Halcrow and Transport for London

Upper Lee Valley Transport Study

November 2012

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Executive Summary

The Upper Lee Valley is a large Opportunity Area (OA) in North London, stretching some 14kms from the northern edge of the Olympic Park to the M25. It is currently home to around 237,000 people and 76,000 jobs. It has an extensive highway and public transport network that provides for external and internal linkages, supplemented by local pedestrian and cycling routes.

Currently, transport infrastructure in the Upper Lee Valley (ULV) is predominately focussed on meeting radial movements to and from central London. An effect of the heavy rail network, the strategic highway infrastructure, the River Lea and the reservoirs, is to restrict orbital movement within the area, particularly for pedestrians and cyclists.

There is a need to constrain road congestion on both the local and strategic road networks, enhance the local bus network to provide better public transport connections, and to exploit the opportunities around enhancing the rail services which run the length of the opportunity area, to both reduce crowding and to increase accessibility.

The OAPF is promoting aspirational growth in the ULV. This transport assessment work has tested growth of 55,000 residents and 15,000 jobs. Much of this growth is focussed on Tottenham Hale, Central Leaside, and Blackhorse Road, with a spread across other areas too. Each of these brings challenges to the fore.

In the light of some existing issues and in respect of some future growth, there are a number of committed transport improvements in the area that are at various stages of delivery. These include an overall 43% increase in National Rail capacity, through train lengthening, up to 25% increase in capacity on the Victoria line, and highway changes at Tottenham Hale and on the A406 North Circular.

The implications of growth, taken together with known transport improvements, are to produce an overall picture of marginal change. For some modes in some places, issues slightly improve, in others, they get worse. On the rail networks: Underground, Overground and National Rail; capacity improvements are largely matched by demand increases. The Victoria line remains severely crowded to the south of the OA. National Rail services crowding eases in some locations but gets worse in others, partially impacted by the limited stopping patterns of services. On the highway network, overall traffic levels increase, up to 7%. Travel time similarly increases and average speed falls. Most junctions experience additional delay, and a small number move into a critical condition.

A package combining further public transport improvements and soft measures was designed and modelled in order to assess their potential to relieve congestion on the transport system and support the forecast growth.

The additional public transport improvements include interventions being lobbied for the HLOS2 package of railway enhancements, further Victoria line frequency enhancements beyond those already committed, and improvements to the bus network. The details of improvements for pedestrians and cyclists are not finalised at the time of writing but it is expected to achieve a combined walk and cycle mode share of around 36% in the Upper Lee Valley by 2031. This modelling exercise was complemented with other sensitivities like the inclusion of the Crossrail 2 line, further bus priority measures, and different levels of walking and cycling.

The main conclusion of the study is that further interventions, beyond those already committed are required to ensure growth in the Upper Lee Valley is not to the detriment of transport outcomes, such as road congestion and public transport crowding. The proposed package of HLOS2 railway enhancements, especially on the West Anglia Mainline, are vital to unlocking growth potential in the Upper Lee Valley, as are interchange enhancements at Tottenham Hale. Crossrail 2 has the potential to support further intensification of land-use in the Upper Lee Valley beyond the 2031 time horizon of this OAPF, as well as tackling chronic overcrowding on the Victoria Line. Enhancements to bus services to reflect increased and altered patterns of demand as a result of growth, schemes to improve conditions for cycling and walking and targeted interventions to smooth the flow of traffic will also play crucial roles in ensuring sustainable travel patterns in the Upper Lee Valley.

1 Introduction

1.1 Purpose of the document

The Upper Lee Valley boroughs, Transport for London, and the Greater London Authority are working collaboratively to produce the opportunity area planning framework (OAPF) setting out the Mayor's and the local authorities' aspirations for the regeneration of the Upper Lee Valley, represented in Figure 1.

The OAPF aims to deliver strategic growth and improve the urban and natural environment. It will provide a strategy for how growth can revitalise parts of the area, including a spatial framework for delivering an additional 15,000 jobs and a minimum of 9,000 homes. Once completed, the Mayor intends to adopt the OAPF as his spatial planning framework for the Upper Lee Valley upon which to realise its growth potential to 2031.

In this context, Halcrow was commissioned by Transport for London to undertake public transport and highway modelling with the objective to understand the impact on the transport networks of development growth in the Upper Lee Valley Opportunity Area.

A number of technical notes and reports were issued during 2010 and 2011 by Halcrow detailing the assumptions, methodology, and findings of different modelling tests. These notes and reports were used to inform the ULV Strategic Transport Study (issued as draft by TfL) and subsequently the OAPF.

The report we are now presenting aims to:

- Provide information about the context and the need for the modelling exercise
- Describe the modelling exercise, linking all the information available in the different documents issued by all parties, in a way that reflects the logic behind all the work undertaken
- Present all the modelling findings on a comparative manner in order to further inform the OAPF

Sometimes this document uses fragments directly taken from the already issued reports; this has been referenced in the text.

Figure 1 - Upper Lee Valley Opportunity Area

1.2 Report Structure

The remainder of the report is organised as follows:

- Chapter 2 describes the context for the Upper Lee Valley strategic transport study and the need for modelling
- Chapter 3 provides a methodology outline of the strategic transport study. This chapter includes modelling and also other elements of work undertaken by TfL as part of the strategic transport study that finally informs the OAPF
- Chapter 4 focuses on the modelling approach and methodology, including the performance of the models in the ULV area
- Chapter 5 describes the current situation in the Upper Lee Valley. This chapter includes a section on the geography of the ULV, as well as an analysis of the main transport challenges, based on observed and modelled data
- Chapter 6 describes the levels of growth forecasted in the Upper Lee Valley in 2021 and 2031
- The effect of the aspirational growth on the transport system is reported in chapter 7 (public transport) and chapter 8 (highway network)
- Chapter 9 looks at the transport intervention measures designed to alleviate the effect of increased pressure on the Upper Lee Valley Area
- Chapters 10 and 11 focuses on how successful those intervention measures are likely to be in alleviating congestion on the public transport and highway networks
- Chapter 12 reports on other tasks that were undertaken in order to further understand the potential of different transport interventions.

Figure 2 shows the different parts of this report and the interactions between them.

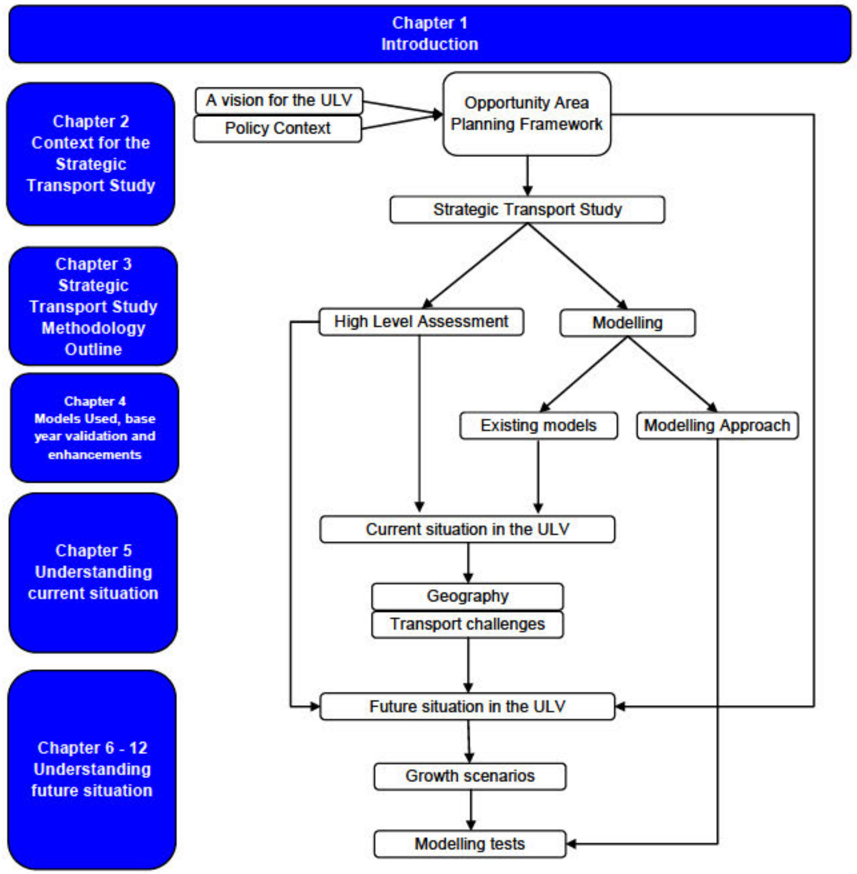

Figure 2 - Report Structure and contents

2 Context for the transport study

The contents of this chapter are taken from the *Upper Lee Valley OAPF Strategic Transport Study – Draft – March 2011 (by TfL),* and the *ULV OAPF – Consultation Draft – November 2011 (by the Greater London Authority).*

2.1 Vision and Objectives for the Upper Lee Valley Opportunity Area

The North London Strategic Alliance (NLSA) undertook a visioning exercise for the Upper Lee Valley in 2006, setting out the consensus for change in the Upper Lee Valley to utilise its strategic position to deliver significant growth in jobs and housing in the next twenty years.

Building on this, the emerging objectives of the OAPF are to:

- Objective 1 – To make better use of the unique landscape assets of the Upper Lee Valley and open up the Lee Valley Regional Park to promote the area as North London's Riverside
- Objective 2 – To ensure all new development is of the highest possible design quality and reflective of its use and of the surrounding environment
- Objective 3 – To provide a third rail track to improve transport connections and the frequency of train services on the West Anglia Line and to improve rail services on the Southbury Loop
- Objective 4 – To improve connectivity in all transport modes throughout the valley
- Objective 5 – To make better use of urban land around the transport hubs at Tottenham Hale, Blackhorse Lane, Central Leeside and Ponders End accommodating more housing and business uses which integrate with existing out of centre retail
- Objective 6 - To reverse the economic decline of the town centres along the A1010, such as Tottenham, and the large industrial estates to create a strong platform for economic growth
- Objective 7 – To create exemplar low carbon communities linked to a decentralised energy network and the growth of a green industries hub linked to the Edmonton Eco Park
- Objective 8 – To ensure all new development promotes social inclusion, sustainability and an improved quality of life for new and existing residents alike.

2.2 Policy context

The Draft Revised Mayor's Transport Strategy sets out six "goals" which constitute its defining aspirations:

- Supporting economic development and population growth;
- Enhancing the quality of life for all Londoners;
- Enhancing the safety and security of Londoners;
- Improving transport opportunities for all Londoners;
- Reducing transport's contribution to climate change and improving its resilience; and
- Supporting delivery of the London 2012 Olympic and Paralympic Games and its legacy.

Policy 2A.5 in the London Plan states that strategic partners should work with the Mayor to prepare, and then implement, spatial planning frameworks for Opportunity Areas and that these frameworks will set out a sustainable development programme for each Opportunity Area (OA), to be reflected in Development Plan Documents (DPDs).

At the borough level significant work is underway to bring forward local development frameworks to facilitate growth. Enfield Council has adopted its Local Development Framework (LDF) Core Strategy, which focuses growth in the Upper Lee Valley, Enfield Town and in the south west of the borough at New Southgate. Area Action Plans are being prepared for these areas to provide the context for more detailed master planning work in the Place Shaping priority areas of New Southgate, Enfield Town, Ponders End, Edmonton and Meridian Water. Meridian Water at Central Leeside has the potential to accommodate up to 5,000 new homes and 1,500 new jobs to 2031. Ponders End, in North East Enfield, will undergo considerable change with the redevelopment of three key sites in the area at Middlesex University, Southern Brimsdown and South Street, for which planning briefs are being prepared to bring forward mixed use development, coupled with an industrial renaissance in the Upper Lee Valley. Also at Pickett's Lock the Lee Valley Park Authority is looking to redevelop its site.

At Tottenham Hale, the London Borough of Haringey has produced a Masterplan for the delivery of development, which is already taking place. The next development phase planned is for up to 1,600 new homes, 30,000sq.m. of office, industrial and retail space, and improved community and public transport facilities. Plans are also advancing for the redevelopment of the White Hart Lane Football Stadium, which will have implications for transport and accessibility. TfL, in partnership with the London Borough of Haringey have recently been consulting on the removal of the Gyratory road system at Tottenham Hale which is happening in the next couple of years, providing for local growth in the area. The LDA also commissioned a piece of work looking at the economic viability and public realm along the A1010 corridor at Tottenham High Road.

In Waltham Forest, the Blackhorse Lane area is a key regeneration site at the edge of the Lee Valley Park, with the potential to provide over 2,000 new homes and 1,000 new jobs over the next ten years as part of the comprehensive regeneration of the local area including new parks, roads, schools and community facilities. An Interim Planning Policy Framework is in place to support and encourage regeneration in the area over a ten year period. Touching upon the area towards the south, Waltham Forest's advocacy of the Hall Farm Curve, a station at Lea Bridge, and Chingford-Stratford rail services has led to significant studies of these possible interventions, and a feasibility study has already reported. The Waltham Forest Core Strategy has also identified Walthamstow town centre, Wood Street and the Northern Olympic Fringe as further growth areas. These are outside the OAPF area, but may well have impacts upon it.

Also outside of the Opportunity Area, but with potential impact on it, the Borough of Broxbourne (to the immediate north of Enfield) shares many transport connections with north London, notably the A10, the Liverpool Street to Cambridge railway line, TfL bus services which terminate at Waltham Cross bus station and walking and cycling routes in the Lee Valley Regional Park. The East of England Plan sets a target for Broxbourne to build 5,600 dwellings and a share of 68,000 jobs in the period 2001-2021. The Council is currently progressing its Core Strategy towards pre-submission consultation. It will include a strategic allocation for significant retail, leisure and housing development at Greater Brookfield as well as a number of Areas of Search that have medium/long term potential for housing and employment development. Land in the 'Southern A10 Corridor' (within Broxbourne) is considered to have particular merits for employment development, notably land at Park Plaza North for mixed uses, and land at Theobald's Park Farm / Park Plaza West for high quality business park development. It is hoped that all of these schemes will contribute to wider regeneration initiatives for the Upper Lee Valley. The Council is currently in the process of commissioning high-level transport evidence to support its spatial vision.

2.3 Objectives of the Strategic Transport Study

The strategic transport study was carried out in consultation with key stakeholders Transport for London; the Greater London Authority; the London Boroughs of Enfield, Haringey, Waltham Forest, Hackney and Broxbourne; the Homes and Communities Agency (HCA) who founded the work; Hertfordshire County Council; and the Lee Valley Regional Park Authority.

The objectives of the Strategic Transport Study are to:

- Provide a strategic assessment of the likely multi modal transport impacts of the development scenario outlined in the emerging OAPF

- Identify the indicative transport improvements required to support development in order to:

    1. Encourage the scale and form of development to be designed in to maximise the number of public transport, walking and cycling trips and minimise car use

    2. Mitigate adverse impacts caused by the additional traffic associated with increased developments, especially increases in congestion and adverse impacts on the environment

    3. Build on the current network of good strategic and local connections within the Upper Lee Valley Opportunity Area, including committed transport infrastructure improvements, so as to fully integrate new developments with surrounding communities, London and beyond

    4. Maximise accessibility to the development sites by walking, cycling, and public transport, as well as providing suitable facilities for taxis and goods vehicles that are inherently incorporated through good design

    5. Reduce severance from existing barriers such as the Lea Valley rail line, the North Circular and other roads, and enhance access into the Lee Valley Regional Park

3 Strategic Transport Study Methodology Outline

The contents of this chapter are taken from the *Upper Lee Valley OAPF Strategic Transport Study – Draft – March 2011 (by TfL).*

The Strategic Transport Study has involved two key elements in order to meet the objectives of the work and provide an evidence base. These are:

- A high level assessment of possible interventions, against London-wide and more local Upper Lee Valley Transport objectives
- An assessment of the development impacts on the transport network through a comprehensive modelling process using a suite of integrated models

3.1 High Level assessment

TfL's Strategic Assessment Framework was used to understand the broad impacts of each scenario on the objectives of the Mayor's Transport Strategy (MTS), the Opportunity Area Planning Framework as well as considering broad deliverability issues. The assessment framework provides a means of establishing the differences between the scenarios being considered in meeting required objectives.

The MTS sets out six goals for how this overarching vision should be implemented. These are:

- Support economic development and population growth
- Enhance the quality of life for all Londoners
- Improve the safety and security of all Londoners
- Improve transport opportunities for all Londoners
- Reduce transport's contribution to climate change and improve its resilience
- Support delivery of the London 2012 Olympic and Paralympic Games and its legacy (only relevant where projects will be delivered by 2012)

The key objectives from the OAPF that were relevant to the assessment framework objectives were to cater for considerable growth by:

- Maximising accessibility to the development sites by walking, cycling, and public transport
- Minimising additional traffic and congestion through application of smarter travel packages
- Reducing severance from existing barriers such as the Lea Valley rail line, the North Circular and other roads, and enhancing access into the Lee Valley Regional Park
- Mitigating adverse impacts caused by the additional traffic associated with increased developments, especially increases in congestion and adverse impacts on the environment.

3.2 Modelling Approach

The modelling exercise used components from the recently developed London Sub Regional Modelling Suite. This included TfL's London Transportation Studies (LTS B6.2), North London Highway Assignment Model (NoLHAM v.00d), and London Regional Railplan (v6.1x) for demand, highway and public transport assignment modelling respectively.

The Regional Railplan version used was an interim version, and the latest available at the time (released October 2010). The model (v6.1x) was assigned with non-standard boarding penalty and effective headway parameters in line with the latest development of the model. The demand matrices are converted from LTS v6.15. Local recalibration and validation were also completed to fit the ULV area, with some additional National Rail data included.

The modelling work (LTS, NoLHAM and RRP) involved the following aspects:

- Model review and development of the analytical plan: the models to be used were identified and their performance in the ULV was reviewed. This contributed to the understanding of the key concerns to be addressed, and to develop the methodological approach
- Definition of base year: Base year models were used, together with textual identification of existing issues based on the review of the emerging OAPF and borough documents, to define the base year against which the future year scenarios (in 2021 and 2031) would be compared
- Assessment of the impacts of the developments on the transport network: future year models were used to assess the impact of the proposed development scenarios on the transport network and to identify the issues given the quanta and land use mixes. This is commonly known as the "do minimum" scenario, and it is referred as *ULV1 – Growth without transport interventions* throughout this report.
- Definition of transport interventions: where the *ULV1 – Growth without transport interventions* ("do minimum") models identified that the developments were likely to cause significant issues on the transport networks, this information was used to help define packages of transport interventions that could help to accommodate the development quantum proposed by the GLA. Two types of transport interventions were considered:
    - Mode shift interventions, which in modelling terms were coded by factoring the future year matrices, generally removing trips from the car matrix and adding them to the public transport matrix
    - Public transport, which in modelling terms were coded by modifying the public transport networks
- Assessment of the potential success of the transport intervention packages: this is commonly referred as the "do something" scenario, and it is referred as *ULV2 – Growth with transport interventions* throughout this report. The results from these tests were compared to the base year and *ULV1 – growth without transport interventions* (or "do minimum") results.

Figure 3 shows the modelling approach. The base year models were reviewed and adjusted as relevant.

The estimated future year (2031) number of jobs and population in the Upper Lee Valley Area were inputted to PCOTE and LTS to generate Public Transport and Highway origin/destination matrices.

The origin/destination matrices were then assigned to future year NoLHAM and Railplan networks for both the ULV1 ("do minimum") and ULV2 ("do something") scenarios.

The main outputs from NoLHAM were highway traffic flows and congestion, while public transport flows and crowding were extracted from Railplan.

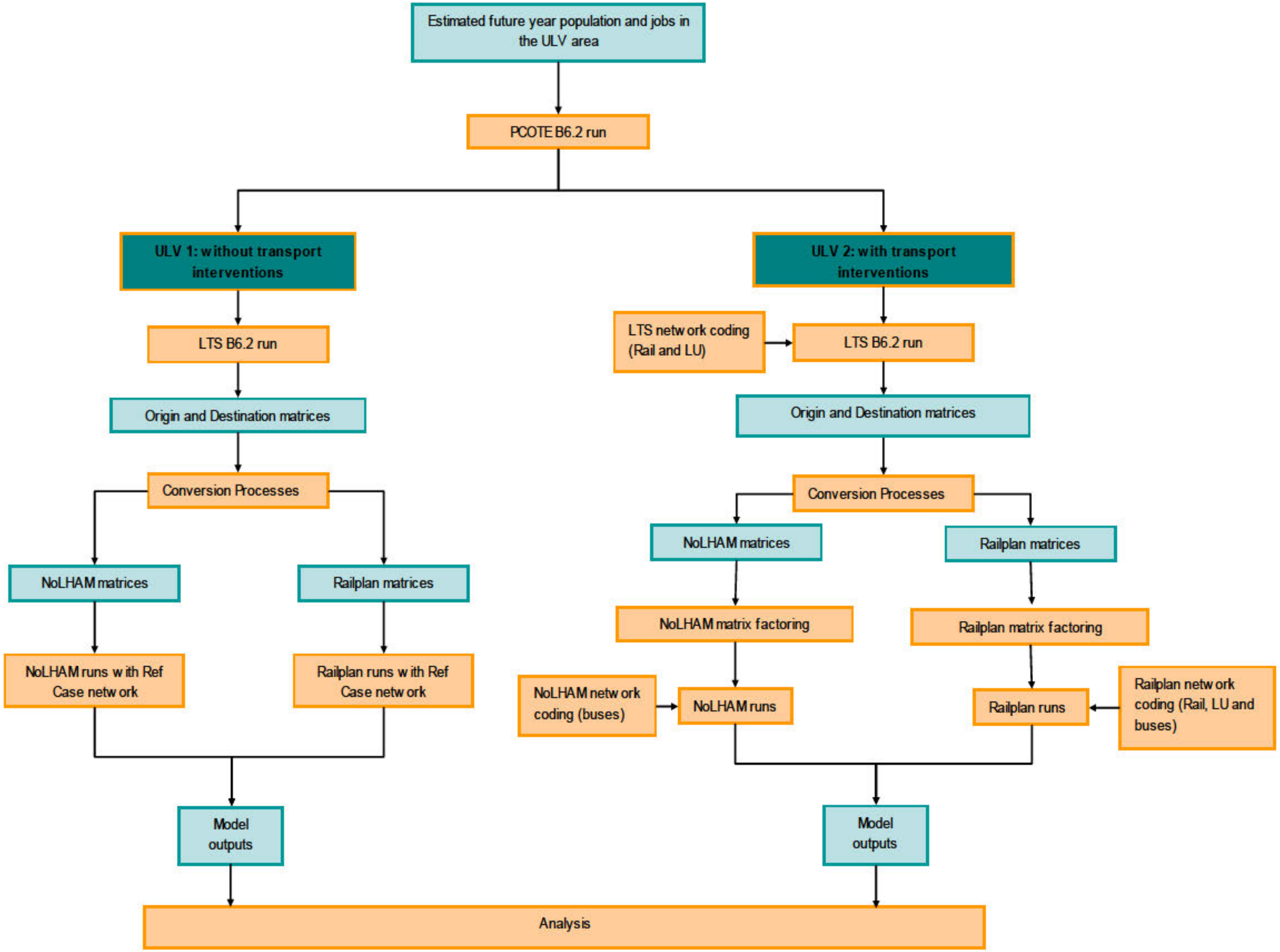

Figure 3 - Modelling Approach

4 Models used, base year validation and enhancements

The contents of this chapter have been taken from *Upper Lee Valley Model Analysis – March 2011 (by Halcrow).* Three technical notes with the findings of the review of the models were issued previously: *TN01- Review of Existing Highway Model – October 2010; TN02 – Review of LTS 6.15 – November 2010;* and *TN03 – Review of RRP – October 2010.*

4.1 London Transportation Studies (LTS)

The LTS model is used in this study to provide Origin and Destination matrices for highway and public transport that were later assigned to the relevant networks using NoLHAM and Railplan.

The LTS model is a strategic modelling suite of the whole of London and it is not intended for local area modelling. Highway and public transport network representation in the ULV area was checked, as well as validation results for screenlines in the vicinity of the ULV and future year schemes coded on the network. The zone system was also examined. Details are given in *TN02 ULV - Review of LTS 6.15.*

LTS B6.15 was the latest version at the time the Upper Lee Valley transport study was being undertaken. The relevant model runs used was 6107rfw9 (2007) without modification.

Highway network representation in the base year is generally good. However, the level crossings in the area are not represented, as the vehicle traffic is not restricted by rail movement.

As expected, the validation of the individual counts in the ULV area was poor. Very few of them meet the DMRB criteria. In some cases the differences between observed and modelled are significant, especially in some important roads like the North Circular, the M25 and the A10. When those counts are grouped on screenlines, the validation improves significantly, although only one of them meets DMRB criteria.

With regards to the highway future year schemes, the Tottenham Hale gyratory and the improvements to the North Circular are not included in the future year runs. The WEZ (Western Extension Zone of the London Congestion Charging scheme) had not been removed from the version used for the checks but it was understood that it will be removed from subsequent LTS versions.

The public transport network is well represented. However, the Victoria line validates poorly between Blackhorse Lane and Tottenham Lane, which is core to the ULV area. In addition to that, boarders and alighters for some of the rail stations seem to be unrealistically low.

Figure 4 shows the LTS zone system in the ULV area. A total of 21 zones form the ULV. The zones are somehow coarse and the match with the ULV boundary is not very precise. This reflects the strategic, as opposed to detailed, nature of the model.

The following strengths and weaknesses were highlighted with respect to the LTS model:

- The network representation was acceptable for Public Transport and highway, and a decision was made to use the existing networks without modification
- As expected, highway count validation was poor at individual level but improved at screenline level. It was decided that, although better validation would be desirable, this was not an impediment to use the model
- Public transport validation in the Upper Lee Valley stations was also a weakness; however, it was considered that localised improvements were not likely to have a significant effect on the overall demand
- LTS was the strongest tool to forecast mode split and demand in the Upper Lee Valley Opportunity Area

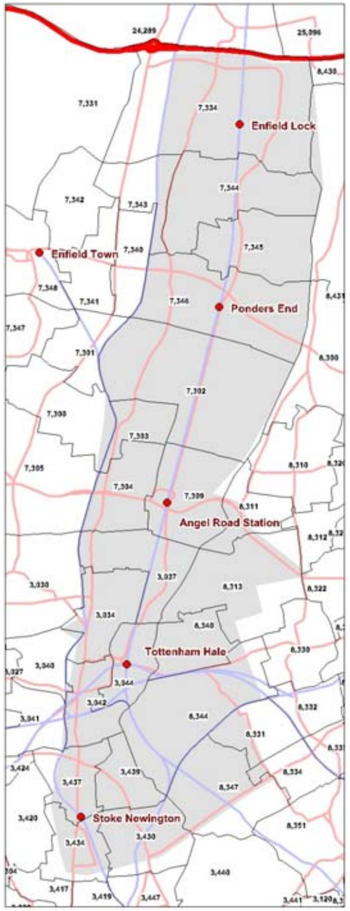

Figure 4 - LTS system in the ULV area

4.2 Railplan

An audit was carried out to check the networks and assignment validation within the study area of the base year model. This assessment is complete for all three time periods and is documented in full within *TN1: Review of Regional Railplan for Upper Lee Valley*.

The remainder of this section reports an overview and key features of this assessment.

The relevant base year Regional Railplan runs are defined as follows:

- 2007 AM base ~ RS0131C
- 2007 IP base ~ RS018A3
- 2007 PM base ~ RS016AD

4.2.1 Network Checks

The study area in relation to the public transport networks is shown below in Figure 5.

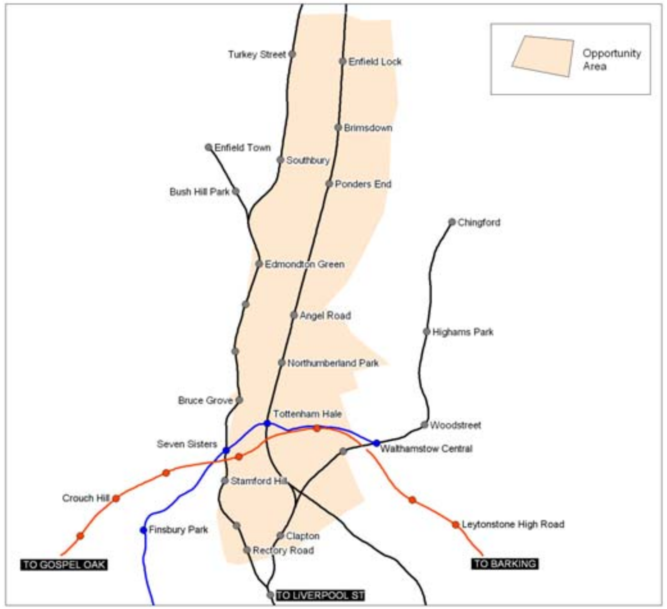

Figure 5 - Upper Lee Valley Opportunity Area and the public transport network

The Opportunity Area is served by London Underground (Victoria line), London Overground, National Rail services and local buses. Each of these sub-modes is represented in the model and have been checked against the available observed data. The National Rail network within the study area includes 20 stations; commuter services (currently operated by National Express East Anglia) primarily operating to and from London Liverpool Street.

The network audit has included, where possible, a check of frequencies, capacities and stopping patterns for all relevant services. Interchange links at Tottenham Hale, Blackhorse Road and Seven Sisters have also been considered. No requirement for modification of the base year model networks has been found as a result of this exercise.

The Victoria line and London Overground services have a simple service pattern making it relatively straightforward to check network specification. However, this is not the case for National Rail and bus services where routes are more dispersed and the 2007 specification is not readily available. It has only been possible to check the base year (2007) National Rail frequencies against the current year timetable – although a good correlation is found, the detail of any changes between 2007 and 2011 is largely unknown.

There are more than 70 bus routes coded within the model that pass through the Upper Lee Valley study area. Checks have ensured that the correct routes are included at an aggregate level but it has only been possible to check the detail of individual services for a selection of key routes.

4.2.2 Assignment Validation

The level of validation of modelled flows relating to the study area has been assessed for all four relevant sub-modes (National Rail, LUL, bus and London Overground) making best use of available observed data.

4.2.3 London Underground

The Victoria line generally validates well during the peak periods. Figures 6 and 7 show the line load validation in the peak direction with respect to the study area. There is however more variability between modelled and observed at the individual station level; under assignment of -33% at Tottenham Hale (boarders) in the AM peak and -38% at Blackhorse Road (boarders) in the PM peak are the most notable examples. The AM peak model validates better than the PM with respect to Victoria line demand (further detail provided in appendix B).

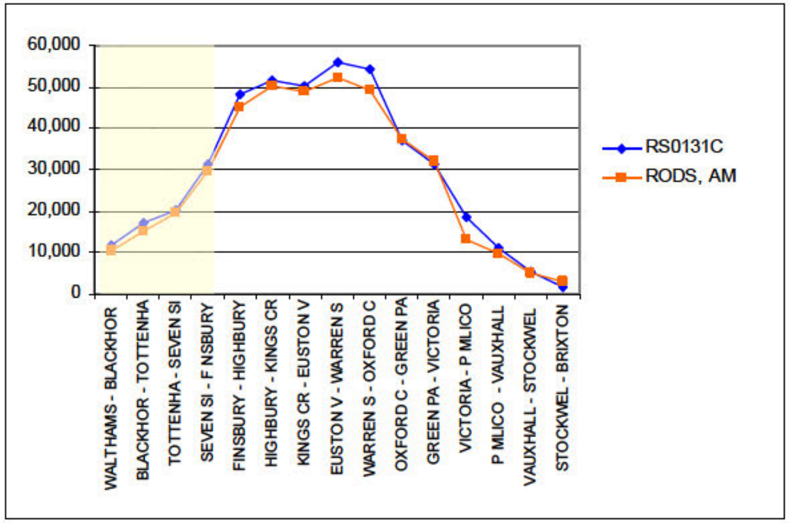

Figure 6 - Victoria line (southbound): AM peak model

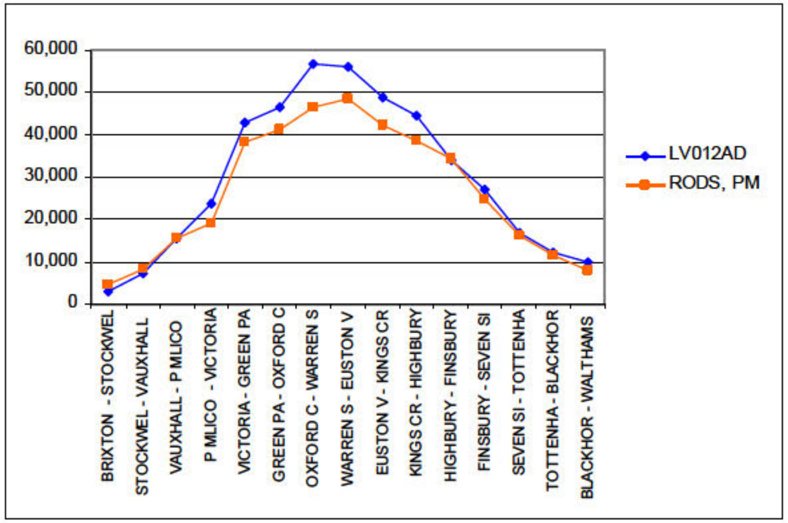

Figure 7 - Victoria line (northbound): PM peak model

4.2.4 National Rail

A complete assessment of National Rail assignment validation is made difficult by the only partial availability of appropriate observed data. However, various analysis has been completed (see appendix B for full details) and the results from three key links in the AM and PM peak direction are shown in Tables 1 and 2.

	Modelled	Observed	Difference	%
Northumberland Park to Tottenham Hale	14,330	14,417	-87	-1%
Bruce Grove to Seven Sisters	6,168	7,334	-1,166	-19%
Bethnal Green to Liverpool Street	21,272	20,706	566	3%

Table 1 - National Rail line loads (AM peak period). Observed data from 2007 Autumn PIXC counts

	Modelled	Observed	Difference	%
Tottenham Hale to Northumberland Park	14,686	12,947	1,739	12%
Seven Sisters to Bruce Grove	5,899	6,197	-298	-5%
Liverpool Street to Bethnal Green	17,386	17,641	-255	-1%

Table 2 - National Rail line loads (PM peak period). Observed data from 2007 Autumn PIXC counts

This data indicates the model validates well in the peak direction on the heavily loaded sections into and out of Liverpool Street, Tottenham Hale and Seven Sisters. However, less data is available at the individual station level and where partial data does exist it suggests some wide variation between modelled and observed values.

4.2.5 London Overground

The London Overground link loads within the study area are within +/- 20% of observed. Validation is therefore good, but it is noted that modelled passenger volumes tend to be consistently low.

4.2.6 Bus

Bus link flow assignment validation is poor as reported by comparing modelled flows with 2007 BODS data. Figure 8 shows the absolute difference between modelled and observed for the AM peak period. This analysis suggests that there is over-assignment of 1,500 – 2,000 trips (40-50%) along sections of some key corridors in the study area (e.g. the High Road through Tottenham).

Figure 8 - Bus link flow validation (AM peak period)

4.2.7 Overall Assessment

The following strengths and weaknesses are highlighted with respect to the base model and application for testing future year development and intervention scenarios in the Upper Lee Valley:

- The validation of the strategic rail network is good and assessment of congestion levels on the main commuter corridors can be carried out with confidence.
- The model is strongest when used to forecast the level of growth or incremental impacts of development rather than absolute volumes.
- Validation of bus passenger volumes is poor on many key routes within the study area. Forecast bus passenger demand should be interpreted with care and only used to assess relative change between scenarios.
- Whilst aggregate National Rail volumes validate well on key sections, consistent observed data at a station level is often not available and therefore station entries and exits (particularly for less busy stations) should be interpreted with care.

4.3 NoLHAM

Detailed analysis on validation of the NoLHAM model in the study area was carried out as part of the Upper Lee Valley transport study. This was reported in *TN04 ULV – NoLHAM model validation*. The main findings of this analysis were that the model performance is generally good and the model is considered fit for future year forecasting. However the following weaknesses have been identified:

- Innova Park and surrounding area: The model is forecasting zero flows on a couple of links. This is considered a localised problem caused by the semi-isolated character of the area. The problems do not compromise the suitability of the model in the future year; however, the underestimation of flows in the

WB direction will need to be taken into account when looking at specific junctions concerning those links.

- Enfield Town: The model appears to underestimate flows in a few links, and although the differences are within reason, this will need to be taken into account when using the model in the future year. There are two relevant aspects mitigating this problem: the first one is that the counts are relatively far from the ULV, and the second one is that the counts in the A110 validate well.
- Picketts Lock and Tottenham High Road: The count coverage is poor in this area although the few counts presented validate well. This is a small area with relatively few changes in the future year and it is expected that, in line with the other areas analysed, the model is generally fit for purpose.
- Central Leeside and Northumberland Park: The trade-off between Park Lane (where one level crossing is located) and Leeside Road is a localised problem that needs to be remembered when using the model to forecast flows in junctions related to those links.
- Tottenham Hale: The model appears to be forecasting slightly lower flows in this area. Turning counts at Tottenham Hale gyratory appear to contradict link flows in some instances. Generally the model is fit for purpose here but the issues identified must be considered in any forecasting.
- Blackhorse Road: The model appears to be overestimating NB flows in a few links. This needs to be kept in mind when forecasting.

A decision was made that all the weaknesses identified are of minor importance and therefore model enhancements are not recommended at this stage. Some extra counts have been provided by Hertfordshire, however their inclusion into the model does not seem appropriate given that the counts do not fall inside the simulation area.

Similarly, a decision was made of not pursuing any network amendments at this stage. The main reason for this is that it has not been possible to link any of the weaknesses identified in the model with a specific network problem. The network coding appears correct throughout the ULV area.

Further analysis has been done using the count validation results in the context of 45 key junctions in the ULV area. The objective was to understand if there were counts in the approaches or turns of any of those key junctions and how they validate. It is anticipated that some of the counts will be inaccurate, but this exercise will be useful to put the model results into context, inform the intervention packages and identify areas where more data collection or further analysis might be recommended. Figure 9 shows all the 45 junctions in the context of the validation counts.

Some of the issues described above that might have an impact on junction performance are:

- Junctions 21 to 24, in the north of the Upper Lee Valley, are located in an area characterised by the underestimation of flows in the WB direction. This might contribute to paint an over-optimistic picture of the performance of the junctions and their individual approaches, in the base and future years.
- Similarly, junction 34 is in an area where the model appears to be underestimating flows in the SB direction. This again might make the junction appear less congested than it really is
- Junction 14, located in the corner of Church Lane and A109 Lordship Lane, where a localised routing issue has been detected; this information will need to be taken into account when looking at individual arms (although overall flows are at very similar levels)

Whilst the validation of the model is satisfactory at a strategic level there are a number of individual junctions where the validation against observed levels of congestion and delay is not good. Therefore, the use of NoLHAM in assessing the performance of individual junctions is limited – NoLHAM is best suited to assessing the performance of the strategic road network as a whole. At individual junctions NoLHAM is useful to assess the scale of change in demand in future years, but not necessarily the future levels of delay (or level of service) at a particular junction.

The level crossings have also been studied in relation to the count validation. There are three level crossings in the area: Ordinance Road (North of Enfield Lock station), Green St (Brimsdown Station) and Park Lane (between Angel Road and Tottenham Hale stations).

For Ordinance Rd and Park Lane there are validation counts. The count in Ordinance Rd is failing in the AM and passing in the PM. The difference between observed and modelled in the AM is of around 200 pcu (model higher). In Park Lane there is a localised routing problem by which car users appear to favour Park Lane over the parallel Leaside Road.

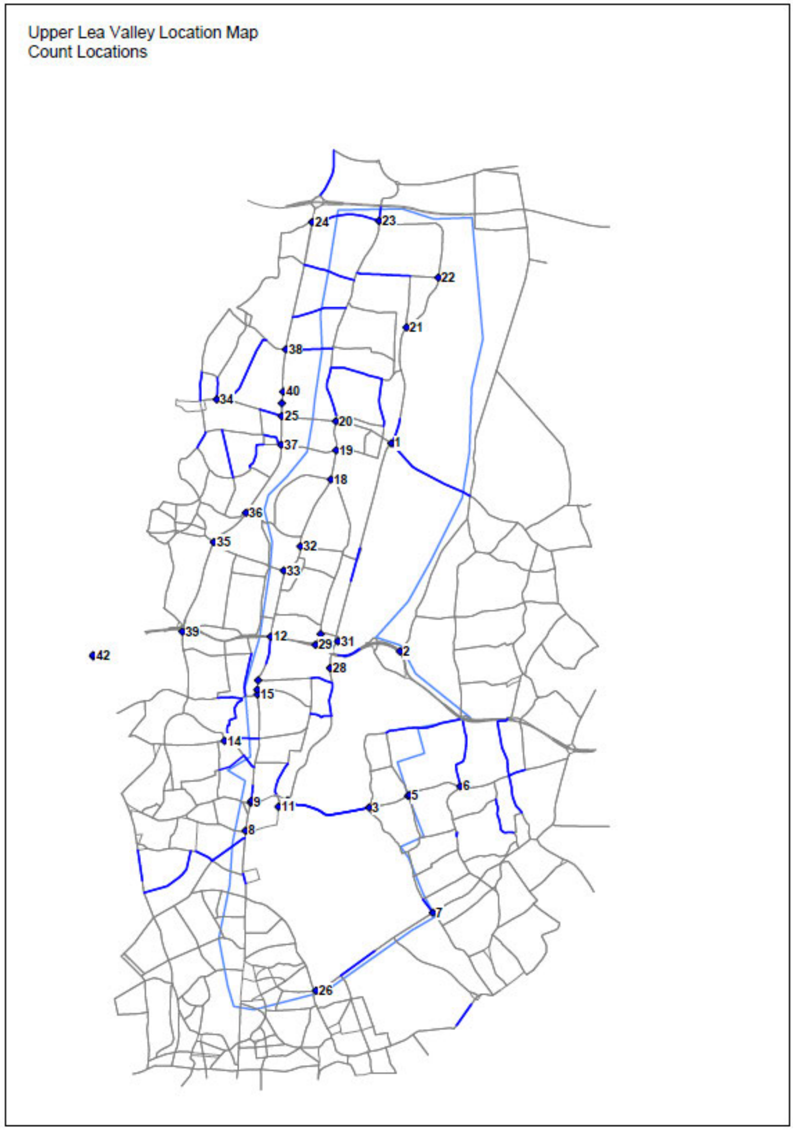

Figure 9 - Key junction locations in relation to the counts

5 Understanding the current situation

5.1 Geography

The Upper Lee Valley is a diverse location that has been identified as the largest (by surface area) Opportunity Area in the London Plan. Following the river Lee, and running parallel to the A10 until joining it at the south end, the Upper Lee Valley stretches from the M25 to the Hackney border; with the A112 to the East and the A1010 to the West. The local network includes radial A roads (A1010, A10, A1055 and A112). The A110 and the A406 (North Circular) cross the area transversally.

South of the North Circular, the area is served by the London Overground (Gospel Oak – Barking line), and the Victoria line. Main line services between Central London and Cheshunt, Hertford East and most importantly Stansted Airport run parallel to the Lee river and the A10, with several stations in the Upper Lee Valley, including Tottenham Hale.

The site is strategically located in the London-Stansted-Cambridge-Peterborough corridor, which has been identified as a growth area of national importance. The Olympic site is situated immediately to the south of the Upper Lee Valley. An area of great potential, with Blackhorse Lane, Ponders End, Central Leeside and Tottenham Hale considered being the most important places for change.

Large parts are taken up by the open water of a number of reservoirs, and the Lee Valley Regional Park also provides a linear green base. A map of the Upper Lee Valley Opportunity Area can be seen in the Introduction of this report, in Figure 1.

The Upper Lee Valley is currently home to around 237,000 people and 76,000 jobs (data extracted from the LTS model).

5.2 Main connectivity and transport challenges

5.2.1 Overview

This section is based on Upper Lee Valley OAPF Strategic Transport Study – Draft – *November 2011* (by TfL), and *Upper Lee Valley Model Analysis – March 2011* (by Halcrow).

The Upper Lee Valley has an extensive highway and public transport network that provides for external and internal linkages. It is supplemented by local pedestrian and cycling routes.

Currently, transport infrastructure in the Upper Lee Valley is predominately focussed on meeting radial movements to and from central London, and one of its the strengths lies in its fast connections to Central London, Stansted and Cambridge, including its role as London's gateway to the Stansted/Cambridge/Peterborough growth area.

On the other hand, the irregular and infrequent pattern of local services on the West Anglia Main Line and how this has a detrimental impact on public transport accessibility must be tackled in order to unlock growth potential.

The area of Tottenham Hale in particular has an excellent public transport service and will continue to be a gateway to and from the Opportunity Area. Seven Sisters is being shaped as a further gateway. However, as so much of the growth is focussed around Tottenham Hale or on routes that feed into Tottenham Hale, improvements to the interchange will be crucial to supporting sustainable growth and encouraging public transport use.

Its proximity to the M25 and North Circular continues to attract logistics-type operations to the area.

An effect of the heavy rail network, the strategic highway infrastructure, the River Lea and the reservoirs, is to restrict orbital movement within the area, particularly for pedestrians and cyclists, and between its neighbouring town centres, such as Enfield, Walthamstow and Wood

Green. Movement is also restricted by the number of level crossings where road and rail routes overlap.

Figure 10 shows the highway and public transport networks in the Upper Lee Valley Opportunity Area.

Much of the transport infrastructure of the wider area has grown around the historic town centres, and as much of the Upper Lee Valley is currently in industrial use, public transport is, in some parts, less developed than in other areas of London.

The Upper Lee Valley therefore presents a challenge to deliver sustainable transport connections to the inner part of the study area and particularly the open space of the Lee Valley Regional Park, and the reservoirs. There is a need to reduce road congestion on both the local and strategic road networks, enhance the local bus network to provide better public transport connections, and to exploit the opportunities around enhancing the rail services which run the length of the opportunity area.

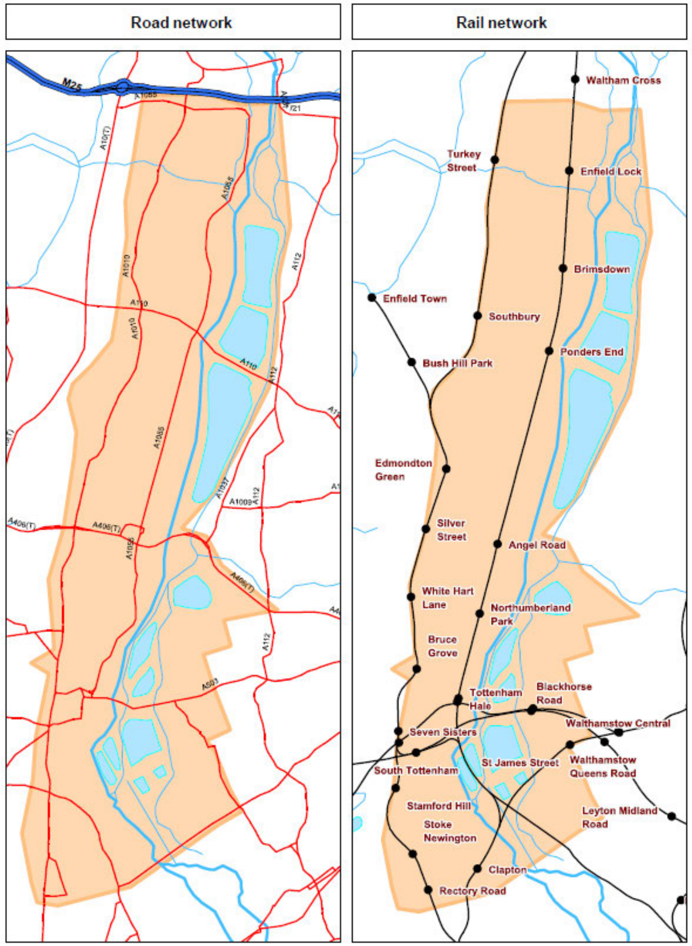

Figure 10 - ULV highway and public transport network

5.2.2 Cycling

The amenity of the Lee Valley Regional Park means it is a key area for recreational cycling. Dedicated cycle paths and cycling Greenways offer an uninterrupted network across the valley (with the exception of Central Leeside) and are well used, particularly along the towpath of the River Lea. The National Cycle Network route 1 runs north-south through the valley and its path offers a connection also suitable for commuters between Tottenham Hale and the Docklands.

Despite this, cycling in the Upper Lee Valley is made difficult by the barriers presented by infrastructure and the industrial nature of the land use. The recreational cycle paths are unlit, have narrow bridges shared with pedestrians and their surfaces are unsuitable for heavy usage, so upgrading work would be needed. Off-highway (adjacent) cycle routes run along most of the A10 and Meridian Way/Mollison Ave, but these are unpleasant, heavily trafficked routes. The severance caused by the railway, the A12 and A406 are also major disincentives to cyclists. There is a further gap in provision on the eastern side of the valley, running north-south through Blackhorse Lane, with the A12 and A406 acting as major obstacles for cyclists, and east-west movement across the Valley is mainly restricted to on-highway routes.

Further to enhancing routes to central London, there is a need to satisfy the principal east-west routes across the valley, which provide connections to existing centres in Enfield and Waltham Forest and access for people travelling to work in the Opportunity Area. Improvements to cycle connections to serve this will be important to enhancing this orbital connectivity and promoting the quick local point-to-point journeys offered by cycling. Additionally, there is currently a demand for cycling to and from the employment areas of the Docklands and, in the near future, at Stratford and the Olympic Park.

A number of interventions to improve cycling within the OA, which enhance the legibility and quality of cycle routes, will help to overcome the barriers mentioned above, including:

- Blackhorse Lane riverside park and railway underpass link
- Ponders End bridge project
- Cycle Superhighway One (CS1) which will run from Tottenham to Liverpool Street

5.2.3 Walking

An extensive network of pedestrian routes is compromised by missing key links and/or by a poor environment that creates a strong disincentive to pedestrian activity. The major challenge for walking in the study area is the hostile nature of the pedestrian environment which acts as a disincentive to walking, and as a result, local centres and stations are poorly connected. Although the River Lea and Lea Navigation offer good bases for walking environments, these are predominantly for leisure usage, and the river and reservoirs can act as barriers, particularly where routes are badly lit, or where access points are limited.

As improving conditions for pedestrians often focuses on a site-specific basis, the role of individual development proposals is key to addressing many of the barriers to walking. Linking individual developments into the wider walking network is important, and this should make use of an appropriate wayfinding system, such as Legible London.

5.2.4 Highway

The road network is dominated by two orbital routes; the M25 to the north and the A406 to the south; and two radial routes between these; the A10 and Mollison Ave/Meridian Way. In addition to these, the Hertford Road (A1010) also provides a north-south route for more local traffic. Given the barrier effect of reservoirs, additional east-west movement is constrained to 3 ‘crossings’, at Lea Bridge Road, in the south, Forest Road, and Lea Valley Road.

Much of the reduced east-west connectivity is further worsened by the levels of congestion on the existing highway network. The location of motorway junctions mean that there is indirect access to the M25 along the A1055 Bullsmoor Lane and the congestion restricts orbital movements, as does congestion on the A406 North Circular Road, particularly at New Southgate, to the west of the Valley. To the south of the area the nature of the A10 and A107, being largely single carriageway and often in High Street environments, restricts traffic flow out of central London. Such restrictions on traffic movement, along with the constraints imposed by the reservoirs, serve to disconnect the

Upper Lee Valley from the surrounding growth areas at Stratford and in the Lower Lee Valley, limiting opportunities for growth.

Figure 11 shows a *Trafficmaster* map with observed weekday's delays in the morning peak (7-10am).

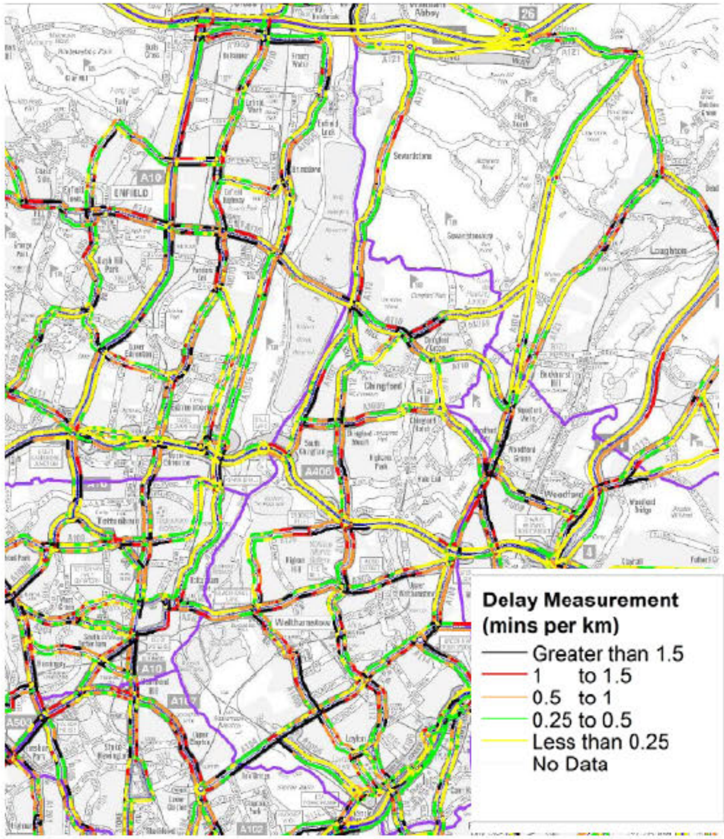

Figure 11 – 2008-09 – average delays map (weekdays 7-10am) provided by Trafficmaster

5.2.5 Bus

The bus network in the Upper Lee Valley is reasonably dense and provides for both radial and orbital movement. It accounts for the highest mode share of any London sub region and will be key in delivering the level of development growth set out in this report. The A1010 corridor from Tottenham Hale to Edmonton Green and Turkey Street has particularly high bus usage, and this correlates closely with the Valley's areas of high population density and relatively low car ownership. To the east, the corridor along the A1055 suffers from relatively poor transport accessibility. The east-west bus network across the valley is constrained by the limited number of roads crossing the valley, meaning longer journeys between centres not directly connected by a crossing, which reduces demand for such routes.

The transport strategy will recognise the impact of, and opportunities from, increased demand arising from development in the area, and the importance of driving further investment in the bus network to maintain and improve service reliability and journey times in some areas, whilst enhancing accessibility in others.

5.2.6 Freight

The Upper Lee Valley comprises one of the largest clusters of industrial estates in London. Much activity is anchored to the strategic north-south routes into London from the wider east of England. The A406 North Circular Road, the West Anglia Main Line, the waterways and the extensive reservoirs serve to constrain movement within the area. Heavy peak hour traffic flows serve to constrain the movement of freight by road along the A1010, on the A1055 and at the Tottenham Hale Gyratory. Other constraints include access to and from the M25 from the Brimsdown area, the bottleneck of the A406 at Green Lanes and road access across the rail level crossings.

There is a need to ensure that freight journeys are efficient and rationalised, to reduce total number of trips and to avoid critical times on the road network. The River Lea offers the opportunity to exploit water based transport where appropriate. Currently, the full potential of the area's waterways for the transportation of freight is not being realised.

5.2.7 National Rail

The rail network serving the area is predominately radial, providing services to Stratford, to Liverpool Street station for the City and to the West End via the Underground interchange at Tottenham Hale or Seven Sisters. The West Anglia Main Line runs through the central length of the Opportunity Area with services form London Liverpool Street to Cambridge, Stansted Airport and Hertford East. Accommodating high-speed services too, the twin-tracked nature of the line constrains the stopping pattern of many services, resulting in a low service frequency (with no services at many stations between the morning and evening peaks) and peak period overcrowding. This serves to limit rail accessibility, placing further pressure on alternatives modes. As a result of planned enhancements to rail operations in the area, mainly through the lengthening of trains, Lee Valley services to Liverpool Street will have an additional capacity in the order of 40% in the AM peak. The majority of these capacity improvements were completed in December 2011. The key enhancements included moving from 8 to 12-car operation on the Liverpool St – Stansted Airport services, a similar 12-car operation on the Liverpool St – Cambridge services, and other peak services going from 4-car to 8-car, including some Stratford services. These are included in the future year forecasts as committed, funded schemes.

Figures 12 and 13 show passenger flows and standees per square metre on National Rail services in the base year 2007.

In the morning peak hour, maximum levels of crowding peak at 4+ standees per m^2 in base and future years on southbound services approaching Tottenham Hale.

In the evening peak, the reverse pattern is true; maximum levels of crowding peak at 4+ standees per m^2 in base and future years on northbound services from Tottenham Hale.

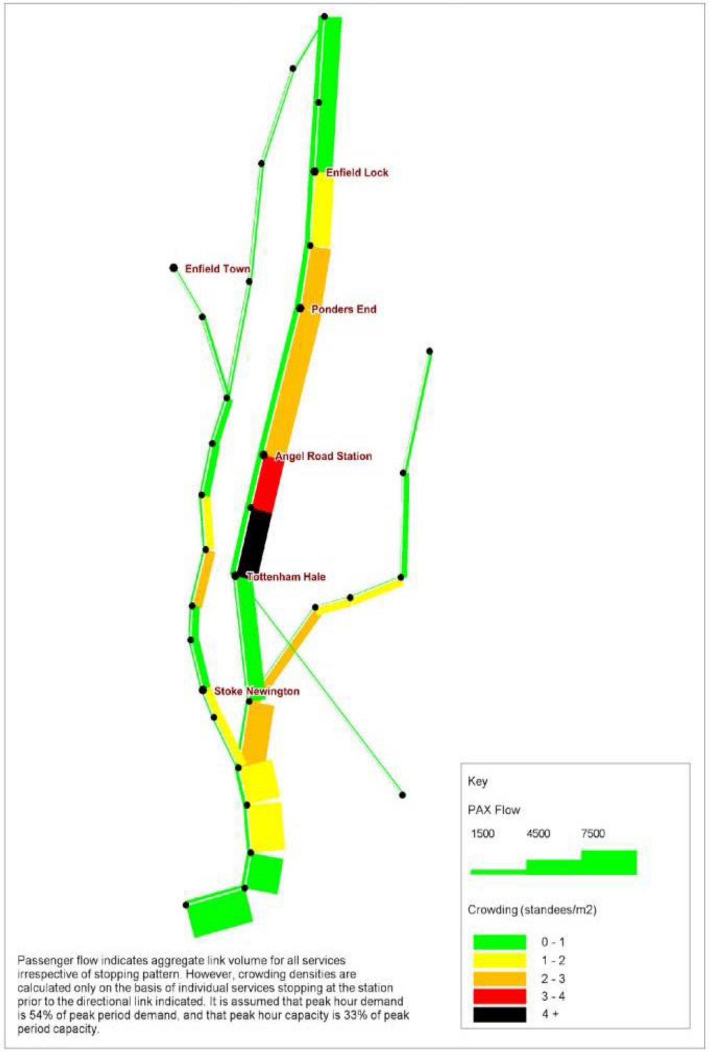

Figure 12 – Passenger flow and standees per square metre on National Rail services - AM peak – base year (2007)

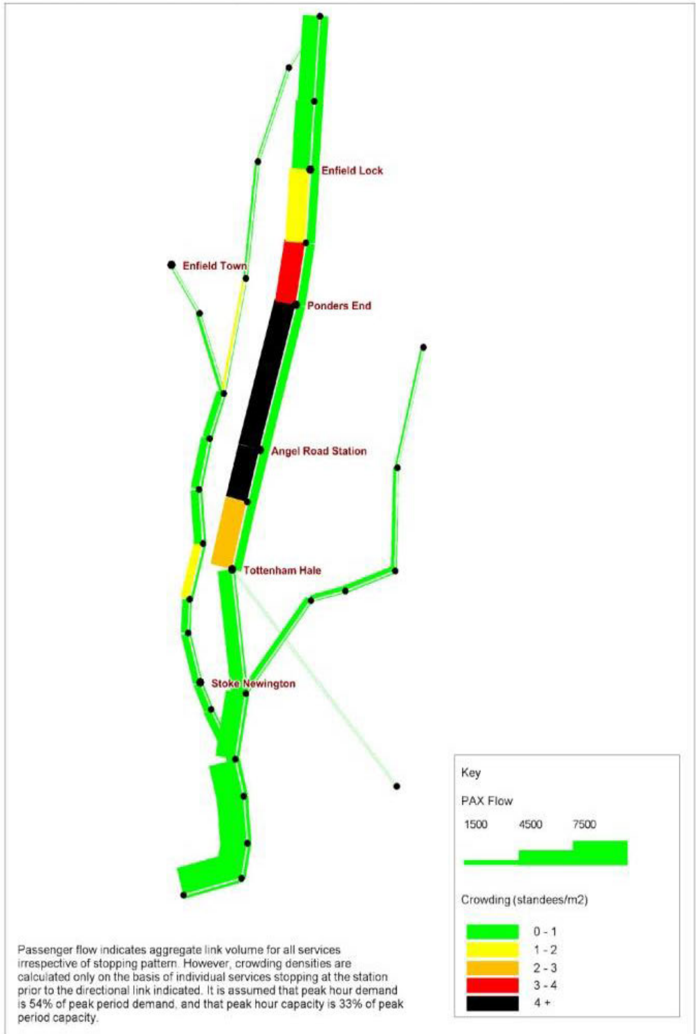

Figure 13 – Passenger flow and standees per square metre on National Rail services - PM peak - base year (2007)

5.2.8 Overground

The Barking – Gospel Oak line provides a useful orbital service as part of the new London Overground service with stations at South Tottenham, Blackhorse Road and Walthamstow Queen's Road. London Overground has an incremental programme of improvements that will see all stations on this route refurbished and provided with improved passenger facilities, including better security, new rolling stock and more frequent services. A Department for Transport funded programme is also enhancing the capability and capacity of the line so that it can accommodate increased passenger and freight services.

5.2.9 Underground

The Victoria Line provides the most frequent radial rail service at Seven Sisters, Tottenham Hale and Blackhorse Road, all providing interchange with National Rail services, but these stations are located at the southern end of the OA. The demand within Tottenham Hale station currently exceeds capacity in the peak hours, primarily due to the small concourse and the layout of the gatelines, stairs and National Rail platforms. Out of the area, the Victoria Line suffers from significant levels of crowding in and out of central London, particularly south of Highbury and Islington in the peak hours.

Only the peak direction relevant to the study area (southbound in the morning and northbound in the evening peak) is shown in this report. Full results including flows for the other directions and time periods can be found in Appendix B of the report called *Upper Lee Valley Model Analysis – March 2010 (by Halcrow)*.

There is severe crowding (in excess of 4 standees per m2) on sections of the Victoria line in both base and future years in the peaks. This is particularly prevalent in the southbound directions (Finsbury Park to Oxford Circus) in the AM peak hour and northbound direction (Oxford Circus to Highbury and Islington) in the PM peak hour.

At Tottenham Hale, funding has been secured for the removal of the gyratory, a new bus station, and other improvements to the surface interchange. TfL also has aspirations to provide improved facilities to accommodate demand within the station itself.

Tables 3 and 4 show the level of crowding (taken from Railplan) for all the line segments in the base year.

AM Peak - Standees per m2	2007
Walthamstow C - Blackhorse Road	0.9
Blackhorse Road - Tottenham Hale	2.4
Tottenham Hale - Seven Sisters	3.2
Seven Sisters - Finsbury Park	2.5
Finsbury Park - Highbury & Is	5.1
Highbury & Is - Kings Cross	5.6
Kings Cross - Euston	5.4
Euston - Warren Street	6.3
Warren Street - Oxford Circus	6.0
Oxford Circus - Green Park	3.4
Green Park - Victoria	2.5
Victoria - Pimlico	0.6
Pimlico - Vauxhall	0.0
Vauxhall - Stockwell	0.0
Stockwell - Brixton	0.0

Table 3 - Victoria Line - Level of crowding - 2007 AM peak - Southbound direction

PM Peak - Standees per m2	2007
Brixton - Stockwell	0.0
Stockwell - Vauxhall	0.0
Vauxhall - Pimlico	0.1
Pimlico - Victoria	1.3
Victoria - Green Park	4.2
Green Park - Oxford Circus	4.8
Oxford Circus - Warren Street	6.4
Warren Street - Euston	6.3
Euston - Kings Cross	5.2
Kings Cross - Highbury & Is	4.5
Highbury & Is - Finsbury Park	2.9
Finsbury Park - Seven Sisters	1.9
Seven Sisters - Tottenham Hale	1.4
Tottenham Hale - Blackhorse Road	0.4
Blackhorse Road - Walthamstow C	0.0

Table 4 - Victoria Line - Level of crowding - 2007 PM peak - Northbound direction

5.2.10 Public Transport Accessibility Levels

Public Transport Accessibility Level (PTAL) scores range on a scale where 0 is poor and 6 is excellent. A PTAL study shows that the southern portion of the study area, where population density is generally greater, benefits from a higher PTAL because of the Tube station and frequent bus service at Tottenham Hale. However the northern portion of the study area (with the exception of Enfield town centre) has poorer access to public transport. In terms of access to jobs via the public transport network, the Valley fares comparatively well for an outer London area.

6 Understanding future growth in the Upper Lee Valley

6.1 Population and Employment in the Upper Lee Valley

It is expected that the ULV area will experience a growth of 55,000 residents by 2031, which represents an increase of 24% from 2007. Almost half of the forecast growth is concentrated in Central Leeside and Tottenham Hale. Other areas of important growth are Clapton, Highams Hill (Walthamstow area) and Ponders End.

The population is forecast to increase by 12% between 2007 and 2021, and a further 10% between 2021 and 2031.

Employment in the area is expected to increase by around 15,000 jobs by 2031, which is 20% more jobs than in 2007. The zones attracting more employment are again located in the areas of Central Leeside and Tottenham Hale, accommodating more than half the proposed growth. Similarly, other important areas of growth are Highams Hill (Walthamstow area) and Clapton.

Approximately 12% of the growth in jobs is expected to happen between 2007 and 2021, while a further 8% increase is expected in the next 10 years, from 2021 to 2031.

Table 5 shows the ULV zones (LTS structure), with the population and employment figures for 2007, 2021 and 2031. The zones are ordered North to South, but for the exact location see Figure 4 in Chapter 4.

Table 6 compares the ULV figures with the expected growth in the surrounding boroughs. The ULV Opportunity Area experiences similar population growth rates to the borough of Hackney, which are high in comparison with other parts of North London. Employment growth rates are also on the high side, as would be expected in an Opportunity Area.

Figures 14 and 15 show the distribution and growth of population and jobs in the ULV area, highlighting the areas where growth concentrates.

Figure 16 shows the number of trips between the ULV and the surrounding areas by mode in 2031.

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LTS zone	Name	Pop 2007	Pop 2021	Pop 2031	Population2 031-2007 increase	Emp 2007	Emp 2021	Emp 2031	Employment 2031-2007 increase
7334	Enfield Wash and Freezy Water	28,611	29,166	29,543	932	4,877	5,515	5,977	1,100
7344	Enfield Highway West	10,827	10,978	11,082	255	7,463	6,739	6,459	-1,004
7345	Enfield Highway East	2,861	2,886	2,924	63	1,169	1,931	2,269	1,100
7346	Ponders End	13,290	15,930	15,870	2,580	4,762	5,168	5,462	700
7303	Lower Edmonton East	8,247	8,382	8,475	228	2,733	3,023	3,233	500
7302	Pickets Lock	21,078	21,452	21,706	628	2,806	2,922	3,031	225
7304	Upper Edmonton	14,640	14,851	14,996	356	2,108	2,166	2,208	100
7309	Upper Edmonton East	1,526	3,566	14,826	13,300	3,726	5,176	6,226	2,500
3037	Tottenham East	6,890	7,398	7,610	720	6,294	6,816	7,194	900
3034	Tottenham Hale West	18,011	19,011	19,747	1,736	5,405	5,637	5,805	400
8313	Chapel End	15,319	16,814	17,712	2,393	4,057	4,173	4,263	206
8340	Highams Hill	3,318	5,848	7,538	4,220	2,523	3,219	3,723	1,200
8344	Walthamstow West	13,516	14,190	16,013	2,497	4,293	4,351	4,393	100
3044	Tottenham Hale East	3,111	10,693	14,211	11,100	4,214	7,114	9,214	5,000
3042	South Tottenham	12,709	13,651	14,311	1,602	4,827	4,943	5,013	186
8331	Walthamstow South	10,254	12,587	12,963	2,709	2,286	2,144	2,222	-64
8347	Lea Bridge	4,904	5,095	5,838	934	3,985	4,217	4,385	400
3439	Upper Clapton	11,713	12,873	13,691	1,978	1,550	1,669	1,757	207
3437	Stamford Hill	16,822	18,378	19,730	2,908	4,001	4,443	4,735	734
3430	Clapton	19,731	22,450	24,399	4,668	2,607	3,111	3,387	780
	Total ULV	237,378	266,199	293,185	55,807	75,686	84,477	90,956	15,270

Table 5 – Planning data for the ULV area

	population 2007	population 2031	population 2007-2031 increase	employment 2007	employment 2031	employment 2007-2031 increase
ULV	237,381	293,185	24%	75,675	90,956	20%
Enfield	187,575	195,906	4%	60,553	66,430	10%
Haringey	191,740	221,908	16%	58,648	67,211	15%
Hackney	170,634	215,727	26%	66,195	79,268	20%
Waltham Forest	176,731	192,149	9%	45,897	48,497	6%

Table 6 – Population and Employment Growth in the ULV and surrounding boroughs

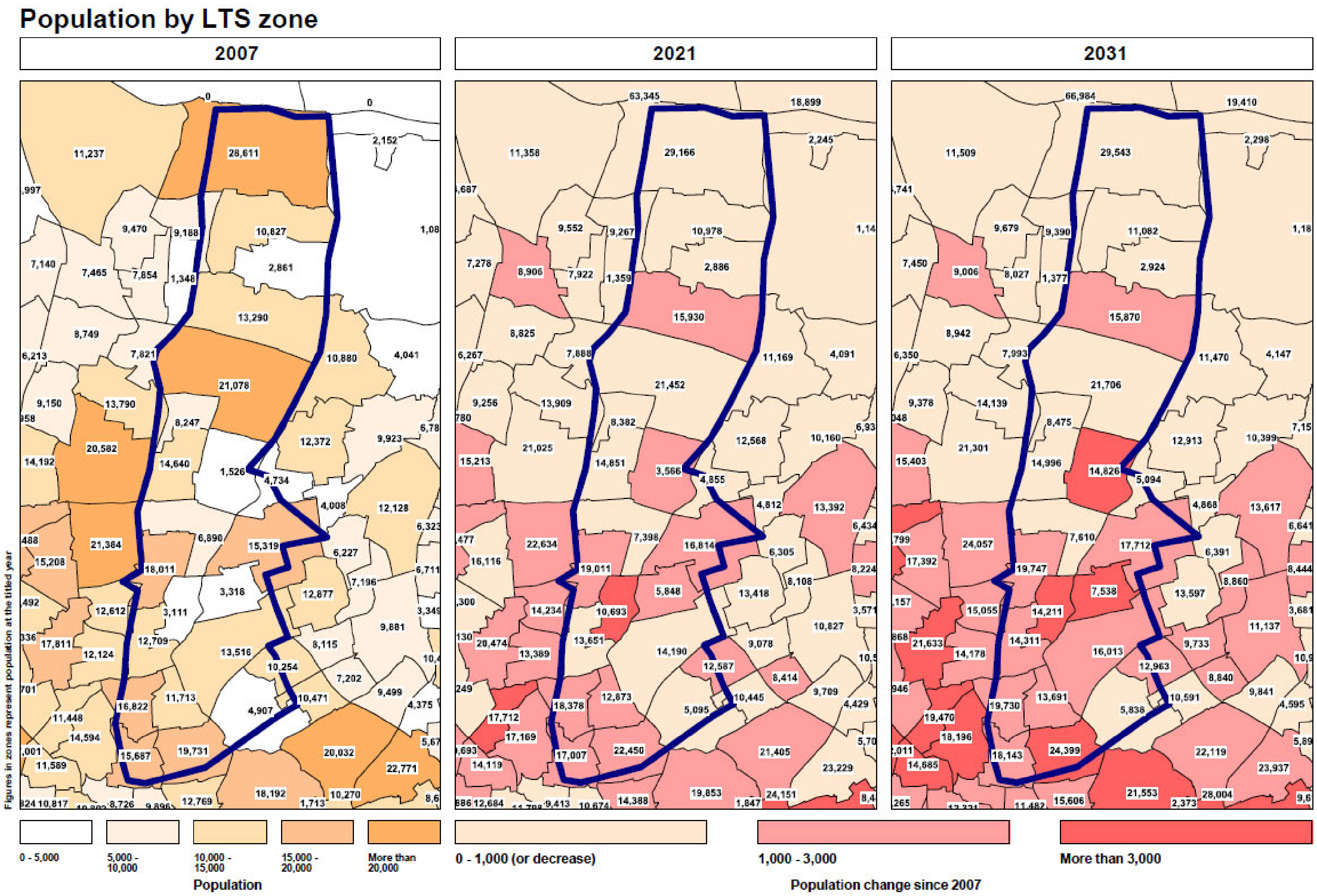

Figure 14 - Population in the ULV

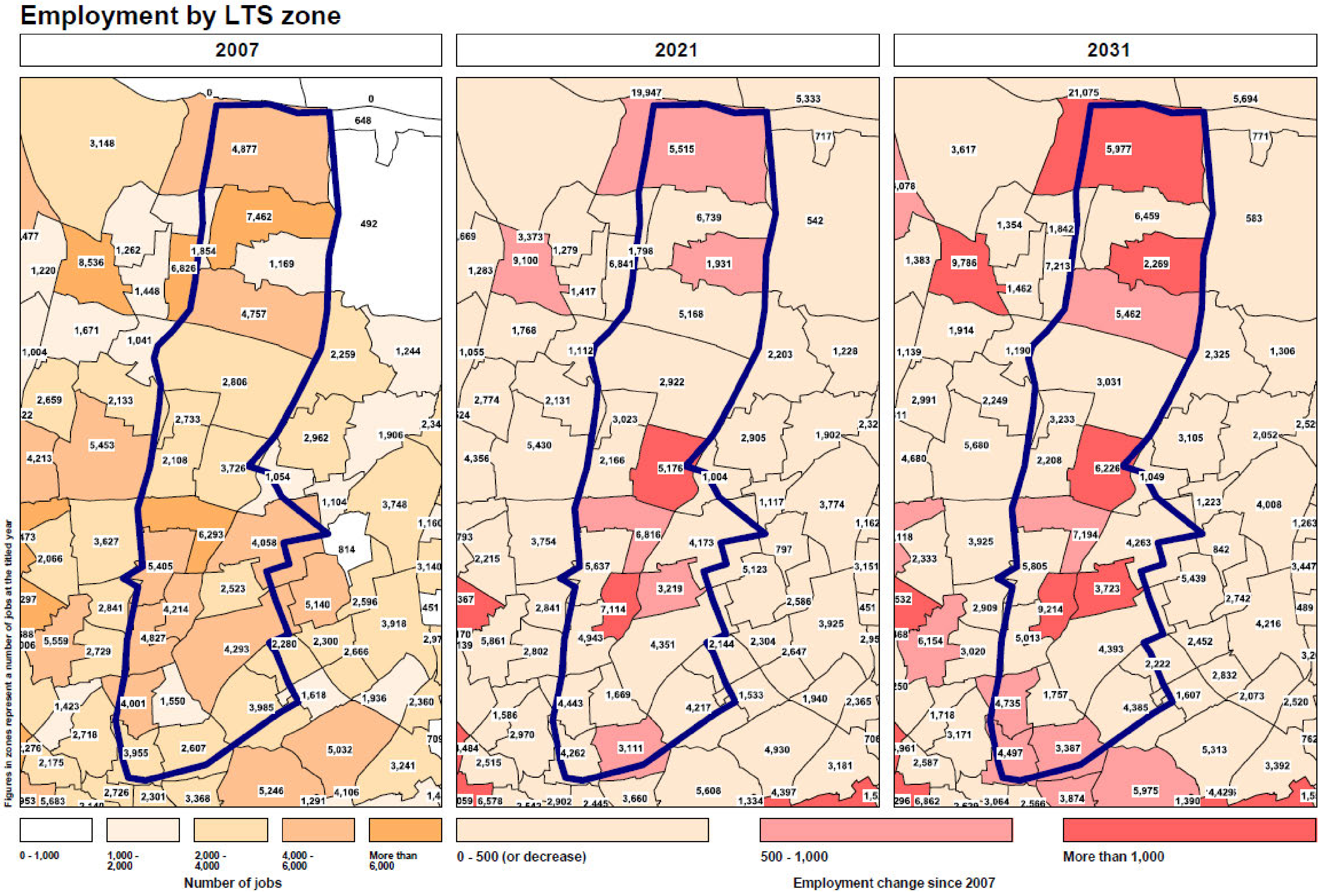

Figure 15 - Employment in the ULV

6.2 Additional trips, mode share and OD patterns

Section 6.1 described how population and jobs are expected to grow up to 2031 in the Upper Lee Valley, as well as where the growth is likely to occur. This section looks at the number of trips that will be generated and attracted to the area due to the increase in population and jobs. Subsequent sections will look at the impact of the forecast number of trips on highway and public transport networks, and how to best alleviate the effect of these.

Table 7 shows the number of trips and the mode share in 2007 and 2031, for the AM and PM peaks, for car, public transport and walking/cycling. The number of trips in the morning peak grows from 161,521 in 2007 to 200,003 in 2031, an increase of 38,482 trips. This represents an increase of 23% by 2031. There are an additional 1,925 taxi, LGV and OGV trips, which have not been included in the table. In the PM, the number of trips grows from 163,378 in 2007 to 200,992 in 2031. This is a difference of 37,614 which represents an increase of 23%. There are another 1,738 taxi, LGV and OGV trips which have not been included in the table.

The pace of growth for both peaks is similar: over half the increase is experienced between 2007 and 2021, and the rest happens between 2021 and 2031; however looking at car only, the vast majority of the growth is done between 2021 and 2031, while the number of car trips remains almost constant between 2007 and 2021.

Moving onto origin-destination patterns, Figure 17 shows morning peak trips to and from the ULV in 2031. The most frequent movements are within the ULV and to and from North London. Other important movements in the AM are to and from East London and to Central London.

Car is the most popular mode for trips to and from the rest of the UK and East London. Also most trips from North London to the ULV are made by car, although the reverse direction appears to favour PT. Trips to and from West, Central and South London are made predominantly by public transport. Walking and cycling is the main mode for internal trips within the ULV.

MODE SHARE ULV MP 2007		
CAR	60,000	37%
PT	63,000	39%
Slow	39,000	24%
2031 ULV1 growth only with no interventions MP		
CAR	65,000	33%
PT	84,000	42%
Slow	51,000	26%

MODE SHARE ULV EP 2007		
CAR	68,000	42%
PT	59,000	36%
Slow	36,000	22%
2031 ULV1 growth only with no interventions EP		
CAR	76,000	38%
PT	79,000	39%
Slow	47,000	23%

Table 7 - Number of trips and mode share in the ULV

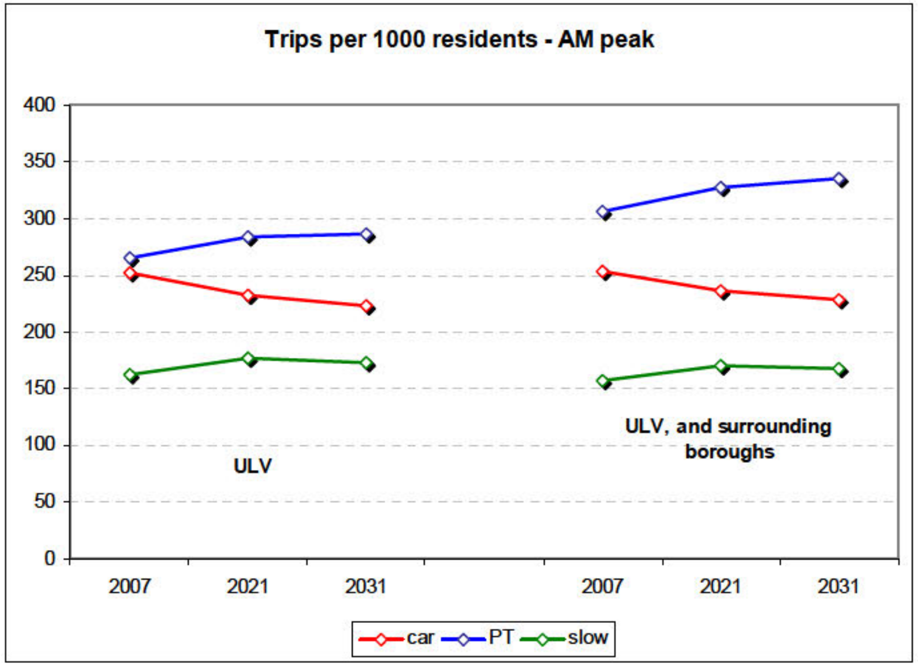

Figure 16 - Trips per 1000 Residents to and from the ULV

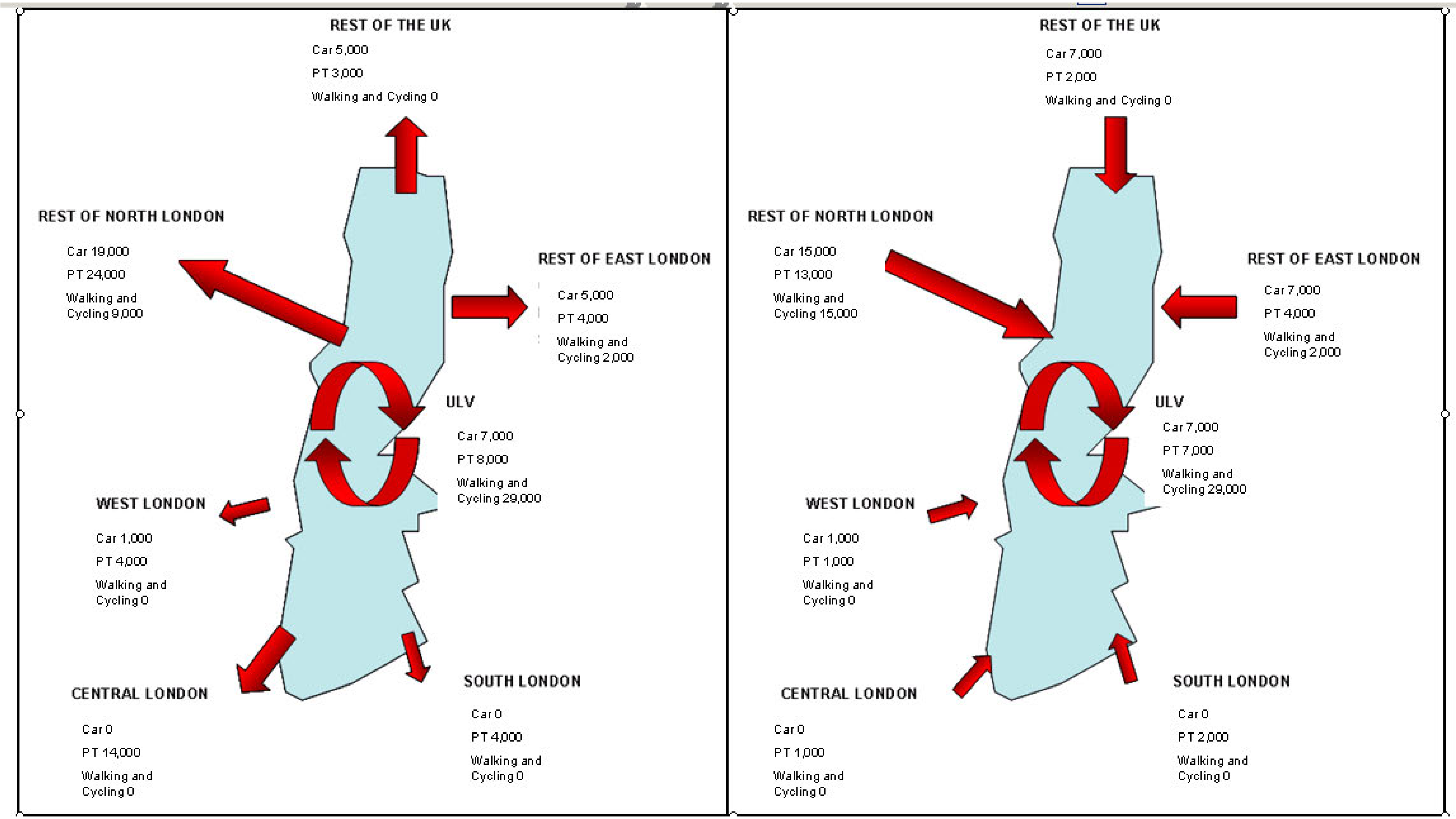

Figure 17 - Trips to and from the ULV - 2031 AM peak

6.3 Conclusions

The main conclusions are:

- The amount of travel increases significantly over the years up to 2031. The trip rates are however relatively low in comparison with the benchmark area (surrounding boroughs of Enfield, Haringey, Hackney and Waltham Forest). The trips rates remain at similar levels throughout the years.
- The number of trips in the area increases at a similar pace in both years (2021 and 2031). However, when looking at specific modes, it becomes clear that car trips remain almost constant until 2021, growing more between 2021 and 2031. In contrast, public transport and walking and cycling grow more from 2007 to 2021 than in the subsequent 10 year period.
- A trend of mode shift is forecast by the model. The number of internal car trips (with an origin and destination in the ULV) decreases. This trend is common to all the boroughs in the GLA. In the ULV, people switching from car appear to be choosing walking and cycling for the internal trips, rather then public transport. This is not so in the benchmark area (boroughs of Enfield, Haringey, Hackney and Waltham Forest), where PT trip rates are higher, and slow mode trip rates are lower, than in the ULV.
- The most important movements are between the ULV and the rest of North London. For these trips, PT is the preferred mode towards North London in the AM and towards the ULV in the PM, although car dominates the picture in all other scenarios and years. Car is the predominant mode for trips to and from East London. PT is the preferred mode to and from Central, East and West London. These findings need to be taken into account should an intervention package contain mode shift elements. Further analysis of the OD patterns might be needed.
- The mode share varies considerably in different parts of the ULV. Car appears to be more popular in the North of the ULV, while public transport catches most trips in areas like Tottenham Hale and Walthamstow. This might be related with issues like poor rail connectivity in the North of the ULV, low train frequencies, and lack of east-west public transport links.

7 Understanding the effect of future growth on the public transport system

7.1 Introduction

Chapter 6 looked at the forecast growth in population, jobs and number of trips in the Upper Lee Valley area between the base year 2007 and the future year 2031.

Chapter 7 focuses on the impact of the expected number of trips on the public transport system. The "do minimum" or *ULV1 - Growth with no additional interventions* model was run for 2021 and 2031. Initially, this was reported in the *Upper Lee Valley Model Analysis – March 2011 (by Halcrow)*. However a new version of the LTS model was released by TfL soon after, and the model runs were repeated with this new version (LTS 6.2). The results of this second round of runs were documented in two reports:

- Year 2021: *Upper Lee Valley Model Analysis – Stage 4b Task A – August 2011 (by Halcrow)*
- *Year 2031: Upper Lee Valley Model Analysis – Stage 4a – August 2011 (by Halcrow)*

The contents of this chapter are taken from the above reports.

7.2 Overview of model runs

Table 8 shows the model runs completed for 2021 and 2031 future years using standard Regional Railplan parameters. Demand matrices from study specific LTS runs have been assigned (runs 6207ref1, 6221ulv1 and 6231ulv1). Reference case networks have been adjusted to reflect minor corrections to local National Rail services[1].

Year / Period	Model Run ID
2021, AM peak period	LV0205Z
2021, Interpeak period	LV021EZ
2021, PM peak period	LV022Z5
2031, AM peak period	LV017A4
2031, Interpeak period	LV019C4
2031, PM peak period	LV018B4

Table 8 - Railplan model runs

7.3 Results by sub-mode

7.3.1 London Underground

Crowding on the Victoria Line in the base year and 2021 / 2031 reference cases is shown below in Tables 9 and 10, demonstrating the following levels of standees:

1 Removal of services LW634U and LW635U

Some Seats Available
Some Standing (0-1 standees m²)
Busy (1-2 standees m²)
Crowded (2-3 standees m²)
Very Crowded (3-4 standees m²)
Maximal (4+ standees m²)

Only the peak direction relevant to the study area is shown; southbound in the morning peak and northbound in the evening peak. Full results for the other directions and time periods can be found in the *Stage 4b – Task A* and *Stage 4a* reports.

	2007	2012 ULV1	2031 ULV1
Walthamstow C - Blackhorse Road	0.9	0.7	0.8
Blackhorse Road - Tottenham Hale	2.4	2.0	2.1
Tottenham Hale - Seven Sister	3.2	3.0	3.3
Seven Sister - Finsbury Park	2.5	3.0	3.3
Finsbury Park - Highbury & Is	5.1	5.1	5.7
Highbury & Is - Kings Cross	5.6	5.6	6.1
Kings Cross - Euston	5.4	5.0	5.5
Euston - Warren Street	6.3	5.7	6.3
Warren Street - Oxford Circus	6.0	5.5	6.1
Oxford Circus - Green Park	3.4	2.9	3.4
Green Park - Victoria	2.5	2.2	2.6
Victoria - Pimlico	0.6	0.7	0.9
Pimlico - Vauxhall	0.0	0.0	0.0
Vauxhall - Stockwell	0.0	0.0	0.0
Stockwell - Brixton	0.0	0.0	0.0

Table 9 - Victoria Line standing densities; standees per m^2 (Southbound, AM peak hour)

	2007	2021 ULV1	2031 ULV1
Brixton - Stockwell	0.0	0.0	0.0
Stockwell - Vauxhall	0.0	0.0	0.0
Vauxhall - Pimlico	0.1	0.3	0.5
Pimlico - Victoria	1.3	1.4	1.7
Victoria - Green Park	4.2	3.6	4.1
Green Park - Oxford Circus	4.8	4.0	4.6
Oxford Circus - Warren Street	6.4	5.5	6.3
Warren Street - Euston	6.3	5.5	6.3
Euston - Kings Cross	5.2	4.5	5.1
Kings Cross - Highbury & Is	4.5	4.5	5.1
Highbury & Is - Finsbury Park	2.9	3.4	4.0
Finsbury Park - Seven Sister	1.9	1.9	2.3
Seven Sister - Tottenham Hale	1.4	1.8	2.1
Tottenham Hale - Blackhorse Road	0.4	0.6	0.7
Blackhorse Road - Walthamstow C	0.0	0.1	0.2

Table 10 - Victoria Line standing densities; standees per m^2 (Northbound, PM peak hour)

There is severe overcrowding (in excess of 5 standees per m^2) on sections of the Victoria Line in both base and future years in the peaks. This is particularly prevalent southbound between Finsbury Park and Oxford Circus in the AM peak hour and northbound between Oxford Circus and Highbury and Islington in the PM peak hour.

With reference to the peak direction Victoria Line flows, the increase in demand is broadly matched by an increase in capacity by 2031. The three Victoria Line links directly serving the study area do not become excessively crowded, relative to other sections of the line. However, demand within the study area does contribute to the severe crowding on inner sections of the line and by 2031 in particular crowding levels on the busiest links are made worse.

7.3.2 National Rail

Figures 18 – 23 show flows and crowding on National Rail services for years 2007, 2021 and 2031, for the AM and PM peak hours.

In year 2007 there are maximum levels of crowding on southbound services approaching Tottenham Hale peaking at 4+ standees per m^2. This confirms the hypothesis that a significant number of passengers on West Anglia services tend to interchange when they reach the appropriate Victoria Line station (be that Walthamstow Central, Tottenham Hale or Seven Sisters) to travel to the West End - unless their destination is in The City in which case they will remain on the service until Liverpool Street.

Figures 20 - 21 show that crowding levels in 2021 are much less severe than in the equivalent scenario for 2031 (Figures 22 – 23). This will be the result of the enhanced service levels being identical to that assumed in 2031, but with lower demand. In the AM peak, some standees are evident between Enfield Lock and Tottenham Hale in the southbound direction, and also on links on the Chingford route approaching Walthamstow Central and also towards Clapton. This observation squares with the known propensity for passengers on the Lea Valley lines to transfer to the Victoria Line where possible, unless heading directly to The City.

Between the AM base (Figure 18) and 2031 future year (Figure 22), the increase in flow is matched by extra capacity in some line segments; in particular crowding is alleviated through Seven Sisters. On the main line route (notably south of Ponders End approaching Tottenham Hale) services get busier causing more crowded conditions.

For the PM, Figure 19 shows the base year, and Figure 23 shows 2031. In the base year the main line appears to be severely overcrowded between Northumberland Park and Ponders End in the northbound direction. Congestion levels are lower in the Future year, thanks to the capacity increases.

To sum up, the effect of growth on the flows is significant. Despite some funded capacity improvements, crowding increases significantly in the northbound direction in two sections: between Tottenham Hale and Northumberland Park, and between Ponders End and Enfield Lock, and alleviated between Northumberland Park and Ponders End. Crowding conditions on the Seven Sisters branch remain unchanged, and the flow increases are also of a lesser magnitude.

It is notable that severe crowding remains on the West Anglia Main Line approaching Tottenham Hale in spite of capacity increases in the area between the base year, 2007, and 2031. It can be seen from comparing figures 18 and 22 (AM peak flows) that the flow increases significantly as a result of the developments in the Lea Valley.

While there are indeed service increases on the West Anglia Main Line, operational constraints do not allow much alleviation of the crowding on the route, particularly north of Tottenham Hale. The section of track has a mixture of fast and slow services, and the number of slow services that can operate are severely limited by the need to let frequent fast services from further afield (Stansted Airport and Cambridge, for example) to run through. These services stop only at Tottenham Hale on the section.

Slow services do not consistently serve all stations. In particular, Angel Road is skipped by almost all services and Northumberland Park retains a poor service, both currently and in the 2031 reference case.

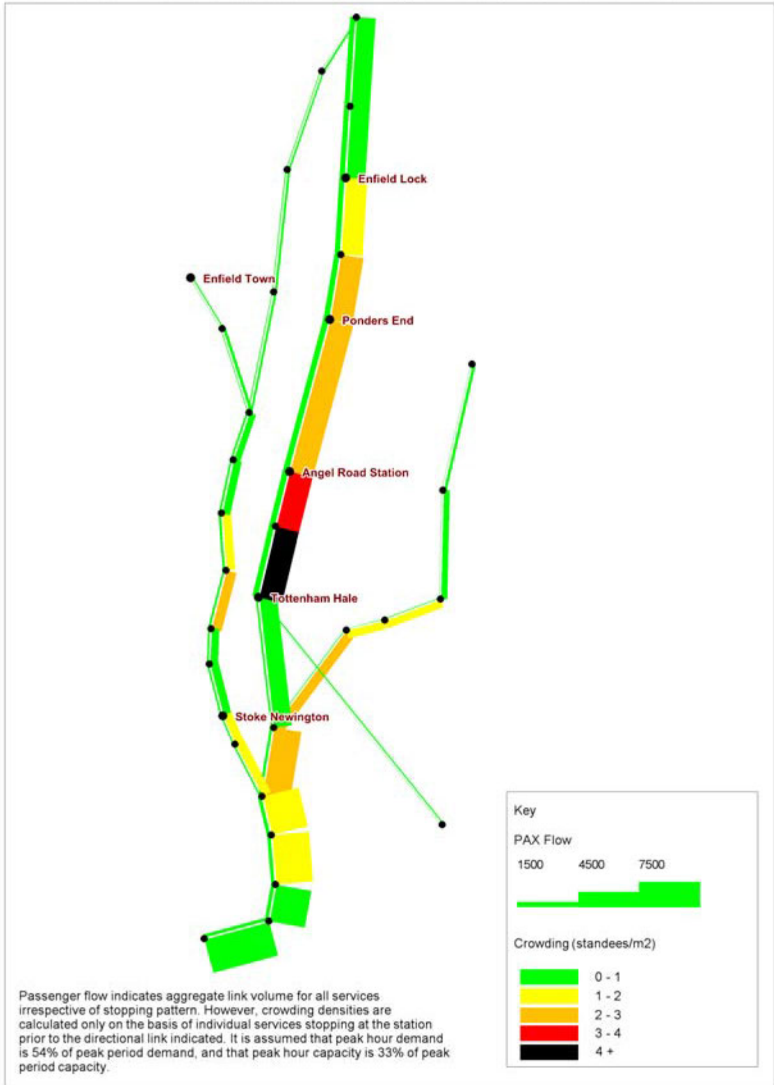

Figure 18 - National Rail Crowding and Passenger Flow; 2007 AM peak hour

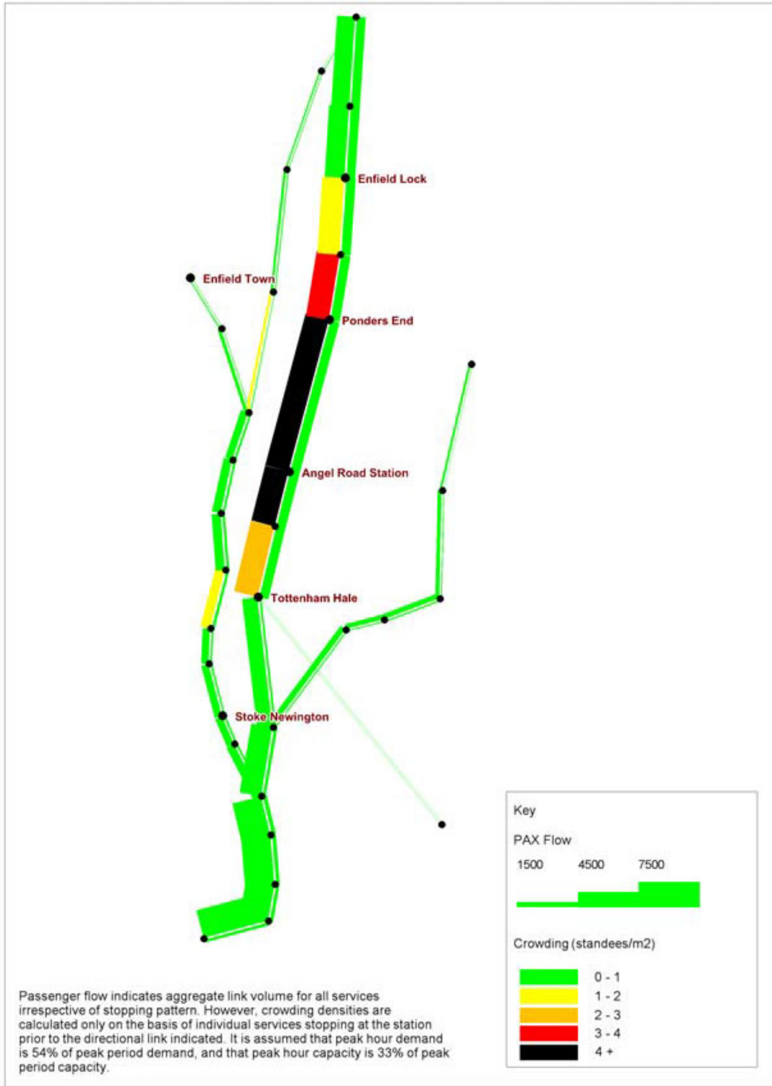

Figure 19 - National Rail Crowding and Passenger Flow; 2007 PM peak hour

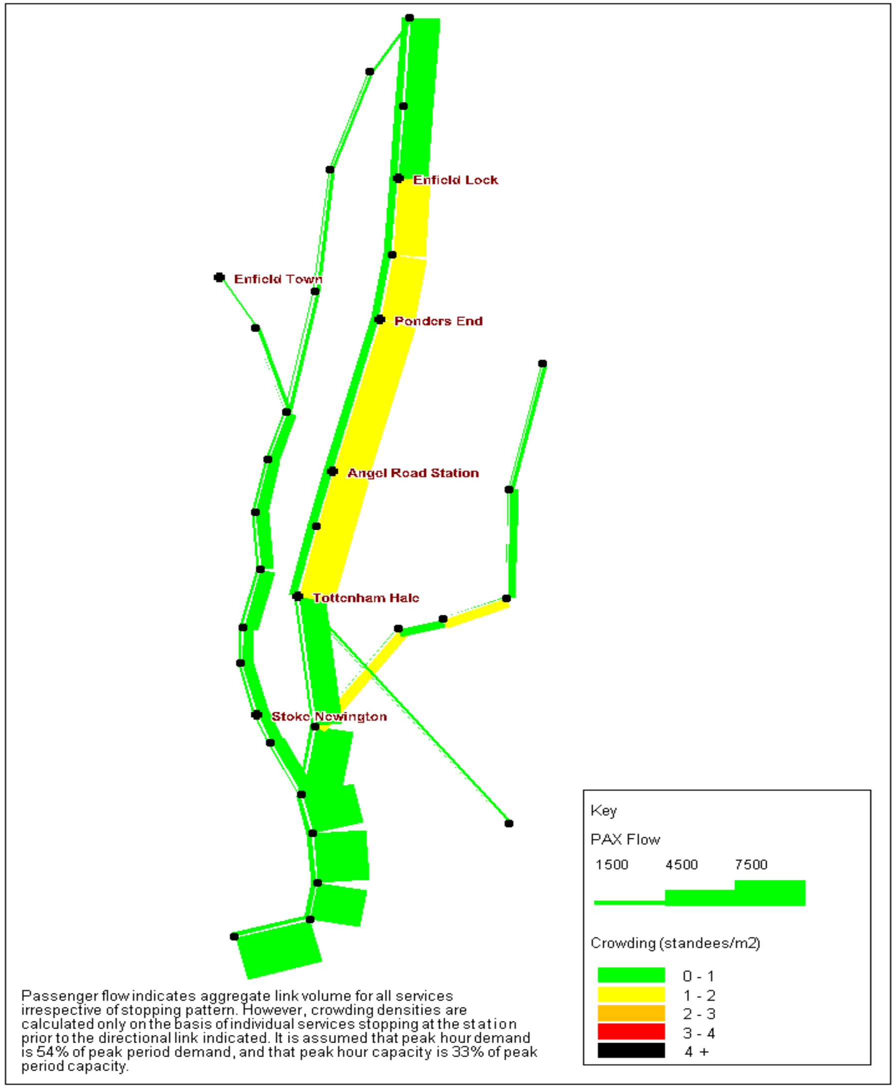

Figure 20 - National Rail Crowding and Passenger Flow; 2021 AM peak hour

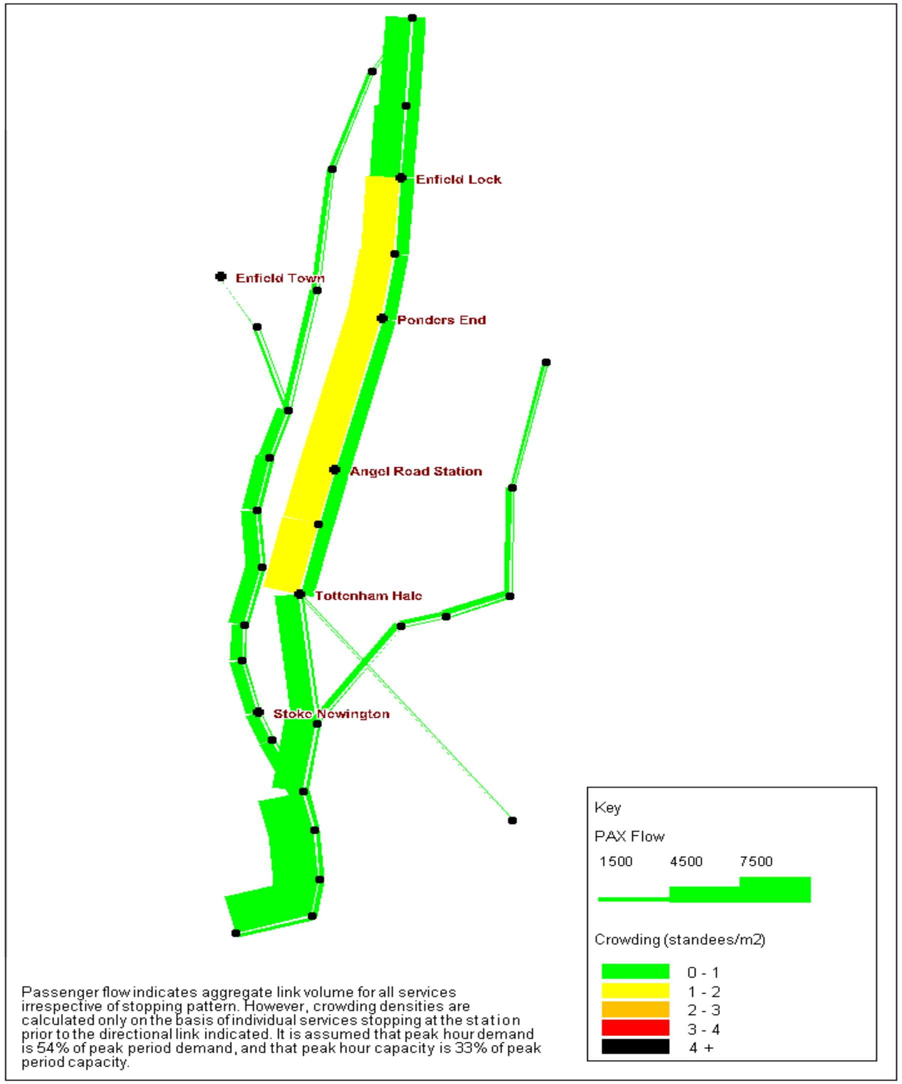

Figure 21 - National Rail Crowding and Passenger Flow; 2021 PM peak hour

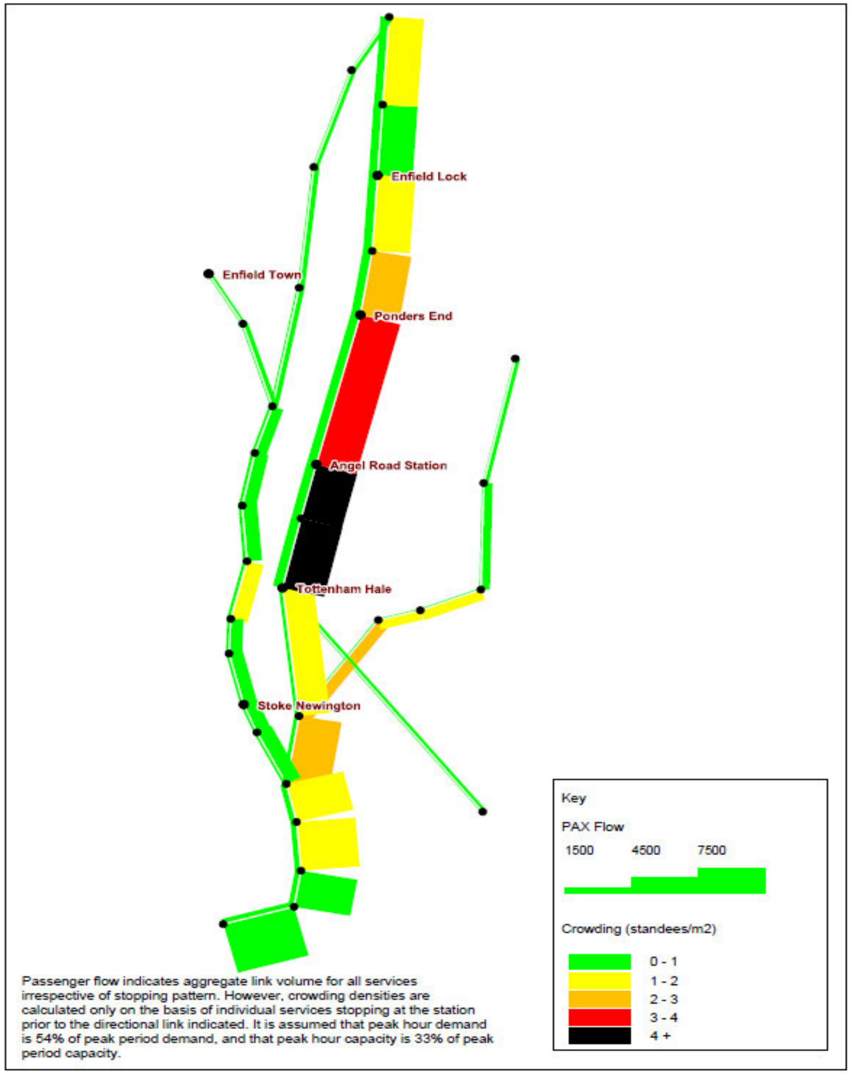

Figure 22 – National Rail Crowding and Passenger Flow; 2031 AM peak hour

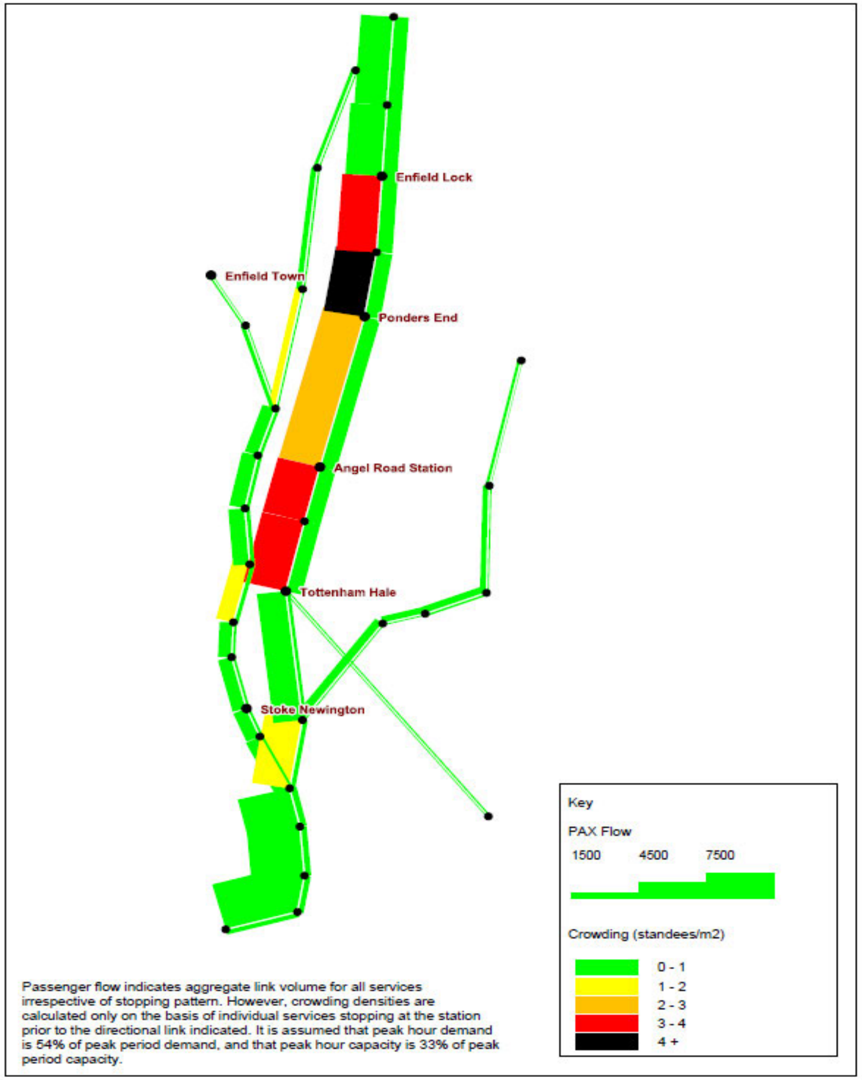

Figure 23 – National Rail Crowding and Passenger Flow; 2031 PM peak hour

7.3.3 Bus

Plots showing the modelled bus flows for all modelled scenarios are provided in Figures 24 – 29.

The most important bus flows in the area are along the A10 at Tottenham Hale, as well as east-west roads that feed into it from the west. This pattern remains unchanged for the PM, and is consistent on routes with the most services. Routes with infrequent or few services, especially to and from the east across the reservoir, experience low flows.

Bus flows are particularly heavy along High Road (Tottenham) and Fore Street, a corridor with frequent services. On the equivalent north-south corridor to the east side of the reservoirs, flows are also heavy along Chingford Road and Hoe Street, heading between Leyton, Walthamstow and Chingford. However, east-west flows across the reservoirs on streets such as Lea Bridge Road, Ferry Lane and service roads adjacent to the north Circular are much lower, probably due to the relative lack of connectivity of the bus network in this region. Improvements to east-west services in the region could be expected to draw significant demand.

The bus flows are very similar between 2007 and 2021. This is partly because the bus services in both years are almost identical. The only area where a noticeable flow increase is observed is along the A10 in the proximity of Tottenham Hale.

Flows increase in 2031 due to the frequency uplifts, which attract demand. The growth in bus passenger volumes throughout the study area during the morning peak period is illustrated in Figure 28 and 29. The largest increases occur south of the North Circular and on the main radial routes into central London. There are smaller increases on the few east-west routes across the Upper Lee Valley. The evening peak period also shows a similar pattern.

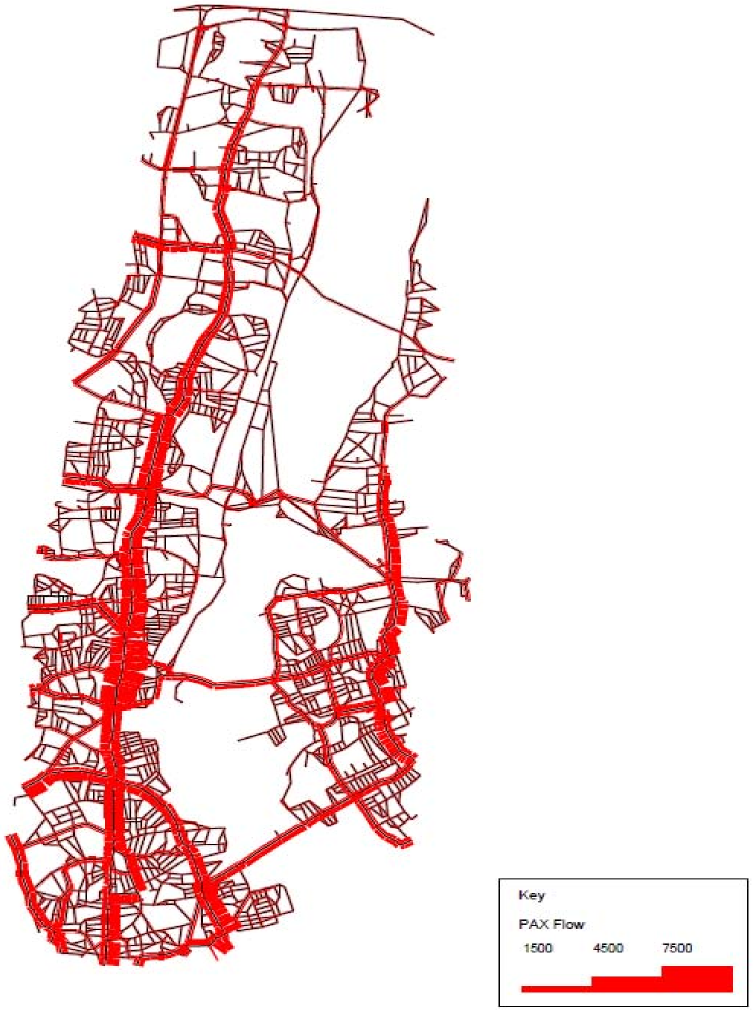

Figure 24 - Bus Passenger Flow 2007 AM peak hour

Figure 25 - Bus Passenger Flow 2007 PM peak hour

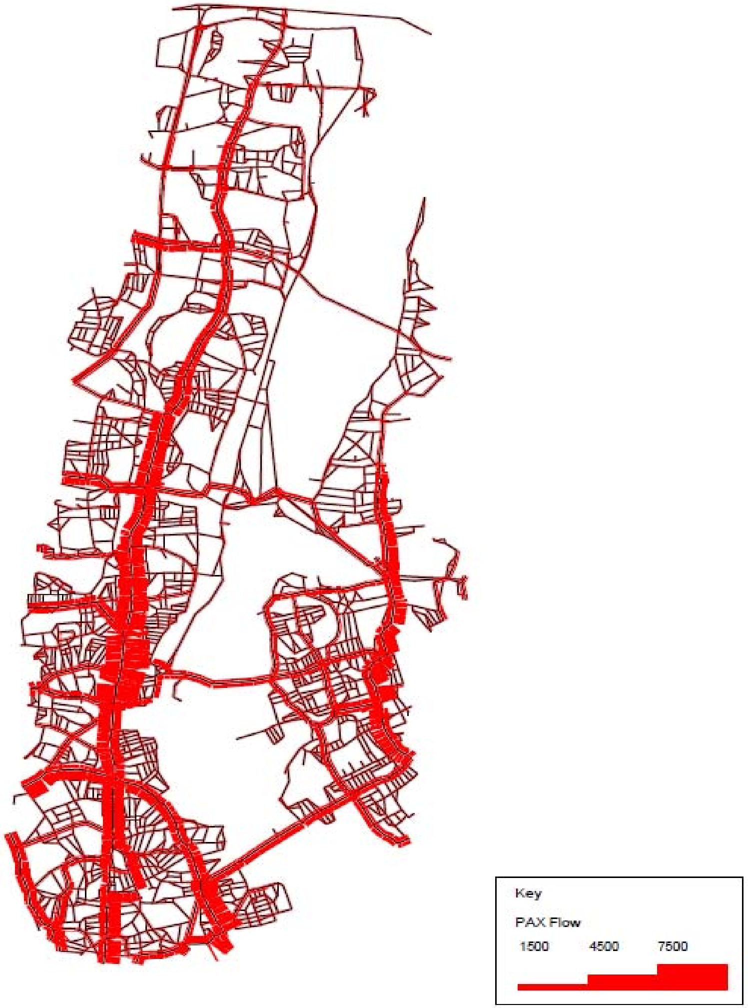

Figure 26 - Bus Passenger Flow 2021 AM peak hour

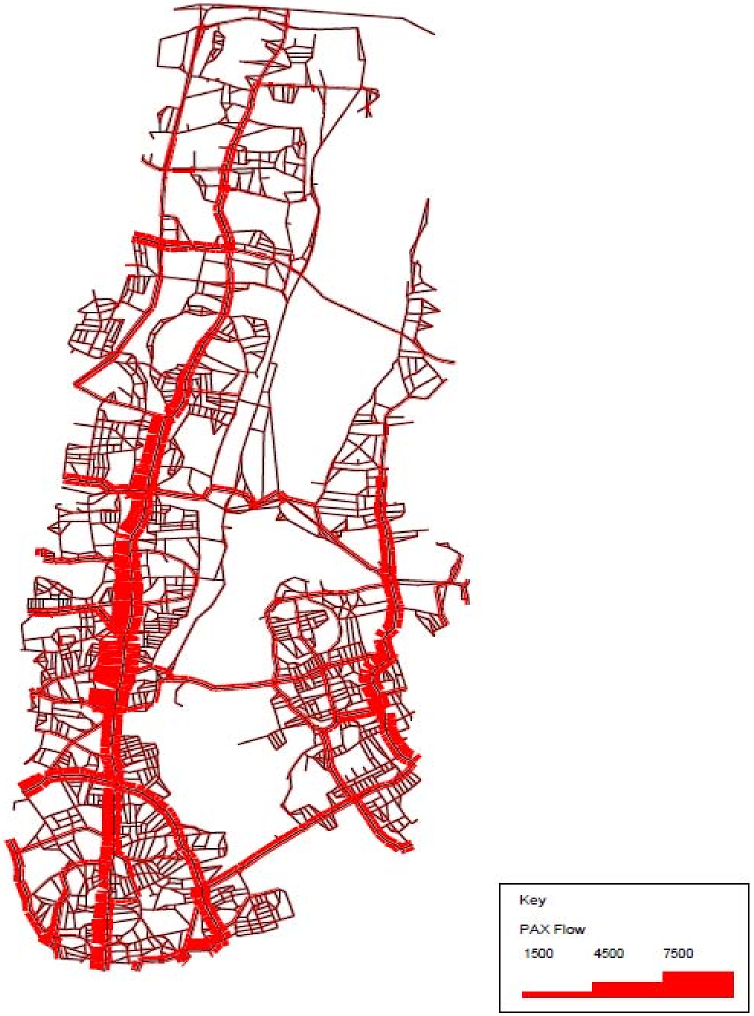

Figure 27 - Bus Passenger Flow 2021 PM peak hour

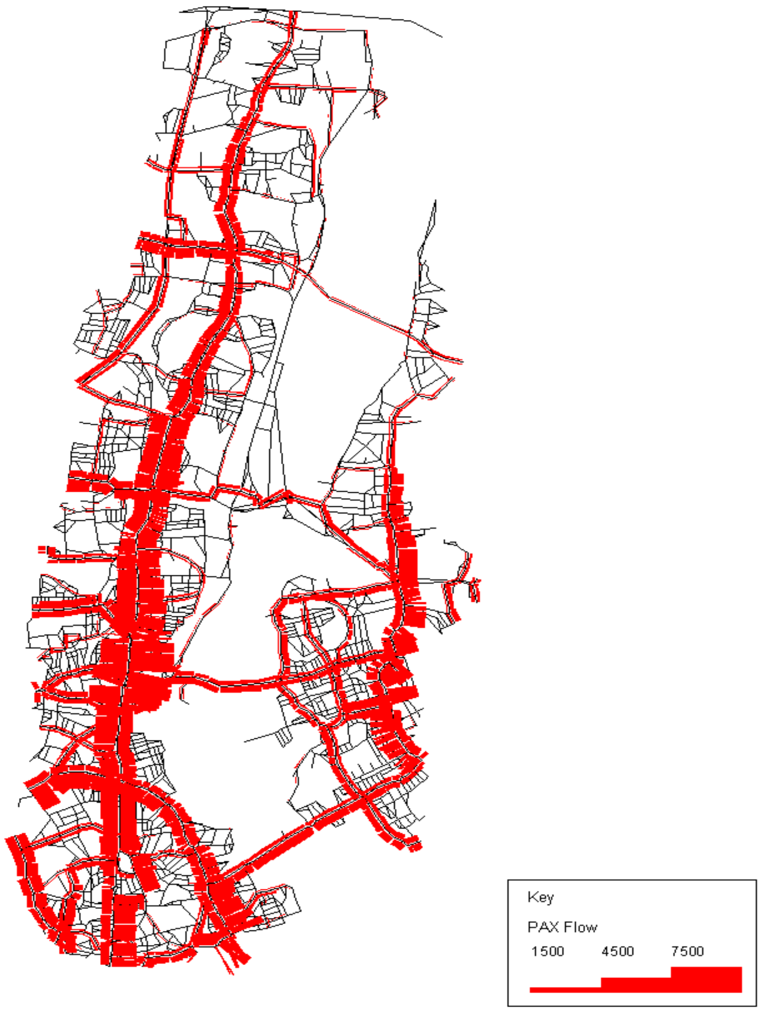

Figure 28 - Bus Passenger Flow 2031 AM peak hour

Figure 29 - Bus Passenger Flow 2031 PM peak hour

7.4 Conclusions

Significant crowding exists on sections of the Victoria Line and National Rail network served by the Upper Lee Valley Opportunity Area. As would be expected this is particularly associated with the peak direction flows. Although crowding is moderately worse on key sections of the line between 2007 and 2031, increases in capacity largely offset the increases in demand.

The interchanges at Tottenham Hale and Seven Sisters are critical to public transport demand in the study area. The significant majority of all crowding generated by the Opportunity Area is associated within trips that interchange at one of these two stations, typically from National Rail to London Underground in the morning peak and the reverse in the evening peak.

Although levels of crowding on the Victoria line actually decrease in 2021 and only see small increases in 2031 relative to 2007 levels, the Opportunity Area does actively contribute to excessive levels of crowding on the core section approaching central London.

The following key conclusions can be drawn with respect to public transport usage in the study area:

- Very high levels of crowding are forecast on peak direction sections of the Victoria Line and West Anglia mainline. The level of crowding is significant in both base and future years.
- Availability of capacity on the Victoria Line south of Tottenham Hale is critical to relieving congestion on routes to or from Central London.
- Capacity increases (through introduction of new rolling stock and train lengthening) assumed in the reference case broadly offset the rise in demand between 2007 and 2031 and are essential for development growth to be catered.
- Stopping patterns on National rail services may require optimisation (or if possible, further enhancement) in order to best serve the key areas of future year development within the study area (Angel Road, for example, is currently poorly served).
- Further use of available capacity on the London Overground and local bus routes should be recognised with respect to development of further interventions.

8 Understanding the effect of future growth on the highway network

8.1 Introduction

The effect of growth on the highway network was first analysed and reported in the *Upper Lee Valley Model Analysis – March 2011 (by Halcrow).* When a new LTS version was released, the different scenarios were re-run and the updated results documented in:

- Year 2021: *Upper Lee Valley Model Analysis – Stage 4b Task A – August 2011 (by Halcrow)*
- *Year 2031: Upper Lee Valley Model Analysis – Stage 4a – August 2011 (by Halcrow)*

The contents of this chapter are taken from the above reports.

The demand matrices that were used for the highway modelling were developed using LTS outputs. These outputs were obtained for 2007, 2021 and 2031, covering the AM, Inter and PM peaks (runs 6207ref1, 6221ulv1 and 6231ulv1).

In order to develop the matrices the LTS zones were converted to HAM zones using the same process that was adopted for the '*NoLHAM Reference Case and Intervention Testing*' study that was undertaken by Halcrow for TfL at the beginning of 2010.

The approach that was used has four stages, and these are explained below:

- The first stage was to disaggregate the origin and destination zones using Address Point and Journey to Work data. Having completed this task adjustments were made to the splits for the zones in the ULV study area based on the current land use and the potential location of developments in the area;
- The second stage was to split the LTS outputs into purposes using the LTS purpose splits;
- The third stage was to calculate the growth between the 2007 base year and the forecast years (2021 and 2031), by taking the LTS forecast year matrices and subtracting the 2007 LTS matrix; and,
- The fourth and final stage of the process was to add the growth that was calculated in stage three to the NoLHAM base year matrices and then to remove all negative trips to produce the future year matrices.

Once the matrices had been completed the forecast year networks were then developed. The networks that were produced for the *'NoLHAM Reference Case Intervention Testing'* study were used for this process.

The network already existed for the AM peak and included the following schemes:

- Tottenham Hale Gyratory improvements;
- A406 Henley's Corner improvements; and,
- A406 Bowes Road improvements.

These schemes were then added to the Inter peak and PM peak networks to produce the forecast year networks for these time periods. For each time period and year, a minimum of three runs were undertaken: a standard run, uncapped signal optimisation and capped signal optimisation. The results presented in this report refer to the relevant capped signal optimisation runs. A decision has been made that the relevant caps are 10% for 2021 and 20% for 2031. The rest of the runs are necessary to benchmark the information and support the findings of the main runs. Results for all of them are presented in the relevant reports.

8.2 Borough wide travel statistics

This section reports on the impact of growth in travel distance, travel time and average speed. The tables compare the statistics between 2008 and 2021 and then, between 2008 and 2031. The model outputs for 2008 and 2021 are very similar, which makes sense with the fact that most of the development and subsequent growth in the number of trips takes place between 2021 and 2031.

Link delays have been capped to a maximum of 300 seconds. The reason is that despite the improvements made by means of signal optimisation, sometimes the model shows unrealistic delays on some links. Excessive delays in the future year runs are sometimes due to 'noise' in the model (artificially high delays at a small number of locations due to the lack of perfect convergence in the model); and sometimes due to the fact that an element of flow has no choice other than to pass through a very congested junction because of the location of the centroid connectors. It has been considered that a delay in excess of 300 seconds on a single link is unlikely to happen on the ground, and therefore the delays represented on tables have been capped at this level in order to avoid spurious distortions. The uncapped results are presented in Appendix D of the *Stage 4a* report.

8.2.1 2008 – 2021

The total travel distance in the ULV area and in the adjoining boroughs, in the base year and under the ULV1 scenario in 2021 is shown in Table 11; the total travel time in Table 12; and average speed in Table 13.

Over the simulation area as a whole in the model, the total distance travelled increases by around 4% in both peaks, relative to the base year, but the bulk of this increase occurs outside London; when excluding that part of the network outside London, the increase falls to around half that level.

Because of the very limited increase in car travel, it can be seen that the total travel distance in the ULV area only increases by around 1% compared with the base year, in both the AM and PM peaks. This is actually lower than in most of the adjoining boroughs; e.g. it amounts to around 5% in the rest of Enfield, and over 2% in Hackney, in the two peaks.

In the AM peak, the average speed in the ULV area actually increases by around 1% despite the small increase in traffic; in the PM peak, it declines by around this level. The increase in the AM peak is due to the fact that the bulk of the increase takes place on the more major (and hence faster) roads; this aspect will be discussed in more detail in the next section.

Travel Distance (pcu-km)

Peak period	London Borough	model outputs		effect of growth	
		2008	2021 ULV1	2008 - 2021 ULV1	2008 - 2021 ULV1 % change
AM	**Upper Lea Valley**	**114,673**	**115,766**	**1,093**	**0.95%**
	Enfield	233,921	245,348	11,426	4.88%
	Haringey	68,643	68,521	-122	-0.18%
	Hackney	54,771	56,382	1,612	2.94%
	Waltham Forest	88,925	90,684	1,759	1.98%
PM	**Upper Lea Valley**	**113,208**	**114,326**	**1,118**	**0.99%**
	Enfield	224,328	237,530	13,202	5.89%
	Haringey	65,275	65,855	580	0.89%
	Hackney	55,746	57,130	1,384	2.48%
	Waltham Forest	97,935	99,023	1,088	1.11%

Table 11 - Travel Distance (pcu-km), 2008 – 2021 ULV1 (growth and no additional interventions)

Travel Time (pcu-hours)

Peak period	London Borough	model outputs: 2008	model outputs: 2021 ULV1	effect of growth: 2008 - 2021 ULV1	effect of growth: 2008 - 2021 ULV1 % change
AM	**Upper Lea Valley**	**4,555**	**4,537**	**-18**	**-0.4%**
	Enfield	7,675	7,842	166	2.2%
	Haringey	3,513	3,375	-137	-3.9%
	Hackney	3,029	2,795	-234	-7.7%
	Waltham Forest	3,563	3,546	-17	-0.5%
PM	**Upper Lea Valley**	**4,620**	**4,729**	**109**	**2.4%**
	Enfield	7,453	7,613	160	2.1%
	Haringey	3,069	3,050	-19	-0.6%
	Hackney	2,782	2,820	38	1.4%
	Waltham Forest	4,451	4,386	-64	-1.4%

Table 12 - Travel Time (pcu-hrs), 2008 – 2021 ULV1(growth and no additional interventions). NB a cap of 300 seconds cap has been applied to link delay

Average Speed (km/h)

Peak period	London Borough	model outputs: 2008	model outputs: 2021 ULV1	effect of growth: 2008 - 2021 ULV1	effect of growth: 2008 - 2021 ULV1 % change
AM	**Upper Lea Valley**	**25.2**	**25.5**	**0.3**	**1.4%**
	Enfield	30.5	31.3	0.8	2.7%
	Haringey	19.5	20.3	0.8	3.9%
	Hackney	18.1	20.2	2.1	11.5%
	Waltham Forest	25.0	25.6	0.6	2.5%
PM	**Upper Lea Valley**	**24.5**	**24.2**	**-0.3**	**-1.3%**
	Enfield	30.1	31.2	1.1	3.7%
	Haringey	21.3	21.6	0.3	1.5%
	Hackney	20.0	20.3	0.2	1.1%
	Waltham Forest	22.0	22.6	0.6	2.6%

Table 13 - Average Speed (km/h), 2008 – 2021 ULV1(growth and no additional interventions), 300 seconds cap

8.2.2 2008 – 2031

The trend changes for 2031. Firstly, it is shown in Table 14 that the additional trips will cause an increase in total travel distance in the ULV area of between 6 and 7%. This figure is within the scale of the changes expected in the benchmark area.

Travel time (Table 14) is shown to increase by between 8 and 10% in the ULV area, and average speed (Table 15) goes down by between 1 and 3%. The changes in travel time and average speed appear to be greater in the ULV than in the benchmark area; and also more noticeable during the AM peak.

Travel Distance (pcu-km)

Peak period	London Borough	model outputs: 2008	model outputs: 2031 ULV1	effect of growth: 2008 - 2031 ULV1	effect of growth: 2008 - 2031 ULV1 % change
AM	**Upper Lea Valley**	**114,673**	**122,317**	**7,644**	**6.7%**
	Enfield	233,921	251,572	17,650	7 5%
	Haringey	68,643	71,549	2,907	4 2%
	Hackney	54,771	60,132	5,361	9 8%
	Waltham Forest	88,925	97,340	8,415	9 5%
PM	**Upper Lea Valley**	**113,208**	**120,506**	**7,297**	**6.4%**
	Enfield	224,328	245,086	20,759	9 3%
	Haringey	65,275	69,525	4,251	6 5%
	Hackney	55,746	61,208	5,462	9 8%
	Waltham Forest	97,935	104,167	6,232	6.4%

Table 14 - Travel Distance (pcu-km), 2008 – 2031 ULV1 (growth and no additional interventions)

Travel Time (pcu-hours)

Peak period	London Borough	model outputs: 2008	model outputs: 2031 ULV1	effect of growth: 2008 - 2031 ULV1	effect of growth: 2008 - 2031 ULV1 % change
AM	**Upper Lea Valley**	**4,555**	**5,029**	**474**	**10.4%**
	Enfield	7,675	8,415	740	9.6%
	Haringey	3,513	3,530	18	0 5%
	Hackney	3,029	2,916	-112	-3.7%
	Waltham Forest	3,563	3,879	316	8 9%
PM	**Upper Lea Valley**	**4,620**	**5,032**	**412**	**8.9%**
	Enfield	7,453	7,947	494	6.6%
	Haringey	3,069	3,235	166	5.4%
	Hackney	2,782	2,991	209	7 5%
	Waltham Forest	4,451	4,592	141	3 2%

Table 15 - Travel Time (pcu-hrs), 2008 – 2031 ULV1(growth and no additional interventions). NB a cap of 300 seconds cap has been applied to link delay

Peak period	London Borough	Average Speed (km/h) model outputs 2008	2031 ULV1	effect of growth 2008 - 2031 ULV1	2008 - 2031 ULV1 % change
AM	**Upper Lea Valley**	**25.2**	**24.3**	**-0.9**	**-3.4%**
	Enfield	30.5	29.9	-0.6	-1.9%
	Haringey	19.5	20.3	0.7	3.7%
	Hackney	18.1	20.6	2.5	14.0%
	Waltham Forest	25.0	25.1	0.1	0.5%
PM	**Upper Lea Valley**	**24.5**	**23.9**	**-0.6**	**-2.3%**
	Enfield	30.1	30.8	0.7	2.5%
	Haringey	21.3	21.5	0.2	1.0%
	Hackney	20.0	20.5	0.4	2.1%
	Waltham Forest	22.0	22.7	0.7	3.1%

Table 16 - Average Speed (km/h), 2008 – 2031 ULV1(growth and no additional interventions), 300 seconds cap

8.3 Flow and delay differences

Flow and delay differences have been plotted for all scenarios and periods. The first set of plots compares flow and delay differences between 2008 and 2021, while the second set of figures compares 2008 and 2031.

8.3.1 2008 – 2021

The changes in flow within and on the periphery of the ULV area, in the 2021 ULV1 scenario compared with the base year, are shown for the AM peak in Figure 30 and for the PM peak in Figure 32. Equivalent plots showing changes in delay are contained in Figures 31 and 33, for the AM and PM peaks respectively.

The main arterial routes generally show significant increases in flow, reflecting the fact that the bulk of any increases in flow relate to traffic with one or both ends outside London. The increases during both time periods are particularly apparent on the M25, the North Circular, the M11 and the A2 East Cross Route. In the AM peak, the more local roads within the ULV area show a combination of small increases and small decreases; the large changes apparent in the Tottenham area reflect the re-structuring of the Tottenham Hale Gyratory, with the western side of the gyratory (High Road) now used by 2-way traffic. The re-structuring has also resulted in increases in delay at one junction in particular on the south side of the gyratory. This is the only significant delay increase apparent within the ULV area in 2021, reflecting the observation made above that overall journey speeds remain broadly at base year levels.

In the PM peak, the pattern is slightly different with flow decreases less prominent, and flow on most local roads remaining at around the base year level or showing a small increase. As in the AM peak, the only area where the pattern of movement shows a significant change is around the Tottenham Hale Gyratory, primarily for the reason noted above. The feeder links to the North Circular to the west of the study area show some increases in delay, reflecting the increased demand in this area, but apart from this, any delay increases are highly sporadic, and balanced by a similar number of flow reductions. These results suggest that the overall speed reduction in this area in the PM peak (in contrast to the AM peak) reflects the local nature of the additional traffic more than any significant increase in junction delays.

A full set of plots without caps were supplied in Appendix E of the Stage 4b – Task A report.

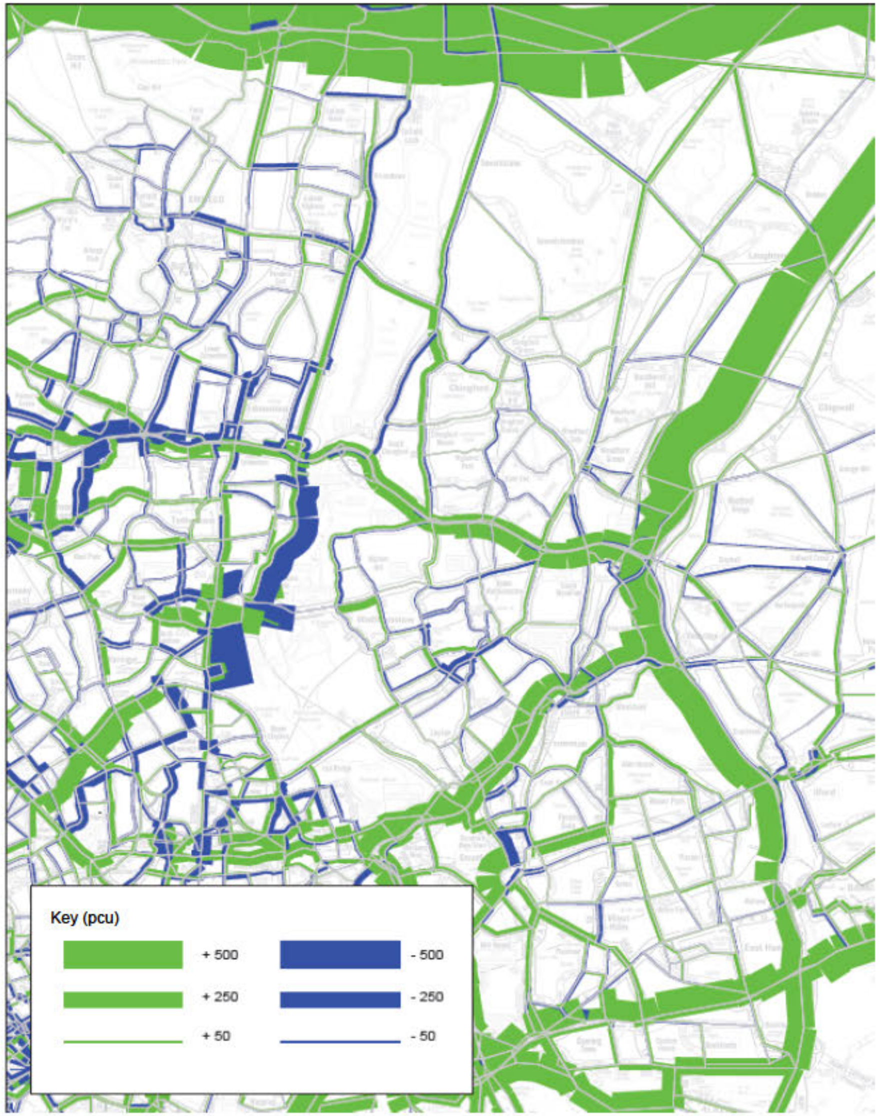

Figure 30 - Flow differences (pcu), AM peak hour, 2008 – 2021 ULV1 (growth and no additional interventions)

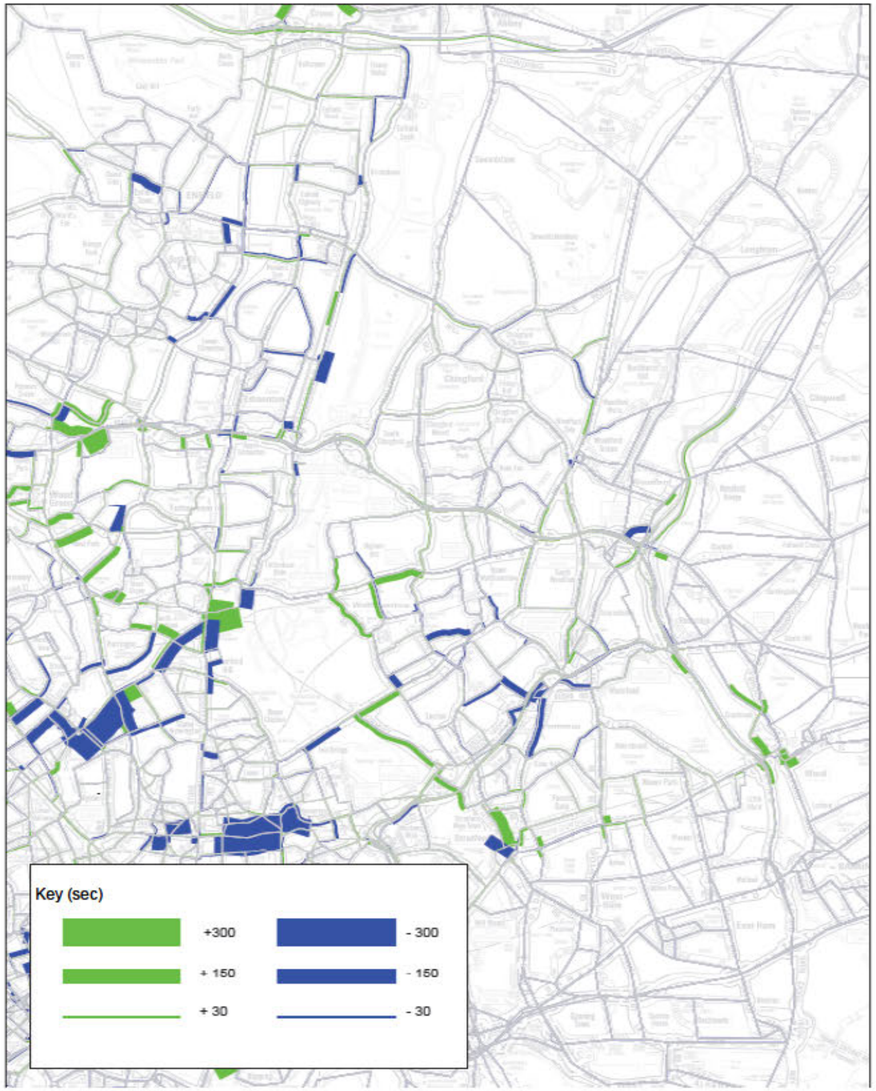

Figure 31 - Delay differences, AM peak hour, 2008 – 2021 ULV1 (growth and no additional interventions). NB a cap of 300 seconds has been applied to link delays

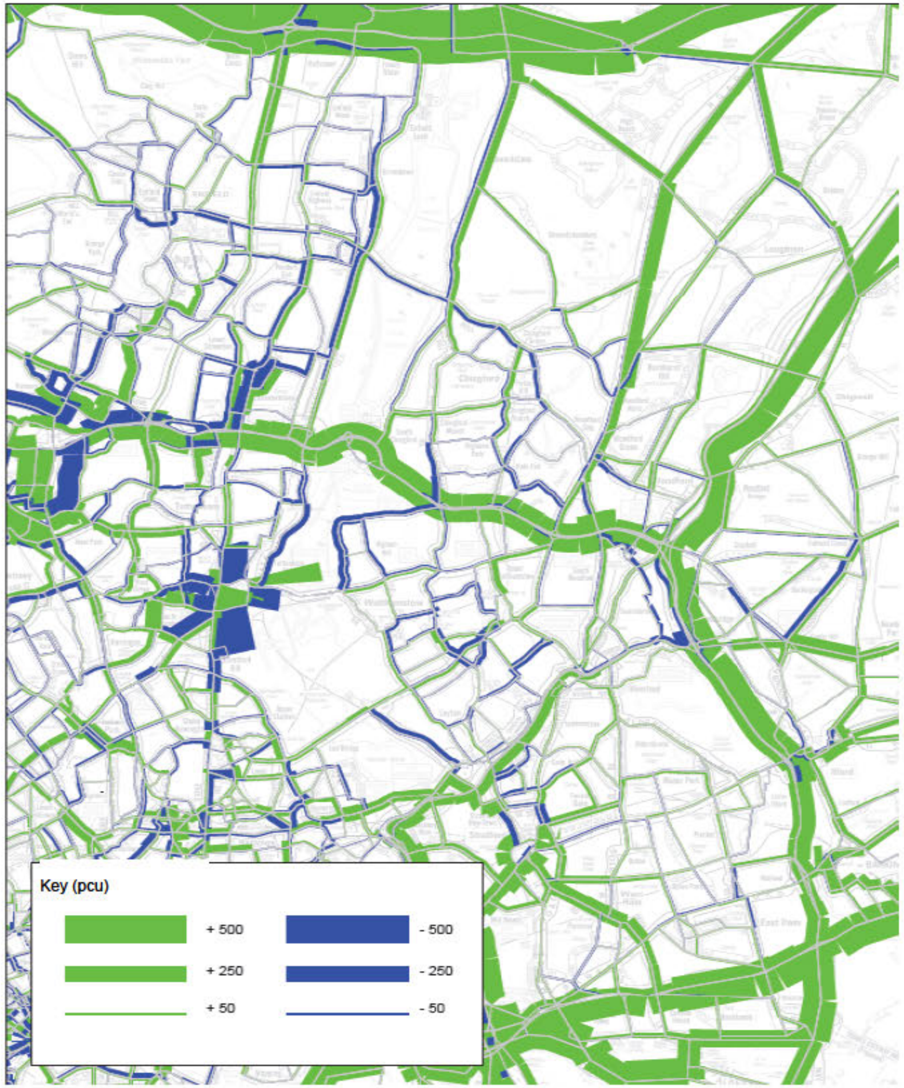

Figure 32 - Flow differences, PM peak hour, 2008 – 2021 ULV1 (growth and no additional interventions)

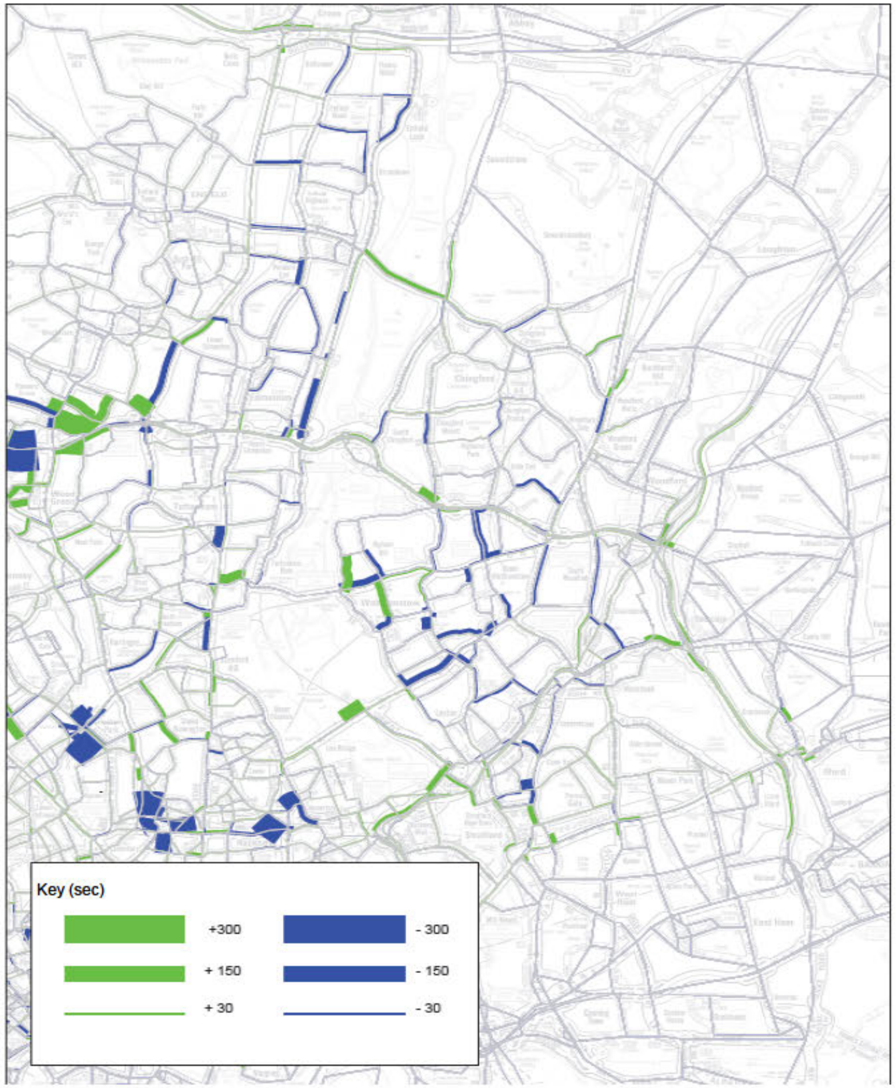

Figure 33 - Delay differences, PM peak hour, 2008 – 2021 ULV1 (growth and no additional interventions) NB A cap of 300 seconds has been applied to link delays

8.3.2 2008 – 2031

LTS model results show that the total number of additional car trips are 5,571 in the AM peak and 7,470 in the PM peak. This represents a growth of between 9 and 10% by 2031 in comparison with 2007 figures.

Figures 36 - 37 show the impact of the additional trips in the AM peak hour; Figures 38 - 39 present the same information for the PM peak hour. These plots include not only trips with an origin and/or a destination in the Upper Lee Valley, but also through traffic.

The change in flow is especially noticeable in the main arteries, while the local network experiences more moderate changes. In the AM, delays increase in some parts of the network like the Tottenham Hale Gyratory. Also flow increases on the North Circular are causing extra delays on the A104 (outside the Opportunity Area). Similarly, flow increases on the A12 are introducing some delays on Upper Clapton Rd and Lea Valley Road, in the Clapton area.

In the PM peak, flow increases are more obvious on main roads like the M25 and the North Circular. There is some re-routing in the Walthamstow area, on roads leading to the North Circular, which is causing extra delay on some links, but reduced delay on others.

Link delay has been capped to 300 seconds for the reasons set out above. A full set of plots without caps have been included in Appendix D of the Stage 4a report.

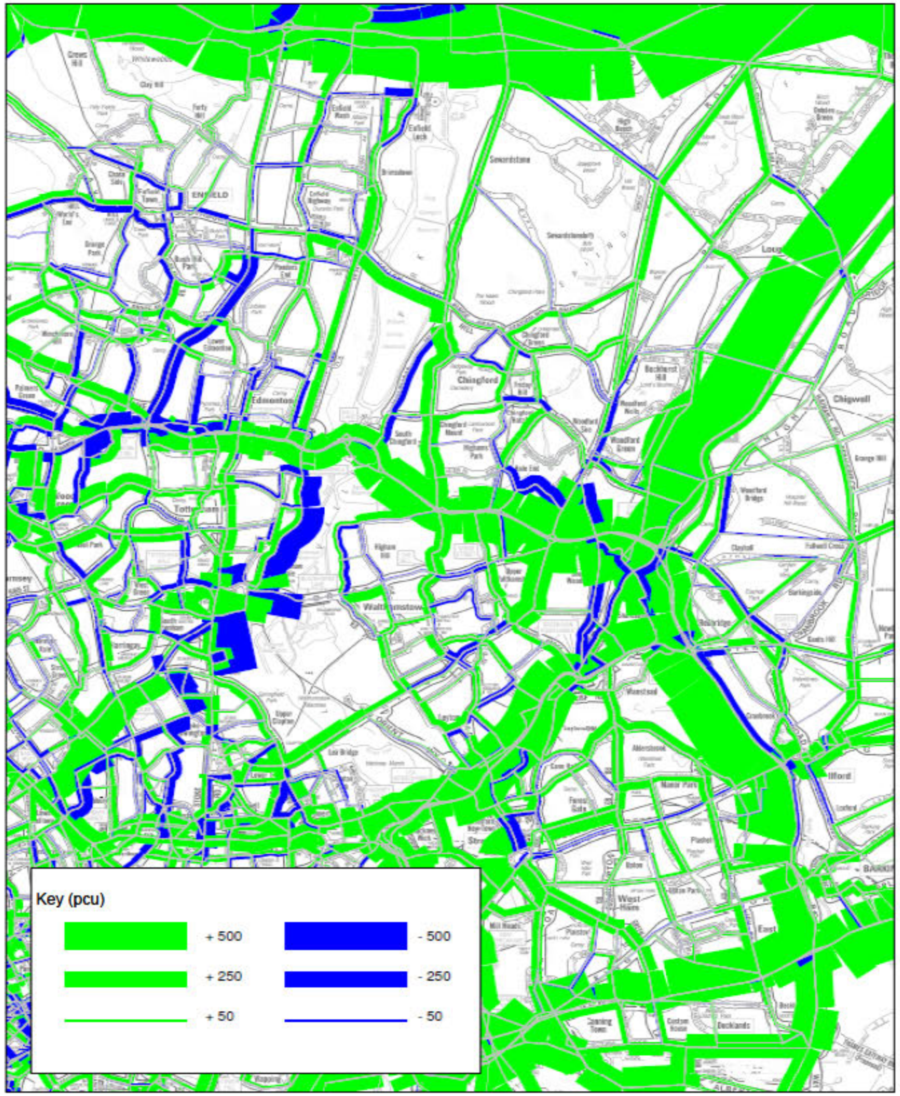

Figure 34 - Flow differences (pcu), AM peak hour, 2008 – 2031 ULV1(growth and no additional interventions)

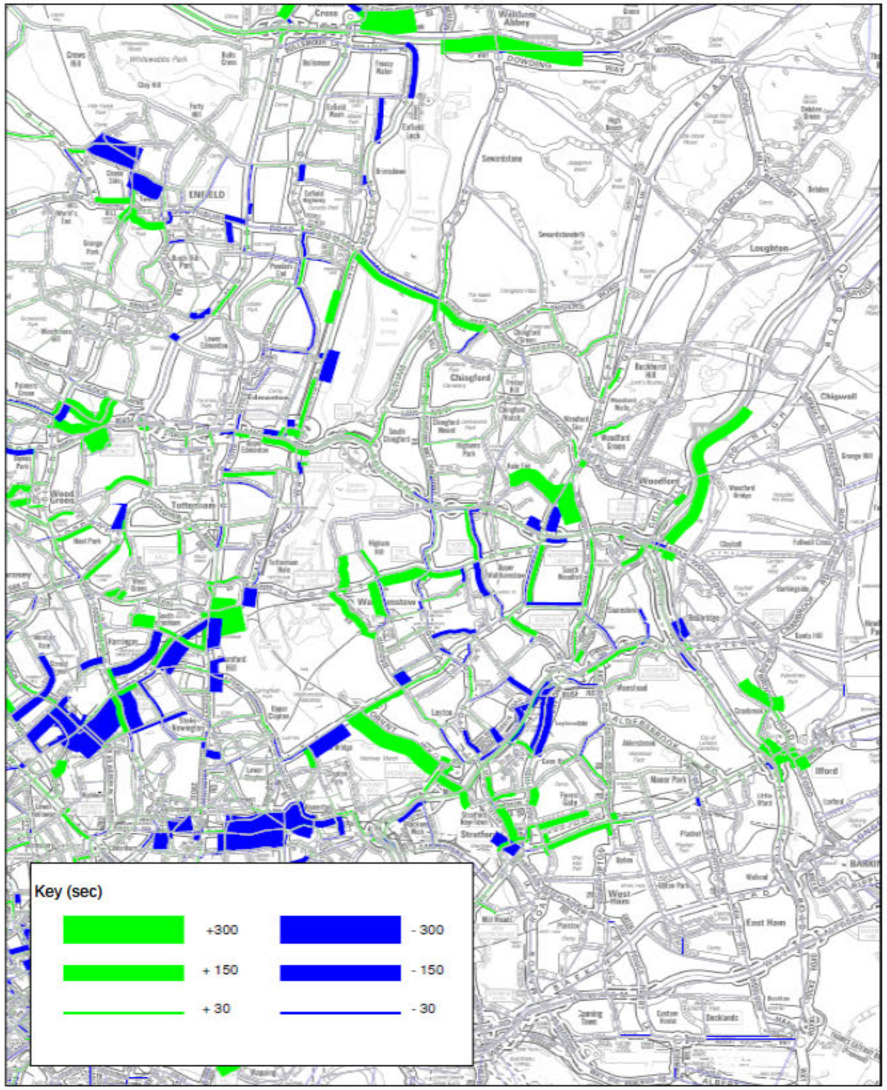

Figure 35 - Delay differences, AM peak hour, 2008 – 2031 ULV1(growth and no additional interventions). NB a cap of 300 seconds has been applied to link delays.

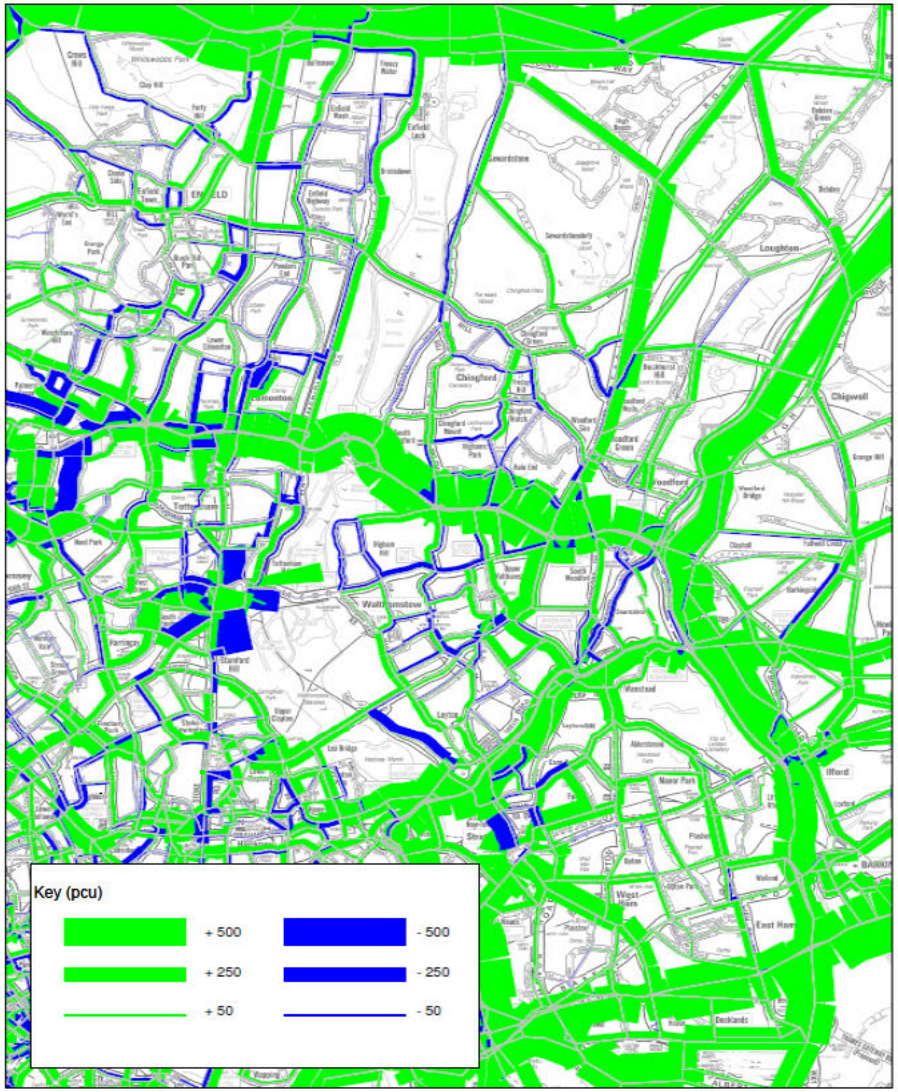

Figure 36 - Flow differences, PM peak hour, 2008 – 2031 ULV1(growth and no additional interventions)

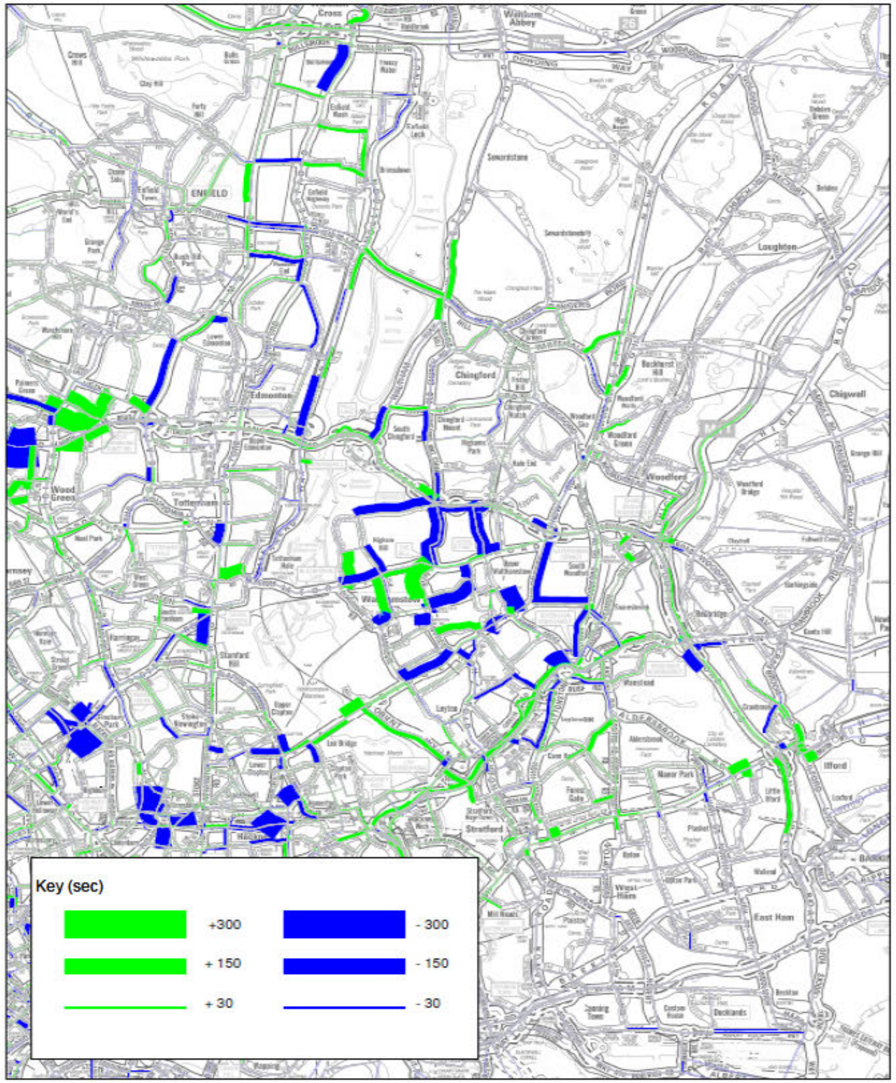

Figure 37 - Delay differences, PM peak hour, 2008 – 2031 ULV1(growth and no additional interventions) NB A cap of 300 seconds has been applied to link delays

8.4 Junction performance

The performance of a total of 45 key junctions in the Upper Lee Valley and its proximity was analysed for years 2008, 2021 and 2031, for the AM and PM peaks.

Figure 38 shows the definition of Level of Service used for this analysis.

CMP Level of Service Criteria for Arterials[a] Based on Volume-to-Capacity Ratios

Level of Service	Description	V/C[b]
A	Free-flow conditions with unimpeded maneuverability. Stopped delay at signalized intersection is minimal.	0.00 to 0.60
B	Reasonably unimpeded operations with slightly restricted maneuverability. Stopped delays are not bothersome.	0.61 to 0.70
C	Stable operations with somewhat more restrictions in making mid-block lane changes than LOS B. Motorists will experience appreciable tension while driving.	0.71 to 0.80
D	Approaching unstable operations where small increases in volume produce substantial increases in delay and decreases in speed.	0.81 to 0.90
E	Operations with significant intersection approach delays and low average speeds.	0.91 to 1.00
F	Operations with extremely low speeds caused by intersection congestion, high delay, and adverse signal progression.	Greater Than 1.00

[a] For arterials that are multilane divided or undivided with some parking, a signalized intersection density of four to eight per mile, and moderate roadside development.
[b] Volume-to-capacity ratio.

≥ greater than or equal to.
< less than.

Source: Transportation Research Board, *Highway Capacity Manual, Special Report 209* (Washington, D.C., 1994).

Figure 38 - Definition of Levels of Service

The use of NoLHAM in assessing the performance of individual junctions is limited – NoLHAM is best suited to assessing the performance of the strategic road network as a whole. At individual junctions NoLHAM is useful to assess the scale of change in demand in future years, but not necessarily the future levels of delay (or level of service) at a particular junction.

The Level of Service, based on the volume over capacity ratio, has been calculated for traffic entering the junction on each of the entry arms. (The flows used include traffic loading directly onto the junctions from network connectors). The results for the base year 2008 are shown in Figures 39 – 40; scenario ULV1 in 2021, are displayed in Figures 41 – 42. Figures 43 – 44 are for year 2031. Tables with the Level of Service were supplied in Appendix E of the Stage 4b – Task A and Stage 4a report.

In the AM peak, the differences between 2008 and 2021 are limited, as one would expect given that the overall flow in the ULV area only increases by 1% in the 2021 scenario. A small number of junction entry arms are sometimes better and sometimes worse, but the great majority remain the same. The only junction showing a significant overall deterioration is the junction of West Green Road, Broad Lane and High Road, on the south side of the Tottenham Hale gyratory. This is the junction on this gyratory as referred to under Flow and Delay above.

In the PM peak, the overall pattern of results is very similar. The great majority of junction entry arms show no change in LoS, and where there is a change it is a small one. The only junction showing a significant deterioration is the junction on the south side of the Tottenham Hale gyratory as referred to above; the southern entry arm changes from the LoS A-C to the LoS E/F category – but this is due entirely to a reduction in the green time for this movement.

In the same area, some deterioration in the results relative to the base year is apparent at two of the junctions along Forest Road in Walthamstow, despite this road showing very limited flow increases in Figure 32. The explanation is that this section of road is operating at or very close to capacity, and the small increase in demand leads to more queuing and delays.

Looking at the 2031 outputs (Figures 43 – 44), in the AM peak, two junctions in the Ponders End area show worse Levels of Service, particularly in the NB-SB direction: these are the A1010 with the A110 (Nags Head Road), and the A1010 with the B137 (Nightingale Road). Similarly, the A110 (Nags Head Road) with the A1055 (Meridian Way) junction shows worse LoS in 2031. Junctions along the A503 in the Tottenham Hale and Walthamstow areas also show significant deterioration in 2031, showing LoS E or F in most arms.

In the PM peak, three junctions along the A10 (Great Cambridge Road) experience worse LoS in the NB-SB direction; these are the junctions with Hoe Lane, Carterhatch Lane and the A110 (Nags Head Road). Three other junctions with the North Circular or in close proximity also show worse conditions in 2031; these are located on the intersections with the A1055 Meridian Way and the A1037 Hall Lane. Another two junctions on the A503 also deteriorate: one is located in the Tottenham Hale area, and the other one in Walthamstow. The intersection between the A104 (Lea Bridge Road) and the A1006 (Markhouse Road) also shows a worse LoS in 2031.

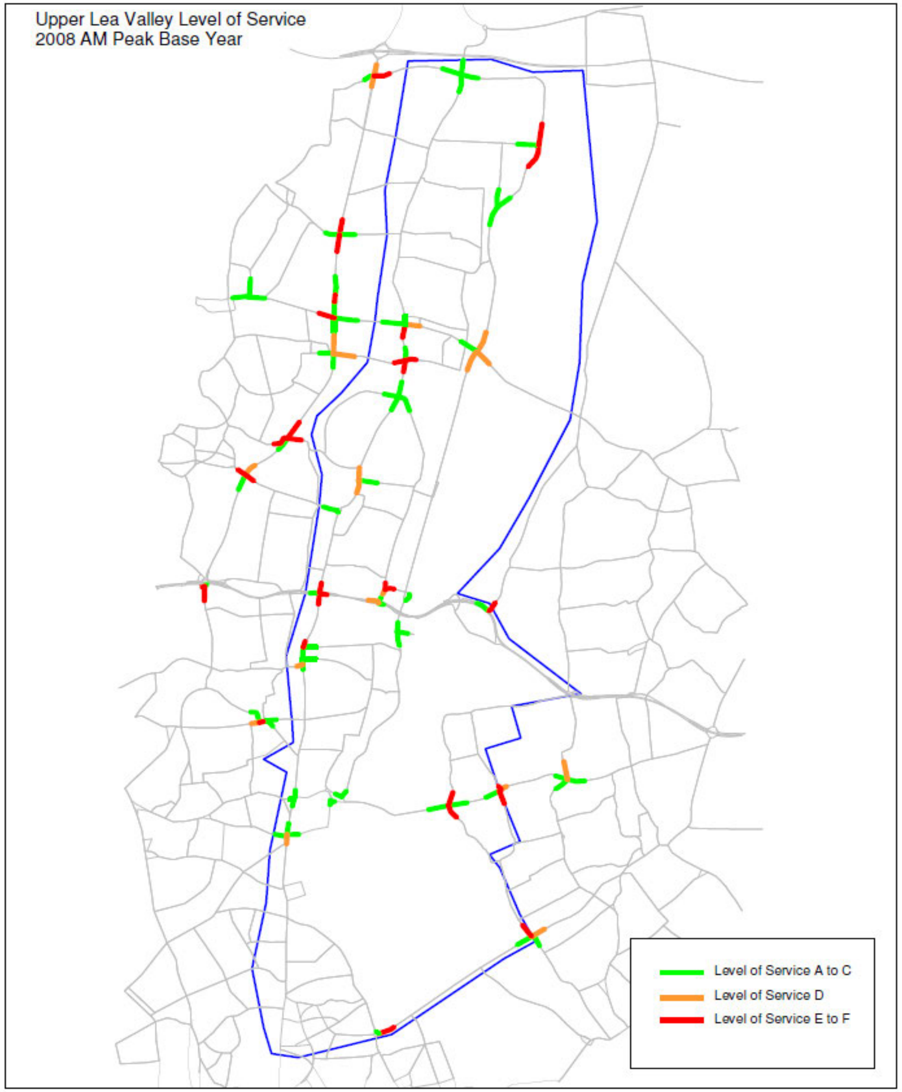

Figure 39 – Level of Services in Junctions, AM peak hour, 2008

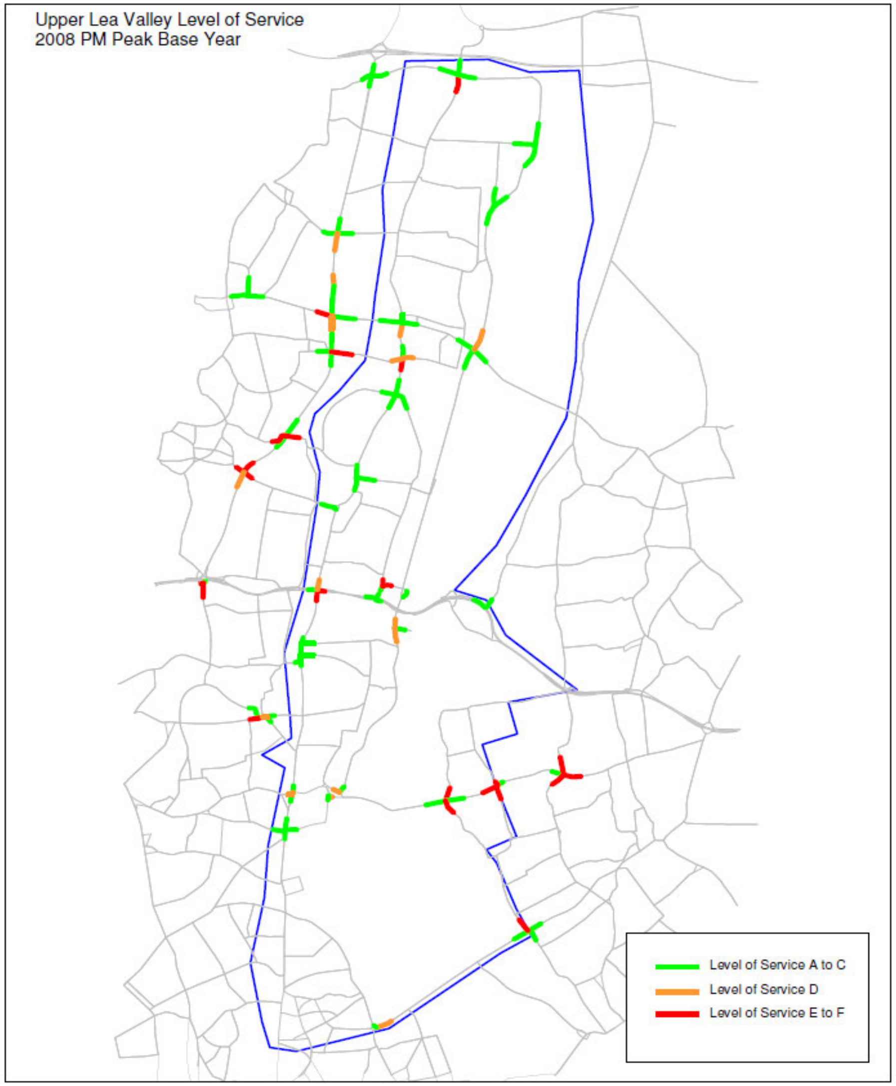

Figure 40 - Level of Services in Junctions, PM peak hour, 2008

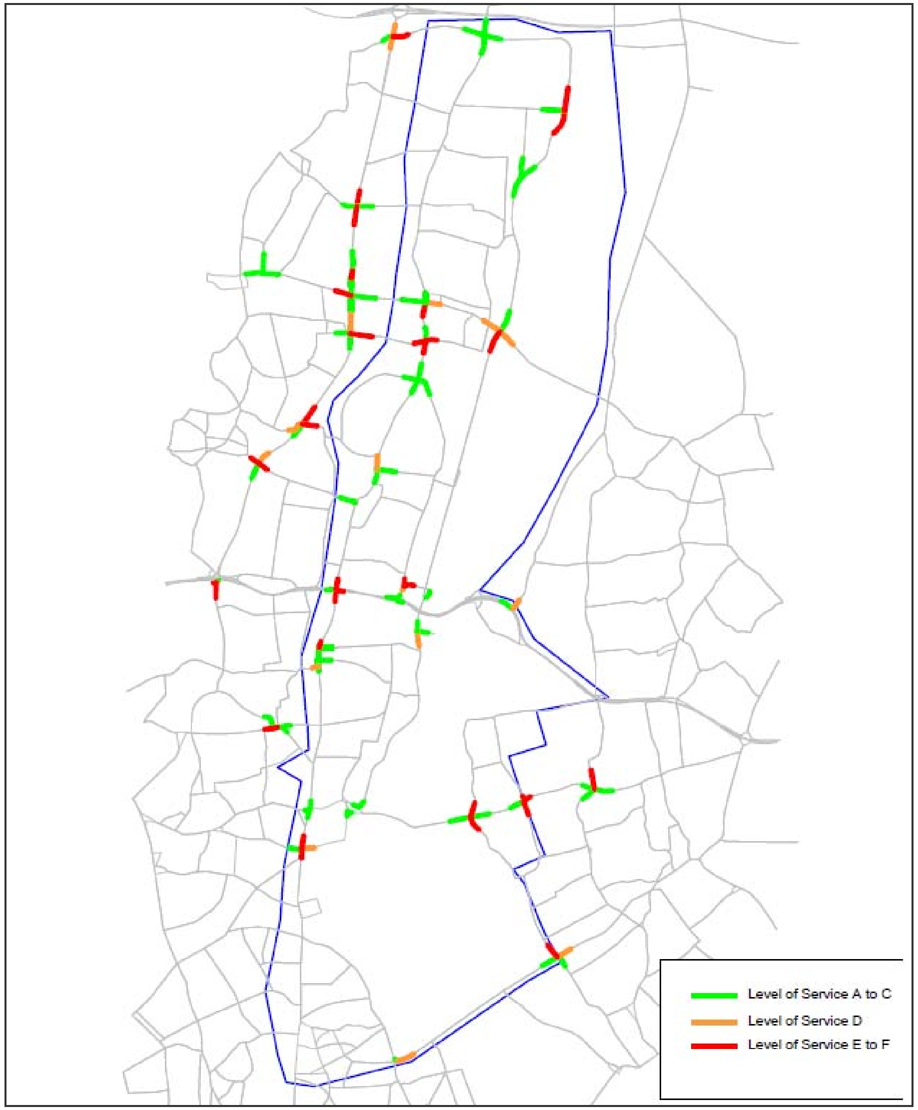

Figure 41 – Level of Services in Junctions, AM peak hour, 2021 ULV1 (growth and no additional interventions)

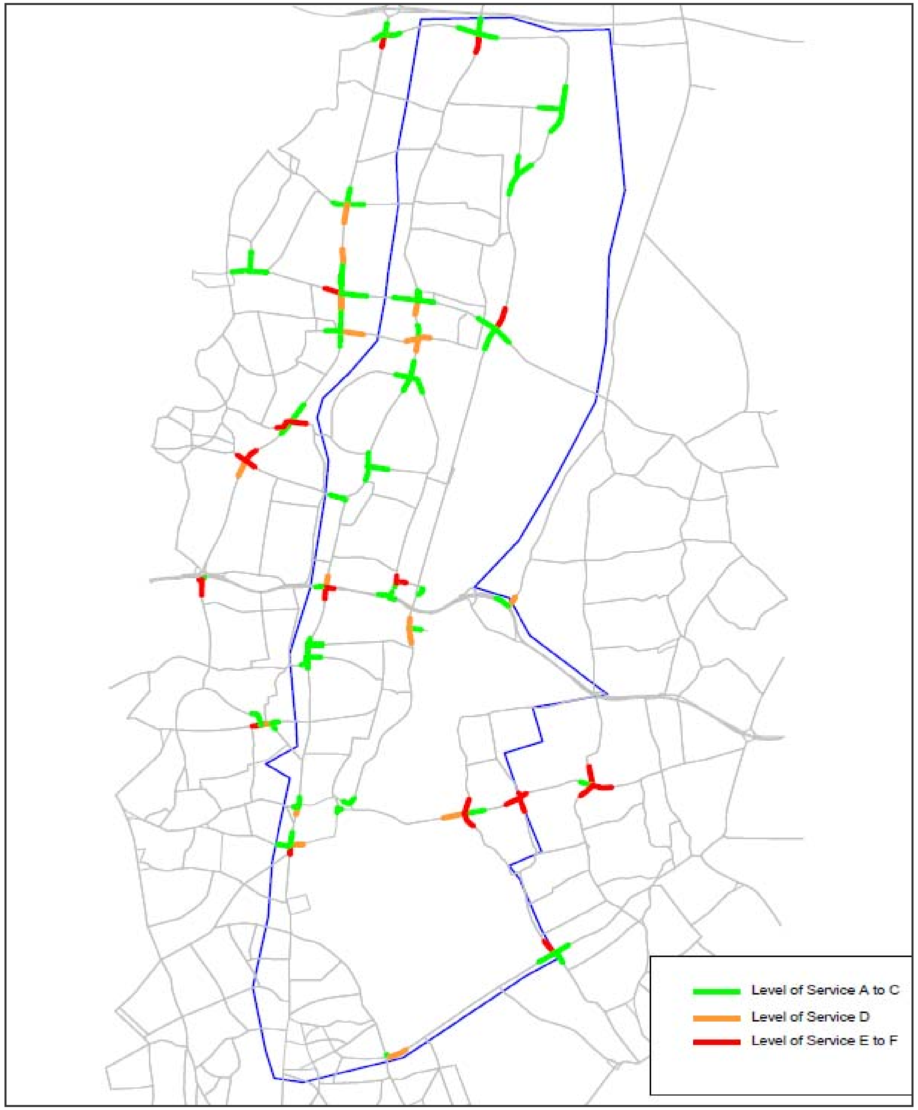

Figure 42 - Level of Services in Junctions, PM peak hour, 2021 ULV1(growth and no additional interventions)

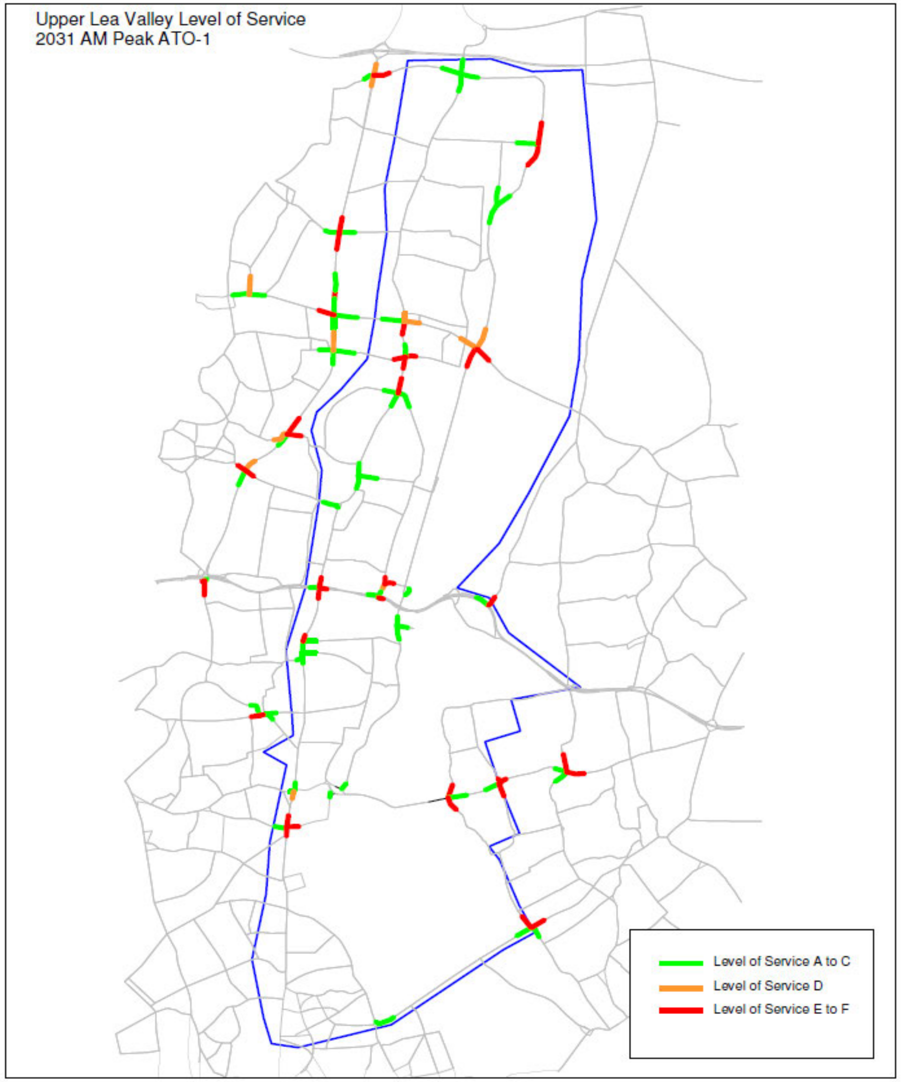

Figure 43 – Level of Services in Junctions, AM peak hour, 2031 ULV1 (growth and no additional interventions)

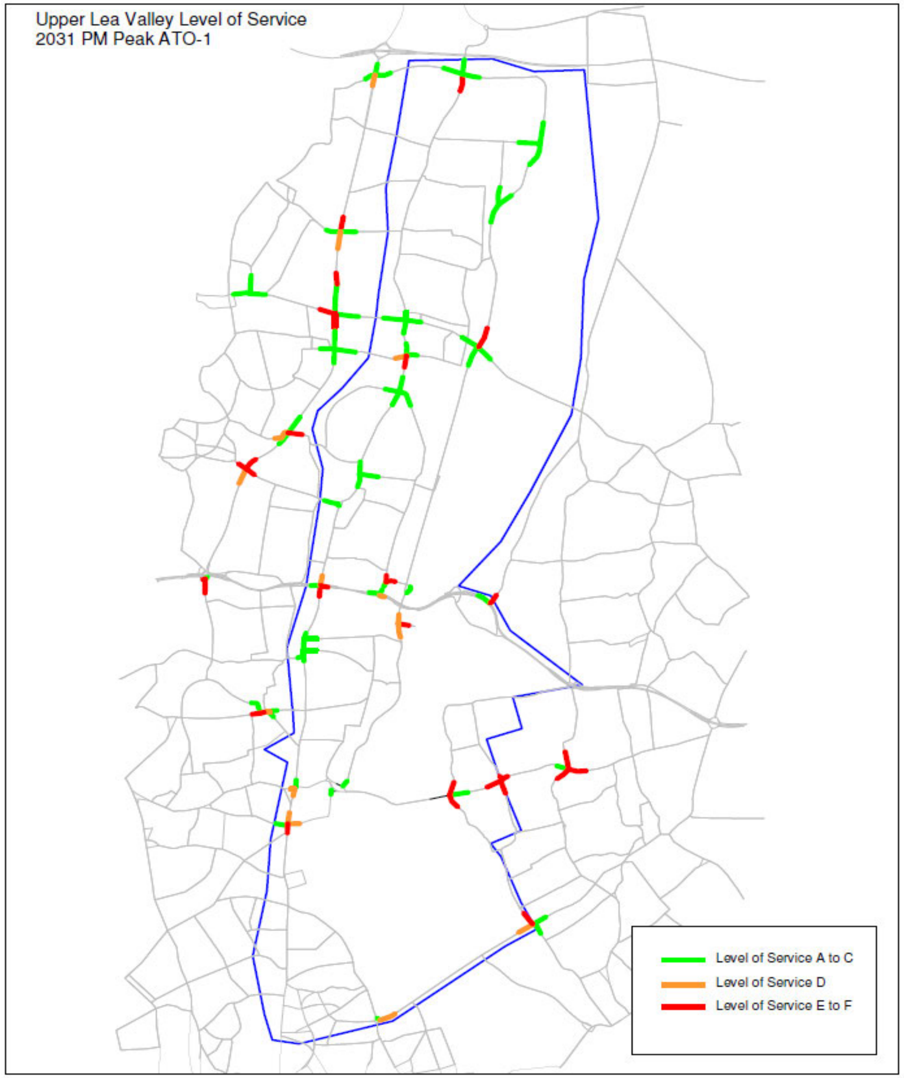

Figure 44 - Level of Services in Junctions, PM peak hour, 2031ULV1 (growth and no additional interventions)

8.5 Conclusions

The key points to note with respect to the impact of forecast growth on the Upper Lee Valley highway network are:

- Taking into account the trip rates forecasted by the model, the planned levels of development do not have a noticeable impact on the network in 2021. However, by 2031 there are several areas which become under great pressure.
- Probably the most serious problem in the area is the lack of capacity on the A10. This is especially in the SB direction during the AM peak, although the NB direction is also more congested.
- Along the A1010, consecutive junctions show poor level of service, indicating severe congestion. In comparison, the A1055 Mollison Rd appears to perform better, although this is limited by the delays observed at the junction with the A110 Lea Valley Road.
- East-west circulation becomes more difficult with the A110 Lea Valley Rd experiencing very high delays. In addition to this, the entry and exit points to the North Circular also register significant levels of congestion. In comparison, junctions on the A503 appear to perform better.
- The significance of the highway problems in the ULV was assessed by benchmarking the results against the surrounding boroughs (Enfield, Haringey, Hackney and Waltham Forest). It appears that in the future year, the situation in the ULV is relatively worse than in the surrounding areas.
- In 2021, half the time spent travelling in the ULV is likely to be spent queuing. This is an increase of almost 10% with respect to the 2008 situation. This increase appears to be higher than in the benchmark area.
- By 2031, travel time for car trips starting in the ULV in the morning will increase by 7.2 minutes, increasing from an average journey time of 25.2 to 33.5 minutes. This represents a 27% rise in the average journey time, in comparison with a 23% increase in the surrounding areas.
- Similarly, trips ending in the ULV in the PM peak will experience a journey time of 33.8 minutes by 2031, which is an increase of 8.6 minutes (or 34%) with respect to the estimated 2008 average journey time of 25.2 minutes. In the surrounding boroughs, journey times are expected to increase by 26%.
- The trends observed in travel speeds and distances reinforce the idea that the congestion in the ULV is somehow significantly higher than in the peripheral areas.

9 Transport Interventions

9.1 Overview

The *ULV1 – growth and no transport interventions* or “do minimum” scenario, incorporated no changes to the reference case LTS, NoLHAM or Railplan networks (except a very small improvement in the Railplan network). This is because the ULV1 scenario runs were done to understand the impact of growth only. The aim was to assess the potential problems that development growth was likely to bring to the transport system.

The *ULV2 – growth with public transport and other mode shift interventions* or “do something” incorporates changes on the networks with the objective of achieving a sustainable transport outcome. The transport interventions are very similar for 2021 and 2031.

For the ULV2 scenario, the ULV1 networks have been modified to incorporate a transport intervention package comprising:

- A 4 trains per hour regular service interval between Brimsdown and Stratford, calling at all stations, has been included in the LTS and Railplan networks (see section 9.2.1)
- Frequency improvements to the Victoria Line have been incorporated in the LTS and Railplan networks (see section 9.2.2)
- Enhancements to local bus services have been largely coded in the Railplan and NoLHAM networks (see section 9.2.3).

9.2 Public Transport networks

Two of our three models, LTS and Railplan, contain Public Transport networks. For the ULV1 scenario, the Railplan reference case networks have been adjusted to reflect minor corrections to local National Rail services. The adjustment consists of the removal of two contra-peak West Anglia services between Liverpool St and Cheshunt / Hertford that did not appear in the London Rail specification. The LTS network remains as per in the reference case.

For the ULV2 scenario, both ULV1 networks (LTS and Railplan) have been modified to incorporate a transport intervention package designed to alleviate the pressure of the forecast growth on the public transport system. Details of the schemes comprising the package are given in the next sub-sections.

9.2.1 National Rail services on the West Anglia Mainline

Existing Railplan code of the scheme provided by TfL was used as a starting point to modify the ULV1 LTS and Railplan networks. The scheme removes all LW transit lines and replaces them with a new set which contains a series of service changes, including the Brimsdown to Stratford services.

On the West Anglia Mainline the main changes are:

- The frequency of local services between Stratford and Brimsdown increases, from 1 train in the morning peak to 4 trains per hour at regular service intervals and calling at all stations.
- The frequency of regional services between Liverpool Street and destinations such as Stansted and Cambridge increases; however they do no call at ULV stations other than Tottenham Hale.
- The existing code was updated to the relevant version of Railplan, and translated into LTS using a spreadsheet process developed by TfL.

9.2.2 Victoria Line frequency improvements

Victoria Line frequency has been increased up to 36 trains per hour. The frequency changes with respect to the 2031 reference case networks (both LTS and Railplan) were:

- From 20.48 to 22.48 in 2021 and 25.78 in 2031 trains per hour between Walthamstow Central and Seven Sisters:
- From 30.7 to 33 in 2021 and 36 in 2031 trains per hour between Seven Sisters and Brixton.

9.2.3 Bus enhancements

The enhancements to local bus services added to the Railplan and Highway reference case network are:

- Two new routes:
  - LV1 from Brimsdown to Tottenham Hale, via Meridian Way/Watermead Way with a frequency of 5 buses per hour
  - LV2 from Tottenham Hale to Walthamstow, via Watermead Way, Angel Road, North Circular, Chingford Road and Hoe St with a frequency of 5 buses per hour
- Extensions to five existing routes:
  - 476 extension from Northumberland Park to Angel Road, via Willoughby Lane (only to highway network)
  - 76 extension from Town Hall Approach Road to Blackhorse Road, via Monument Way and Tottenham Hale (only highway)
  - 377 extension from Southbury to Chingford, along Nags Head Road, Lea Valley Road, and Station Road (only highway)
  - 425 extension from Clapton to Tottenham Hale, via Upper Clapton Road and High Road
  - 41 extension from Tottenham Hale to Blackhorse Road (only highway)
- Frequency changes to the following existing lines:
  - W3: 12 to 14 buses per hour
  - 491: 4 to 5 buses per hour
  - 149: 12 to 15 buses per hour
  - 243: 11 to 12 buses per hour (only in 2031)
  - 230: 5 to 6 buses per hour
  - 34: 7.5 to 9 buses per hour
  - 253: 12 to 14 buses per hour (only in 2031)
  - 254: 12 to 14 buses per hour
  - 476: 7.5 to 8 in 2021 and 9 in 2031 buses per hour
  - 76: 8 to 10 buses per hour
  - 377: 2 to 3 in 2021 and 4 in 2031 buses per hour
  - 41: 12 to 14 buses per hour

The original package of bus enhancements did also include the re-routing of service 444 via Angel Road development. This was not coded in the ULV2 network because if would have required new links to reflect the road network in the new developments. In addition, one of the new routes, and some of the extensions were simplified to fit onto the existing network structure.

9.3 Highway networks

Two of our models (LTS and NoLHAM) contain highway networks.

In the case of LTS, the reference case highway network was used for both scenarios (ULV1 and ULV2) without any change.

Reference case NoLHAM version 00d is used. The reference case network was used for ULV1 without modification. The reference case network was produced for the 'NoLHAM Reference Case Intervention Testing' study and already included the following schemes in the Upper Lee Valley or close proximity:

- Tottenham Hale Gyratory improvements;

- A406 Henlys Corner improvements;
- A406 Bowes Road improvements.

For the ULV2 scenario, the ULV1 NoLHAM network was modified to introduce the effect of bus changes in the network capacity. The adjustment consists in coding the changes in frequencies and routes into the highway network, so the capacity left to cars is recalculated within the assignment. It is expected that the improvements to buses will reduce the capacity available for cars.

9.4 Soft measures

In addition to the transport intervention package described above, it is expected that a soft measures package will be implemented in the Upper Lee Valley by 2031. 'Soft' measures cover a potential package of Travel Demand Management interventions such as school and work place travel plans and local community awareness and marketing, improved infrastructure and facilities for pedestrians and cyclists, local price interventions such as parking charges, and, use of planning policy such as car and cycle parking at new developments. The objective of the interventions is to reduce unnecessary trips and achieve a mode shift in favour of public transport, walking and cycling.

The package of 'soft' interventions that is appropriate for the ULV will be determined alongside the more detailed elements of the planning process. For this stage of work, it was considered appropriate to apply factors to the Public Transport and Car matrices in order to achieve the desired mode share.

From the modelling point of view, the greater mode shift facilitated by the soft measure package is achieved as follows:

- LTS is run with the PT transport measures (as explained above: HLOS option, Victoria Line enhancements and bus improvements) coded into the network
- The origin and destination matrices (which are an output of the LTS model) are modified externally. The modifications consists of removing trips from the car and PT matrices to reflect the fact that the soft measures package will achieve a greater mode shift, thus resulting in less car and PT trips. The way trips are removed from the car and PT matrices is by the use of factors. These factors are calculated and applied separately to internal ULV trips, and trips to and from the ULV.

The following constraints were set in the factoring process:

- The most important target is that sustainable modes (walking and cycling) achieve a rate close to 27% in 2021 and 30% in 2031. The targets for car and public transport are more flexible.
- In this round of modelling, the number of car origins and destinations would not be allowed to go below 2007 levels after the factoring.
- The soft measures package would prompt mode shift from car and PT, even if PT forecast share is initially lower than in 2007
- Trips produced in the ULV are more sensitive to the soft measures than trips attracted to it. As a result, the impact of the soft measures would be higher for trips with an origin in the ULV in the morning peak, and a destination in the ULV in the evening peak; the proportion applied is 65-35 (i.e. from all the trips that change from PT to walk/cycle in the morning, 65% originate in the ULV, and 35% have a destination in the ULV).
- Following data presented in *North Subregion Walking v3* trips removed from car and PT should not exceed 17% which is the percentage of mechanised trips that could potentially be walked in the North London sub-region.

Taking into account the mode share targets for the Upper Lee Valley and the restrictions explained above, a set of factors were calculated and applied to the matrices from the ULV2 LTS run, before being used for the subsequent NoLHAM and Railplan runs. The exact point where the factors were applied is illustrated in Figure 3 in the Chapter 3.

It was considered that trips not exceeding 8km are more likely to shift to walking/cycling. A methodology was developed to factor the public transport matrices taking this into account. The ULV trips within the public transport matrix were multiplied by the following factors in order to achieve the reduction of trips required to simulate the target mode share brought by the soft measures package:

- AM 2021: ULV to ULV 1, From ULV 1, To ULV 1
- PM 2021: ULV to ULV 0.93, From ULV 0.96, To ULV 0.95
- AM 2031: ULV to ULV 0.93, From ULV 0.97, To ULV 0.95.
- PM 2031: ULV to ULV 0.82, From ULV 0.88, To ULV 0.93

For the highway matrix, it was judged appropriate to factor all trips to and from the ULV irrespective of trip length. This was to avoid excessive changes in the trip length distribution of the car matrices, which contain a smaller proportion of short distance trips. Factors to trips within, to and from ULV used were:

- AM 2021: ULV to ULV 0.99, From ULV 0.98, To ULV 0.99
- PM 2021: ULV to ULV 0.97, From ULV 0.98, To ULV 0.96
- AM 2031: ULV to ULV 0.94, From ULV 0.91, To ULV 0.97
- PM 2031: ULV to ULV 0.92, From ULV 0.95, To ULV 0.88

Between 3% and 18% (depending on direction of travel and time of day) of trips are shifted to walking/cycling in order to meet the mode share targets.

Tables 17 and 18 show the number of trips in each scenario matrices and the mode share achieved.

MODE SHARE ULV MP 2007			MODE SHARE ULV EP 2007		
CAR	60,000	37%	CAR	68,000	42%
PT	63,000	39%	PT	59,000	36%
Walk and Cycle	39,000	24%	Walk and Cycle	36,000	22%
2021 ULV1 growth only with no interventions MP			**2021 ULV1 growth only with no interventions EP**		
CAR	61,000	33%	CAR	71,000	38%
PT	76,000	41%	PT	70,000	38%
Walk and Cycle	48,000	26%	Walk and Cycle	44,000	24%
2021 ULV2 growth and PT t interventions MP			**2021 ULV2 growth and PT interventions EP**		
CAR	61,000	33%	CAR	71,000	38%
PT	77,000	41%	PT	71,000	38%
Walk and Cycle	48,000	26%	Walk and Cycle	44,000	24%
2021 ULV2 growth and PT and other mode shift interventions MP			**2021 ULV2 growth and PT and other mode shift interventions EP**		
CAR	60,000	33%	CAR	67,000	36%
PT	77,000	42%	PT	68,000	37%
Walk and Cycle	46,000	25%	Walk and Cycle	51,000	27%

Table 17 – Number of trips per mode and mode share for all scenarios, 2021 AM and PM peaks

MODE SHARE ULV MP 2007		
CAR	60,000	37%
PT	63,000	39%
Walk and Cycle	39,000	24%
2031 ULV1 growth only with no interventions MP		
CAR	65,000	32%
PT	86,000	43%
Walk and Cycle	50,000	25%
2031 ULV2 growth and PT t interventions MP		
CAR	65,000	32%
PT	86,000	43%
Walk and Cycle	50,000	25%
2031 ULV2 growth and PT and other mode shift interventions MP		
CAR	60,000	30%
PT	83,000	41%
Walk and Cycle	60,000	30%

MODE SHARE ULV EP 2007		
CAR	68,000	42%
PT	59,000	36%
Walk and Cycle	36,000	22%
2031 ULV1 growth only with no interventions EP		
CAR	76,000	38%
PT	79,000	39%
Walk and Cycle	47,000	23%
2031 ULV2 growth and PT interventions EP		
CAR	75,000	37%
PT	80,000	40%
Walk and Cycle	46,000	23%
2031 ULV2 growth and PT and other mode shift interventions EP		
CAR	69,000	34%
PT	72,000	36%
Walk and Cycle	60,000	30%

Table 18 - Number of trips per mode and mode share for all scenarios, 2031 AM and PM peaks

10 Understanding the impact of transport interventions on the future year public transport system

10.1 Introduction

Chapter 7 reported on the impact of the ULV forecast growth on the public transport networks, for years 2021 and 2031. Instances of crowding were identified on the National Rail and Underground networks, as well as bus flow increases, which put the public transport networks under greater pressure.

A package of public transport improvements affecting the Upper Lee Valley area is likely to be implemented by 2021 and further improvements by 2031. These public transport improvements have been detailed in Chapter 9. In addition, a package of soft measures is expected to be in place, achieving significant mode shift towards walking and cycling.

Public transport improvements and soft measures have been coded into the future year models with the objective of assessing their potential to alleviate congestion brought to the networks by the increased numbers of people and jobs expected in the future years. These runs form scenario *ULV2 Growth and additional PT and other mode shift interventions*.

Section 10.2 reports on the impact that the interventions have in year 2021, in comparison with scenario *ULV1 Growth without transport interventions*. The results of the ULV2 Railplan runs are compared with scenario ULV1 in order to isolate the effect of the measures, as opposed to the effect of growth (reported in Chapter 7). Section 10.3 does the same for year 2031.

10.2 2021 ULV2 (Growth and additional PT and other mode shift interventions)

10.2.1 London Underground

Tables 19 and 20 show the crowding (standees per m^2) on the Victoria Line for scenarios ULV1 and ULV2. With the interventions in place on the Victoria Line, and increasing capacity to 33 tph in the peaks, there is a very slight decrease in crowding over all links in the AM peak.

Crowding remains severe between Finsbury Park and Oxford Circus (Southbound). All but one of these links remain at 5 or more people/sqm.

The PM model runs show a very slight change in crowding on the Victoria Line as a result of the interventions. As in the AM model, there is a small increase in flows on all links, but in the PM the reference case train frequency is already 33 tph, so this is not altered. Crowding therefore increases slightly on some links.

Crowding tables for the off peak direction and flow plots for the Victoria Line were presented in Appendix B of the Stage 4b – Task A report.

	2021 ULV1	2021 ULV2
Walthamstow C - Blackhorse Road	0.7	0.6
Blackhorse Road - Tottenham Hale	2.0	1.8
Tottenham Hale - Seven Sisters	3.0	3.0
Seven Sisters - Finsbury Park	3.0	2.9
Finsbury Park - Highbury & Is	5.1	5.0
Highbury & Is - Kings Cross	5.6	5.4
Kings Cross - Euston	5.0	4.9
Euston - Warren Street	5.7	5.6
Warren Street - Oxford Circus	5.5	5.3
Oxford Circus - Green Park	2.9	2.8
Green Park - Victoria	2.2	2.1
Victoria - Pimlico	0.7	0.6
Pimlico - Vauxhall	0.0	0.0
Vauxhall - Stockwell	0.0	0.0
Stockwell - Brixton	0.0	0.0

Table 19 - Victoria Line, Crowding Levels, AM peak, Southbound, 2021 (growth and additional PT and other mode shift interventions) – 2021 (growth and no interventions)

	2021 ULV1	2021 ULV2
Brixton - Stockwell	0.0	0.0
Stockwell - Vauxhall	0.0	0.0
Vauxhall - Pimlico	0.3	0.3
Pimlico - Victoria	1.4	1.4
Victoria - Green Park	3.6	3.6
Green Park - Oxford Circus	4.0	4.0
Oxford Circus - Warren Street	5.5	5.5
Warren Street - Euston	5.5	5.5
Euston - Kings Cross	4.5	4.5
Kings Cross - Highbury & Is	4.5	4.6
Highbury & Is - Finsbury Park	3.4	3.5
Finsbury Park - Seven Sisters	1.9	2.0
Seven Sisters - Tottenham Hale	1.8	1.9
Tottenham Hale - Blackhorse Road	0.6	0.5
Blackhorse Road - Wal hamstow C	0.1	0.1

Table 20 - Victoria Line, Crowding Levels, PM peak, Northbound, 2021 (growth and additional PT and other mode shift interventions) – 2021 (growth and no interventions)

10.2.2 National Rail

Figures 45 – 46 show that the impact of interventions on National Rail links through the Upper Lee Valley is relatively modest, but crowding is already relatively light as a result of the enhancements in the reference case. See Figures 20 and 21 in Chapter 7 for comparison.

The interventions cause seats to become available between Brimsdown and Ponders End in the southbound direction in the AM peak, but crowding remains unchanged on other links as a result of the interventions. An impact of the interventions is a general increase in flow on southbound links, particularly between Tottenham Hale and Stratford, but this flow increase does not result in any crowding.

In the PM peak the impact of the interventions is similarly slight. There is a slight decrease in flow on services out of Liverpool St, but traffic between Tottenham Hale and Stratford increases slightly. This causes a small increase in flow north of Tottenham Hale in the northbound direction. The northbound link between Enfield Lock and Brimsdown sees some standees as a result of the interventions; due to the new train coding, there is a slight reduction in capacity on this link in order to provide more services further south.

Figure 45 - NR Crowding and Flow, AM peak hour, 2021 ULV2 (growth and additional PT and mode shift interventions)

Figure 46 - NR Crowding and Flow, PM peak hour, 2021 ULV2 (growth and additional PT and mode shift interventions)

10.2.3 Bus

Figures 47 and 48 show that the impact of the interventions is most noticeable in the increase in flow along Meridian Way/Watermead Way – which is served by the new LV1 route. In the AM peak the predominant flow along these roads is in the southbound direction. There is some abstraction of flow from the principal bus corridor along Fore Street, but as additional capacity is also provided along Fore Street in the interventions package, the abstraction is limited.

South of Tottenham Hale, a general increase in flow is observed in both directions as a result of the new routes and increase frequency on this corridor. Generally, east-west bus movements are unchanged by the interventions.

The PM shows similar patterns to the AM, with large increases in flow along the routes of the new buses. The direction of flow along the new routes is more balanced in the PM peak, and abstraction from Fore Street onto Meridian Way/Watermead Way is more obvious in the southbound direction.

See Figures 26 and 27 in Chapter 7 for comparison.

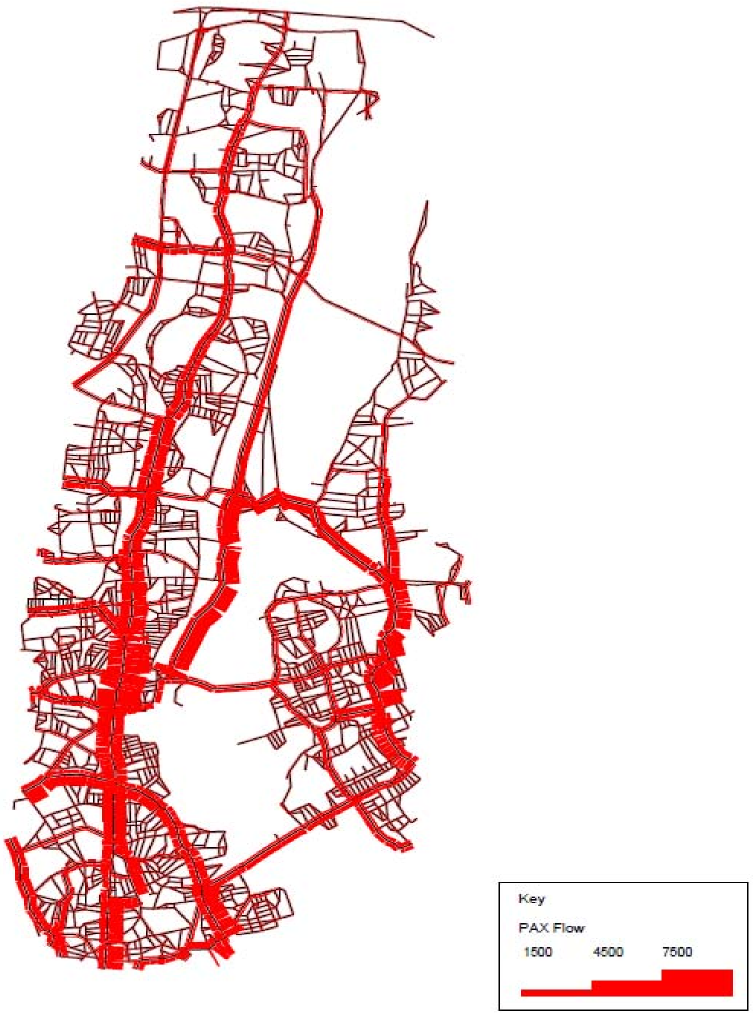

Figure 47 - Bus Passenger Flow, AM peak hour, 2021 ULV2 (growth and additional PT and other mode shift interventions)

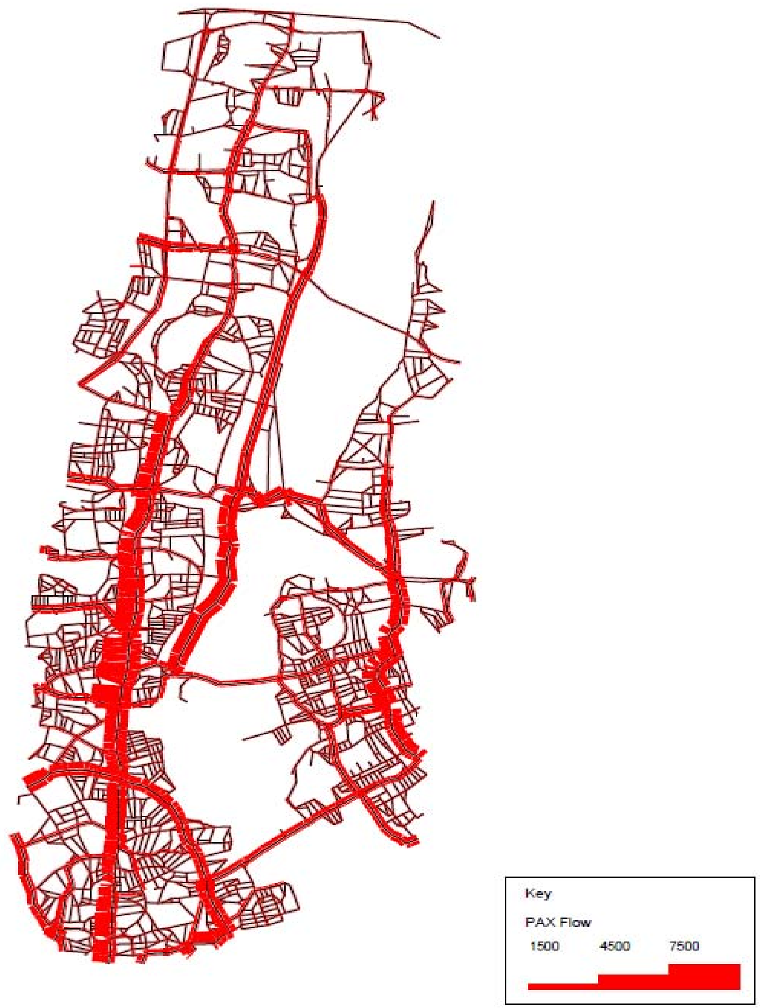

Figure 48 - Bus Passenger Flow, PM peak hour, 2021 ULV2 (growth and additional PT and other mode shift interventions)

10.3 2031 ULV2 (Growth and additional PT and other mode shift interventions)

10.3.1 London Underground

This section reports on the effect of the transport intervention package plus the soft measures package on London Underground in 2031.

Tables 21 and 22 show the crowding on the Victoria Line for scenarios ULV1 and ULV2. The transport intervention measures, which included uplifted frequencies on the Victoria Line do not deliver a significant improvement in the crowding levels. Further investigations show that the flows are very similar in both scenarios (ULV1 and ULV2) which suggest that the extra capacity created by the enhancements is quickly filled up with induced demand. Crowding tables for the off peak direction and flow plots for the Victoria Line can be found in Appendix B of Stage 4b report.

AM Peak - Standees per m2	2031 ULV1	2031 ULV2
Walthamstow C - Blackhorse Road	0.8	0.4
Blackhorse Road - Tottenham Hale	2.1	1.5
Tottenham Hale - Seven Sisters	3.3	3.2
Seven Sisters - Finsbury Park	3.3	3.0
Finsbury Park - Highbury & Is	5.7	5.3
Highbury & Is - Kings Cross	6.1	5.7
Kings Cross - Euston	5.5	5.2
Euston - Warren Street	6.3	6.0
Warren Street - Oxford Circus	6.1	5.8
Oxford Circus - Green Park	3.4	3.1
Green Park - Victoria	2.6	2.3
Victoria - Pimlico	0.9	0.7
Pimlico - Vauxhall	0.0	0.0
Vauxhall - Stockwell	0.0	0.0
Stockwell - Brixton	0.0	0.0

Table 21 - Victoria Line, Crowding Levels (standees per m^2), AM peak, Southbound, 2031 (growth and additional PT and other mode shift interventions) – 2031 (growth and no additional interventions)

PM Peak - Standees per m2	2031 ULV1	2031 ULV2
Brixton - Stockwell	0.0	0.0
Stockwell - Vauxhall	0.0	0.0
Vauxhall - Pimlico	0.5	0.4
Pimlico - Victoria	1.7	1.5
Victoria - Green Park	4.1	3.9
Green Park - Oxford Circus	4.6	4.4
Oxford Circus - Warren Street	6.3	6.1
Warren Street - Euston	6.3	6.1
Euston - Kings Cross	5.1	4.9
Kings Cross - Highbury & Is	5.1	4.9
Highbury & Is - Finsbury Park	4.0	3.9
Finsbury Park - Seven Sisters	2.3	2.3
Seven Sisters - Tottenham Hale	2.1	2.3
Tottenham Hale - Blackhorse Road	0.7	0.5
Blackhorse Road - Walthamstow C	0.2	0.0

Table 22 - Victoria Line, Crowding Levels (standees per m^2), PM peak, Northbound, 2031 (growth and additional PT and other mode shift interventions) – 2031 (growth and no additional interventions)

10.3.2 National Rail

Flows and crowding for the ULV2 scenario are presented in Figures 49 and 50. See Figures 22 and 23 in Chapter 7 for comparison. The transport intervention package delivers dramatic improvements in the main line services in both peak periods. There are several aspects contributing to this improvement:

- Flows to Stratford increase due to the new services. This alleviates the Liverpool Street route
- The Stratford services are not only more regular but their stopping pattern includes the ULV stations up to Brimsdown. The higher frequency of services stopping in local stations is associated with less crowding

Liverpool Street services stop only at Tottenham Hale, which means they are less likely to be used by people with an origin or a destination in other parts of the Upper Lee Valley, especially because the trains to and from Stratford offer a suitable alternative.

Figure 49 - NR Crowding and Flow, AM peak hour, 2031 ULV2 (growth and additional PT and mode shift interventions)

Figure 50 - NR Crowding and Flow, PM peak hour, 2031 ULV2 (growth and additional PT and mode shift interventions)

10.3.3 Bus

The effect of the transport intervention measures can be seen in Figures 51 and 52. See Figures 28 and 29 in Chapter 7 for comparison. Flow in the main arteries is at similar levels of those observed in scenario ULV1. The flows on Meridian Way, Watermead Way and across the reservoirs increase as a result of some of the bus enhancements, in particular the extensions to routes 377 and 41, and the introduction of route LV2.

Figure 51 - Bus Passenger Flow, AM peak hour, 2031 ULV2(growth and additional PT and other mode shift interventions)

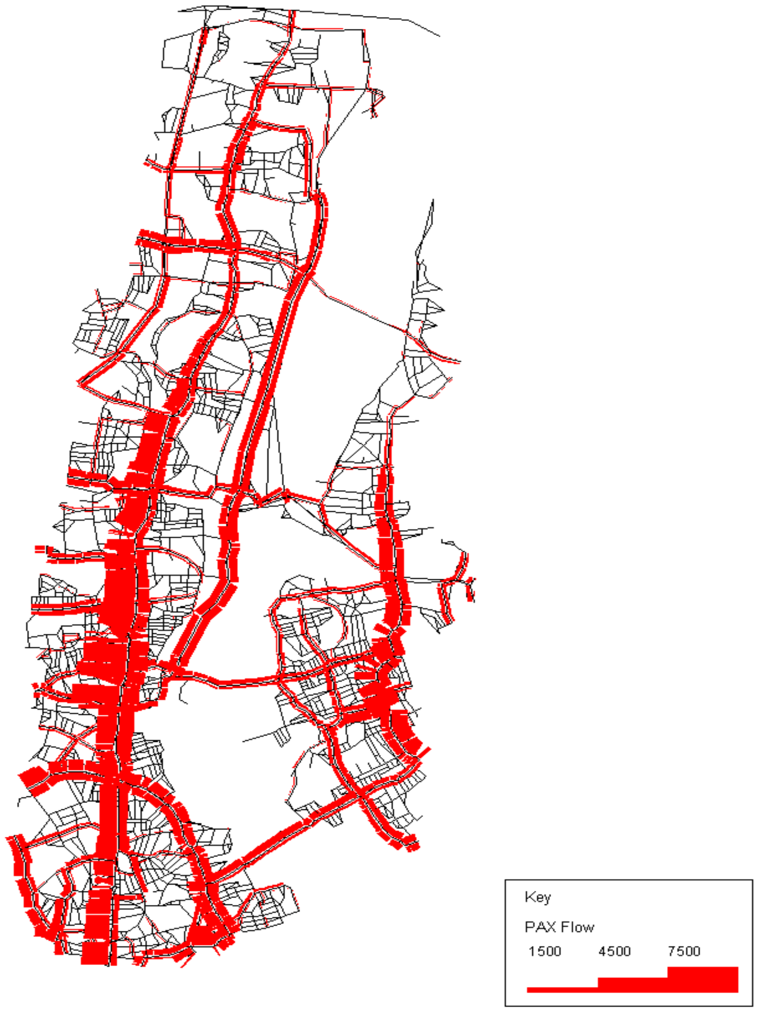

Figure 52 - Bus Passenger Flow, PM peak hour, 2031 ULV2(growth and additional PT and other mode shift interventions)

10.4 Conclusions

After all the public transport interventions and soft measures have been implemented, the flows and crowding on the Victoria Line remain at levels similar to that without the interventions. This suggests that the extra capacity provided by the frequency uplift is filled up with new demand. The demand making use of the new capacity is not attracted from car or walking and cycling, it is caused by other public transport users re-routing via the Victoria line.

Crowding is alleviated on the National Rail services. While flow levels remain similar to the 2031 growth only scenario (ULV1), the level of crowding decreases to 0-2 standees per square metre in both peak hours. The only exception is between Tottenham Hale and Northumberland Park in the PM, which reaches 2-3 standees per square metre; and between Brimsdown and Ponders End, which reaches more than 4 standees per square metre in the PM.

Bus flows increase on the North Circular, Watermead Way and Meridian Way, in accordance with the route extensions.

11 Understanding the impact of transport interventions on the future year highway system

11.1 Introduction

Chapter 8 reported on the impact of the ULV forecast growth on the highway network, which was put under increased pressure especially in 2031.

This chapter looks at the potential of the public transport and other mode shift interventions (as described in chapter 9) to alleviate congestion.

11.2 2021 ULV2 (Growth and additional PT and other mode shift interventions)

11.2.1 Borough-wide Travel Statistics

The total travel distance in the ULV area and in the adjoining boroughs, in the base year and under the ULV2 scenario in 2021 compared with ULV1 is shown in Table 23; the total travel time in Table 24; and average speed in Table 25. As per all the runs, link delays have been capped to a maximum of 300 seconds.

It has been noted in chapter 9 that the only impact of ULV2 on the highway demands (as opposed to ULV1) in 2021 consists of small reductions in car travel into and out of the area. However, in the AM peak, the travel distance in the ULV area remains virtually the same in the two scenarios, suggesting that the vacated road-space is used up by additional through traffic.

This conclusion is supported by the fact that adjoining areas generally show minor reductions in flow. In the PM peak, the reduction in car travel is somewhat greater than in the AM peak, and also cars are a higher proportion of the total flow (fewer goods vehicles). These two factors together result in a decline in travel distance in the ULV area, but only amounting to around 1%. As in the previous time period, there is a further small decline in flow in the adjoining boroughs.

In the AM peak, travel times in the ULV area also remain the same in this scenario as in the previous. Some neighbouring boroughs show small increases in speed, and others small reductions, overall speeds remain the same. In the PM peak, travel time in the ULV area declines by slightly more than the reduction in flow, resulting in a very slight increase in speed. Again, no significant changes in speed are apparent in the adjoining boroughs.

Travel Distance (pcu-km)

Peak period	London Borough	model outputs		effect of transport interventions	
		2021 ULV1	2021 ULV2	2021 ULV1 - 2021 ULV2	2021 ULV1 - 2021 ULV2 % change
AM	**Upper Lea Valley**	**115,766**	**115,772**	**7**	**0.0%**
	Enfield	245,348	245,031	-317	-0.1%
	Haringey	68,521	68,635	114	0.2%
	Hackney	56,382	56,527	145	0.3%
	Waltham Forest	90,684	90,612	-71	-0.1%
PM	**Upper Lea Valley**	**114,326**	**113,596**	**-730**	**-0.6%**
	Enfield	237,530	236,904	-626	-0.3%
	Haringey	65,855	65,840	-15	0.0%
	Hackney	57,130	57,190	60	0.1%
	Waltham Forest	99,023	98,677	-345	-0.3%

Table 23 - Travel Distance (pcu-km), 2021 ULV1(growth and no additional interventions) - 2021 ULV2 (growth and additional PT and other mode shift interventions)

Travel Time (pcu-hours)

Peak period	London Borough	model outputs 2021 ULV1	model outputs 2021 ULV2	effect of transport interventions 2021 ULV1 - 2021 ULV2	effect of transport interventions 2021 ULV1 - 2021 ULV2 % change
AM	**Upper Lea Valley**	**4,537**	**4,537**	**0**	**0.0%**
	Enfield	7,842	7,809	-33	-0.4%
	Haringey	3,375	3,390	15	0.4%
	Hackney	2,795	2,805	10	0.4%
	Waltham Forest	3,546	3,540	-5	-0.1%
PM	**Upper Lea Valley**	**4,729**	**4,670**	**-59**	**-1.2%**
	Enfield	7,613	7,565	-49	-0.6%
	Haringey	3,050	3,043	-7	-0.2%
	Hackney	2,820	2,838	18	0.6%
	Waltham Forest	4,386	4,352	-35	-0.8%

Table 24 - Travel Time (pcu-hrs), 2021 ULV1(growth and no additional interventions) - 2021 ULV2 (growth and additional PT and other mode shift interventions)

Average Speed (km/h)

Peak period	London Borough	model outputs 2021 ULV1	model outputs 2021 ULV2	effect of transport interventions 2021 ULV1 - 2021 ULV2	effect of transport interventions 2021 ULV1 - 2021 ULV2 % change
AM	**Upper Lea Valley**	**25.5**	**25.5**	**0.0**	**0.0%**
	Enfield	31.3	31.4	0.1	0.3%
	Haringey	20.3	20.2	-0.1	-0.3%
	Hackney	20.2	20.1	0.0	-0.1%
	Waltham Forest	25.6	25.6	0.0	0.1%
PM	**Upper Lea Valley**	**24.2**	**24.3**	**0.1**	**0.6%**
	Enfield	31.2	31.3	0.1	0.4%
	Haringey	21.6	21.6	0.0	0.2%
	Hackney	20.3	20.1	-0.1	-0.5%
	Waltham Forest	22.6	22.7	0.1	0.4%

Table 25 - Average Speed (km/h), 2021 ULV1(growth and no additional interventions) - 2021 ULV2 (growth and additional PT and other mode shift interventions)

11.2.2 Flow and Delay

The changes in flow within and on the periphery of the ULV area, in the 2021 ULV2 scenario compared with ULV1, are shown for the AM peak in Figure 53 and for the PM peak in Figure 55. Equivalent plots showing changes in delay are contained in Figures 54 and 56, for the AM and PM peaks respectively.

In the AM peak, the flow change plot shows a small reduction in flow in one direction on the North Circular as it crosses the Lea Valley, and a small increase in the other. There are also reductions apparent on the M25, again pointing to some re-routeing of through traffic. Apart from these, the flow changes within the area are trivial. In the PM peak, following on from the comments above, flow reductions are more prominent; most of the more major roads in the area show a small decline; particularly the North Circular and Meridian Way/Watermead Way.

The delay plots as referred to above show very limited changes; some minor reductions in both periods balanced by minor increases. The precise location of the changes in delay reflects minor fluctuations between the two model runs (ULV1 and ULV2) rather than any meaningful impact of the demand changes incorporated in the latter scenario.

Figure 53 - Flow differences (pcu), AM peak hour, 2021 ULV1(growth and no interventions) – 2021 ULV2(growth and PT and mode shift interventions)

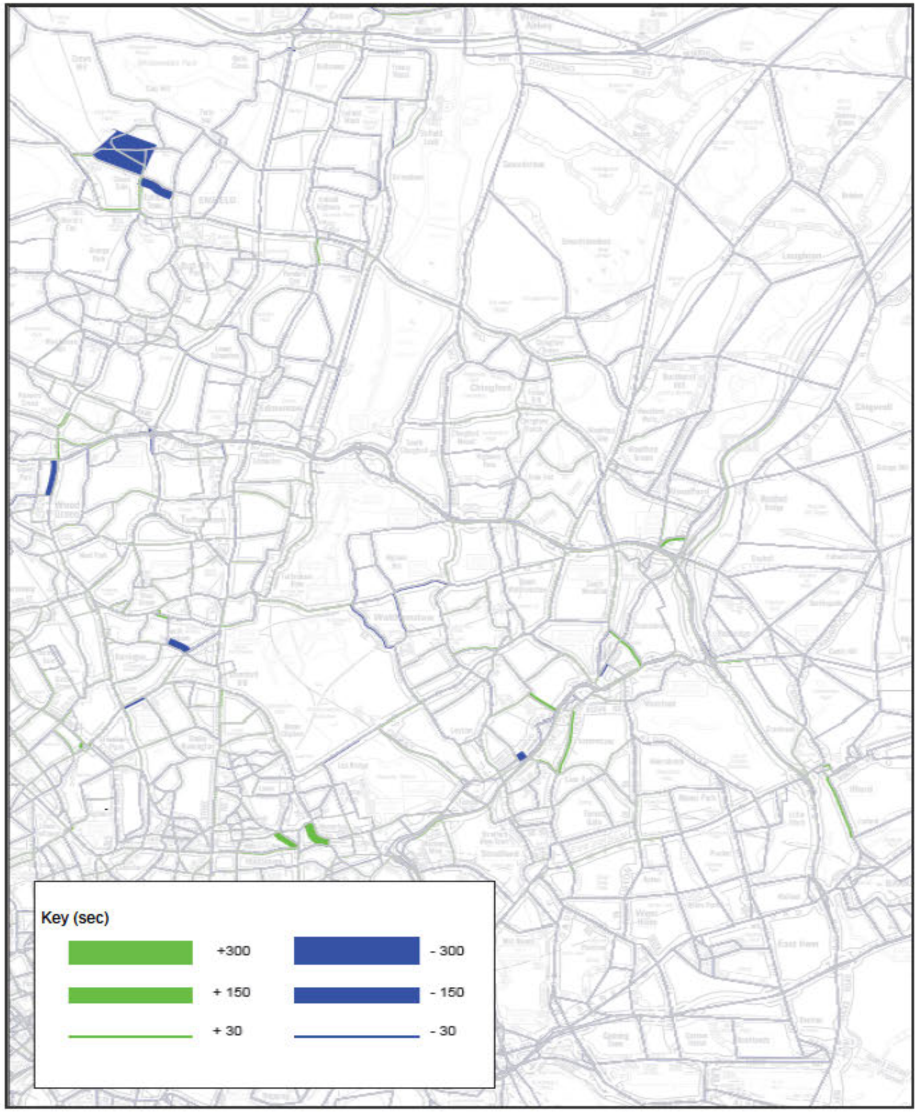

Figure 54 - Delay differences (pcu), AM peak hour, 2021 ULV1(growth and no interventions) – 2021 ULV2(growth and PT and mode shift interventions

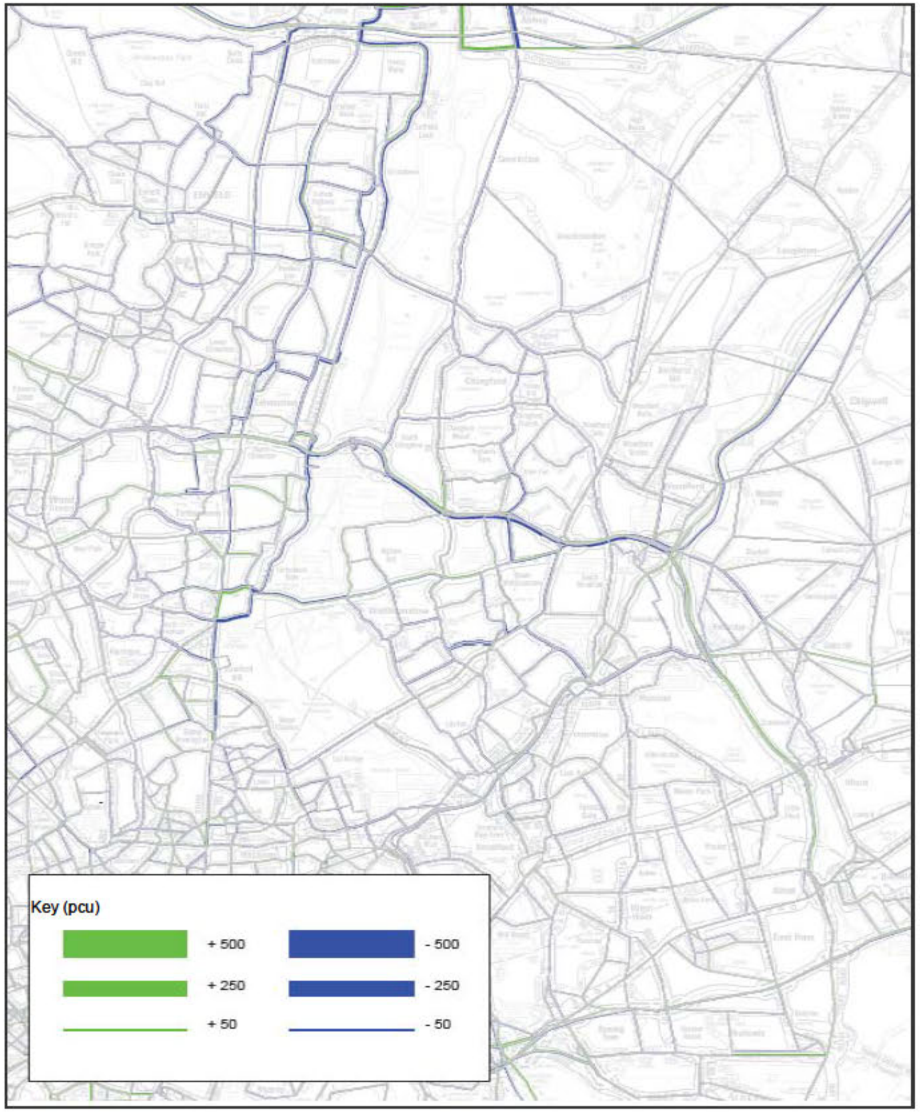

Figure 55 - Flow differences (pcu), PM peak hour, 2021 ULV1(growth and no interventions) – 2021 ULV2(growth and PT and mode shift interventions)

Figure 56 - Delay differences (pcu), PM peak hour, 2021 ULV1(growth and no interventions) – 2021 ULV2(growth and PT and mode shift interventions)

11.2.3 Junction performance

Figures 57 and 58 show the impact of the measures on individual junctions, comparing 2021 with additional PT and mode shift interventions against 2021 growth with no interventions. See Figures 41 and 42 in Chapter 8 for comparison. The same key junctions have been selected for detailed analysis, and using the same methodology, as in the previous section.

In the AM peak, the ULV2 results are identical to ULV1; every entry arm into every junction selected, is in the same level of service category. This is hardly surprising given the very minor differences between the flow and delay in the two scenarios, as reported above.

In the PM peak, the minor reductions in flow and delay reported earlier have resulted in some minor differences between the ULV1 and ULV2 results; a small number of junction entry arms show an improvement by one category. The main examples consist of the two junctions along Forest Road in Walthamstow, as noted under ULV1 above, where the results broadly return to base year levels. In addition, at the junction of Valley Road and Mollison Avenue, the entry arm from the north had crept up into the LoS E/F category in ULV1, but it has now returned to LoS D.

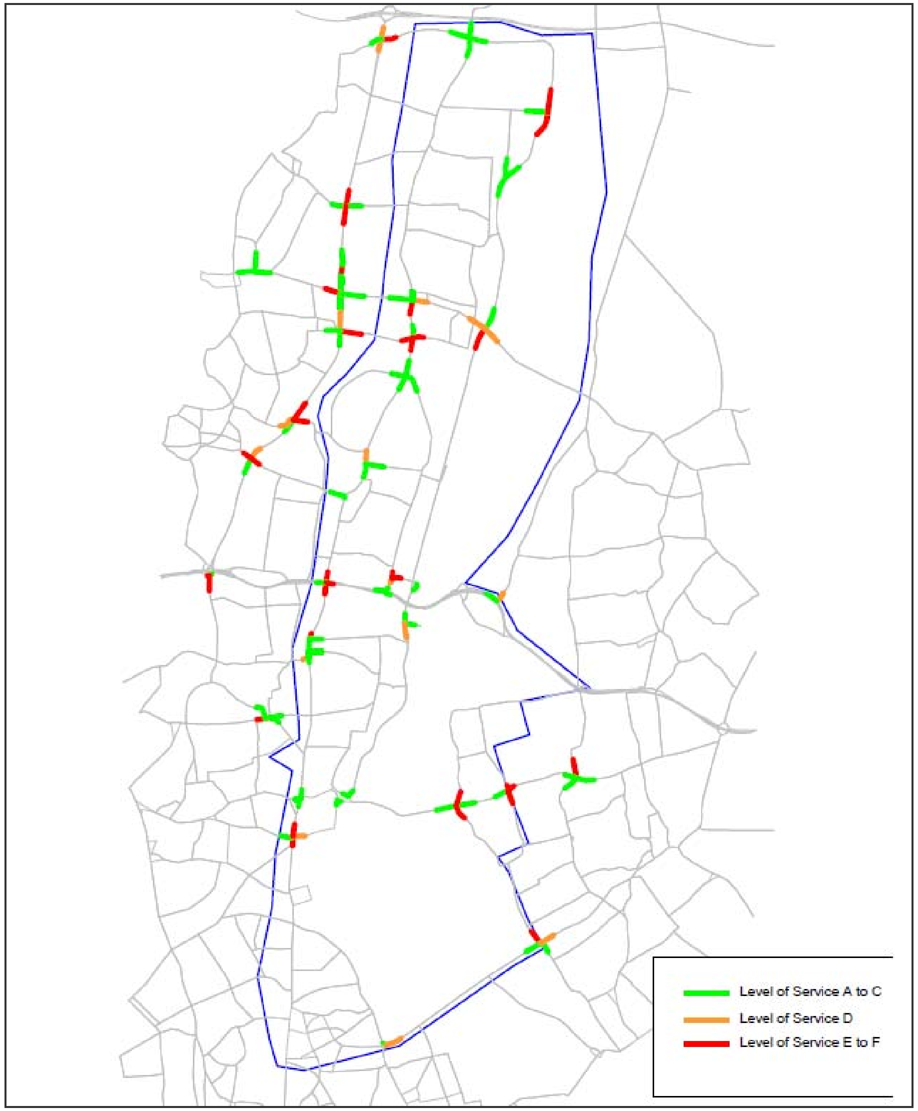

Figure 57 - LoS in Junctions, AM peak hour, 2021 ULV2 (growth and additional PT and other mode shift interventions)

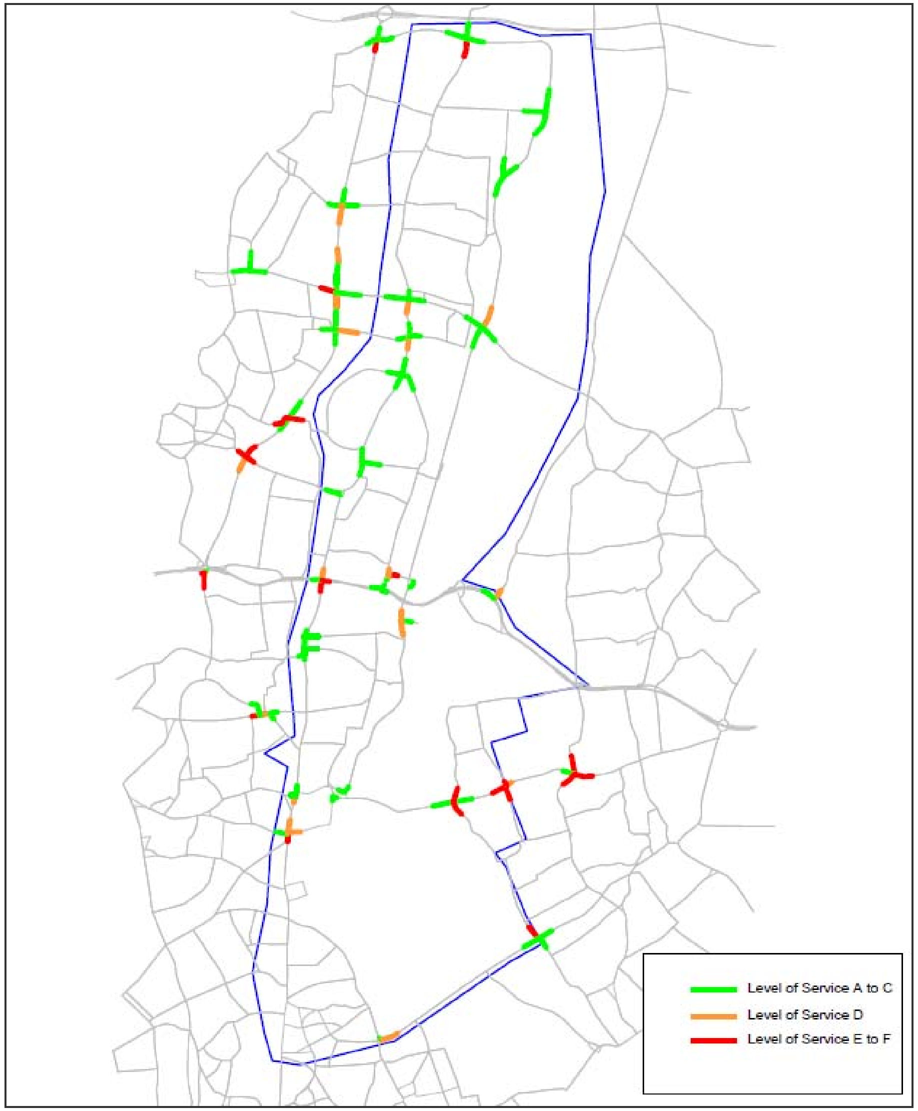

Figure 58 - LoS in Junctions, PM peak hour, 2021 ULV2 (growth and additional PT and other mode shift interventions)

11.3 2031 ULV2 (Growth and additional PT and other mode shift interventions)

11.3.1 Borough-wide Travel Statistics

The statistics presented in this section report on the traffic conditions on all model links in the ULV area. The figures are calculated taking into consideration trips with an origin and/or a destination in the ULV as well as through traffic.

The impacts of the proposed package of interventions are:

- Travel distance decreases by 0.78% in the AM and 1.92% in the PM
- Travel time decreases by 5.31% in the AM and 4.78% in the PM
- Average speed goes up by 4.78% in the AM and 3.01% in the PM

The results are shown in Tables 26 to 28. The change in the ULV area appears to be higher than in the benchmark area for the three measures, which is consistent with the fact that that the additional interventions affect only trips with an origin and/or a destination in the ULV.

The changes observed in these measures, together with the changes in flow and delay suggest that the local network is driving the improvements experienced in the area: the flow and delays difference plots show that savings in delays are concentrated in the local network.

The trips affected by the soft measures (trips with an origin and/or a destination in the ULV area) are more likely to use the local network. Travel distance and time are reduced because through traffic might travel shorter distances in the ULV and therefore spend less time in the ULV network than the local trips. Similarly, through traffic using the main roads is likely to be faster than traffic in small local roads, which explains the faster speeds.

Travel Distance (pcu-km)

Peak period	London Borough	model outputs		effect of transport interventions	
		2031 ULV1	2031 ULV2	2031 ULV1 - 2031 ULV2	2031 ULV1 - 2031 ULV2 % change
AM	**Upper Lea Valley**	**122,317**	**121,359**	**-957**	**-0.8%**
	Enfield	251,572	250,300	-1,272	-0.5%
	Haringey	71,549	71,149	-400	-0.6%
	Hackney	60,132	60,054	-78	-0.1%
	Waltham Forest	97,340	96,581	-759	-0.8%
PM	**Upper Lea Valley**	**120,506**	**118,194**	**-2,312**	**-1.9%**
	Enfield	245,086	243,401	-1,685	-0.7%
	Haringey	69,525	69,217	-308	-0.4%
	Hackney	61,208	60,981	-227	-0.4%
	Waltham Forest	104,167	103,305	-863	-0.8%

Table 26 - Travel Distance (pcu-km), 2031 ULV1(growth and no additional interventions) - 2031 ULV2 (growth and additional PT and other mode shift interventions)

Travel Time (pcu-hours)

Peak period	London Borough	model outputs		effect of transport interventions	
		2031 ULV1	2031 ULV2	2031 ULV1 - 2031 ULV2	2031 ULV1 - 2031 ULV2 % change
AM	**Upper Lea Valley**	**5,029**	**4,762**	**-267**	**-5.3%**
	Enfield	8,415	8,055	-360	-4.3%
	Haringey	3,530	3,442	-88	-2.5%
	Hackney	2,916	2,931	14	0.5%
	Waltham Forest	3,879	3,783	-97	-2.5%
PM	**Upper Lea Valley**	**5,032**	**4,791**	**-241**	**-4.8%**
	Enfield	7,947	7,793	-154	-1.9%
	Haringey	3,235	3,203	-32	-1.0%
	Hackney	2,991	2,958	-33	-1.1%
	Waltham Forest	4,592	4,446	-146	-3.2%

Table 27 - Travel Time (pcu-hrs), 2031 ULV1(growth and no additional interventions) - 2031 ULV2 (growth and additional PT and other mode shift interventions)

Average Speed (km/h)

Peak period	London Borough	model outputs		effect of transport interventions	
		2031 ULV1	2031 ULV2	2031 ULV1 - 2031 ULV2	2031 ULV1 - 2031 ULV2 % change
AM	**Upper Lea Valley**	**24.3**	**25.5**	**1.2**	**4.8%**
	Enfield	29.9	31.1	1.2	3.9%
	Haringey	20.3	20.7	0.4	2.0%
	Hackney	20.6	20.5	-0.1	-0.6%
	Waltham Forest	25.1	25.5	0.4	1.8%
PM	**Upper Lea Valley**	**23.9**	**24.7**	**0.7**	**3.0%**
	Enfield	30.8	31.2	0.4	1.3%
	Haringey	21.5	21.6	0.1	0.5%
	Hackney	20.5	20.6	0.2	0.7%
	Waltham Forest	22.7	23.2	0.5	2.4%

Table 28 - Average Speed (km/h), 2031 ULV1(growth and no additional interventions) - 2031 ULV2 (growth and additional PT and other mode shift interventions)

11.3.2 Flow and Delay

Figures 59 to 62 show the impact of the additional PT and other mode shift interventions on the highway network (ULV2), in comparison with scenario ULV1 (growth with no interventions). The interventions consisted of reducing some highway capacity as a result of improvements to bus services; and reducing the ULV car non business trips to 2007 levels, to reflect the target mode shift of the soft measures. It is important to note that only ULV car trips have been reduced to 2007 levels, while they remain at 2031 levels for the rest of the UK.

There are reductions in the scale of 50pcu in the peak hour on local and main roads. This is accompanied by reductions in delay on local roads, especially south of the North Circular and in the Blackhorse and Walthamstow area. The soft measures affect the trips with origins and/or destinations in the ULV, which are more likely to use local roads, and therefore the local network benefits the most.

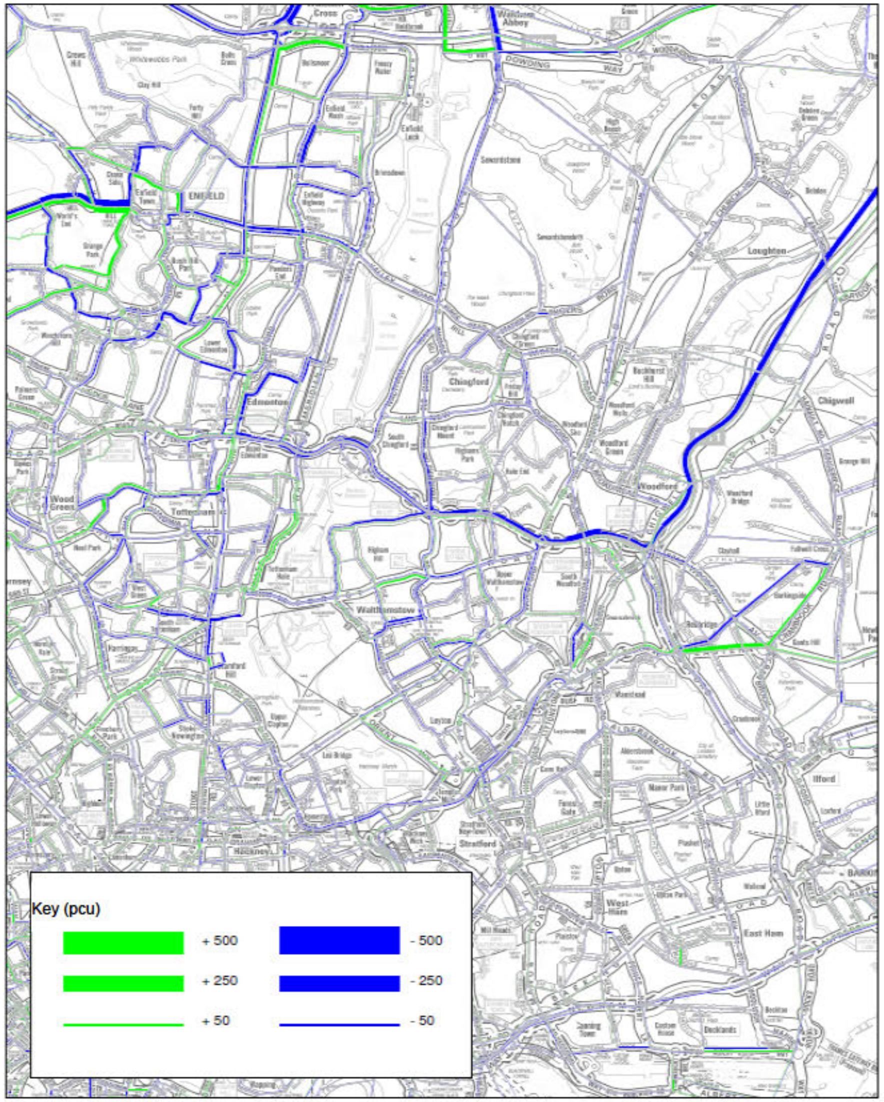

Figure 59 - Flow differences (pcu), AM peak hour, 2031 ULV1(growth and no interventions) – 2031 ULV2(growth and PT and mode shift interventions)

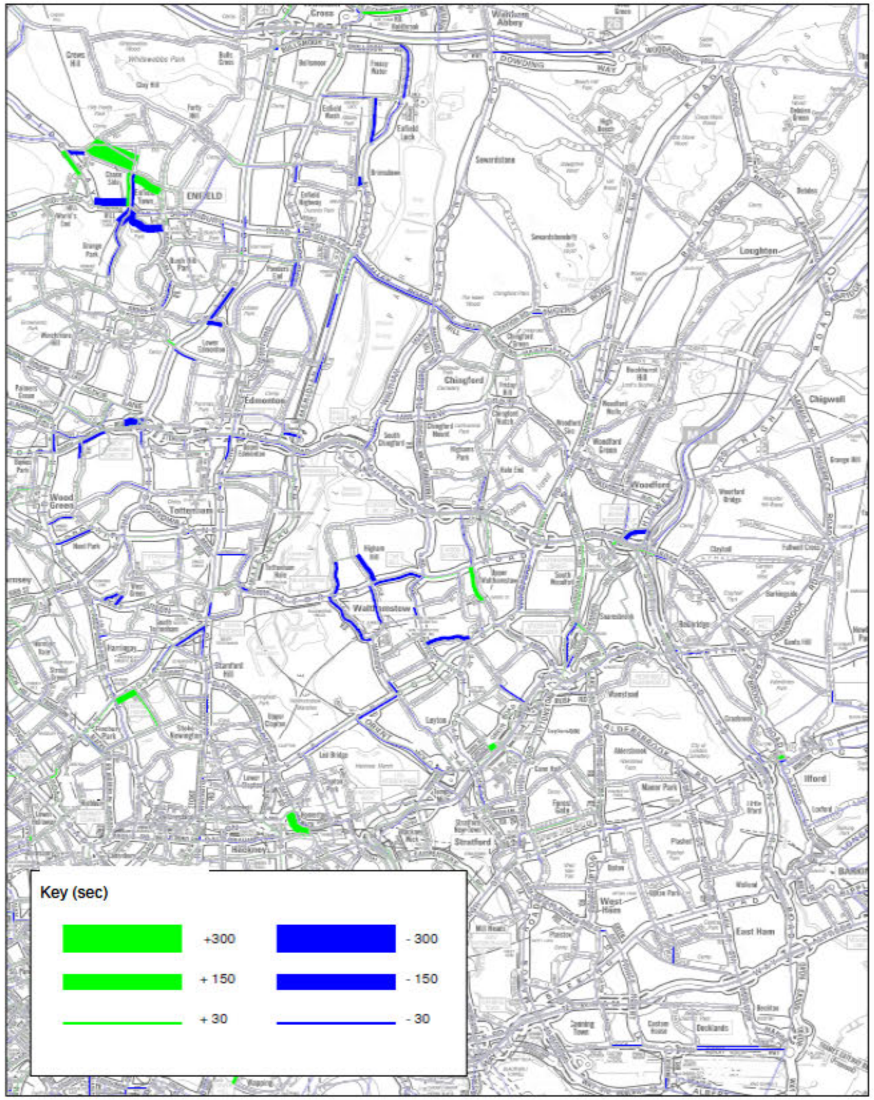

Figure 60 - Delay differences, AM peak hour, 2031 ULV1(growth and no additional interventions) – 2031 ULV2(growth and additional PT and other mode shift interventions)

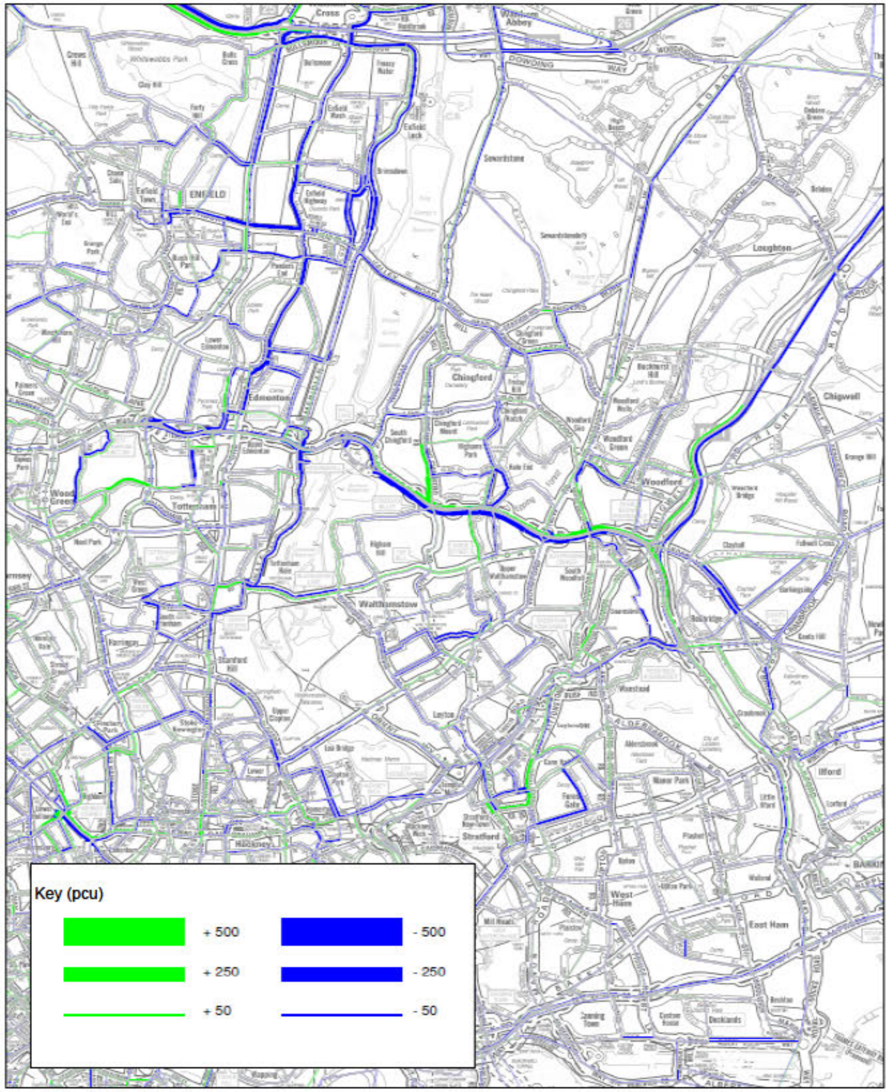

Figure 61 - Flow differences, PM peak hour, 2031 ULV1(growth and no additional interventions) – 2031 ULV2(growth and additional PT and other mode shift interventions)

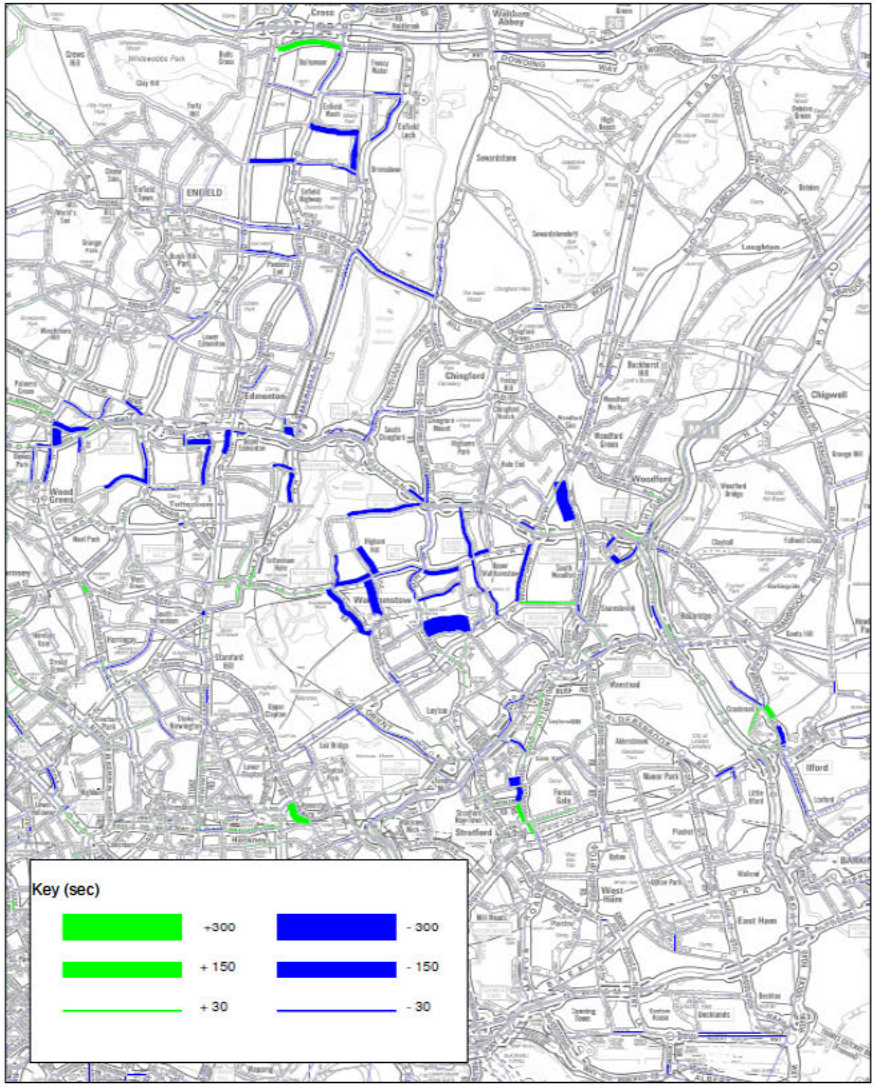

Figure 62 - Delay differences, PM peak hour, 2031 ULV1(growth and no additional interventions) – 2031 ULV2(growth and additional PT and other mode shift interventions)

11.3.3 Junction performance

Figures 63 and 64 show the impact of the measures on individual junctions, comparing 2031 with additional PT and mode shift interventions against 2031 growth with no interventions.

Overall the changes are small, however some junctions experience an improvement with at least one approach offering a better Level of Service. In the AM peak, this is the case for three junctions in Ponders End (A110 Nags End Road/A10, A110 Nags End Road/A112, and A1010 Hertford Road/B137 Nightingale Road). The north approach of the junction between the A1010 Fore Street and the A406 North Circular also shows an improvement. Finally, the east side of the A1010 Stamford Hill with the A504 West Green Road also performs better.

In the PM peak, four junctions show improvements. South of the M25, the south approach of junction A10/A1055 Mollison Avenue offers better LoS. One junction in the Ponders End area (A1010/South Street) shows improved conditions in the south approach. Finally, a couple of junctions in the proximity of the North Circular or close vicinity are performing better: A406 North Circular/B137 Nightingale Road and the A10 Watermead Way/Leaside Road.

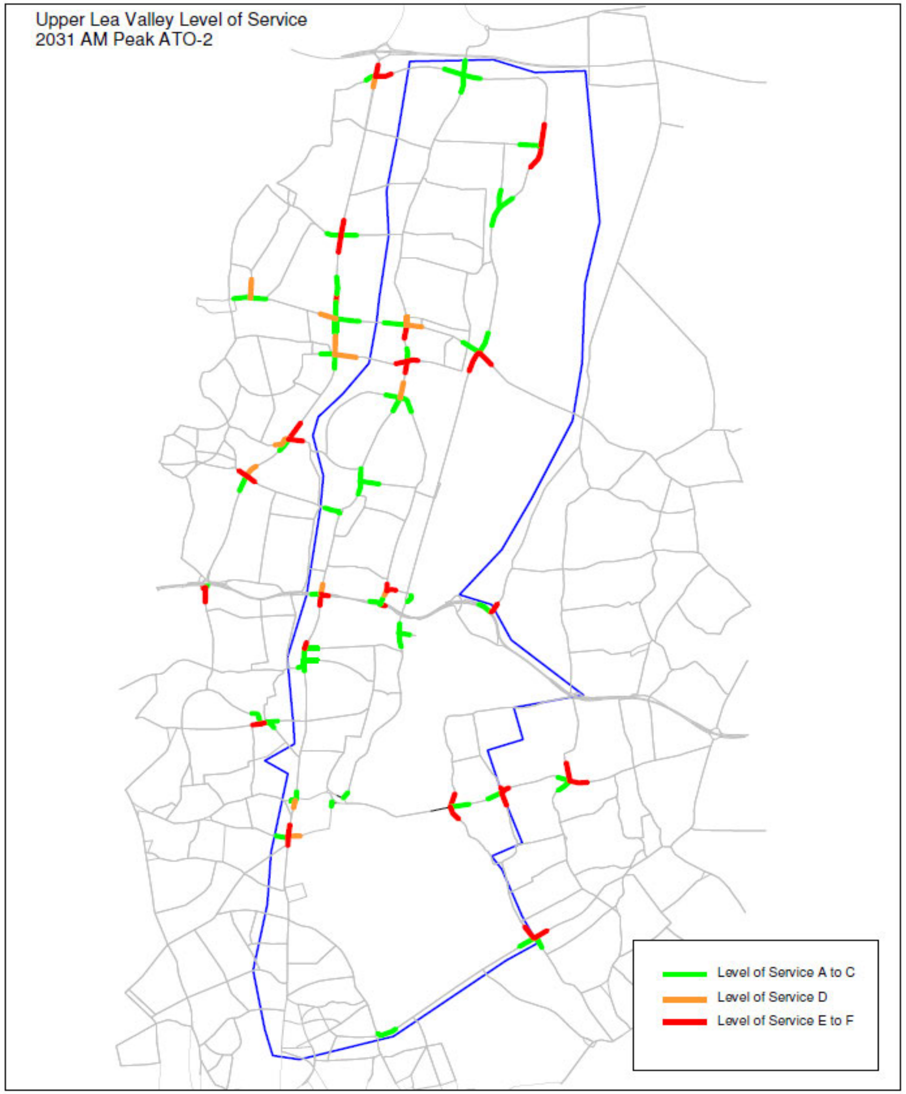

Figure 63 - LoS in Junctions, AM peak hour, 2031 ULV2 (growth and additional PT and other mode shift interventions)

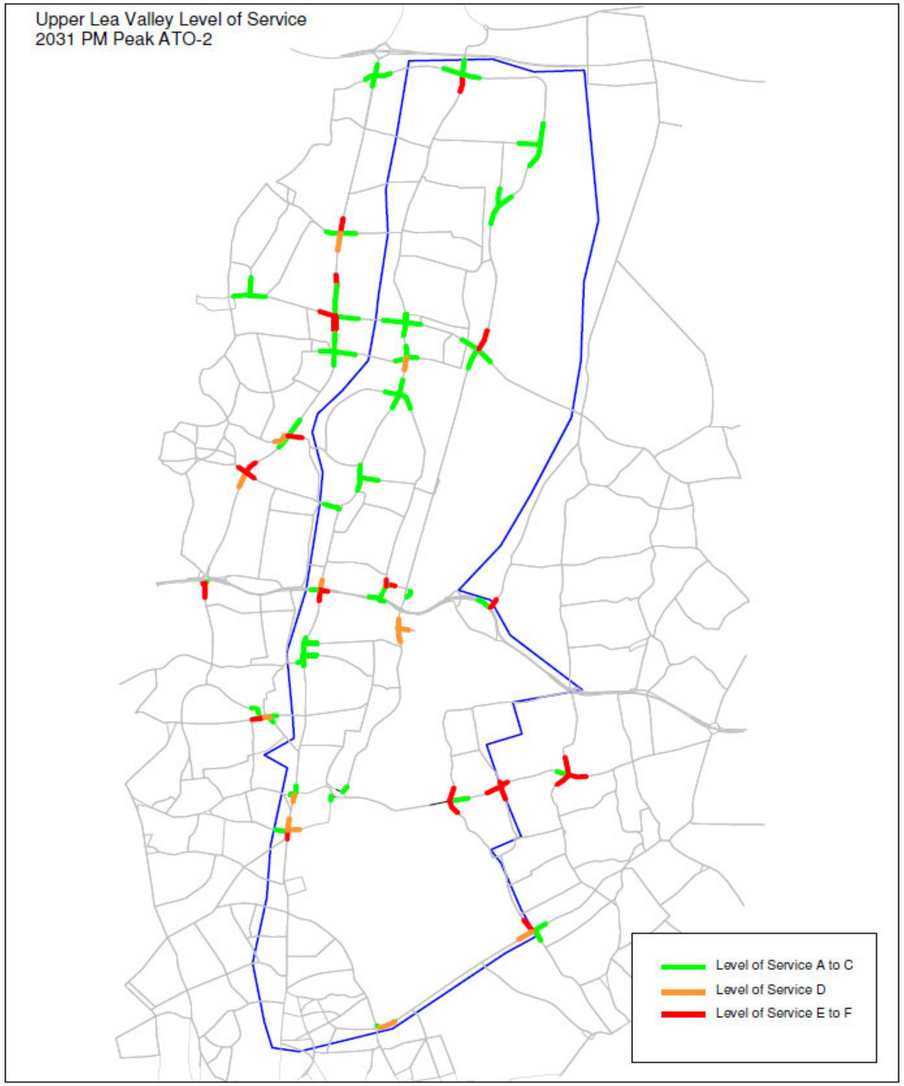

Figure 64 - LoS in Junctions, PM peak hour, 2031 ULV2 (growth and additional PT and other mode shift interventions)

11.4 Conclusions

On the highway network, flows appear to decrease consistently by approximately 50 pcu in the peak hours on many local and main roads, in comparison with the "growth only" scenario. Delays decrease accordingly but only on the local roads. There are some improvements in network statistics: travel distance and travel time appear to decrease in the ULV, while travel speeds increase. The improvements observed in the model are not enough to return to 2008 figures, except for travel speed in the AM peak. A few key junctions also show improvements on at least one approach as a result of the interventions.

Although the highway impact of the tests at a strategic level are not significant, at a local level and at individual junctions there may be serious issues that need to be addressed. The investigation of such issues is better suited to a local model than a strategic model such as NoLHAM. The impact of growth in the areas immediately adjacent to the development locations is reported in section 12.4.

12 Further tasks

12.1 Introduction

After the main body of work was finished, Halcrow was commissioned to undertake four additional modelling tasks for the Upper Lee Valley Opportunity Area study, with the objective of gaining a better understanding of the following aspects:

- Potential impact of bus priority measures on the highway network: Stage 4b – Task B
- Potential impact of the implementation of Crossrail 2 on Victoria Line crowding: Stage 4b – Task C
- Localised impact of the developments on the immediate public transport and highway network: Stage 4b – Task D
- Impact of a bigger mode shift towards walking and cycling on the highway and public transport networks: Stage 4b – Task E

For each of these tasks, networks and matrices were amended as relevant, models were run, and the results were reported in two technical notes and two further reports.

This chapter goes through the details of each of the tasks as well as the main findings.

12.2 Potential impact of bus priority measures on the highway network

The contents of this section are taken from *Task B : Impact of ULV1 scenario on bus speeds and delays, and consideration of impact of bus priority measures – August 2011 (by Halcrow).*

This task focuses specifically on the bus routes which serve the ULV area. It uses NoLHAM to identify conditions along the routes in the two forecast years (2021 and 2031) and considers (in a somewhat indicative fashion) what could be done to improve conditions at the points where the most significant delays are incurred.

12.2.1 Background Bus Information

The main bus corridors in the ULV area comprise primarily:

- the main north/south links on either side of the Lea Valley (the A1010 on the west side, feeding into the A10, and the A1006 on the east side)
- various east-west spurs off the A1010/A10, including the two most principal river crossings (the North Circular and Lea Bridge Road)

A brief review was carried out of the slowest routes through the ULV area in the two time periods. In the AM peak, these tend to fall into two categories. The first consists of a small proportion of routes running along local roads in the Clapton area (just north of Lea Bridge Road), where the slow running is more a function of slow link speeds rather than junction delays. Examples include routes S2, 425 and 488. The remainder of the relatively slow routes tend to start along the A10 north of the North Circular, and continue south, generally diverging from the A10 at some point, and terminating either on or within the Inner Ring Road. Examples of these are routes 76, 259 and 476.

In the PM peak, junction delays tend to be more widespread, and the slowest routes tend to show greater variety, including some east-west routes (e.g. route 230 through Tottenham) as well as north-south. However, it is again the case that the routes along the A10 are heavily represented in this category (northbound in this case).

Very little variation is apparent between the AM and PM peak bus speeds in the different scenarios; overall the ULV2 speeds tend to be slightly faster than the ULV1 (as one would expect).

12.2.2 Identification of main delay-points for buses

Subsequently, the total bus-delay times at all junctions within (or on the fringe of) the ULV area were identified (where bus-delay time is defined as the delay incurred on each turn through the junction, weighted by the number of buses making the turn). The twenty junctions with the highest bus-delay time were then identified for further analysis.

This work was undertaken for the ULV1 scenario in the AM and PM peaks in 2031, and the junctions identified (and numbered in declining order of delay) are indicated in Figures 65 and 66. It can be seen that given the bus flow-weighting (as noted above), the great majority of the bus stops lie along the main bus corridors. The greatest concentration can be seen to be along the A1010, particularly south of the North Circular, feeding into the A10. All the junctions on the list are signal junctions.

2031 runs were selected in preference to 2021 because the network is more congested, and ULV1 was selected in preference to ULV2 because the background delays are generally a little higher. (As noted previously, there are a small number of differences between the bus routes assumed in the two scenarios. There are two additional routes operating in ULV2, but they do not run along major corridors; it has been established that if they had been included, the list of twenty junctions identified would have been the same.)

The intention at this point was to review each junction, and consider what bus priority (or other) measures could be implemented to reduce the delays for buses at these points. Supplementary runs of the model would then be carried out to identify the impact of these changes, and establish the broad scale of the benefit which could be gained. In the very limited time available, only basic broad-brush measures could be considered; options such as banning turns at junctions, or creating additional bus-only movements, would require a much more detailed appraisal than we had time for in this brief exercise, and could not be considered.

The first point to note is that, at the great majority of the junctions, no further improvement could be identified by means of bus lanes. There is already an extensive network of bus lanes in the area (particularly south of the North Circular), and these generally extend right up to the stop line at junctions along their route.

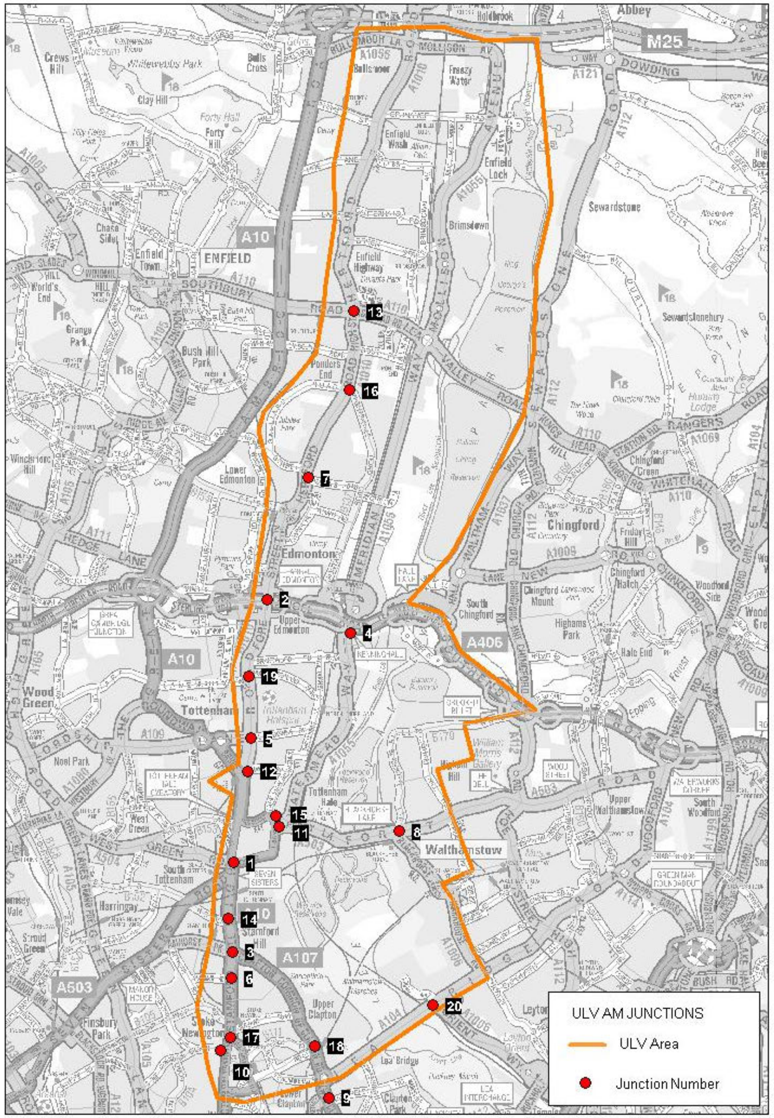

Figure 65 - Junctions with highest bus delay - 2031 AM

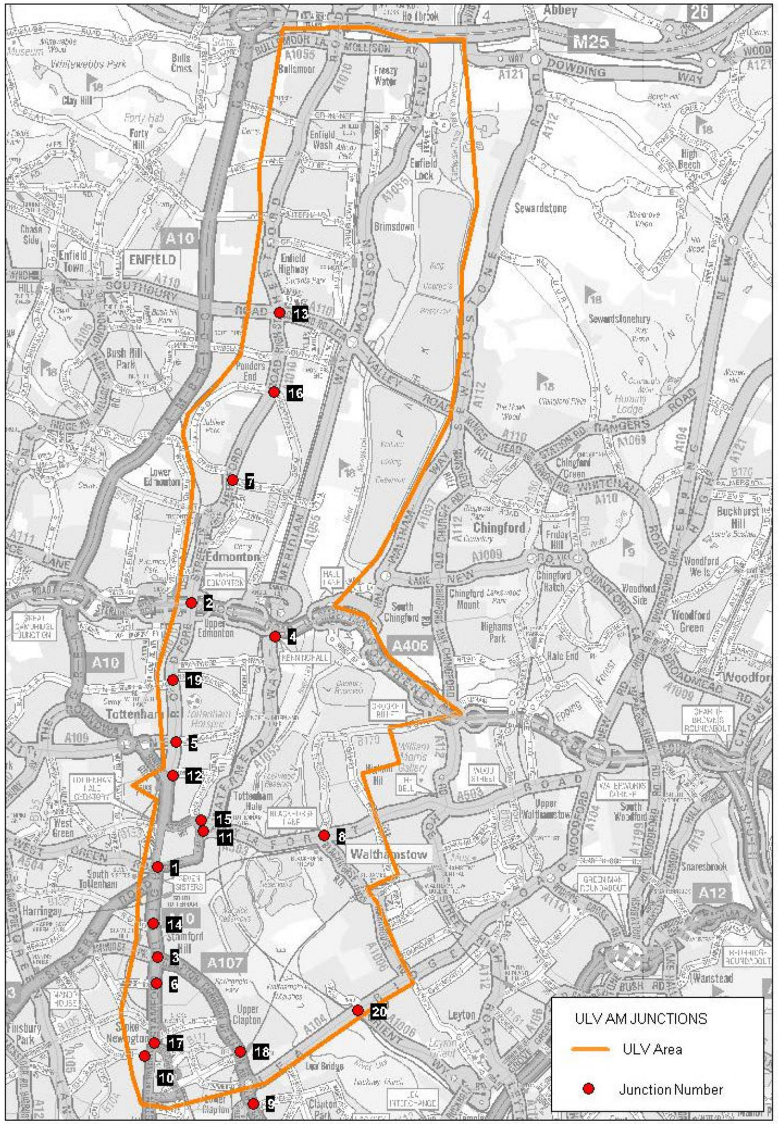

Figure 66 - Junctions with highest bus delay - 2031 PM

Where major delays occur to buses, with no bus lane, it was generally apparent that there was no bus lane in place for a reason; normally, it would be impossible to accommodate it given the width of the section of road in question (often with a bus lane in the other direction). In other cases, there exists a bus lane but stopping short of the junction. In these instances the bus lane is not included in the model - and therefore, the bus delay is being exaggerated.

A relatively common situation found was of delays occurring simply as a result of the signal timings. With three or more signal stages for different movements, delays on individual arms of the junction become unavoidable, even when running well below capacity - and buses are not exempt. An additional factor in this situation is the fact that the great majority of junctions have a pedestrian phase, which by definition will extend the delays for vehicular movements, again including buses. It is also worth noting that quite frequently in the network, a junction will appear to have a pedestrian phase, which in reality is a vehicular phase serving a minor arm of the junction which is not included in the network.

As noted above, many of the junctions on the two lists lie along the A1010/A10 corridor, on which the total bus flows are particularly high, and therefore even moderate delays incurred below capacity levels (no more than around 30 seconds, on average) are sufficient to cause their inclusion amongst the twenty 'worst' junctions. Examples include:

- the junction of Stamford Hill High Road and Dowsett Road, Tottenham, and
- the junction of Stoke Newington Toad and Rectory Road, Stoke Newington

In contrast, where the bus movement is over capacity, resulting in high delays in the worst cases, the whole junction was found to be heavily congested. In this situation, it would be difficult to make any change benefitting buses without causing significant disbenefit to other movements. The primary example of this is the junction of A1010 Fore Street and the North Circular in the AM peak. Here the predominant problem is northbound; it might be possible to ban the right turn onto the North Circular eastbound, as there are alternative routes available for traffic seeking to make this movement - but we did not wish to consider this option without a much more detailed appraisal of the impacts. Also there is a bus lane northbound stopping short of the junction, so buses would avoid most of the delay anyway.

Modelling additional bus priority measures could not comprise additional bus lanes, for the reason set out above. The most likely mechanism was considered to be a system for giving priority to buses, over and above other traffic, as they approach the junctions in question. It is understood that bus priority can be provided in SCOOT using a facility of this nature. On average, this would have the effect of increasing the green time for the movements of which buses form a major component, with a reduction for other movements. The general procedure adopted, therefore, was to increase the green time by (normally) 10% for the bus oriented movements at the junctions on the list. Other arms were generally reduced pro rata, but in some cases, the reduction was focused on arms which had capacity to spare.

A small number of junctions were excluded from this process. These comprised: junctions which had a relatively high bus flow during each phase (with similar delays), and junctions where the minor arm (with no bus flow) already incurred relatively heavy delays. In particular, where every arm is operating over capacity, there is little that could be done; the facility of SCOOT (or a similar system) to provide bus priority in this situation would be limited, anyway. During this exercise, we sought to avoid making matters significantly worse for other movements.

Having made these modifications to the signal timings as a proxy for additional bus priority measures, revised 2031 ULV1 model runs were carried out for the AM and PM peaks, using these modified networks. The bus travel times were extracted as before, and all the standard comparisons were made against the original ULV1 model output. The results obtained are set out in the next section.

12.2.3 Impacts of signal timing revisions at the twenty key junctions

The travel times on each of the bus routes which pass through the ULV area were re-calculated from the new assignments.

Comparing the total junction times, before adjusting the signal timings, in the ULV area with the equivalent results for ULV1 2031 at the key junctions as described above, a fall of around 2% is apparent in the AM peak, and around 5% in the PM peak. A small but significant improvement in bus travel times has therefore been obtained by means of these revisions, with the improvement particularly noticeable in the evening, when the network is more congested, and junction delays more prevalent.

Total travel distance in the ULV area increases slightly whilst total travel times decline slightly; average speeds increase by almost 1% in both time periods. The conclusion is that the adjustments to the signals in favour of the major arms benefit traffic generally, and less traffic is held up in queues at the bottleneck junctions. In the neighbouring areas, travel distance declines slightly (particularly in the AM peak) suggesting that a small element of traffic diverts into the ULV area as a result of the changes.

In the AM peak, flow changes tend to be minor; with most junctions affected showing increases on some arms and reductions on others. The only stretch of road showing a significant increase is the A1010 from the south side of the North Circular northwards; but even this is very minor. Reductions in delay are generally very minor at some junctions, and balanced by small increases on other arms. The only junctions showing a major improvement are along Forest Road in Walthamstow, due to the small increase in capacity provided for traffic from the south at junction 8. Outside the ULV area, there are some significant changes in delay shown, but this is almost certainly just model “noise”.

In contrast, in the PM peak the changes are significantly more pronounced. The network is slower on balance, junction delays are more pronounced, and the adjustments to the signal timings have a greater impact, both in terms of flow increases on the arms gaining capacity and reductions on the other arms. However, over the network as a whole, total travel distance in the ULV area only increases slightly as in the AM peak, and total travel times remain the same.

In this time period, the main bus corridor (the A1010 fed by the A10 in the south) shows an increase in flow along almost its entire length, and particularly northbound into the Tottenham Hale gyratory from the south. The corresponding reduction is particularly noticeable southbound on Meridian Way / Watermead Way, again feeding into the Tottenham Hale gyratory.

12.2.4 Summary and conclusions

There are a large number of bus routes serving the ULV area, and on the main north/south corridor (the A1010 feeding into the A10), bus flows can approach 80 buses per hour in each direction in the AM and PM peaks. Despite the fact that many bus lanes are provided in the area, junction delays comprise around 40% of the total bus travel times (excluding time spent at bus stops), and will be a major contributory factor to unreliability to bus travel times.

Using the 2031 ULV1 models, the twenty junctions with the highest flow-weighted delays to buses were identified in the AM and PM peaks. The possibility of improving the situation at each of these junctions by means of additional bus priority measures was considered. Generally, the provision of additional bus lanes was not found to be possible; where these would be beneficial but are not installed, there normally appears to be a reason. Nor could we consider site-specific measures (such as banning certain turns) in the very limited time available for this exercise.

Generally, at junctions such as these, the most likely way forward is thought to be a system of giving greater priority to buses at traffic signals. This was modelled by making adjustments to the signal timings in favour of the stages heavily used by buses; this was found to be possible at the majority of the junctions identified (junctions where this would cause major disbenefit to other movements were excluded).

Supplementary NoLHAM runs for ULV1 in 2031 were then undertaken using these revised signal timings. Compared with the original runs, junction delays on bus routes in the ULV area were found to decline by 2% in the AM peak and 5% in the PM peak. The impact on other traffic was smaller, and generally beneficial.

We therefore conclude that there is the potential for small but significant improvements to bus times in the ULV area by implementing additional bus priority of the type indicated, without any significant disbenefit to other traffic.

12.3 Potential impact of the implementation of Crossrail 2 on Victoria Line crowding

The contents of this section are taken from *Upper Lee Valley Model Analysis_Stage 4b – Task C – September 2011 (by Halcrow).*

This task builds on the ULV2 Growth with public transport and additional mode shift interventions runs undertaken for the main body of work. In addition to the transport interventions included in the ULV2 models (HLOS2, Victoria line frequency enhancements and bus improvements), the Crossrail 2 scheme was also included.

The goal of this task was to understand if this scheme could potentially alleviate the congestion forecasted on the Victoria line.

Existing Railplan code of the Crossrail 2 scheme (Option A) provided by TfL was used as a starting point to modify the ULV2 LTS and Railplan networks. Option A runs from Seven Sisters to Clapham Junction, and it is coded as an underground line entirely.

The scheme was originally coded on an enhanced base network, and some modifications were needed in order to adapt the code to the LTS ULV base network. Other manual adjustments to walk and access links were also carried out.

This set of runs is referred as *ULV3 CHL*.

Tables 29 and 30 show the crowding on the Victoria Line for the base year and scenarios ULV1, ULV2 and ULV3. Looking at the AM peak crowding on the Victoria Line increases up to Seven Sisters, where passengers interchange to the Crossrail 2, alleviating crowding on the Victoria Line from this stop onwards. This pattern is mirrored in the PM peak.

Analysis of the flows on the Victoria Line show that there is an increase from Walthamstow to Seven Sisters, and a decrease in the central section of the line, in comparison with the ULV2 scenario. Crowding tables for the off peak direction and flow plots for the Victoria Line can be found in Appendix B of the Stage 4b – Task C report.

AM Peak - Standees per m2	2007	2031 ULV1	2031 with measures ULV2	2031 with measures and CHL ULV3
Walthamstow C - Blackhorse Road	0.9	0 8	0.4	0.6
Blackhorse Road - Tottenham Hale	2.4	2.1	1.5	1.7
Tottenham Hale - Seven Sisters	3.2	3 3	3.2	3.7
Seven Sisters - Finsbury Park	2.5	3 3	3.0	1.6
Finsbury Park - Highbury & Is	5.1	5.7	5.3	4.3
Highbury & Is - Kings Cross	5.6	6.1	5.7	4.7
Kings Cross - Euston	5.4	5 5	5.2	4.3
Euston - Warren Street	6.3	6 3	6.0	5.1
Warren Street - Oxford Circus	6.0	6.1	5.8	4.9
Oxford Circus - Green Park	3.4	3.4	3.1	2.3
Green Park - Victoria	2.5	2.6	2.3	1.4
Victoria - Pimlico	0.6	0 9	0.7	0.5
Pimlico - Vauxhall	0.0	0 0	0.0	0.0
Vauxhall - Stockwell	0.0	0 0	0.0	0.0
Stockwell - Brixton	0.0	0 0	0.0	0.0

Table 29 - Victoria Line, Crowding Levels, AM peak, Southbound, 2007 and 2031 various scenarios

PM Peak - Standees per m2	2007	2031 ULV1	2031 with measures ULV2	2031 with measures and CHL ULV3
Brixton - Stockwell	0.0	0.0	0.0	0.0
Stockwell - Vauxhall	0.0	0.0	0.0	0.0
Vauxhall - Pimlico	0.1	0.5	0.4	0.2
Pimlico - Victoria	1.3	1.7	1.5	1.3
Victoria - Green Park	4.2	4.1	3.9	2.7
Green Park - Oxford Circus	4.8	4.6	4.4	3.4
Oxford Circus - Warren Street	6.4	6.3	6.1	5.0
Warren Street - Euston	6.3	6.3	6.1	5.0
Euston - Kings Cross	5.2	5.1	4.9	4.0
Kings Cross - Highbury & Is	4.5	5.1	4.9	4.0
Highbury & Is - Finsbury Park	2.9	4.0	3.9	3.0
Finsbury Park - Seven Sisters	1.9	2.3	2.3	1.0
Seven Sisters - Tottenham Hale	1.4	2.1	2.3	2.8
Tottenham Hale - Blackhorse Road	0.4	0.7	0.5	0.7
Blackhorse Road - Walthamstow C	0.0	0.2	0.0	0.2

Table 30 - Victoria Line, Crowding Levels, PM peak, Northbound, 2007 and 2031 various scenarios

The introduction of Crossrail 2 has some impact on the National Rail crowding levels. Higher flows and more standees per square metre have been modelled on the ULV section of the line (Enfield Lock to Tottenham Hale). This can be explained by the increased number of users alighting at Tottenham Hale to use the Victoria Line, attracted by the congestion relief experienced on the Victoria Line from Seven Sisters. The same patterns are observed in the PM. Flows on the Seven Sisters branch increase slightly due to the new interchange with the Crossrail 2 at Seven Sisters station.

For buses, the results are very similar to those obtained for ULV2 (growth and additional public transport and mode share interventions but without the CHL), which is suggesting that the impact of the CHL on buses is very moderate.

The impact of the implementation of Crossrail 2 on the highway network was found to be very minor.

12.4 Localised impact of the developments on the immediate highway and public transport network

The contents of this section are taken from *TN08 Impact of main development sites on transport facilities in ULV area, in 2031 – September 2011 (by Halcrow).*

This task focuses on four of the main growth areas in the ULV, and identifies the scale of growth in the four areas between the base year and the year 2031. It then assesses in some detail the impact of the additional trips generated in each area on the transport facilities in the vicinity, and considers the extent to which the facilities are able to accommodate the additional demand, in the AM and PM peaks.

The ULV1 scenario is used initially to undertake this exercise; it is understood that the same appraisal may be carried out in the context of ULV2 at a later stage.

In each area, in the absence of a Base Minus scenario, the difference between the base year and 2031 ULV1 demands is taken as a proxy for the development trips.

The four growth areas under consideration, and the LTS zones in which they lie, are as follows:

- Growth Area 1: LTS zone 7346 Ponders End, served by Ponders End station
- Growth Area 2: LTS zone 7309 Upper Edmonton East, served by Angel Road station
- Growth Area 3: LTS zone 8340 Highams Hill, served by Blackhorse Road station
- Growth Area 4: LTS zone 3044 Tottenham Hale East, served by South Tottenham and Tottenham Hale stations

The location of each area is shown in Figure 67.

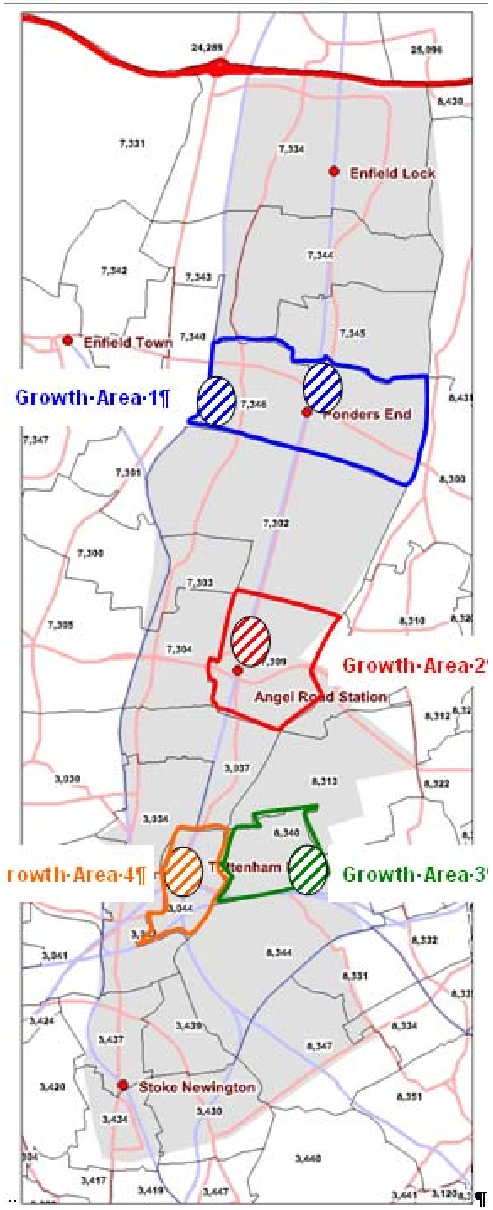

Figure 67 - Location of the ULV developments

The scale of growth in each area is indicated in Table 31:

LTS zone	*Name*	*Pop 2007*	*Pop 2031*	*Population 2007-2031 increase*	*Emp 2007*	*Emp 2031*	**Employment 2007-2031 increase**
7346	Ponders End	13290	15870	2580	4762	5462	700
7309	Upper Edmonton	1526	14826	13300	3726	6226	2500
8340	Highams Hill	3318	7538	4220	2523	3723	1200
3044	Tottenham Hale East	3111	14211	11100	4214	9214	5000

Table 31 - Population and Employment Increases forecast in four growth areas

This task looks at the potential impact of development trips in the highway and public transport network in the four key development areas in the Upper Lee Valley: Ponders End, Upper Edmonton East, Highams Hill and Tottenham Hale.

In the absence of a Base Minus model, the growth in car trips between 2007 and 2031 in the zones where the developments are located has been used as a proxy for development trips. In the case of public transport, the difference in the boarding and alighting movements between the two years in the stations located near the developments has been taken as an indicator of the trips generated by the developments.

For both modes, the emphasis of this task has been on:

- identifying the number of development trips in each zone (highway model) or relevant station (PT model);

- understanding the relative significance of those trips in the network;
- studying the routing of development trips; and
- assessing the potential impact of development trips on congestion and delays, and other local issues.

The main conclusions for each development area are set out below.

12.4.1 Ponders End

The development at Ponders End is expected to generate very little motorised traffic; the number of additional car and goods vehicle trips into and out of the site in the PM peak hour amounts to no more than 40 in each direction, and less than that in the AM peak. The development traffic never amounts to more than 1% of the total flow on any one link. So although there is considerable increase in delays at certain junctions in the area, the development traffic appears to make a very minor contribution to this.

The number of AM boarders and PM alighters at Ponders End station increases by 78% and 74% respectively. Loadings on the West Anglia Main Line increase in similar proportions due to service improvements. It is believed that the trips with an origin or a destination at this station will only contribute to the crowding of the line to a very limited extent, as they represent less than 5% of the line load south of this station.

12.4.2 Upper Edmonton East

This development area is the one generating the greatest pressure on the road network, resulting in 600 additional origins and 300 additional destinations during the AM peak hour. The additional car demand comprises many trips of considerable length and is concentrated primarily on the strategic network (North Circular, A1055, and M11). However, although the new demands are high, the development traffic is never more than a small proportion of the total on any one link.

Angel Road station is quite a minor station but is very well located for the new development. In 2007, boarding and alighting demand at this station was well below 100, but by 2031, AM peak boarders in the peak direction increase to almost 500, and PM peak alighters to almost 600. However, this large increase in station demand is as much an effect of the improvement in the train service from the station as it is an effect of the increased population in the area.

12.4.3 Highams Hill

The development in Highams Hill is expected to generate up to 200 pcu in the peak directions, in both AM and PM. The additional trips appear to be relatively short distance and the impact does not extend beyond the immediate area. The additional traffic represents up to 15% of the total traffic on the B179 Blackhorse Lane, making a significant contribution to the increased delays on this road. Similarly, the additional numbers of development trips are expected to contribute to the delays experienced at junctions along Forest Road in 2031.

Blackhorse Road station in close proximity to the development site is served by the Victoria Line and the Overground line Gospel Oak to Barking. There is a significant increase of boarders and alighters at this station due to the development. However the percentage of line loading they represent does not change as much due to general increase of line loading in the vicinity of this station.

12.4.4 Tottenham Hale East

The development is expected to generate around 300 pcu in each direction in the AM peak, and somewhat more in the PM peak. The additional traffic spreads in all directions in a fairly even fashion. The development traffic comprises almost 10% of the traffic at the westbound flow on the south side of the Tottenham Hale gyratory in the AM, making a major contribution to the congestion in the area. Elsewhere along the gyratory, the development traffic represents less than 5% of the total flow, and as such is not having a significant impact on delays.

This development is served mainly by Tottenham Hale station. Although the Victoria line experiences a large increase in AM boarders in the peak direction, only a small proportion of these are expected to be development trips; most of them are additional WAML interchanges resulting from changes in the service pattern along the line.

12.5 Impact of a larger mode shift towards walking and cycling on the highway and public transport networks

The contents of this section are taken from *Upper Lee Valley Model Analysis – Stage 4b – Task E – August 2011 (by Halcrow).*

As part of the main body of work, a soft measures package was tested under the assumption that it would be able to achieve a mode share of 30% for sustainable modes in 2031. The impact of the soft measures combined with the public transport improvements was reported in chapter 10 of this document.

This task looks at the impact of a bigger mode shift towards cycling and walking, reaching a mode share of up to 32% for sustainable modes. Highway and public transport matrices were factored to reflect the target mode share, and assigned to their respective networks. For this test, most of the mode shift has been assumed to come from car, which falls under 2007 levels, while public transport retains its 2031 share. The public transport demand levels after the factoring are very similar to the previous ULV2 Stage 4a run, and therefore the results obtained for that are still valid.

The reduction in car demand caused by the mode shift interventions is on the scale of 15% of trips with an origin or a destination in the ULV. This reduction brings the matrix below 2007 levels. Travel distance and travel time decrease while travel speed increases. The scale of the impacts reflects the fact that the flow reductions are focused on local traffic, using congested local roads; not through traffic passing through on the relatively free-flowing arterials.

Flows and delays fall accordingly; in the AM, flow reductions are apparent throughout the ULV area, on local roads and main roads equally. The flow reductions are particularly pronounced in the more residential areas (e.g. the NW corner of ULV) reflecting the fact that trip generations are considered more sensitive to the policies being tested than trip attraction. The reduced flow results in many reductions in delay throughout the area, particularly pronounced on feeder roads into the main arterials, such as the roads feeding Forest Road in Walthamstow. Approaches to some of the key junctions also improve.

In the PM peak, the flow reductions can be seen to be significantly more pronounced than the AM, and again are noticeable throughout the area, on roads of all types. Delay reductions are particularly pronounced on the access roads into Forest Road in Walthamstow. They are also important along the North Circular in Edmonton; another very congested area which is clearly benefitting considerably from the small reductions in demand. Similarly, the performance of some of the key junctions is improved.

13 Timeline: modelling tests and issued reports

This chapter summarises the modelling tests undertaken as part of the Upper Lee Valley Transport Study and the working notes and reports issued to Transport for London in chronological order.

Before October 2010 – Stage 1 – Proposal/Inception

Technical and commercial proposals were submitted in July and October 2010.

October-November 2010 – Stage 2 – Review of Existing models

The performance of LTS 6.15, NoLHAM 00d and Regional Railplan 6.1x was assessed in the Upper Lee Valley Area. Findings are reported in three technical notes:

- TN01 ULV - Review of Existing Highway Model
- TN02 ULV - Review of LTS 6.15
- TN03 ULV - Review of RRP

No model runs were undertaken during Stage 2

January-March 2011 – Stage 3 – Forecasting and Analysis

Two additional technical notes further analysing the performance of NoLHAM and RRP models in the Upper Lee Valley area were issued in February and March 2011:

- TN04 ULV - 2007 NoLHAM model validation
- TN05 ULV - Review of RRP v5

A first round of LTS, NoLHAM and RRP runs was undertaken for years 2021 and 2031, for the AM, IP and PM peaks. In total, one LTS test, 6 NoLHAM tests (2021 and 2031, AM, IP and PM) and 6 RRP tests (2021 and 2031, AM, IP and PM) were initially carried out. An additional 4 NoLHAM tests were then undertaken (2031 AM and PM, with capped and uncapped signal optimisation)

The results were reported in March 2011 in the following report:

- Upper Lea Valley Model Analysis.doc

May-September 2011 – Stage 4 – Assessment of Transport Options

Stage 4a: LTS 6.2 was released and a second round of modelling runs was carried out for 2031. This round comprised:

- 2 LTS tests
    - o 2031 ULV1 only growth
    - o 2031 ULV2 growth and PT transport interventions
- 8 NoLHAM tests
    - o 2031 ULV1 AM and PM, plus capped and uncapped signal optimisation tests
    - o 2031 ULV2 AM and PM, , plus capped and uncapped signal optimisation tests
- 4 RRP tests
    - o 2031 ULV1 AM and PM
    - o 2031 ULV2 AM and PM

The findings were reported in August 2011 in the following document:

- Upper Lea Valley Model Analysis_Stage 4a

Stage 4b: Five tasks were undertaken under this stage of work, which tool place during August and September 2011.

Task A: identical to Stage 4a but for year 2021 (in this case no signal optimisation tests were considered necessary). The findings were reported in August 2011 in the following report:

- Upper Lea Valley Model Analysis_Stage 4b - Task A

Task B: Bus priority measures were studied. This involved running at least 8 NoLHAM tests with signal timing revisions (2021 and 2031 AM and PM with 2 different versions of signal timing revisions). The findings were reported in August 2011 in the following working note:

- TN06 ULV - bus_routes_ULV1_v1

Task C: Crossrail 2. This involved one complete modelling round for 2031, including LTS, NoLHAM and RRP tests as in Stage 4a. The findings were reported in September 2011:

- Upper Lea Valley Model Analysis_Stage 4b - Task C

Task D: Detailed analysis of growth areas. This task consisted of looking to the Stage 4a model results in more detail for the area immediately adjacent to the developments. It did not involve new model runs. The findings were reported in September 2011 in the following technical note:

- TN08 ULV01_devsite_impacts_v2

Task E: Increased mode shift. This task involved replicating all the NoLHAM and RRP tests (as undertaken for Stages 4a and 4b -Task A) for 2021 and 2031, with different factors applied to the Stage 4a and 4b- Task A LTS matrices . The objective was to understand the impact of an improved package of soft measures, to achieve a higher mode shift in the Upper Lee Valley. The findings were reported in September 2011 in the following document:

- Upper Lea Valley Model Analysis_Stage 4b - Task E