Annex 32

Havering
LONDON BOROUGH

CABINET MEETING
19th JULY 2017

HAVERING LOCAL PLAN

HAVERING STRATEGIC MODELLING TECHNICAL NOTE 2016

Transport for London

Havering Strategic Modelling Technical Note

October 2016

1. Introduction and Objectives

This note provides a high level analysis of the network performance and changes between the base year 2012 and forecast year 2031 LoHAM (London Highway Assignment Model). Although LoHAM is a London-wide strategic model, the analysis focuses on traffic issues in and around the London Borough of Havering.

LoHAM is a detailed highway assignment model developed by TfL which represents traffic flows and congestion across the whole of the Greater London area and extending beyond the M25 boundary. LoHAM is used to provide the means for assessing strategic infrastructure and development impacts across London.

The LoHAM model employs the SATURN (Simulation and Assignment of Traffic to Urban Road Networks) modelling software package which allows detailed modelling of congestion in urban areas. SATURN is a suite of flexible network analysis programs developed at the Institute for Transport Studies, University of Leeds and distributed by Atkins Limited since 1982.

The base year models, developed for AM and PM peak hours and an average Inter Peak hour are fully calibrated representations of traffic flows and conditions across the modelled area. The models are calibrated to 2012 count data and traffic movements and validated to exacting standards against a large number of observed journey times for routes across the network. The 2012 models serve as bases for the development of 2031 forecast year (Reference Case) models with trip growth controlled to LTS (London Transport Study) trip levels, taking account of changes between base and forecast zonal level trip ends and the inclusion of all committed and funded highway schemes.

The analysis of the strategic highway modelling presented here was undertaken by the Strategic Analysis team within TfL Group Planning on behalf of the London Borough of Havering. The overall objective was to provide information about the network based plots which show distributions of traffic growth and the locations of major delays across Havering, in particular for the major A12 and A127 trunk roads and the A13 in the south of the borough.

This note describes the analysis of the Base 2012 and forecast year 2031 for AM, Inter peak and PM peak hours.

2. LoHAM background Demand Growth

Reference Case Demand matrices were developed using the CHAMP (Cube to HAM Process) process to apply, at zone level, changes in LTS 7.0 demand between the 2012 Base Year and the relevant Reference case year (2031). CHAMP is a calculation process which derives the incremental demand growth between the LTS base and forecast year. CHAMP then applies this incremental growth to the LoHAM base year to create a LoHAM forecast model. The LTS matrices included specific major developments but control of trip totals was applied to wider areas. The 2012 demand matrices were used to pivot from and corresponding to each of the periods.

LTS used the population, household and employment data from the London Plan: the hybrid borough-level projections for the GLA area, produced by the GLA. For the Annulus (the area between GLA boundaries and M25) and External (mostly outside the M25) areas, population, household and employment data was based on Department of Transport projections in TEMPRO 6.2.

Matrices are defined in Passenger Car Units (PCU) and are equivalent to one car. The matrices are one hour demand flow and formed the basis for the development of the Reference Case demand matrices for the following time periods:

- AM peak hour 8:00-09:00
- Inter peak – Average hour of 10:00-16:00
- PM peak hour 17:00-18:00

The model has five user classes factored to PCUs as follows:

1. Car (In Work Time) – PCU Factor 1
2. Car (Out of Work Time) – PCU Factor 1
3. Taxi – PCU Factor 1
4. Light Goods Vehicles (LGV) – PCU Factor 1
5. Other Goods Vehicles (OGV) – PCU Factor 2

A PCU Factor of 2 is also applied to busses.

Table 2.1 below shows the total trip origins and destinations in Havering between 2012 and 2031 Reference Case year for AM, Inter peak and PM. Growth in the totals of trip origins and destinations averages between 3.35% and 3.6% by time period, with growth in the Inter peak slightly higher than in the two peak hours. AM peak

origins and PM peak destinations show the greatest growth at 4.3% and 3.9% respectively.

Table 2.1 Origin/ Destination in Havering

	Origin				Destination			
	2012	2031	Diff	%diff	2012	2031	Diff	%diff
AM	30,898	32,218	1,319	4.3%	30,828	31,519	691	2.2%
IP	25,021	25,894	873	3.5%	25,642	26,583	942	3.7%
PM	28,805	29,611	807	2.8%	30,138	31,307	1,169	3.9%

The 'heat' maps shown in Figure 2.1 to Figure 2.7 show related information on origin and destination trip-end growth from the 2012 base year to the 2031 Reference Case for the AM, Inter peak and PM periods, but by LoHAM zone. The figures confirm that growth is generally concentrated away from Havering, but also serve to highlight the growth hot-spots around designated development areas such as Barking Riverside and North Greenwich.

Figure 2.1 Trip End Changes by LoHAM zone: AM Peak Origins 2012 to 2031

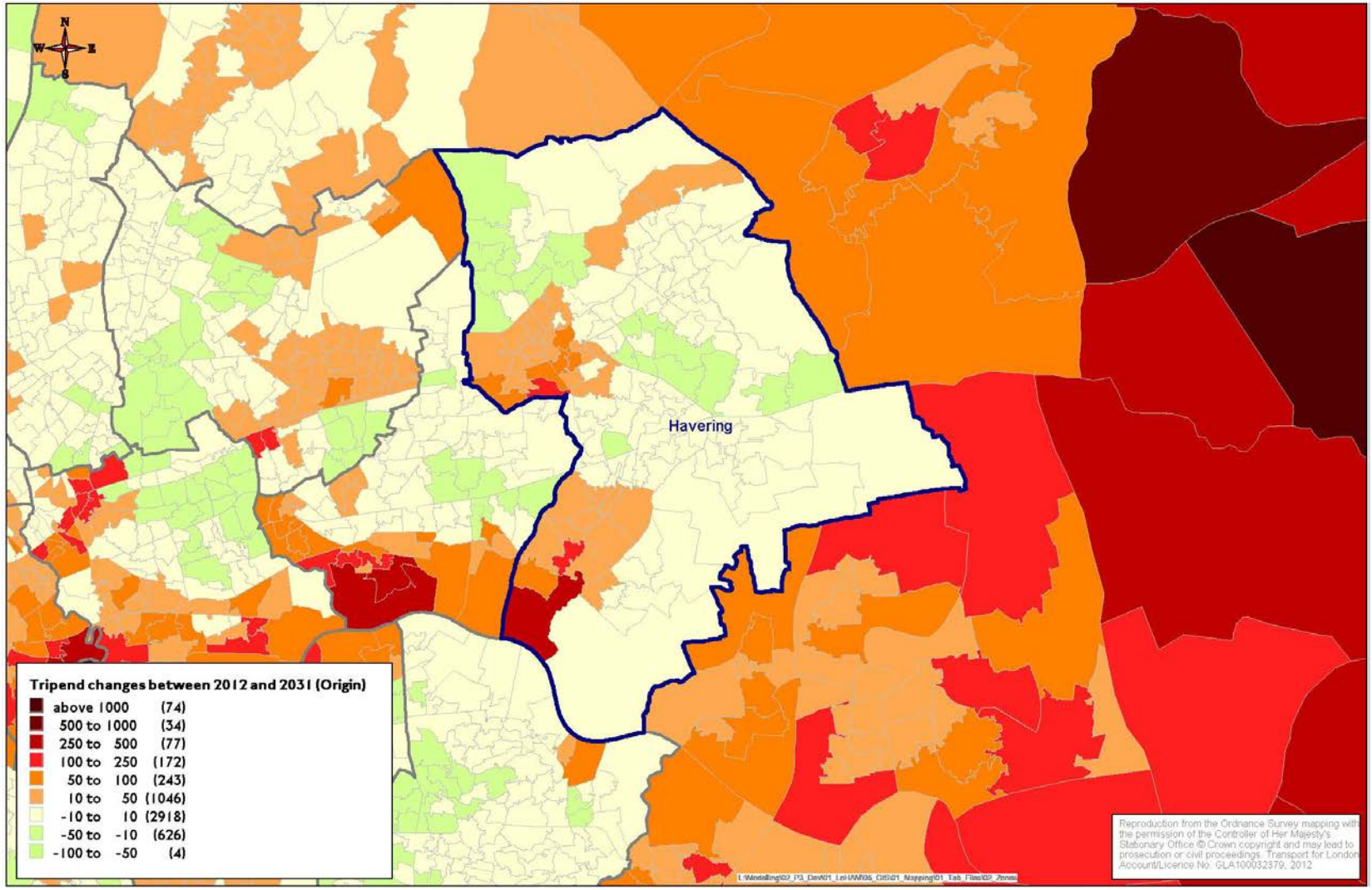


Figure 2.2 Trip End Changes by LoHAM zone: AM Peak Destinations 2012 to 2031

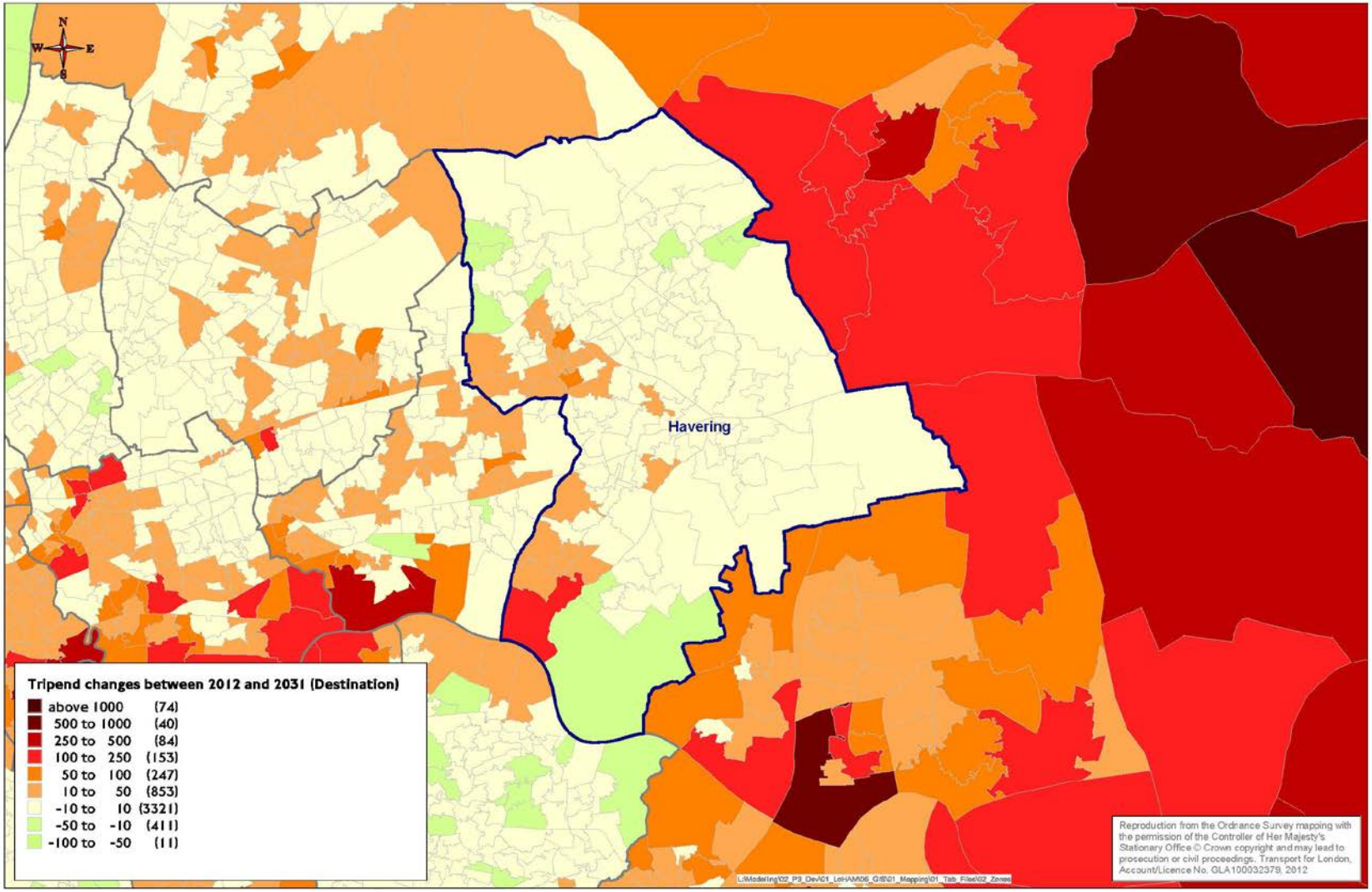


Figure 2.3 Trip End Changes by LoHAM zone: Inter Peak Origins 2012 to 2031

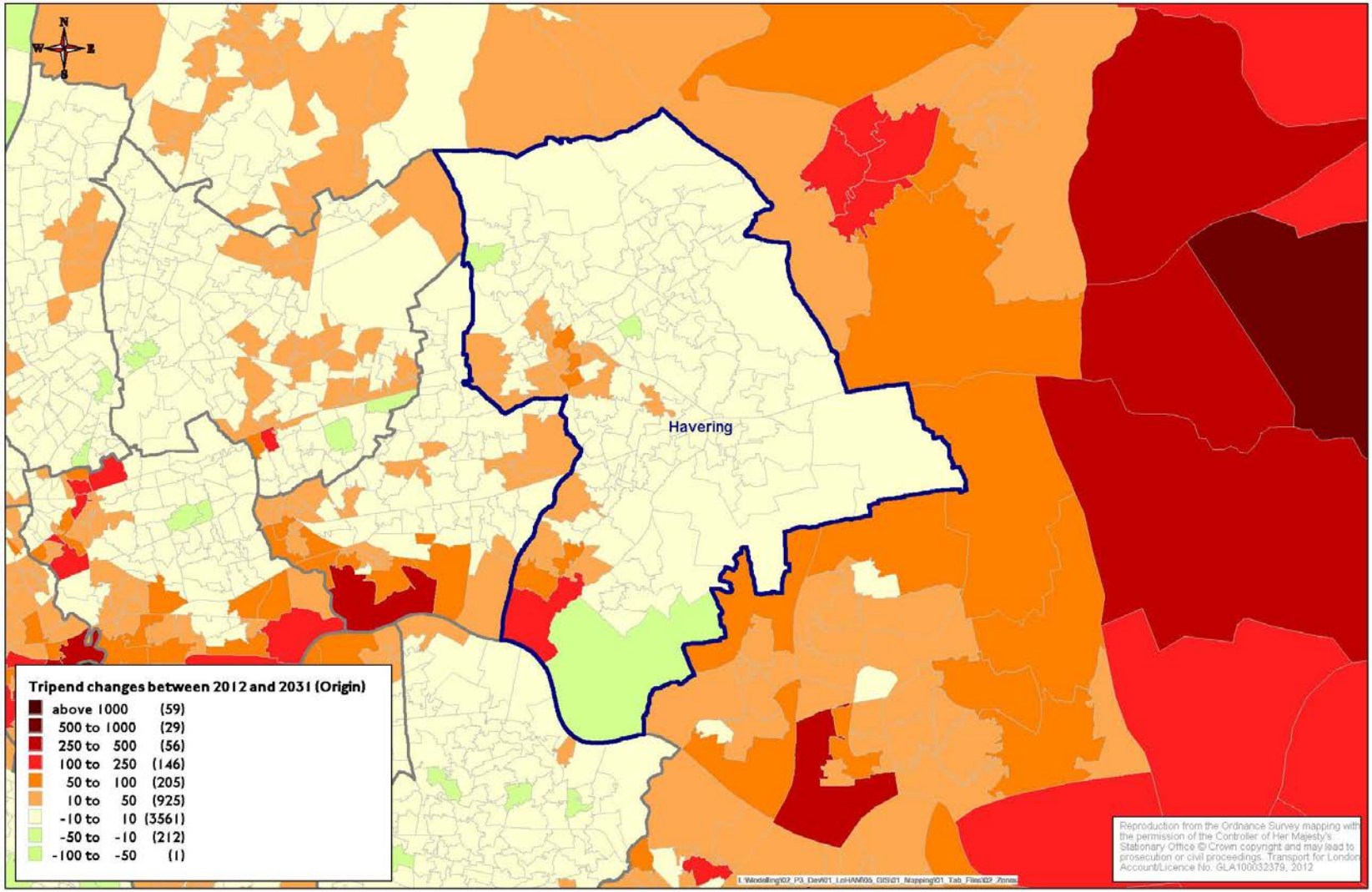


Figure 2.4 Trip End Changes by LoHAM zone: Inter Peak Destinations 2012 to 2031

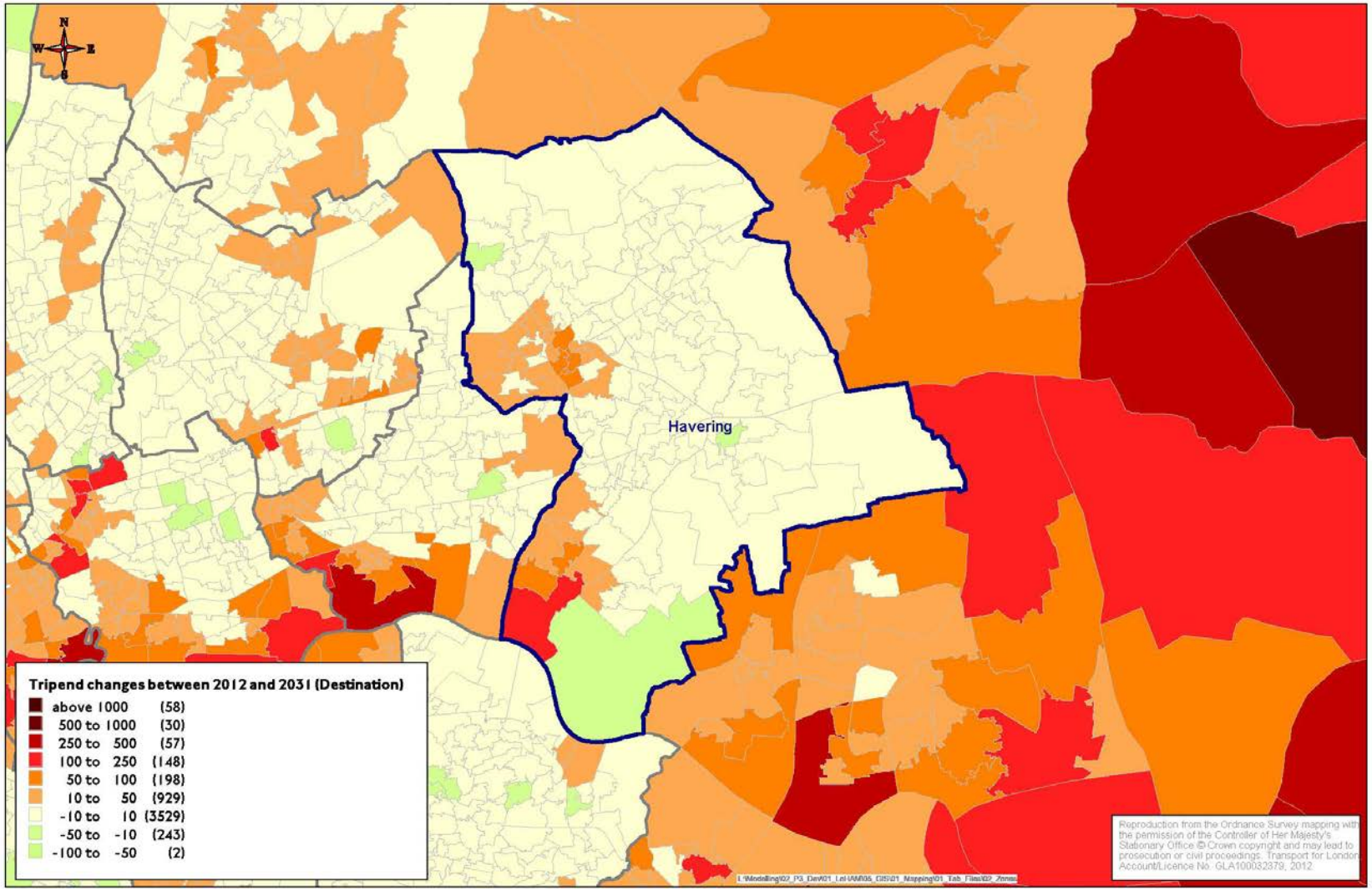


Figure 2.5 Trip End Changes by LoHAM zone: PM Peak Origins 2012 to 2031

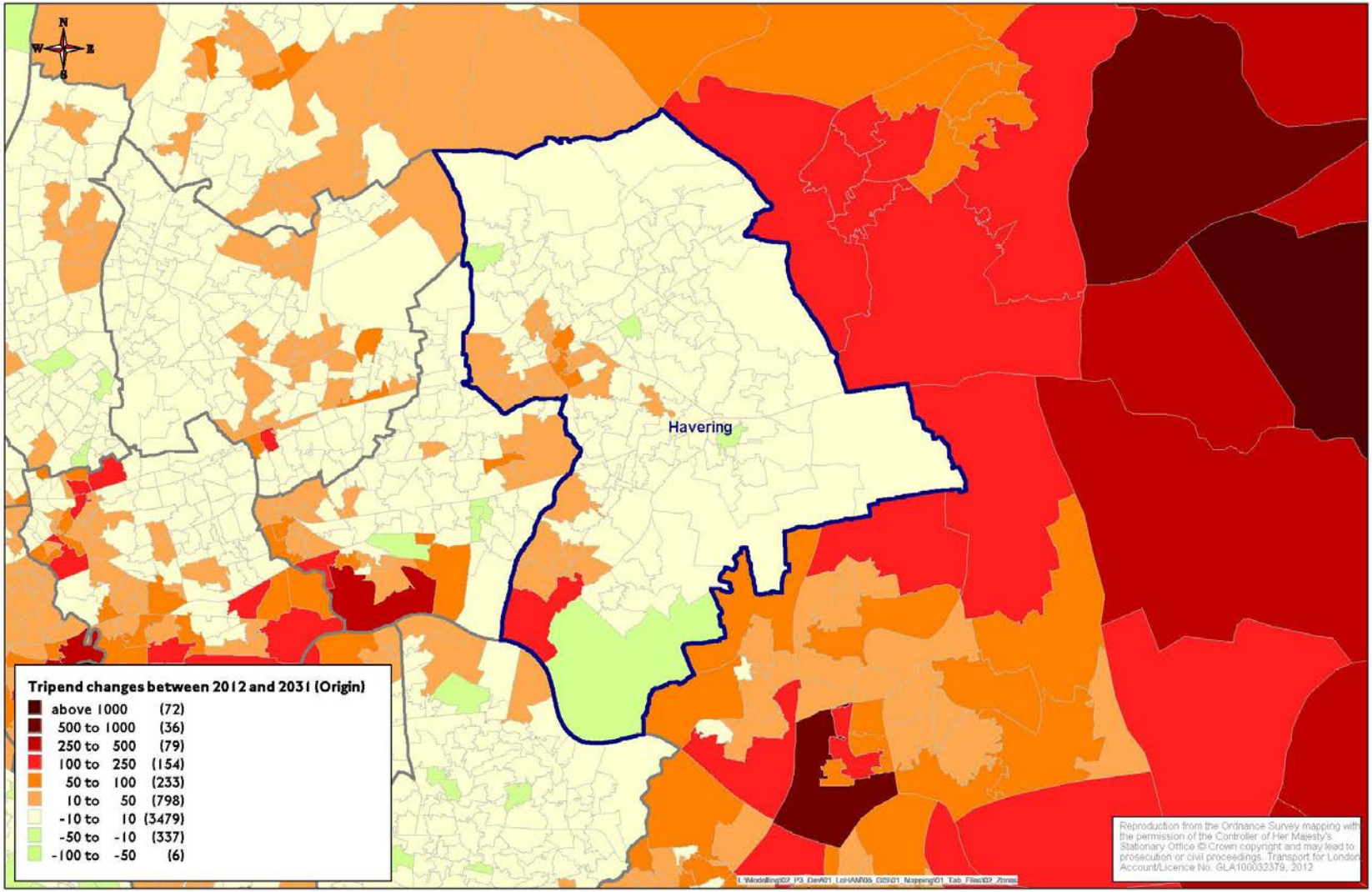
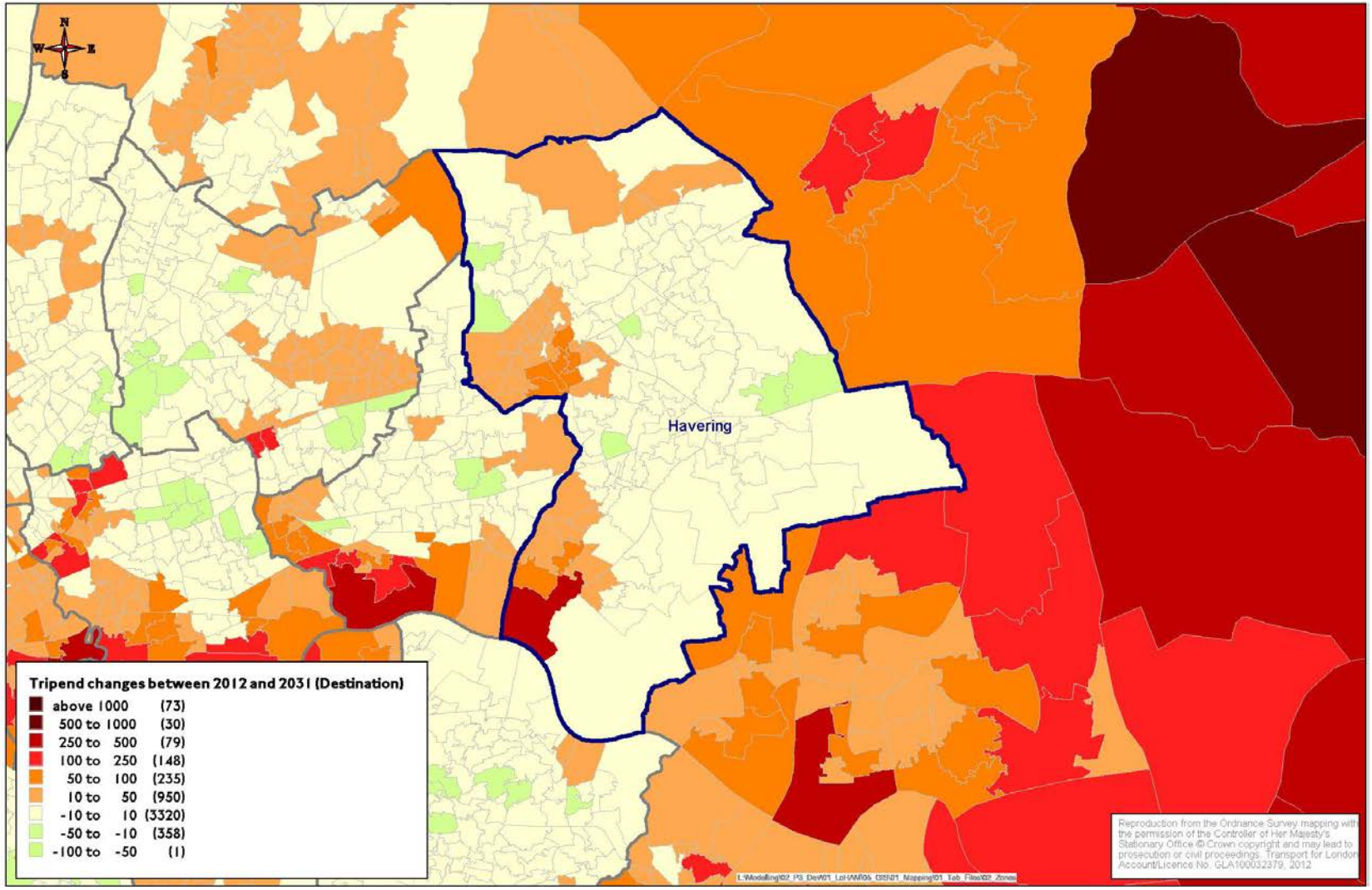


Figure 2.6 Trip End Changes by LoHAM zone: PM Peak Destinations 2012 to 2031



3. Traffic Flow Growth and Comparisons

Figure 3.1 to Figure 3.3 illustrate the change in actual flows (PCU/hour) for the AM, Inter peak and PM peak between the 2012 base year and reference case year 2031.

The green bandwidths show an increase in traffic flows between the reference case year and the base year model and the blue bandwidths show a decrease in traffic flows.

The traffic growth is most evident in outer London, the M25 and principal outer London radial corridors. In all periods, there is a significant M25 growth of traffic that occurs between the junctions 27 to 30, of typically in the range of 7% and 27 % in the AM peak, 14% to 21% in Inter peak and 15% to 33% in PM peak.

The three principle roads in Havering are the A12, A127 and A13 all providing links from M25 towards central London. The pattern of traffic growth shows increase of typically between 5% and 20% across all periods, with peak period growth being strongest against the peak directions, assuming the peak directions to be into London in the AM peak and towards the M25 in the PM Peak. This reflects a general lack of excess capacity in the peak direction in 2012.

For the AM peak, A12 traffic increases by some 13% from Gallows Corners to M25 J28, but by just 5% in the peak westbound direction. West of Gallows Corner, the A12 shows increases in flow in the order of 5% to 7% in the two directions.
On the A127 there is an increase of traffic up to 13% in the contra-peak direction from Gallows Corners to M25 J29, in contrast to the 5% increase in the peak westbound direction. Whilst peak direction flows on the A13 in the Rainham area show a near equivalent level of growth at 4%, eastbound growth is more substantial, reaching a maximum of 40%.

Increases in flow for the Inter peak are generally more balanced than for the AM peak and are typically somewhat higher, particularly in the westbound direction. The A12 from Gallows Corners to M25 J28 shows an increase of approximately 7% eastbound but a more significant 19% westbound. West of Gallows Corner, traffic flows on the A12 increase by approximately 6% to 9%. On the A127 there are increases in traffic of approximately 7% eastbound and 6% westbound, whilst the A13 shows increases of 14% eastbound and 19% westbound.

The pattern of higher levels of traffic growth in the contra peak direction is also reflected in the PM Peak, as in the AM peak. Peak direction flows on the A12 eastbound from Gallows Corner to M25 J28 increase by just 4% but westbound flows increase by some 23%. On the A12 west of Gallows Corner, traffic levels of

increase by around 7% to 8% in the two directions. On the A127 there is an increase in traffic of just 3% from Gallows Corners to M25 J29, with a 2% increase in the contra peak westbound direction perhaps reflecting congestion issues at J29. The A13 near Rainham shows traffic increasing by approximately 30% westbound and about 6% eastbound, effectively mirroring the AM peak findings.

There is generally little growth in traffic demand for the less major roads in Havering, particularly in absolute terms. Flows do increase, but changes are typically in the range 3% to 10%, with relatively few routes displaying increases of greater than 100 pcus per hour. There is no strong trend indicating that peak direction flows on these less major routes increase significantly more due to the higher levels of delay on the major traffic arteries, possibly due to their limited spare capacity in the base year.

Flows on the A1306, particularly east of Rainham, do show significant increases, of typically 400 westbound and 200 eastbound in the AM peak and 300 in each direction in the PM peak. Whilst these changes do represent large percentage increases (of the order 40-70%), some caution must be attached to their interpretation because of the location towards the edge of the simulation model and limited calibration in the area.

Figure 3.1 2012 to 2031 AM Traffic flow Changes

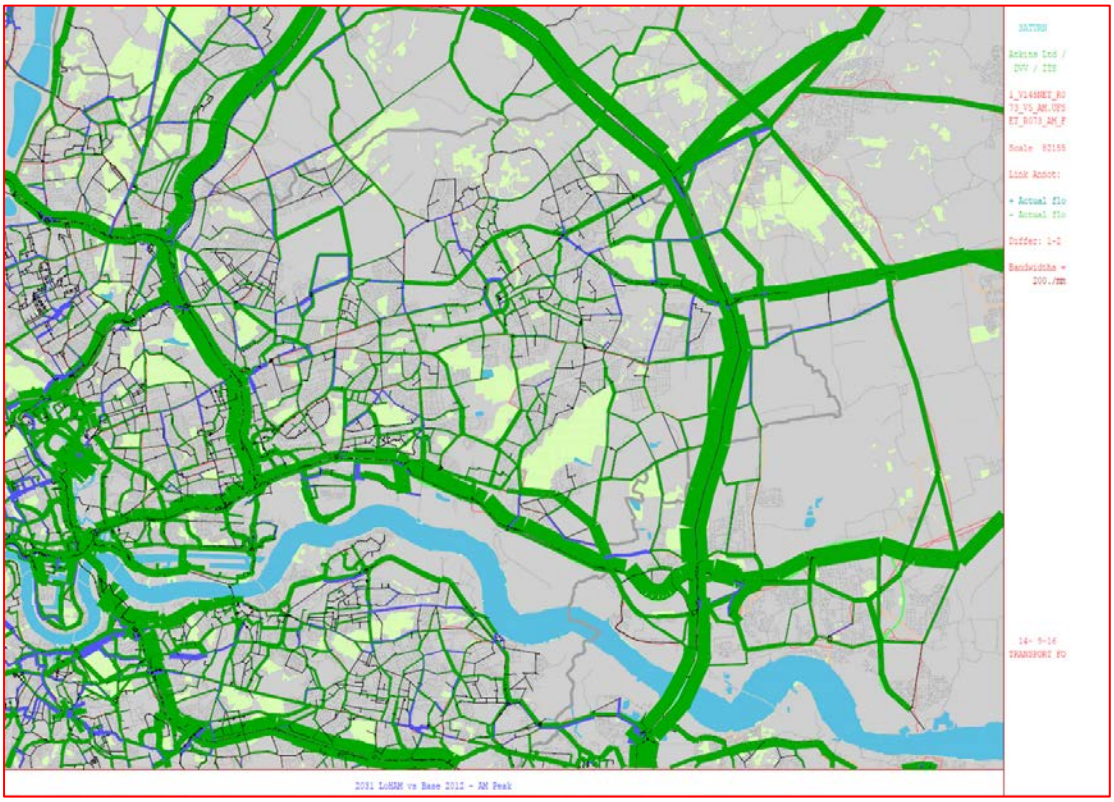


Figure 3.2 2012 to 2031 Inter Peak Traffic flow Changes

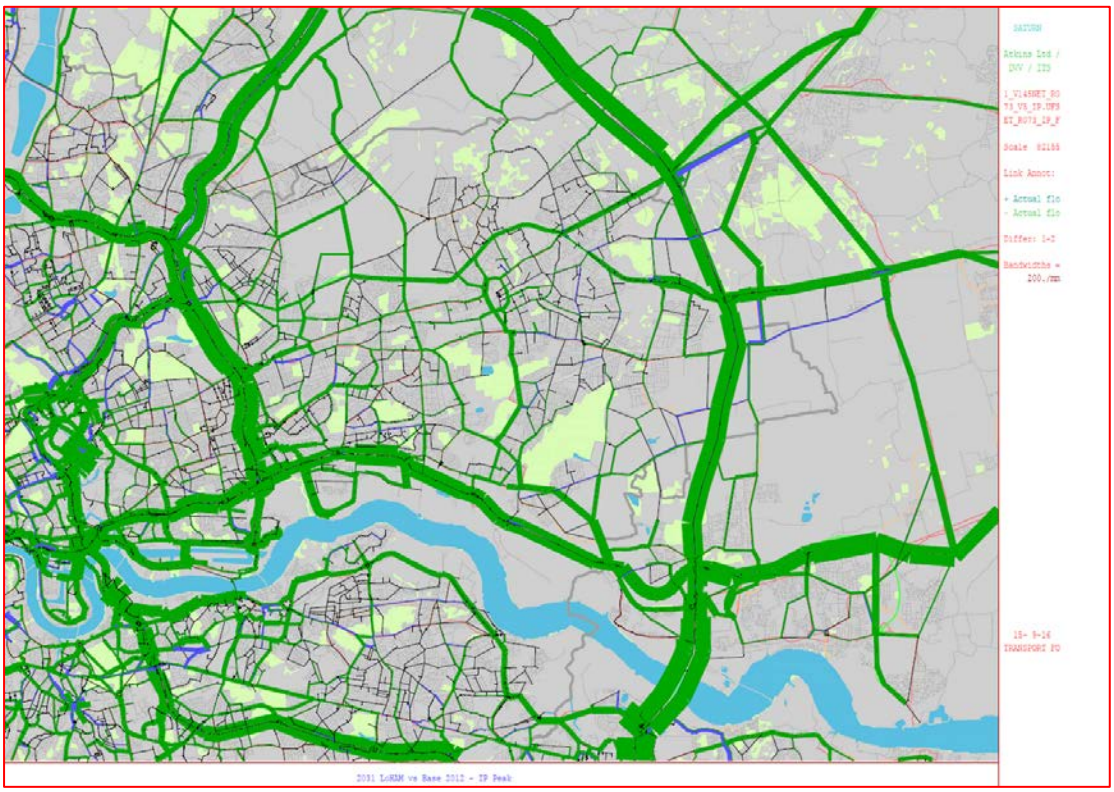
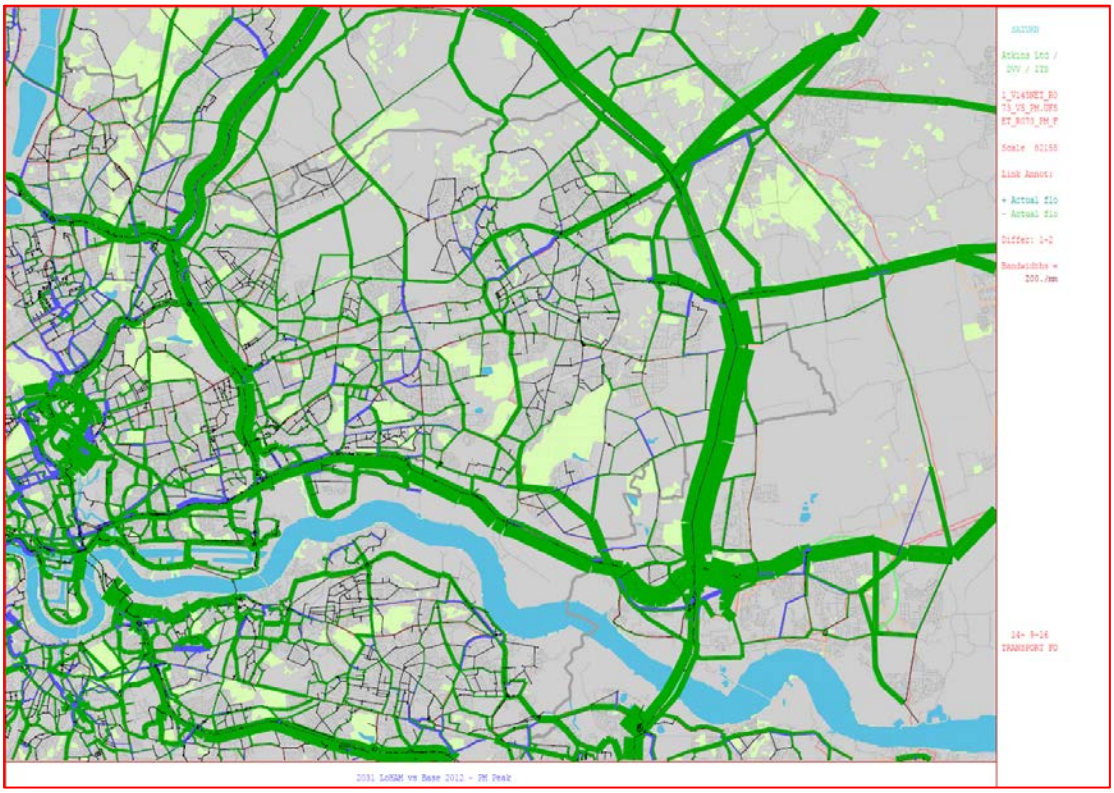


Figure 3.3 2012 to 2031 PM Traffic flow Changes



4. Junction Delays

Junction delays, which are reported below (in PCU hours - actual flow multiplied by average delay time per PCU for each simulated junction) provide a measure of total delay accumulated at the junction due to the individual delays, taking into the account the total volume of traffic through the junction. The choice of PCU hours reflects more appropriately the greater importance of changes in delay where high volumes of traffic flows are affected, but does naturally emphasize delays on high capacity roads, particularly motorways.

Figure 4.1 and Figure 4.2 show in graphical form the total AM peak junction delays (in PCU hours) in LoHAM for the 2012 Base Year and 2031 Reference Year. Changes in delay for the AM peak between 2012 and 2031 are shown in Figure 4.3. In these and subsequent 'difference' plots, the cyan bandwidth discs show an increase in delays (PCU hours) between the base and reference case year and the pink discs show a reduction, the disc radius being proportional to the size of change. The delay differences shown relate to individual LoHAM nodes so a junction (or queue) may comprise a number of such nodes.

Equivalent information on changes in junction delays for the Inter peak are provided in Figure 4.4 to Figure 4.6, and for the PM peak in Figure 4.7 to Figure 4.9
Taken together, the plots show the impacts of changes in traffic flow on modelled junction delays between 2012 and the reference year 2031.

For the AM peak hour, increases in delay can be seen across the highway network from the M25 and its approach roads. 2031 shows a significant deterioration in traffic delays relative to 2012. Some of the largest increases in junction delays occur around the M25 Dartford crossing, M25 J29 (A127), junctions around A13 and Southend Arterial Road A127 /Ardleigh Green Road. The overall picture suggests a network under increasing stress.

Figure 4.9 shows the change in PCU hours at junctions relative to 2012. Where differences are shown, the large majority indicate increases in total delays, confirming the observations made above. Around the M25, particular impacts are shown for J29 (A127), Dartford Crossing, the A13 and Blackwall Tunnel also show deteriorating traffic conditions. For the Inter peak, the increases in delays across the network are generally much smaller, especially on the M25 and A13.

Figure 4.1 2012 AM Total PCU hours Delay

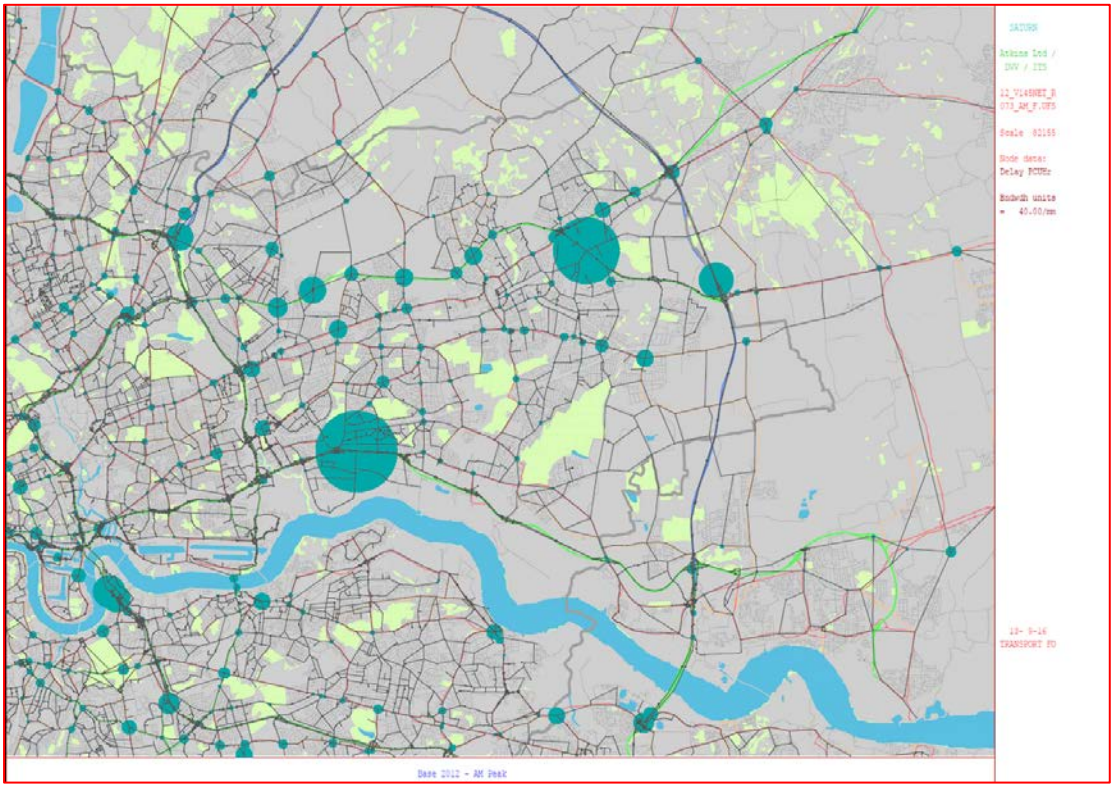


Figure 4.2 2031 AM Total PCU hours Delay

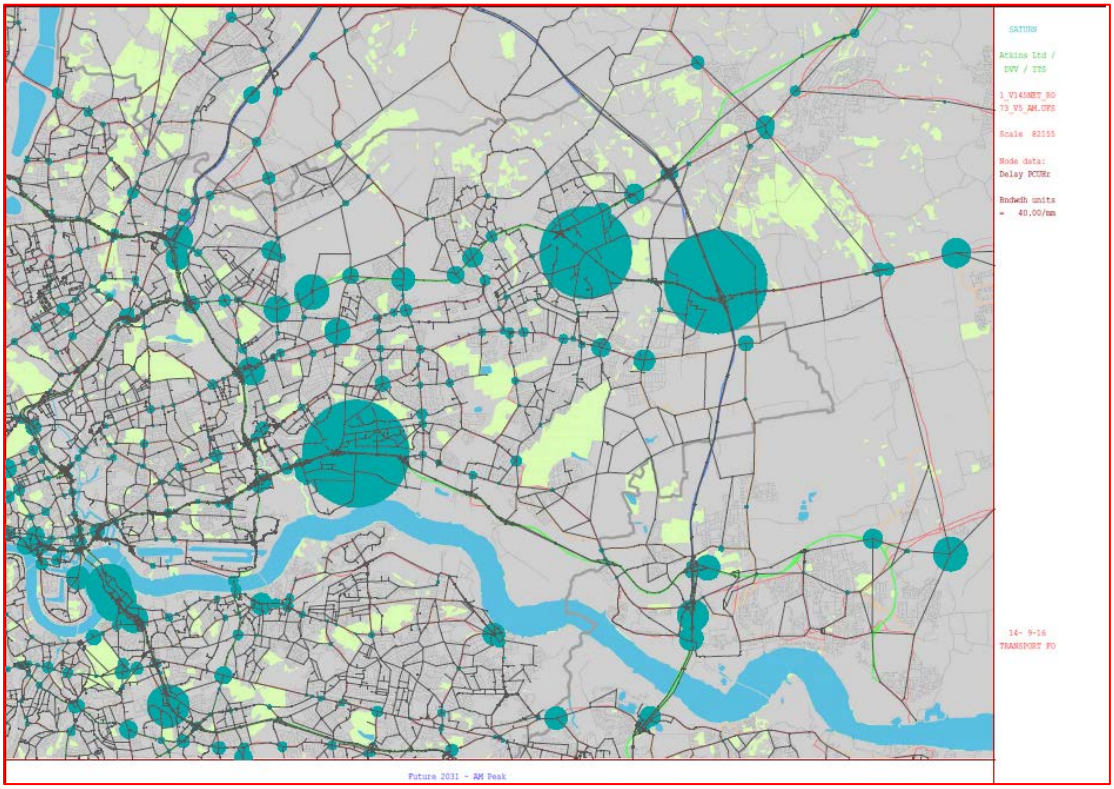


Figure 4.3 2031 AM Total PCU hours Delay Change

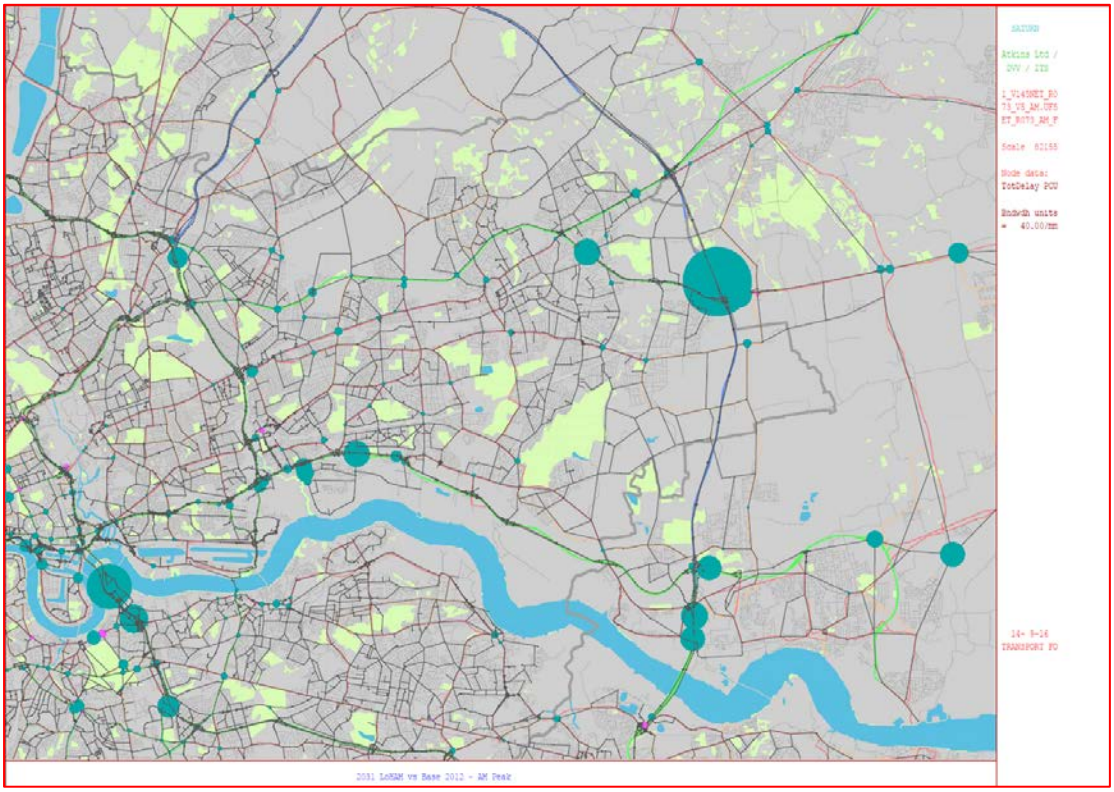


Figure 4.4 2012 Inter Peak Total PCU hours Delay

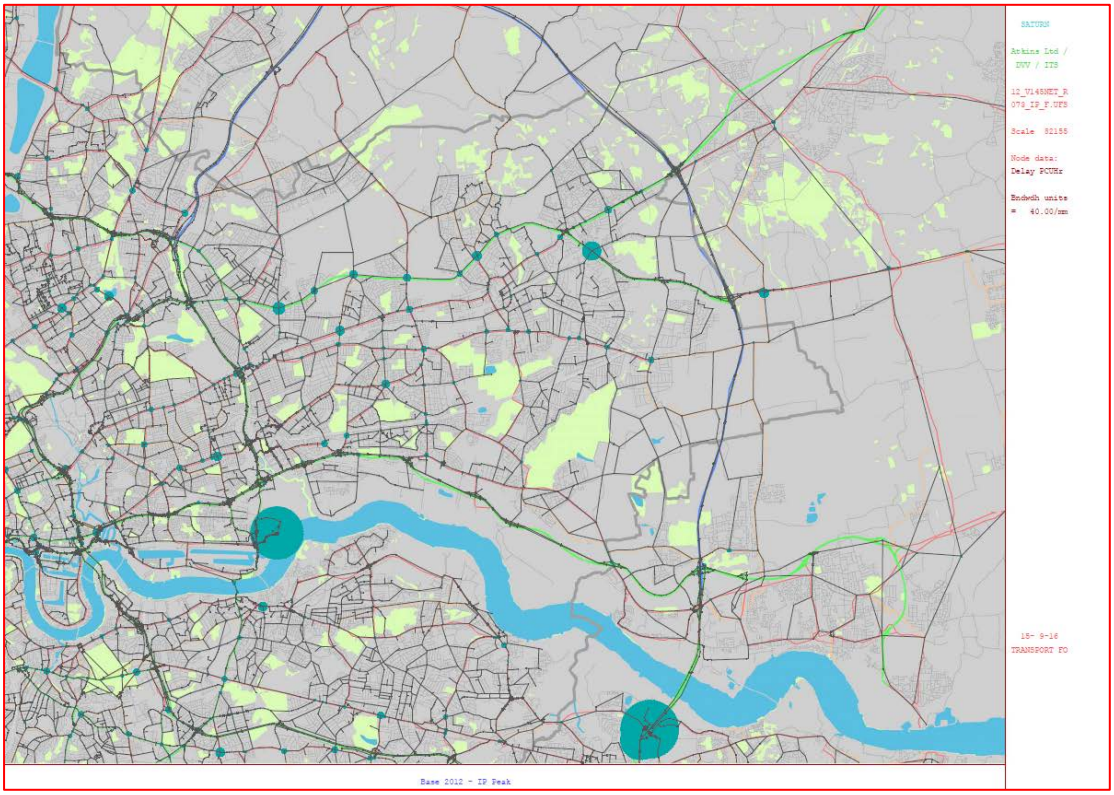


Figure 4.5 2031 Inter Peak Total PCU hours Delay

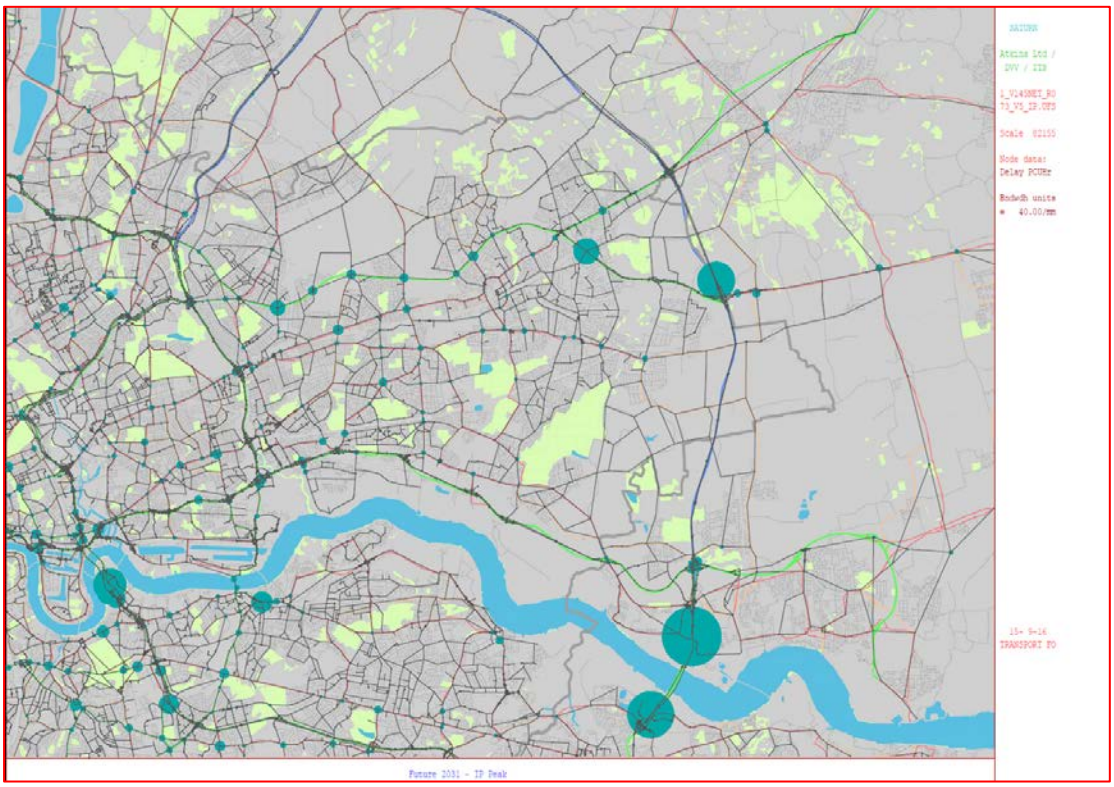


Figure 4.6 2031 Inter Peak Total PCU hours Delay Change

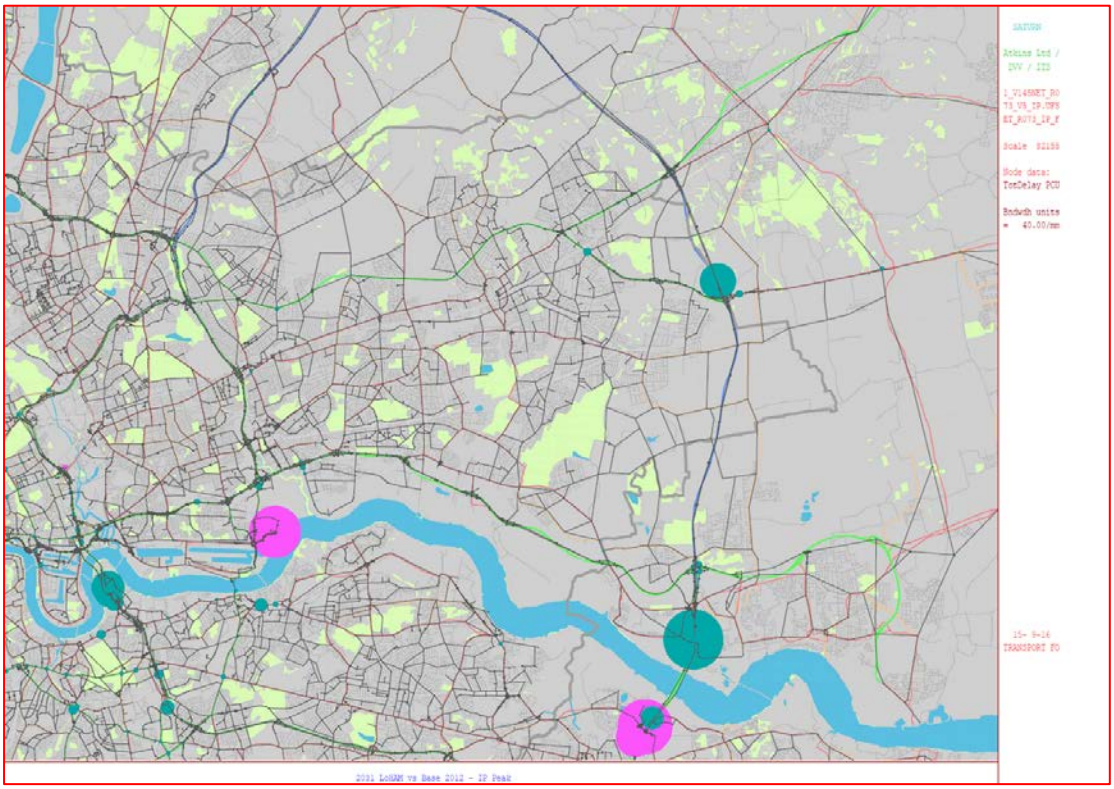


Figure 4.7 2012 PM Total PCU hours Delay

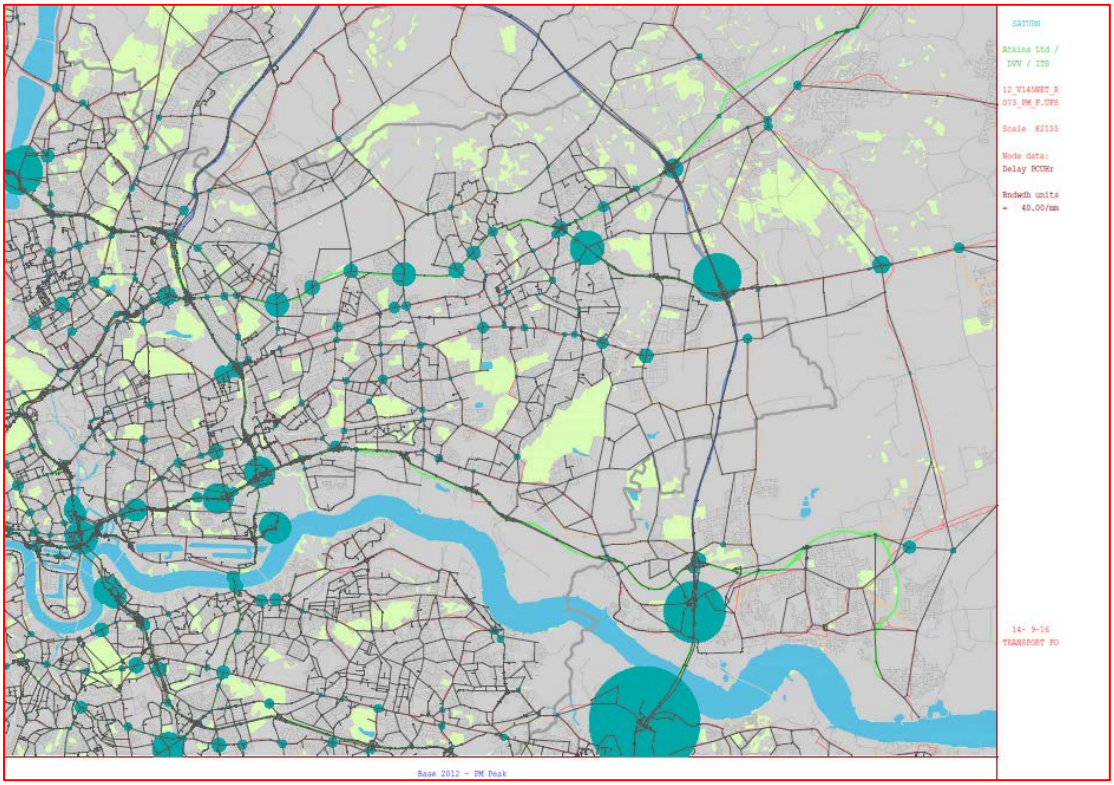


Figure 4.8 2031 PM Total PCU hours Delay

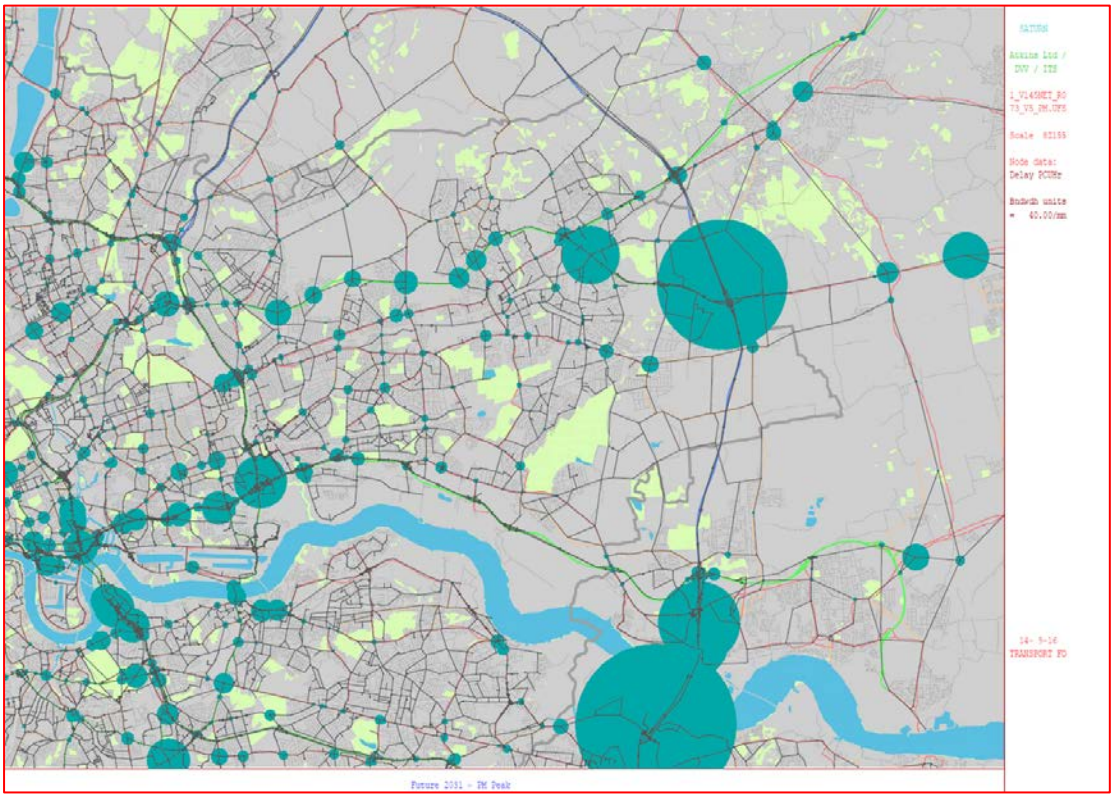
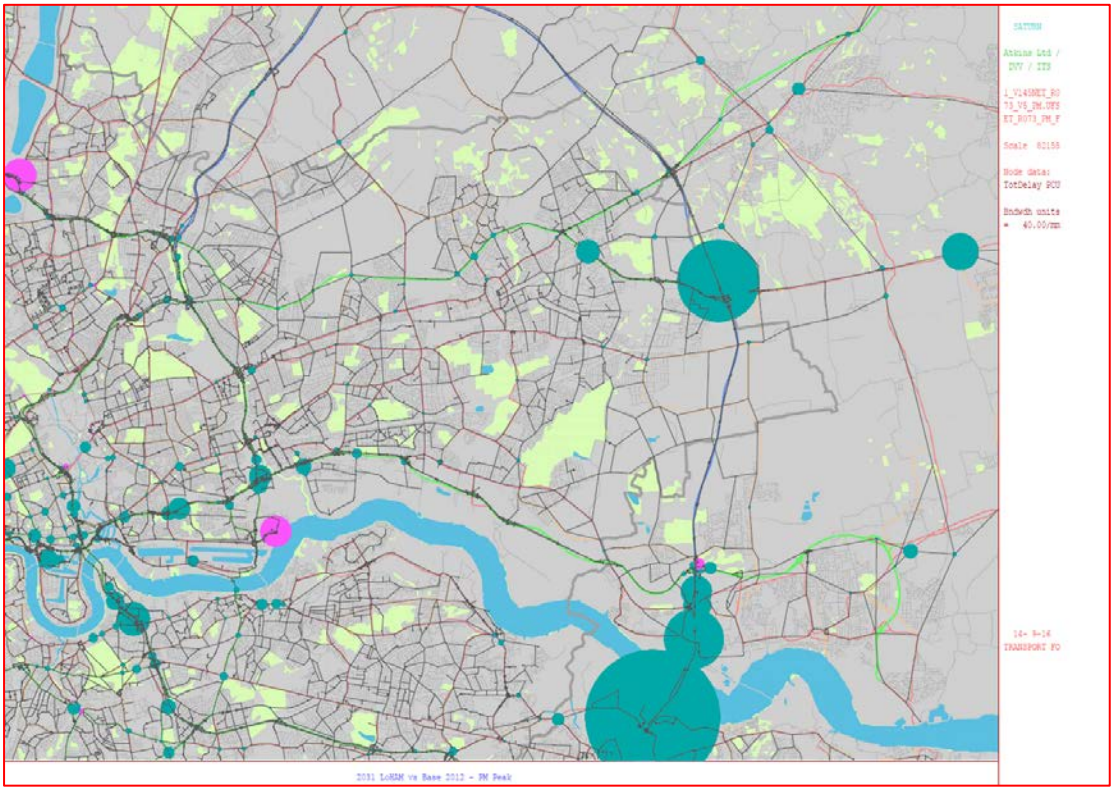


Figure 4.9 2031 PM Total PCU hours Delay Change



5. Volume over Capacity Ratio (V/C)

The junction volume to capacity (V/C) ratio is a standard indicator to measure how close a junction or link is to theoretical capacity, under actual traffic flows.
The volume-to-capacity ratio can be calculated for an individual turning movement, a link, or for the junction as a whole. In SATURN simulation, it is dependent on a wide range of factors including type of junction, numbers of lanes, lane capacity, traffic signal staging and traffic levels, both opposing and 'on-link' volumes.

Figure 5.1 to Figure 5.4 illustrate the ratios of volume over capacity (V/C) for links and junctions in the AM peak for 2012 and 2031. Figures 5.5 to 5.8, and Figures 5.9 to 5.12 show the same information for the IP and the PM peak respectively.

The different coloured bandwidth illustrate the range for different percentages of V/C with orange coloured bandwidths representing the links with a V/C between 85% and 95%, red coloured indicating links with a V/C between 95% and 100% and black coloured bandwidths showing where link V/C exceeds 100%, The same V/C ranges were also applied to the junctions with different coloured bandwidth discs at the junction.

Conditions in the network could be expected to worsen in the future in line with an estimated growth in traffic of 5% for London between 2012 and 2031; however, the growth in Havering is lower at around 4%.

Figure 5.1 shows the distribution of junction V/C across the network in the 2012 AM peak with all junctions experiencing a total V/C greater than 85% highlighted. There are relatively few junctions in the red or black regions, indicating V/C greater than 95% or 100%. The number and spread of junctions in each of these regions increases between 2012 and 2031, illustrating the increasingly congested state of the network.

The A118 St Edward Way/A125 junction indicate an increase in V/C and some junctions on A12 High Road/ A1112 Whalebone Lane North, M25 Dartford crossing and on A127/ Squirrels Heath Road for both AM and PM peaks.

Figure 5.3 to Figure 5.4 show equivalent information for link data for 2012 to 2031, based on a combination of pure link capacity and capacity constrained by the downstream junction. Although the density of congested links does increase over time in central and inner London, greater impacts are apparent for outer London, non GLA areas inside the M25 and the various radials outside the M25, reflecting the higher traffic growth in these areas.

Figures 5.4 and 5.12 show an increase in link V/C on A127/B186 St Mary, A12/A127 Gallows Corner, A12/ Petersfield Avenue, A127 East of M25 up to A128, A125/ A124 Upper Rainham Rd and A124/B1421 in Upminster.

The IP shows similar trends but remains significantly less congested. For the PM peak, changes over time follow closely those for the AM peak, with widespread overcapacity around and outside the M25. AM and PM peaks, the increase in the number of highly congested links is substantial and some caution is urged when interpreting results.

Figure 5.1 2012 AM Junction V/C

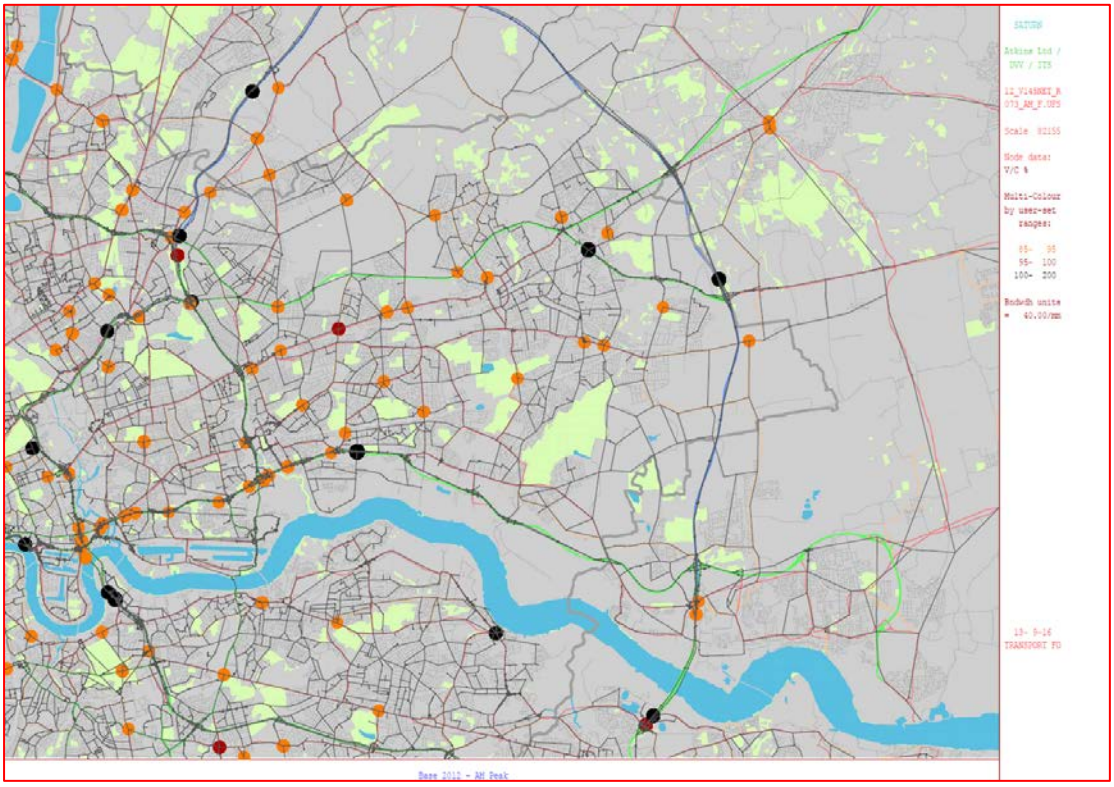


Figure 5.2 2031 AM Junction V/C

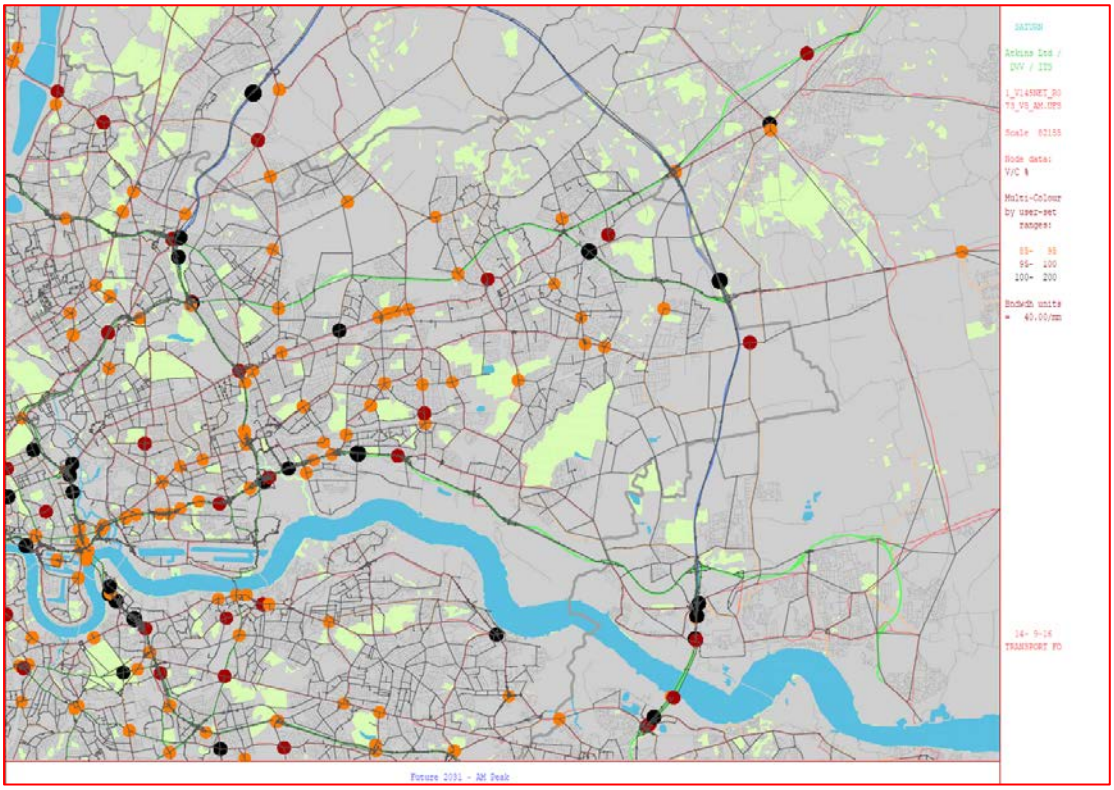


Figure 5.3 2012 AM Link V/C

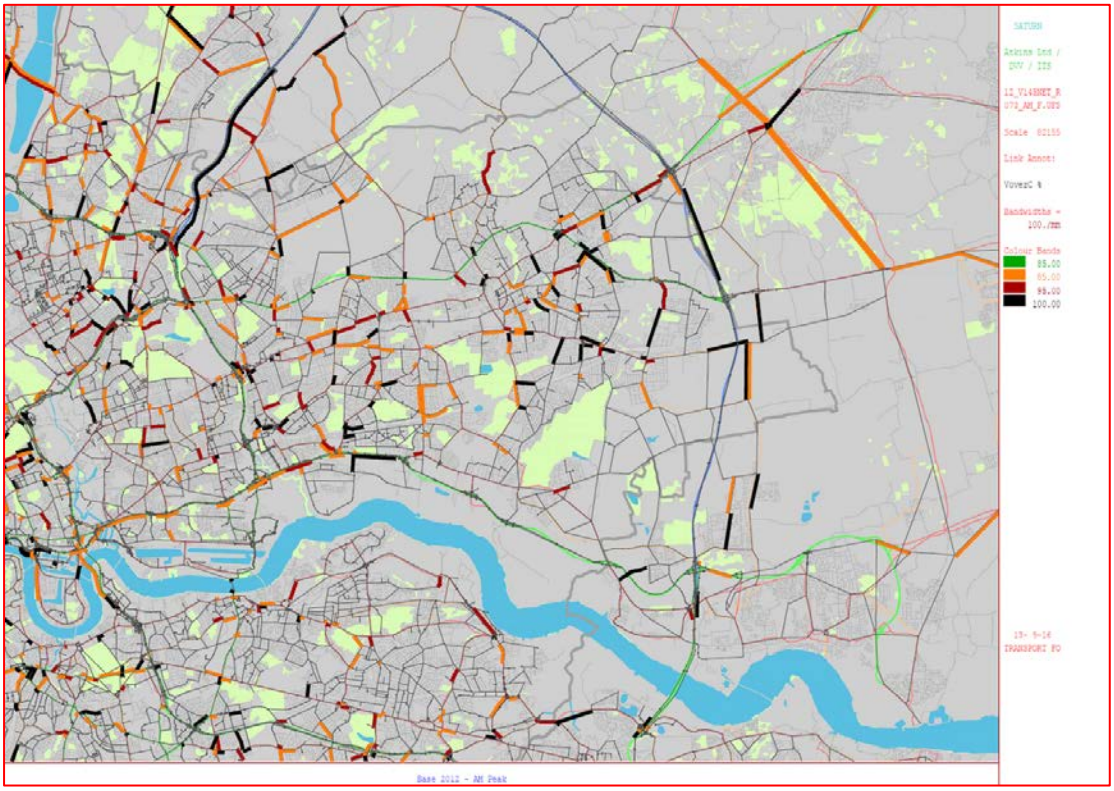


Figure 5.4 2031 AM Link V/C

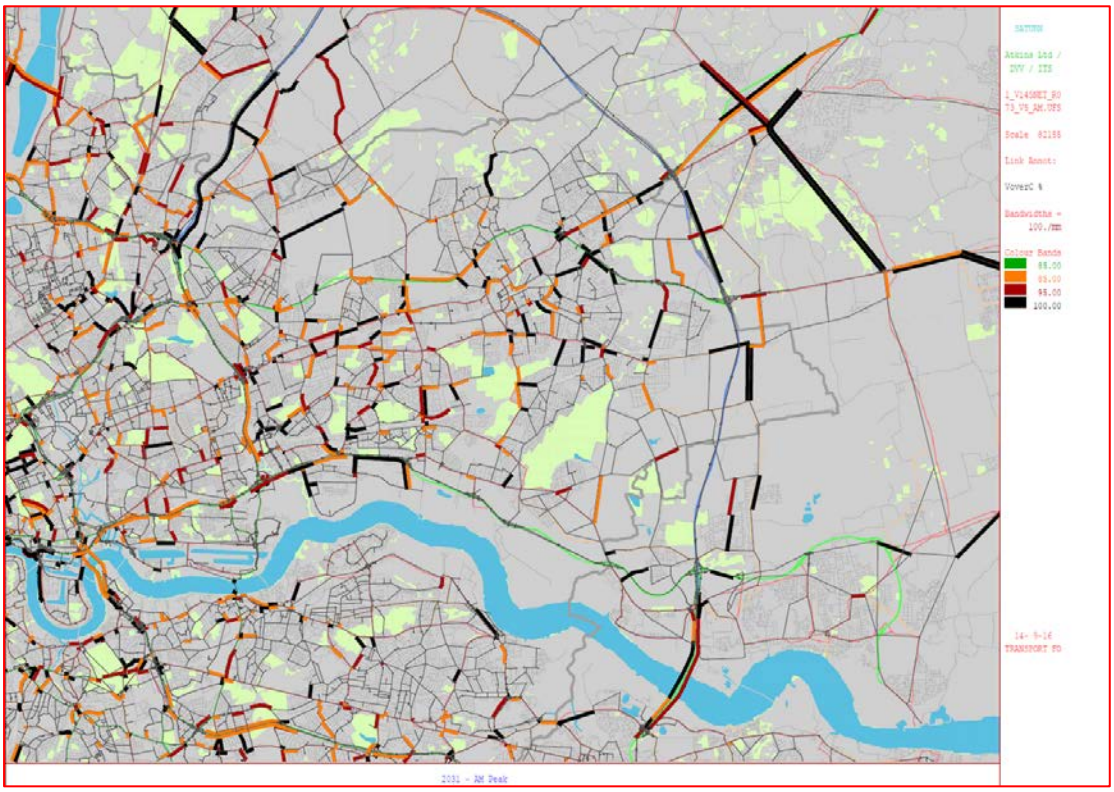


Figure 5.5 2012 Inter Peak Junction V/C

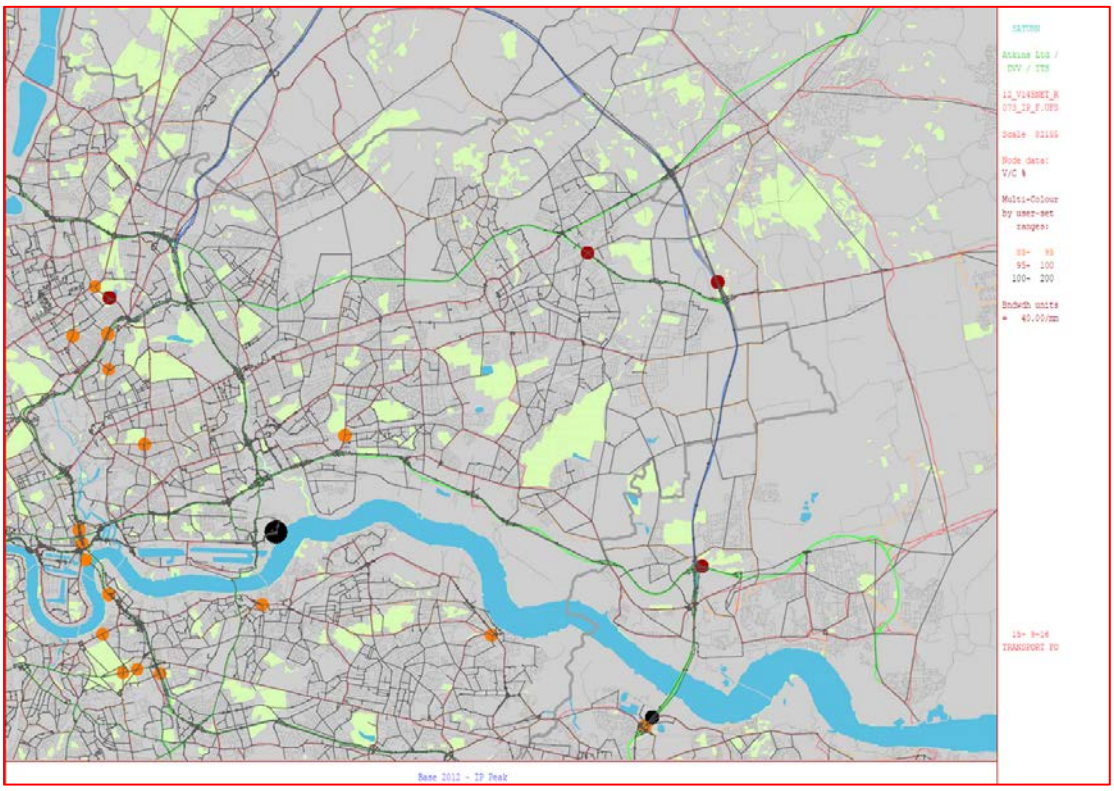


Figure 5.6 2031 Inter Peak Junction V/C

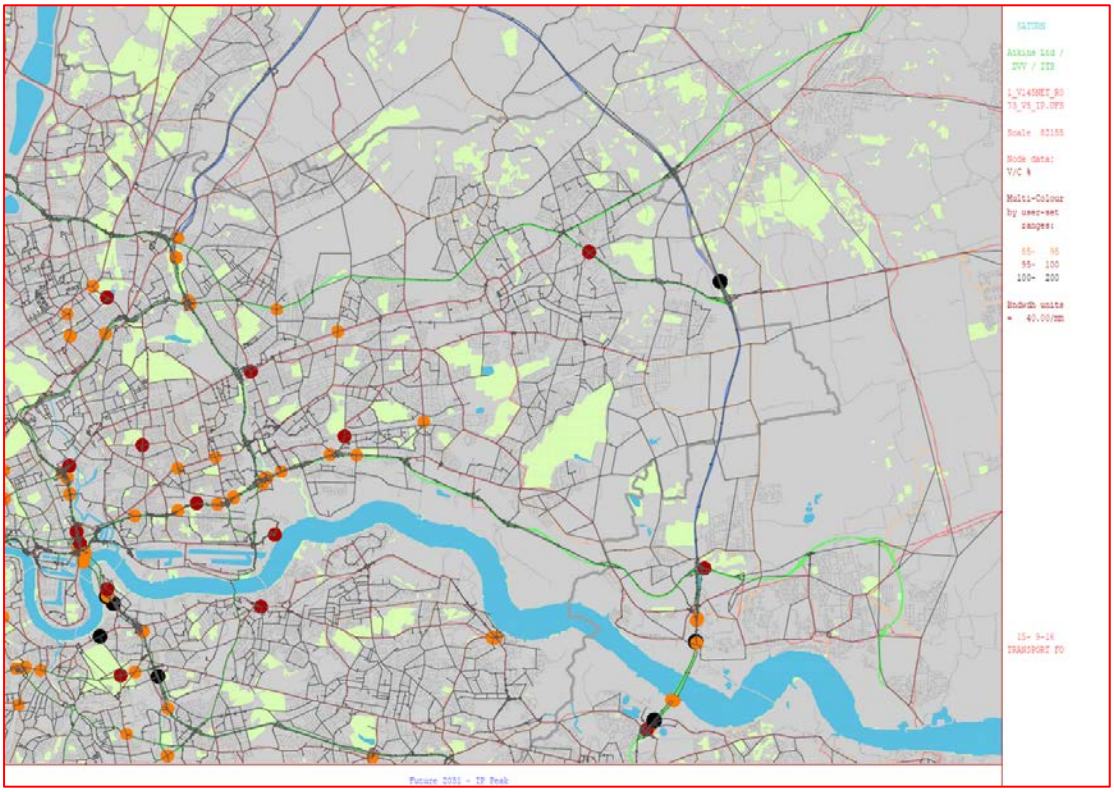


Figure 5.7 2012 Inter Peak Link V/C

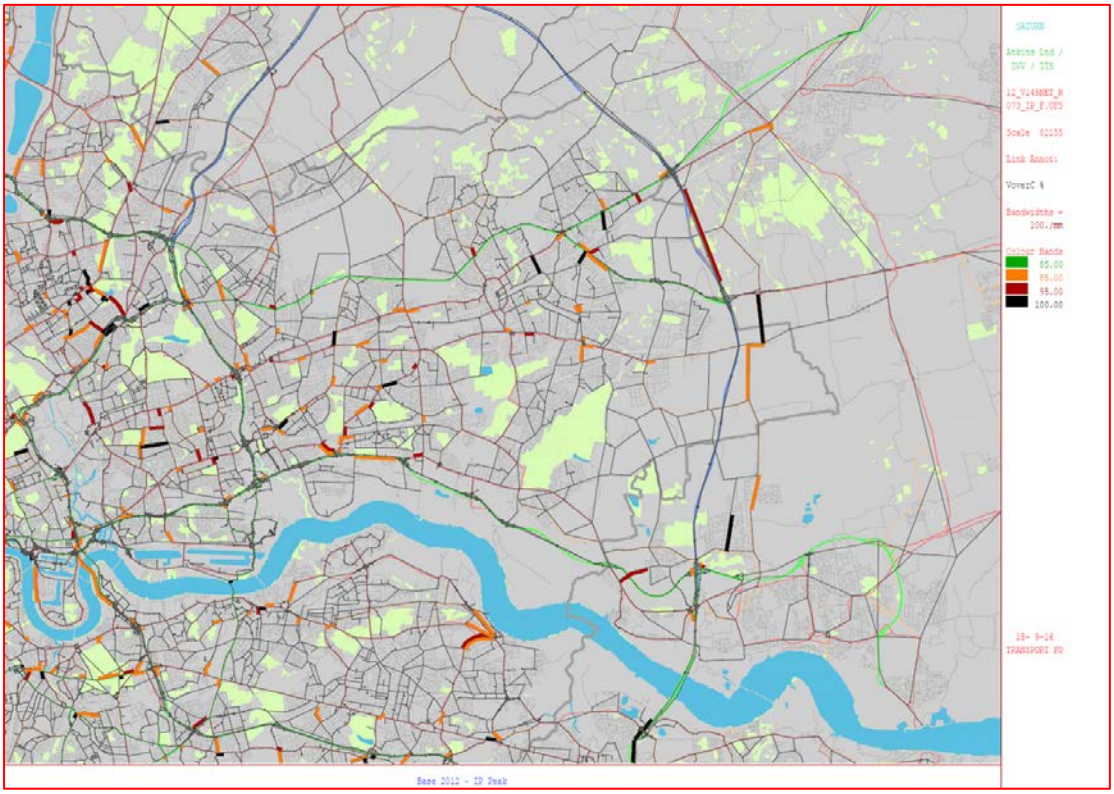


Figure 5.8 2031 Inter Peak Link V/C

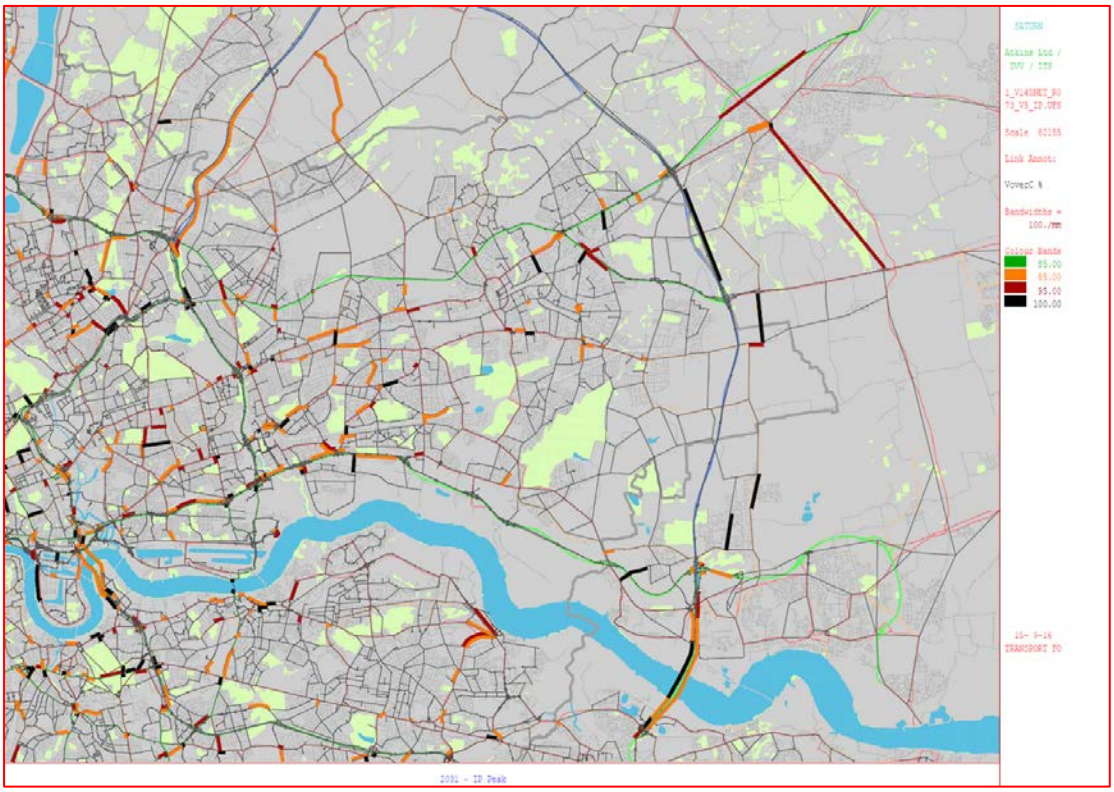


Figure 5.9 2012 PM Junction V/C

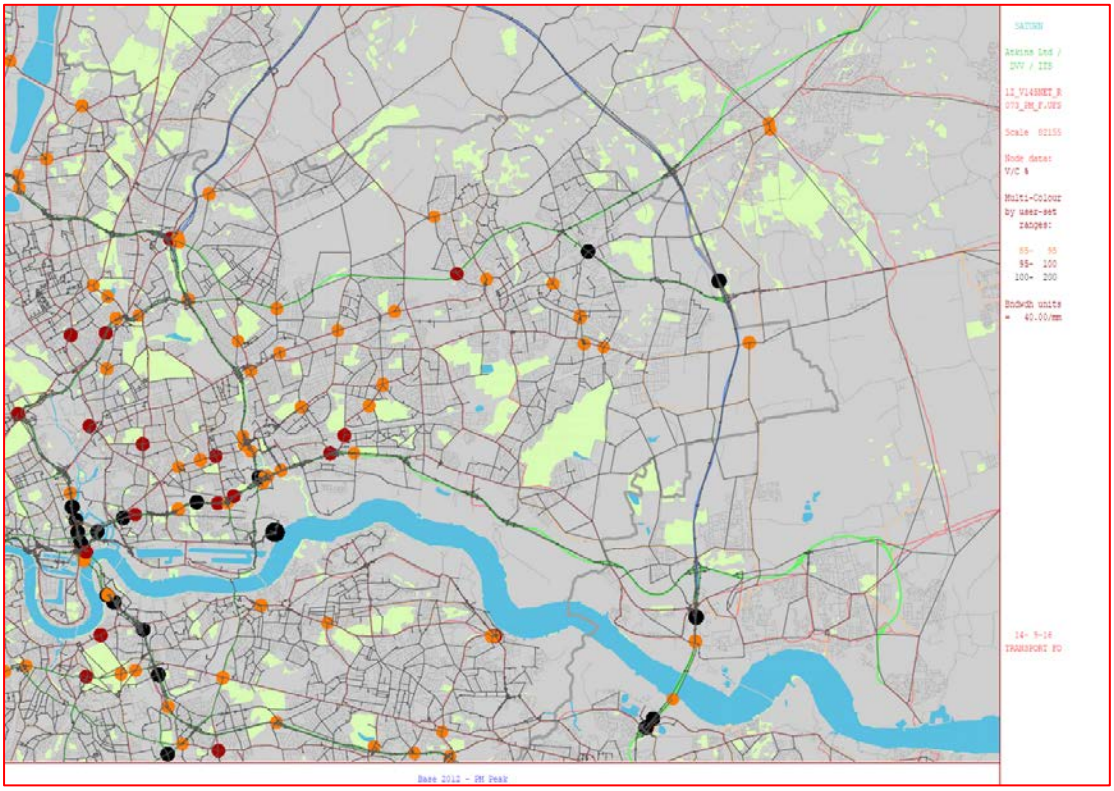


Figure 5.10 2031 PM Junction V/C

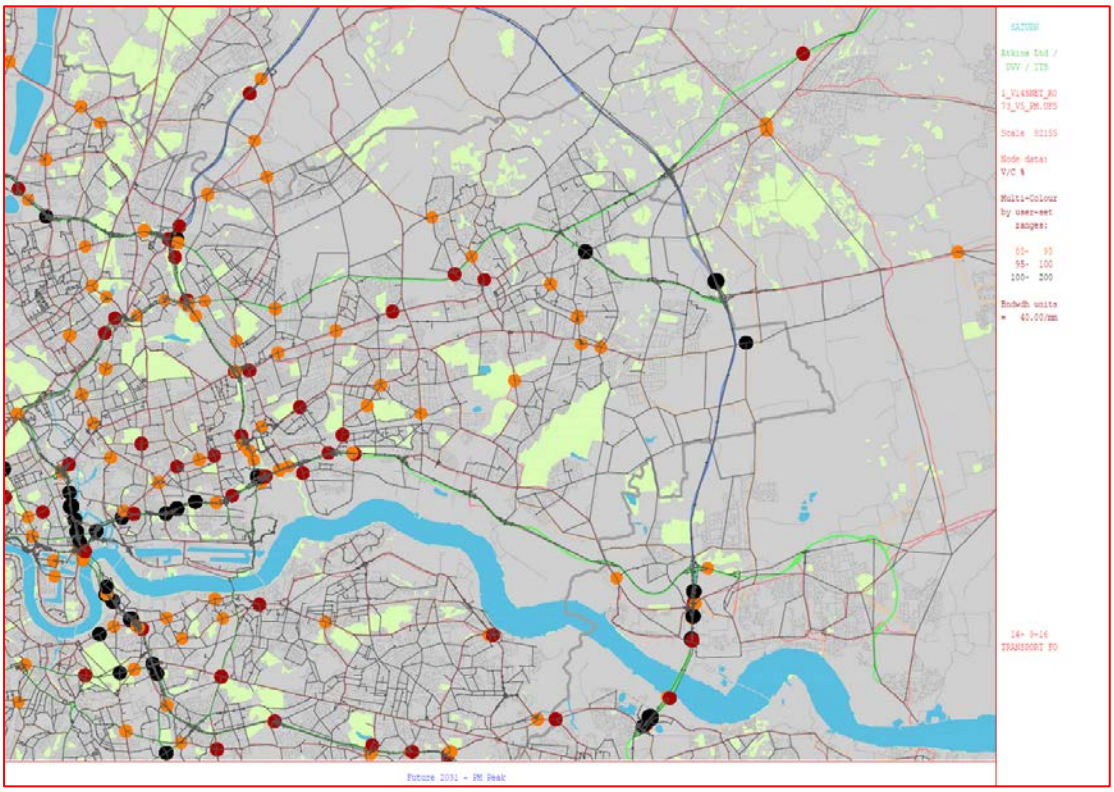


Figure 5.11 2012 PM Link V/C

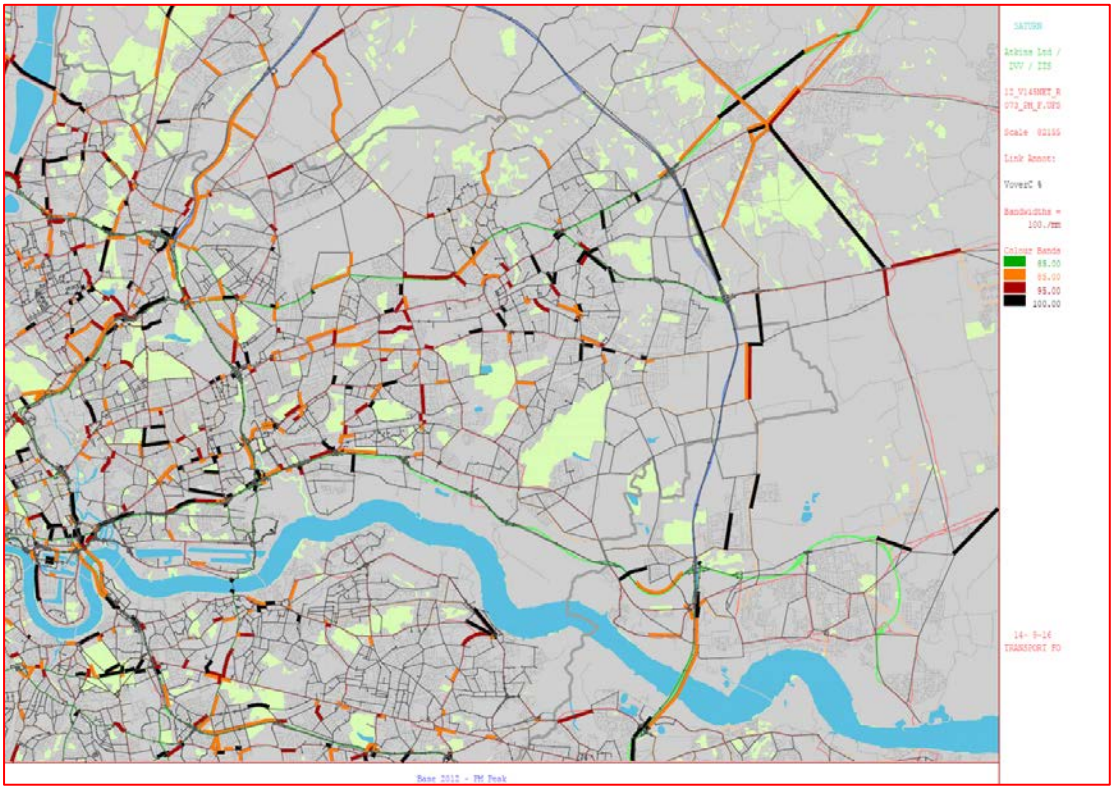
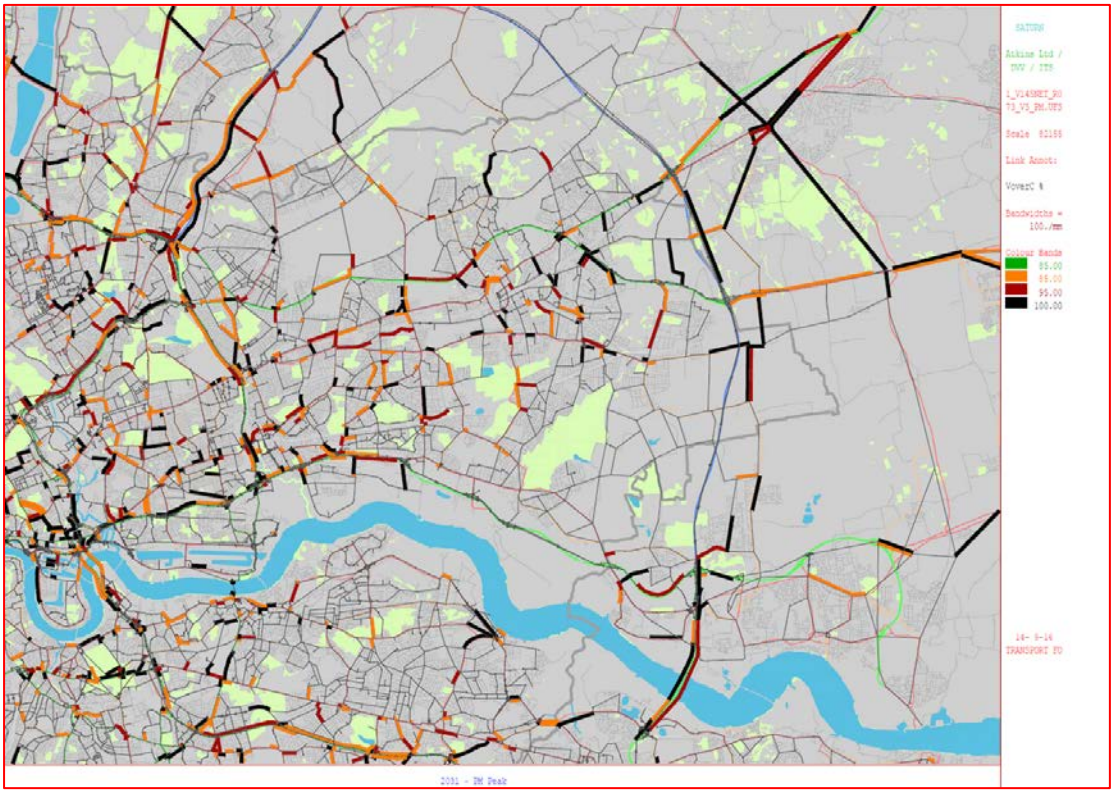


Figure 5.12 2031 PM Link V/C



6. Borough Statistics

Borough statistics were calculated for each time period and for the 2012 base and 2031 forecast years. At the Havering borough level, figures for PCU kilometres, PCU hours and average speeds and queues provide a high level view of changing network conditions over time and by time period.

Table 6.1 shows the calculated statistics in detail for Havering and neighbouring borough in total during the AM, Inter peak and PM peaks respectively for the reference year 2031, with comparisons made to equivalent statistics for 2012 in each case. For 2031 demand, there is clear evidence of a generally small percentage increase in PCU kilometres in most boroughs, typically associated with a larger increase in time (PCU hours) and a commensurate reduction in average speeds.

PCU kilometres increase in all the periods, by some 12% in the AM and Inter Peak and 11% in PM peak. A large increase is in travel time in all periods, by some 21% in the AM Peak and PM peak and 15 % in Inter Peak.

However the Inter peak reduction in speed of 3% is significantly lower than the equivalent 8% reductions in the AM and PM peaks, indicating that the network is less congested in the Inter Peak. Figure 6.1 to Figure 6.3 support the above finding.

Figure 6.4 shows an increase in the total queues at the end of the three time period across Havering, accounting for transient and over capacity queues and indicating the increased congestion in the network. The magnitudes of the increased queues are approximately 1500 PCUs, 280 PCUs and 1400 PCUs in the AM, IP and PM time period respectively.

Table 6.1 Statistics for the London Borough

		Travel Distance (PCU-km)			Travel Time (PCU-hours)			Average Speed (km/h)			Queue at End of Modelled Period (PCUs)		
Time Period	London Borough	2012	2031	% Change	2012	2031	% Change	2012	2031	% Change	2012	2031	% Change
AM	Barking and Dagenham	113,905	127,262	11.7%	5,659	7,409	30.9%	20.1	17.2	-14.7%	1,146	2,194	91.5%
	Bexley	184,662	203,561	10.2%	6,444	7,472	16.0%	28.7	27.2	-4.9%	202	404	100.2%
	Havering	**360,614**	**402,340**	**11.6%**	**11,583**	**14,018**	**21.0%**	**31.1**	**28.7**	**-7.8%**	**1,250**	**2,748**	**119.8%**
	Redbridge	228,159	244,573	7.2%	8,900	10,506	18.0%	25.6	23.3	-9.2%	997	2,248	125.4%
	Total	887,340	977,735	10.2%	32,587	39,406	20.9%	27.2	24.8	-8.9%	3,595	7,595	111.3%
IP	Barking and Dagenham	96,864	110,666	14.2%	3,497	4,227	20.9%	27.7	26.2	-5.5%	9	48	413.1%
	Bexley	153,697	168,061	9.3%	4,738	5,190	9.5%	32.4	32.4	-0.2%	11	12	14.8%
	Havering	**301,129**	**335,615**	**11.5%**	**7,525**	**8,637**	**14.8%**	**40.0**	**38.9**	**-2.9%**	**26**	**304**	**1087.0%**
	Redbridge	184,660	207,218	12.2%	5,625	6,418	14.1%	32.8	32.3	-1.6%	7	47	619.7%
	Total	736,351	821,560	11.6%	21,386	24,472	14.4%	34.4	33.6	-2.5%	52	411	689.1%
PM	Barking and Dagenham	114,959	127,535	10.9%	4,869	6,014	23.5%	23.6	21.2	-10.2%	347	901	160.0%
	Bexley	187,966	201,658	7.3%	6,620	7,914	19.5%	28.4	25.5	-10.3%	327	904	176.6%
	Havering	**368,028**	**407,678**	**10.8%**	**10,995**	**13,245**	**20.5%**	**33.5**	**30.8**	**-8.0%**	**946**	**2,328**	**146.1%**
	Redbridge	229,150	248,662	8.5%	8,073	9,415	16.6%	28.4	26.4	-7.0%	443	893	101.4%
	Total	900,102	985,534	9.5%	30,558	36,587	19.7%	29.5	26.9	-8.6%	2,063	5,027	143.7%

Figure 6.1 LB of Havering Travel Distance (PCU KM) for 2012 and 2031

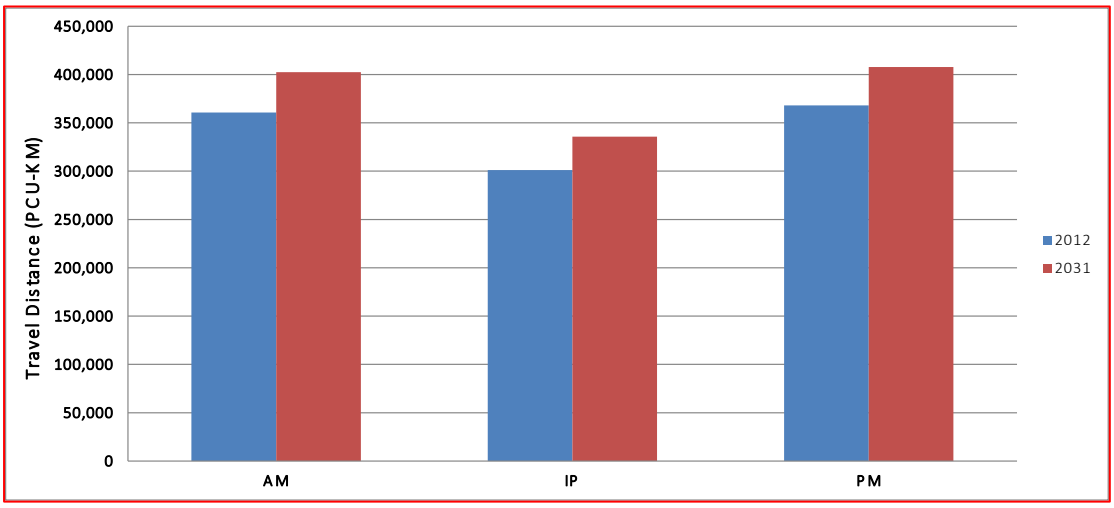


Figure 6.2 LB of Havering Travel Time (PCU hours) for 2012 and 2031

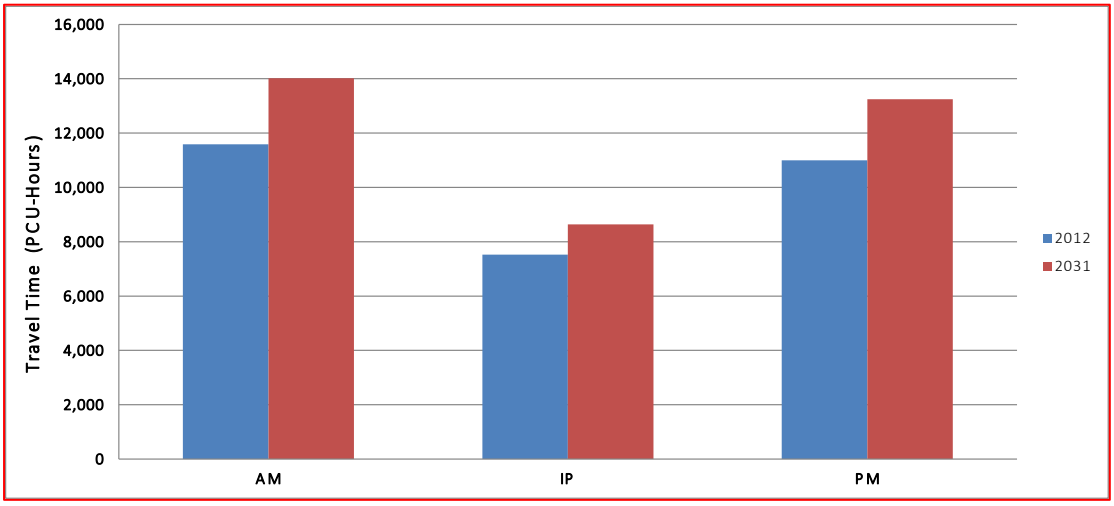


Figure 6.3 LB of Havering Average Speed (Km / Hr) for 2012 and 2031

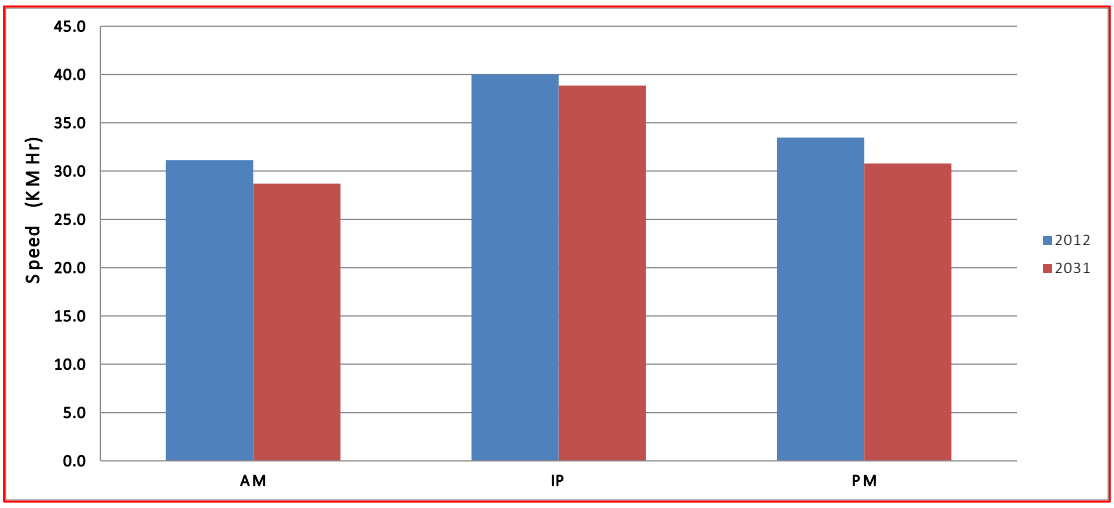
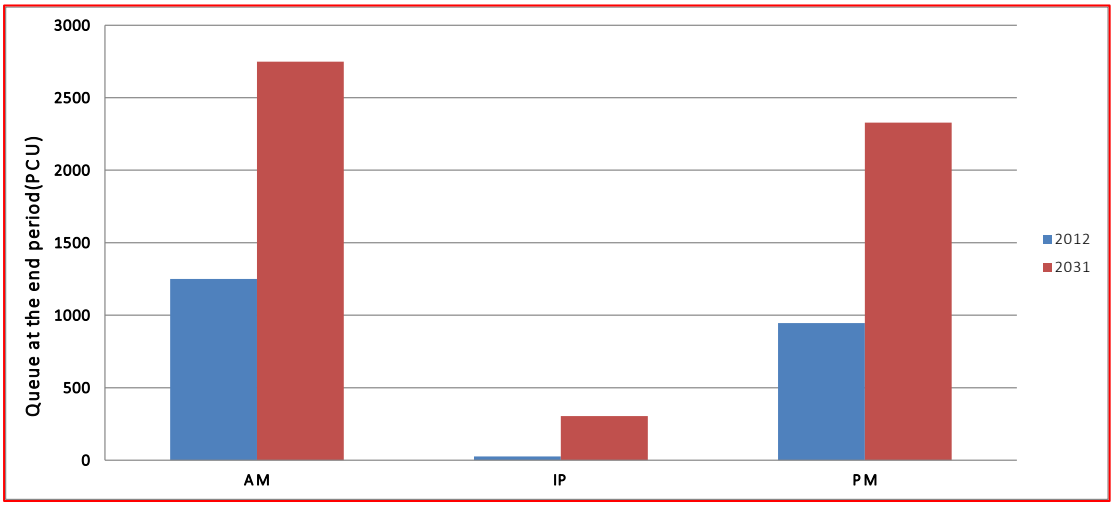


Figure 6.4 LB of Havering Queue at the end of Period (PCU) for 2012 & 2031



7. Summary and Conclusions

The three principle roads in Havering are the A12, A127 and A13 all providing links from M25 towards central London. The pattern of traffic growth shows increase of typically between 5% and 20% across all periods, with peak period growth being a strongest against the peak directions, assuming the peak directions to be into London in the AM peak and towards the M25 in the PM Peak. This reflects a general lack of excess capacity in the peak direction in 2012.

On A12 from Gallows Corners to M25 J28 shows an increase of 13%, 7% and 4% during AM peak, Inter peak and PM peak respectively. Westbound direction shows also an increase of 5%, 19% and 23% during AM peak, Inter peak and PM peak respectively.

On the A127 from Gallows corner to M25 J29 the contra-peak direction show increase of 13% in the AM peak. The Inter Peak shows an increase of approximately 7% and 3% in the PM peak. Westbound direction also experienced a modest increase in traffic flow of 5%, 6% and 2% in the AM peak, Inter peak and PM peak respectively.

A13 in the Rainham area eastbound direction experience a significant increase in traffic flow in the contra-peak direction by 40%, 14% and 6% in AM peak, Inter peak and PM peak. The westbound show increases in traffic flow of 4%, 19% and 30% for AM, Inter peak and PM peak respectively.

It can also be noticed that a little growth in traffic for non-principle road in the borough of Havering. Some of the largest increases in junction delays occur around the M25 Dartford crossing, M25 J29 (A127), a number of junctions around A13 and at the Southend Arterial Road A127 /Ardleigh Green Road junction.

Over all delays noticed to be increased in 2031 with some concerns over the increasing number of links with V/C greater than 100% along the A12/A127 Gallows Corner and A127 east of M25 up to A128.

Total travel times increase significantly by 21% during AM and PM peaks and 15% during the Inter peak and decrease in speed by 8% during AM and PM peaks. However the Inter peak reduction in speed is lower at 3%, indicating that the network is less congested in the Inter Peak.

The overall results in the reference case include all committed schemes but may not fully reflect potential for additional development not committed at this time.