
Project:	DIAMOND Application for Southwest Hertfordshire	Job No:	60217288/MH001
Subject:	Transport Impacts of Core Strategy Development Scenarios		
Prepared by:	Menaka Dharmaraj / Mark Chadwick	Date:	24 November 2011
Checked by:	Mark Chadwick	Date:	24 November 2011
Approved by:	Ian Burrows	Date:	25 November 2011

1. Introduction

The Highways Agency requires estimates of the likely impact of the changes in housing and employment use in six districts in southwest Hertfordshire upon the Strategic Road Network (SRN). AECOM are able to provide this by making use of the existing DIAMOND (Demand Impact Assessment Of New Development) model of Hertfordshire.

The proposed land-use development strategies for both housing and employment from each of the six planning authorities have been reviewed and an estimate of likely development locations and sizes produced for each of the districts under consideration. As the districts are at different stages of adopting their Plans and LDFs locations of development are less certain for some of the districts.

The best estimates of the location, type and quantum of development for each site have been incorporated into DIAMOND, and the model run to provide estimates of the impact of these development sites.

This technical note outlines the methodology and assumptions in developing the model inputs, provides results and discusses the potential implications of the proposed developments based on the results obtained, with a focus on the SRN.

DIAMOND is intended to provide a relatively quick assessment of the impacts of development proposals on the strategic road network. It is recommended further supporting assessment is subsequently carried out to determine the potential mitigation measures required to facilitate development as well as further detailed junction operational assessments which may be required to help support the evidence base in due course.

2. Overview of Approach

In undertaking this work AECOM have undertaken a number of key tasks outlined as follows;

Task 1: Consider Development Loading: Consideration has been given as to how each of the major development sites loads onto the DIAMOND network to ensure this is plausible. Where there are a large number of very small developments, these have been allocated to existing zones.

Task 2: Network Link Coding Review: The network in the vicinity of large developments and clusters of small developments has been reviewed to ensure it is sufficiently detailed and that there are no errors in the coding.

Task 3: Review Flow Data: Modelled base flows in the vicinity of developments have been reviewed, and consideration given to whether any new data could usefully be incorporated where flows are uncertain, important, or considered unrealistic. This has focussed on the Strategic Road Network.

Task 4: Gravity Model Distributions Checks: For the larger developments, checks have been undertaken on DIAMOND's gravity model outputs to inspect where development demand is modelled as travelling to and from, to assess whether this is plausible and that trip-length distributions are reasonable.

Task 5: Development Coding: The developments will be coded into DIAMOND, by zone, land-use type, and size.

Task 6: Run Scenarios: DIAMOND was assigned for a single forecast year, 2031. It has been assumed that by 2031 all development will be built out, and as such, the impacts of full development have been assessed. Two models have been created, one with all the developments included, and one with no development at all in the six districts to aid in assessing the impact. Increases in car trip-making due to increased car ownership have been included in both scenarios.

Task 7: Analyse Data and prepare Outputs: The model runs have been inspected and various pieces of data extracted and analysed. Plots of flows and flow differences and summary statistics on modelled speeds and vehicle kilometres have been produced with and without development, by district.

Task 8: Produce Technical Note: The analysis has been collated into this technical note describing the approach and work undertaken and providing key conclusions and recommendations.

3. Planning Data

This section provides detail of the assumptions made in preparing planning data inputs for the DIAMOND model, used to assess the impact of development proposals in Southwest Hertfordshire, on the strategic road network. The planning data consists of housing and employment proposals for six districts in Southwest Hertfordshire:

- Dacorum;
- Hertsmere;
- St Albans;
- Three Rivers;
- Watford; and
- Welwyn Hatfield.

This work has been undertaken due to the abolition of previous planning targets determined by the East of England Regional Assembly, since when most Local Authorities have reverted to their own planning aspirations, to shape the development strategy of their district. This has resulted in ad-hoc progress, with some local authorities having already determined growth targets and locations, whilst others are still consulting on options.

AECOM have obtained planning data from various local authority Core Strategy (CS) documents and Strategic Housing Land Availability Assessment (SHLAA) documents. These generally cover the 15 year period from 2011 to 2026 but in some cases from 2006 up to 2031. It should be noted that a majority of local authorities have only determined the quantum and type of development over their respective planning horizon. The planning process has not, in most cases, reached a stage where spatial distribution of developments is being considered in detail.

As the DIAMOND model has a base year of 2009 and forecast year of 2031 the available planning data has been adjusted to provide inputs consistent with these modelled years. The following sections detail the assumptions of how the available planning data for each of the six Hertfordshire Districts under review have been processed for use in the DIAMOND model.

Some general assumptions have been made in preparing the planning data for the model. These are as follows:

- 1) The DIAMOND model base year is 2009 whereas the commencement of the Core Strategy varies by district with starting years of 2006, 2009 and 2011 as shown in **Table 1**. Therefore, one of the following two methods has been used to adjust the available data to ensure compatibility with the model base year:
 - I. Where a trajectory of projected housing completions has been available in the CS document, the annual projected completion figure has either been deducted from or added to the CS housing allocations; depending on whether the start of the CS period is before or after 2009.
 - II. Where a trajectory of projected housing completions has not been available in the CS document, an annual average of the CS housing allocations has been used to determine the appropriate quantum of growth from the model base year of 2009.
- 2) The model assessment year is 2031, however, only Dacorum, Watford and Welwyn Hatfield districts have planning horizons that extend to 2031. For the purposes of this exercise it has been assumed that no growth occurs beyond the final year of a Core Strategy as the planning aspirations of a Local Authority beyond the current CS could be significantly different to those of current planning strategies.
- 3) Where no detailed spatial information has been provided, housing has been allocated equally to all urban model zones across districts or sub-district areas.
- 4) Housing within sub-districts have been allocated equally unless the quantum of housing has been specified by the Local Authority. Minor differences may exist due to rounding effects.

As an example of how the above process has been applied, the Core Strategy period for St Albans City and District Council is 2011 to 2028, with an allocation of 4,250 dwellings. We have used the average build for the 17 years (of 250 dwellings per annum) to inform projected housing growth for 2009 to 2011. No additional dwellings have been assumed for the three years' post 2028 and hence the assumed housing total used within the DIAMOND for the 2009 to 2031 period is 4,750 dwellings.

Generally, from the available information, there is limited information as to where new development will occur within districts or sub-district areas. Where detail has been provided development has been placed in the appropriate DIAMOND model demand zones. Where spatial distribution detail is absent development has been spread evenly across sub-districts.

Table 1 : Documents referenced in obtaining planning data information

Local Authority	Source of Information	Core Strategy Period
Dacorum Borough Council	<ul style="list-style-type: none"> Dacorum Draft Core Strategy, published November 2010 Dacorum Draft Core Strategy Review, Technical Note prepared by AECOM, 26 November 2010 	2006 to 2031
Hertsmere Borough Council	<ul style="list-style-type: none"> Hertsmere Local Development Framework Development Plan Document, Revised Core Strategy Consultation Draft, published December 2010 Hertsmere Revised Core Strategy Review, Technical note prepared by AECOM, 14 February 2011 	2011 to 2026
St Albans City and District Council	<ul style="list-style-type: none"> St Albans Shaping our Community Core Strategy Document, published December 2010 St Albans SHLAA Appendix 6 published in Sept 2009 	2011 to 2028
Three Rivers District Council	<ul style="list-style-type: none"> Three Rivers Core Strategy Submission, published March 2011 	2001 to 2026
Watford Borough Council	<ul style="list-style-type: none"> Watford Core Strategy Pre-Submission, May 2011 	2010 to 2031
Welwyn Hatfield Borough Council	<ul style="list-style-type: none"> Welwyn Hatfield Core Strategy Consultation Leaflet, June 2011 Welwyn Hatfield SHLAA: Phase 1 – Urban Capacity Final Report 	2011 to 2031

Table 2 to **Table 10** show the housing and employment targets for each of the six districts obtained from the Local Authority planning documents. These have been adjusted to represent the 2009-2031 period prior to input into DIAMOND. It should be noted that these figures represent allocations by each Local Authority for their district. The allocations may not necessarily be confined to the Local Authority's district itself and by the same token does not include allocations by other Local Authorities which may fall in these districts due some zones within DIAMOND crossing district boundaries.

Dwelling Growth

Table 2: Dacorum Borough Council Dwelling Growth Allocations

Sub-District/ Location	Additional Location Details*	Total Dwellings 2006-2031	Adjusted Total Dwellings 2009-2031
Dacorum Total		10,890	9,583
Hemel Hempstead	Hemel Hempstead Town Centre	1,800	1,584
	East Hemel Hempstead	1,000	880
	North of Hemel Hempstead	1,280	1,126
	Marchmont Farm	300	264
	Old Town	80	70
	West Hemel Hempstead	900	792
	within the town plus local allocations	3,440	3,028
Berkhamsted	a mix of urban and other locations	1,200	1,056
Tring	unspecified	480	422
Markyate	unspecified	190	167
Bovingdon	unspecified	150	132
Kings Langley	unspecified	70	62

*Where allocations were not specifically stated dwellings have been evenly distributed across Dacorum sub-districts. For example to each of the 3 model demand zones that represent Berkhamsted the 1,056 dwelling increase from 2009-31 have been divided by 3 to give 352 dwellings per zone.

Table 3: Hertsmere Borough Council Dwelling Growth Allocations

Sub-District/ Location	Total Dwellings 2011-2026	Adjusted Total Dwellings 2009-2031
Hertsmere Total	3,346	3,792
Borehamwood	2,093	2,372
Potters Bar	296	335
Bushey	810	918
Elstree	31	35
Shenley	29	33
Radlett	87	99

Table 4: St Albans City and District Council Dwelling Growth Allocations

Sub-District/ Location	Total Dwellings 2011-2028	Adjusted Total Dwellings 2009-2031
St Albans Total	4,250	4,750
London Road/Alma Road, St Albans	100	112
Ridgeview, Barnet Road, London Colney	100	112
Spencer's Park, Cherrytree Lane, Hemel Hempstead	150	168
Building Research Establishment, Bricket Wood	150	168
Harperbury Hospital	250	279
Harpenden	Remaining allocations not specified in Core Strategy	559
Redbourn		559
Wheathamstead		559
St Albans		559
Chiswell Green and Park Green		559
London Colney		558
Bricket Wood		558

Table 5: Three Rivers District Council - Dwelling Growth Allocations

Sub-District/ Location	Total Dwellings 2001-2026	Adjusted Total Dwellings 2009-2031
Three Rivers Total	4,500	2,886
Abbots Langley	Allocations not specified	346
Ashridge		82
Bedmond and Primrose Hill		82
Carpenders Park		82
Chorleywood East		174
Chorleywood West		172
Croxley Green		346
Croxley Green North		82
Croxley Green South		82
Eastbury		82
Hayling		82
Langleybury		82
Leavesden		346
Maple Cross		82
Northwick		82
Oxhey Hall		346
Penn		82
Rickmansworth		82
Rickmansworth West		82
Sarratt		90

Table 6: Watford Borough Council - Dwelling Growth Allocations

Sub-District/ Location	Total Dwellings 2010-2031	Adjusted Total Dwellings 2009-2031
Watford Total	5,120	5,637
Callowland	Allocations not specified	1,619
Central		919
Holywell		439
Leggatts		316
Meridien		206
Nascot		307
Oxhey		273
Park		528
Stanborough		40
Tudor		242
Vicarage		374
Woodside		374

Table 7: Welwyn Hatfield Borough Council Dwelling Growth Allocations

Sub-District/ Location	Total Dwellings 2011-2031	Adjusted Total Dwellings 2009-2031
Welwyn Hatfield Total	5,800	6,380
SHLAA & Urban Capacity Sites:	2,900	3,190
Hatfield Aerodrome		1,700
Creswick School Site, WGC		50
Land at Chequersfield, WGC		218
Former Wellfield Works, Wellfield Road, Hatfield		60
Adj. Factory Site, Wellfield Road, Hatfield		22
Peartree Redevelopment Area, WGC		94
Godfrey Davis Garage Site		28
The Dairy, Homestead Lane, WGC		12
Garage and Depot, Lemsford Lane, WGC		24
Sea Cadet Hut, Lemsford Lane, WGC		22
Oaklands Campus, Lemsford Lane, WGC		23
SKB Site, Ridgeway, WGC		128
Mount Pleasant Depot, Hatfield		73
Hilltop, High View, Hatfield		75
Claregate, Great North Road, Little Heath		14
Howe Dell School, Hatfield		10
Former Allotments, Knella Road, WGC		22
Catomance Site, Bridge Road East, WGC		86
Knella Road Workshops, WGC		22
Hatfield Town Centre		165
The Forum, Hatfield Town Centre		84
Hatfield Aerodrome District Centre		200
Welwyn Garden City town centre		58
Site E	2,900	3,190

Note: The SHLAA & Urban Capacity site allocations totalled 3,182 dwellings. However the allocation in the Core Strategy was for 2,900 dwellings at these sites. Adjusted figures totalled 3,190 after including projected completions for 2009 to 2011. Therefore, the original numbers were used, with minor adjustments for 'Welwyn Garden City Town Centre' to obtain a total of 3,190 dwellings.

Employment Growth

Table 8: Dacorum Borough Council Employment Growth Allocations 2009-31

Sub-District/ Location	Development Type	Employment Area (m ²)
Dacorum Total		258,896
Maylands Business Park	B1	114,400
Maylands Business Park	B8	25,080
Hemel Hempstead	B1	48,942
Hemel Hempstead Town	A1	37,840
Berkhamsted	B1	10,876
Tring	B1	5,438
Markyate	B1	5,438
Bovingdon	B1	5,438
Kings Langley	B1	5,444

Table 9: Three Rivers District Council Employment Growth Allocations 2009-31

Sub-District/ Location	Development Type	Employment Area (m ²)
Three Rivers Total		75,000
Leavesden Aerodrome	B1	70,000
Leavesden Aerodrome	B8	5,000

Table 10: Watford Borough Council Employment Growth Allocations 2009-31

Sub-District/ Location	Development Type	Employment Area (m ²)
Watford Total		73,920
Callowland	B1	21,228
Central	B1	12,054
Holywell	B1	5,762
Leggatts	B1	4,144
Meridien	B1	2,704
Nascot	B1	4,026
Oxhey	B1	3,577
Park	B1	6,930
Stanborough	B1	519
Tudor	B1	3,176
Vicarage	B1	4,900
Woodside	B1	4,900

It can be seen that although housing growth has been allocated to all six districts, albeit at varying level of detail, employment growth has only been allocated to three districts, Dacorum, Three Rivers and Watford. No employment growth has been allocated to Hertsmere as their Core Strategy stated that employment growth would only be considered if employment growth in adjacent districts boroughs were not forthcoming, St Albans Core Strategy stated that existing sites would be maintained and enhanced (with no employment growth envisaged at this stage), whereas the planning for Welwyn Hatfield has not reached a stage where employment growth is being considered.

Further information regarding the assumptions used in producing the planning data can be obtained from 'Planning Assumptions for South West Hertfordshire Districts' Technical Note prepared by AECOM, dated 20 October 2011.

The trip rates applied to the residential and employment areas are those previously agreed with the Highways Agency in October 2010. The trip rates are based on average rates and therefore can be deemed to include some element of sustainable travel within these. It is also noted that the trip rates do not vary by development location within the model and consistent values are applied across all development.

4. Scenario Analysis

Analysis has been undertaken for 2031 comparing the southwest Hertfordshire Core Strategy growth scenario against a no development growth scenario in these six districts. The 'No Development' scenario includes growth from the East of England Final Plan Review across the rest of Hertfordshire, but assumes no development within the six districts in southwest Hertfordshire itself. This therefore allows a cumulative assessment of development along with the associated impacts to be assessed, without 'double counting' the growth. Furthermore it also allows a 'reference case' to be established against which the development option can be compared.

Flow difference plots and stress (flow/capacity) plots (relative to the 'No Development' scenario) have been produced and are provided in **Figure 1** to **Figure 6**. The maximum flow difference or stress for either direction is used, therefore the plots do not implicitly provide information by direction of travel. It should be noted that only links that have progressed to the next stress threshold, in the presence of development, are shown in the difference maps. In some cases, this could have been caused by a small percentage increase that was sufficient to increase stress to the next level. In other cases, larger increases in stress would have been ignored on the basis that stress had not reached a higher threshold. It should be emphasised that "stress" is calculated on a link-by-link basis and does not include any representation of junction capacities or delays.

The SRN routes within southwest Hertfordshire and contained within DIAMOND include:

- M1;
- M25.
- A1(M); and
- A1
- A5 (although it is considered that this would be de-trunked by 2031 following completion of the A5-M1 Dunstable Northern Bypass)

Figure 1 and **Figure 2** show the changes in flows on the network due to the proposed housing and employment in southwest Hertfordshire. The route sections that have experienced the highest increase in flows (above 600 PCUs) in the AM and PM peak include:

AM:

- Hemel Hempstead, A414 St Albans Road;
- Hemel Hempstead, Two Waters Road;
- Hemel Hempstead, A4146 Leighton Buzzard Road;
- St Albans, A414 North Orbital Road east of London Road;
- North Watford, A41 North Western Avenue; and
- North Watford, A412 St Albans Road.

PM:

- Hemel Hempstead, A414 St Albans Road;
- Hemel Hempstead, Two Waters Road;
- Hemel Hempstead, A4146 Leighton Buzzard Road;
- North Watford, A41 North Western Avenue; and
- North Watford, A412 St Albans Road.

The highest increases in flows are observed along the road network in the vicinity of developments. Whilst the SRN has recorded increases in flows, they are lower than the increases on primary and 'A' roads, as traffic has dispersed over the wider network by the time it reaches the SRN.

Figure 3 and **Figure 5** show the level of stress on the network in 2031 with housing growth within southwest Hertfordshire. These represent the 'Do Minimum' scenario. **Figure 4** and **Figure 6** show the changes in stress levels as a result of developments in southwest Hertfordshire. Sections of the SRN which have experienced increases in stress include:

AM Peak:

- M1 between J9 and J10;
- Sections of the A1(M) between J3 and J4; and
- M1 between J6A and J7.

PM Peak:

- M1 between J7 and J8; and
- A1 Barnet Bypass.

Various parts of the primary and A roads have experienced an increase in stress due to additional trips caused by the development. This includes, but not limited to, the following:

- Hemel Hempstead, A414 St Albans Road;
- Hemel Hempstead, Two Waters Road;
- Hemel Hempstead, A4146 Leighton Buzzard Road;
- St Albans, A414 North Orbital Road east of London Road;
- St Albans radial routes, such as A1081 and A5183
- North Watford, A41 North Western Avenue; and
- North Watford, A412 St Albans Road.

Figure 1: Flow Difference 2031 AM Peak

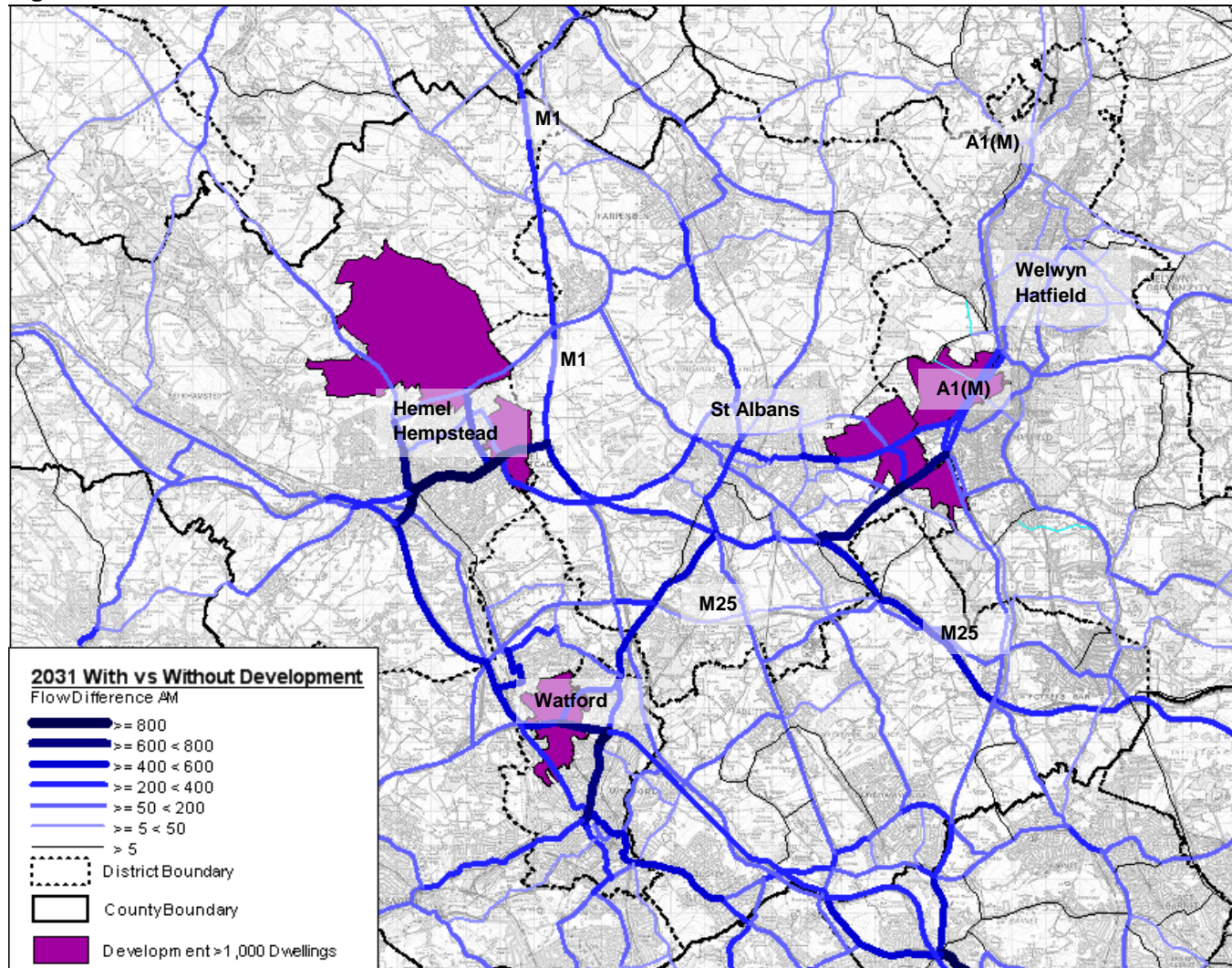


Figure 2: Flow Difference 2031 PM Peak

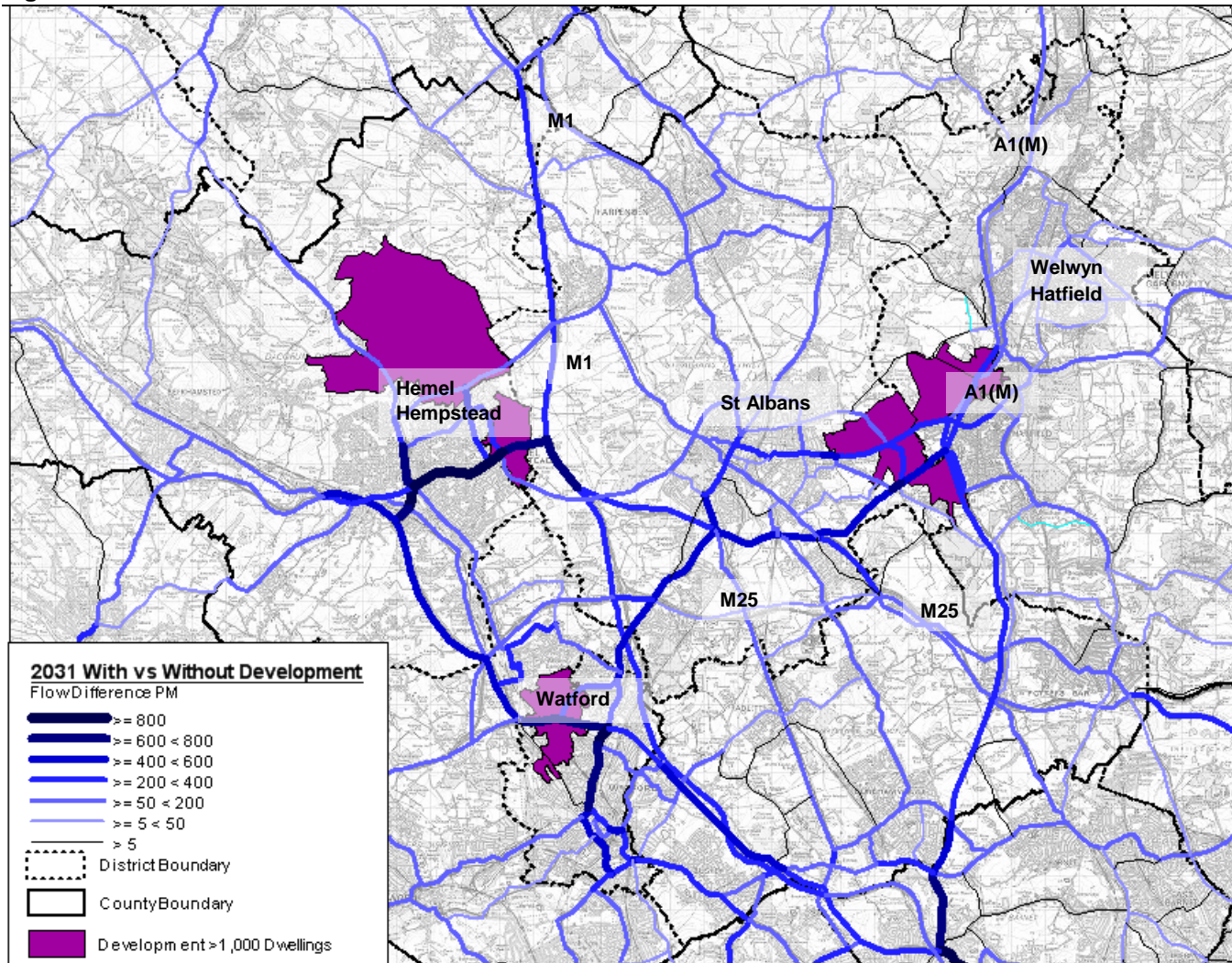


Figure 3: Without Development Stress 2031 AM Peak

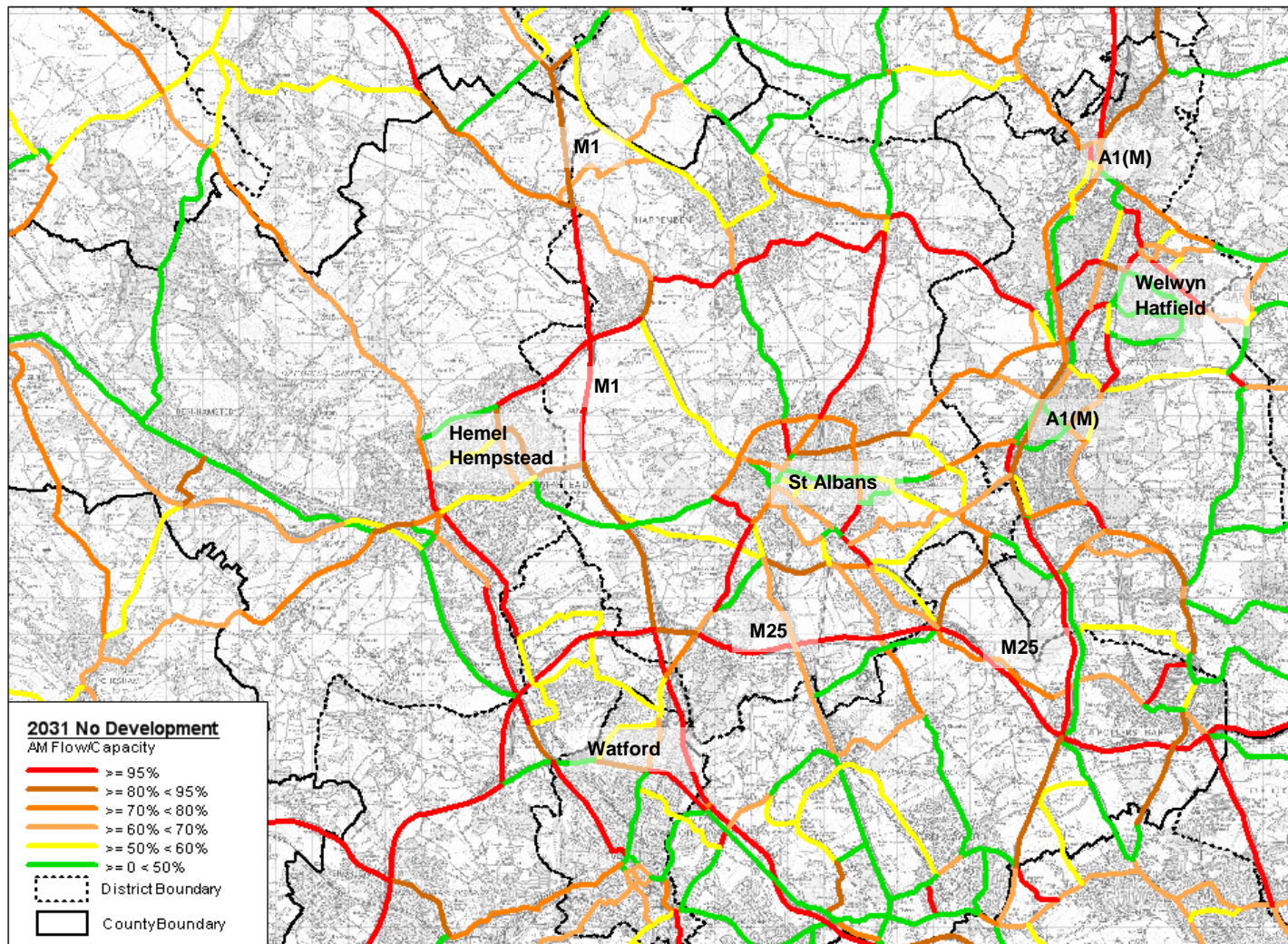


Figure 4: Stress Change With Development 2031 AM Peak

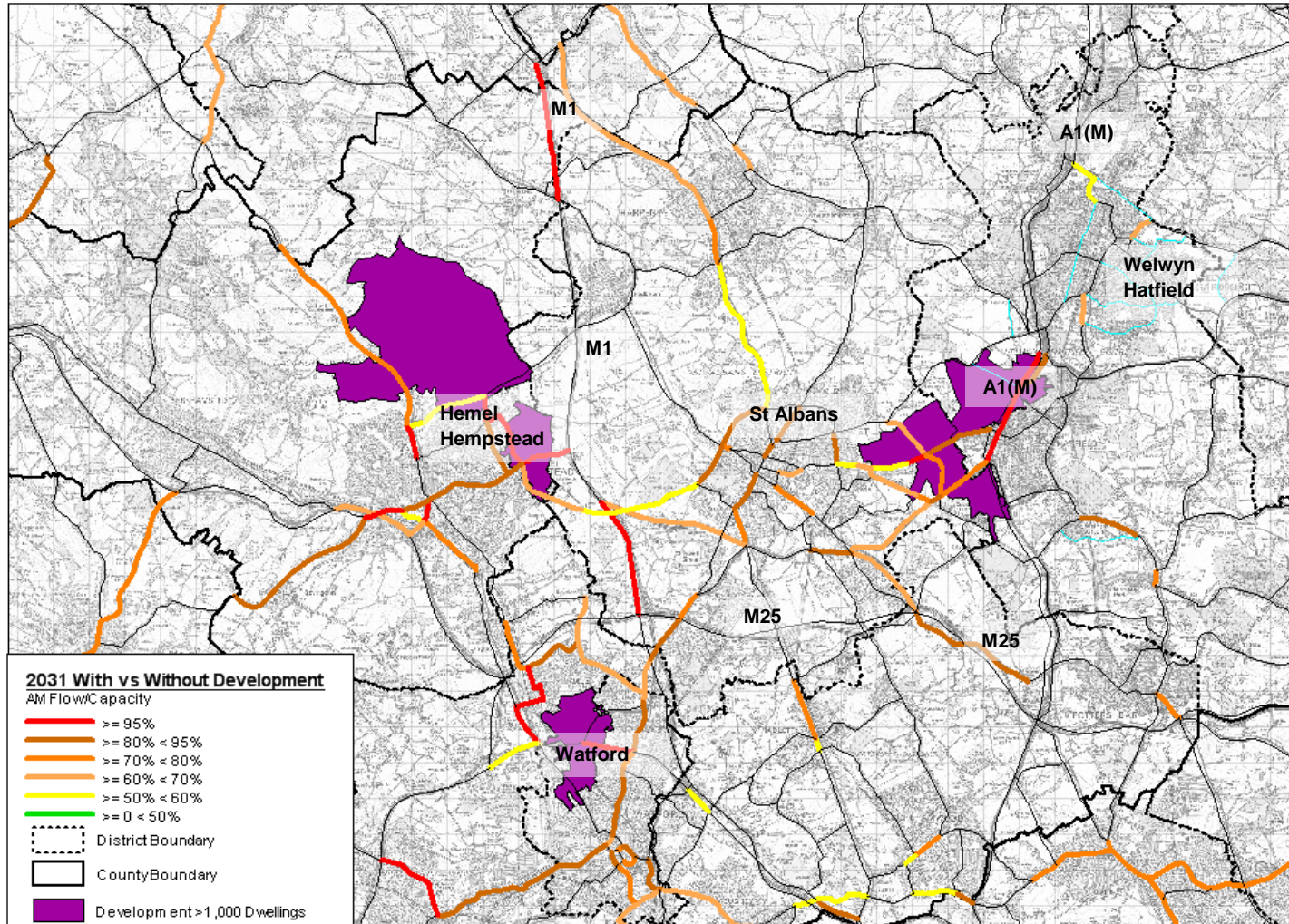


Figure 5: Without Development Stress 2031 PM Peak

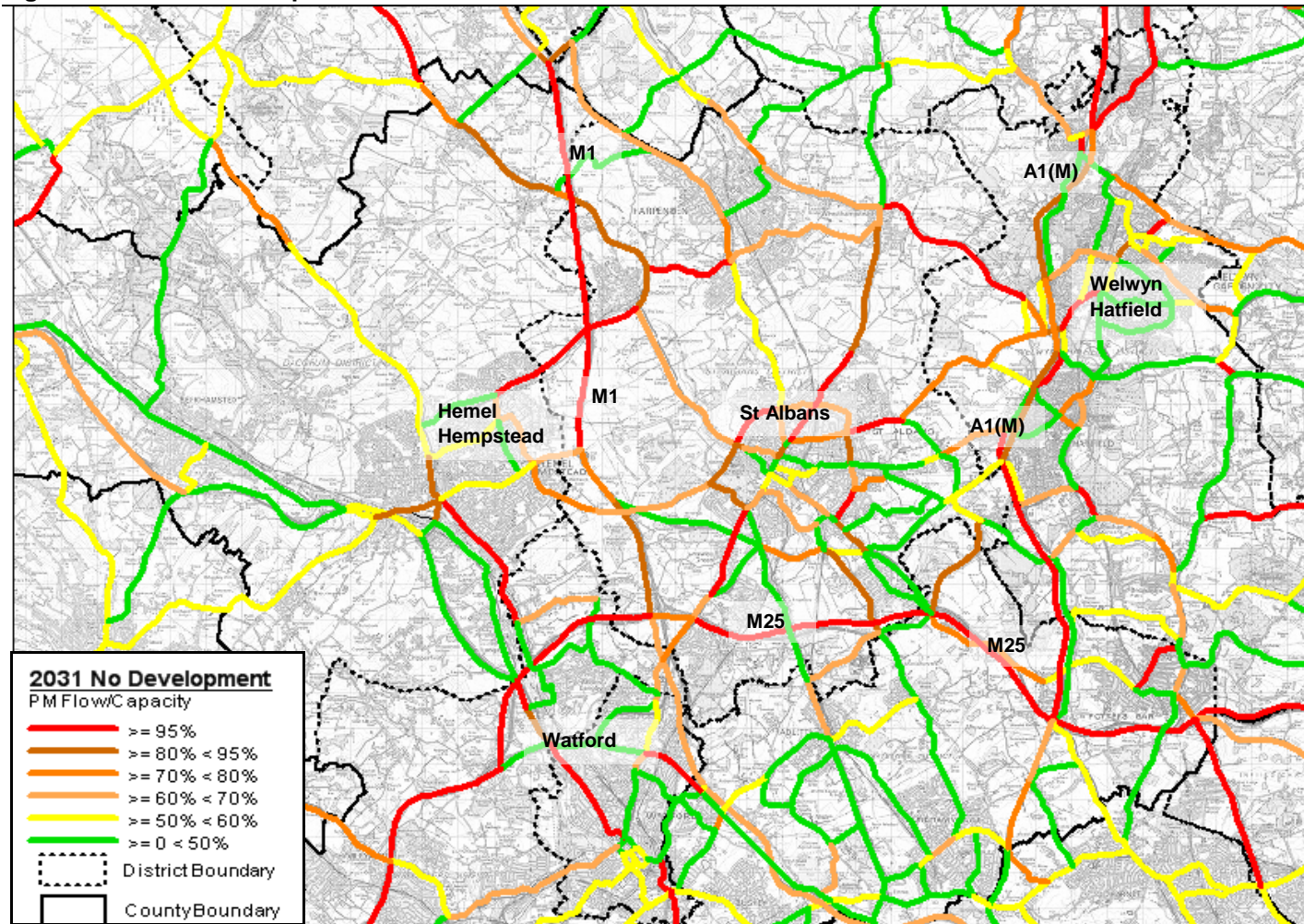
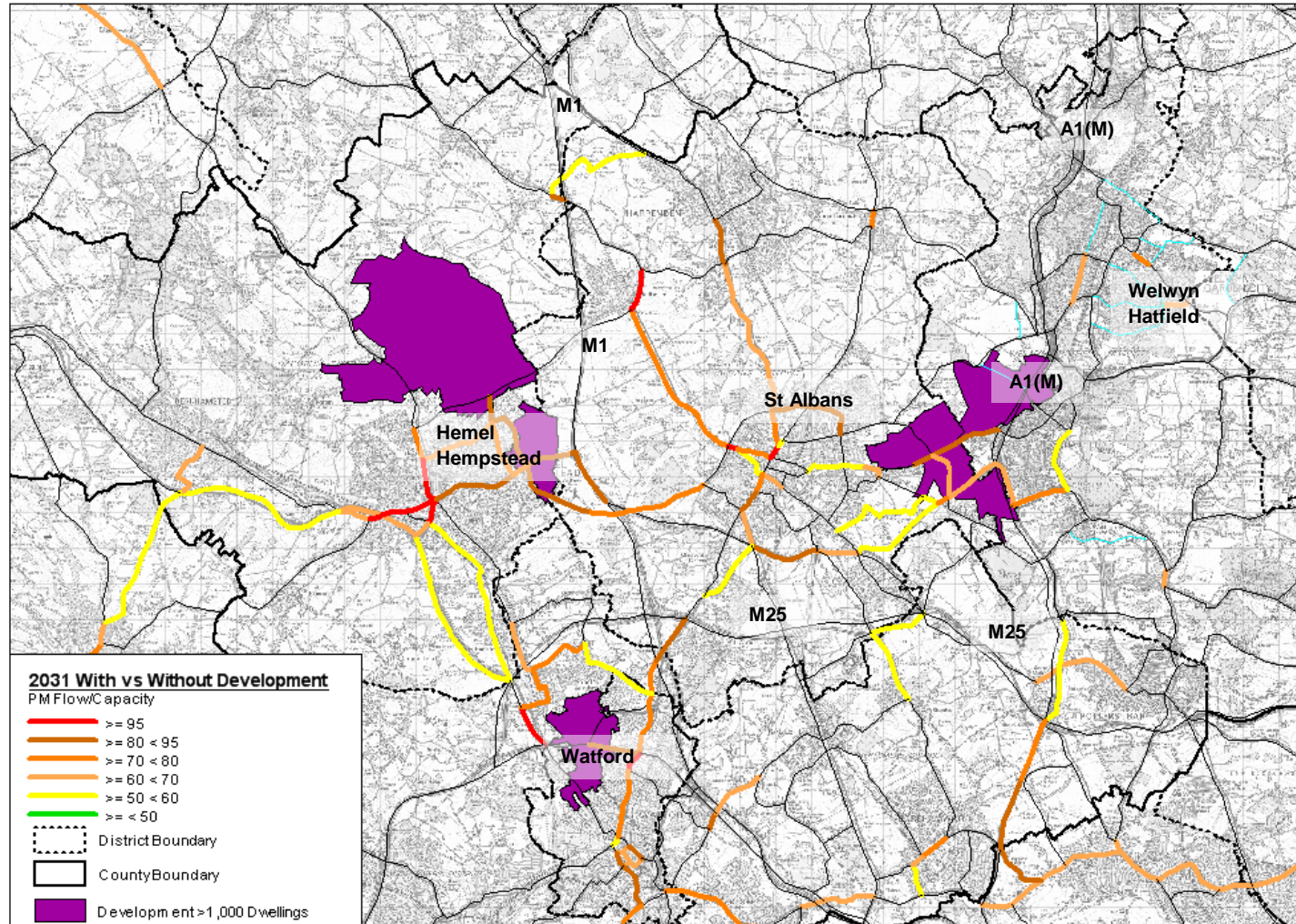


Figure 6: Stress Change With Development 2031 PM



5. Analysis of Network Outputs

For each of the AM (08:00 to 09:00) and PM (17:00 to 18:00) peak hours, six sets of statistics have been used to assess the impact of each development scenario quantitatively. These are:

- Average Speed (kph) on the whole Hertfordshire network;
- Average Speed (kph) only on links within each of the six districts (kph);
- Additional Passenger Car Unit (PCU) kilometres (km) on the whole network;
- Additional PCU-km within each of the six districts;
- Additional PCU-Hours on the whole network; and
- Additional PCU-Hours within each of the six districts.

These are presented in **Table 11** and **Table 12** for the AM and PM peaks respectively.

Average speed has been calculated using two methods. For average speed in the UK for the 2009 base year, all links are used, whereas for 2031 scenarios, only links traversed by development traffic are included. For average speed in the six districts, all links have been used. All average speeds are weighted by flow and link length.

Passenger Car Unit (PCU) is a term used to measure the impact that a mode of transport has on traffic variables, such as speed or headway, compared to a single car. A PCU factor of 2.2 is used for HGVs. All other vehicles, including LGVs have a PCU factor of 1.0.

Total PCU kilometres across the whole network and separately, within the six districts, have been calculated for the base year (2009) as well as 2031 with and without development. This is calculated by multiplying the volume of traffic on a link by the length of that link. The additional kilometres, created as part of the developments are also shown.

PCU-hours have been calculated for all links within Southwest Hertfordshire as well as links within each of the six districts. PCU-hours are calculated by multiplying the volume of traffic on a link by the time taken for this traffic to travel along this link. The additional PCU-Hours which are added due to the developments have also been calculated. Note that these include additional hours created for existing traffic due to increased congestion from development traffic. As existing traffic does not re-route within DIAMOND, this is a key difference from the PCU kilometre statistic, which is strictly for development trips.

Table 11 shows that the average speeds reduce at varying degrees due to the delivery of housing and employment growth in the AM peak in 2031. The lowest change is experienced by Hertsmere where speed has decreased by 0.4 kph from 67.1 to 66.6 kph. Watford experiences the highest network impact, with speed decreasing by 4.0 kph from 72.7 to 68.7 kph. Even though Dacorum has been allocated the highest level of housing growth, the change in network speed is less significant than in Watford. In terms of overall network performance, Three Rivers has the lowest speed of 57.1 kph with development in 2031.

St Albans has recorded the highest increase in PCU-km of 38,510 compared to other districts. This is followed by Dacorum and Hertsmere, both recording an increase by 34,487 and 22,249 PCU-km respectively. This trend has been observed despite St Albans having the lowest allocation of housing growth, as housing allocations for Welwyn Hatfield fall within the St Albans district boundary, which therefore have the capacity to affect the road network within St Albans. The high increase in PCU-km in Dacorum is expected, given the quantum of housing allocation in the district.

The trend in PCU-hours mirrors that of PCU-km, with the highest increase experienced by the road network in St Albans. This is followed by Dacorum and Hertsmere. This shows that the increase in housing development is not only causing people to travel further, but also spend longer on the road network due to increased congestion.

Table 12 shows the impact of development on the all modelled roads in the DIAMOND network in the PM peak. In terms of average speed, Dacorum experiences the largest decrease in speed, from 79.3 to 76.7 kph. It is followed by St Albans and Watford, which experience decreases of 2.0 and 1.7 kph respectively. The best performing district is Hertsmere, which has an average speed of 82.1 kph.

In terms of PCU-km, St Albans experiences the highest increase, followed by Dacorum, with increases of 37,300 and 33,519 PCU-km respectively. This is similar to the trend experienced in the AM peak. The best performing district is Welwyn Hatfield, with an increase of PCU-km by 13,578.

Again, with PCU-hours, the trend mirrors PCU-km, with St Albans, Dacorum and Hertsmere experiencing the highest decreases. The best performing district is Watford, with an increase in PCU-hours of 277.

Table 11: AM Peak Hour Quantitative Analysis

	2009	2031 Without Dev	2031 With Dev	With Dev vs Without Dev Abs Diff	With Dev vs Without Dev % Diff
Average speed (kph) - Hertfordshire	81.7	67.0	66.3	-0.7	-1.0%
Dacorum	87.4	75.0	73.1	-1.9	-2.5%
Hertsmere	82.0	67.1	66.6	-0.4	-0.7%
Three Rivers	71.4	57.9	57.1	-0.7	-1.4%
St Albans	82.2	66.2	64.8	-1.4	-2.1%
Watford	77.5	72.7	68.7	-4.0	-5.5%
Welwyn Hatfield	82.8	65.2	64.6	-0.7	-0.9%
Vehicle (PCU) KM - Hertfordshire	2,409,889	2,995,318	3,135,470	140,152	4.7%
Dacorum	263,697	312,968	347,455	34,487	11.0%
Hertsmere	374,805	452,149	474,397	22,249	4.9%
Three Rivers	246,819	308,544	323,726	15,182	4.9%
St Albans	471,403	588,025	626,535	38,510	6.5%
Watford	48,286	57,180	72,320	15,140	26.5%
Welwyn Hatfield	436,088	556,238	568,396	12,158	2.2%
Vehicle (PCU) Hours - Hertfordshire	31,860	52,770	55,622	2,852	5.4%
Dacorum	3,164	5,966	6,614	648	10.9%
Hertsmere	4,816	7,688	8,081	393	5.1%
Three Rivers	3,635	5,739	6,098	360	6.3%
St Albans	6,415	10,958	11,807	850	7.7%
Watford	659	864	1,161	297	34.4%
Welwyn Hatfield	5,813	9,731	9,998	267	2.7%

Table 12: PM Peak Hour Quantitative Analysis

	2009	2031 Without Dev	2031 With Dev	With Dev vs Without Dev Abs Diff	With Dev vs Without Dev % Diff
Average speed (kph) - Hertfordshire	84.6	73.3	72.2	-1.1	-1.5%
Dacorum	88.7	79.3	76.7	-2.6	-3.3%
Hertsmere	90.7	83.3	82.1	-1.2	-1.4%
Three Rivers	72.9	57.6	56.9	-0.7	-1.2%
St Albans	87.2	71.2	69.1	-2.0	-2.9%
Watford	78.6	67.3	65.6	-1.7	-2.5%
Welwyn Hatfield	84.0	70.1	69.2	-0.9	-1.3%
Vehicle (PCU) KM - Hertfordshire	2,254,668	2,698,013	2,836,304	138,291	5.1%
Dacorum	245,929	282,551	316,069	33,519	11.9%
Hertsmere	323,854	360,583	382,729	22,147	6.1%
Three Rivers	244,575	291,185	305,163	13,978	4.8%
St Albans	440,869	548,528	585,828	37,300	6.8%
Watford	44,414	51,492	66,954	15,462	30.0%
Welwyn Hatfield	415,581	504,128	517,707	13,578	2.7%
Vehicle (PCU) Hours - Hertfordshire	28,511	41,848	44,620	2,772	6.6%
Dacorum	2,898	3,874	4,499	625	16.1%
Hertsmere	3,787	4,779	5,144	365	7.6%
Three Rivers	3,445	5,236	5,565	329	6.3%
St Albans	5,525	9,701	10,540	839	8.6%
Watford	591	842	1,119	277	32.9%
Welwyn Hatfield	5,351	8,394	8,700	307	3.6%

6. Conclusions

It should be stressed that DIAMOND, and our assessment, can only consider the transport network implications of locating developments, and can consider even these only with some caveats. Our conclusions should therefore be appreciated in a wider context, as there will be substantial considerations as to where a development should be located and how it will interact with the SRN.

Primary and A roads with the highest increase in flows and stress levels include:

AM:

- A414 St Albans Road, Hemel Hempstead;
- Two Waters Road, Hemel Hempstead;
- A4146 Leighton Buzzard Road, Hemel Hempstead;
- A414 North Orbital Road east of London Road, St Albans;
- A41 North Western Avenue, North Watford; and
- A412 St Albans Road, North Watford.

PM:

- A414 St Albans Road, Hemel Hempstead;
- Two Waters Road, Hemel Hempstead;
- A4146 Leighton Buzzard Road, Hemel Hempstead;
- A41 North Western Avenue, North Watford; and
- A412 St Albans Road, North Watford.

Sections of the SRN with increases in stress include:

AM Peak:

- M1 between J9 and J10;
- Sections of the A1(M) between J3 and J4; and
- M1 between J6A and J7.

PM Peak:

- A1(M) between J2 and J3; and
- A1 Barnet Bypass;

Based on the analysis, Watford and Dacorum experience the largest decrease in average speeds in the AM and PM peak respectively highlighting the likely increases in congestion with the proposed development quantum. Despite the significant drop in speeds, the networks in these two districts perform better than Three Rivers, which has the lowest average speed amongst the six districts.

St Albans experiences the largest increase in PCU-km and PCU-hours, in both the AM and PM peaks. Welwyn Hatfield has the best performing network, with the smallest increase in both PCU-km and PCU-hours.

The trend in PCU-hours mirrors that of PCU-km, with the highest increase experienced by the road network in St Albans. This is followed by Dacorum and Hertsmere. This shows that the increase in housing development is not only causing people to travel further, but also spend longer on the road network due to increased congestion.

Limitations of the model should be considered in quantifying the results. DIAMOND does not model junctions, therefore, the stress levels observed in the outputs may well be different from stress on the network in reality, especially on urban roads where stress is dictated by junction capacity rather than link capacity.

Finally, it should be borne in mind that this is a very broad assessment of the growth forecasts between 2009 and 2031. Whilst some districts may appear to perform better than others, they do not currently operate at a level playing field, as the growth forecasts are available at varying levels of detail. In addition, some districts currently do not envisage employment growth, however in reality there is likely to be some level of employment growth within all districts over the 22 year assessment period.

7. Next Steps

As set out within the Specification Note for the work, the additional task of assessing the cumulative impacts development on the Strategic Road Network junctions was identified.

DIAMOND does not explicitly model junctions, but it is possible to extract the turning flows induced by development. Should analysis at key strategic road junctions be required, development turning movements could be 'overlaid' on top of extracted flows (and capacities) from the East of England Regional Models. This would provide indicative estimates of the impact of development on each junction, allowing a valuable indication of the influences of development on the SRN and its junctions. It will also provide an indication if there are likely to be operational issues at the junctions in question and indeed identify if there are solutions readily available at low cost.

It is now recommended the assessment of the performance of the M25 junctions 20, 21, 21A and 22 and key junctions on the M1 and A1 is undertaken to gain an overview of the scale of impacts.

The planning data incorporated within the model is highlighted in Chapter 3 for the six southwest Hertfordshire Districts. It is important to note, the impacts of the cumulative development on the Strategic Road Network as outlined in this note will be subject to change, if differing assumptions of the quantum and spatial allocation of development are applied. This is likely to occur since the Districts are currently at different stages of the Core Strategy process. As a result assumptions have been applied within the model, in terms of the quantum and distribution of development, which may not represent the assumptions in the final Core Strategy documents.

It is therefore recommended the planning data, which is included in this assessment, is reviewed and updated in due course and a revised cumulative development impact assessment is undertaken.

Tables 11 and 12 in the Analysis of Network Outputs present sets of output statistics from DIAMOND. These sub-divide outputs by the six Districts. It is however noted the Strategic Road Network could be presented separately, allowing the Highways Agency insight into the change in network performance within the scenario tested.

It is also recommended that further refinement of DIAMOND is now undertaken to enhance its capability of modelling restricted movements at junctions. We would also recommend that a further review of available traffic data is undertaken given that only a limited amount have been used to date on the local road network.

It is also recommended that a meeting is arranged to explain the analysis and conclusions reached to discuss the modelling process undertaken as well as the implications and interpretation of the analysis and results.