lane, Hertingfordbury
9022	Tyttenhanger Estate
9023	Letchworth North
9024	Land North Of Stevenage (part), Stevenage
9025	North East Harpenden
9026	North St Albans
9028	Land West of Stevenage
9029	Land at Watford Junction
9031	S of WGC (Birchall W)
9032	Stanboroughbury

Derivation of Development Zone Demand

5.4.3 Zones which are empty in the Base Model require special consideration in the demand model. The trip-end model generates estimates of trips from them as described in the section entitled COMET Trip End Model Forecast Update. However, it is not possible to apply proportional growth to the base matrix for these zones as the Base matrix has no associated demand.

5.4.4 A set of gravity models, calibrated by mode and purpose based on the distribution of the base matrices, have been created for the purpose of estimating distribution to and from development zones. The gravity model is often the preferred approach for solving the trip distribution problem in transport planning. It assumes that the interaction between two zones is inversely proportional to the distance between them, inversely proportional to the cost and/or time of travel between them but is proportional to the amount of activity at each zone.

5.4.5 Because the incremental variable demand model will be applied to these zones, as well as all others, the gravity models are based on base year generalised cost of travel, along with the trip-ends for the forecast year.

5.4.6 Having estimated the distribution of travel using a gravity model, the total level of trip-making for the development zones is then set to the trip ends from the trip-end model.

5.5 Variable Demand Modelling

Process

5.5.1 As a result of the updates described above, the COMET Trip-End model for the Forecast Year outputs trip-end growth estimates between the Base Year (2014) and the Forecast Year (2036). The proportional growth implied by the trip-end model from Base Year 2014 to the forecast year is applied to the Base Year matrix to create an estimate of forecast demand, a “reference” forecast matrix (see WebTAG Unit M2 Variable Demand Modelling – section 2.5.5). For example, if the trip-end model has 100 trips for a zone in the base year, and 130 in 2036, and the base matrix has 60 trips, the forecast matrix will have 60*130/100=78 trips. A “matrix balancing” approach is used, where the reference matrices are controlled first to matrix rows (productions), and then to the matrix columns (attractions). This approach is repeated iteratively until the matrix “balances” both productions and attractions.

5.5.2 These are not the final forecast matrices. Final forecast matrices are developed from reference matrices by application of the variable demand model to take account of the effect of changes in transport cost over time on traveller behaviour.

5.5.3 The forecasted matrices are then adjusted iteratively by the VDM taking into account the forecast changes in generalised cost based on the Highway model and Public Transport model assignments. In effect, trips will be decreased between areas with increases in generalised cost (e.g. increase in congestion), and vice versa. The VDM includes components that adjust mode shares based on relative changes in cost between modes, adjust time period splits based on relative changes in cost between periods, and adjust attraction sites based on relative change in cost for travel to various attractions.

5.5.4 A bespoke add-on to the VDM has been created for the purpose of this forecast in order to simulate modal shift from highway to PT/sustainable modes. This add-on is described in more detail in paragraph 4.3.6.

Convergence

5.5.5 The convergence of the variable demand model is measured through %GAP[8] between iterations set out in Figure 3-1. The convergence of a variable demand model is closely linked to the convergence of the assignment models, however, in the case of the COMET, the lack of modelled congestion in the public transport model means there is no convergence to measure. Therefore, the convergence of the COMET variable demand model is strongly related to that of the highway assignment model, discussed further in Chapter 6.

[8] %GAP is the difference between the costs along the chosen routes and those along the minimum cost routes, summed across the whole network, and expressed as a percentage of the minimum costs. %GAP provides a measure of the proximity to equilibrium of the assignment.

5.5.6 The 2036 forecast is currently capped to 14 variable demand model iterations and reaches an aggregate %GAP convergence of 0.48% (Hertfordshire productions) and 0.049% across the model. According to WebTAG M2 section 6.3.8: “Tests indicate that gap values of less than 0.1% can be achieved in many cases, although in more problematic systems this may be nearer to 0.2%”. Whilst the value achieved for Hertfordshire productions is above the value suggested by WebTAG the full model is within guidance. Further work modelling work or allowing more than 14 iterations may improve the convergence for Hertfordshire productions, however for the purpose of this model run (i.e. for a Local Plan run), the increased level of convergence would not materially affect the results reported.

5.6 Economic Parameters

5.6.1 The variable demand model uses economic parameters including values of time, fuel prices, etc. to calculate the generalised costs of travel. These vary over time and forecast projections for most of these parameters are provided in WebTAG. The forecast values for these parameters are summarised in Table 5-10 alongside the base values and growth factors. Bus and rail fare change assumptions are not provided in WebTAG but based on recent trends are assumed to grow by 1% per year above inflation.

Table 5-10: Economic Parameter Changes over Time, Fixed 2010 Prices[9]

Values	2014	2036	Change
Value of Time, Commuting (p/min)	17.46	23.96	37.2%
Value of Time, Business (p/min)	26.07	35.78	37.2%
Value of Time, Other (p/min)	7.97	10.94	37.2%
Value of Time, LGV (p/min)	16.92	23.22	37.2%
Value of Time, HGV (p/min)	42.31	58.06	37.2%
Petrol Price – Non work (p/litre)	119.21	121.87	2.2%
Diesel Price – Non work (p/litre)	124.44	126.62	1.8%
Petrol Car Fuel Consumption Factor	0.965	0.686	-28.9%
Diesel Car Fuel Consumption Factor	0.958	0.761	-20.6%
Car Fleet Proportion, Diesel	0.485	0.299	-38%
Car Fleet Proportion, Electric	0.001	0.261	38139%
Rail Fares	Varied	Varied	27.1%
Bus Fares	Varied	Varied	27.1%
Rain and Bus Fares	Varied	Varied	27.1%
Car Passenger Occupancy	Varied	Varied	None

[9] Source: WebTAG Databook May 2019 v1.12 (except Rail Fares and Bus Fares which both rise at 1% per annum above inflation – this is in line with government policy for rail, and in line with recent historical trends for bus).

5.7 Forecast Growth Rates

5.7.1 The overall growth in highway trips from the demand model is summarised in Table 5-11.

5.7.2 “BY 2014” below refers to COMET Base Year. “LP5 2036” refers to COMET LP5 Forecast Year being reported in this document. “Ref 2036” refers to the COMET 2036 Reference Case model.

5.7.3 Commuting trips show a 7% increase between BY 2014 and LP5 2036.

5.7.4 Home-based Other trips present a considerable increase between LP5 2036 and BY 2014 compared to all other user class types (22%). The majority of these trips occur in the IP period and PM peak when congestion levels and delays are lower compared to the AM peak.

5.7.5 The relatively high growth in Light Goods Vehicle trips (vans) relative to Heavy Goods Vehicle trips is consistent with current trends. Even though there is a small increase in HGV trip numbers, the distance over which they travel is considerably longer in 2036. This was sense checked against RTF 2018 assumptions.

5.7.6 There is a 2% increase in the number of freight trips (LGV and HGV) between the Ref 2036 forecast and the LP5 2036 forecast. This is due to the way the updated version of the COMET model has been set up and is in line with standard practice for freight forecasting. It reveals the increased accuracy of this model version compared to the previous versions of COMET.

Table 5-11: Highway Trip Growth over Time, 24 Hour Person Trips, Hertfordshire Productions Only

User Class	BY 2014	Ref 2036	LP5 2036	Trip Growth (2014 - 2036)
Commuting	589,996	583,401	629,824	7%
HB Business	112,085	119,201	124,927	11%
HB Other	1,639,275	1,840,454	1,997,282	22%
NHB Business	61,190	69,930	67,881	11%
NHB Other	143,879	156,400	160,753	12%
LGV	251,639	315,255	325,286	29%
HGV	104,320	100,451	104,933	1%
All	**2,902,384**	**3,185,091**	**3,410,886**	**18%**

5.7.7 A directly comparable table for public transport results is shown in Table 5-12. Although population and employment changes still have a significant effect, here the impact of the demand model is proportionally much lower. The demand model reduces travel largely because fares are modelled as increasing and income levels (values of time) are modelled as increasing more, while car fuel consumption reduces and enables travelling by car.

5.7.8 It is also highlighted that there is no modelling of crowding within the public transport model (the increase in public transport trips is therefore unconstrained by congestion). Consequently, while the highway assignment model experiences increased congestion and thus an increase in generalised cost for car travel, this increase is not reflected in public transport, resulting in a mode shift.

Table 5-12: Public Transport Trip Growth over Time, 24 Hour Person Trips, Hertfordshire Productions Only

User Class	BY 2014	Ref 2036	LP5 2036	Trip Growth (2014 - 2036)
Commuting	109,596	109,641	131,179	20%
HB Business	12,904	14,198	16,051	24%
HB Other	112,400	126,635	146,433	30%
NHB Business	4,477	14,497	16,230	263%
NHB Other	20,237	123,017	137,877	581%
All	**259,615**	**387,988**	**447,770**	**72%**

5.7.9 For highway trips, “Home-Based Other” and HGV trips show the greatest increases. For public transport trips “Non-Home Based Business” and “Non-Home-Based Other” trips present the greatest changes. This is primarily due to an ageing population, with a smaller proportion of people in employment. Forecast assumptions relating to the ageing profile of the population are derived from the National Trip-End Model (NTEM), version 7.2.

6. Forecast Assignments

6.1 Highway Assignment

Assignment Parameters

6.1.1 No changes have been made in terms of SATURN assignment options or parameters relative to the base year. For reference, a full list is provided in *Appendix II: SATURN Highway Assignment Parameters.*

Assignment Convergence

6.1.2 The convergence of the highway assignment has been measured according to standards set out in Table 6-1 (as stated in WebTAG M3.1 section 3.3.5). When a model does not achieve convergence criteria, it may produce large variations between iterations, “noise”, leading to unreliable results.

6.1.3 Every effort was made to optimise signals and reduce delays wherever possible, however this had to be considered alongside creating a stable, reliable forecast model scenario which converged in all time periods

6.1.4 In SATURN terms, “percentage of links with flow change (P) <1%” is referred to as %FLOWS.

Table 6-1: Convergence Measures and Base Model Acceptable Values

Measure of Convergence	Base Model Acceptable Values
Delta and %GAP[10]	Less than 0.1% or at least stable with convergence fully documented and all other criteria met
Percentage of links with flow change (P) <1%[11] (%FLOWS)	Four consecutive iterations greater than 98%

6.1.5 For reference, the 2014 base year highway assignment convergence values are given in Table 6-2. Previous experience suggests that a base year model should converge in approximately 30 iterations or fewer; however, the AM and PM peak required more iterations to converge.

Table 6-2: Base Year Convergence Values

Time Period	Iterations	%FLOWS	%GAP
AM	38	98.5	0.002
IP	29	98.9	0.001
PM	41	99.0	0.003

6.1.6 The 2036 convergence values in terms of %FLOWS and %GAP are presented in Table 6-3, and show that both indicators meet WebTAG criteria in all time periods.

[10] %GAP is the difference between the costs along the chosen routes and those along the minimum cost routes, summed across the whole network, and expressed as a percentage of the minimum costs. %GAP provides a measure of the proximity to equilibrium of the assignment.
[11] The percentage of links on which flows change by less than 1% between iterations.

Table 6-3: 2036 Convergence Values

Time Period	Iterations	%FLOWS	%GAP
AM	59	98.8	0.007
IP	40	98.7	0.002
PM	58	98.3	0.006

6.2 Public Transport Assignment

Assignment Parameters

6.2.1 Other than the modelled schemes, the forecast 2036 public transport assignment is identical to the Base Year, except for the previously noted 1% increase per year in public transport fare and an increase in the passenger value of time in line with the demand model. The increases in fare and values of time above inflation are applied for both bus and rail travel.

Assignment Convergence

6.2.2 The public transport model does not model congestion, and as such there is no convergence to measure.

7. Highway Forecast Results

7.1 Simulation Area Statistics

7.1.1 This section provides a summary of simulation area statistics concerning the highway assignment. For reference, the 2014 Base Year model values are also given. All values only include travel within the time period simulated, and do not consider extra time and distance in later periods due to vehicles queued at over-capacity junctions.

7.1.2 Table 7-1 and the following figures show assignment statistics for all user classes combined. Other than Total Trips Loaded, all statistics refer to the simulation area only. For the equivalent assignment statistics by user class, see Appendix IV: Highway Simulation Area Statistics by User Class. Comparisons to LP4 results are also made.

7.1.3 In terms of Total Trips Loaded, the increase between the 2014 Base Year and 2036 Forecast Year is 21% in the AM Peak, 19% in the PM Peak, and 28% in the Inter-peak (reflecting the relatively uncongested network in the Inter-peak). The percentage increase in travel distance is higher than the percentage increase in trips, suggesting that highway trips are longer in the forecast relative to the Base Year. The total travel time increases at a faster rate than the total trips loaded and travel distance, suggesting the forecast network has higher levels of delay and congestion.

7.1.4 Over-capacity queueing[13] increases most significantly in the Inter-peak period (by 254%), however, a smaller percentage increase also occurs in the AM and PM Peaks (128% and 109% respectively). The smaller increase in over-capacity queueing in the AM and PM Peaks is likely to be a result of the already more congested Base Year starting point from which the forecast pivots. It is likely that the level of over-capacity queueing reaches a “ceiling” beyond which people choose to take alternative routes/modes to reach their destination. Transient queues[13] increase more evenly across the different time periods.

7.1.5 The overall difference between Base Year and LP5 for total trips loaded, travel distance, total travel time, average speed and over-capacity and transient queues are consistent with the results derived for LP4.

Table 7-1: Simulation Area Assignment Statistics – All User Classes including fixed flows

	AM Peak				Inter-Peak				PM Peak			
	2014	2036	Δ (LP5)	Δ (LP4)	2014	2036	Δ (LP5)	Δ (LP4)	2014	2036	Δ (LP5)	Δ (LP4)
Total Trips Loaded (PCU)	778,800	944,805	166,005 (21%)	167,875 (21%)	561,011	717,286	156,275 (28%)	161,489 (27%)	724,408	861,640	137,232 (19%)	150,072 (18%)
Travel Distance (PCU km)[12]	4,776,256	6,014,192	1,237,936 (26%)	1,036,980 (22%)	3,624,869	4,933,183	1,308,314 (36%)	1,098,112 (30%)	4,904,949	6,027,588	1,122,640 (23%)	904,248 (19%)
Total Travel Time (PCU hours)	95,416	139,118	43,702 (46%)	39,208 (43%)	61,580	92,593	31,013 (50%)	26,658 (42%)	102,723	148,130	45,407 (44%)	28,553 (27%)
Average Speed (Kph)	50	43	-7 (-14%)	-7 (-14%)	59	53	-6 (-10%)	-5 (-9%)	48	41	-7 (-15%)	-3 (-7%)
Over-Capacity Queues (PCU hours)[13]	8,380	19,106	10,726 (128%)	13,996 (135%)	1,339	4,742	3,403 (254%)	4,059 (154%)	13,165	27,499	14,334 (109%)	7,623 (34%)
Transient Queues (PCU hours)[13]	14,935	25,296	10,361 (69%)	7,078 (51%)	8,347	14,685	6,338 (76%)	5,272 (57%)	15,819	25,527	9,707 (61%)	5,772 (40%)

[12] PCU = Passenger Car Unit

[13] From SATURN manual section 8.4.1: “Delays (and queues) may be subdivided into two main components:

- “transient” or “under capacity” delays and
- “queuing” or “over capacity” delays

where, for example at traffic signals, the transient delays correspond to the time spent queuing during the red phase by vehicles which then depart during the green phase, whereas the queuing delays only occur for turning movements in excess of capacity where a permanent queue builds up which is unable to clear in a single cycle.”

Figure 7-1: Travel Distance (Simulation Area only)

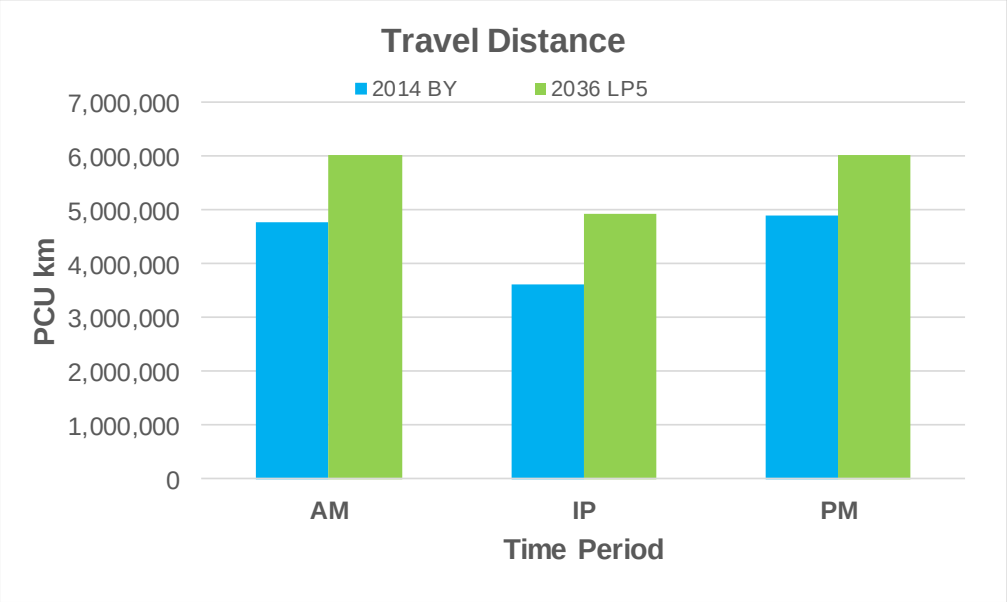


Figure 7-2: Total Travel Time (Simulation Area only)

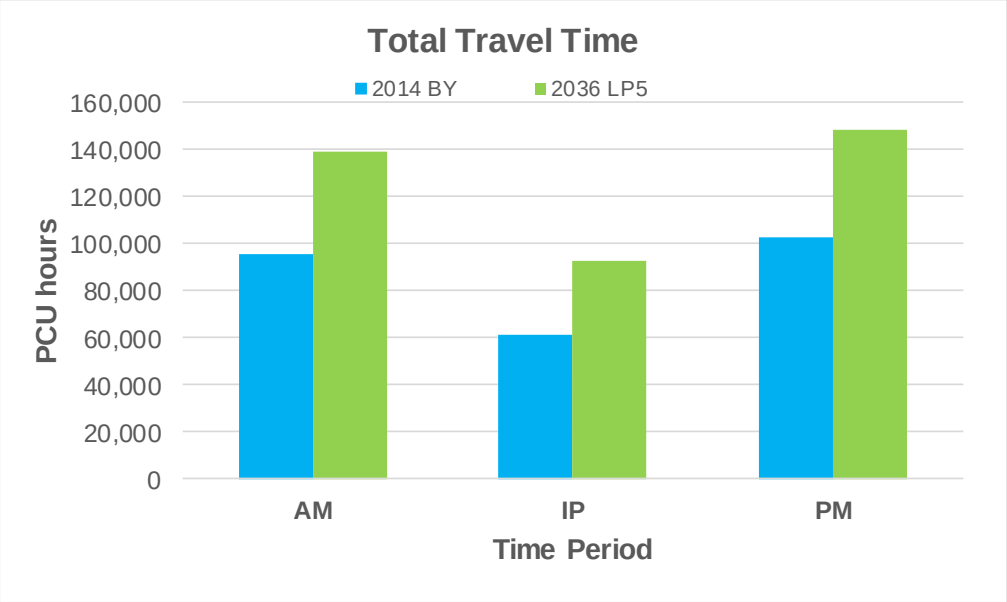


Figure 7-3: Average Speed (Simulation Area only)

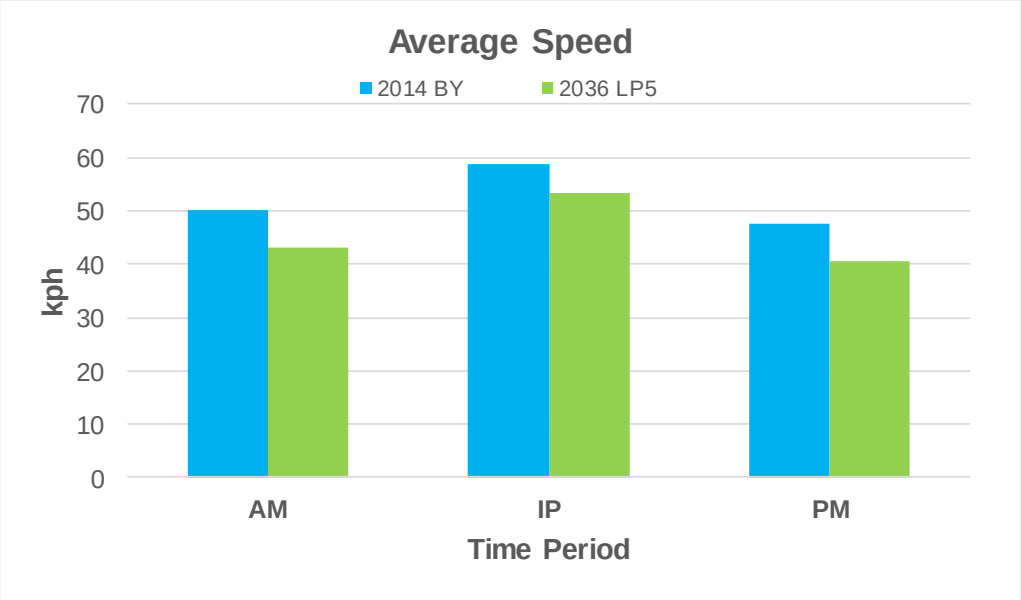
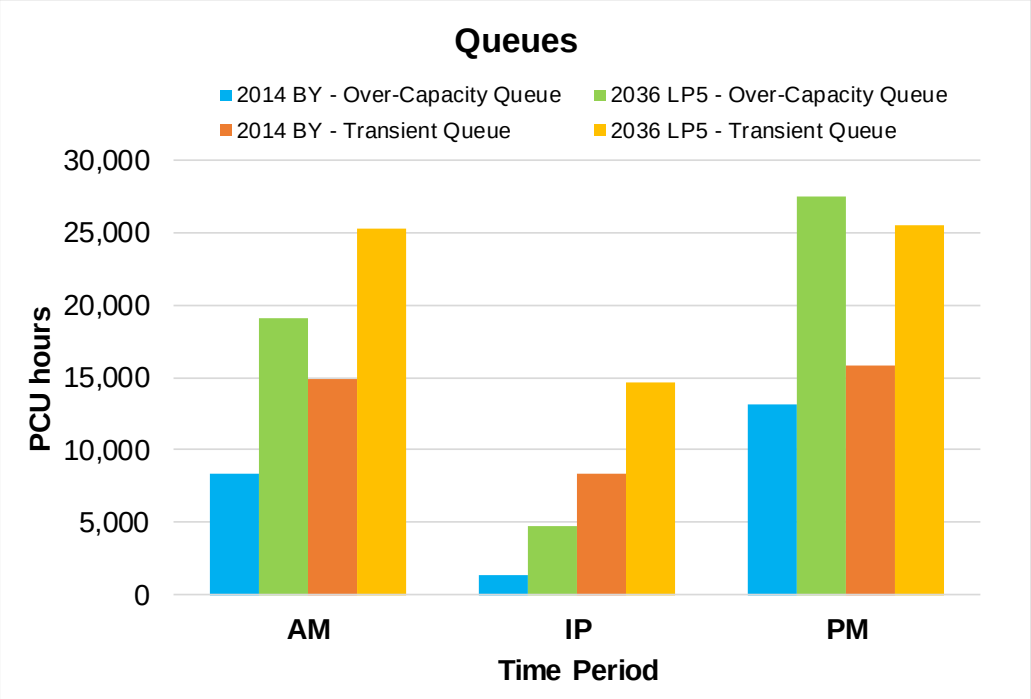


Figure 7-4: Queues (Simulation Area only)



7.2 Traffic Flows

7.2.1 The flow difference plots presented in this section display the change (in passenger car units) between the 2014 Base Year and LP5 2036 forecast year in Hertfordshire.

7.2.2 Green bands indicate flow increase in the forecast, whilst blue indicates flow decrease. The thickness of the lines represents the volume of traffic. As expected, the greatest increases in absolute terms in vehicle flow occur on the strategic road network, however, most of the minor links also experience traffic growth.

7.2.3 Notwithstanding some local re-routeing in town centres leading to flow reductions on some links, there are a number of notable impacts on strategic routes, presented next:

7.2.4 The M1 and A1(M) are more popular for strategic north-south movements than the A10, possibly due to the speed reduction scheme on the A10;

7.2.5 Increased flows along the M1 cause delays around junctions 5, 6a, 8, 9 and 10;

7.2.6 The A1(M) carries more traffic between North London and the M25 than the M1;

7.2.7 The A414 broadly operates within capacity, but the model predicts increased flows on the A414 corridor between the A10 and A1(M);

7.2.8 Decreased westbound flow on the A414, between the A10 and Harlow, could be expected due to delays at the A414/Fifth Avenue junction in Harlow and A414/A1170 junction. This may affect the parallel A120 corridor further north;

7.2.9 Reduced eastbound flow on the A414, between the A10 and Harlow, in the AM and PM, could possibly occur due to junction upgrades at A1184/West Road/Station Rd, which allow for re-routeing;

7.2.10 Reduced flow on the A414 through central Hemel Hempstead can be experienced due to the new routeing scheme at M1 Junction 8, the link road across North Hemel and the reduction of the A414 to one lane for general traffic in each direction;

7.2.11 Reduced flow on the A414, between A1(M) and M1, are possibly due to the schemes in St Albans (e.g. at A414/A1081/London Colney Roundabout junction/Colney Heath Longabout/ speed reduction to 50mph), the new junction on the A414 that connects it to the Park Street Garden Village and the new link road that connects the A414 to the A5183 Radlett Road;

7.2.12 Considering that the Hertford Bypass is not included in the LP5 application, marginal flow increases are to be expected on the A414 around Hertford;

7.2.13 A1(M) experiences greatest increase in flows between Hatfield and Stevenage, especially in the AM and PM peaks due to the additional capacity provided as a result of the Smart Motorway scheme between junctions 6 and 8;

7.2.14 Decreased flows on the A602 between Valley Way and Gresley Way in the PM suggest that traffic prefers to use the parallel Broadwater Crescent / Oaks Cross due to increased delays from signalisation at the A602/Gresley Way Junction

7.2.15 Capacity improvements at the M25 Junction 21a are critical and Influence routeing choices between the M1, A414 and A405 in this area. A reduction in delays at M25 Junction 21a would also contribute to varying flows in this area;

7.2.16 Increased flows on the A120 are likely to be the result of the Little Hadham bypass reducing delay along this route and additional traffic from development around Bishops Stortford;

7.2.17 The A10, especially between the M25 and A414, operates at reduced flows for most of the day. This might be linked to the lower speed limit in place in the 2036 scenario (40mph);

7.2.18 The western part of the M25 to and from Buckinghamshire is very congested in the AM peak and IP periods. The section between the M1 and A10 also experiences high congestion;

7.2.19 A localised flow reduction is predicted on the M25 approaching Junction 20 (A41) in the PM peak. This might be owned to the considerable delays observed at the junction and on the A41 approaching Junction 20 and shows that the expected traffic is avoiding the junction.

Figure 7-5: 2036 AM Peak Flow minus 2014 AM Peak (Key Links)

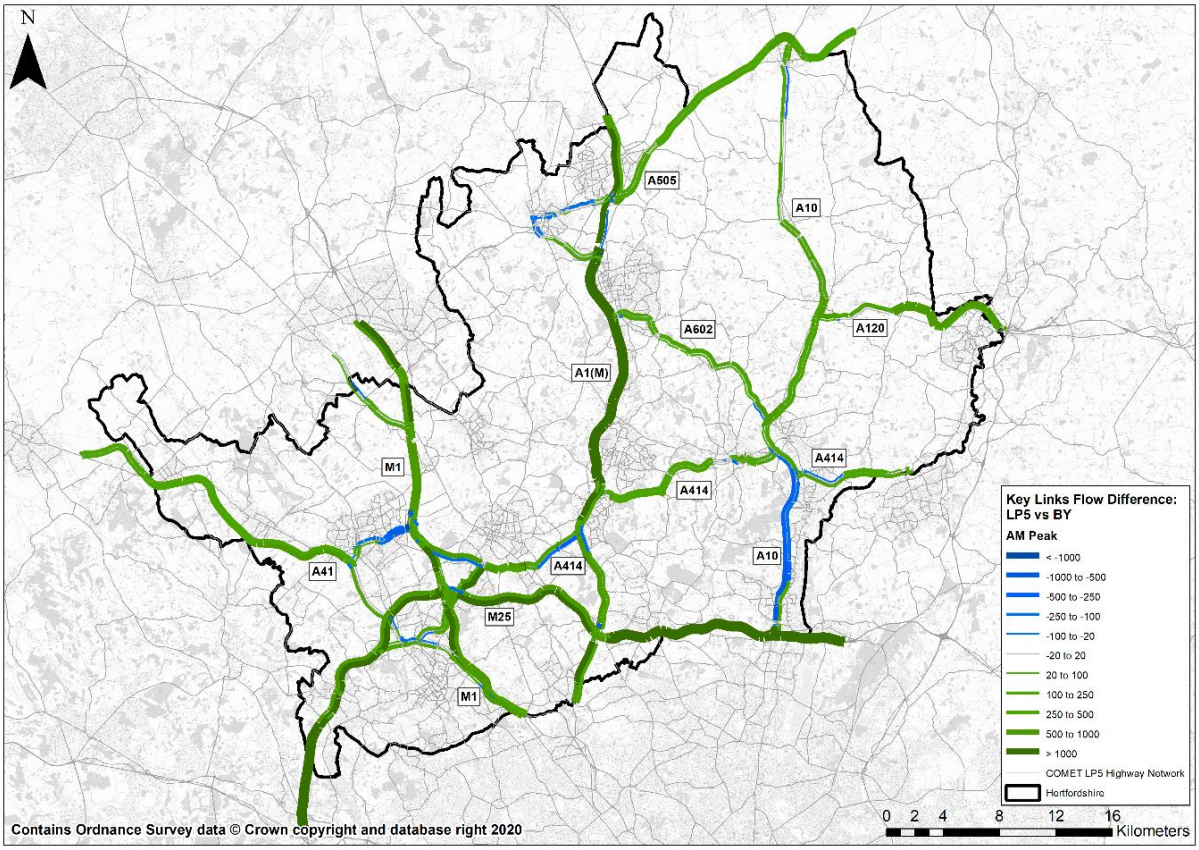


Figure 7-6: 2036 AM Peak Flow minus 2014 AM Peak (All Links)

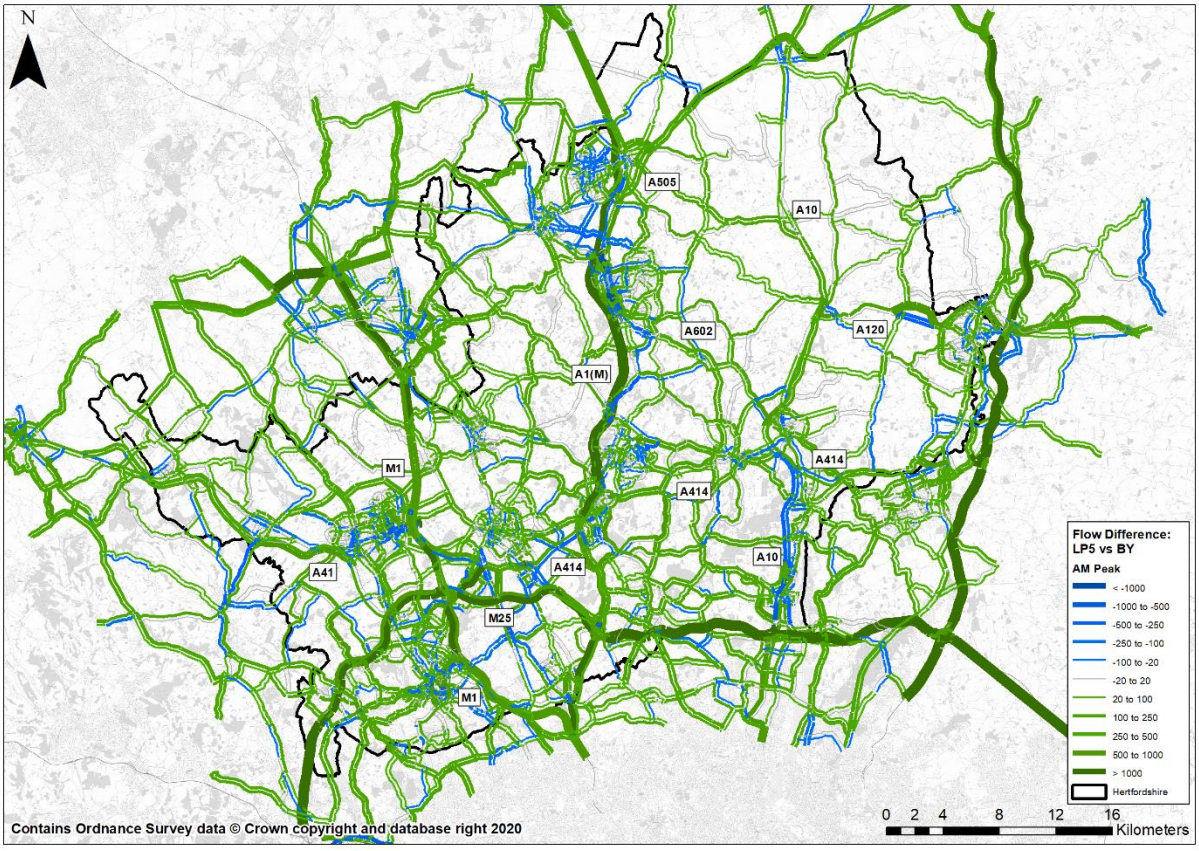


Figure 7-7: 2036 Inter-peak Flow minus 2014 Inter-peak (Key Links)

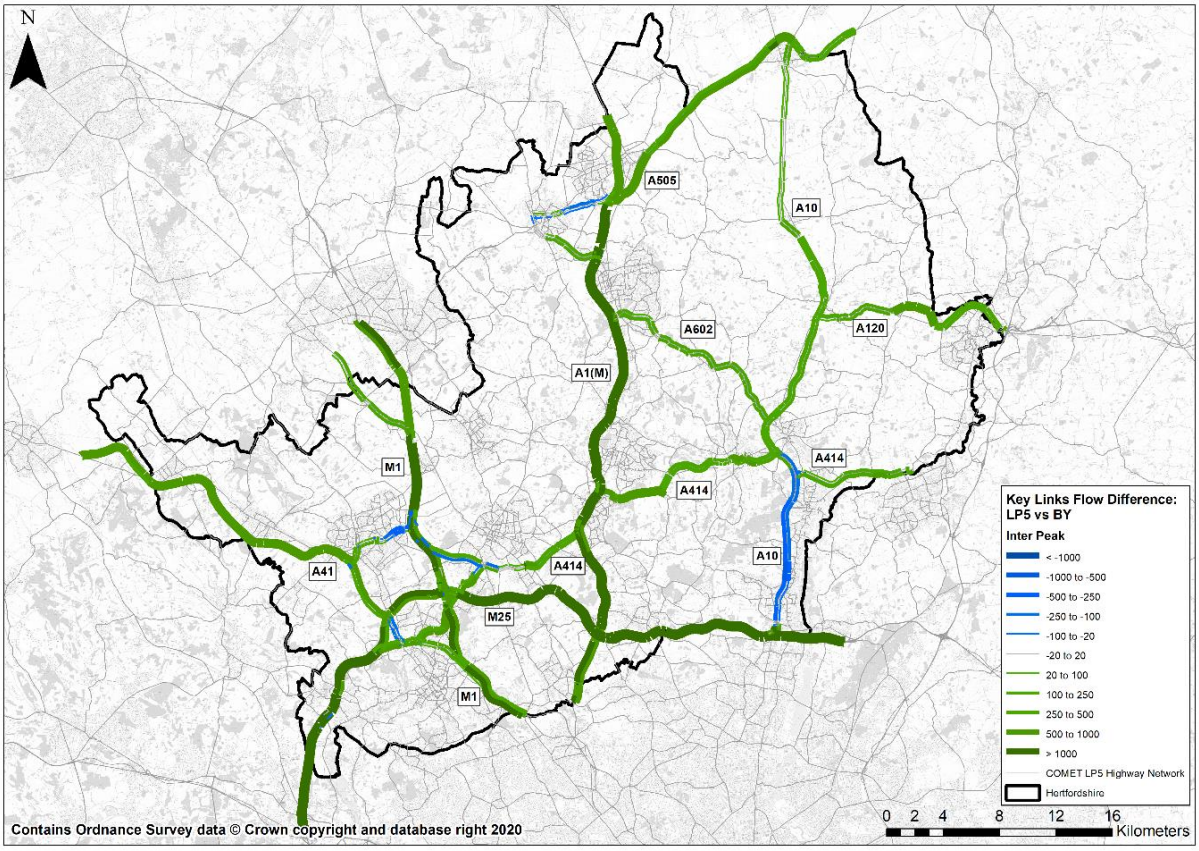


Figure 7-8: 2036 Inter-peak Flow minus 2014 Inter-peak (All Links)

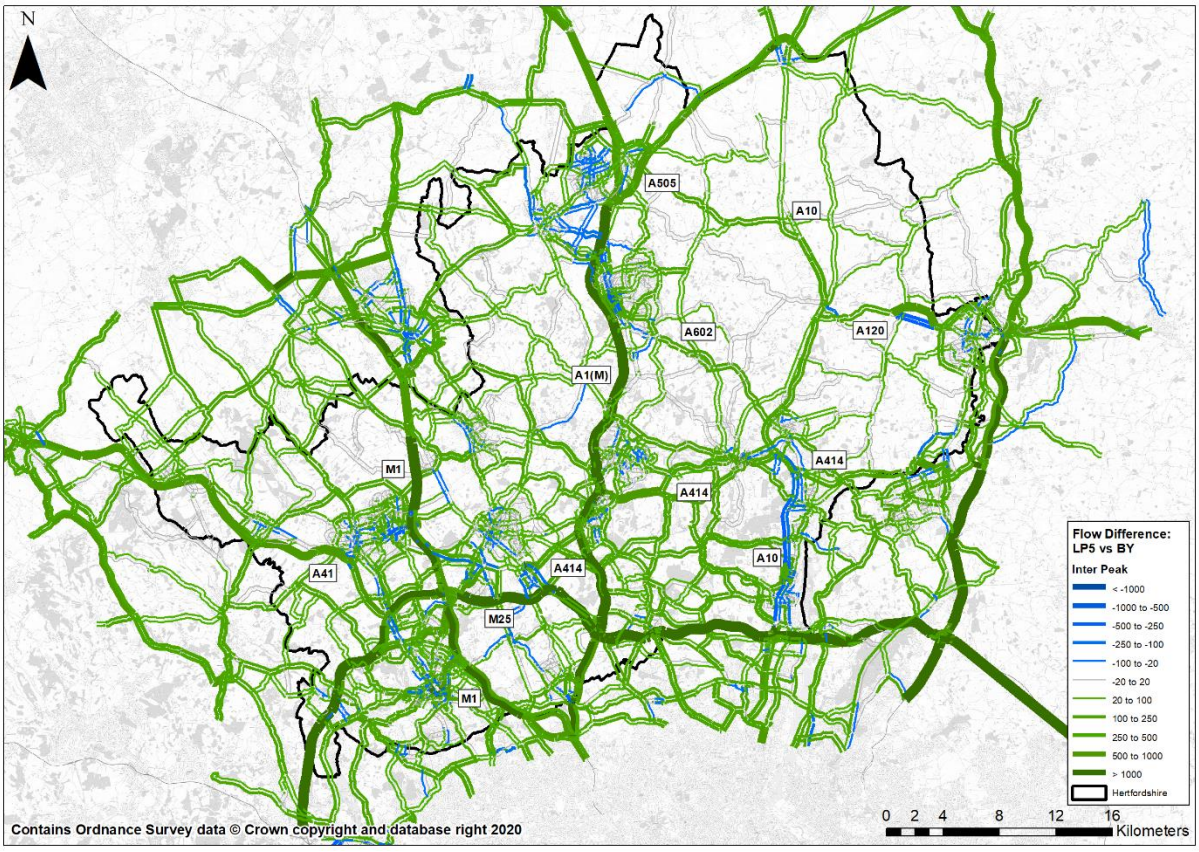


Figure 7-9: 2036 PM Peak Flow minus 2014 PM Peak (Key Links)

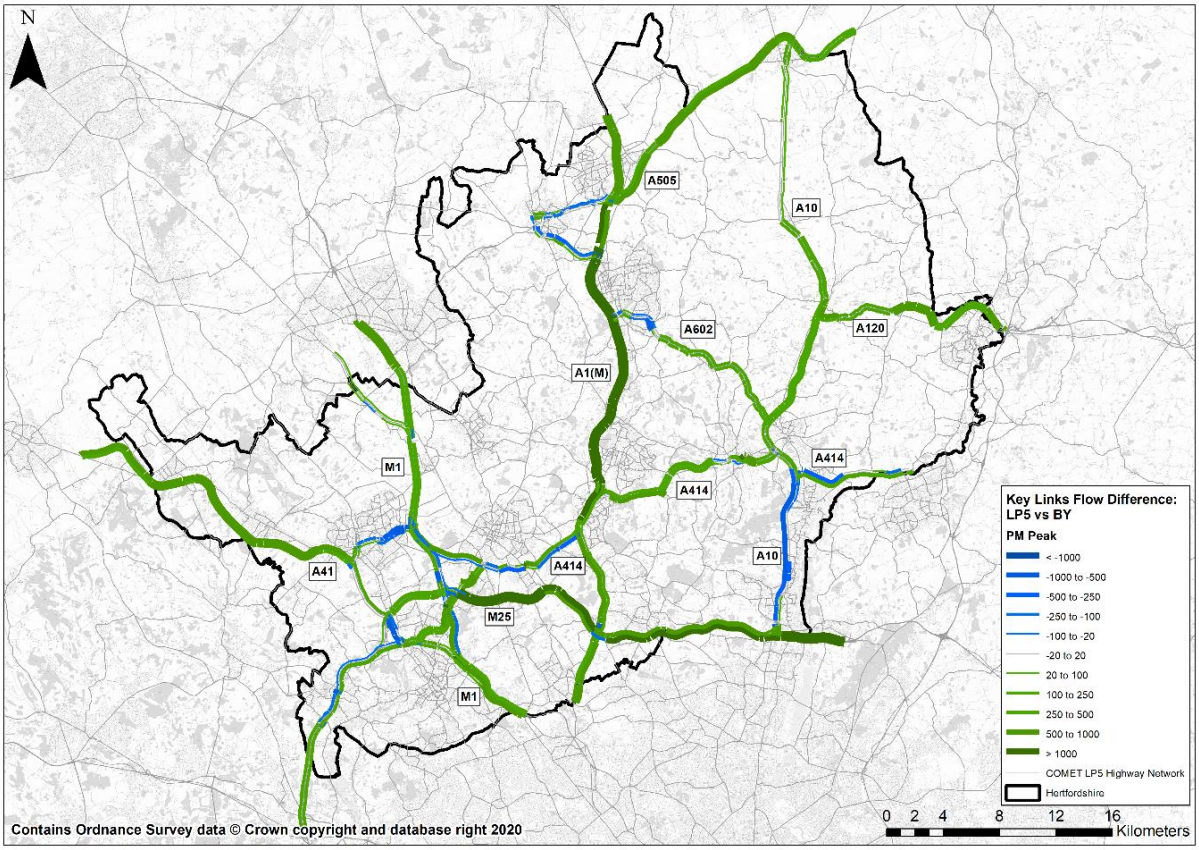
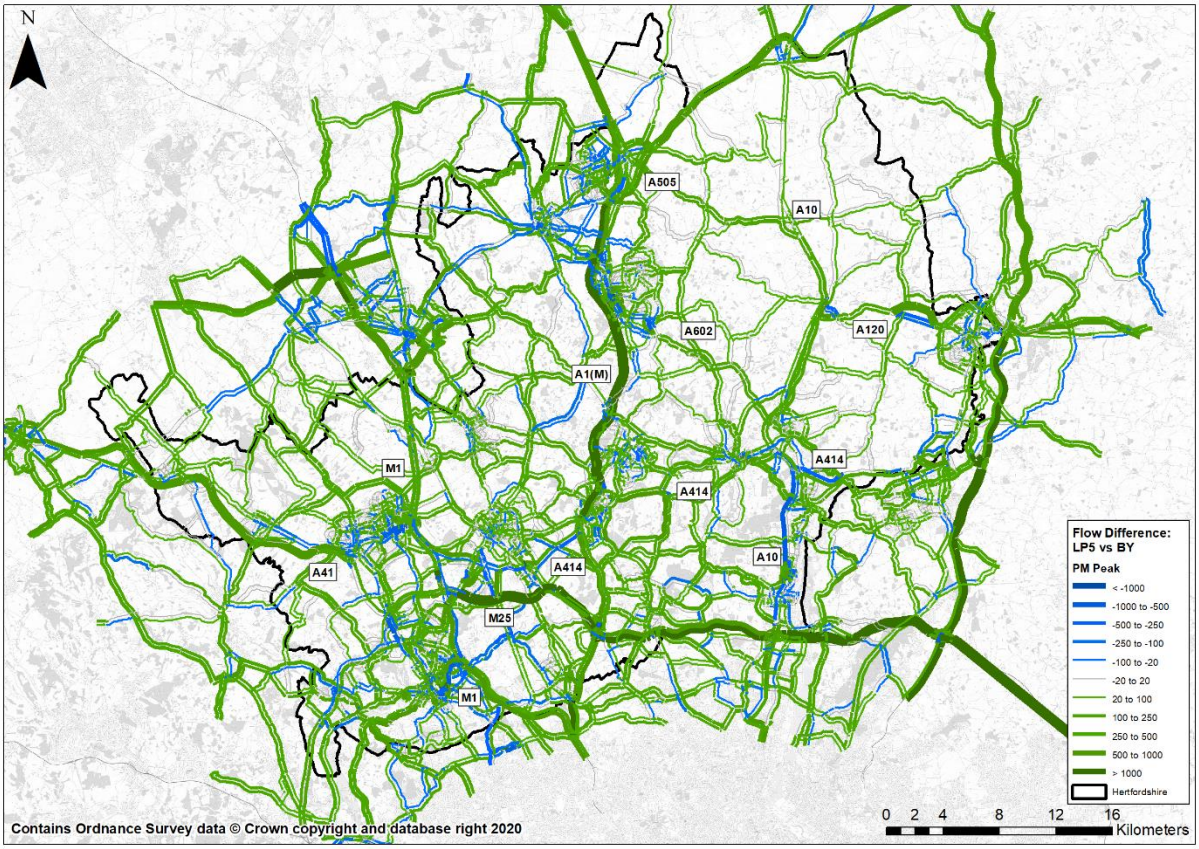


Figure 7-10: 2036 PM Peak Flow minus 2014 PM Peak (All Links)



- Comparing the impact on strategic routes between the LP4 and LP5 applications, the model suggests that in LP5 flow reductions are experienced on the A10 between the M25 and Hertford, locally on the A414 between A1(M) and M1 and around Hemel Hempstead, on the A505 between Letchworth Garden City and Hitchin, on the A602 near Stevenage in the PM peak, on the A41 south of the M25, and eastbound on the M25 (from Buckinghamshire) in the PM peak.
- Similarly, compared to LP4, flow increases are expected on the A414 around Hertford, on the A1(M), between Hatfield and Welwyn Garden City, on the M25, west of the A1(M), on the A41, north of the M25, on the A120 leading to Bishop's Stortford, on the A602 near Stevenage in the AM and marginally on the M1.
- These differences are mainly related to the differences in modelled schemes in the above mentioned areas and to the fact that the Hertford Bypass is not included in LP5, the effect of which is shown with additional trips on strategic routes.

7.3 Network Stress and Delays

7.3.1 Delays modelled in the highway assignment model are presented in the following sections in terms of link stress (volume over capacity – V/C) and junction (node) delay in minutes. Link stress (or V/C) represents the level of congestion along a link (road). At link stress of below 80%, roads are expected to be relatively free-flowing with minimal delays. For link stress between 80% and 90% roads will begin to show signs of congestion, speeds will lower, and delays will occur at junctions. When link stress is over 90% the road will be very congested with lower average speeds and longer delays expected at junctions.

7.3.2 The commentary given in the following sections is not intended as a comprehensive statement of network functionality, rather, it points out where the main areas of congestion and delays are expected to occur on a corridor, given the assumptions inherent in these tests.

7.3.3 The reliability of the forecast results is dependent on the performance of the Base Year model, and that there are currently areas identified as not meeting WebTAG criteria.

Link Stress

7.3.4 The figures in this section show the 2036 modelled link stress in terms of volume over capacity (V/C) for the three modelled time periods.

7.3.5 Modelling shows the highest levels of congestion in the western half of Hertfordshire (west of the A1(M)). More specifically, the urban areas of Watford, St Albans, Hemel Hempstead, Hertford, between Welwyn Garden City and Stevenage, and Hitchin as well as Bishop's Stortford show link stress above 90%. Link stress between 80%-90% is experienced in Hatfield, Baldock and Epping Forest.

7.3.6 With regards to the impact on the road network, the following key roads in Hertfordshire show evidence of congestion (link stress of above 80%) in the 2036 model forecast:

7.3.7 Parts of the M25, east of the A1(M) and west of the M1, are very congested, especially in the AM and PM peaks. This shows that traffic prefers the M25 for east-west movements;

7.3.8 High congestion on the A1(M), particularly between the M25 and A414 and between Hatfield and Stevenage, is experienced due to the increased flows in the area;

7.3.9 The A414 around Hertford and between the A1(M) and Colney Heath Longabout junction is operating above capacity throughout the day due to increased delays;

7.3.10 The M1, north of Hemel Hempstead, experiences high congestion as a result of the increased flows presented above;

7.3.11 Increased link stress on the A602 towards Hitchin is attributed to the delays experienced along the link;

7.3.12 Although low volume over capacity is predicted for the A120, a part of the ring road north of Bishop's Stortford appears to operate near capacity, due to the delays on the link to and from Essex.

7.3.13 Decreased link stress (< 80%) is expected on the A10, the A41 north of the M25 and the A414 east of the A10 throughout the day. This is due to reduced flows and small or moderate delays along this links.

Figure 7-11: COMET 2036 AM Peak Link V/C (Key Links)

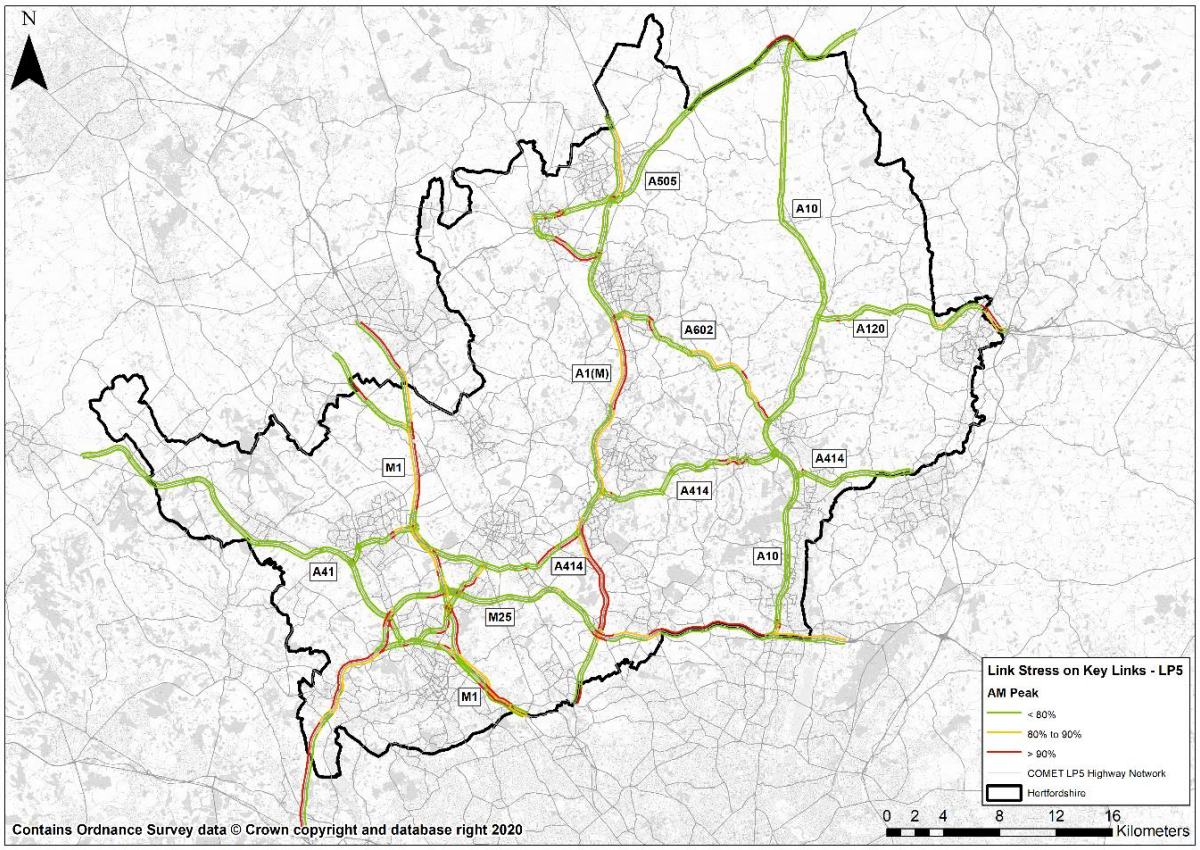


Figure 7-12: COMET 2036 AM Peak Link V/C (All Links)

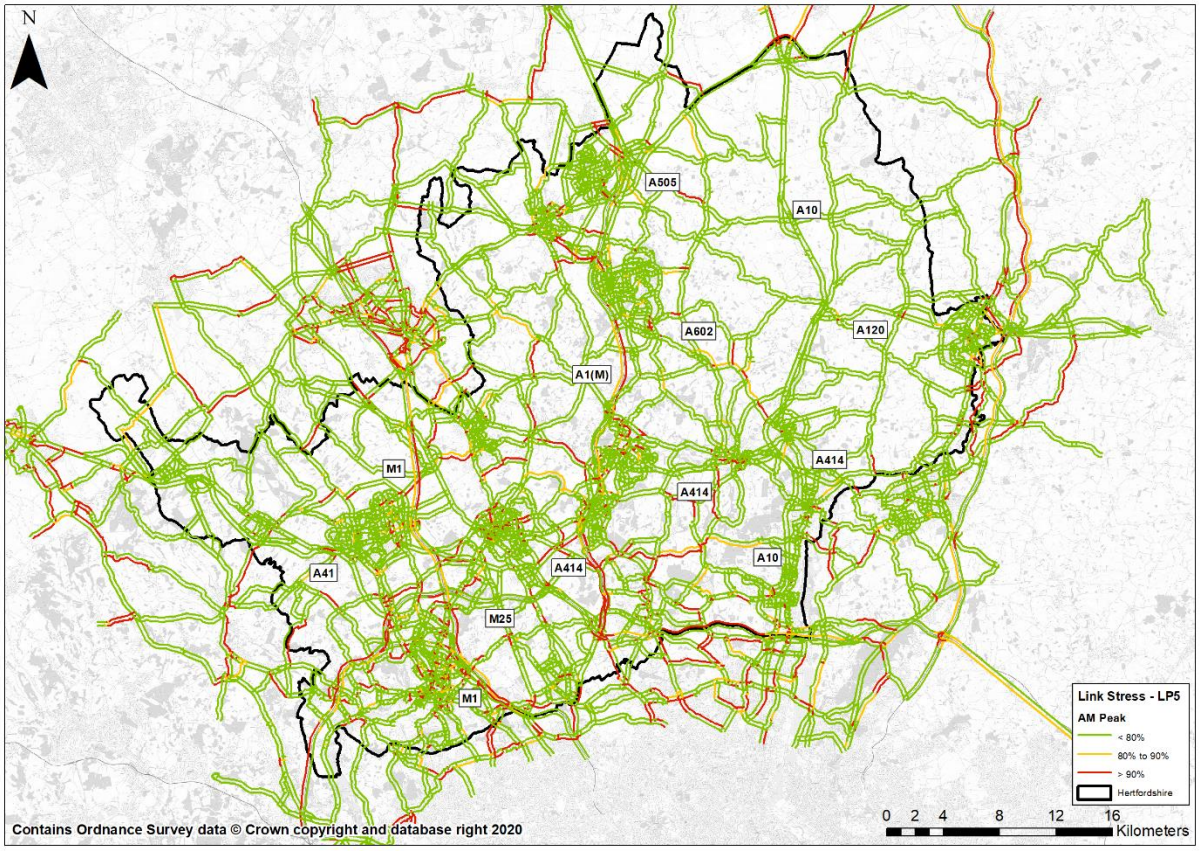


Figure 7-13: COMET 2036 Inter-peak Link V/C (Key Links)

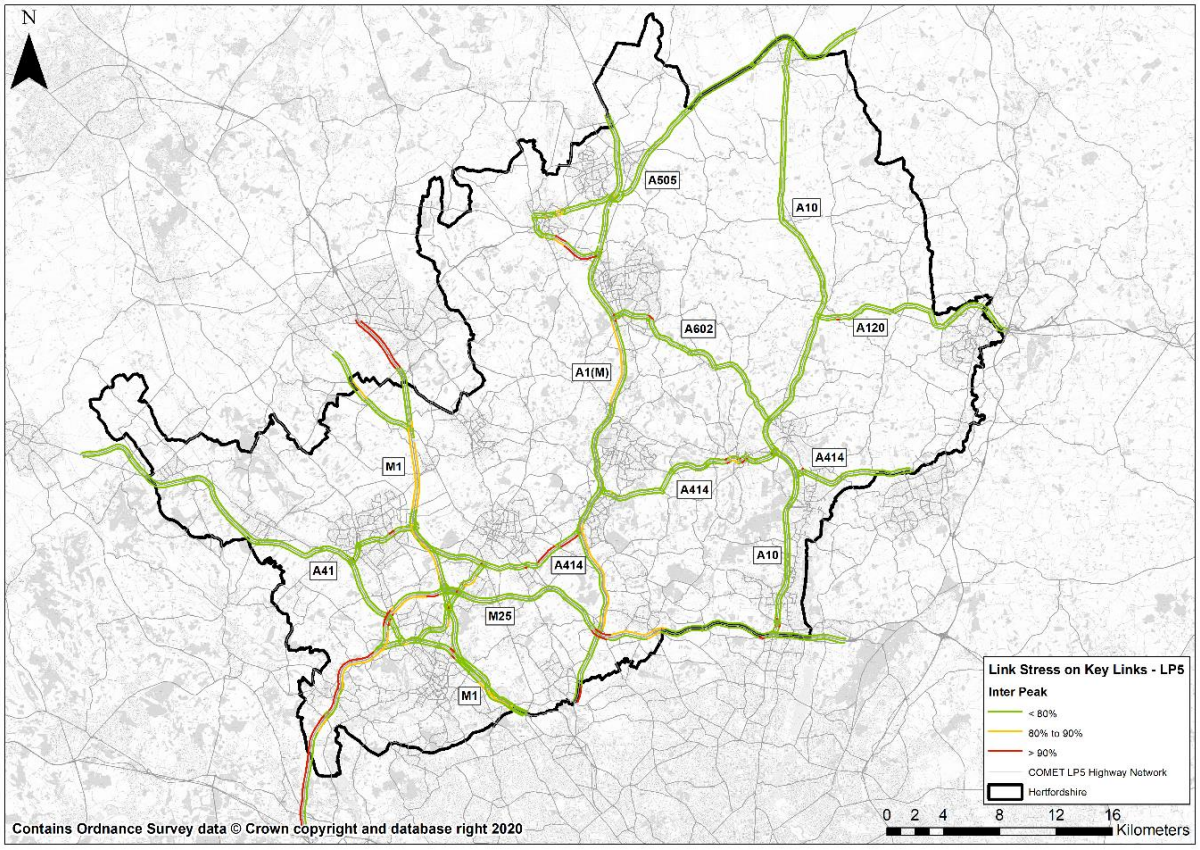


Figure 7-14: COMET 2036 Inter-peak Link V/C (All Links)

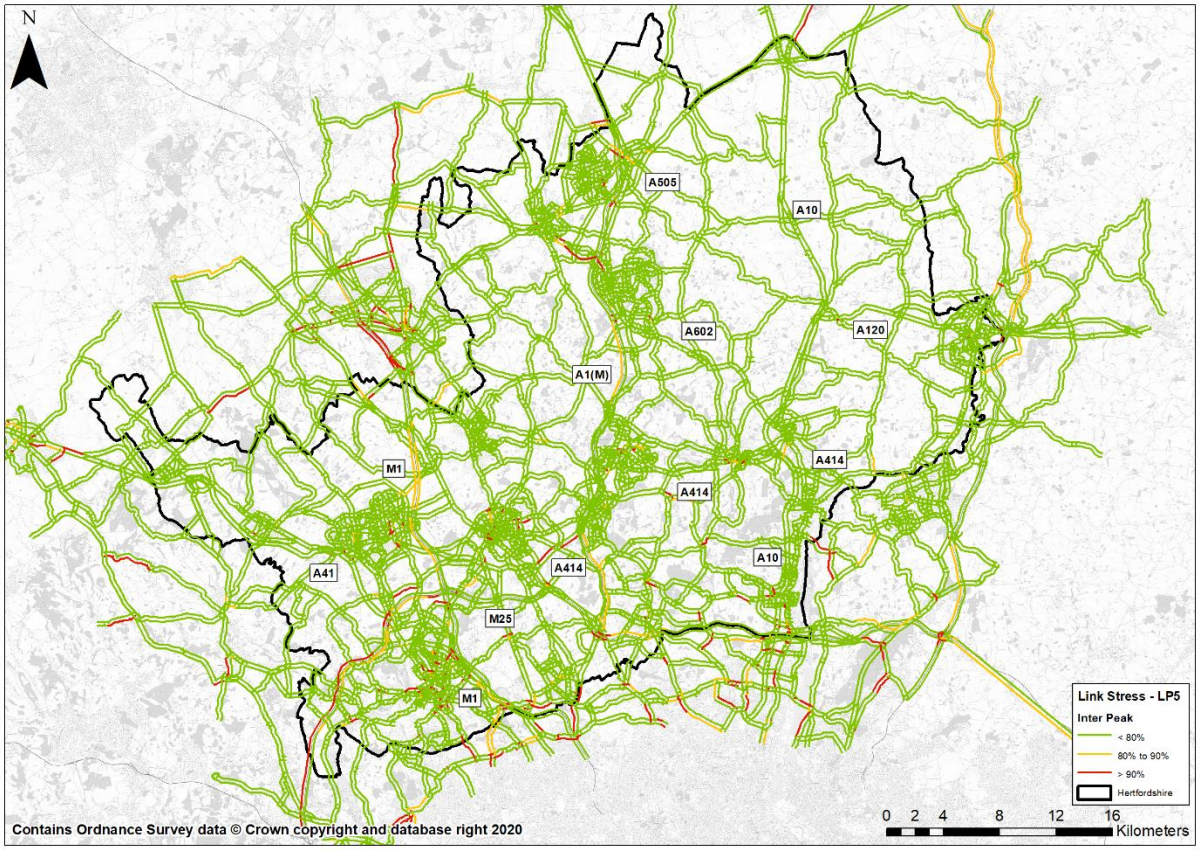


Figure 7-15: COMET 2036 PM Peak Link V/C (Key Links)

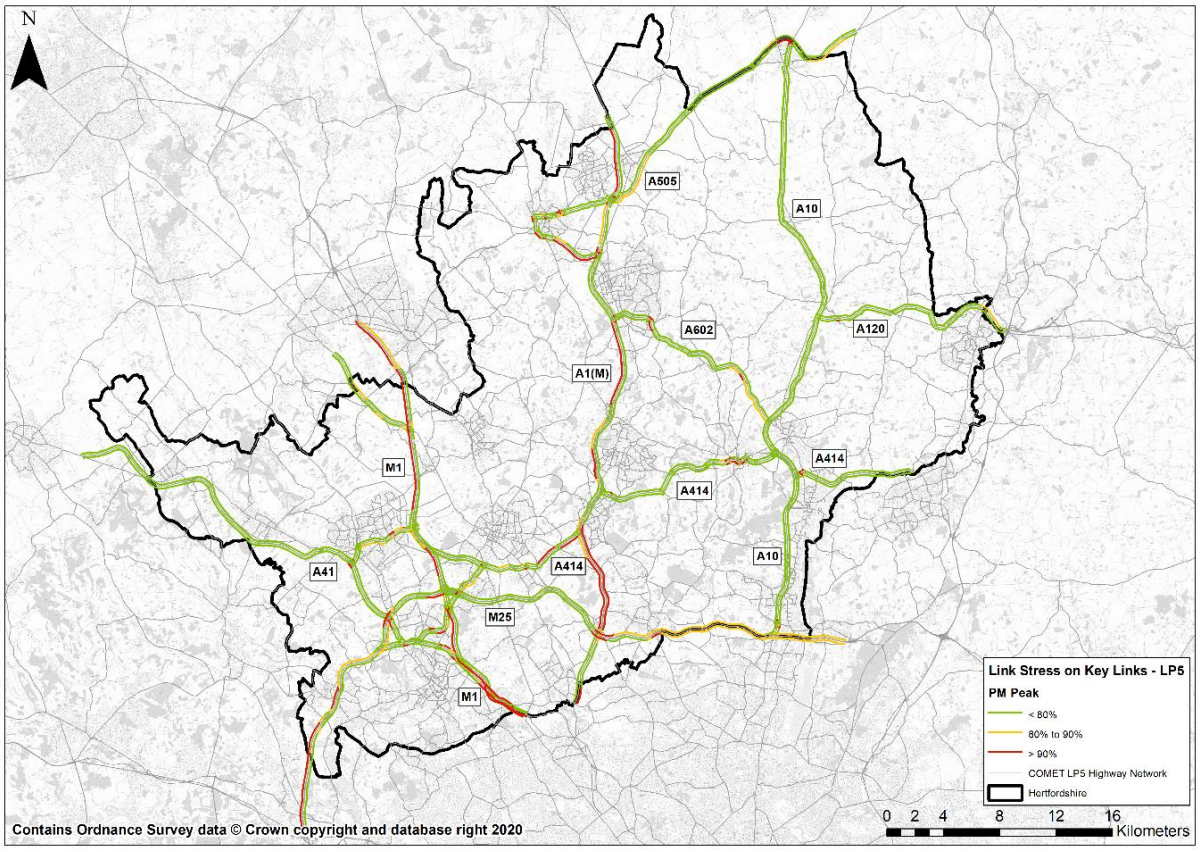
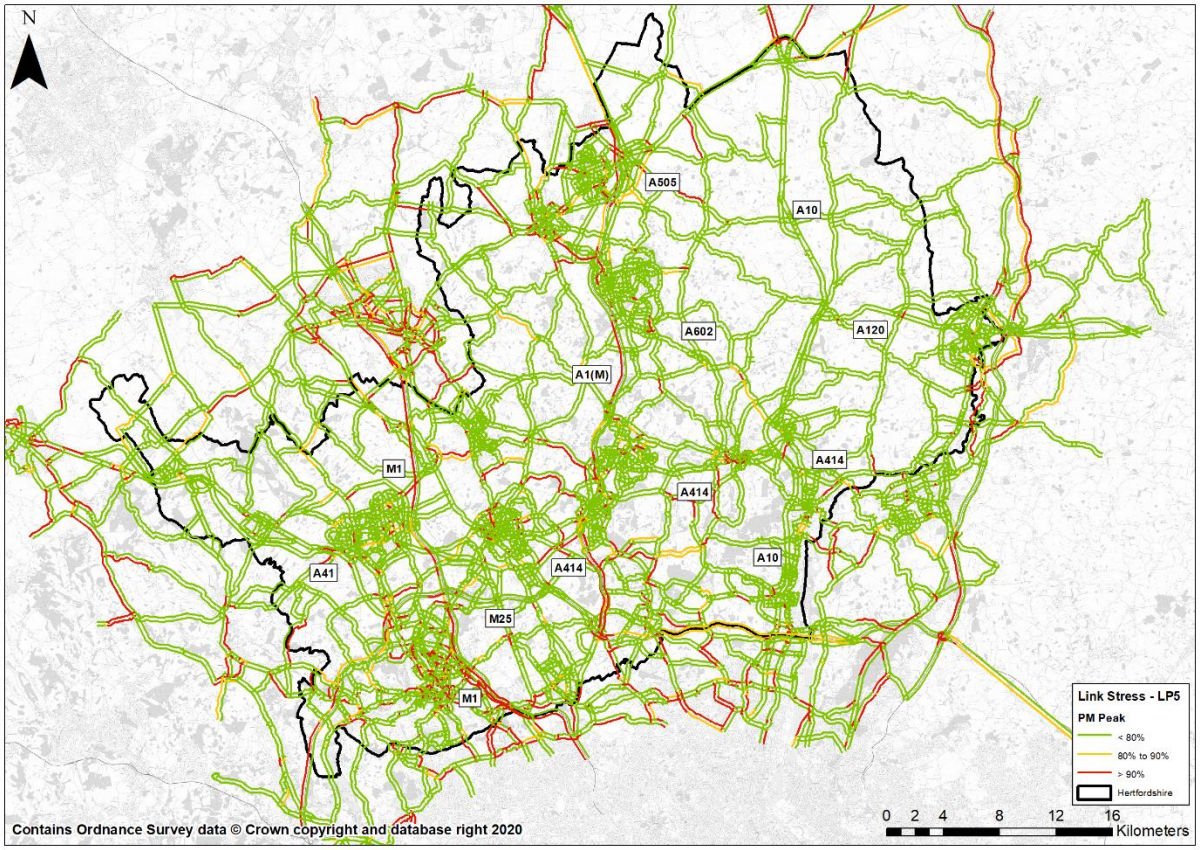


Figure 7-16: COMET 2036 PM Peak Link V/C (All Links)



7.3.14 Compared to LP4, higher levels of congestion will be experienced in the LP5 scenario on the following key links: on the M25 between the A10 and A1(M) and west of the M1, on the A1(M) between the M25 and Hatfield and on the M1 south of Hertfordshire and approaching the M25, and between Hemel Hempstead and Luton. The increased differences in link stress on the M1, A1(M) and M25 south of Hertfordshire may be due to the increased sensitivity of COMET v5 in the calculation of delays.

7.3.15 Overall, western Hertfordshire experiences more congestion than eastern Hertfordshire, which is consistent with the results derived from the LP4 application of the forecast model.

Junction Delay

7.3.16 Junction delay per vehicle is presented in the following figures for the three modelled time periods in 2036. The delay shown for each junction is an average (weighted by vehicular flow) of the delays for each possible turn at that junction.

7.3.17 Junction delays can be seen to increase across the western half of Hertfordshire, and it can be recognised that the longest junction delays are located on junctions west of the A1(M). There are also long delays at some of the A1(M) junctions, however there is no obvious long delay at the A414/M1 junctions.

7.3.18 Along the strategic road network, significant delays (> 5 min) are experienced at the M25 Junction 20 (A41) and the Stirling Corner roundabout (A1(M), which enables traffic from northern London to access Hertfordshire. There are also delays on the strategic road network around Watford in the PM peak.

7.3.19 Junction delays between 2.5 min and 5 min are experienced at junctions on the A414/A41 and A414/M1 and at the M25 Junction 25 (A10), especially in the AM peak. These junctions are key to the area and facilitate east-west movements.

7.3.20 Long delays will also be experienced in the Luton and Aylesbury Vale areas due to the development and growth assumptions which are expected to affect the districts west of Hertfordshire.

Figure 7-17: COMET 2036 AM Peak Delay (Key Junctions)

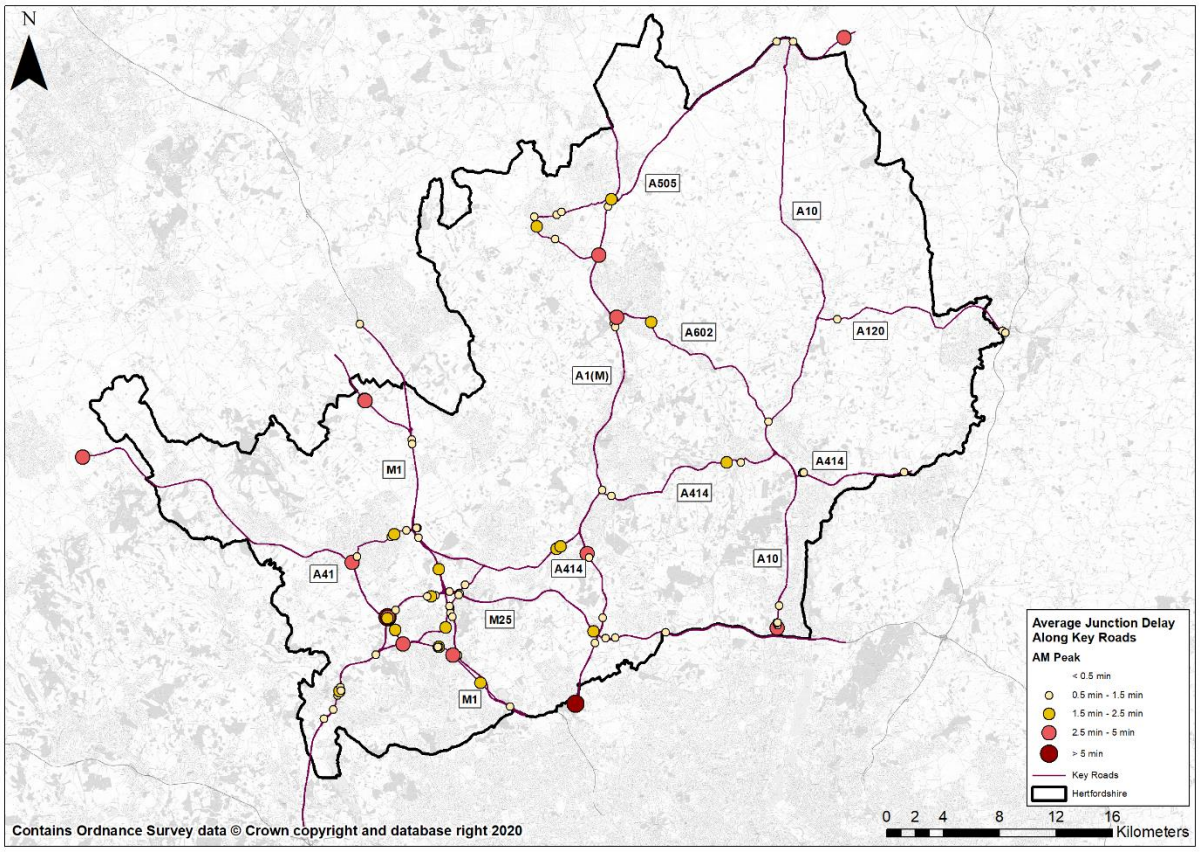


Figure 7-18: COMET 2036 AM Peak Delay (All Junctions)

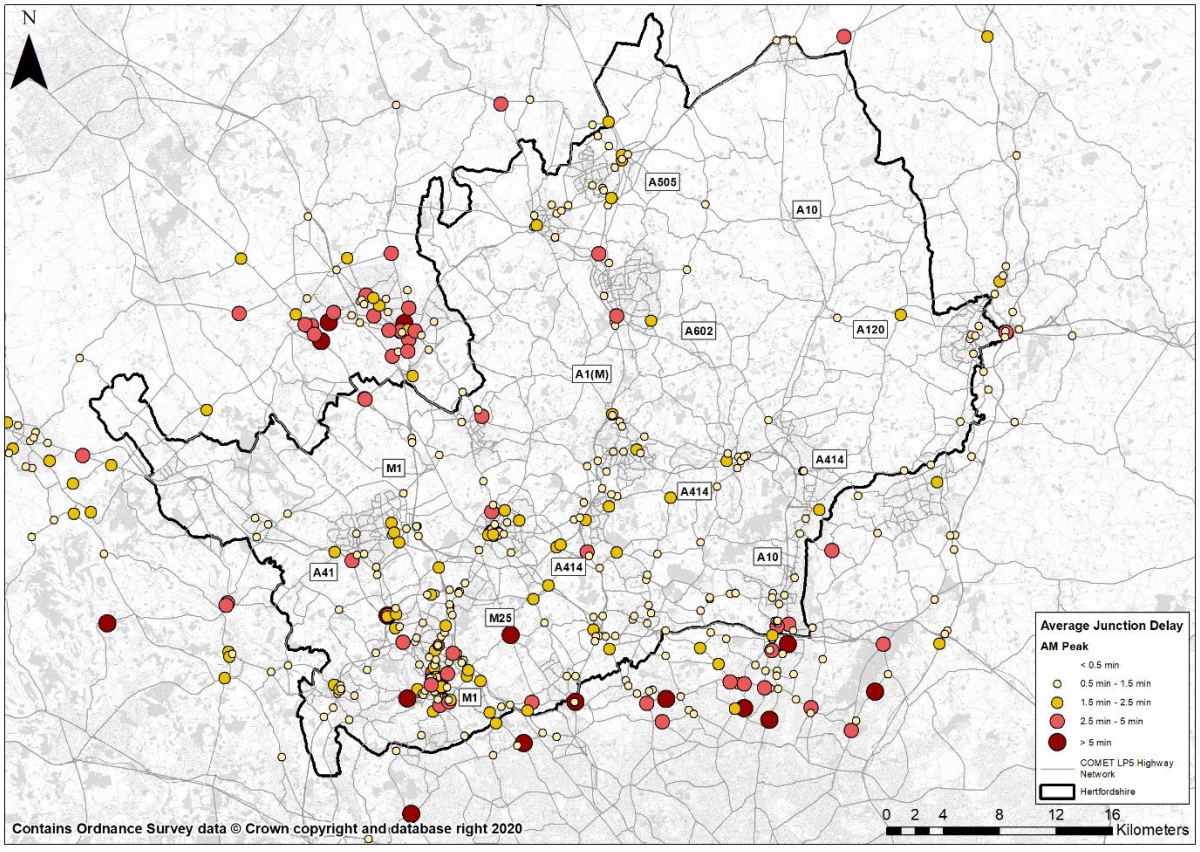


Figure 7-19: COMET 2036 Inter-peak Delay (Key Junctions)

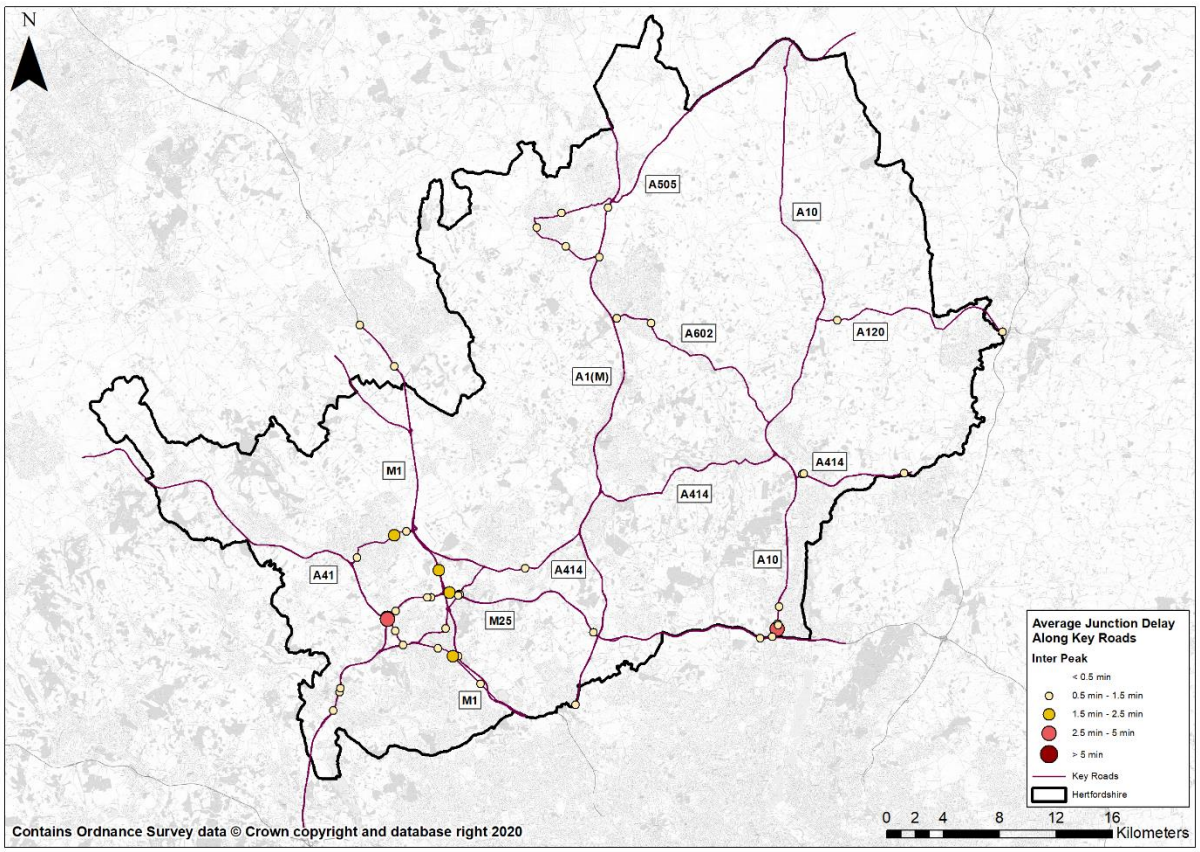


Figure 7-20: COMET 2036 Inter-peak Peak Delay (All Junctions)

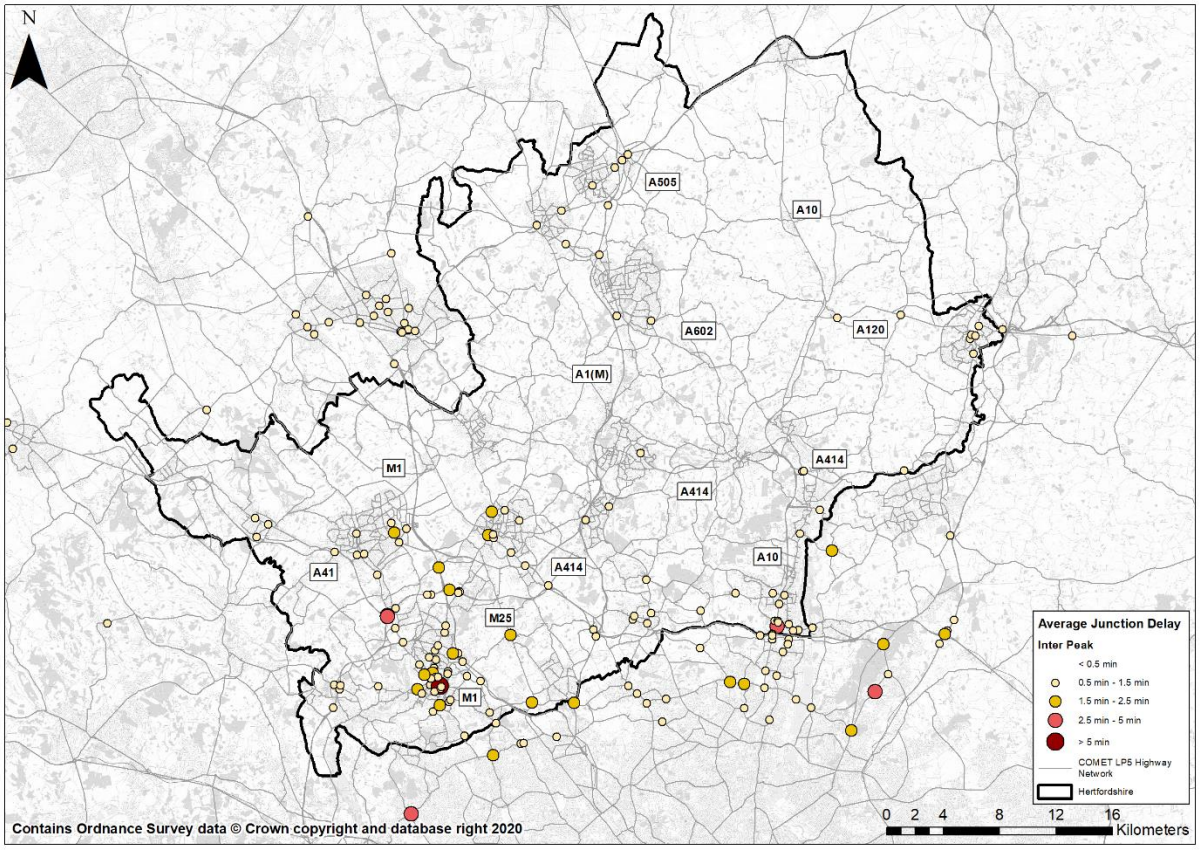


Figure 7-21: COMET 2036 PM Peak Delay (Key Junctions)

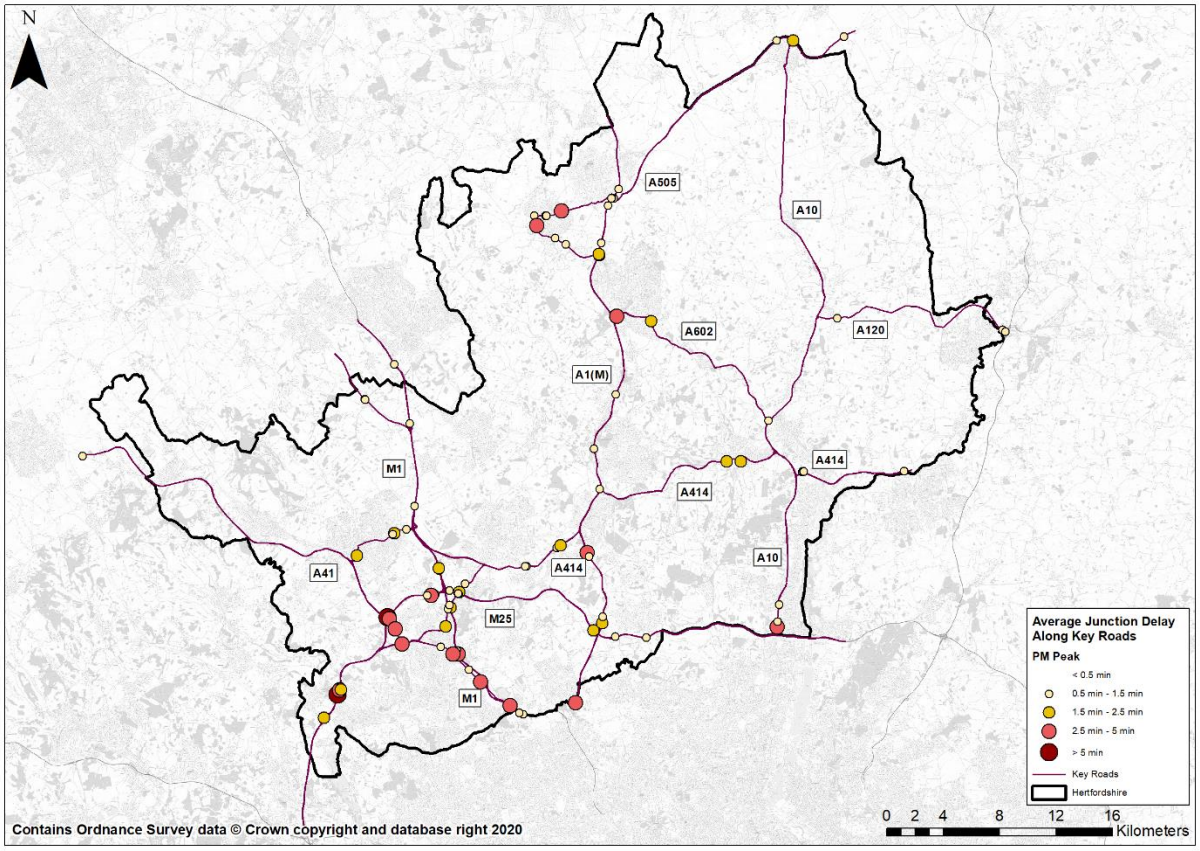
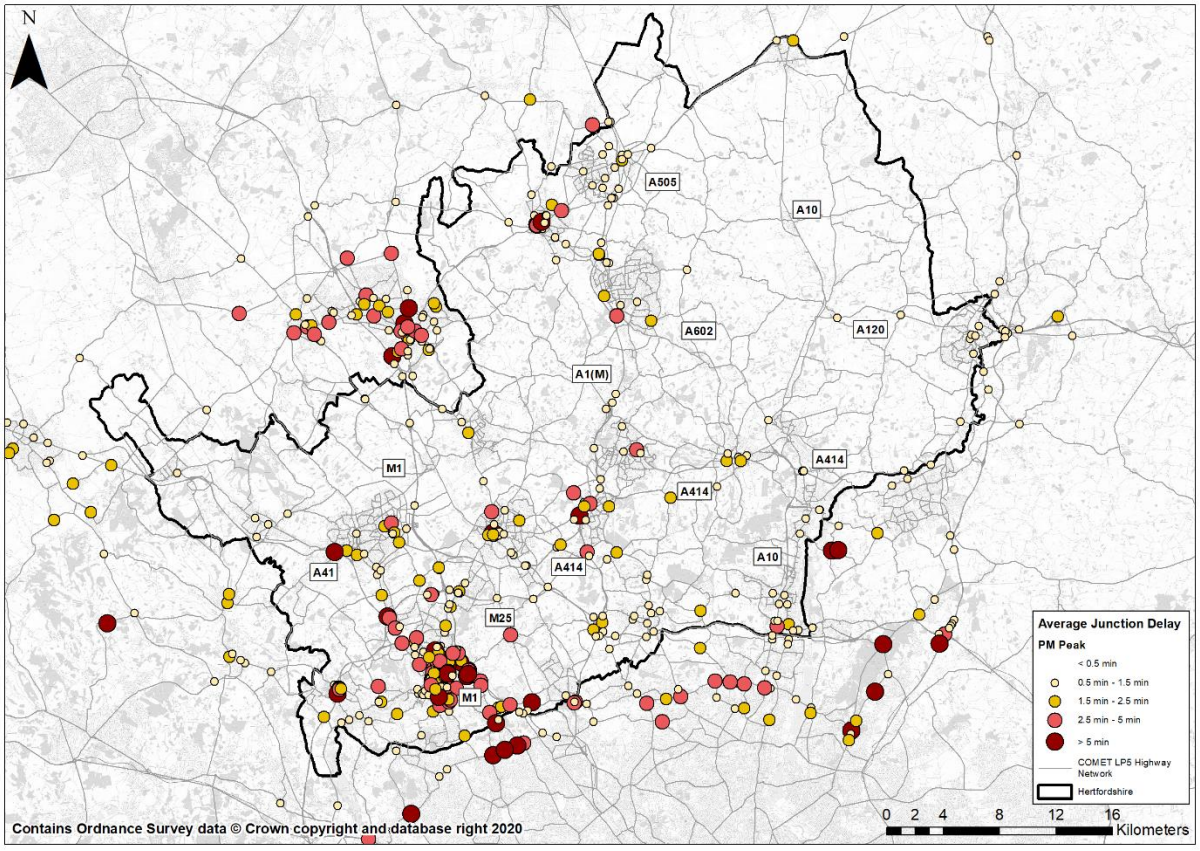


Figure 7-22: COMET 2036 PM Peak Delay (All Junctions)



7.3.21 The following figures show the node delay difference between the 2014 Base Year and 2036. Some reductions are noted along key links where signal optimisation has been undertaken in LP5.

7.3.22 As suggested by the model, increase in delay difference of up to 3 min will be experienced on the western section of the M25, on the M1 approaching the M25, around the M25 Junction 21 (M1) and at Watford Road/A405 junction, around the A1(M) and M25 at Junction 23 and on the A120 at Bishop's Stortford.

7.3.23 Long decreases in delay differences (up to -6 min) are modelled at the A414/London Colney Roundabout junction, the M25 Junction 21A towards the A405 to St Albans, the M25 Junction 25 (A10) and the A10/Church Lane junction and the A602/GSK Junction 7 (A1(M)).

7.3.24 These reductions are related to the modelled schemes. Especially for the longest decrease, this is observed at the A1(M) Junction 7. The A1(M) currently consists of 2 lanes but was modelled with 3 lanes between Junctions 6 and 8 to examine the effect of this scheme. The model suggests that delays at junctions on this part of the A1(M) are mitigated and transferred to the adjacent entry junctions (e.g. junction on the A602 just before the A1(M) Junction 7).

7.3.25 Overall, east-west movements via the A414 experience increased delays at key junctions and town centres, including Hertford, A1(M) Junction 4 and M1 Junction 8. Increases in delays along the A414 in Hemel Hempstead may be due to the reduced road capacity, while increase in delays on junctions along the A1(M) and M1 can be owed to the increased flows on these links.

7.3.26 Decrease in delays on the A10 are a result of the decreased flows which may be due to the speed reduction scheme. Similarly, decrease in delays on the A602 may be due to the junction upgrades.

7.3.27 Compared to LP4, it is clear that delays increase significantly across the strategic routes, especially in south west Hertfordshire and this might be due to the increased sensitivity of COMET v5 in the calculation of the new saturation flows and thus of delays.

Figure 7-23: 2036 AM Peak Delay minus 2014 AM Peak (Key Junctions)

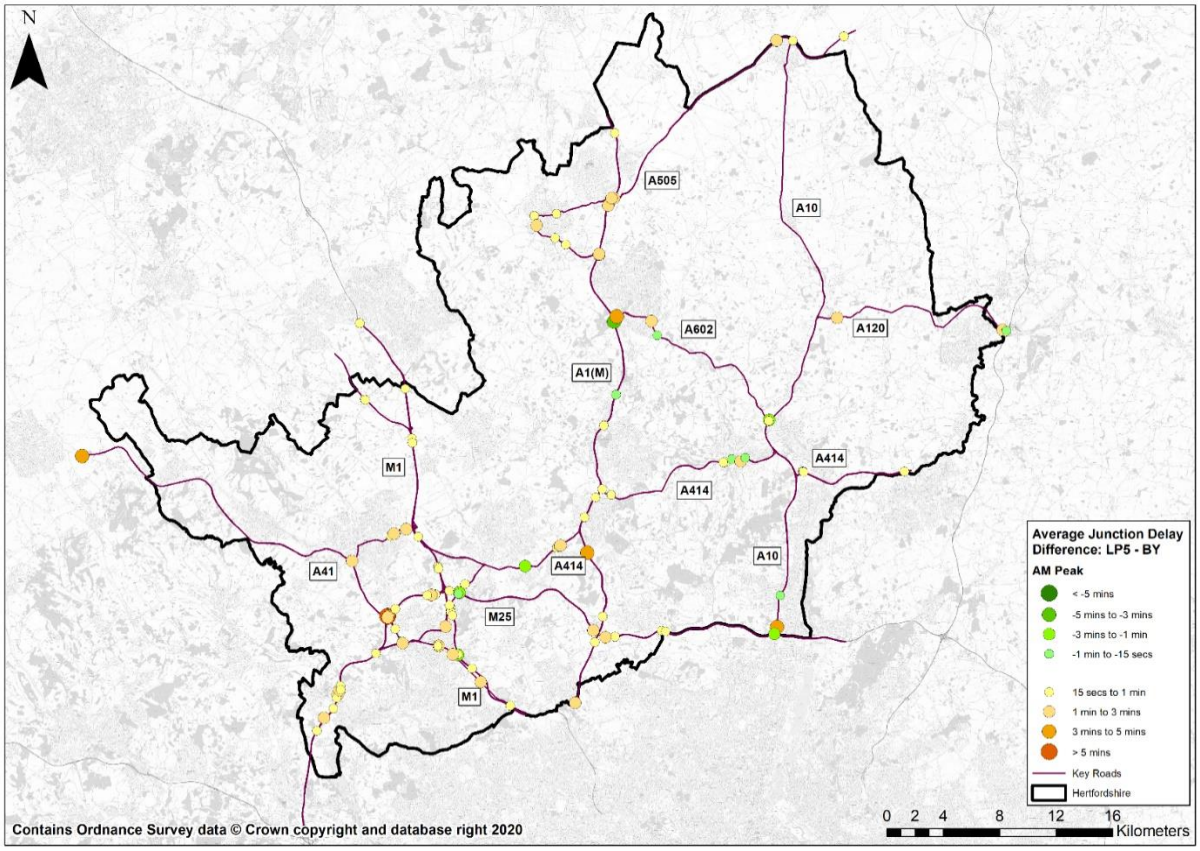


Figure 7-24: 2036 AM Peak Delay minus 2014 AM Peak (All Junctions)

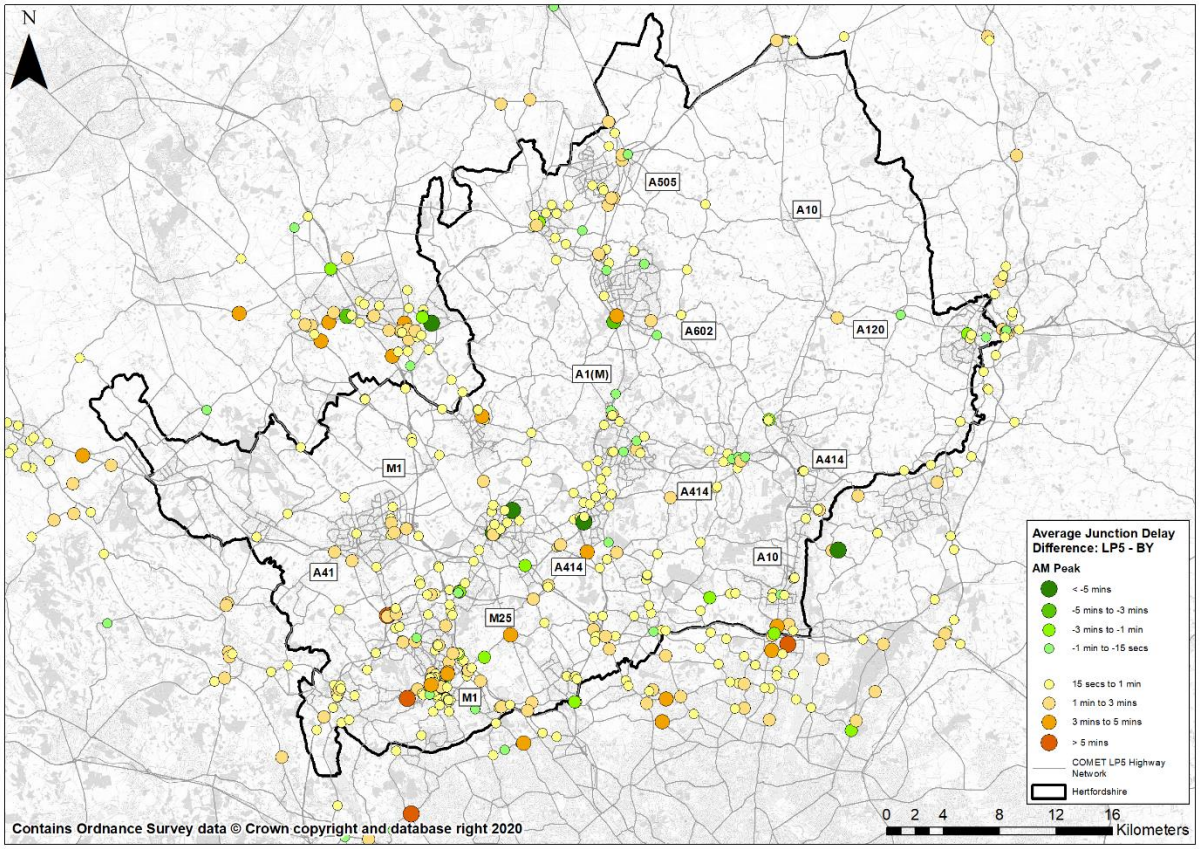


Figure 7-25: 2036 Inter-peak Delay minus 2014 Inter-peak Peak (Key Junctions)

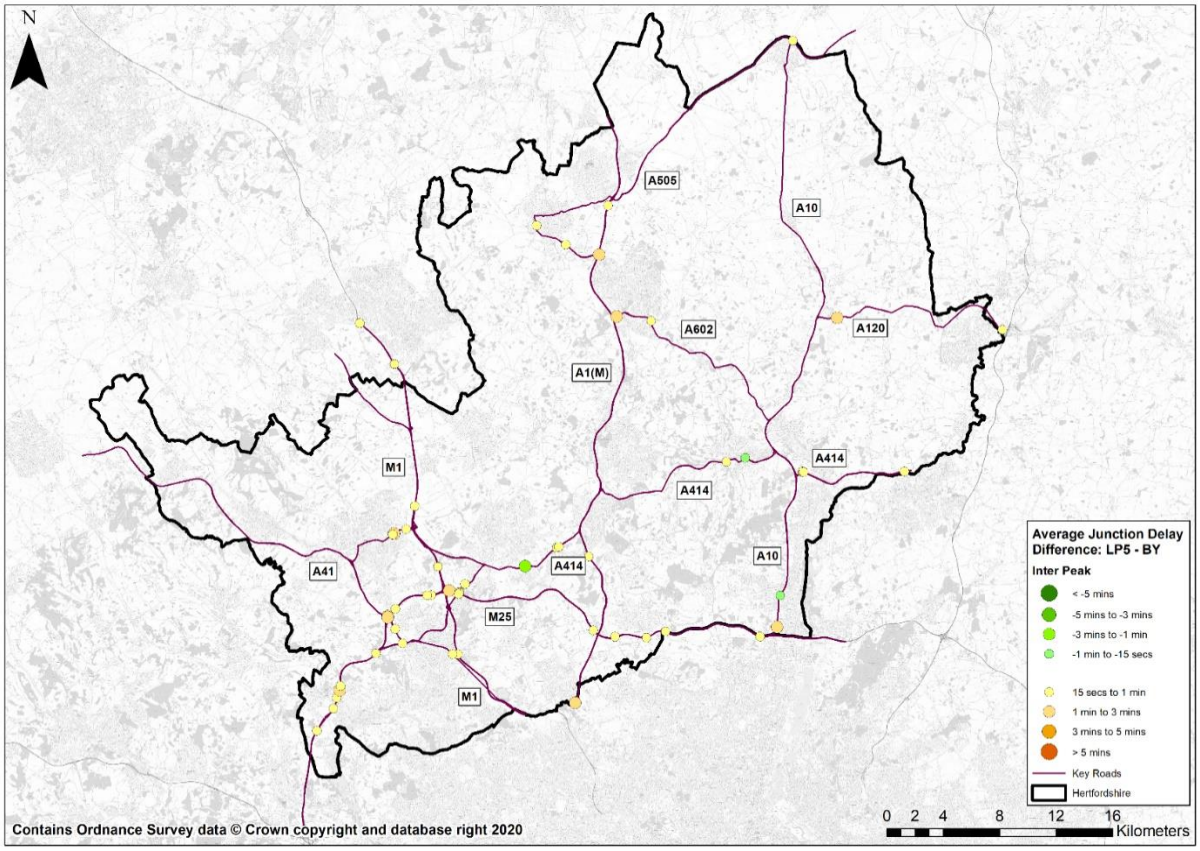


Figure 7-26: 2036 Inter-peak Delay minus 2014 Inter-peak Peak (All Junctions)

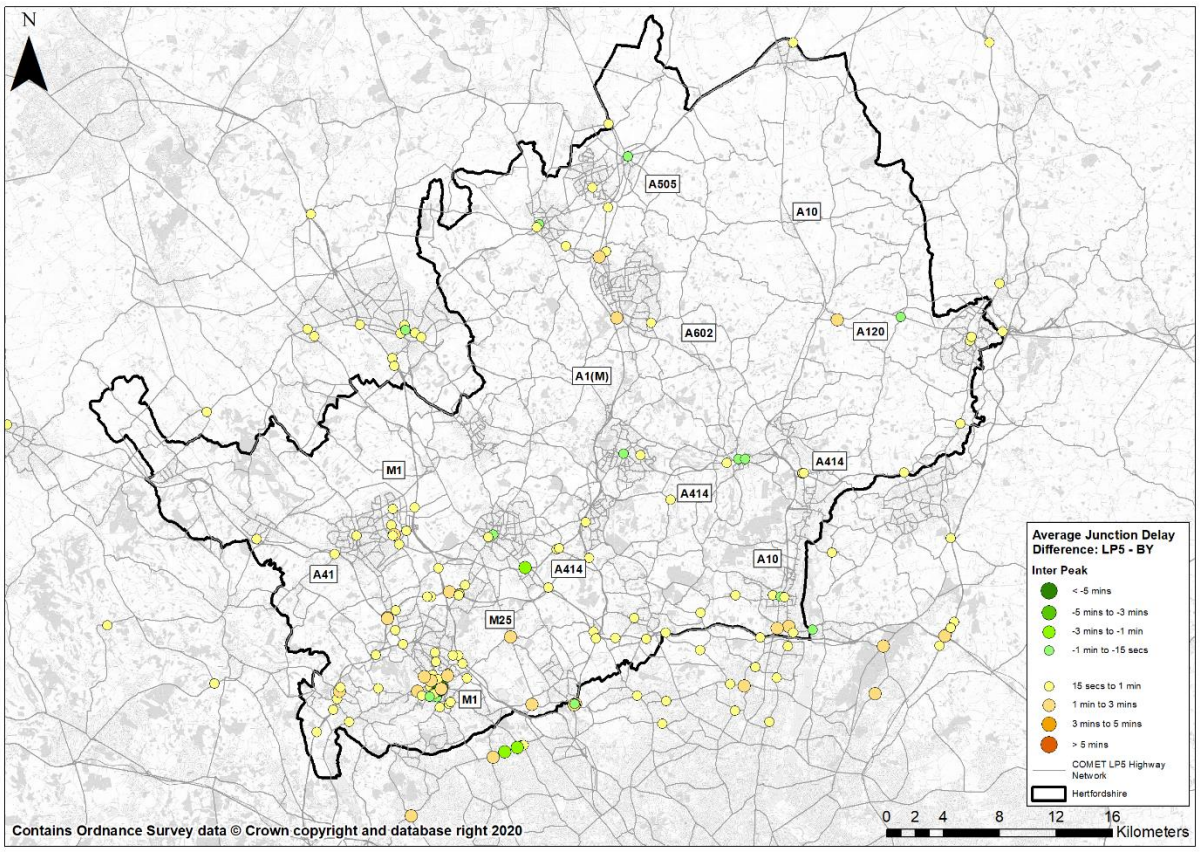


Figure 7-27: 2036 PM Peak Delay minus 2014 PM Peak (Key Junctions)

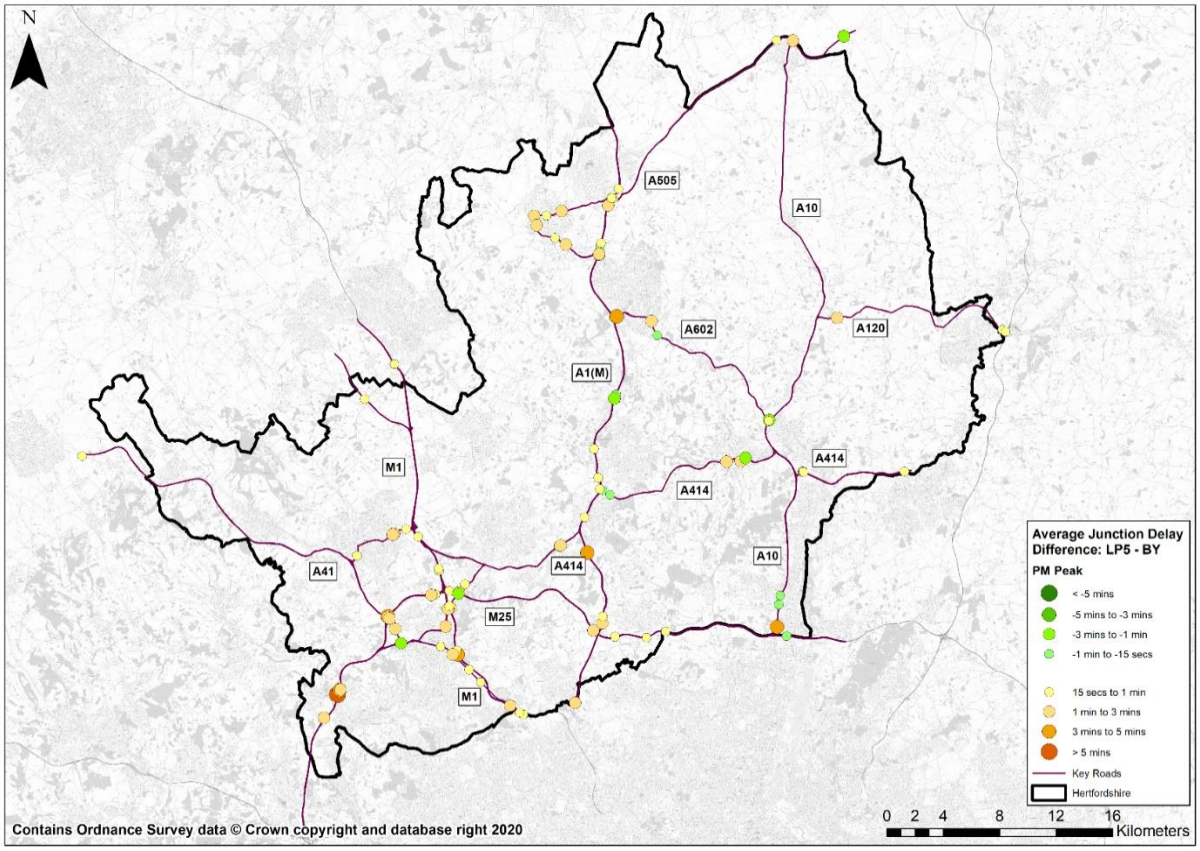
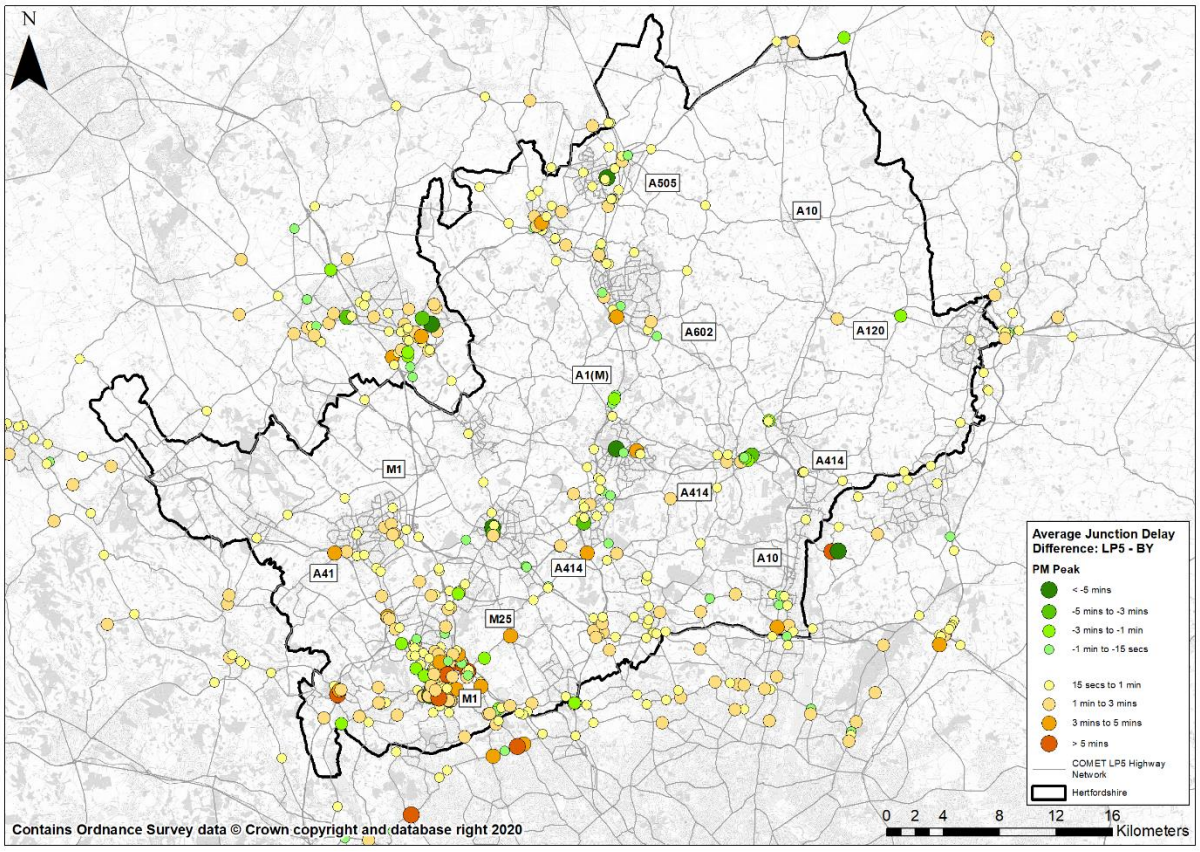


Figure 7-28: 2036 PM Peak Delay minus 2014 PM Peak (All Junctions)



Summary

7.3.28 The following table summarises the key highway flows, link stress and delay impacts noted from LP5 in the urban areas of Hertfordshire.

Table 7-2: LP5 Traffic Impacts in Key Hertfordshire Towns

Urban Area	Strategic Impacts
Hemel Hempstead / Tring / Berkhamsted	• Schemes at M1 Junction 8, combined with the North Hemel link road, provide a new routeing choice through Hemel • Traffic avoids the A414 through central Hemel Hempstead, possibly due to the reduction in lanes • Increased flows around Maylands are possibly linked to Hemel developments. There are increased delays at M1 Junction 8 and junctions along St Albans Road • Traffic from Tring and Berkhamsted may also use the North Hemel link road rather than the A414/A41 to access the M1/M25 motorways • The A41 will be heavily influenced by the significant growth planned in Aylesbury • Hemel contains the largest amount of significant infrastructure schemes in Local Plan Run 5, which all contribute to the new routeing patterns observed • Reduced flows on linkage roads to St Albans Road are possibly linked to improvements at A4147/Hemel Hempstead Road and King Harry Lane junction • Increased flows on A41 from Tring to M25 will be experienced • Increased flows on M1 in both directions will be experienced • Longest delays (>5 min) at M25 Junction 20 (A41) in the AM peak may be influencing route choice in the area • Reductions in flows around Berkhamsted and linkages with rural routes, possibly due to the new A5-M1 and M1-A6 links • Flow differences on the A41 and M25 are higher compared to LP4
Watford	• Traffic flows are reduced in the centre of Watford but increase in peripheral roads. • Delays at junctions on M25, east of Rickmansworth and Watford influences re-routeing on rural linkage roads • Increases in flows around the town centre and Watford junction linked to the new developments. Longest delays in the model (> 5 min) in the PM peak are on M25 Junction 18, around Chorleywood Road and impact routeing in the area • Increases in flows on M25, M1 and A41 (east of Watford) will be experienced • Some reductions between Radlett and Watford are suggested, possibly linked to delays at junctions crossing the A41 in either direction • Delays for traffic crossing the A41 at junctions along A41 in both peak periods • A 20% decrease in car ownership was applied to specific new developments in Watford
Elstree / Borehamwood	• Increases in flows around the town centre of Borehamwood, but reductions in flows on cross country routes between London Colney and the M1 • Delays at Stirling Corner continue to influence route choices in the area • Decreased flows between Stirling Corner roundabout and Borehamwood
St Albans / Harpenden	• Reduced westbound flows along the A414, between the A1(M) and London Colney Roundabout and between Park Street Roundabout and the M1 • Additional M1 SB traffic avoids the M1 J6a M25 EB diverge and prefers to re reroute at the M1 J8, towards the North Orbital to reach the M25. • Reduced flows to the centre of St Albans due to schemes on A1081/ London Colney Roundabout and A5183/A4147 junctions • Increased flows on road linkages to Park Street Garden Village

Urban Area	Strategic Impacts
	• Localised re-routeing around the town centres may be linked to the expanded 20mph zone • Most local east-west cross-country routes between Hemel Hempstead and Hatfield show increases in flows
Hatfield / Welwyn Garden City	• Increased congestion on the A1(M) will be experienced by southbound traffic approaching Junction 6 • Flow increase on the A1(M) is significantly higher compared to LP4 • Increased flows on routes to/from these towns • Increased flows around the town centres but some localised re-routeing • Decreased flows on A414 between A1(M) and M1 • This area will be influenced by the VDM parameter reflecting 5% mode shift
Stevenage / Hitchin / Baldock	• Increased congestion on the A1(M) past these towns and increased flows on routes to/from towns • Decreased flows on rural routes to/from Hitchin and north Stevenage. Increased flows to/from Baldock off the A1(M) • Upgrade of A602 / Gunnels Wood Road / GSK junction results in some re-routeing on local roads around Stevenage town centre. • Delays at junctions 8 and 9 of the A1(M), due to increased traffic. Increase in delays in the PM peak at these junctions • A 20% decrease in car ownership was applied to specific new developments in Stevenage
Broxbourne	• Decreased flows on the A10, especially northbound due to the speed limit reduction to 40mph • Decreased flows on Church Lane, east of A10, possibly related to the prohibition of right turns • The M25 is operating above capacity around Broxbourne • Some flow reductions on the old A1170, especially northbound and around Cheshunt, will be experienced • Increased flows east/west rural routes to/from Broxbourne
Hertford / Ware	• Increased flows on the A414 between Hertford and Ware • Increased flows on routes through Hertford and Ware • Decreased flows on the A10, south of Rush Green linked to the speed limit reduction implemented • The B158, between Hertford and A602, experiences increased flows • Reduced flows on the A602 northbound, between A10 and B158, possibly due to the signalisation and upgrade of the A10 / A602 junction • Increased flows on the eastbound and decreased flows on the westbound of the A119 (between Hertford and the A1170)
East Herts / Harlow	• Increased flows on the A414 through Harlow, but some localised (minimal) re-routeing around the town which is linked to the delays at junctions in Harlow • Increased flows on the A120 and using Little Hadham bypass. Reduced flows will be experienced through the junction • Increased flows around the outer link roads around Bishops Stortford and some localised re-routeing the town centre due to the development on Rye Street • Minimal increase in flows (especially northbound) between Harlow and Stansted via rural routes • The M11 Junction 7a is influencing route choices in the area • Flow reductions on Church Road, between the A1060 and B1256

7.4 Inter-urban Journey Times

7.4.1 Inter-urban journey times have been assessed in LP5 by skimming the time matrices in SATURN.

7.4.2 Increased vehicle flow and congestion in the Forecast Year cause a rise in the average journey time between urban areas in Hertfordshire. The tables below present the journey times between key towns in Hertfordshire.

7.4.3 These tables show journey times for the “average route”; therefore, some journeys will be considerably slower than the indicated values. Journey times are also compared to the 2014 Base Year.

7.4.4 The following key points are observed in the journey time analysis:

7.4.5 Compared to Base Year, the PM peak shows greatest increases in journey times locally, however the average increase in both the AM and PM peaks is around 8 minutes. This can be explained by the increased congestion on key links in the AM peak and increased delays at key junctions in the PM peak.

7.4.6 Overall, the AM and PM journey times in 2036 are similar, but locally slightly more increased in the PM peak.

7.4.7 Towns in the south and west of Hertfordshire experience some of the greatest changes in journey times due to the congestion on the network.

7.4.8 Increased journey times for routes passing through the M1/M25, A1(M)/M25 and A1(M)/A414 junctions will be experienced due to increased flows and delays at that junction.

7.4.9 Compared to the LP4 application, journey times for Hemel Hempstead, Rickmansworth and Watford are increased.

7.4.10 Hertford bypass in LP4 was providing an alternative route choice across the county, that explains reductions in journey time from north east districts to south west districts, e.g. Bishop’s Stortford to Hemel Hempstead

7.4.11 Journey times in LP5 are more sensitive to delays as a result of new saturation flows used in COMETv5 when compared to results from LP4.

Table 7-3 LP5 Journey times between key towns AM peak (mins)

LP5 2036	2036 LP5 AM (min)										
	Town	Bishop's Stortford	Cheshunt	Borehamwood	Rickmansworth	Watford	Hertford	Welwyn Garden City	Stevenage	Hitchin	St Albans	Hemel Hempstead
	Bishop's Stortford	0	41	54	74	75	32	44	43	51	65	75
	Cheshunt	44	0	33	53	54	29	34	45	50	44	54
	Borehamwood	60	39	0	38	41	35	30	37	39	30	39
	Rickmansworth	73	52	33	0	16	49	46	53	53	32	24
	Watford	71	50	33	16	0	47	44	51	51	30	22
	Hertford	32	26	34	53	53	0	13	23	33	33	48
	Welwyn Garden City	45	34	31	49	50	14	0	23	24	24	41
	Stevenage	45	44	41	60	60	27	30	0	17	39	52
	Hitchin	54	56	47	60	58	39	35	19	0	38	46
	St Albans	65	44	28	39	35	34	27	36	35	0	23
	Hemel Hempstead	81	60	40	28	32	51	45	52	45	23	0

Table 7-4 LP5 Journey times between key towns in Inter-peak (mins)

LP5 2036	2036 LP5 IP (min)										
	Town	Bishop's Stortford	Cheshunt	Borehamwood	Rickmansworth	Watford	Hertford	Welwyn Garden City	Stevenage	Hitchin	St Albans	Hemel Hempstead
	Bishop's Stortford	0	38	52	67	66	31	41	42	49	56	68
	Cheshunt	38	0	27	43	41	24	29	40	44	37	45
	Borehamwood	48	31	0	30	28	26	22	30	33	24	32
	Rickmansworth	64	47	32	0	14	44	40	49	48	31	22
	Watford	62	45	27	15	0	41	37	45	46	28	23
	Hertford	30	22	25	43	39	0	11	21	29	27	40
	Welwyn Garden City	41	30	22	39	35	12	0	20	22	20	35
	Stevenage	40	35	28	45	41	21	17	0	15	30	42
	Hitchin	47	45	33	50	44	29	22	16	0	32	39
	St Albans	54	38	23	32	27	27	21	31	32	0	20
	Hemel Hempstead	68	49	32	24	22	40	35	44	40	21	0

Table 7-5 LP5 Journey times between key towns in PM peak (mins)

LP5 2036

2036 LP5 PM (min) Town	Bishop's Stortford	Cheshunt	Borehamwood	Rickmansworth	Watford	Hertford	Welwyn Garden City	Stevenage	Hitchin	St Albans	Hemel Hempstead
Bishop's Stortford	0	39	56	75	73	31	42	44	51	63	76
Cheshunt	43	0	29	48	46	28	31	46	51	40	48
Borehamwood	57	37	0	36	34	32	27	40	41	27	37
Rickmansworth	79	59	43	0	17	59	54	67	66	44	39
Watford	90	70	47	18	0	69	65	77	74	49	43
Hertford	32	27	33	49	45	0	11	24	35	32	45
Welwyn Garden City	45	36	30	46	42	14	0	27	27	25	40
Stevenage	44	40	35	51	47	24	18	0	19	35	47
Hitchin	50	53	44	60	55	34	26	20	0	35	46
St Albans	62	43	26	34	30	31	24	38	35	0	22
Hemel Hempstead	78	55	36	26	29	47	41	52	47	22	0

Table 7-6 Journey time comparisons between LP5 and Base Year in AM peak (mins)

LP5 vs BY

2036 LP5 - BY AM (min) Town	Bishop's Stortford	Cheshunt	Borehamwood	Rickmansworth	Watford	Hertford	Welwyn Garden City	Stevenage	Hitchin	St Albans	Hemel Hempstead
Bishop's Stortford	0	5	9	17	16	0	0	1	7	6	17
Cheshunt	9	0	9	17	16	9	3	11	9	11	18
Borehamwood	14	17	0	12	15	10	8	10	8	6	11
Rickmansworth	15	17	2	0	3	11	10	12	8	5	5
Watford	13	15	10	3	0	9	8	10	7	4	4
Hertford	1	3	7	14	12	0	0	1	3	4	14
Welwyn Garden City	3	6	7	14	12	3	0	4	3	3	11
Stevenage	3	7	6	13	11	5	4	0	5	4	10
Hitchin	8	10	8	12	12	7	5	5	0	4	9
St Albans	7	12	3	9	6	7	5	7	3	0	3
Hemel Hempstead	19	22	9	5	7	11	7	9	6	2	0

Table 7-7 Journey time comparisons between LP5 and Base Year in Inter-peak (mins)

	2036 LP5 - BY IP (min)										
	Town	Bishop's Stortford	Cheshunt	Borehamwood	Rickmansworth	Watford	Hertford	Welwyn Garden City	Stevenage	Hitchin	St Albans	Hemel Hempstead
LP5 vs BY	Bishop's Stortford	0	4	8	12	11	1	3	3	7	4	9
	Cheshunt	4	0	7	10	10	6	2	8	5	8	13
	Borehamwood	6	10	0	4	4	2	1	4	4	1	5
	Rickmansworth	10	14	5	0	1	7	6	9	6	5	4
	Watford	8	13	7	2	0	4	2	5	5	2	6
	Hertford	0	4	1	6	4	0	0	1	2	1	6
	Welwyn Garden City	0	3	1	6	3	1	0	2	2	1	4
	Stevenage	1	5	2	7	4	1	1	0	3	2	7
	Hitchin	5	8	3	7	4	3	2	4	0	1	5
	St Albans	2	9	1	6	3	2	0	3	1	0	1
	Hemel Hempstead	12	16	5	5	4	6	3	7	4	1	0

Table 7-8 Journey time comparisons between LP5 and Base Year in PM peak (mins)

	2036 LP5 - BY PM (min)										
	Town	Bishop's Stortford	Cheshunt	Borehamwood	Rickmansworth	Watford	Hertford	Welwyn Garden City	Stevenage	Hitchin	St Albans	Hemel Hempstead
LP5 vs BY	Bishop's Stortford	0	5	11	17	16	0	1	3	7	5	18
	Cheshunt	5	0	7	13	13	8	3	10	8	8	13
	Borehamwood	11	16	0	9	7	7	4	7	6	4	10
	Rickmansworth	18	22	13	0	4	18	15	18	15	14	11
	Watford	19	23	15	5	0	18	16	19	17	12	13
	Hertford	0	3	6	10	8	0	0	2	5	3	9
	Welwyn Garden City	2	6	7	11	9	3	0	5	3	2	8
	Stevenage	2	6	7	11	9	3	1	0	5	6	11
	Hitchin	6	9	10	14	12	6	4	7	0	1	9
	St Albans	4	10	2	7	5	4	2	4	2	0	1
	Hemel Hempstead	16	18	8	6	8	10	6	8	5	2	0

8. Public Transport Forecast Results

8.1 Hertfordshire Statistics

8.1.1 The model forecast of change in public transport usage in Hertfordshire is summarised in the tables below. It should be noted that the COMET rail model does not consider capacity or passenger crowding and is therefore unconstrained by congestion. Rail and Bus mode was considered in COMET v5 to account for the interchange on trips requiring more than one mode to be completed. While the model forecast is not considered implausibly high as a central assumption, it might require capacity improvements on the rail network.

8.1.2 Table 8-1, rail travel distance increases by 89% - 148%. While bus travel distance also increases, this is at a lower rate compared to rail (by 17% - 48%). Considering both rail and bus, travel distance increases more than all three public transport modes (by 128% - 261%). Travel distance growth is generally larger in the inter-peak – this is due to the higher growth in "Non-Home Based Other" trips compared to "Home-Based Business" and Commuting trips (see paragraph 5.7.9 for explanation of this trend).

Table 8-1: Public Transport Passenger Distance (passenger kms), Hertfordshire Only, Hourly

Period	Mode	BY 2014	LP5 2036	Change
AM	Rail	1,032,098	2,377,205	130%
IP	Rail	399,171	988,616	148%
PM	Rail	1,014,562	1,912,455	89%
AM	Bus	70,148	82,257	17%
IP	Bus	61,482	91,108	48%
PM	Bus	68,094	85,264	25%
AM	Rail and Bus	77,913	177,796	128%
IP	Rail and Bus	27,049	97,768	261%
PM	Rail and Bus	67,532	169,693	151%

8.1.3 Table 8-2 presents the forecast results in terms of passenger boardings in Hertfordshire. It should be noted that whilst bus travel accounts for approximately 45% of total passenger transport boardings, it only represents a small minority (~10%) of total passenger distance. This is because rail trips are substantially longer.

8.1.4 Bus demand in the AM and PM Peaks falls at a higher rate than in the inter-peak due to increased highway congestion in the peak hours.

8.1.5 The number of rail boardings in the AM Peak (around 15,000 in the BY and around 30,000 in the LP5 application) is much larger than in other periods, as much of the demand is heading outside Hertfordshire as commuting trips. This is also shown by the passenger boardings on the rail and bus mode, where the AM peak boardings are approximately double to the boardings in the IP period and PM peak.

8.1.6 While the model forecast for rail growth is high relative to other modes, it is quite likely to be accurate. UK rail growth in the past two decades has been close to 4% per year, which if continued, would imply 95% growth from 2014 to 2036.

Table 8-2: Public Transport Passenger Boardings, Hertfordshire Only

Period	Mode	BY 2014	LP5 2036	Change
AM	Rail	15,233	29,772	95%
IP	Rail	4,039	11,233	178%
PM	Rail	6,390	14,910	133%
AM	Bus	6,658	7,936	19%
IP	Bus	6,282	9,438	50%
PM	Bus	5,511	7,760	41%
AM	Rail and Bus	3,475	8,752	152%
IP	Rail and Bus	771	3,875	403%
PM	Rail and Bus	981	4,692	378%

8.1.7 Table 8-3 shows the average public transport fare per journey. The fare values are the actual average fare paid by an average passenger, i.e. (Sum of demand x Cost)/Sum of Demand.

8.1.8 The average fare increase for rail trips (27.1%, see Table 5-10) is much higher than the fare growth assumption of 2%. It is larger for bus trips (between 2% and 5%), suggesting some lengthening of the average trip. An average fare decrease below -1% is suggested for rail and bus, showing that as more people choose rail and bus for long distances, the cost of such trips reduces. The overall average public transport fare increase is much larger, at over 6%. This is because demand has shifted from bus travel (which has lower fares) to rail and rail and bus travel (which have higher fares).

Table 8-3: Average Public Transport Fare per Journey, Hertfordshire Only, 2010 prices

Period	Mode	BY 2014	LP5 2036	Change
AM	Rail	£ 7.41	£ 7.08	-4%
IP	Rail	£ 6.87	£ 7.02	2%
PM	Rail	£ 7.05	£ 7.08	0%
AM	Bus	£ 0.92	£ 0.94	2%
IP	Bus	£ 0.84	£ 0.87	3%
PM	Bus	£ 0.85	£ 0.89	5%
AM	Rail and Bus	£ 6.66	£ 5.92	-11%
IP	Rail and Bus	£ 6.65	£ 6.55	-1%
PM	Rail and Bus	£ 6.74	£ 6.55	-3%
AM	All	£ 5.29	£ 5.62	6%
IP	All	£ 3.00	£ 4.11	37%
PM	All	£ 3.86	£ 4.80	24%

8.1.9 Table 8-4 shows the average public transport journey distance per journey. Neither bus nor rail average journey distance change significantly, however, average distance on the rail and bus mode is longer, especially in the AM peak (17%). As a result, the overall public transport journey distance is notably higher (above 18%). This is because rail growth is predicted to be higher than bus growth, and rail trips are significantly longer in the first place.

Table 8-4: Average Public Transport Journey Distance (km), Hertfordshire Only

Period	Mode	BY 2014	LP5 2036	Change
AM	Rail	34.0	34.6	2%
IP	Rail	30.8	30.8	0%
PM	Rail	31.1	31.3	0%
AM	Bus	6.8	6.7	-1%
IP	Bus	6.0	6.0	0%
PM	Bus	6.1	6.3	3%
AM	Rail and Bus	60.9	71.0	17%
IP	Rail and Bus	72.4	75.4	4%
PM	Rail and Bus	82.0	84.1	2%
AM	All	27.2	32.0	18%
IP	All	16.1	22.5	40%
PM	All	20.0	26.5	32%

Bus Passenger Flow

8.1.10 Flow difference plots for bus demand are presented below. These show the differences between 2036 and 2014 passenger flow. Red bars indicate a decrease in flow, while green bars indicate an increase. The greater the thickness of the line, the greater the flow difference.

Figure 8-1: Bus Passenger Flow Change, 2014 to 2036, AM Peak Hourly Flow

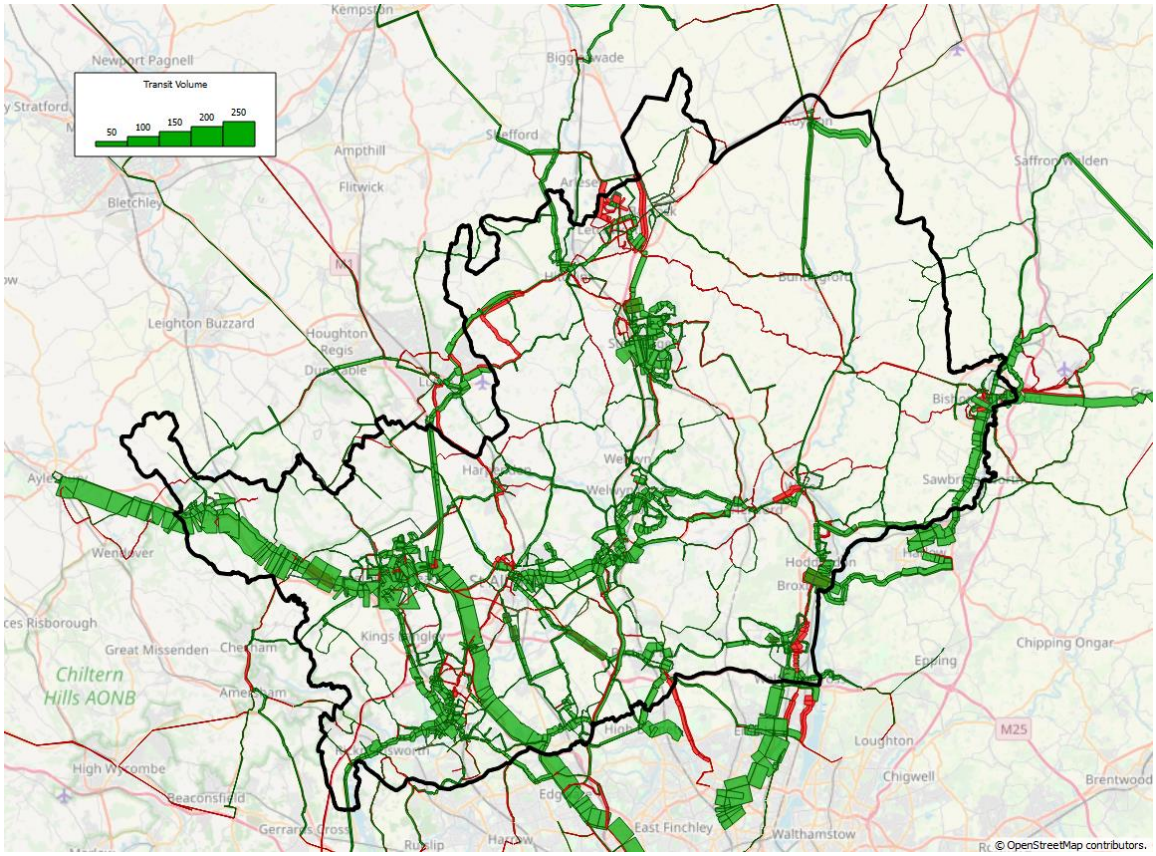


Figure 8-2: Bus Passenger Flow Change, 2014 to 2036, Inter peak Hourly Flow

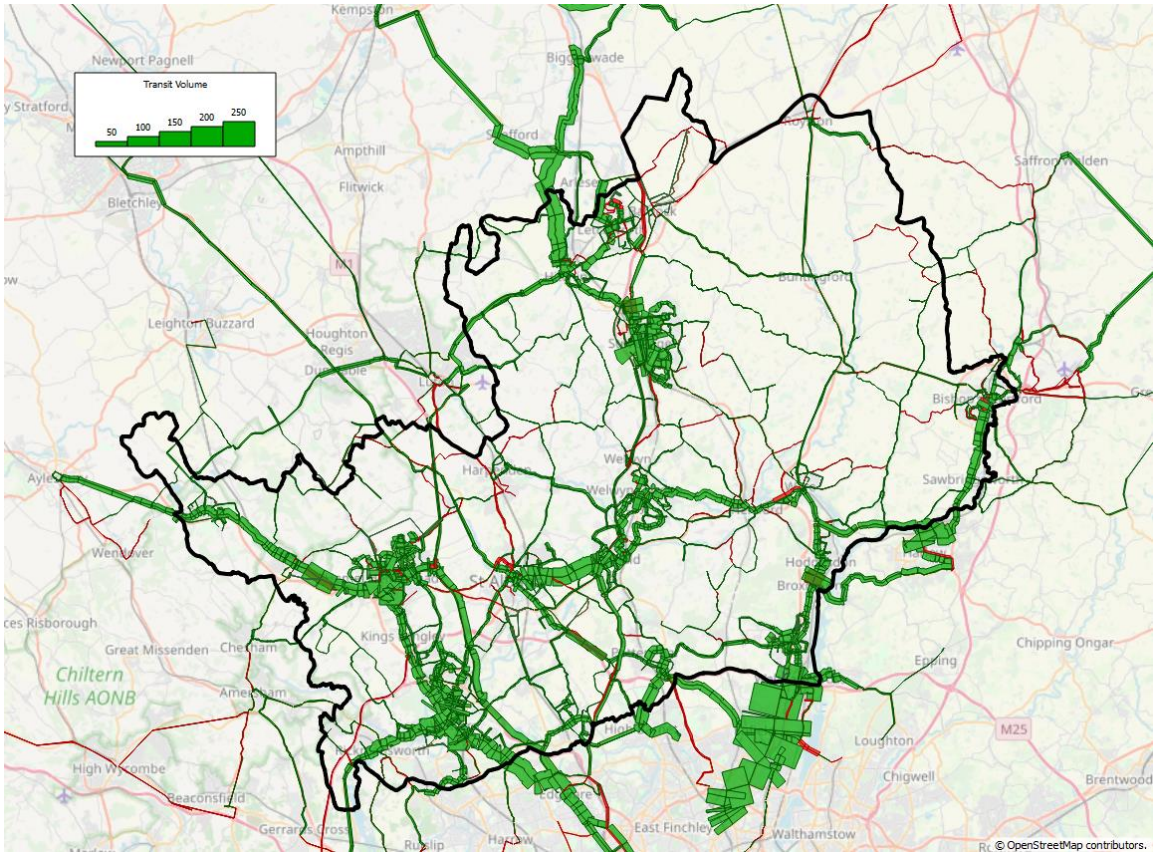
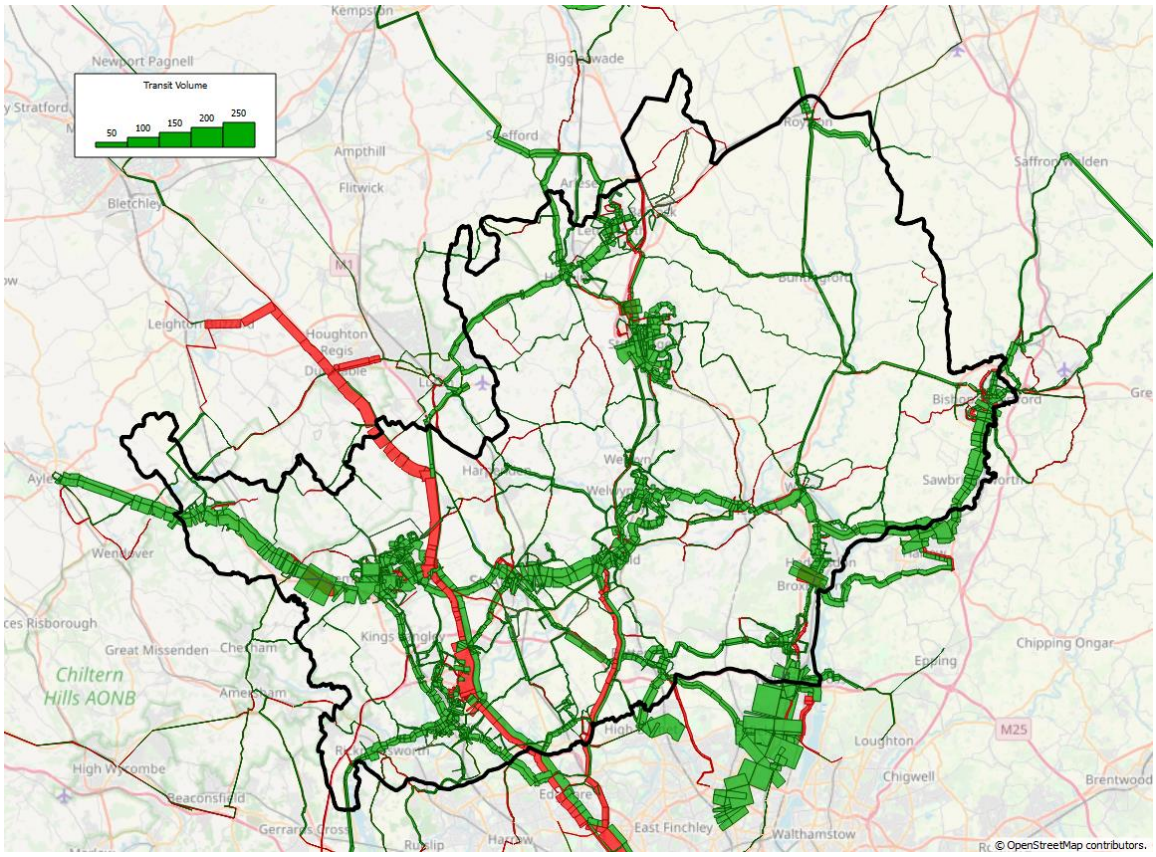


Figure 8-3: Bus Passenger Flow Change, 2014 to 2036, PM Peak Hourly Flow



8.1.11 The largest increase in bus passenger flows is observed in Enfield. It is suggested that the new bus service, modelled between Hoddesdon and Enfield via the A10, will provide an alternative for local trips.

8.1.12 Smaller localised increase in bus passenger flows are also observed in Stevenage and along the A414, especially around Hatfield and Hemel Hempstead. This may be attributed to the increased traffic flows along the rural links around these towns, as well as the bus schemes that make the bus service more attractive. One lane of the A414 through central Hemel Hempstead has been converted to sustainable modes in the model (i.e. bus and cycling).

8.1.13 The main decrease in bus passenger flow is modelled along the M1 around the new developments in Watford, Hemel Hempstead South and Hemel Hempstead North and in Potters Bar around the Tyttenhanger Estate and Land at Marshmoor developments. This may be linked to the key rail services that are operating in the north-south direction, which present an increased demand (discussed below).

8.1.14 Localised decrease in bus passengers is also suggested around the new developments in Baldock, Letchworth Garden City and Bishop's Stortford. This might also be attributed to the rail lines serving these areas.

8.1.15 The largest decrease in bus passenger flows is observed along the M1 corridor (where rail services between London and Luton operate) with a decrease of up to ~100 passengers in the northbound direction during the PM Peak. A smaller decrease of up to 50 passengers is observed on the A1(M) south of Hatfield. This may be due to the growth in personal incomes and to the lack of congestion on the highway network. On the M1 corridor, for example, the decrease in bus passenger flow is likely to be related to a rise in rail passenger flow on Thameslink and Midland Main Line. The decrease in bus travel associated with this modal shift does not extend to any significant extent beyond Aylesbury Vale.

8.1.16

8.1.17 The growth in personal incomes is likely to be higher than the growth in rail fares. As incomes rise, rail becomes relatively more attractive than bus, so some passengers switch from bus to rail (where the modes compete on the same corridor).

8.1.18 Increasing congestion on the highway network along these key links encourages shift from bus (and highway) to rail (where the modes compete on the same corridor).

8.1.19 The lack of rail services along the east-west direction, encourages people to use their cars and bus services, hence demand on east-west links across Hertfordshire increases.

8.1.20 A decrease in bus passenger is also modelled along the Cheshunt-Enfield corridor (which has a competing and improved rail service - Crossrail2).

Rail Passenger Flow

8.1.21 Similar plots for rail flow are shown below. Of necessity, a different scale is used for the rail flows, as these are very much larger than bus.

Figure 8-4: Rail Passenger Flow Change, 2014 to 2036, AM Peak, Hourly Flow

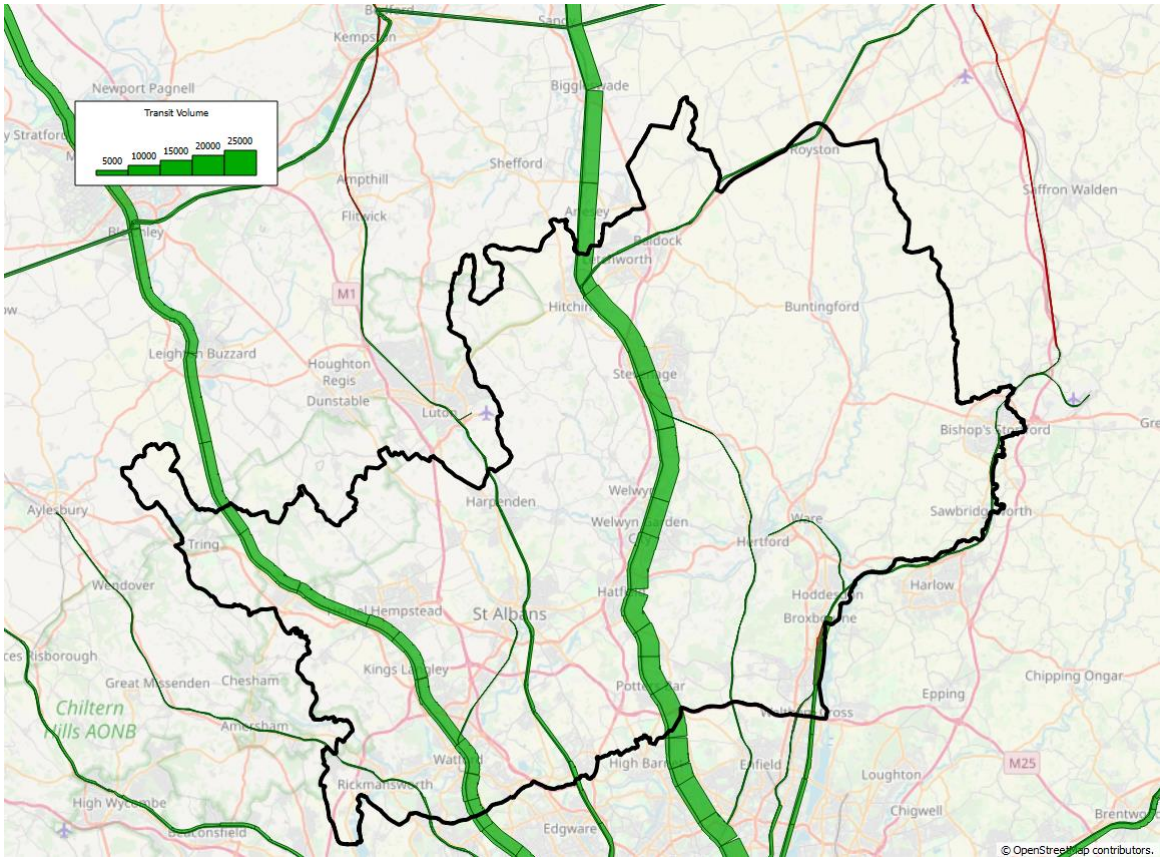


Figure 8-5: Rail Passenger Flow Change, 2014 to 2036, Inter peak, Hourly Flow

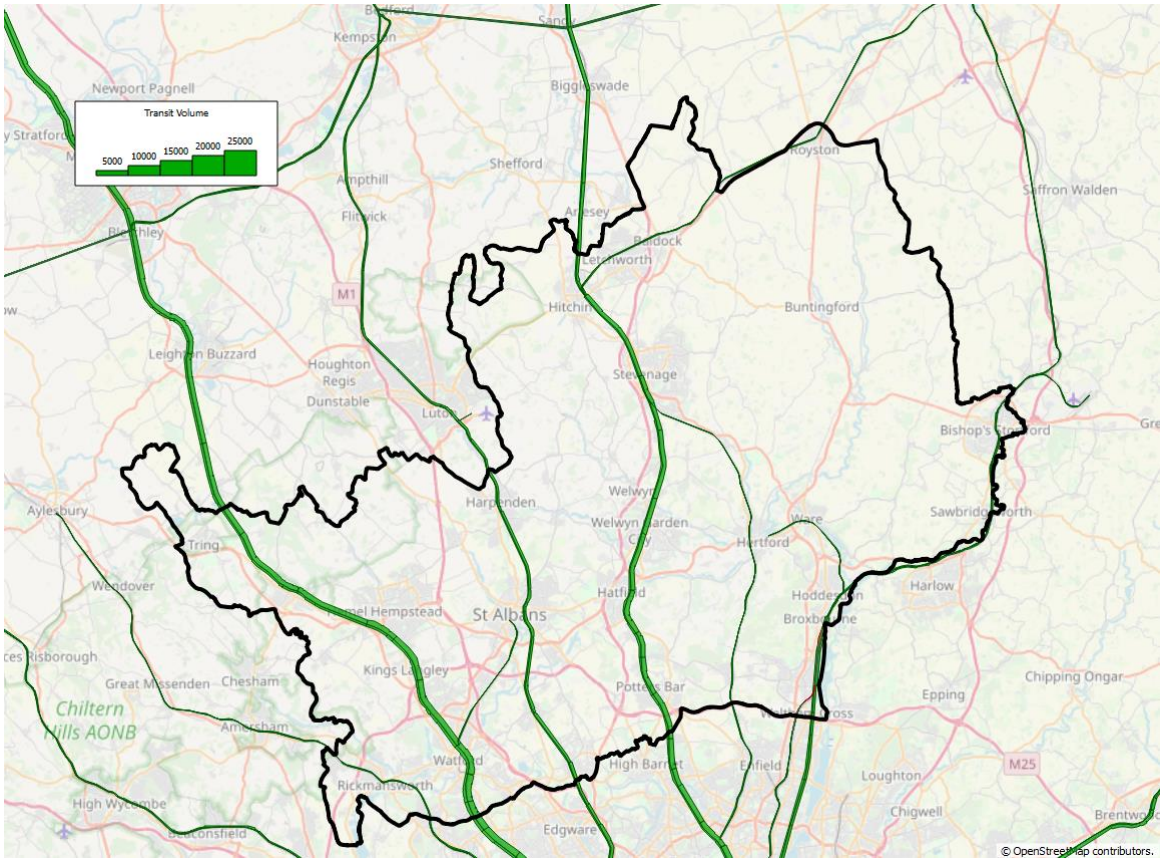
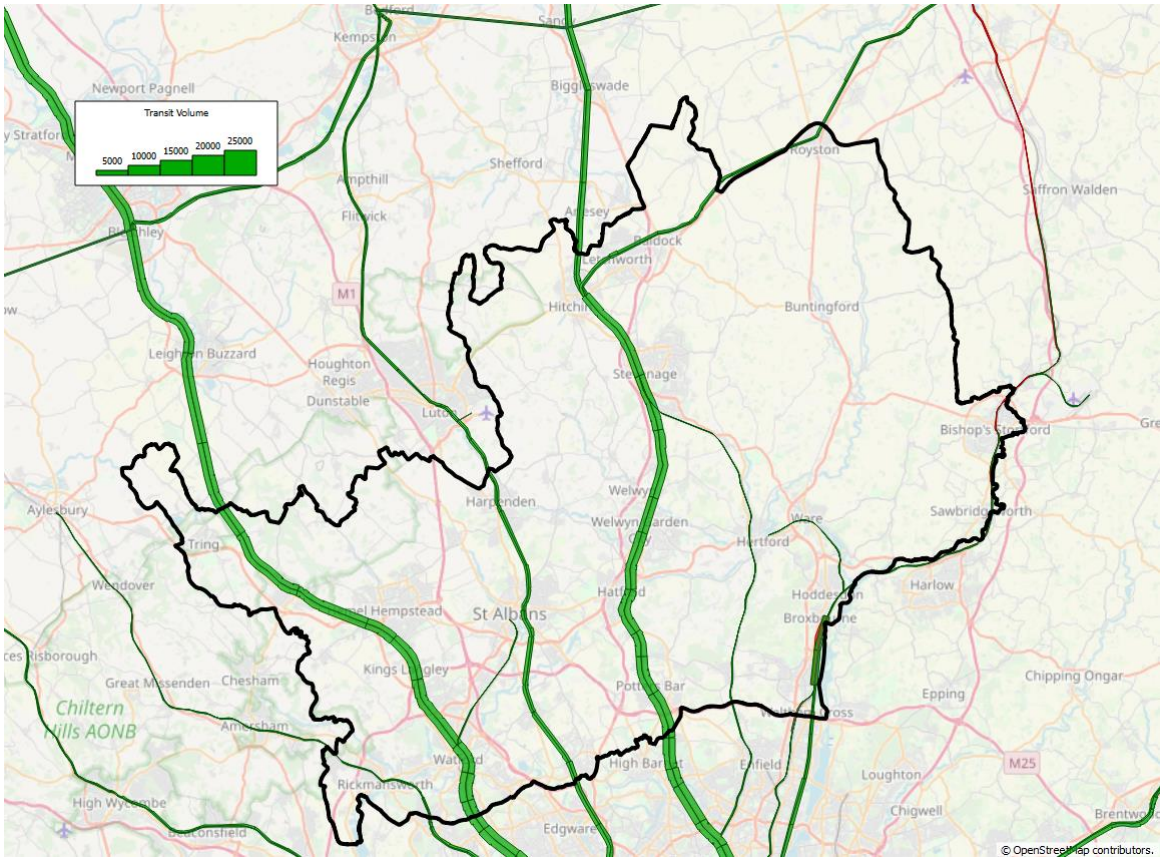


Figure 8-6: Rail Passenger Flow Change, 2014 to 2036, PM Peak, Hourly Flow



8.1.22 The main decrease in rail passenger flow is suggested around Broxbourne, where passengers switch from the London Overground service (between Cheshunt and Liverpool St) onto the West Anglia Mainline, and on the Stansted Express around Bishop's Stortford. These are mostly observed in the AM and PM peaks.

8.1.23 Demand on all other rail services in the area increases. The key increase is in north-south movements to and from London. Considering Hertfordshire's proximity to London and that traffic flows increase along the south-north key links, this may provide an explanation for the increased rail demand.

8.1.24 It must be acknowledged that as a multi-modal logit model, COMET is not an ideal tool for assessing most strategic rail schemes; this would more usually be done with a rail elasticity model based on the Passenger Demand Forecasting Handbook (PDFH).

9. Airport Growth Sensitivity Test

9.1 Introduction & Caveats

9.1.1 In addition to the detailed 2036 Local Plan results reported in this report, Hertfordshire County Council would like to understand the likely impact of planned airport growth from Luton and Stansted Airports on Hertfordshire's roads given their proximity to the county. It is important to consider the following when viewing the results detailed in this section:

- Both airports operate as employment zones in COMET therefore COMET forecasting is only able to reflect increases in jobs at the airports around Hertfordshire. Moreover, the employment segmentation is not accurate whilst passenger trips to and from the airports are a proxy. The COMET demand segmentation is not representative of Airport demand data and as such predicted growth is not reflected;
- It is acknowledged airports have very bespoke trip patterns given they generate both local and more strategic trips and their catchment areas are much greater than other transport hubs. As the airports operate as employment zones in COMET the trip distribution in COMET will be very different to trip patterns in dedicated airport models;
- Model performance around both airports is largely unknown as COMET was developed to calibrate / validate trips within Hertfordshire. Impacts around both airports reported in dedicated airport models will be significantly different to those seen in COMET;
- As both airports are outside Hertfordshire, network and zoning coverage is not as detailed;
- This sensitivity tests only investigated the likely impacts on the highway network. Impacts on public transport were not assessed;
- The forecast year scenarios used to inform the sensitivity test were obtained from airport models with different forecasts years to LP5's 2036. For this high level assessment the differences were ignored; and
- This sensitivity test was conducted as a highway only assignment. This comes at the expense of the use of the variable demand model. Given this is a very high level sensitivity test, this was deemed a sensible and proportionate approach. These results should not be used in a non-local plan context.

9.2 Methodology

9.2.1 AECOM were provided the following documentation to inform the sensitivity test:

- Stansted Airport 35+ Project, the Surface Access Transport Assessment (TA), produced for Stansted Airport Limited in February 2018. The flow information from the 2028 'Development Case' with 43 million passengers per annum were applied; and
- Future Luton: Surface Access Strategy Report, produced for London Luton Airport Limited in October 2019. The flow information from the 2039 "with" scenario with projections of 32 million passengers per annum were applied.

9.2.2 The sensitivity test adjusted trip ends for both Luton and Stansted Airports to match highway flows reported in both reports detailed above, whilst keeping the network and non-airport zone demand fixed. COMET LP5 formed the base for this analysis.

9.2.3 Table 9-1 summarises the expected passenger trips which were added to the LP5 matrices. The analysis was only undertaken for the AM and PM peak periods as an average inter-peak hour (to match COMET) was not provided in the documentation. Impacts in the inter-peak would also be less critical.

Table 9-1: Airport Passenger Trips

Airport	AM		PM	
	Arrivals	Departures	Arrivals	Departures
Luton Airport[14]	1,023	1,023	1,042	1,042
Stansted Airport[15]	958	936	1,405	1,335

9.2.4 As the additional trips relate to passenger trips, the increase was applied to COMET user classes 2 & 3 (car employers' business & car other). In order to split between these two user classes, existing proportions were retained.

9.2.5 By factoring up the existing demand matrix, the distribution of trips is retained when adding the additional trips. This matrix was assigned to the final COMET LPR5 network using a highway only assignment. Differences between LP5 and this LP5a (airport re-assignment) are reported below.

9.3 Trip Distribution

9.3.1 In SATURN, a select link analysis shows the distribution and routeing of a given link, zone or node in the model. Figure 9-1 to Figure 9-4 show the select link distribution for user classes 2 & 3 combined travelling to and from both Airports. This provides the distribution of the adjusted airport trips.

[14] Luton Airport is COMET model zone 8001
[15] Stansted Airport is COMET model zones 8000 and 8002. 8000 represents the main terminal and short stay car parks. 8002 represents the Long Stay car parks. The Stansted TA references a 57% proportion using Car Parks and 43% using the Drop off. This proportion has been applied to the two Stansted zones to split the airport passenger trips.

9.3.2 The figures indicate that the routeing into Hertfordshire's road network is mainly confined to the strategic routes such as the M1, M11 and M25. This is to be expected given the location of the airports and their proximity to the motorway network. There are also considerable movements in the local areas around both airports. This is also to be expected but will be driven by the fact the airports operate as employment zones in COMET.

9.3.3 For trips to and from Luton airport, trips route on the A505 towards Hitchin and cross county rural routes towards St Albans District. For trips to and from Stansted, trips route on the A120 and the Little Hadham Bypass. Overall routing in COMET into Hertfordshire's local road network are minimal and impacts from the modelling are discussed in section 9.4 below.

Figure 9-1: Airport Select Link Analysis – AM Peak – To Luton/Stansted Airport

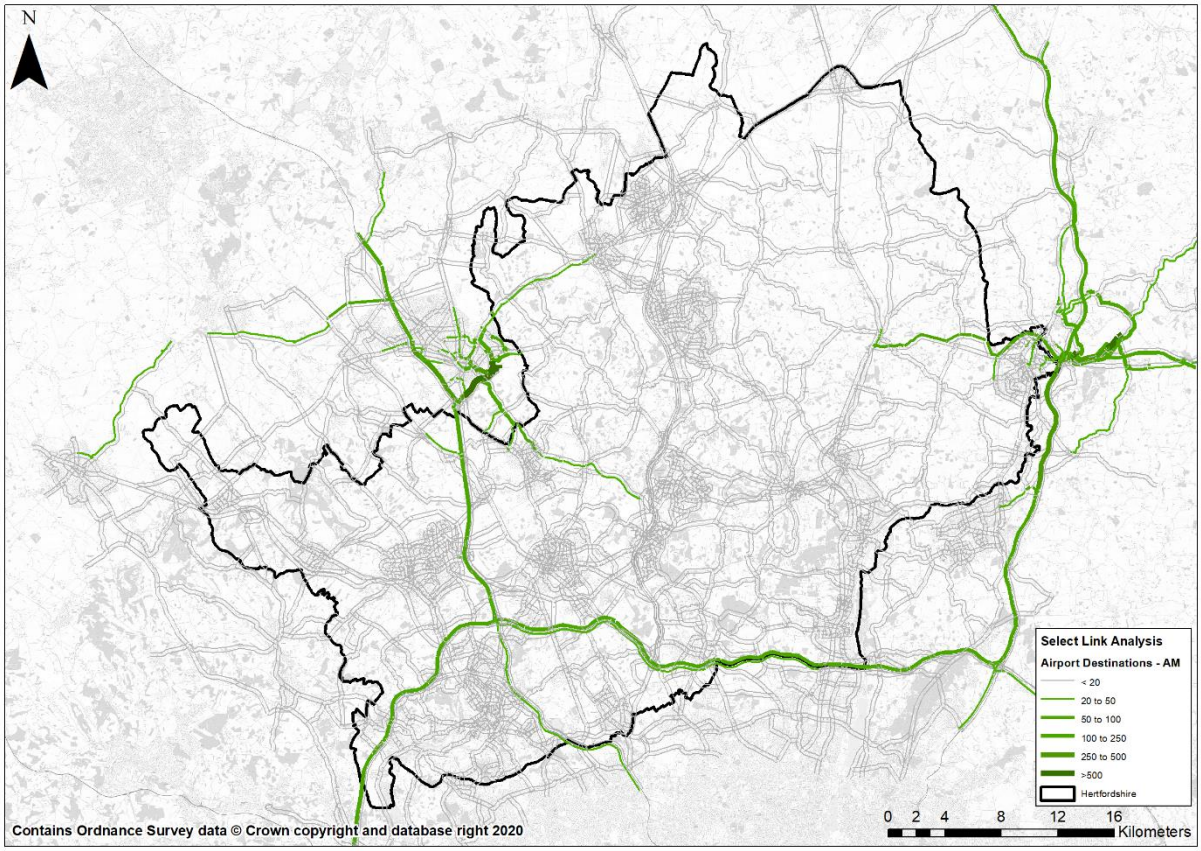


Figure 9-2: Airport Select Link Analysis – PM Peak – To Luton/Stansted Airport

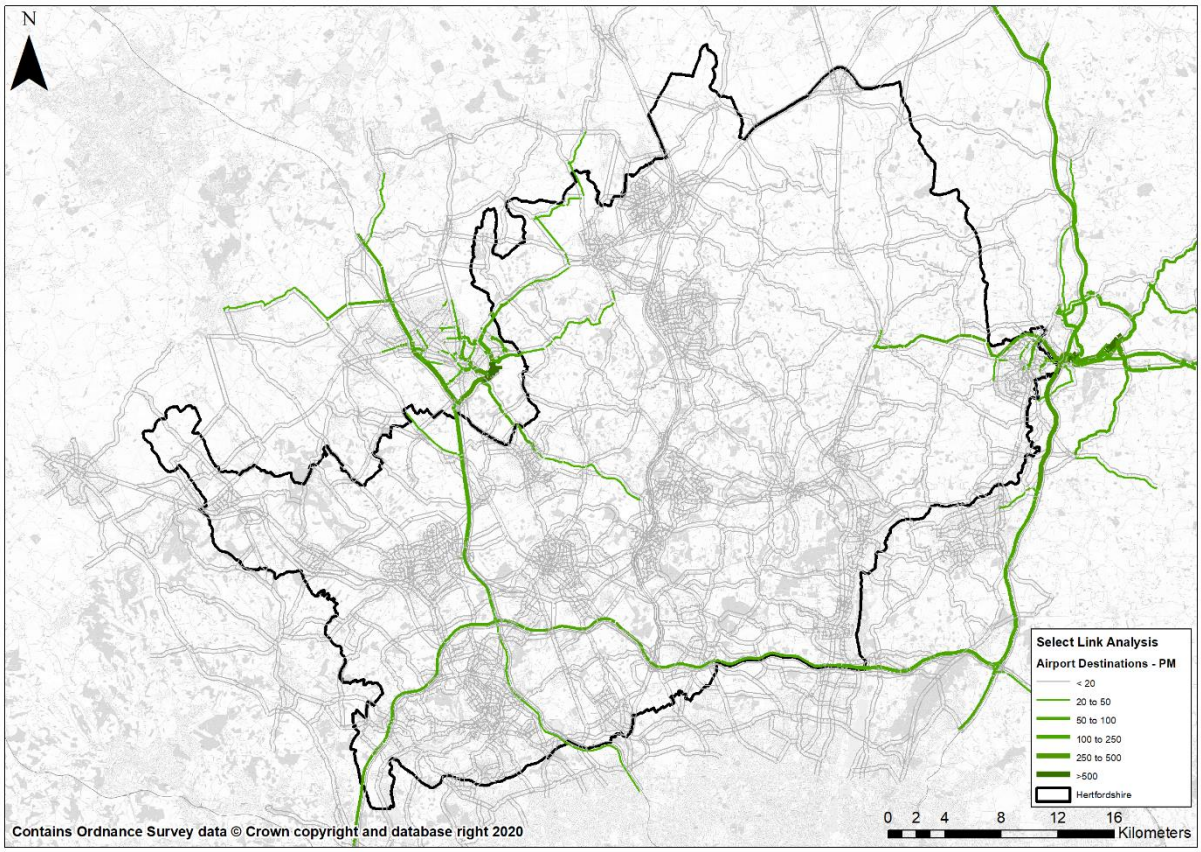


Figure 9-3: Airport Select Link Analysis – AM Peak – From Luton/Stansted Airport

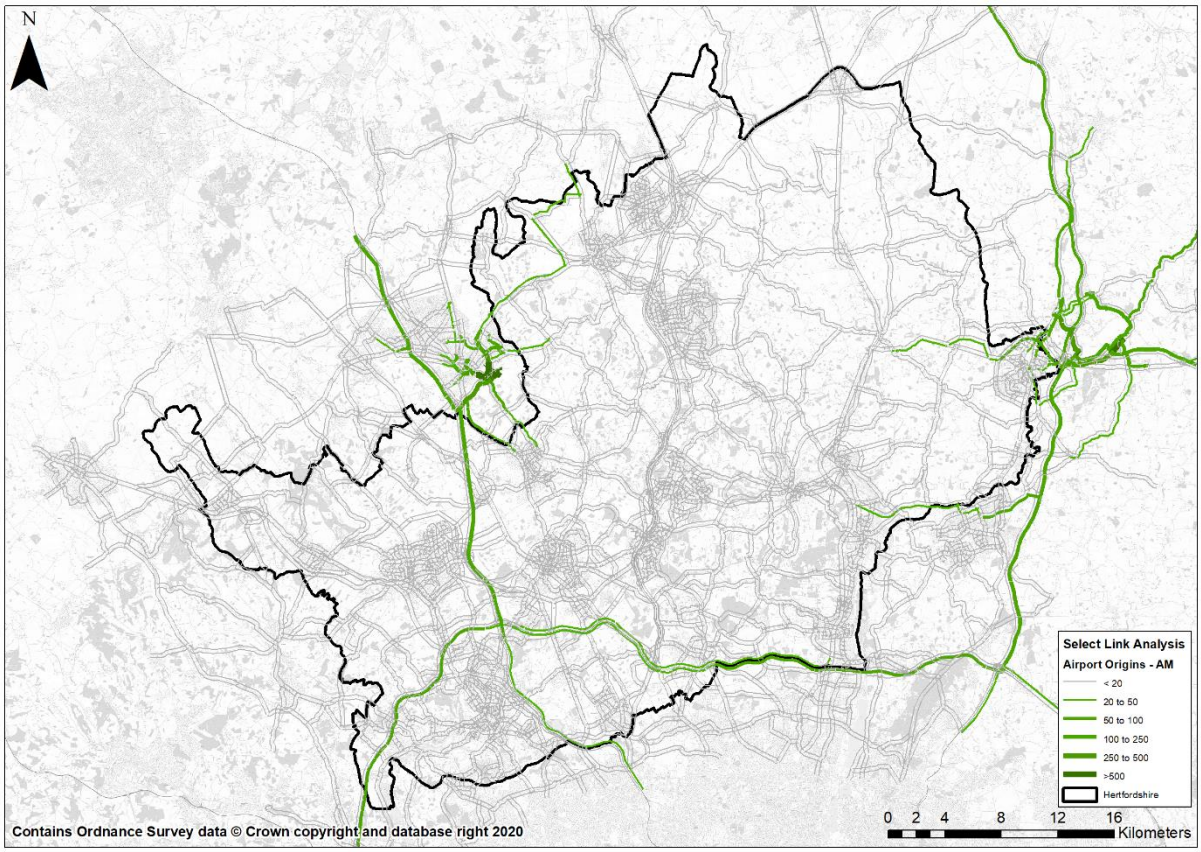
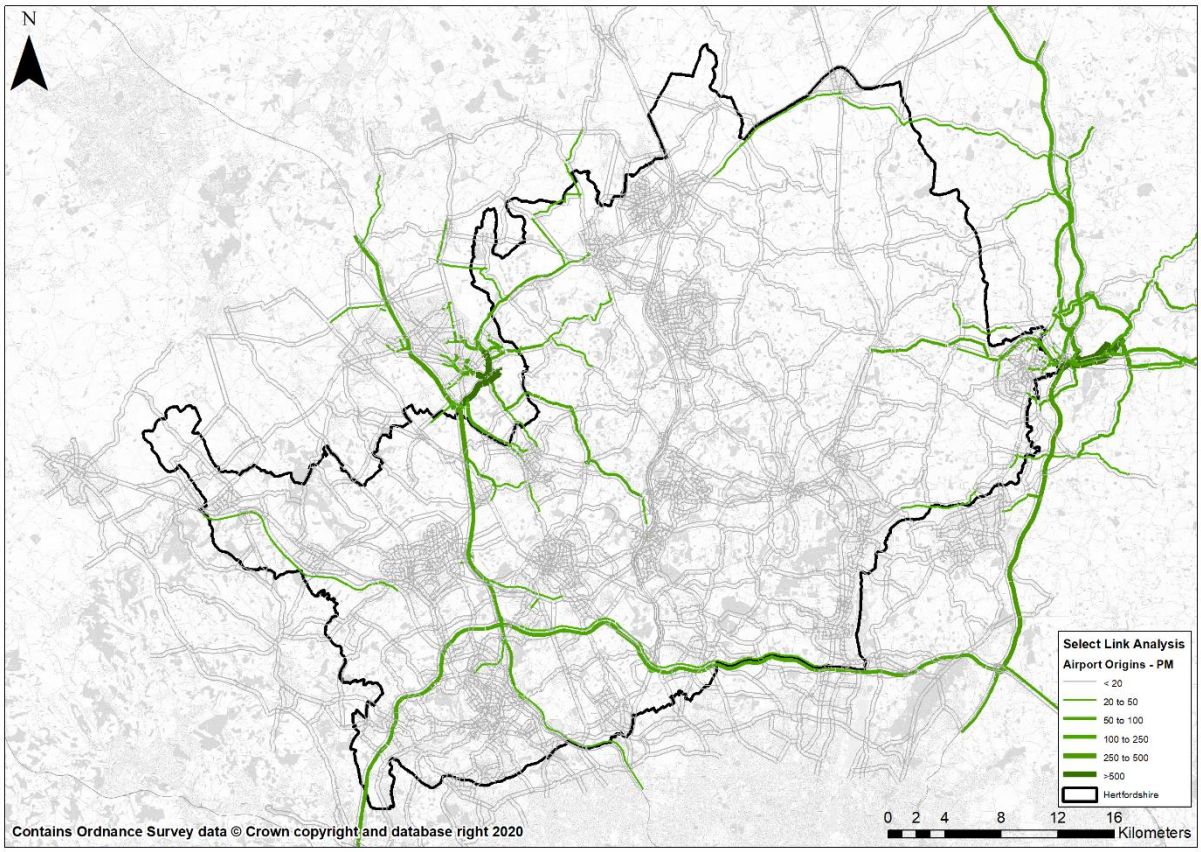


Figure 9-4: Airport Select Link Analysis – PM Peak – From Luton/Stansted Airport



9.4 Sensitivity Test Results

9.4.1 Figure 9-5 and Figure 9-6 show the flow and delay difference plots for the AM and PM peaks respectively. These compare LP5 and LP5a flows and delays. These figures show the impacts on Hertfordshire's network to be limited. Delays and congestion around both airports are likely to increase, but not to such critical levels that mitigation schemes are required to release any suppressed demand. The flow difference plots follow closely the pattern observed in the select link analysis plots shown in section 3.3. Differences in link stress are not included in this section as there are no discernible changes apart from on the immediate local roads around the airports outside Hertfordshire.

9.4.2 These results indicate that COMET predicts most of the airport growth would impact the strategic road network in Hertfordshire. Further work to enhance COMET around the airports and refine the demand and trip distribution should be considered if COMET is to be used for another sensitivity test.

Figure 9-5: Flow Difference and Delay Difference – AM Peak

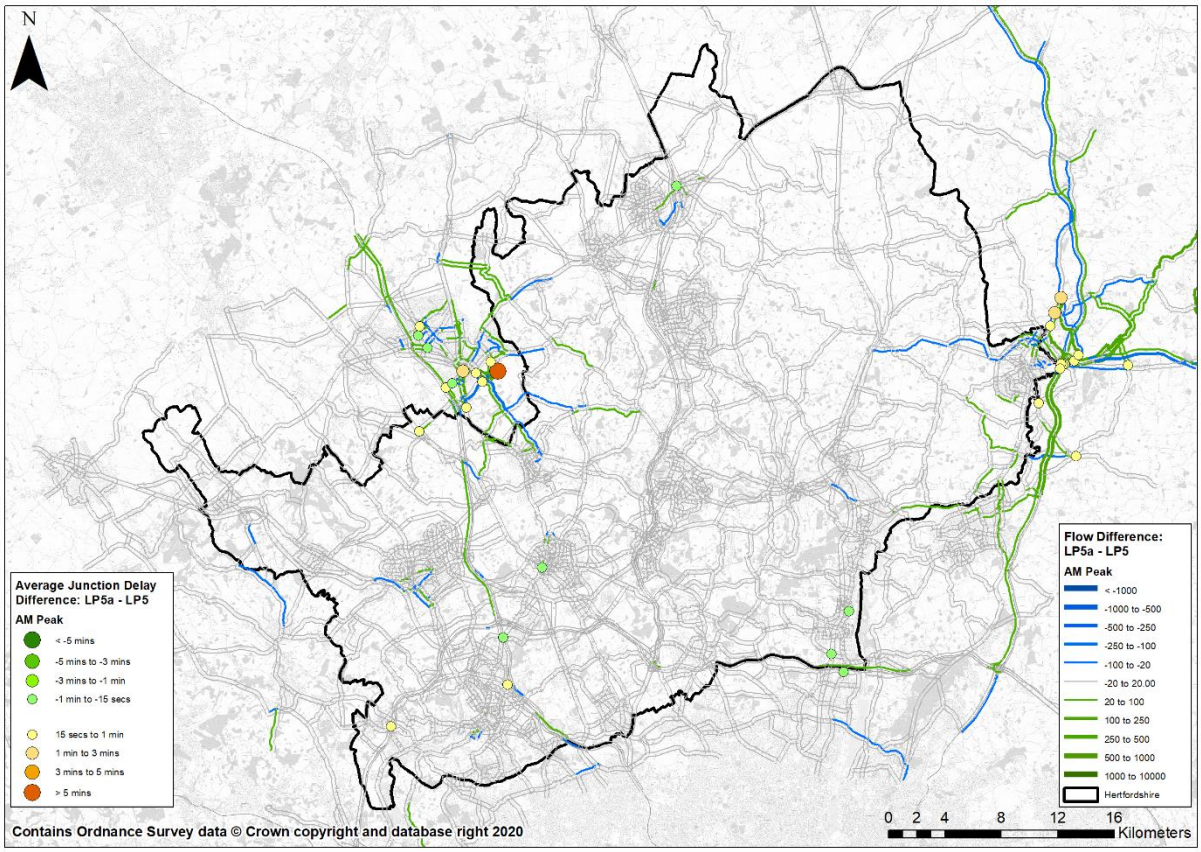
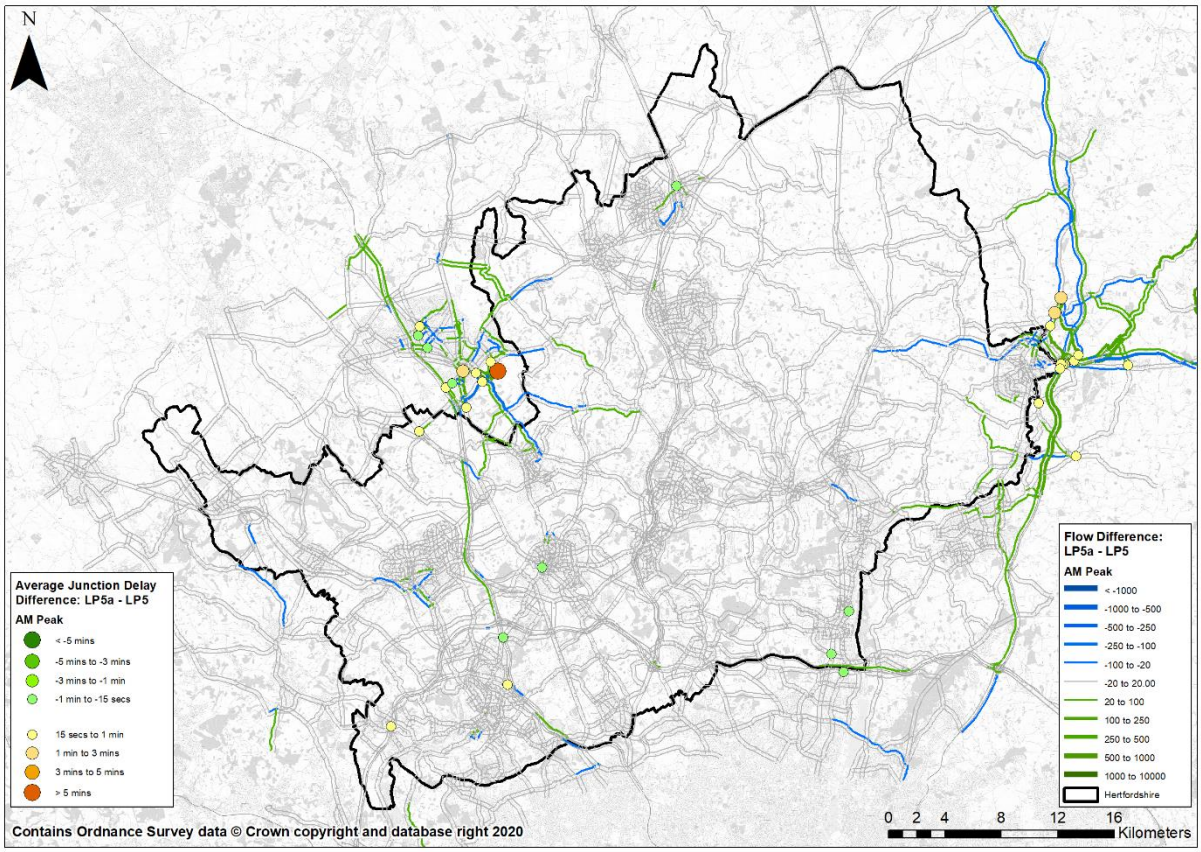


Figure 9-6: Flow Difference and Delay Difference – PM Peak



10. Summary and Discussion

10.1 Summary

10.1.1 A new version of the COMET model (involving an updated zoning system) was developed and used to test the 2036 forecast and the cumulative impact of the Local Plan growth in Hertfordshire and selected neighbouring authorities[16] on the transport network.

10.1.2 This document outlines the forecasting approach, development of forecast networks and trip matrices, and presents the results in terms of highway and public transport assignments. This forecast shows that the variable demand, highway and public transport models all behave as expected and provide reasonable results.

10.1.3 In terms of highway trips originating in Hertfordshire, an increase of approximately 13% (at a 24 hour level) is forecast between 2014 and 2036. This increase is accompanied by a rise in travel distance of between 23% - 36% (depending on time period, longest distances travelled in the IP period), and an increase in travel time of between 44% to 50% (maximum increase in the Inter-peak). The relatively sharp rise in travel time compared to travel distance is indicative of increasing congestion and corroborates the maximum fall in average network speed of approximately -15% in the PM Peak.

10.1.4 Forecast results show some significant congestion on key urban and inter-urban roads in 2036:

- Various sections of the M25, A1(M) and M1; Various sections of the A1(M) and M1;
- East-west routes between Bishops Stortford and Hertford and east of Hemel Hempstead;
- Links around Maylands in Hemel Hempstead;

10.1.5 Rail boardings increase approximately by 180% at most between 2014 and 2036, bus boardings increase up to 50%, whilst rail and bus boardings increase up to 400%. Travel distance by rail in Hertfordshire increases by 89% - 148%, bus traveller distance increases at a lower rate (by 17% - 48%), while travel distance on the rail and bus increases significantly (by 128% - 261%). Travel distance growth is generally larger in the inter-peak due to the higher growth in “Non-Home Based Other” trips compared to “Home-Based Business” and Commuting trips.

10.1.6 Journey distance on the rail and on the bus is approximately equal (change is insignificant); bus travel decreases as rail becomes a more attractive option in the AM Peak, while rail is preferred less in the PM Peak. Average journey distance for trips that include an interchange (rail and bus combined) increases up to 40%.

10.1.7 Increasing congestion on the highway network along the key links of M1 and A1(M) encourages shift from bus (and highway) to rail (where the modes compete on the same corridor).

10.1.8 The lack of rail services along the east-west direction, encourages people to use their cars and bus services, hence demand on east-west links across Hertfordshire increases.

[16] Central Bedfordshire, Luton, Buckinghamshire (all districts), part of Essex (i.e. Epping Forest, Harlow, and Uttlesford), and part of Cambridgeshire (i.e. South Cambs and Cambridge)

10.2 Discussion

Future Uncertainty and COMET Forecasts

10.2.1 The COMET forecasting methodology takes into consideration future changes in population, number of jobs and dwellings, as well as rising costs of travel and proposed transport infrastructure schemes.

10.2.2 However, there is currently no allowance for factors that may fundamentally alter the nature of travel in Hertfordshire or elsewhere in Great Britain. These factors may include the introduction of new technologies (e.g. autonomous vehicles) or a significant shift in travel patterns relative to the Base Year model as a result of behavioural change. Such behavioural change may be brought about by factors such as changing demographic characteristics / consumer preferences, economic instability, climate change and globalisation.

10.2.3 Consequently, COMET forecasts should be viewed as possible representations of the future in Hertfordshire among a number of potentially different alternatives that require unconventional approaches to planning and investment in the county.

Sustainable Transport

10.2.4 It should be noted that the approach to modelling modal shift in a multi-modal model (such as COMET) should be based on the inclusion/coding of infrastructure to facilitate such behaviour change in the forecast network. Without doing so (as applies to this forecast) the modelled modal shift is not a result of COMET's Variable Demand Model representing behavioural change; rather, it is the result of a parameter adjustments that are currently not based on any specific interventions to the transport network. Once more specific scheme assumptions regarding the proposed sustainable travel initiatives are known, these should be coded into COMET as other forecast schemes already are.

Related HCC Projects

10.2.5 The forecast results presented in this document suggest that the usage of Hertfordshire's transport network will continue to grow until 2036. This is particularly the case during the peak hours and in the county's known congestion hotspots. One such hotspot is the A414 corridor that runs through the core of the county and will be a major focus of growth in future housing and employment. The concentration of high levels of link stress, delays and congestion around the south west of Hertfordshire highlight the importance of the SW GTP (South West Herts Growth and Transport Plan).

10.2.6 These results therefore reinforce the critical nature of ongoing and related HCC projects including the A414 Corridor Strategy and Hertford Transport and Movement Package. These projects will contribute to the evidence-based development of interventions that promote sustainable and future-proof transport in Hertfordshire.

11. Appendices

11.1 Appendix I: Employment Densities used for Calculation of Jobs

Land Use Class	Area per FTE (m^2)	Comment
A1 (Retail)	18	Assumed value is the average of “High Street” (15-20) and “Foodstore” (15-20) in Employment Density Guide. Value for “Retail Warehouse” (90) is excluded as it is significantly higher and would distort the calculation.
A2 (Finance & Professional Services)	16	Directly from Employment Density Guide
A3 (Restaurants & Cafes)	18	Assumed average of range (15-20) in Employment Density Guide
A4 (Drinking Establishments)	46	Not available in Employment Density Guide, so derived from 47 TRICS sites.
A5 (Hot Food Takeaways)	59	Not available in Employment Density Guide, so derived from 28 TRICS sites.
B1(a) (Offices)	10	Assumed value is average of the 5 “General Office” types and Call Centres.
B1(b) (R&D Space)	50	Assumed value is average of given range (40-60)
B1(c) (Light Industrial)	47	Directly from Employment Density Guide
B2 (Industrial & Manufacturing)	36	Directly from Employment Density Guide
B8 (Storage & Distribution)	81	Assumed value is average of 3 “Storage & Distribution” use classes.
C1 (Hotels)	100	Value in Employment Density Guide is given in terms of hotel rooms, which is inconsistent with HCC planning data. Therefore, TRICS is used to derive a density value based on 40 sites.
C2 (Residential institutions)	100	Not available in Employment Density Guide, so derived from 49 TRICS sites.
D1 (Non-residential institutions)	36	Not available in Employment Density Guide, so derived from 203 TRICS sites.
D2 (Assembly and leisure)	71	Assumed value is the average of “Fitness Centres” (all types), “Cinema”, and “Amusement & Entertainment Centres” in Employment Density Guide. Value for “Visitor & Cultural Attractions” (30-300) is excluded as its range is very large and would distort the calculation.
Sui Generis	92	Not available in Employment Density Guide, so derived from 26 TRICS sites.

11.2 Appendix II: SATURN Highway Assignment Parameters

LOGICAL PARAMETERS

AMY = F
ASHORT = T
ATLAS = F
AUTNUC = T
AUTOK = T
AUTONA = T
AUTOX = F
AUTOZ = F
BANKER = F
BB109 = T
BEAKER = T
BUSKER = T
CLIMAX = T
COMPAS = F
CROWCC = F
CUMULO = F
DCSV = F
DIDDLE = T
DOUBLE = T
DUALEX = T
DUTCH = F
ERTM = F
EXPERT = T
EZBUS = T
FIFO = T
FOZZY = T
FREDDY = F
FREEKY = F
FREEXY = T
FREE77 = F
FREE88 = F
FUNNEL = F
ICING = F
ILOVEU = T
KERMIT = F
KINKY = T
KONAL = F
LCR108 = T
LEFTDR = T
LIST = T
MINDER = F
MONACO = T
M108 = T
MULTIC = T
NOXYC = F
NO333C = F
PARTAN = F
PHILIP = F
PRINT = F
PRINTF = F
PRSFD = F
QUEEN = F
QUIKSA = F
QRTP = F
Q105 = T
RAGS = T
RB106 = T
REDMEN = F
REFFUB = F
ROSIE = F
RTP108 = T
SATOFF = F
SATTIT = T
SAVEIT = T
SAVUFO = F
SECRET = F
SHANDY = T
SIGOPT = F
SIM109 = T
SIM111 = F
SOWHAT = F
SPARSE = T
SPEEDS = T
SPIDER = T
STOLL = F
STUART = F
SUZIE = F
SUZIEQ = T
TOPUP = F
UFC109 = T
UFC111 = T
UNIQUE = F
UPBUS = T
USEUFO = F
WHATHO = F
WINDY = T
WRIGHT = T
ZILCH = F
GIS7 = T

INTEGER PARAMETERS

IBUSVC = 1
IROCKY = 0
IYSHFT = 0
KDF = 1
KOMBI = 0
KPHMAX = 120
MANOFF = 0
MAXDTP = 10
MAXSPB = 6
MCCS = 3
MINLSF = 300
MYTVV = 5
NISTOP = 4
NITA_M = 3
NOMADS = 5
NUC = 25
IFCC = 2
ISTOP = 98
IXYDEC = -1
KLUNK = 1
KONSTP = 5
LCY = 120
MASL = 401
MAXLSF = 3000
MAXZN =99999
MCGILL = 0
MINRED = 10
NFT = 113
NITA = 30
NITA_S = 256
NOPD = 0
NUCMIN = 1
IFRL = 1
IEPSG =27700
KANGA = 9999
KNOBS = 0
KORN = 0
LRTP = 60
MASL_F = 0
MAXQCT = 60
MCALG = 1
MCUBC = 0
MINSAT = 500
NIJKST = 0
NITA_C = 256
NITS = 20
NOPMAX = 1
INKS_S = 0
IXSHFT = 0
KARL = 50
KOB = 0
KPHMIN = 10
LTP = 60
MASL_M = 1
MAXSPA = 30
MCNUM = 0
MET = 0
MODET = 0
NIPS = 2
NITA_F = 0
NITS_M = 5
NOTUK = 0

REAL PARAMETERS		CHARACTER PARAMETERS
AFTERS	= 0.5000	COINS = 'PENCE'
APRESV	= 1.0000	CURNCY = 'POUNDS'
BETA	= 0.1000	FILGIS = 'COMET.GIS'
BETA_T	= 0.1000	UCNAME(1) = 'Car Commute'
BTKNOB	= 0.0000	UCNAME(2) = 'Car Employers
COBAF	= 1.0000	Business'
DMWL2	= 2000.0000	UCNAME(3) = 'Car Other'
FLAREX	= 2.0000	UCNAME(4) = 'LGV'
GAPM	= 1.0000	UCNAME(5) = 'HGV'
OBAMAX	= 0.1000	VCNAME(1) = 'Lights'
PMAX	= 5.0000	VCNAME(2) = 'HGV'
PPM	= 1.0000	XYFORM = '2I10'
RESIDD	= 0.0000	
STPCPU	= 1000.0000	
TAX	= 2.0000	
UNCRTS	= 0.0050	
WLMIN	= 300.0000	
W32T	= 0.1000	
XYUNIT	= 1.0000	
AK_MIN	= 0.2000	
BBKING	= 0.9500	
BETA_2	= 0.1000	
BUSPCU	= 2.2000	
CAPMIN	= 30.0000	
DEFCAP	= 1250.0000	
FISTOP	= 0.0500	
FRED	= 1.0000	
GAPR	= 2.0000	
PCNEAR	= 1.0000	
POWER	= -1.0000	
QDMAX	= 227.0000	
RESIDR	= 0.0000	
STPGAP	= 0.0100	
TDEL	= 3.0000	
VCPCU	= 1.0000	
WLMAX	= 2000.0000	
W32KPH	= 1.5000	
XYFACT	= 1.0000	
ALEX	= 5.7500	
BCRP	= 2.0000	
BETA_D	= 0.1000	
BUSSPK	= 0.0000	
CLICKS(5)	= 80.0000	
DMWL	= 300.0000	
FLAREF	= 2.0000	
GAP	= 2.0000	
GONZO	= 1.0000	
PLUFO	= 0.0001	
PPK	= 0.0000	
QVCMIN	= 0.7500	
RSTOP	= 98.0000	
SUET	= 0.2000	
TIJMIN	= 0.0000	
VCPCU(3)	= 2.2000	
W32D	= 0.0010	
XFSTOP	= 0.0500	

11.3 Appendix III: Full List of Highway Schemes

District	Scheme Type	Location	Description	Modelled before?
Broxbourne	Junction	M25 jct 25-27	Widening of motorway to 4 lanes with hard shoulder running	LP3 and LP4
Broxbourne	Junction	M25 junction 25	M25 junction 25 RIS 2 capacity improvements - Option 2	LP3 and LP4
Broxbourne	Infrastructure	Hoddesdon	New road alignment and bridge	LP4
Broxbourne	Link Road	Turnford / Brookfield	New 4 lane Link road runs through to Halfhide Lane which then becomes Brookfield Lane W south of the retail park - SB onslip at the Turnford interchange is no longer assumed.	LP3 and LP4
Broxbourne	Roundabout	Hoddesdon	Additional lane on eastern arm of roundabout	No
Broxbourne	Roundabout	Hoddesdon	Roundabout improvements to provide additional eastbound & southbound lanes	No
Broxbourne	Roundabout	Hoddesdon	A10 Hoddesdon_Dumbell Roundabout - Dinant Link Road - New roundabout to permit access to High Leigh development	No
Broxbourne	Speed Limit	A10 between Hertford to M25	Speed limit reduction (to 40mph) on A10 between Hertford to M25.	No
Broxbourne	Bus Infrastructure	Enfield Town and Hoddesdon Via the A10	Zero emissions bus route between Enfield Town and Hoddesdon via the A10	No
Broxbourne	Signalisation	Cheshunt	Reduction in green time of 10 seconds applies to northbound and Southbound traffic on A10	No
Broxbourne	Bus Infrastructure	Broxbourne	New bus service Hoddesdon to Enfield via A10(2 services per hour)	No
Broxbourne	Bus Infrastructure	Broxbourne	New bus service hoddesdon to Enfield via Cheshunt(2 services per hour)	No
Broxbourne	Bus Infrastructure	Broxbourne	New Bus Service Harlow to Hertford (2 Services per hour)	No
Broxbourne	Junction	Broxbourne Station	Replace priority give way junction with signalised junction incorporating pedestrian facilities	No
Broxbourne	Junction	Waltham Cross	Modify existing 3 arm signal junction on A10 to provide at grade 4 arm junction for access into Park Plaza North & West	No
Broxbourne	Junction	Waltham Cross	Reconfiguration of the junction into a hamburger with access into (and out of) the Park Plaza West site at the	No

District	Scheme Type	Location	Description	Modelled before?
			Great Cambridge Road/Great Eastern Road signals.	
Broxbourne	Junction	Waltham Cross	New 4 arm junction on Lieutenant Ellis Way to north of Park Plaza	No
Broxbourne	Ban	Cheshunt	Implementation of right turn bans between A10 and College Road and free flow LT slip from A10 north to College Road E	No
Broxbourne	Junction	Cheshunt	A10 / Church Lane at grade junction improvements	No
Broxbourne	Roundabout	Cheshunt	Reconfiguration of roundabout to provide signalised crossing junction & crossing points for pedestrians	No
Broxbourne	Roundabout	Flamstead End	Reconfiguration of roundabout to provide signalised crossing junction & crossing points for pedestrians	No
Broxbourne	Link Road	Brookfield Centre	New link road running between Turnford Link Road and A10 providing revised access into Brookfield and Tescos with closure of existing junction between Halfhide Lane and the Links	LP3 and LP4
Broxbourne	Infrastructure	Turnford	Provision of additional capacity	No
Broxbourne	Junction	Waltham Cross	Reconfiguration of junction to provide signalised junction & crossing points for pedestrians	No
Broxbourne	Junction	Goffs Oak	Reconfiguration of junction to provide signalised junction & crossing points for pedestrians	No
Broxbourne	Speed Limit	Hoddesdon / Broxbourne / Turnford / Cheshunt	Provision of traffic calming	No
Broxbourne	Junction	Hoddesdon	Reconfiguration of junction to provide additional capacity-Right Turn Facility at the P J Widen 2. Proposed right turn facility at the Priority junction of Pindar Road and Essex Road	No
Broxbourne	Junction	Cheshunt	Old Pond junction improvement	No
Dacorum	Infrastructure	Hemel Hempstead	Lane reallocation	No

District	Scheme Type	Location	Description	Modelled before?
Dacorum	Signalisation	Hemel Hempstead	Junction Signalisation	No
Dacorum	Signalisation	Hemel Hempstead	Rearrangement of junction & signal optimisation	No
Dacorum	Link Road	Hemel Hempstead	New link between Boundary Way and Wood Lane End (assume single carriageway with 3 way traffic and 30mph. Buncefield Lane north of Boundary Way (between Boundary Way and Cherry Tree Lane and between the A414 and Green Lane will become a quietway so does not need to be added).	LP3 and LP4
Dacorum	Signalisation	Hemel Hempstead	Signal optimisation	No
Dacorum	Signalisation	Hemel Hempstead	Signal optimisation	No
Dacorum	Signalisation	Hemel Hempstead	Signal optimisation	No
Dacorum	Signalisation	Berkhamsted	improvements including traffic lights and pedestrian crossings required in association with MU/6: Land at Durrants Lane / Shootersway (Egerton Rothesay School) and Local Allocation LA4: Hanburys.	No
Dacorum	Access Road	Hemel Hempstead	Development site Secondary site access onto The Avenue (extension of existing spur)	No
Dacorum	Roundabout	Hemel Hempstead	New roundabout access	No
Dacorum	Junction	Hemel Hempstead	T Junction onto Fletcher Way, Hemel Hempstead	No
Dacorum	Link Road	A5 Dunstable	M1 A5 Link Road	LP3 and LP4
Dacorum	Ban	A4146 Water End	A4146 HGV ban at Waterend	No
Dacorum	Roundabout	Hemel Hempstead	Part-time signals at the Leighton Buzzard Rd / Queensway roundabout with widening to allow two lanes& intro of yellow box junction. Leighton Buzzard Road / Queensway lane reallocation - 2 lanes SB on LBR	No

District	Scheme Type	Location	Description	Modelled before?
Dacorum	Junction	Hemel Hempstead	Junction Improvement	No
Dacorum	Ban	Hemel Hempstead	T/18 removal of approach flare on eastern arm	No
Dacorum	Access Road	Tring	New access and north south distributor road	LP4
Dacorum	Signalisation	Hemel Hempstead	(Possibly) addition of pedestrian crossing phase to signal timings	No
Dacorum	Speed Limit	Hemel Hempstead	Reduction of speed limit and implementation of signalised crossing	No
Dacorum	Ban	Maylands Area, Hemel Hempstead	Close the existing narrow country lanes within the industrial area of Cherry Trees Lane, Buncefield Lane (north) and Buncefield Lane (south) to through traffic	No
Dacorum	Sustainability Improvements	Maylands Area, Hemel Hempstead	New pedestrian / cycle crossings in Maylands area - Maylands Growth Corridor study SC3-6 Options Report 080416	No
Dacorum	Signalisation	Hemel Hempstead	Interim at grade signalisation scheme	No
Dacorum	Ban	Redbourn	HGV restrictions on B487 and A5183	No
Dacorum	Link Road	Hemel Hempstead	Model as reduced speed along link to simulate impact of cycle lane and road narrowing- coded in 20 m/hour	No
Dacorum	Access Road	Berkhamsted	New access and east west link road	LP4
Dacorum	Sustainability Improvements	Hemel Hempstead	Ped / cycle improvement.	No
Dacorum	Bus Infrastructure	Hemel Hempstead	Bus priority lanes on A414 WB, Station Road and Two Waters Road approaches	No
Dacorum	Infrastructure	Hemel Hempstead	Multi-Purpose Street	No
Dacorum	Speed Limit	Berkhamsted	Extension of 20mph zone and pedestrian crossing facilities	No
Dacorum	Sustainability Improvements	Tring	New junctions to development with associated highway improvements, including new cycle and pedestrian routes in line with the site master plan. New layout plans available. Assume priority junction at highlighted T junctions, refer to LA5 layout plan	No
Dacorum	Access Road	Bovingdon	New access to LA6 development	No
Dacorum	Signalisation	Hemel Hempstead	Junction Signalisation	No
Dacorum	Infrastructure	Maylands Area, Hemel Hempstead	New spine road from B487 Redbourn Road to A414 St Albans Rd - dual carriageway up to new link	LP3 and LP4

District	Scheme Type	Location	Description	Modelled before?
			from M1. Single carriageway north of here.	
Dacorum	Junction	M1 Junction 8, Hemel Hempstead	Junction 8 - Major reconfiguration to provide direct access into Maylands	LP3 and LP4
Dacorum	Link Road	Hemel Hempstead	New link road serving North Hemel development between Redbourn Road and Leighton Buzzard Road	LP3 and LP4
East Herts	Junction	Bishops Stortford	Junction capacity improvements associated with Bishops Stortford North development	No
East Herts	Link Road	Bishops Stortford	Additional lanes on approach arms	No
East Herts	Bypass	A120 Little Hadham	New A120 bypass	LP4
East Herts	Signalisation	A602 Ware - Watton at Stone	signalisation and upgrade of A10 / A602 junction, upgrade of Anchor Lane junction, realignment of A602	No
East Herts	Bus Infrastructure	Stansted Abbotts	Remove the existing Bus Ln on Ware Rd approach to A10 Amwell Rbt	No
East Herts	Access Road	Bishops Stortford	New access from Bishops Stortford North development to A1250 Hadham Road	No
East Herts	Speed Limit/Infrastructure	North Bishops Stortford	30mph single carriageway road connecting A1250 Hadham Road with A120 and B1004 Rye Street. Early accesses to existing roads already being built. Full Spine Road and new A120 access assumed by end of development	No
East Herts	Access Road	North Bishops Stortford	New access from Bishops Stortford North (ASR5) development to Rye Street	No
East Herts	Signalisation	Bishops Stortford	Signalisation of existing junction and provision of rear access from Motorway Service area	No
East Herts	Signalisation	Bishops Stortford	Provision of new MSCP with new signalised access and signalisation of A1250 / Northgate End junction	LP4
East Herts	Signalisation	Bishops Stortford	Signal optimisation - signals are being refurbished	No
East Herts	Signalisation	Standon	Signalisation of junction	No
East Herts	Speed Limit	Bishops Stortford	Introduction of traffic calming measures, improvements of pedestrian footpaths and crossing facilities.	No
East Herts	Access Road/ Roundabout/ Signalisation	North and East of Ware	1.New arm on A1170 / A10 roundabout and signalisation. 2.Access onto B1004 Widbury Hill East of Ware. 3. Two Accesses are	No

District	Scheme Type	Location	Description	Modelled before?
			joined by a distributor Road in between which also intersects with Fanhams Hall Road	
East Herts	Junction	Sawbridgeworth	Upgrades of A1184/West Road/Station Rd junction	No
East Herts	Junction	Buntingford	Capacity enhancements to junction	No
East Herts	Signalisation	Hertford	Signal optimisation.	No
East Herts	Signalisation	Buntingford	Reduced speed limit from 40 - 30mph	No
East Herts	Speed Limit	Sawbridgeworth	New priority junction on Cambridge Road	No
East Herts	Access Road	Bishops Stortford	New development access	No
East Herts	Access Road	Gilston area	New accesses and internal distributor road for Gilston development	No
East Herts	Roundabout	Bishops Stortford	Revise accesses to include roundabout connecting small portion of northern part of development (125 homes) to Whittington Way. Main access now via roundabout on A1184 St James Way and secondary priority access onto Obrey Way. Although a spine road runs through the site only buses will be able to run straight through.	No
East Herts	Link Road	Bishops Stortford station area	New link road between London Road and Dane Street, Bishops Stortford, now to be coded as bus only link (previously modelled as all-purpose route (for all vehicles). Assume design speed of 20mph with 6m carriageway width	LP3 and LP4
East Herts	Signalisation	East of Stevenage	Provision of new signalised accesses from East of Stevenage development (EOS1)	No
East Herts	Signalisation	Stansted Abbotts	Capacity upgrade / signalisation	No
East Herts	Ban	Bishops Stortford	Road closure during peak hours	No
East Herts	Access Road	Bishops Stortford	Means of Access - Hazelend Road	No
East Herts	Signalisation	Sawbridgeworth	Signalise existing junction	No
East Herts	Link Road	Hertford	Lengthening of A10 SB off slip identified through North Ware development technical work. Measure is to provide additional queueing spaces to prevent blocking back onto A10. Highway land is available. Assume slip is lengthened to 3 lanes for 50m back from stop	No

District	Scheme Type	Location	Description	Modelled before?
			line. In reality bridge structures limit length.	
East Herts	Access Road	Hertford	Scheme to improve access to Marshgate Drive development but Marshgate Drive not coded in model so not included to date.	No
East Herts	Junction	A414/B195 Birchall Lane/Cole Green Lane	Capacity improvements identified through WHBC junction design study	No
Hertsmere	Signalisation	Borehamwood	Changes to signal staging and timing	No
East Herts	Link Road	Bishops Stortford	Additional lanes on approach arms	No
East Herts	Bypass	A120 Little Hadham	New A120 bypass	LP4
East Herts	Signalisation	A602 Ware - Watton at Stone	signalisation and upgrade of A10 / A602 junction, upgrade of Anchor Lane junction, realignment of A602	No
East Herts	Bus Infrastructure	Stansted Abbotts	Remove the existing Bus Ln on Ware Rd approach to A10 Amwell Rbt	No
East Herts	Access Road	Bishops Stortford	New access from Bishops Stortford North development to A1250 Hadham Road	No
East Herts	Speed Limit/Infrastructure	North Bishops Stortford	30mph single carriageway road connecting A1250 Hadham Road with A120 and B1004 Rye Street. Early accesses to existing roads already being built. Full Spine Road and new A120 access assumed by end of development	No
East Herts	Access Road	North Bishops Stortford	New access from Bishops Stortford North (ASR5) development to Rye Street	No
East Herts	Signalisation	Bishops Stortford	Signalisation of existing junction and provision of rear access from Motorway Service area	No
East Herts	Signalisation	Bishops Stortford	Provision of new MSCP with new signalised access and signalisation of A1250 / Northgate End junction	LP4
East Herts	Signalisation	Bishops Stortford	Signal optimisation - signals are being refurbished	No
East Herts	Signalisation	Standon	Signalisation of junction	No
East Herts	Speed Limit	Bishops Stortford	Introduction of traffic calming measures, improvements of pedestrian footpaths and crossing facilities.	No
East Herts	Access Road/ Roundabout/ Signalisation	North and East of Ware	1.New arm on A1170 / A10 roundabout and signalisation. 2.Access onto B1004 Widbury Hill East of Ware. 3. Two Accesses are	No

District	Scheme Type	Location	Description	Modelled before?
			joined by a distributor Road in between which also intersects with Fanhams Hall Road	
East Herts	Junction	Sawbridgeworth	Upgrades of A1184/West Road/Station Rd junction	No
East Herts	Junction	Buntingford	Capacity enhancements to junction	No
East Herts	Signalisation	Hertford	Signal optimisation.	No
East Herts	Signalisation	Buntingford	Reduced speed limit from 40 - 30mph	No
East Herts	Speed Limit	Sawbridgeworth	New priority junction on Cambridge Road	No
East Herts	Access Road	Bishops Stortford	New development access	No
East Herts	Access Road	Gilston area	New accesses and internal distributor road for Gilston development	No
East Herts	Roundabout	Bishops Stortford	Revise accesses to include roundabout connecting small portion of northern part of development (125 homes) to Whittington Way. Main access now via roundabout on A1184 St James Way and secondary priority access onto Obrey Way. Although a spine road runs through the site only buses will be able to run straight through.	No
East Herts	Link Road	Bishops Stortford station area	New link road between London Road and Dane Street, Bishops Stortford, now to be coded as bus only link (previously modelled as all-purpose route (for all vehicles). Assume design speed of 20mph with 6m carriageway width	LP3 and LP4
East Herts	Signalisation	East of Stevenage	Provision of new signalised accesses from East of Stevenage development (EOS1)	No
East Herts	Signalisation	Stansted Abbotts	Capacity upgrade / signalisation	No
East Herts	Ban	Bishops Stortford	Road closure during peak hours	No
East Herts	Access Road	Bishops Stortford	Means of Access - Hazelend Road	No
East Herts	Signalisation	Sawbridgeworth	Signalise existing junction	No
East Herts	Link Road	Hertford	Lengthening of A10 SB off slip identified through North Ware development technical work. Measure is to provide additional queueing spaces to prevent blocking back onto A10. Highway land is available. Assume slip is lengthened to 3 lanes for 50m back from	No

District	Scheme Type	Location	Description	Modelled before?
			stopline. In reality bridge structures limit length.	
East Herts	Access Road	Hertford	Scheme to improve access to Marshgate Drive development but Marshgate Drive not coded in model so not included to date.	No
East Herts	Junction	A414/B195 Birchall Lane/Cole Green Lane	Capacity improvements identified through WHBC junction design study	No
Hertsmere	Signalisation	Borehamwood	Changes to signal staging and timing	No
Hertsmere	Speed Limit	Bushey	Traffic calming & pedestrian enhancements	No
Hertsmere	Junction	Borehamwood	Upgrade of junction to continental roundabout (DWG files available on AGOL)	No
Hertsmere	Junction	Borehamwood	Junction improvement with replacement of the Tesco roundabout with signals	No
Hertsmere	Junction	M25 junction 18-25	Smart motorway with hard shoulder running	LP3 and LP4
Hertsmere	Sustainability Improvements	Potters Bar	New on street cycle lanes within existing road width	No
Hertsmere	Signalisation	Borehamwood	Rephasing of signals	No
Hertsmere	Signalisation	Potters Bar	Rephase signals	No
Hertsmere	Signalisation	Shenley	Convert to signalised junction & optimise timings with potential widening of approaches	No
Hertsmere	Signalisation	Dancers Hill	Convert to signalised junction and optimise timings	No
Hertsmere	Signalisation	A41 corridor	Signalisation strategy to link junctions	No
Hertsmere	Access Road	Borehamwood	New development access	No
Hertsmere	Access Road	Borehamwood	New development access	No
Hertsmere	Access Road	Bushey	New development access	No
Hertsmere	Signalisation	Bushey	Rephasing of signals	No
Hertsmere	Signalisation	Bushey	Rephasing of signals	No
Hertsmere	Access Road	NE Shenley	New development access and spine road	No
Hertsmere	Access Road	Potters Bar	New development access	No
Hertsmere	Access Road	Potters Bar	New development access	No
Hertsmere	Access Road	Radlett	New development access	No
Hertsmere	Access Road	Radlett	New development access	No
Hertsmere	Access Road	Shenley	New development access	No
Hertsmere	Access Road	South Mimms	New development access	No

District	Scheme Type	Location	Description	Modelled before?
Hertsmere	Access Road	Bushey	New development access	No
Hertsmere	Signalisation	Radlett	Convert to signalised junction & optimise timings	No
Hertsmere	Signalisation	Watford	Convert to signalised junction & optimise timings	No
Hertsmere	Junction	Potters Bar	Junction improvements at Darkes Lane/The Walk to improve conditions for pedestrians and cyclists as well as broader urban realm enhancements along the high street.	No
Hertsmere	Junction	M25 Junction 23	See the layout	No
North Herts	Access Road	Royston	New left in left out access from York Way onto A505	No
North Herts	Signalisation	Baldock	Signal optimisation	LP3 and LP4
North Herts	Signalisation	Letchworth	A505 / Norton Way. Signal optimisation : add extra stage for the movements from Willian Way	No
North Herts	Signalisation	Hitchin	Signal controlled System at junction with optimisation of timings	No
North Herts	Sustainability Improvements	Hitchin	Hitchin Station access improvements to improve pedestrian, bus and cycle access	No
North Herts	Junction	Royston	Widening of junction approach arms	No
North Herts	Signalisation	Hitchin	Improve signalised junction and pedestrian phasing	No
North Herts	Signalisation	Hitchin	Improve signalised junction and pedestrian phasing	No
North Herts	Roundabout	Royston	Widening of roundabout approach arms	No
North Herts	Roundabout	Royston	Widening of roundabout approach arms	No
North Herts	Roundabout	Royston	Construction of a new roundabout onto A505,Royston	No
North Herts	Link Road	Baldock	New Multimodal Link with new bridge over railway & tie into A505 Baldock Bypass / Royston Road roundabout. Priority junction at North Road end.	LP3 and LP4
North Herts	Link Road	Baldock	New link road	LP3 and LP4
North Herts	Signalisation	A1m junction 9	Signalise all arms of roundabout & optimise existing signal entry (NB offslip)	No
North Herts	Junction	Hitchin	Change to junction configuration	No
North Herts	Infrastructure/ Signalisation	Hitchin	Widening approach arms and signalling	No

District	Scheme Type	Location	Description	Modelled before?
North Herts	Signalisation	A1m junction 8	Signalisation of Stevenage Rd and Graveley Rd approaches. Left turn slip to be added from Hitchin Rd to southbound A1(M) ON slip. Signal information assumed by AECOM. Timings to discourage rat runs on minor roads.	No
North Herts	Access Road	Hitchin	New accesses serving Highover Farm development	No
North Herts	Access Road	Letchworth	New access onto Western Way (north of junction with Norrthfields), new link road exiting site to north and connecting to Norton Road & secondary access via Avocet	No
North Herts	Crossing	Hitchin	Bedford Road Pedestrian Crossings	No
North Herts	Sustainability Improvements	Hitchin	On-carriageway cycle route along Bedford Road between town centre and Ickleford serving the Priory School.	No
North Herts	Sustainability Improvements	Hitchin	Hitchin Rail Station to Town Centre Cycle Route	No
North Herts	Sustainability Improvements	Letchworth	A505 cycle route and junction treatment for cycle priority	No
North Herts	Sustainability Improvements	Baldock - Letchworth	Baldock to Letchworth Cycle Route via Works Road, Letchworth Rail Station and Broadway	No
North Herts	Sustainability Improvements	Letchworth - Stevenage	Upgrade existing National Cycle Route between Letchworth and Stevenage with increased cycle priority and provision of on carriageway route through Graveley and into Stevenage via North Road	No
North Herts	Junction	Stevenage	Conversion of priority junction to signal junction	No
North Herts	Speed Limit	Great Wymondley	Reduce speed coded on these roads to 20mph to simulate impact of traffic calming in village	No
North Herts	Speed Limit	Little Wymondley	Reduce speed coded on these roads to 20mph to simulate impact of traffic calming in village	No
North Herts	Speed Limit	Graveley	Reduce speed coded on High Street to 20mph to simulate impact of traffic calming in village	No
North Herts	Speed Limit	Codicote	Reduce speed coded on these roads to 20mph to simulate impact of traffic calming in village	No
North Herts	Speed Limit	Knebworth	Reduce speed coded on these roads to 20mph to simulate impact of traffic calming in village	No

District	Scheme Type	Location	Description	Modelled before?
North Herts	Speed Limit	Titmore Green / Symonds Green	Reduce speed coded on these roads to 20mph to simulate impact of traffic calming in village	No
North Herts	Speed Limit	Hitchin	Assume 20mph as general assumption in Hitchin on non-strategic routes	No
North Herts	Speed Limit	Letchworth	Assume 20mph as general assumption in Letchworth on non-strategic routes	No
North Herts	Speed Limit	Royston	Assume 20mph as general assumption in Royston on non-strategic routes	No
North Herts	Sustainability Improvements	Hitchin	Continuous cycle routes with junction treatments to be provided from the Wilbury Industrial estate and from NHDC Local Plan allocation HT1 to the rail station, including links to schools in the area and links to the A505 North Hertfordshire Sustainable Spine (including towards Letchworth and Baldock).	No
North Herts	Sustainability Improvements	Royston	New, controlled at-grade crossing to the east of A505/A10 junction, cycle priority at junctions along A10, cycle route along Mill Road and Kneesworth Street to complete route of proposed "Melbourn Greenway". Wayfinding to rail station, industrial area, and Royston town centre.	No
North Herts	Junction	Letchworth	Reconfigure B197/A505 junction to remove the need for buses to complete a U-turn.	No
North Herts	Sustainability Improvements	Letchworth - Stevenage	Upgrade existing National Cycle Route between Letchworth and Stevenage with increased cycle priority and provision of on carriageway route through Graveley and into Stevenage via North Road	No
North Herts	Signalisation	North Stevenage	Signalisation and Bus Priority - Stevenage Road/A602	No
St. Albans	Junction	St Albans	St Albans Road/Sandridge Road/Marshalswick Lane/Beech Road - junction improvement	No
St. Albans	Access Road	Colney Heath	A414 Colney Heath longabout safety scheme	No
St. Albans	Access Road	St Albans	Oaklands development new access onto Sandpit Lane	No
St. Albans	Roundabout	Chiswell Green	New Arm to roundabout to serve new hotel development	No
St. Albans	Roundabout	Chiswell Green Corridor	Conversion of the existing roundabout to a signal-controlled	No

District	Scheme Type	Location	Description	Modelled before?
			crossroads with more priority given to the A405 arms. Improvements would need to ensure signal priority is given to bus services (e.g. 321) in terms of GPS / transponder technology. Any junction improvement needs to ensure that provision is made for the planned A405 cycle route (SW-SM20)	
St. Albans	Access Road	Harpenden	NW Harpenden Development accesses	No
St. Albans	Junction	Wheathampstead	B653 Cory Wright Way/Marford Road, Wheathampstead junction improvement	No
St. Albans	Junction	St Albans	A4147 Hemel Hempstead Road / King Harry Lane junction improvement	No
St. Albans	Junction	London Colney	A414-A1081-London Colney Roundabout junction improvement	No
St. Albans	Roundabout	St Albans	A5183 redbourn Road/A4147 bluehouse Hill/Batchwood Drive Roundabout junction improvement	No
St. Albans	Junction	Harpenden	A1081 Luton Road/ Park Hill Junction optimisation	No
St. Albans	Roundabout	St Albans	Hatfield Road/Station Road, Smallford Roundabout junction improvement	No
St. Albans	Access Road	Chiswell Green	New access from Chiswell Green development (site CG)	No
St. Albans	Access Road	Harpenden	New access from North East Harpenden development site (site NEH)	No
St. Albans	Access Road	London Colney	New access from West of London Colney development	No
St. Albans	Access Road	Park Street	New access from Park Street Garden Village	No
St. Albans	Access Road	St Albans	New access from North of St Albans development	No
St. Albans	Speed Limit	St. Albans City Centre	Expanded 20mph zone in St Albans including Victoria Street, Bricket Road and Catherine Street. Any implementation of 20mph zone needs to be in accordance with HCC's Speed Management Strategy	No
St. Albans	Sustainability Improvements	St Peters Street	Reduced severance for pedestrians along A1081 St Peter's Road with a new signal-controlled crossing adjacent to the small shopping parade and St Peter's churchyard between St Peter's Close and Grange Street.	No

District	Scheme Type	Location	Description	Modelled before?
St. Albans	Signalisation	St. Albans City Centre	Reconfigure the signal timings so that the Holywell Hill and Chequer Street arms run separately. The aim would be to reduce the occurrence of right turning vehicles blocking the northbound movements	No
St. Albans	Speed Limit	London Colney	A 20mph speed limit introduced on the section of the High Street adjacent to the shopping parade.	No
St. Albans	Speed Limit	London Colney	A 20mph speed limit introduced on all roads within London Colney	No
St. Albans	Speed Limit	Coopers Green Lane	Reduced speed limit along Coopers Green Lane to support active transport infrastructure and reflect more urbanised environment along route due to Symondshyde development	No
St. Albans	Speed Limit	Harpenden	Narrowing of road, more crossings and speed tables	No
St. Albans	Roundabout	Park Street	A414 / A405 (Park Street) roundabout signalisation	No
St. Albans	Roundabout	St Albans	Sandpit Lane / House Lane enlargement of existing roundabout	No
St. Albans	Junction	St Albans	Sandpit Lane / Barnfield Road junction improvement	No
St. Albans	Junction	St Peters Street/Victoria Street	Junction Reconfiguration including footway widening and closure of Victoria Steet (up to the Maltings GP surgery) to through traffic except buses. Change signals to single way working.	No
St. Albans	Junction	London road corridor	Reconfigure the junction to rationalise surplus roadspace for example the right turn filter lanes on London Road. Remove guardrails. Provide new markings to reinforce existing off-road cycle route or mark it on the road. Widen footways where feasible especially to reduce crossing distances. The potential impact of a loss of roadspace could be increased queues and delays. Any magnitude of impact will need to be carefully investigated prior to implementation of any changes. The objective however of this intervention is to improve the walking environment and encourage modal shift by ‘nudging’ motorists out of their cars, especially those making shorter distance journeys within St Albans e.g. taking pupils to/from school.	No

District	Scheme Type	Location	Description	Modelled before?
St. Albans	Speed Limit	A414 Park Street rbt-A1(M) J3	A review of traffic speed limits and measures required to improve compliance along the A414 Between the Park Street Roundabout and the A1(M) Junction 3). This could include adoption of 'expressway' type technology enhancements which can manage traffic speeds during busy periods and in response to incidents occurring downstream.	No
St. Albans	Sustainability Improvements	Chiswell Green Corridor	Intervention to reduce traffic: Currently B road with highest flows in Hertfordshire. On road cycle lane in each direction (removing central hatched areas) and improved footways and crossing facilities around the shopping parades on both sides of the road.	No
St. Albans	Infrastructure	A414 North Orbital Road	Radlett Railfreight, new access junction onto A414 and new spine road connecting to A5183 Radlett Road (south of Frogmore)	LP3 and LP4
St. Albans	Junction	M25 junction 21a	M25 junction 21a capacity improvements (Radlett Railfreight mitigation)	LP3 and LP4
St. Albans	Junction	M25 junction 22	M25 junction 22 capacity improvements (Radlett Railfreight mitigation)	No
Stevenage	Signalisation	A602 Stevenage	Junction Signalisation	No
Stevenage	Roundabout	Stevenage	Upgrading of the existing Gresley Way/A602 roundabout to signals	No
Stevenage	Signalisation	Stevenage	Signalised on Northern Access and New Southern Access	No
Stevenage	Junction	Stevenage	Upgrade of A602 / Gunnels Wood Road / GSK junction to hamburger layout	No
Stevenage	Junction	Stevenage	Signalisation and capacity improvements at existing junction (A602 phase 1 improvement works)	No
Stevenage	Speed Limit	Stevenage (south)	Hertford Road Speed reduction measures & bus gate	No
Stevenage	Bus Infrastructure	A1 (M) jct 8	Widening of circulatory+ addition of a bus lane. Both "A1(M) J8 Capacity" and "A1(M) J8 Capacity and Bus Priority" have the number NC-SM84.	No
Stevenage	Signalisation	A1m junction 8	Signalisation of Stevenage Rd and Graveley Rd approaches. Left turn slip to be added from Hitchin Rd to southbound A1(M) ON slip. Signal information assumed by AECOM. Timings to discourage rat runs on minor roads.	No

District	Scheme Type	Location	Description	Modelled before?
Stevenage	Sustainability Improvements	Stevenage to WGC	Cycle route between Stevenage and Welwyn Garden City, via Knebworth, Woolmer Green, Oaklands and Welwyn. Potential for off-road route from Oaklands to Digswell. Route to be provided as part of a wider scheme to improve walking, cycling and bus connectivity and adjust the layout of the B197 to better suit its close proximity to schools and residential areas. Speed limit reduction to be considered in urban areas, taking advantage of the opportunity provided by capacity and resilience upgrades on the A1(M).	No
Stevenage	Junction	A1m junction 7	Lengthening of SB off slip identified as a need from the junction 7 / GSK paramics modelling.	No
Stevenage	Access Road	Bragbury End	New development access (SE Stevenage site HO4)	No
Stevenage	Ban	Stevenage (town centre)	Close Lytton Way between Swingate and Six Hills Way to traffic except buses.	No
Three Rivers	Roundabout	Abbots Langley	New roundabout serving development north of Meadowside junction	No
Three Rivers	Access Road	Rickmansworth	New access for 4fe secondary school - access proposed via new roundabout junction on Uxbridge Road (at junction with Long Lane)	LP3 and LP4
Three Rivers	Signalisation	Rickmansworth	Model partial signalisation	No
Three Rivers	Infrastructure	M25 junction 20	Capacity improvements	No
Three Rivers	Infrastructure	Rickmansworth	Additional capacity at the A412 / A404 roundabout to the west of Rickmansworth Town Centre	No
Three Rivers	Access Road	Hunton Bridge	M25 spur approach to Hunton Bridge roundabout - widening approach / circulation or signalisation	LP3 and LP4
Three Rivers	Junction	Watford	Provision of additional right turn lanes into and out of Glen Way and Grove Mill Lane at their junctions with A411 Hempstead Road. Glen Way is not coded in COMET, so not included. A flared approach will be coded out of Grove Mill Ln, however, the right turn lane into Grove Mill Ln already exists (so no change will be made on this arm).	No
Three Rivers	Infrastructure	Watford	Left turn lane from Deacons Hill to Eastbury Road	No
Three Rivers	Access Road	Three Rivers	New access for the Development	No

District	Scheme Type	Location	Description	Modelled before?
Three Rivers	Access Road	Three Rivers	New access for the Development	No
Three Rivers	Access Road	Three Rivers	New access for the Development	No
Three Rivers	Access Road	Three Rivers	1 on Hornhill Road, 1 on A412 and 1 on Chalfont Road	No
Three Rivers	Access Road	Three Rivers	New access for the Development	No
Watford	Speed Limit	Watford	Implement 20 mph zone in defined areas	No
Watford	Link Road	Watford	New link road from Dalton Way providing access to Watford Health Campus	LP3 and LP4
Watford	Roundabout	Watford	Modification to roundabout, new exit from central Avenue car park onto A411 enabling vehicles to exit to the north without having to travel around the junction	No
Watford	Ban	Watford	Restriction of High Street between Beechen Grove to Market Street to buses (and local access) only. Narrow street with bus stops on road (rather than in laybys). Road remains one way northbound. ROAD NOT IN MODEL SO SCHEME CAN'T BE INCLUDED.	No
Watford	Ban	Watford	Clarendon Road converted to one way operation southwest bound south of Beechen Grove (Section Beechen Grove - Market Street).THIS SECTION OF ROAD IS NOT IN THE MODEL SO SCHEME CAN'T BE INCLUDED.	No
Watford	Ban	Watford	Reduction of Ascot Road to single carriageway with bus lane in each direction on current dual carriageway section	No
Watford	Infrastructure	Watford	Road Space Consolidation	No
Watford	Sustainability Improvements	Watford	urban Realm improvement - narrowing carriageway and new pedestrian phase at Beechen Grove /Clarendon Road	No
Watford	Infrastructure	Watford	New Transport Hub	No
Welwyn Hatfield	Infrastructure	Welwyn Garden City	Welwyn Garden City Town Centre Development	No
Welwyn Hatfield	Access Road	A414/Holwell Lane roundabout	New development access and minor capacity improvements	No
Welwyn Hatfield	Infrastructure	A1m junction 6 / B656 Codicote Road / Great North Road	Reduced to a single lane in each direction and put the new crossing on (the north east side)clock roundabout.	No

District	Scheme Type	Location	Description	Modelled before?
		(Clock roundabout)		
Welwyn Hatfield	Access Road	Hatfield aerodrome	New accesses onto Coopers Green Lane and Albatross Way with spine road for buses in between	No
Welwyn Hatfield	Traffic Management	Hatfield	Introduce traffic management measures along Link Drive	No
Welwyn Hatfield	Signalisation	Welwyn Garden City	Signalisation of existing mini roundabouts	No
Welwyn Hatfield	Junction	A1 (M) J 3	A major redesign of the existing A1 (M) junction 3 roundabout. (with Highways England involvement)	No
Welwyn Hatfield	Junction	Hatfield	Replace the existing roundabouts with signalised junctions	No
Welwyn Hatfield	Bus Infrastructure	Hatfield	Cavendish Way bus lane	No
Welwyn Hatfield	Roundabout	Welwyn	Reduce 2 lane dual carriageway section to single lane in each direction with improved off road cycling and walking facilities and new crossing facility	LP4
Welwyn Hatfield	Junction	Hatfield	Cavendish Way-Bishops Rise junction reconfiguration	No
Welwyn Hatfield	Speed Limit	Hatfield	Traffic calming measures along length of corridor	No
Welwyn Hatfield	Infrastructure	Hatfield	Comet Way corridor reconfiguration	No
Welwyn Hatfield	Junction	Lemsford	Junction improvements to reduce congestion and improve capacity and reliability	No
Welwyn Hatfield	Junction	Mill Green	A414 Mill Green Junction Improvements	No
Welwyn Hatfield	Sustainability Improvements	B197 corridor	B197 Sustainable Travel Corridor with footway / cycleway improvements, traffic calming & bus priority	No
Welwyn Hatfield	Access Road	B195 Birchall Lane,	Birchall Lane improvements and new development accesses	No
Welwyn Hatfield	Junction	Brookmans Park	A1000/Swanley Bar Lane junction widening	No
Welwyn Hatfield	Junction	Cuffley	Plough Hill / Station Road Cuffley priority changes	No
Welwyn Hatfield	Roundabout	Brookmans Park	Provision of Right turn flare from A1000 N to Hawkshead Road	No
Welwyn Hatfield	Infrastructure	Welwyn Garden City	Octabout Arrangement in place of signals	No
Welwyn Hatfield	Junction	A1000 /Shepherds Way, Brookmans Park	A1000 / Shepherds Way junction improvement - signal optimisation	No

District	Scheme Type	Location	Description	Modelled before?
Welwyn Hatfield	Junction	Welham Green	A1000 /Dixons Hill Road junction improvement with provision of 4th arm into Marshmoor development & capacity enhancements	No
Welwyn Hatfield	Infrastructure	A414 / A1000, Mill Green	Extension of 2 lane approach to T junction on A414 EB off-slip	No
Welwyn Hatfield	Junction	Hatfield	Wellfield Road/Comet Way junction improvements	No
Welwyn Hatfield	Infrastructure	Coopers Green Lane / Green Lane, near Hatfield	Additional lanes on all approaches	No
Welwyn Hatfield	Signalisation/ Infrastructure	Hatfield	Junction signalisation & additional lane for EB approach	No
Welwyn Hatfield	Infrastructure	A1000 and South Way over-pass, South Hatfield	Extend SB on-slip to provide extra slip capacity and for safety improvement. Modelled approximately by addition of some widening south of junction to allow easier merge	No
Welwyn Hatfield	Infrastructure	Welwyn Garden City	Extend flare on Broadwater Road SB approach and on A1000 NB approach	No
Welwyn Hatfield	Infrastructure	Hatfield	A1000 Great North Road / B6426 St Albans Road East (Red Lion junction), Hatfield	No
Welwyn Hatfield	Infrastructure	Welwyn Garden City	Mundells gyratory improvements – Waterside merge improvements & additional capacity on Black Fan Road & Herns Way approach	No
Welwyn Hatfield	Roundabout	A414 Mill Green junction to Jack Oldings roundabout	A414 section between Mill Green & Tescos reconfiguration	LP3 and LP4
Welwyn Hatfield	Junction	A1(M) Junction 4	Short term capacity improvements	LP3 and LP4
Welwyn Hatfield	Junction	A1 (m) junction 3	Optimise signals on junction in addition to dualling Comet Way NB	LP3 and LP4
Welwyn Hatfield	Roundabout	Stanborough	Stanborough Roundabouts capacity improvements	No
Welwyn Hatfield	Junction	A1m junction 6	Switch on of installed ramp metering as part of final phase of A1m junction 6 improvement works	LP3 and LP4
Welwyn Hatfield	Signalisation	Welwyn Garden City	New Signalisation Pedestrian Crossing	No
Welwyn Hatfield	Speed Limit/ Sustainability Improvements	Coopers Green Lane	Coopers Green Lane Active Travel Infrastructure - multimodal corridor with reduced traffic speeds and pedestrian and cycle provision	No

District	Scheme Type	Location	Description	Modelled before?
North Herts / Stevenage / Welwyn Hatfield	Junction	A1 (M) jct 6-8	Widening of motorway to 3 running lanes between junctions 6-8.	LP3 and LP4
Central Beds	Link Road	M1 - A5	New link between M1 and A5 north of Dunstable	No
Central Beds	Junction	Biggleswade	A1 Biggleswade Junction improvements – capacity improvements and dedicated left turn	No
Luton	Link Road	M1 jnc 11a - A6	New link between M1 and A6 around North Luton	No
Luton	Infrastructure	Luton	Dualling of Vauxhall Way between Stopsley Way / Hitchin Road and Kimpton Road	No
Luton	Infrastructure	Luton	Widening of Gipsy Lane between Kimpton Road to just before link road to New Airport Way to 4 lanes (no central reserve	No
Luton	Bypass	Luton	Luton Town Centre Bypass	No
Luton	Ban	Luton	Reallocation of lanes on part of town centre ring road	No
Luton	Junction	Luton	New grade-separated junction	No
Harlow	Roundabout	Harlow	New Roundabout Junction	No
Harlow	Crossing	Harlow	Central Stort crossing (widening of Fifth Avenue between Eastwick Road and Edinburgh Way (Burnt Mill roundabout), Harlow	No
Harlow	Junction	Harlow	M11 junction 7 short term capacity enhancements	No
Harlow	Crossing	Harlow	Second River Stort crossing	LP3 and LP4
Harlow	Roundabout	Harlow	Replacement of roundabout with signalised junction and provision of new arm to north providing bus access to Gilston development	No
Uttlesford	Junction	M11 junction 8	Lane marking amendments & new dedicated free flow LT lane from M11 SB off slip. The M11 J8 no longer includes a direct slip from S/B carriageway, but now has 5 lanes on that approach instead.	LP3 and LP4

11.4 Appendix IV: Highway Simulation Area Statistics by User Class

Table 11-1: Simulation Area Assignment Statistics – Car Commuting (PCU = Passenger Car Unit)

	AM Peak				Inter-Peak				PM Peak			
	2014	2036	Δ (LP5)	Δ (LP4)	2014	2036	Δ (LP5)	Δ (LP4)	2014	2036	Δ (LP5)	Δ (LP4)
Travel Distance (PCU km)	1,841,945	2,081,088	13%	12%	350,428	417,538	19%	23%	1,467,479	1,604,371	9%	10%
Total Travel Time (PCU hours)	38,364	50,354	31%	29%	6,829	8,744	28%	33%	31,685	40,401	28%	16%
Average Speed (Kph)	48	41	-14%	-13%	51	48	-7%	-7%	46	40	-14%	-6%
Over-Capacity Queues (PCU hours)	2,871	6,389	123%	109%	118	361	206%	174%	3,528	6,838	94%	23%
Transient Queues (PCU hours)	6,302	9,354	48%	35%	1,055	1,502	42%	39%	5,105	7,116	39%	27%

Table 11-2: Simulation Area Assignment Statistics – Car Employers Business (PCU = Passenger Car Unit)

	AM Peak				Inter-Peak				PM Peak			
	2014	2036	Δ (LP5)	Δ (LP4)	2014	2036	Δ (LP5)	Δ (LP4)	2014	2036	Δ (LP5)	Δ (LP4)
Travel Distance (PCU km)	954,834	1,077,831	13%	15%	919,258	1,063,213	16%	19%	1,149,302	1,183,075	3%	11%
Total Travel Time (PCU hours)	14,744	19,911	35%	38%	12,325	16,267	32%	36%	17,845	22,308	25%	27%
Average Speed (Kph)	65	54	-17%	-17%	75	65	-12%	-12%	64	53	-18%	-12%
Over-Capacity Queues (PCU hours)	834	2,074	149%	153%	199	550.3	176%	214%	1,261	3,047	142%	65%
Transient Queues (PCU hours)	1,715	3,071	79%	62%	1,128	2,087	85%	69%	2,116	3,230	53%	53%

Table 11-3: Simulation Area Assignment Statistics – Car Other (PCU = Passenger Car Unit)

	AM Peak				Inter-Peak				PM Peak			
	2014	2036	Δ (LP5)	Δ (LP4)	2014	2036	Δ (LP5)	Δ (LP4)	2014	2036	Δ (LP5)	Δ (LP4)
Travel Distance (PCU km)	810,831	1,282,441	58%	38%	1,161,612	1,906,700	64%	43%	1,344,570	1,925,092	43%	33%
Total Travel Time (PCU hours)	20,896	35,498	70%	57%	24,444	41,722	71%	54%	33,748	54,668	62%	38%
Average Speed (Kph)	39	36	-7%	-12%	48	46	-4%	-7%	40	35	-12%	-4%
Over-Capacity Queues (PCU hours)	2,335	5,628	141%	146%	679	2,879	324%	194%	4,795	11,036	130%	43%
Transient Queues (PCU hours)	3,928	7,160	82%	61%	4,049	7,257	79%	64%	5,882	10,138	72%	49%

Table 11-4: Simulation Area Assignment Statistics – LGV (PCU = Passenger Car Unit)

	AM Peak				Inter-Peak				PM Peak			
	2014	2036	Δ (LP5)	Δ (LP4)	2014	2036	Δ (LP5)	Δ (LP4)	2014	2036	Δ (LP5)	Δ (LP4)
Travel Distance (PCU km)	465,604	673,888	45%	44%	470,671	680,701	45%	46%	445,902	635,669	43%	40%
Total Travel Time (PCU hours)	8,959	14,945	67%	59%	7,720	12,386	60%	55%	9,007	15,000	67%	42%
Average Speed (Kph)	52	45	-13%	-10%	61	55	-10%	-6%	50	42	-14%	-2%
Over-Capacity Queues (PCU hours)	738	1,855	151%	138%	185	456	147%	179%	1,054	2,524	139%	45%
Transient Queues (PCU hours)	1,385	2,721	96%	65%	1,007	1,976	96%	68%	1,397	2,627	88%	55%

Table 11-5: Simulation Area Assignment Statistics – HGV (PCU = Passenger Car Unit)

	AM Peak				Inter-Peak				PM Peak			
	2014	2036	Δ (LP5)	Δ (LP4)	2014	2036	Δ (LP5)	Δ (LP4)	2014	2036	Δ (LP5)	Δ (LP4)
Travel Distance (PCU km)	619,846	727,405	17%	-14%	705,776	847,716	20%	-13%	379,277	445,357	17%	-14%
Total Travel Time (PCU hours)	9,667	13,011	35%	-14%	9,771	12,929	32%	-12%	5,936	8,058	36%	-14%
Average Speed (Kph)	64	56	-13%	0%	72	66	-9%	-1%	64	55	-13%	0%
Over-Capacity Queues (PCU hours)	611	1,445	137%	-13%	155	482	211%	-5%	487	1,187	144%	-8%
Transient Queues (PCU hours)	1,178	2,010	71%	-15%	1,004	1,732	72%	-11%	730	1,143	57%	-18%