T002

Chelmsford Local Plan Review

Transport Impact Appraisal of Preferred Spatial Approach

March 2024

Safer, greener, healthier

integrated expertise

Essex County Council

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- CCC have requested that Essex Highways (EH) undertake further traffic modelling to support the Plan review evidence base - consistent with, and following on from, the modelling undertaken for the 2020 adopted Local Plan.

- This report documents the modelling methodology, results, and findings of the traffic impact appraisal of development identified in Chelmsford's preferred spatial approach – specifically, the new development allocated *in addition* to that in the adopted Local Plan. Work contained within this report follows-on from the findings from the assessment of selected spatial approaches in autumn/winter 2023 and documented within the following evidence base report: *"Chelmsford Local Plan Review: Transport Impact Appraisal of Spatial Approaches – December 2023"* issued by EH on behalf of CCC.

- This study specifically looks at the following:

    1) The relative impact of additional development traffic on the future capacity of links and junctions on the strategic and local road network, at key junctions and across neighbouring authority boundaries.

    2) The effectiveness of mitigation measures proposed by developers of large, allocated development sites in Chelmsford – specifically Chelmsford Garden Community and Hammonds Farm.

    3) The impact of forecast traffic flows on the accessibility of passenger transport services and the network of bus priority infrastructure in Chelmsford.

Preferred Spatial Approach

- With development associated with the adopted Local Plan already accounted for in the baseline, CCC's preferred spatial approach focuses additional development in Growth Area 3, and on sites along the A12 corridor. Approximately three quarters of the total quantum of new housing is allocated on the proposed Hammonds Farm site, and around a half of total employment space is allocated across Hammonds Farm and land south of the A414 adjacent to the A12 Junction 18.

- It should be noted that at the time this modelling was carried out the preferred spatial approach included an allocation of 43,000 sqm of employment space in Chelmsford Urban Area. This site has subsequently been removed from the Council's preferred spatial approach but remains in this modelling. The conclusions of this report should therefore be read in this context.

Key Modelling Assumptions

- The traffic impact appraisal has been undertaken at a strategic scale using the latest version of the Chelmsford VISUM Forecast Model. The modelling makes use of a fixed demand approach which does not consider behavioural responses to congestion that would impact peak hour travel demand. Whilst this might be seen as representative of worst-case traffic conditions, a test run of the VDM process has shown that the use of variable demand modelling with the Chelmsford Model results in little overall change in peak hour traffic volumes across Chelmsford.

- The 2041 forecast modelling includes recent proposed infrastructure in Chelmsford including the redesigned 'hamburger' layout at the Army & Navy Roundabout, and the latest National Highways long-term design proposals for the Boreham Interchange.

- The layout of the proposed Chelmsford North-East Bypass in the forecast model has been updated to reflect the latest position on scheme delivery timescales. Specifically, only the southern section of the bypass between the proposed Northern Radial Distributor Road and Beaulieu Parkway has been modelled for the appraisal of the preferred spatial approach.

Summary of Strategic Network Impact

- In the 2041 baseline modelling (without Local Plan Review development) the following key locations on Chelmsford's transport network are expected to experience notable congestion in the peak hours.

Modelled Queueing 2041 Key Locations
City Centre junctions along Parkway between A1016 Waterhouse Lane and Odeon Roundabout
Army & Navy Roundabout*
A12 J17 (Howe Green)
Princes Road (Miami) Roundabout through to Widford Road Roundabout
Writtle Road junction with A1016 Waterhouse Lane
A1016 Chelmer Valley Road between Nabbotts Farm and Valley Bridge Roundabouts
A138 Chelmer Road southbound in vicinity of New Dukes Way
Valley Bridge Road at junction with B1008 Broomfield Road and A1016 Chelmer Valley Road
A1060 Roxwell Road westbound on approach to junction with Lordship Road B1008 Main Road, Broomfield

*Modelled congestion would be expected to be worse with the existing (2023) roundabout layout.

- Of the Local Plan development allocated in the preferred spatial approach on greenfield sites outside of the city centre, only Hammonds Farm and the employment site adjacent to the A12 J18 are shown in the modelling to generate vehicle flows of sufficient volume to impact traffic conditions significantly on the surrounding road network.

- Network capacity issues are modelled in the 2041 baseline (without Local Plan development) along the A12 between Junction 17 and 19. Proposed development along the A12 corridor has the potential to route a significant proportion of trips via the A12 - both northbound and southbound - from Junction 18, thereby exacerbating congestion along the trunk road. Modelling suggests this will also increase the likelihood of traffic re-routing along rural roads to the east of the A12, impacting the villages of Boreham and Little Baddow.

- At the same time, development trips will likely have a direct impact on queuing along the A414 on the westbound approach to the A12 Junction 18, and this is shown in the modelling to result in the displacement of background traffic flows from the A414 and onto alternative rural routes through Danbury and Sandon.

- The A12 Junction 17 at Howe Green is modelled with significant congestion in the 2041 baseline with queues on the southbound off-slip extending back along the A12 carriageway. Whilst a relatively small proportion of Local Plan development trips are shown in the modelling to route through the junction, queues extending back along the A12 carriageway would likely heighten the impact of development trips routing along the A12.

- A12 carriageway widening between Junctions 15-19 is not considered in National Highways' Road Investment Strategy (RIS3) pipeline for the period 2025-2030, and it is not clear whether National Highways are considering carriageway improvements beyond this period.

- Junction 17 at Howe Green has been the subject of Essex Highways studies in the past, looking at possible capacity improvements to accommodate future growth in traffic. There are recognised restrictions on space at the junction that prevent carriageway widening sufficient to provide the capacity to accommodate long-term traffic flows. A redesign of Junction 17 would therefore require coordination with proposals to widen the A12 carriageway at the location.

Cross-Boundary Impact

- Analysis shows that cross-boundary connections to the north of Chelmsford via the A12 are most affected by the latest proposed Local Plan development, with the highest modelled increase shown in the AM peak of around 13% from 2041 baseline flows.

- Model outputs suggest that with the addition of Local Plan development focused in the vicinity of the A414 (and with site accesses directly onto the route) there will be a small reduction in trips along the A414 corridor caused by the displacement of background traffic flows onto alternative local routes.

- To alleviate the cross-boundary impact of development along the A12 corridor, policy requirements will be put in place at Hammonds Farm to maximise the internalisation of trips and active and sustainable travel schemes including a sustainable corridor to Beaulieu Park Station/Sandon

Park and Ride; connections over and below the A12 linking with existing and planned interventions; and improvements to the east of the site towards Danbury.

Developer Mitigation and Recommendations

- The relative level of sustainable accessibility calculated across sites in the preferred spatial approach is summarised in the table below.

	Average Sustainable Accessibility Score	% of Total Allocated Housing	% of Total Allocated Employment
Growth Area 1			
Chelmsford Urban Area (Residential)	3.00	20%	-
Chelmsford Urban Area (Employment)	3.00	-	30%
Growth Area 2			
Ford End	1.57	1%	-
Boreham	2.14	-	2%
Little Boyton Hall Farm	1.43	-	4%
North-East Chelmsford	2.57	-	8%
Growth Area 3			
East Chelmsford (inc. Hammonds Farm)	2.21	77%	56%
Bicknacre	1.64	1%	-
East Hanningfield	1.50	1%	-

- With development focused on, or in the vicinity of Hammonds Farm, a significant proportion of the preferred spatial approach is located in an area with a potentially good level of sustainable accessibility – subject to the provision of local amenities and sustainable travel infrastructure by developers.

- The Hammonds Farm development is already required to provide substantive improvements connecting the site across the A12 and linking and enhancing the planned sustainable links being provided by the East Chelmsford developments; Army and Navy improvements and outcomes from the Chelmsford Local Cycling and Walking Infrastructure Plans (LCWIPs).

- Central to these proposals are the provision of a bus, walking and cycle-only bridge link over the A12 connecting the development to the western side of the A12 to where Sandon Park and Ride, East Chelmsford site

allocations, schools, leisure facilities and the city centre are located. Provision is also made for an Eastern Orbital Route serving as a bus corridor enabling access for proposed new bus services to Beaulieu Rail Station.

- The proposed bus, walking and cycle-only bridge link over the A12 is necessary to help deliver the required mode shift away from the car and towards more sustainable modes of travel. This, in turn, would likely help reduce the impact of car trips on the surrounding road network – particularly the modelled pinch-point on the A414 on the approach to the A12 Junction 18.

- An important objective of any mitigation proposal will be to help reduce background traffic from Danbury and Maldon away from A12 junction 18, thereby providing capacity for development trips and helping to achieve a nil-detriment impact on flows along the A414. In this location, a key focus will need to be placed on the provision of robust, frequent and attractive sustainable transport options from the site to key attractors (such as the city centre) so that significant mode shift is realised.

- It is recommended that bus accessibility is monitored and potentially improved along the following routes where baseline congestion has the potential to be exacerbated by Local Plan development:
    - A414 westbound approach to A12 Junction 18 (Sandon Interchange)
    - A1060 Parkway between Odeon and Market Roundabouts

- To mitigate the impact of congestion along the A414 on the approach to Junction 18 consideration should also be given to the provision of a bus lane on the westbound approach to the Hammonds Farm access junction, supported by priority signals to accommodate buses into and out of the site and beyond into Chelmsford city centre. The bus lane might then be extended up to the A12 Junction 18, with the provision of a bus gate to help bypass queue extents on the approach.

- Critical to the planning application process should be a requirement to ensure that background traffic flows along the A414 are not unreasonably delayed by the addition of development trips. This may well require significant highway measures in the vicinity of the site access.

- Analysis of model outputs forecasts a potential capacity issue with the Beaulieu Parkway bridge link over the rail line between the Boreham Interchange and the Beaulieu Rail Station access junction. It is recommended that delays along the route are monitored over time to determine the long-term viability of the route serving as a bus access link between the Hammonds Farm development and Beaulieu Rail Station.

- Should future journey times to Beaulieu Station via the Boreham Interchange increase substantially, consideration should be given to placing additional focus on enhancing the provision of sustainable transport links between Hammonds Farm and Chelmsford rail station in the city centre.

- Discussion, under the duty to co-operate will continue with National Highways to keep them aware of the impact of development sites along the A12 and to work collaboratively to inform the scope of sustainable mitigation required to best manage the impact of traffic flows and limit the volume of development trips routing via the A12.

- A12 Junction 17 at Howe Green is a recognised congestion hotspot and is a long-term issue to be considered by ECC in partnership with National Highways.

Conclusion

- With a focus on development along the A12 corridor, the modelled traffic impact of the preferred spatial approach is largely limited to the A12 corridor, the junctions along it and, to a lesser extent, the A1114 and A138 corridors into Chelmsford City Centre. The minor quantum of development allocated in rural areas of Chelmsford is of insufficient size to likely impact the local road network.

- Overall, the allocation of development in the Local Plan preferred spatial approach provides the opportunity to make good use of existing and potential sustainable accessibility to and from proposed sites. However, this will be dependent on the delivery of the bus, cycling and walking infrastructure proposed by developers, as well as additional measures required to provide the necessary connectivity to the wider sustainable transport network.

- By maximising the potential for sustainable accessibility to and from the sites along the A12 corridor, the impact on the strategic highway network should not be considered severe. However, continued discussions with National Highways will be necessary to best ensure that future development growth in Chelmsford can be supported by the strategic highway network over the long-term.

1 Introduction

1.1 Study Context

Chelmsford City Council (CCC) are undertaking a review of their Local Plan adopted in May 2020, extending the Plan period by five years from 2036 to 2041. As of March 2024, the review anticipates accommodating a further 3,862 homes and 111,445 sqm of employment over that period.

CCC have requested that Essex Highways (EH) undertake further traffic modelling to support the Plan review evidence base - consistent with, and following on from, the modelling undertaken for the 2020 adopted Local Plan. This report documents the modelling methodology, results and findings of the traffic impact appraisal of Chelmsford's preferred spatial approach.

Section 4 of this report provides detail on the development allocation within the preferred spatial approach. This specifically covers the development allocated *in addition* to that in the adopted Local Plan. Figure 1-1 on the following page illustrates where this latest study fits within the development of the Local Plan transport evidence base.

With reference to Figure 1-1 overleaf, it is intended for the findings of this modelling study to be considered alongside the documented findings from the earlier evidence base reports covering the sustainable accessibility mapping and appraisal of sites[1] and the traffic impact modelling appraisal of selected spatial approaches[2].

[1] Chelmsford Local Plan Review: Sustainable Accessibility Mapping & Appraisal: Technical Note – Essex Highways, 15th July 2022.
[2] Chelmsford Local Plan Review: Transport Impact Appraisal of Spatial Approaches: Technical Report – Essex Highways, 21st December 2023.

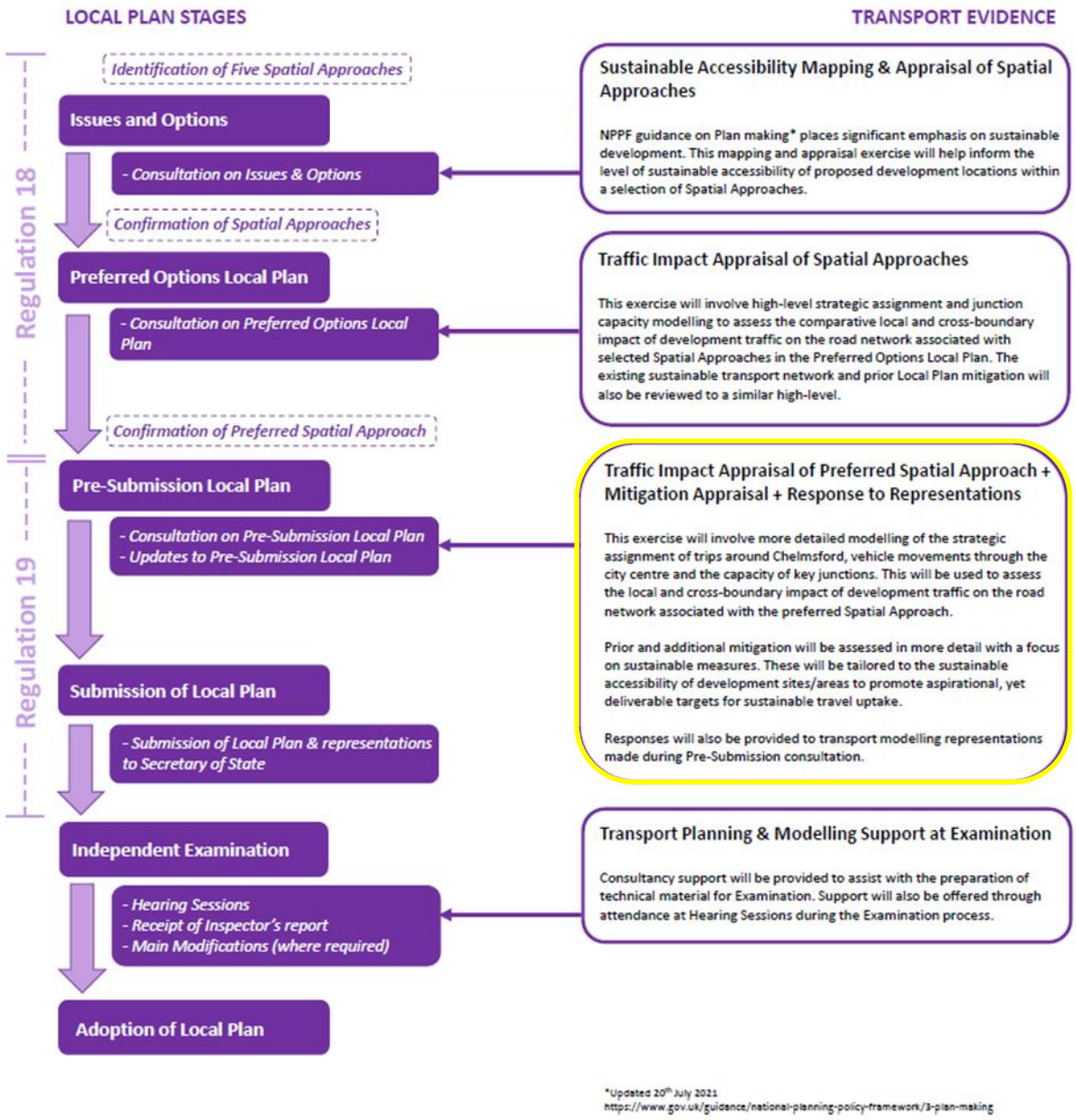

Figure 1-1: Transport evidence to support the various stages of the Local Plan Review

1.1.1 Objectives

As summarised in Figure 1-1, the objective of this study is to provide sufficient transport modelling evidence with which to inform CCC of the potential traffic impact of their preferred spatial approach and insight into the likely effectiveness of proposed infrastructure and/or sustainable measures to mitigate the impact of development traffic growth. Findings from the modelling will be used to inform the pre-submission consultation on the preferred spatial approach.

The study specifically looks at the following:

- The impact of additional development traffic on the future capacity of links and junctions on the strategic and local road network, at key junctions and across neighbouring authority boundaries.

- The effectiveness of mitigation measures proposed by developers of large, allocated development sites in Chelmsford – specifically Chelmsford Garden Community and Hammonds Farm.

- The impact of forecast traffic flows on the accessibility of passenger transport services and the network of bus priority infrastructure in Chelmsford.

2 Glossary of Terms

AM and PM peaks	The AM and PM peaks represent the two single hours with the largest volume of traffic observed across the AM period (before 11am) and the PM period (after 1pm), respectively. The AM and PM peaks used in this study are defined below: • AM peak hour (07:30-08:30) • PM peak hour (17:00-18:00)
Baseline	(For the purpose of this study) The forecast modelled scenario in 2041 without the latest proposed Local Plan development included.
Connectors	An accessory used in traffic models to connect zones to specific points on the road network where vehicle trips enter or exit the model.
Donor Zones	Zones in the model that have been used to represent the trip distribution for a new development zone.
Cordons	In the context of model calibration/validation, a cordon represents a partitioned area of the model. Modelled flows along strategic routes passing through the cordon are subject to calibration/validation against observed traffic count data.
Fixed Demand	Demand for peak hour travel that does not change to take account of congestion on the road network.
Local Model Validation Report (LMVR)	An LMVR documents the base-year traffic model build covering: network and development assumptions, build methodology and model calibration/validation statistics.
Model Calibration	In the development of base-year traffic models, calibration involves making adjustments to modelled demand (typically) in order to reduce the differences between modelled flows and observed data at cordon and/or screenline locations.
Model Matrices	A two-dimensional array where the rows and columns represent the origin and destination model zones respectively and the cell values are the vehicle trips between them. Matrices are created for different trip purposes and vehicular modes. Model matrices in this study represent vehicle rather than person trips.
Model Validation	This is the process of checking the robustness of the base-year traffic model by demonstrating its ability to replicate similar patterns to those observed. The data used for validation is separate from data used for calibration.
Model Zones	Zones are defined areas within the model that represent the origins and destinations of trips.
NTEM	National Trip End Model (NTEM) – produced by the Department for Transport, it uses a number of forecasts for population, employment and households by car ownership to

	forecast changes in trip ends (trips by origin and by destination). The results are viewed in software called TEMPro (Trip End Model Presentation Program).
PTV VISUM	An area-wide assignment modelling package used in this study to assess the impact of development traffic on the wider 'strategic' road network in and around Chelmsford.
Relative Queue Length	The queue of traffic on a junction approach calculated as a percentage of the length of the approach link in the model.
Screenlines	In the context of model calibration/validation, a screenline represents a line through an area of the model. Modelled flows along strategic routes passing across the screenline are subject to calibration/validation against observed traffic count data.
Strategic Modelling	The process of using a transport model to forecast transport demand and the assignment of traffic flows – typically across a wide-area modelled network at a 'strategic' or high level.
Transport Analysis Guidance (TAG)	TAG is guidance released by DfT which provides information on the role of transport modelling and appraisal.
TRICS	TRICS is the system of trip generation analysis for the UK and Ireland. The TRICS database contains over 8,000 transport surveys which can be filtered to help users establish potential levels of trip generation (trip rates) which are reflective of the size, location, and type of development they are proposing.
Trip End Model Presentation Program (TEMPro)	The TEMPro software allows users to view the National Trip End Model (NTEM) dataset and provides forecasts of the growth in background trips for use in modelling.
Variable Demand	Demand for peak hour travel that is adjusted to take account of congestion on the road network.
Volume/Capacity Ratio	A measure of the volume of trips across an hour on a road in relation to its available capacity.

3 Modelling Approach

3.1 Strategic Modelling

The traffic impact appraisal has been undertaken at a strategic scale using the latest 2019 version of the Chelmsford VISUM Forecast Model. This has recently been updated to strict DfT standards for use in the appraisal of design options for the Army & Navy Roundabout.

Two key documents have been produced which detail the latest model build:

- ***'Local Model Validation Report (LMVR) – Chelmsford Model Update – Essex Highways, April 2021'***. This report documents the improvements made to the 2019 base model and the subsequent recalibration and validation process. The document has been finalised and is available from Essex Highways.

- ***'Army & Navy Sustainable Transport Package: Stage 2 Forecasting Report – Essex Highways, September 2022'***. This report documents the development and infrastructure assumptions for Chelmsford included in a 2026 and 2041 forecast year for the purposes of assessing the future-year performance of the Army & Navy junction proposals.

Section 3.2 and 3.3 below provide a high-level summary of the Chelmsford VISUM Model base and forecast year builds. The documents highlighted above should be referenced for a more comprehensive awareness and understanding of the model development process; including calibration/validation and matrix/network build assumptions.

3.2 Chelmsford VISUM Base Model Overview

3.2.1 Model Overview

The Chelmsford model has been built using the latest PTV VISUM software version 2020 (this is an upgraded version of the same software as used in the previous versions of the Chelmsford Model build) and utilises the Intersection Capacity Analysis (ICA) module to enable detailed evaluation of junction performance and represent blocking back and queuing.

3.2.2 Study Area & Network Coverage

The Chelmsford VISUM base model has necessitated a relatively detailed model network in the urban centre of Chelmsford but also sufficient detail at the regional level to capture more strategic movements in traffic flows approaching Chelmsford. The model focuses on car-based travel, which includes P&R, but also considers the impact of development and infrastructure proposals on passenger transport (bus and rail) generalised costs and mode share.

The geographic coverage of the model includes the following:

- The Fully Modelled Area, made up of:
    - The Area of Detailed Modelling (AoDM) - consisting of the Chelmsford administrative area.
    - The rest of the Fully Modelled Area - consisting of the area surrounding the AoDM including Braintree to the north, the M11/A120 junction to the northwest, the A12/A120 junction to the northeast, Basildon to the south and Brentwood and the A12/M25 junction to the southwest.
- The External Area, including all of mainland UK outside of the Fully Modelled Area.

The Fully Modelled Area of the Chelmsford VISUM Model is shown in Figure 3-1 overleaf.

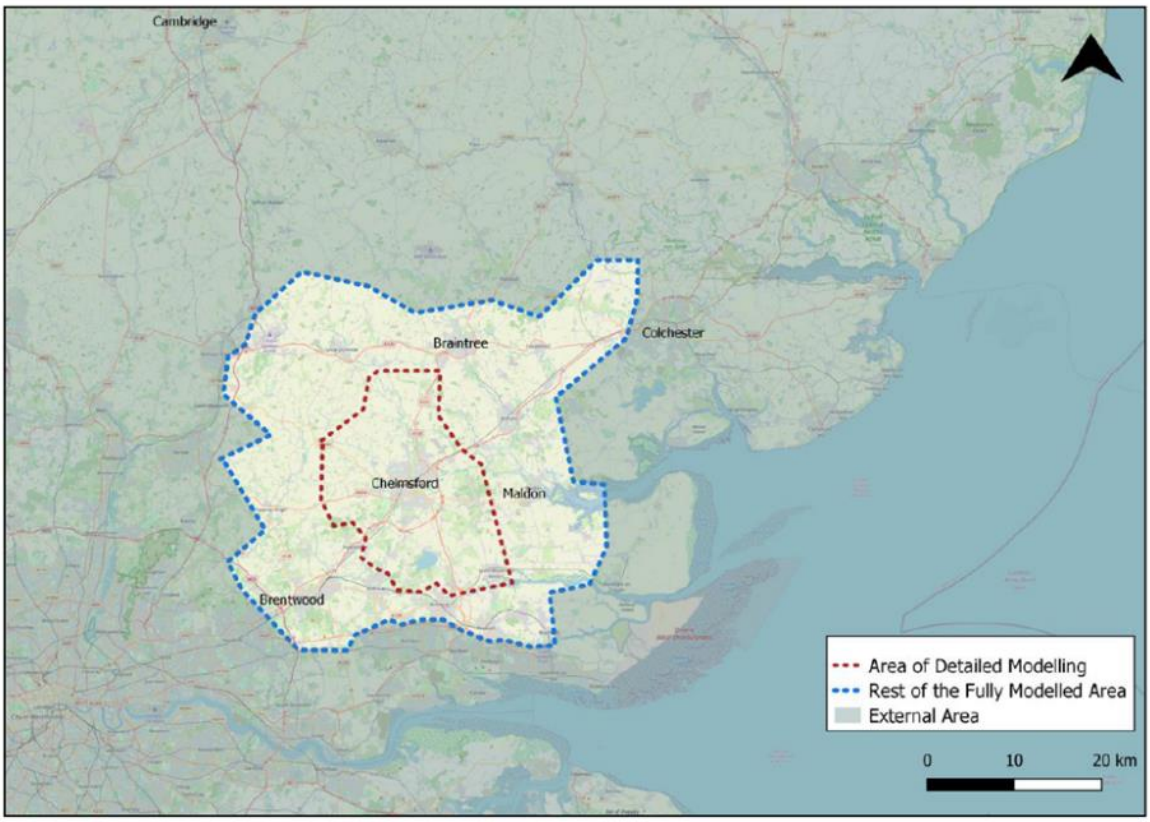

Figure 3-1: Chelmsford VISUM Model – Fully Modelled Area

As shown in Figure 3-1, the Chelmsford administrative area is located within the AoDM, which means that road links and junctions are modelled in more detail in terms of geometry and capacity, and with more granularity / depth of coverage. This detail increases further within the Chelmsford urban area. At the same time, the zone system used is increasingly detailed / granular when closer to the Chelmsford urban area, meaning that traffic is loaded onto the road network with greater precision.

In terms of model calibration and validation, the model is robustly representative of traffic flows and journey times in the Chelmsford urban area and on key strategic routes into the city. Figure 3-2 below illustrates the traffic flow screenlines and cordons used in the calibration and validation of the base model.

A separate calibration cordon can also be seen in north-east Chelmsford. This was introduced at the time of the Chelmsford North-East Bypass (CNEB) modelling appraisal in 2019 to ensure that alternative routes to the bypass were modelled accurately to provide a robust assessment of trip reassignment to the proposed new route.

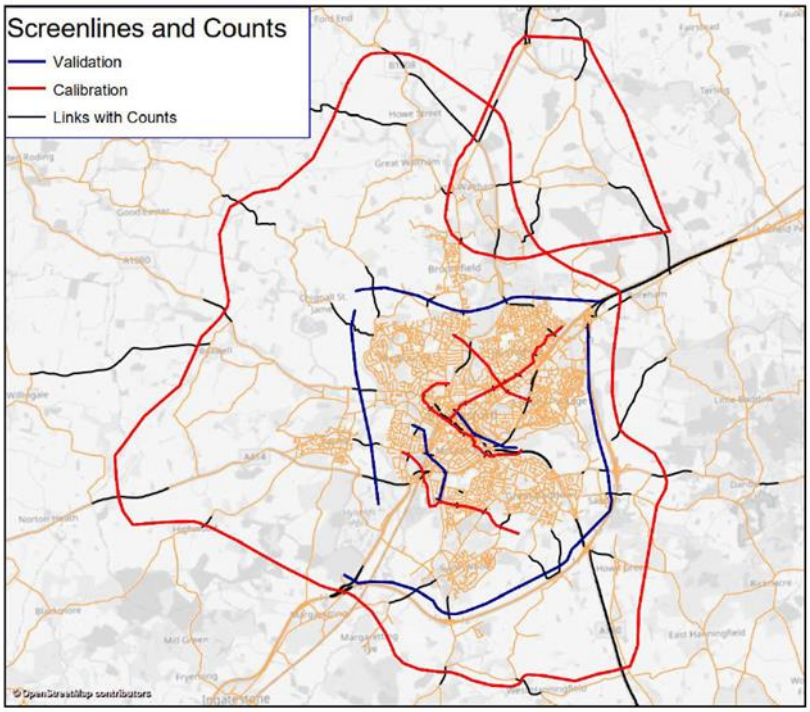

Figure 3-2: Cordons and screenlines used in 2019 base model calibration / validation

It should be noted that any assessment of development impact on the road network outside of the calibrated area of the model will need to be caveated or adapted to accommodate the limitations of the strategic model in these outer areas.

Furthermore, as is typical of large-scale strategic models, the Chelmsford VISUM Model is not validated to turning movements at junctions.

3.2.3 Time Periods

Demand modelling is undertaken at the 24-hour level while the assignment model was built to represent three weekday time periods as follows:

- AM peak hour (07:30-08:30);
- PM peak hour (17:00-18:00); and
- Average hour in the interpeak (10:00-16:00)

3.2.4 Variable Demand Modelling

An updated Variable Demand Model (VDM) was developed and tested as part of work to update the Chelmsford VISUM model to a 2019 base year. The VDM accounts for changes in travel behaviour – specifically the route taken, destination, and/or mode of travel choice due to a change in travel cost, through

traffic intervention or changes in travel demand, often a result of network congestion.

The development and testing of the VDM is covered in detail in both the LMVR and Forecasting Report.

VDM has not been used in this Local Plan review appraisal owing to the longer timescales required in obtaining model outputs. Instead, the appraisal makes use of a fixed demand approach, which provides a theoretical forecast of travel behaviour with costs remaining at base year levels. This approach is commensurate with the higher-level scope of assessment required at this stage of the Local Plan Review, and effectively presents scenarios approximating a 'worst-case'.

A single VDM run of the 2041 forecast model with the latest Local Plan assumptions included was initially run for the purposes of comparing traffic volumes against those from the fixed demand model runs. Outputs from the flow comparison are presented in Appendix D in this report, and show that VDM results in little overall change in peak hour traffic volumes across Chelmsford. However, owing to link capacity constraints along the A12, VDM is shown to reduce flows along the A12 by up to 250 vehicles southbound in the PM peak between Junctions 17 and 19.

The fixed demand approach used for the assessment of the preferred spatial approach is therefore considered suitable - subject to an awareness that, had VDM been used, traffic volumes along the A12 would likely have been supressed.

3.2.5 Park & Ride

A bespoke choice model has been developed to assess how future changes in car-based journey times impact on P&R demand. The validated base year P&R model (2019) – covering both Sandon and Chelmer Valley Park and Ride sites - is not linked to any wider transport model but rather developed as a standalone model based on observed journey times and demand. However, the model is designed such that its structure and the calibrated model parameters can be nested within the Chelmsford VISUM Model.

The proposed P&R to serve the west of Chelmsford (Widford P&R) is not included within the model as funding has not been identified, however it remains a key part of ECC's P&R strategy and a broad location has been identified in CCC's 'Strategic Policy S9 – Infrastructure Requirements'.

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For the purposes of this study, the P&R model has been run for the preferred spatial approach and the fixed demand matrices adjusted accordingly.

3.2.6 Notable changes since 2014 Base Model (used to model the adopted Local Plan)

A multi-modal strategic transport model for Chelmsford with a base year of 2014 was previously developed by Essex Highways to support the Local Plan process and Local Enterprise Partnerships (LEP) funding bids (Chelmsford City Growth Package, Chelmsford to Maldon). This was subsequently used in the Chelmsford North-East Bypass (CNEB) Housing Infrastructure Fund (HIF) bid support for ECC which was successfully awarded funds. The model was developed, calibrated, and validated following Transport Analysis Guidance (TAG).

However, it was identified that the model would need refinements in the context of current and future Army and Navy business case work for the DfT, and the CNEB planning application for ECC. In particular, these refinements pertain to the age of data used within all stages of model development, the extent of the model network, and network changes that have taken place since original validation, in particular the permanent closure/removal of the Army and Navy flyover.

The model update was of particular relevance to the Army and Navy junction, to enable representation of the junction with the flyover closed (the existing model was developed with the flyover open), and to CNEB, to extend the detailed model area further to the north and east of Chelmsford.

To provide the evidence base for a Planning Application for the CNEB and a potential outline business case for a scheme to improve the Army and Navy junction therefore required an update to the existing Chelmsford Model. This also provided an opportunity to feed any critical updates from past local studies (related to observed data or networks information) back to the Chelmsford Model in order to keep it up to date and increase its utility and quality in each subsequent application.

The latest Chelmsford VISUM Model has now been revalidated to 2019 traffic flows, representing average neutral weekday conditions during the period September to November of that year. A supplementary assessment has been developed, detailing the decision to continue using 2019 flows for the Chelmsford Local Plan Review. See section 3.3 below for more detail. The model has been updated to align with the latest DfT Databook (v1.17), with improvements made to both the robustness of model assignment and the representation of junction capacity across the wider network.

Further details on the base 2019 model calibration and validation can be found in the April 2021 LMVR.

3.3 Supplementary Technical Assessments

To support the modelling undertaken for Local Plan appraisal Evidence Base, three short technical notes have been included in Appendix A of this report documenting the methodology and findings from a series of desktop modelling studies, as follows:

- ***Appendix A1: TEMPro V7.2 and V8.0 Background Growth Comparisons***
    - Provides justification for the use of TEMPro V7.2 over the latest V8.0 datasets for the calculation of background growth in this study.

- ***Appendix A2: Pre and Post Covid-19 Traffic Flow Comparison***
    - Provides justification for the use of a 2019 validated base-year VISUM model as a platform for the forecast modelling in this study.

- ***Appendix A3: Low, Core and High Growth Scenarios***
    - Provides context around the potential variability in forecast model projections with which to view the findings of this study.

3.4 Chelmsford VISUM Forecast Model Overview

Two forecast years: 2026 and 2041 were modelled for the Army & Navy study. For now, the 2041 forecast year has been used for the Chelmsford Local Plan Review modelling – representing the end of the updated Plan review period.

3.4.1 2041 Baseline Model – Army & Navy Redesign and Other Infrastructure Assumptions

This study uses a version of the Chelmsford VISUM forecast model that includes the preferred 'hamburger' roundabout design at the Army & Navy junction following public consultation in August 2021.

Figure 3-3: Concept image of the Army & Navy Roundabout proposed 'hamburger' layout[3]

Alongside this key infrastructure proposal, the following additional infrastructure assumptions presented in the Army & Navy modelling study form the basis of a future year scenario for the Chelmsford Local Plan Review modelling:

- A12 Chelmsford to A120 widening scheme (as detailed in the July 2021 public consultation sponsored by National Highways)
- Lower Thames Crossing (sponsored by National Highways)
- Sheepcotes Roundabout A130-A131 left-turn filter (opened since 2019 base model) as part of the A131 Route Based Strategy

[3] Source: https://www.essexhighways.org/highway-schemes-and-developments/highway-schemes/chelmsford-schemes/army-and-navy-taskforce

- Boreham Interchange (A12 J21) improvements (as detailed in June 2023 consultation with signal timings from National Highways modelling)
- Radial Distributor Road (RDR) & Northern Radial Distributor Road (NRDR)
- Chelmsford North East Bypass (CNEB)
- Beaulieu Park Rail Station
- Expansion of Sandon P&R site by 350 spaces
- Expansion of Chelmer Valley P&R site by 500 spaces

More detail on the specifics of the modelled schemes can be found in the September 2022 forecasting report and the following sections below.

3.4.2 Boreham Interchange (A12 Junction 19)

Latest Boreham Interchange designs and signal timings produced by National Highways and published as part of the A12 Chelmsford to A120 widening scheme Development Consent Order (DCO) June 2023, were incorporated into the latest Chelmsford VISUM forecast model. The proposed layout is shown in Figure 3-4.

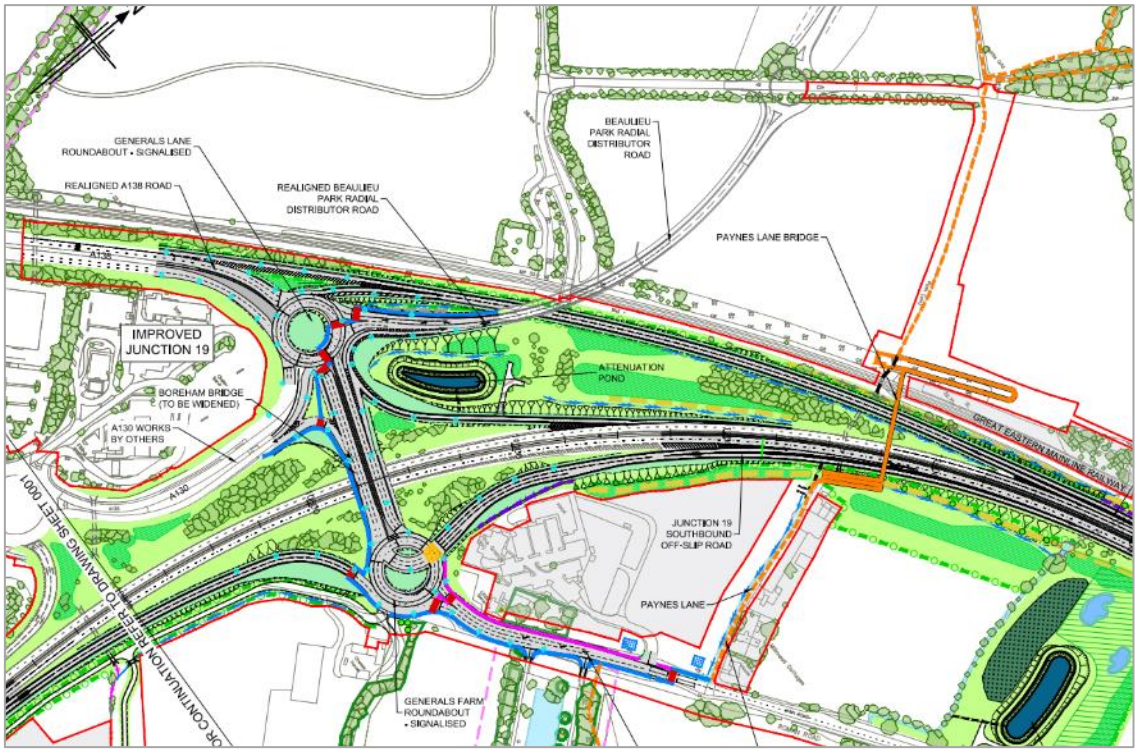

Figure 3-4: Latest National Highways proposals for the Boreham Interchange[4]

[4] Source: https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/TR010060/TR010060-002612-National%20Highways%20-%202.9%20General%20Arrangement%20Plans%20-%20Part%202.pdf

The proposed changes include:

- Controlled crossings at both Generals Lane Roundabout and Boreham Roundabout.
- Signalisation of Generals Lane Roundabout.
- Widening of Boreham Bridge.
- Realignment of Beaulieu Park RDR and the A138.

3.4.3 Chelmsford North-East Bypass

The proposed layout of the CNEB is shown in Figure 3-5 overleaf. When fully built, the expectation is that the scheme will include a single-lane carriageway connecting the RDR to a new junction on the A131 Braintree Road at Chatham Green. An at-grade roundabout will provide a connection to the NRDR. The section of the A131 between the Chatham Green junction and Deres Bridge junction will also be dualled.

As of December 2023, it is understood that proposals for the CNEB have been revised such that only Section 1A of the route with linkage to the NRDR is likely to be constructed by 2041. These latest scheme proposals have therefore been incorporated into the modelling of the preferred spatial approach. The modelled extent of the CNEB and NRDR is highlighted in blue in Figure 3-5.

3.4.4 Howe Green

Given the focus on junctions along the A12 corridor, the existing layout of Howe Green (A12 J17) – as well as Sandon (A12 J18) have been reviewed as part of this study. Through this, it has been noted that the A12 southbound off-slip at Howe Green was redesigned in 2022 with a reduction in the number of approach lanes from three to two. This change has been incorporated into the latest modelling.

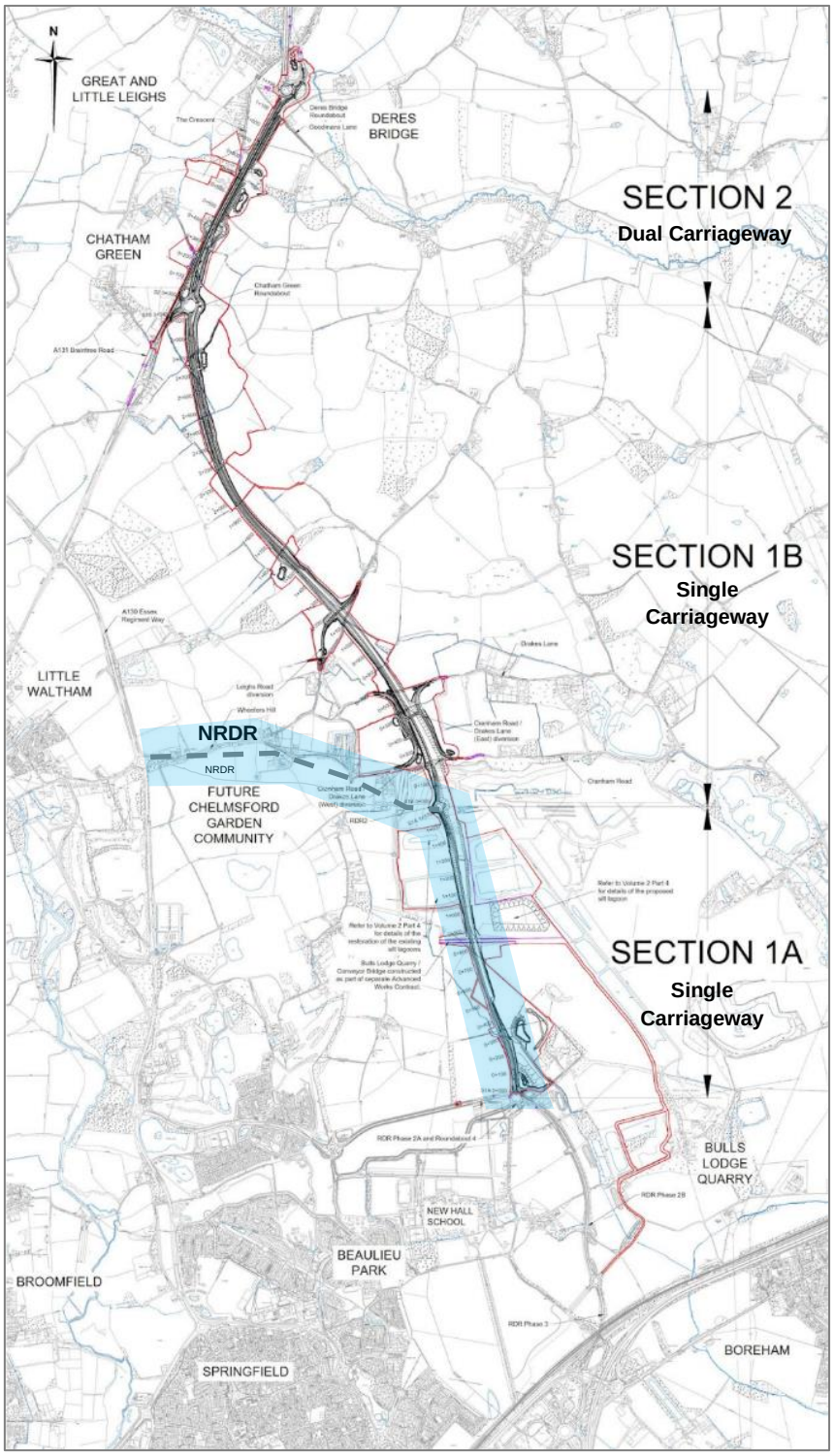

Figure 3-5: Chelmsford North-East Bypass proposed design[5] - Section 1A & NRDR shown in blue

[5] Source: https://www.essexhighways.org/highway-schemes-and-developments/highway-schemes/chelmsford-schemes/chelmsford-north-east-bypass

3.4.5 2041 Baseline Model - Planning and Overall Growth Assumptions

Housing and employment data within the Chelmsford Administrative Area is based on planning data (applications and permissions) confirmed by Chelmsford City Council in summer 2020. Additional sites were added from the approved Chelmsford Local Plan (May 2020).

Housing numbers and employment land use data (e.g. gross floor areas by type), were collated for the model forecast years. Where build-out projections for developments (e.g. Great Notley and Braintree) were not available, a linear trajectory for housing and employment delivery was assumed. This also included brownfield sites and windfall development within the Chelmsford Administrative Area.

The majority of the new housing and jobs allocated during the Local Plan period is located in the specific growth areas as identified under Strategic Policy S7 The Spatial Strategy in the adopted Chelmsford Local Plan[6], those being North Chelmsford, with 4,793 houses (Growth Area 2) and in the central urban area of Chelmsford, with 2,381 houses (Growth Area 1 site 1), making up 75% of all new housing allocations.

A list of developments included in the original forecast model can be found in the Army and Navy forecasting report.

Due to the large number of housing and employment sites built or proposed since 2019 in the Chelmsford Administrative Area, a filtered list of sites to model specifically was determined as follows:

- Housing developments of 50 dwellings or more;
- Class E (previously B1) 'Office Development' with 10,000m² Gross Floor Area (GFA) or more;
- B2 use class 'Industrial Estate' with 1,500m² Gross Floor Area or more;
- B8 use class 'Warehousing' with 5,000m² Gross Floor Area or more;

Smaller sites were then accounted for in general background growth calculations, with overall growth constrained to National Trip End Model (NTEM) assumptions.

3.4.6 Changes to Adopted Local Plan Development Assumptions – 2024 Update

Along with the latest development allocations for the preferred spatial approach, CCC also provided an update (as of January 2024) on development allocations

[6] Source: https://www.chelmsford.gov.uk/media/fvfjkf0i/chelmsford-adopted-local-plan-may-2020-text-only.pdf#page=52

for existing Local Plan sites to be included in the 2041 baseline modelling. These are shown in Table 3-1 below.

Location	Site Name	Total Allocation (No. of dwellings)
Growth Area 1		
City Centre	Former Gas Works Wharf Road Chelmsford	450
	Lockside Navigation Road Chelmsford	130
	Baddow Road Car Park and Land to the East	190
	Travis Perkins Navigation Road Chelmsford	75
	Navigation Road sites Chelmsford	35
	Former St Peter's College Fox Crescent	185
	Riverside Ice and Leisure Land Victoria Road Chelmsford	150
	Civic Centre Land Fairfield Road Chelmsford	100
	Land West of Eastwood House Glebe Road Chelmsford	197
	Ashby House Car Parks New Street Chelmsford	80
	Chelmsford Social Club	29
	Rectory Lane Car Park West Rectory Lane Chelmsford	75
	Former Chelmsford Electrical and Car Wash Brook Street	40
	BT Telephone Exchange Cottage Place Chelmsford	30
	Rectory Lane Car Park East Rectory Lane Chelmsford	23
	Waterhouse Lane Depot and Nursery Chelmsford	20
	Site at Play Area Woodhall Road Chelmsford	12
	British Legion New London Road Chelmsford	15
	Land rear Of 17-37 Beach's Drive Chelmsford	18
	Garage Site St Nazaire Road Chelmsford	12
	Garage Site and Land Medway Close Chelmsford	6
	Car Park R/O Bellamy Court Broomfield Road Chelmsford	10
Writtle	Land Surrounding Telephone Exchange Ongar Road Writtle	25
West Chelmsford	West Chelmsford	880
East of Chelmsford	East of Chelmsford - Manor Farm	360
	East of Chelmsford - Land South and North of Maldon Road	174
Galleywood	Land north of Galleywood Reservoir Beehive Lane Galleywood	24
Growth Area 2		
North East Chelmsford	Chelmsford Garden Community Zone 1 Pratts Farm Lane Little Waltham Chelmsford	1500
	Chelmsford Garden Community Zone 2	3500
	Chelmsford Garden Community Zone 3 Beaulieu Parkway Chelmsford	1250
Great Leighs	Great Leighs - Land at Moulsham Hall	750
	Great Leighs - Land East of London Road	190
	Great Leighs - Land North and South of Banters Lane	100
North of Broomfield	North of Broomfield	512
Growth Area 3		
North of South Woodham Ferre	Land North West of Hamberts Farm Bunham Road South Woodham Ferrers Chelmsford	1020
	Land North of South Woodham Ferrers Burnham Road South Woodham Ferrers Chelmsford	200
Bicknacre	South of Bicknacre	42
	St Giles Bicknacre	32
Danbury	Danbury	100

Location	Site Name	Total Allocation (floorspace m2)
Growth Area 1		
Great Baddow	East of Chelmsford - Land north of Maldon Road	5,000
Growth Area 2		
North East Chelmsford	North East Chelmsford	45,000
Growth Area 3		
South Woodham Ferrers	North of South Woodham Ferrers	1,200
Committed Development (separate to growth areas)		
Springfield	Greater Beaulieu Park White Hart Lane Springfield Chelmsford	62,300

Table 3-1: Revised development allocations on adopted Local Plan sites including in the modelled baseline scenario

In keeping with the modelling assumptions outlined in Section 3.4.5, sites of less than 50 dwellings (greyed out in Table 3-1) were not specifically included in the 2041 baseline modelling and were instead treated as part of background growth.

3.4.7 Beaulieu Park Rail Station

Beaulieu Rail Station is expected to generate what is described either as rail-heading or rail-based Park & Ride behaviour, characterised by trips which use

private transport for the home to station legs and rail for the station to destination legs. The additional mixed mode trips expected as well as the change in rail station usage cannot be modelled directly in the Chelmsford VISUM model and is therefore estimated independently using a bespoke external rail mode, specifically:

The external rail model determines:

- The number of newly generated trips (which did not previously use other stations); and
- The number of trips which are abstracted from other stations.

The final output from this process is a series of adjustment matrices by purpose and time period that represent the change in demand between the ‘with’ and ‘without’ Beaulieu Park station scenarios. These adjustment matrices are applied to the Park & Ride model matrices to be used in the final VISUM model assignment runs.

For the purposes of this study, the rail model was run for each assessed spatial approach and the fixed demand matrices adjusted accordingly.

4 Preferred Spatial Approach Modelling 2036-2041

4.1 Proposed Development Allocations

Development allocations associated with the preferred spatial approach were confirmed with Chelmsford City Council in January 2024 and are shown in Table 4-1 below. These are sites in addition to those already allocated in the adopted Local Plan.

It should be noted that at the time this modelling was carried out the preferred spatial approach included an allocation of 43,000 sqm of employment space at the E2V Teledyne site in Chelmsford Urban Area. This site has subsequently been removed from the Council's preferred spatial approach but remains in this modelling. The conclusions of this report should therefore be read in this context.

Site Name	Residential (units)	Employment (sqm)			
		Office	Research and Industrial	General Industrial	Warehousing
Growth Area 1					
Meadows Shopping Centre and Meadows Surface Car Park	350	-	-	-	-
Former Kay-Metzeler premises, Brook Street	185	-	-	-	-
Land between Hoffmans Way and Brook Street (Marriages Mill)	100	-	-	-	-
Granary Car Park	60	-	-	-	-
Coval Lane Car Park	40	-	-	-	-
Glebe Road Car Park	12	-	-	-	-
E2V Teledyne	-	21500	-	21500	-
Additional Employment (Unallocated) Site 1 - Victoria Road	-	1333	-	-	-
Additional Employment (Unallocated) Site 2 - Glebe Road	-	1333	-	-	-
Additional Employment (Unallocated) Site 3 - Navigation Road	-	1333	-	-	-
Growth Area 1 - Total	**747**	**25499**	**0**	**21500**	**0**
Growth Area 2					
Land West of Back Lane, Ford End	20	-	-	-	-
Land South of Ford End Primary School, Ford End	20	-	-	-	-
Boreham, Waltham Road	-	-	-	1750	1750
Little Boynton Hall Farm	-	-	-	3000	3000
Chelmsford Garden Community	-	302	3265	-	8379
Growth Area 2 - Total	**40**	**302**	**3265**	**4750**	**13129**
Growth Area 3					
East Chelmsford Garden Community (Hammonds Farm)	3000	14333	14333	14333	-
Land adjacent to A12, Junction 18	-	4669	12777	12777	12777
Land at Kingsgate, Bicknacre	20	-	-	-	-
Lane west of Barbrook Way, Bicknacre	20	-	-	-	-
Land north of Abbey Fields, East Hanningfield	15	-	-	-	-
Land east of Highfields Mead, East Hanningfield	20	-	-	-	-
Growth Area 3 - Total	**3,075**	**19002.33**	**27110.33**	**27110.33**	**12777**
Preferred Spatial Approach Total	**3,862**	**44,803**	**30,375**	**53,360**	**25,906**
		154,445			

Table 4-1: Housing and employment allocations modelled for the preferred spatial approach

4.1.1 Forecast Model Zone Updates

Separate new zones were included in the forecast model for housing and employment (office and/or business/industrial) development at each location proposed. A list of new zones has been included in Appendix B of this report.

4.1.2 Forecast Model Zone Connector Updates

Appendix B of this report documents the assumed development access points to the local road network and, where multiple access points were identified, the proportional split of development trips assigned to the access points. Assumptions were confirmed with CCC Officers prior to the updating of the forecast model network.

Where near key impacted junctions, zone connectors were attached to access road 'stubs' served by dedicated development access junctions. For development located in more outer, rural locations where network capacity was not expected to be of concern, zone connectors were loaded directly onto main road links.

4.1.3 Development Trip Generation

Trips associated with the specific Local Plan housing and employment development over the period 2036-2041 were included in the 2041 forecast year Chelmsford Model, replacing generalised TEMPro based growth assumptions used for the recent Army & Navy modelling.

Trip rates used in the calculation of development trips were largely kept consistent with the peak period average hour rates used in previous Chelmsford forecast modelling. However, B2/B8 industrial trip rates were added for this study, calculated from data in TRICS version 7.10. Trip rates used can be found in Table 4-2 below.

		Arrivals Trip Rates			Departures Trip Rates		
Land Use Type	Unit	AM	IP	PM	AM	IP	PM
C3 Residential Mixed Private / Affordable Houses	Per Dwelling	0.094	0.115	0.215	0.216	0.12	0.117
B1a Office	Per 100sqm	0.553	0.113	0.082	0.096	0.121	0.702
B1a Business Park	Per 100sqm	0.907	0.183	0.105	0.118	0.23	1.236
B2/B8 Industrial	Per 100sqm	0.211	0.153	0.080	0.105	0.173	0.145

Table 4-2: Development trip rate assumptions

It should be noted that the trip rates used in the Chelmsford forecast modelling are comparatively 'low', and account for a reasonable level of trip-internalisation (i.e. trips made *within* larger development sites) and a good level of sustainable and active travel mode-share.

Detail of the calculated development trips for the preferred spatial approach can be found in Appendix C of this report, whilst a summary can be found in Table 4-3 below.

Chelmsford Local Plan Review Development Sites	AM		PM	
	Origins	Destinations	Origins	Destinations
Glebe Road Car Park	3	1	1	3
Granary Car Park	13	6	7	13
Kay-Metzeler brownfield Site	40	17	22	40
Land between Hoffmans Way and Brook Street (Marriages Mill)	22	9	12	22
Coval Lane Car Park	9	4	5	9
Meadows Shopping Centre Brownfield Site	75	33	41	75
E2V Teledyne Brownfield Site	43	164	182	35
Additional Employment (Unallocated) - Site 1 (Victoria Road)	1	7	9	1
Additional Employment (Unallocated) - Site 2 (Glebe Road)	1	7	9	1
Additional Employment (Unallocated) - Site 3 (Navigation Road)	1	7	9	1
Bicknacre - New	9	4	5	9
Ford End	9	4	5	9
East Hanningfield	8	3	4	8
East Chelmsford Garden Community (Hammonds Farm)	696	572	726	686
NEC Garden Community	13	51	56	10
Boreham EA	4	8	6	2
Little Boyton Hall Farm	6	12	8	4
Land adjacent to A12 Junction 18	48	212	253	38
TOTAL TRIPS GENERATED	**1000**	**1122**	**1360**	**964**

Table 4-3: Summary of calculated development trips for the preferred spatial approach

4.1.4 City Centre Brownfield Sites + Change in Land-Use

Table 4-4 below details the brownfield sites identified by CCC for inclusion in the modelling for the Chelmsford Urban Area. Unallocated employment was split evenly across sites in Chelmsford known to be focus areas for recent and upcoming redevelopment.

Location Name	Site Name	Residential No. of Dwellings	Employment Floorspace
Chelmsford Urban Area (Residential Sites) - Previously developed sites in Chelmsford Urban Area	Meadows Shopping Centre and Meadows Surface Car Park	350	-
	Former Kay-Metzeler premises, Brook Street	185	-
	Land between Hoffmans Way and Brook Street (Marriages Mill)	100	-
	Granary Car Park	60	-
	Coval Lane Car Park	40	-
	Glebe Road Car Park	12	-
Chelmsford Urban Area (Employment Sites) - Previously developed sites in Chelmsford Urban Area	E2V Teledyne	-	43000
Additional employment allocation (4000sqm) - To be allocated at sites across the city centre	Additional Employment (Unallocated) Site 1 - Victoria Road	-	1333
	Additional Employment (Unallocated) Site 2 - Glebe Road	-	1333
	Additional Employment (Unallocated) Site 3 - Navigation Road	-	1333

Table 4-4: Brownfield residential Local Plan development in Chelmsford Urban Area

Trips associated with existing land-uses on brownfield sites in Chelmsford, were removed from the baseline forecast matrices by estimating the gross floor area of the existing land use and determining existing trip generation via use of the trip rates shown in Table 4-2.

4.2 Development Trip Distributions

4.2.1 Donor Zones

The trip distributions for new development zones modelled for either adopted Local Plan sites or proposed Local Plan Review sites, were taken from nearby 'donor zones'. 'Donor zones' are zones already present in the model that have been used to represent the trip distribution for a new development zone. Care was taken to ensure that selected donor zones were in reasonable geographic proximity to the corresponding new Local Plan zones, and that the quantum of development and make-up of land-uses in the donor zone were reasonably representative.

Following a review of modelling assumptions since the previous assessment of selected spatial approaches, the donor zones used for the preferred spatial approach have been updated. Appendix B provides more detail on the donor zones used.

4.2.2 Trip Distribution Analysis

The selection of plots below demonstrate the modelled distribution of trips to and from donor zones used in the modelling of the Local Plan preferred spatial approach.

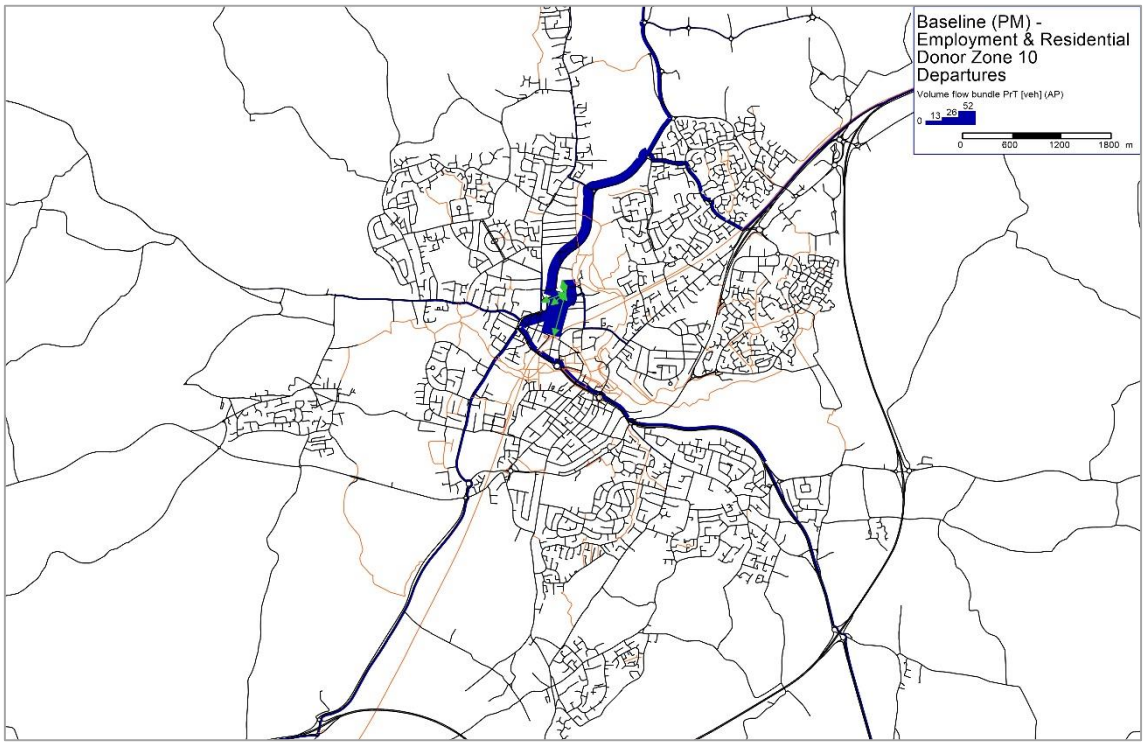

Figure 4-1: Distribution of AM Peak departure trips from ARU and Rectory Lane (Donor Zone 10)

Figure 4-1 illustrates the AM Peak modelled assignment of trips from the Anglian Ruskin University (ARU) campus and Rectory Lane housing – serving as a donor zone for the distribution of high-density urban housing trips to/from Local Plan development in the city centre. Arrivals in the PM peak have a matching distribution (in reverse).

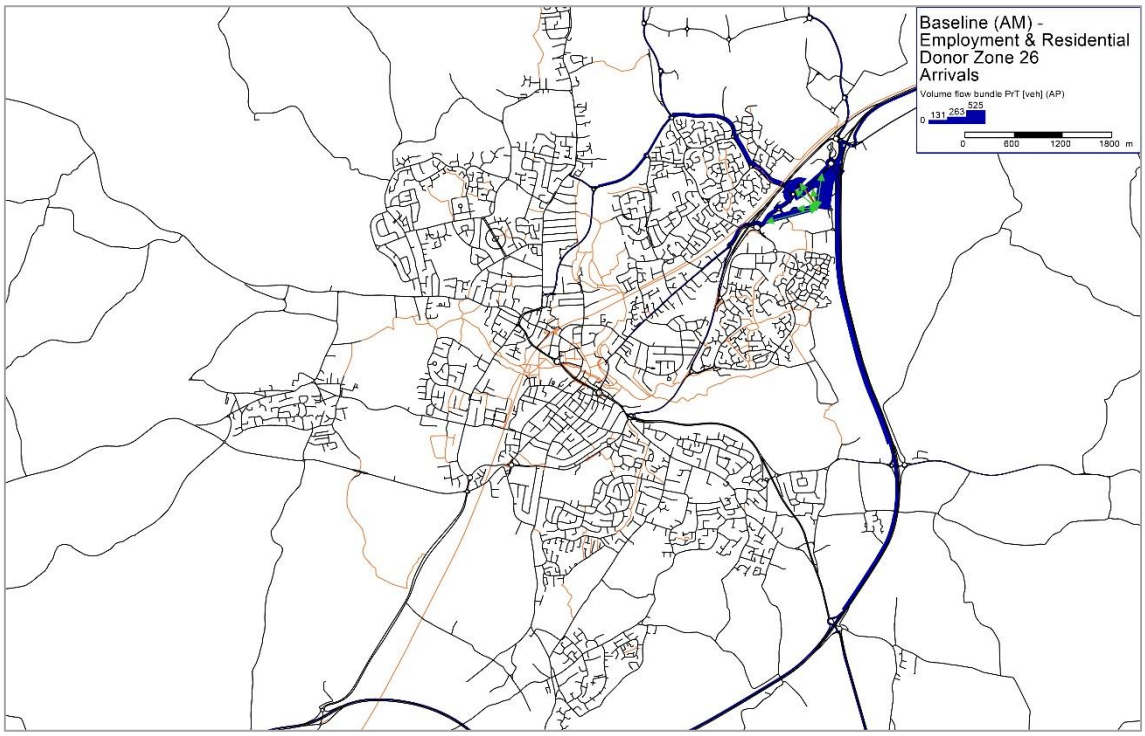

Figure 4-2: Distribution of AM Peak employment arrival trips to Springfield Business Park (Donor Zone 26)

Figure 4-2 illustrates the AM Peak modelled assignment of employment trip arrivals to the Springfield Business Park - serving as a donor zone for the distribution of employment trips to/from Local Plan development in north-east Chelmsford and along the A12 corridor. Departures in the PM peak have a matching distribution (in reverse).

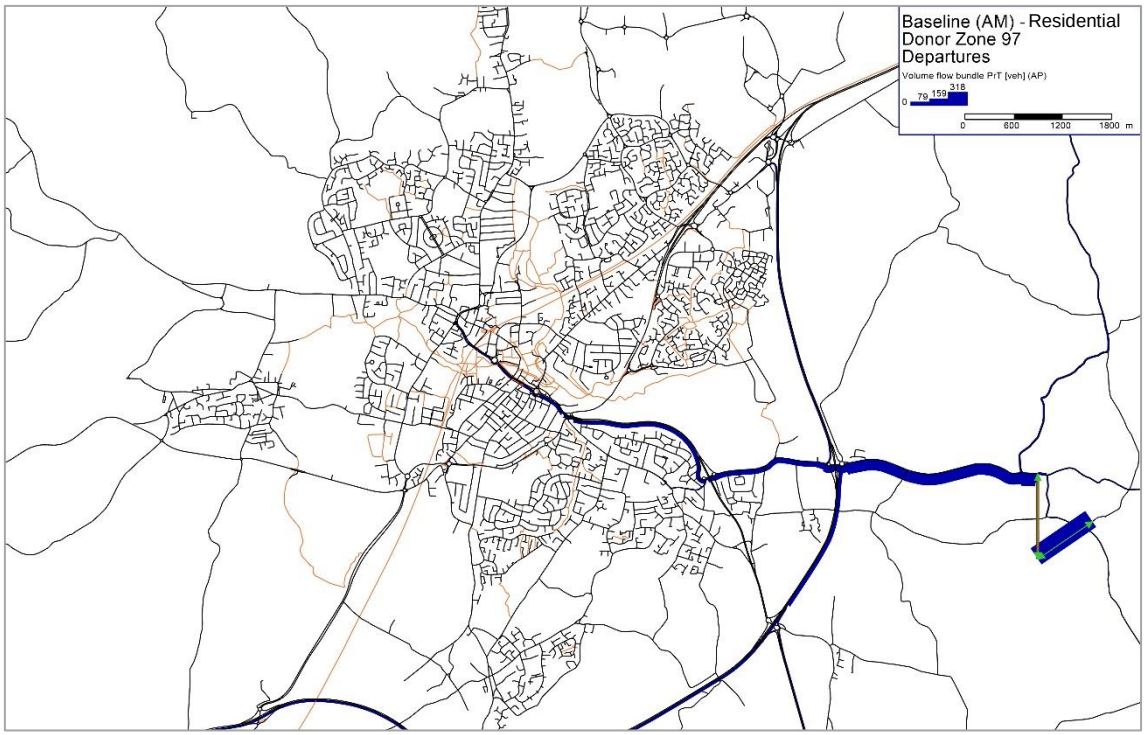

Figure 4-3: Distribution of AM Peak residential departure trips from Danbury (Donor Zone 97)

Figure 4-3 illustrates the AM peak modelled assignment of residential trip departures from Danbury – serving as a donor zone for the distribution of residential trips from the Hammonds Farm development. Arrivals in the PM peak have a matching distribution (in reverse).

Overall, the selected donor zones in the Chelmsford VISUM model can be seen to provide a reasonable and broadly representative distribution pattern of trips for both arrivals and departures to/from residential and employment zones in Chelmsford.

4.3 Proposed Development Access Assumptions Modelled

Section 4.1.2 and Appendix B of this report document the access assumptions modelled for the new Local Plan sites, based around the use of zone connectors. The following sections of this report provide further detail on the specific access assumptions modelled for two of the larger proposed development sites – Hammonds Farm and Chelmsford Garden Community.

4.3.1 Hammonds Farm Access

Current proposals for the Hammonds Farm site include a spine road through the development between a site access from the A414 Maldon Road to the south and Generals Farm Roundabout at the Boreham Interchange to the north. As this is

not intended to be a through-route for general traffic, the spine road was not specifically modelled. However, to ensure the operation of Generals Farm Roundabout was modelled as accurately as possible, a further roundabout arm was added, serving exclusively as a development access point.

To the south of the development, an existing priority junction on the A414 was updated in the forecast model, serving as the development access, with efforts made to ensure that the junction had a reasonable level of capacity to accommodate development trips.

There are also developer proposals for a new bridge link over the A12 providing alternative access to the development from Maldon Road on the west side of the A12. It has been agreed with ECC/CCC that this should serve as a walking, cycling and bus-only access link and has therefore not been included in the modelling as an access route for cars/private vehicles.

4.3.2 Chelmsford Garden Community Access

The developer consortium for the Chelmsford Garden Community (CGC) have provided detail on access and infrastructure proposals for the development in their Development Framework Document agreed by CCC Cabinet as of January 2023[7] with further detail subsequently provided in their outline planning applications, which are currently under consideration.

The development makes use of the RDR and NRDR as well as the CNEB – which are both present in the Chelmsford Forecast Model - and also includes a network of local access roads and junctions. Given the strategic nature of the modelling, and an expectation that developer access junctions will be built on robust designs and with sufficient capacity, the local roads associated with the development have been represented in the model with zone connectors alone.

The latest version of the Chelmsford Forecast Model used for this study includes the detailed access arrangements proposed by developers for the CGC as well as an agreed distribution of development trips to/from each access point onto the existing and proposed road network in north-east Chelmsford.

Figure 4-4 shows the development zones comprising the CGC as well as the proposed access points and road infrastructure to help accommodate the development trips.

[7] https://www.chelmsford.gov.uk/media/vsxh3m1i/chelmsford-garden-community-development-framework-document-january-2023.pdf

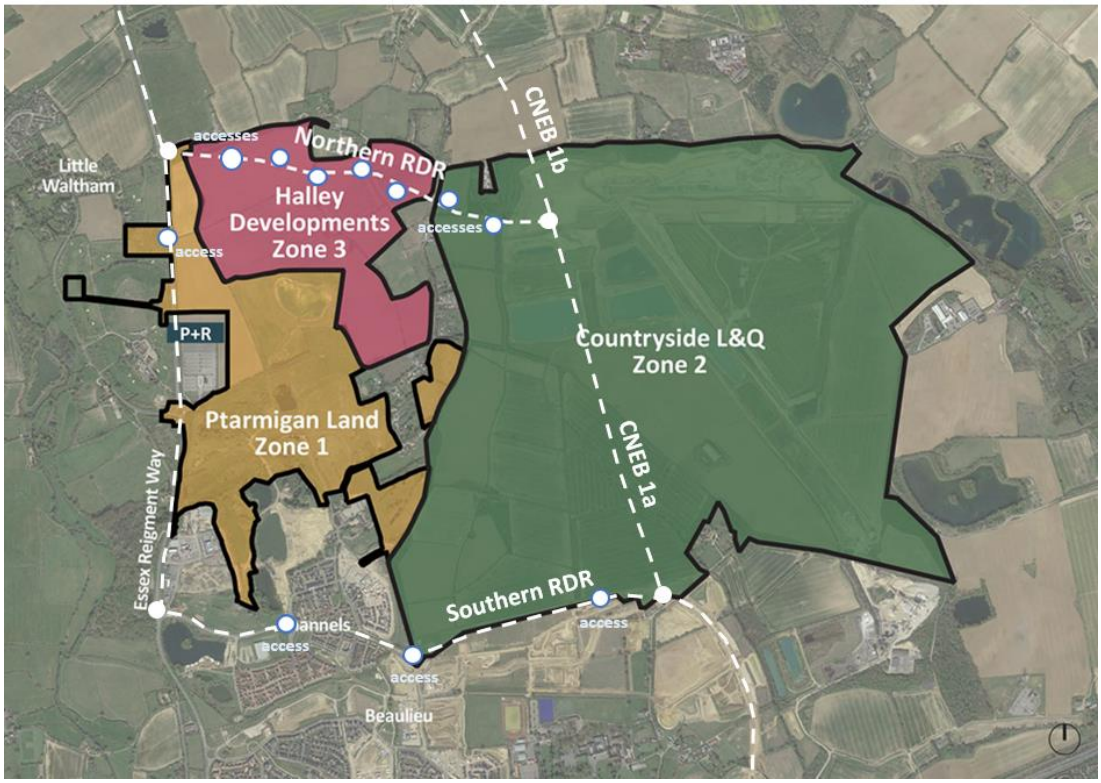

Figure 4-4: Chelmsford Garden Community modelled access points

5 Model Outputs and Analysis

The following section provides analysis of the model outputs produced for the appraisal of the preferred spatial approach. Whilst not all outputs produced have been included for analysis, for reasons outlined within each sub-section below, those shown illustrate the key findings of the modelling work undertaken.

Outputs presented cover two modelled scenarios:

Baseline – This includes traffic flows up to 2036, including trips generated by adopted Local Plan development. It also includes external (outside of Chelmsford) trip-end growth between 2036 and 2041, and traffic growth factors to account for fuel price and income change over time.

Preferred Spatial Approach – This scenario adds the trips associated with the Local Plan review Preferred Spatial Approach to the traffic flows included in the baseline.

5.1 Assignment of Development Trips

Figures 5-1 to 5-7 show the assignment of trips across the network to and from the main development sites in the preferred spatial approach in the AM peak. For this analysis, plots have only been shown for the AM peak, as the distribution follows the same pattern in the PM peak - but in the opposite direction.

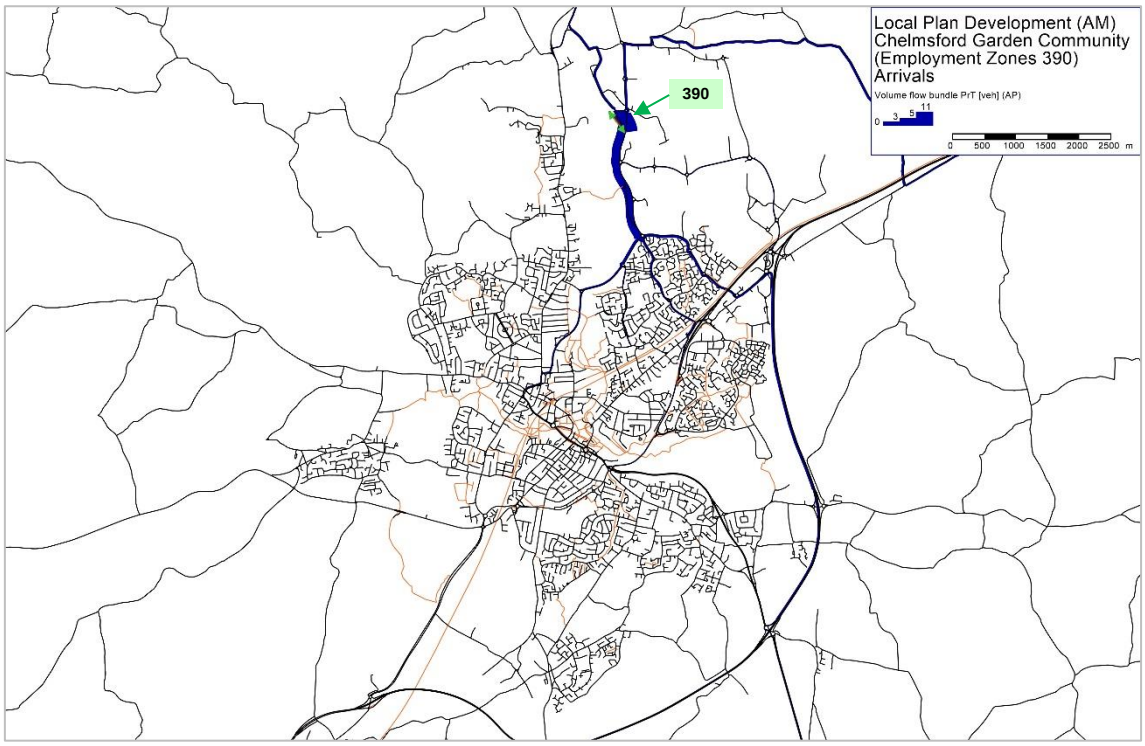

Figure 5-1: Development Trip Assignment for Chelmsford Garden Community (Employment) - AM Arrivals (zone location and ID shown in green)

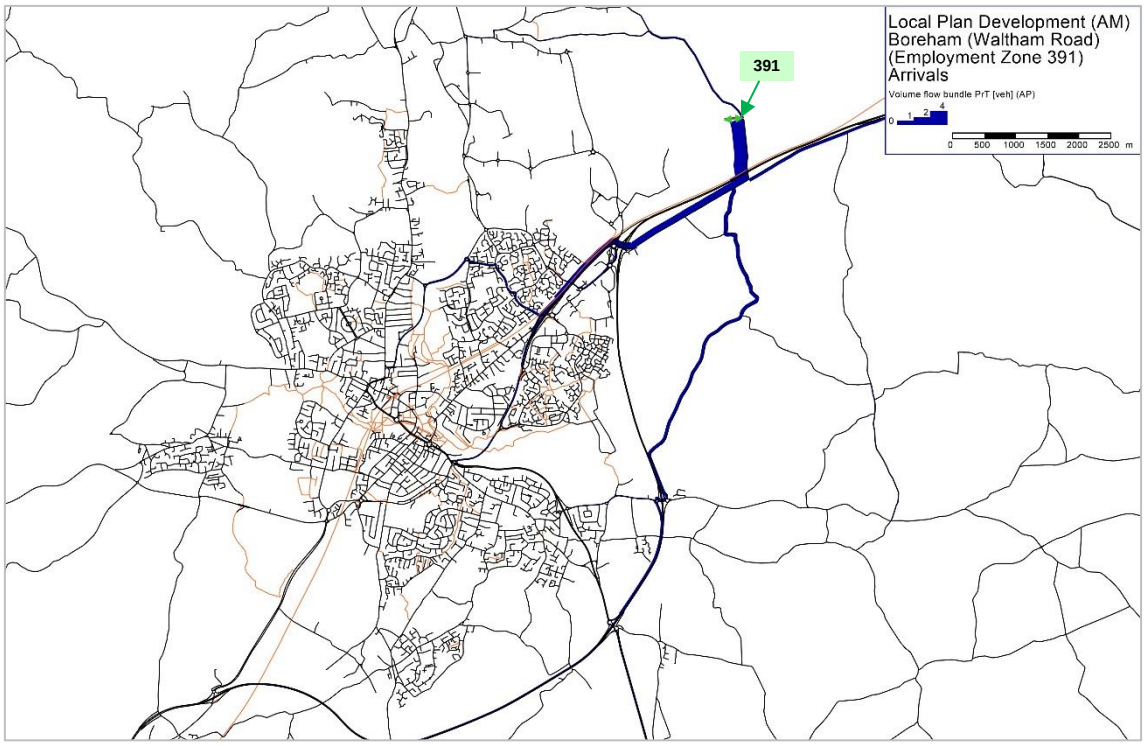

Figure 5-2: Development Trip Assignment for Boreham Employment Area - AM Arrivals (zone location and ID shown in green)

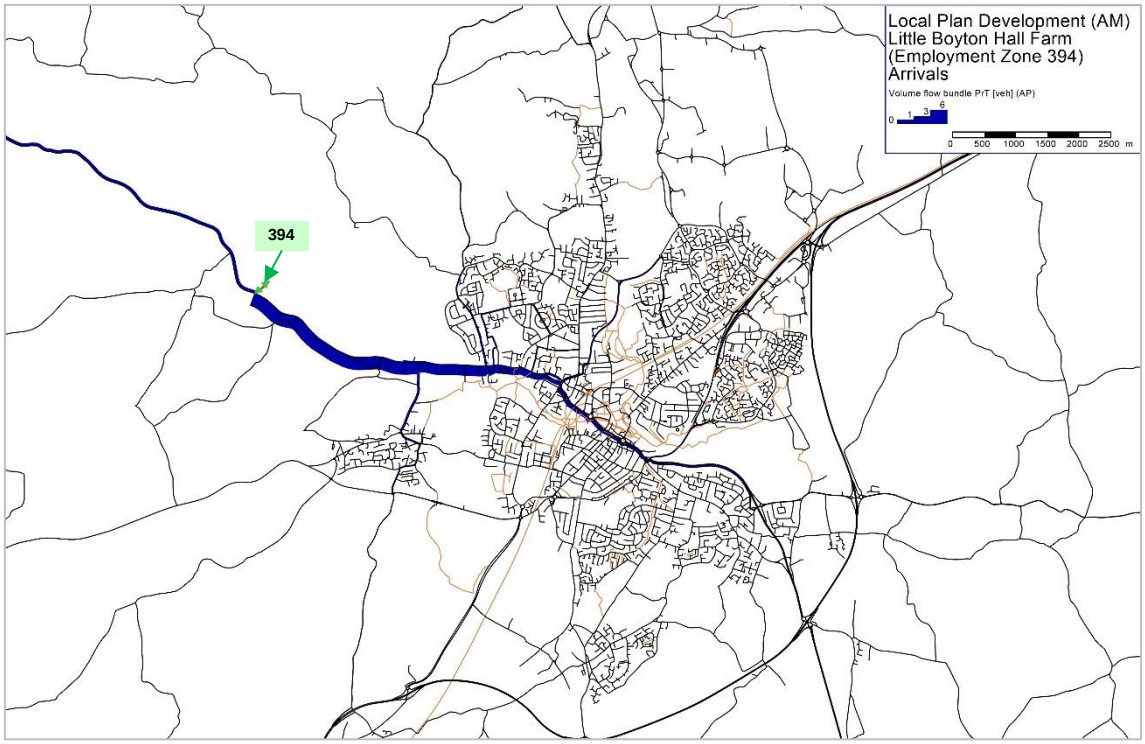

Figure 5-3: Development Trip Assignment for Little Boyton Hall Farm (Employment) - AM Arrivals (zone location and ID shown in green)

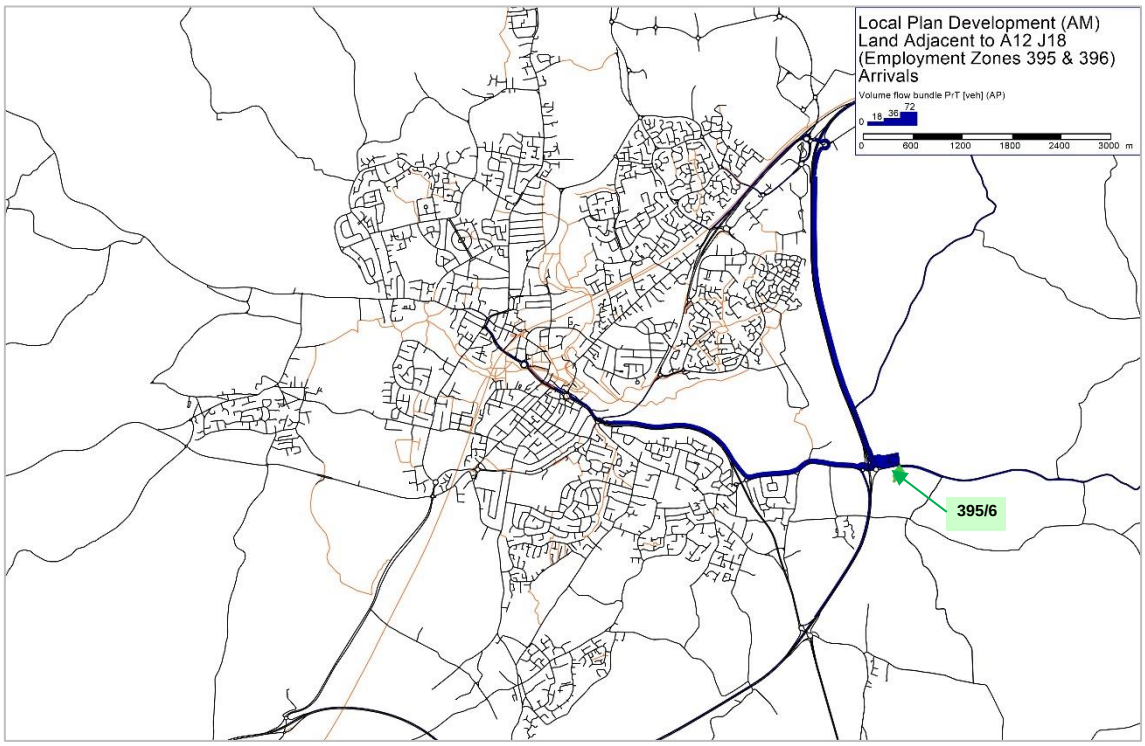

Figure 5-4: Development Trip Assignment for Land Adjacent to the A12 J18 (Employment) - AM Arrivals (zone location and ID shown in green)

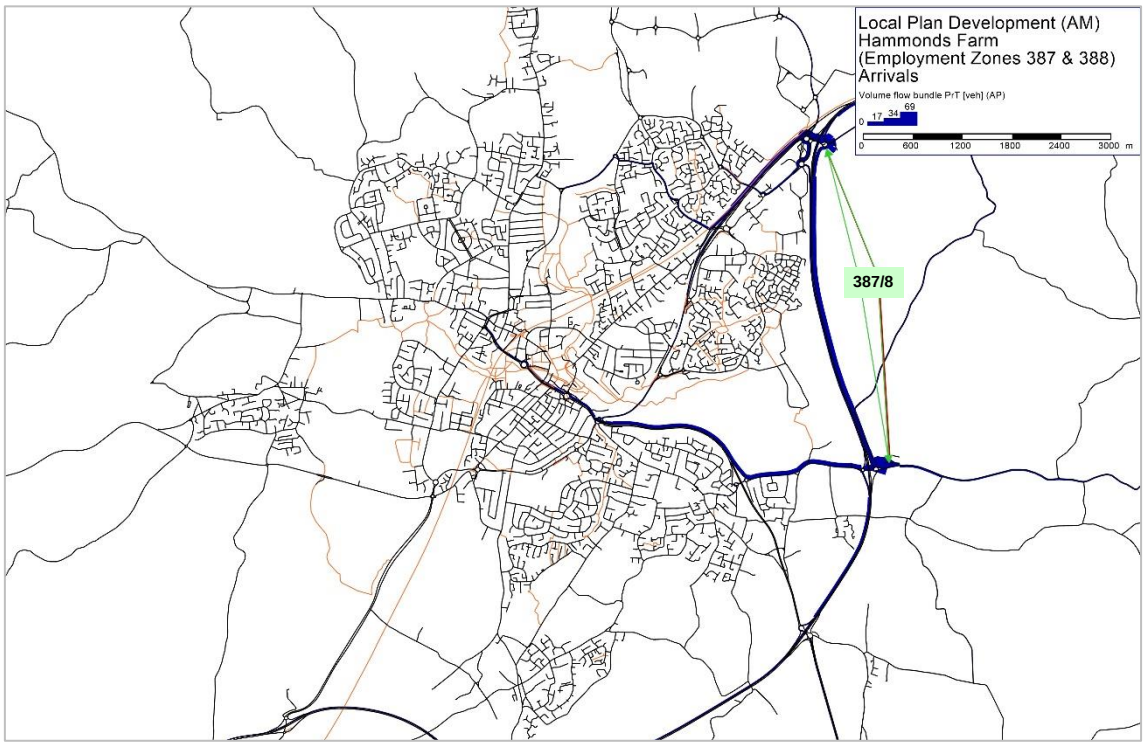

Figure 5-5: Development Trip Assignment for Hammonds Farm (Employment) - AM Arrivals (zone location and ID shown in green)

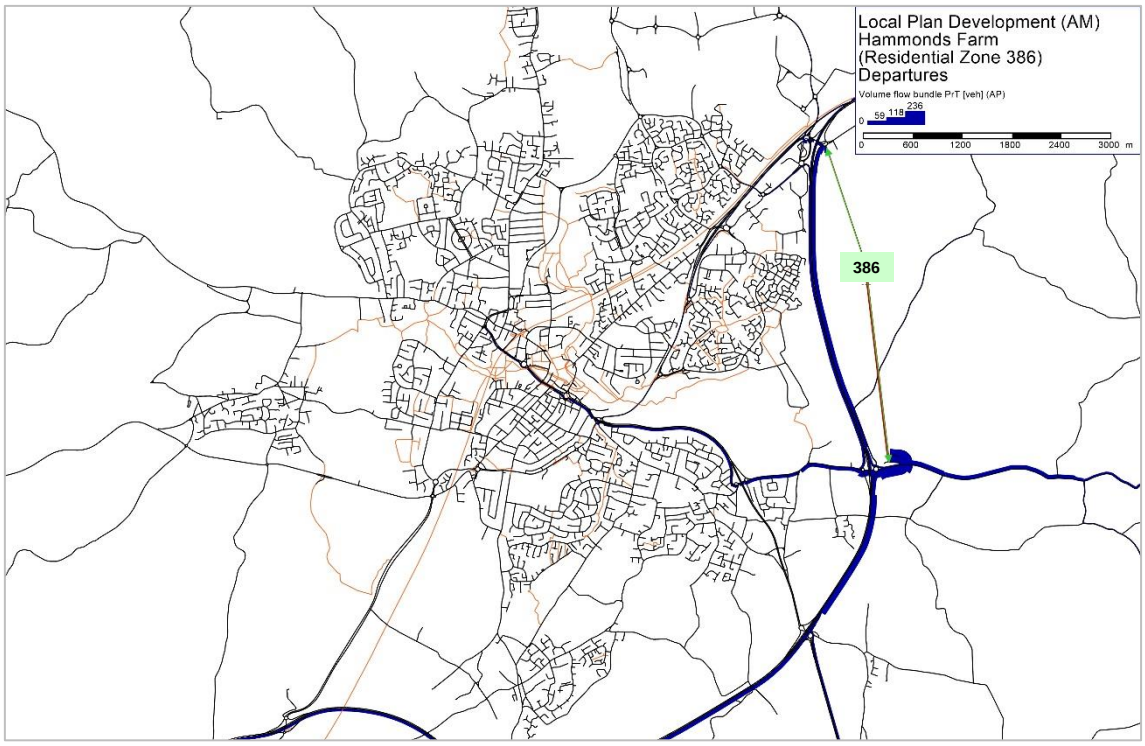

Figure 5-6: Development Trip Assignment for Hammonds Farm (Residential) - AM Departures (zone location and ID shown in green)

Assignment of Development Trips	Key Commentary
Residential Sites	
Hammonds Farm (Zone 386)	Trips from Hammonds Farm are modelled with a broadly balanced distribution and are assigned to the main strategic routes in the vicinity of the development including the A12 and A414.
Employment Sites	
Hammonds Farm (Zone 387/388)	For employment at Hammonds Farm, the assignment of trips is similar to those for residential trips, with a somewhat greater focus on trips from the city centre via the A1114 Essex Yeomanry Way and from Springfield and areas north of Chelmsford via the A12.
Land Adjacent to A12 J18 (Zone 395/396)	Arrivals to the employment site off A12 J18 originate predominantly from Chelmsford city centre via the A1114 Essex Yeomanry Way and areas to the north along the A12 corridor.
Chelmsford Garden Community (Zone 390)	Arrivals to the Chelmsford Garden Community employment site are largely focused from the city centre via the A1016 Chelmer Valley Road, with a proportion using rural routes from satellite villages including Broomfield/Little Waltham and Boreham/Hatfield Peverel.

Boreham (Zone 391)	Modelled trips to the Boreham employment site originate predominantly from central Chelmsford and Springfield and route via the A138 Chelmer Road and through the Boreham Interchange. It is noted that trips with origins from the south, route via A12 J18 and Hammonds Road to avoid congestion along the A12.
Little Boyton Hall (Zone 394)	Trips to Little Boyton Hall route via the A1060 Roxwell Road, with the majority originating or routing through Chelmsford city centre.

In summary:

- To place the development trip assignment into context, of the sites highlighted in the table above, only Hammonds Farm and Land Adjacent to the A12 J18 are shown in the modelling to generate traffic flows of sufficient volume to impact traffic conditions significantly along the routes presented in the assignment plots.
- Focusing on the A12 corridor sites, development trips might be expected to add to existing traffic flows along the A12 itself as well as the A414 to/from Maldon and the A1114 Essex Yeomanry Way route to/from the city centre.
- Development flows from Hammonds Farm are also shown to route via the Boreham Interchange and the A138 Chelmer Road into the city centre from the north, and via local access routes in north Chelmsford including the A130 Colchester Road / White Hart Lane.

5.2 Queue Length Analysis

Relative queue length plots are a useful tool to identify junctions in the strategic model with indicative congestion in the future. It is important to note that the queues illustrated in the plots highlight the full length of modelled links along which queues extend. They do not necessarily represent the absolute length of a modelled queue, but are nevertheless sufficient in indicating the broad extent of modelled congestion in a particular location. Figure 5-7 to Figure 5-10 show the relative queue length plots for the Preferred Spatial Approach for both the AM and PM peaks.

5.2.1 Relative Queue Lengths: 2041 AM Peak

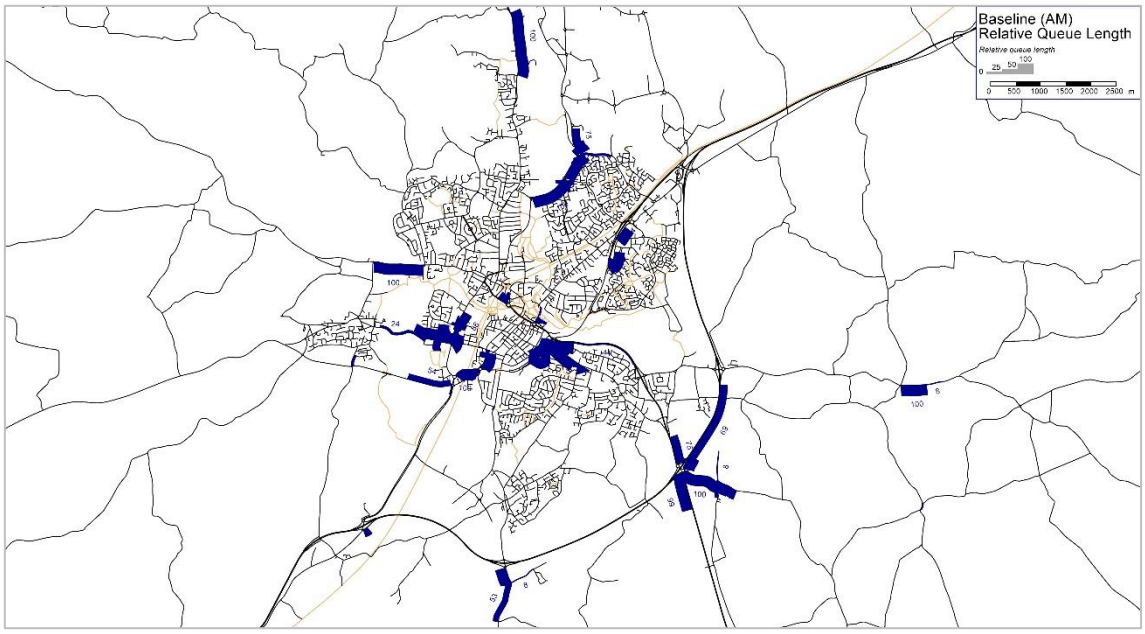

Figure 5-7: Relative queue length plot – Baseline – 2041 AM Peak

Figure 5-7 illustrates the relative queue lengths modelled for the 2041 baseline (without additional Local Plan development) in the AM peak, and shows modelled queuing in the following key locations in Chelmsford:

Modelled Queueing 2041 AM Peak - Key Locations
Army & Navy Roundabout - Baddow Road, Van Diemans Road*
A12 J17 (Howe Green)
Princes Road (Miami) Roundabout through to Widford Road Roundabout
Writtle Road junction with A1016 Waterhouse Lane
A1016 Chelmer Valley Road between Nabbotts Farm and Valley Bridge Roundabouts
A138 Chelmer Road southbound in vicinity of New Dukes Way
A1060 Roxwell Road westbound on approach to junction with Lordship Road B1008 Main Road, Broomfield

*Modelled congestion would be expected to be worse with the existing (2023) roundabout layout.

It should be noted that queues are more extensive in the vicinity of A12 Junction 17 at Howe Green over those shown in the earlier appraisal of the selected spatial approaches. Whilst this, is in part, the result of the additional development allocated along the A12 corridor, it is also the result of updates made to the network coding at Howe Green for this latest study, as documented in section 3.4.4.

The Howe Green junction is modelled with significant congestion in the 2041 baseline with queues on the southbound off-slip extending back along the A12 carriageway. Whilst a relatively small proportion of Local Plan development trips are shown in the modelling to route through the junction, queues extending back along the A12 carriageway would likely heighten the impact of development trips routing along the A12.

Modelled queue extents along the A138 Chelmer Road in the vicinity of New Dukes Way, Springfield are likely linked to the extent of congestion modelled along the alternative A1016 Chelmer Valley Road route into Chelmsford from the north - resulting in traffic routing via the CNEB and A138 Chelmer Road to access the city centre.

It should also be noted that queues shown on approaches to the Army and Navy Roundabout would likely be significantly worse without the proposed redesign of the junction and Park and Ride expansion included in the modelling. The use of fixed demand for this appraisal would also be expected to portray a 'worst-case' account of congestion at the junction.

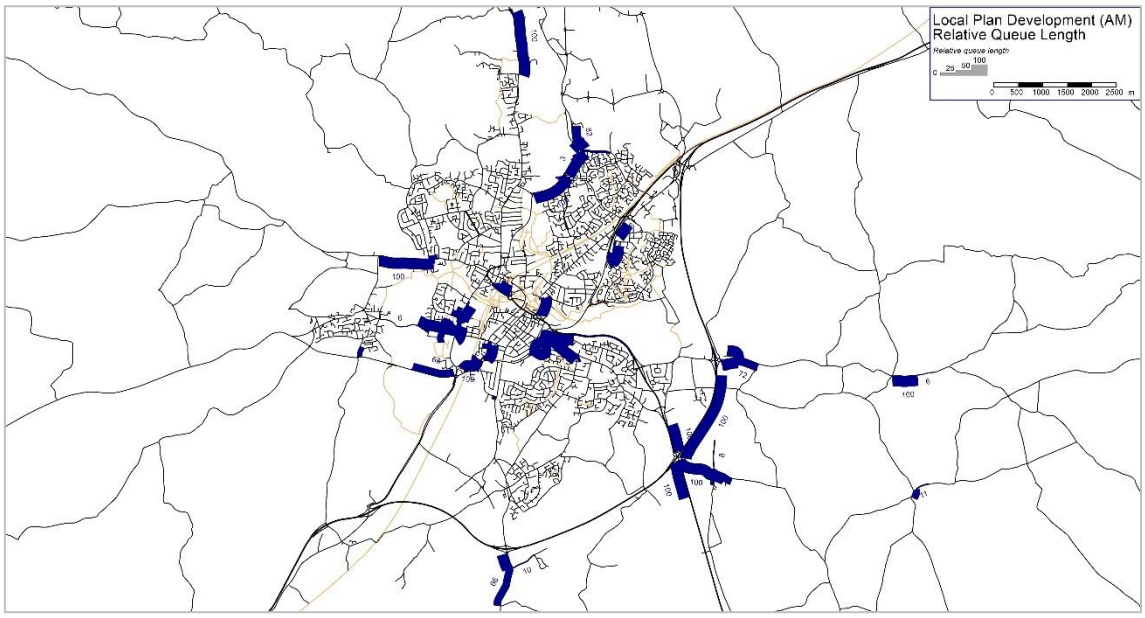

Figure 5-8: Relative queue length plot – Preferred Spatial Approach – 2041 AM Peak

Figure 5-8 illustrates the relative queue lengths modelled for the 2041 Preferred Spatial Approach in the AM peak, and shows modelled queuing in the following key locations in Chelmsford:

Queue Length Analysis - AM Peak	Key Commentary
A12	Moderate increase in queuing along A12 southbound carriageway caused by congestion at A12 J17 (Howe Green)
A414	Queuing introduced along A414 westbound approach to A12 Junction 18 in the vicinity of the Hammonds Farm site access.
Army & Navy Roundabout	Small increases in queue extents modelled along Baddow Road.
City Centre	Small increases in queue extents at junctions along A1060 Parkway - specifically at Odeon and Market Roundabouts.

5.2.2 Relative Queue Lengths: 2041 PM Peak

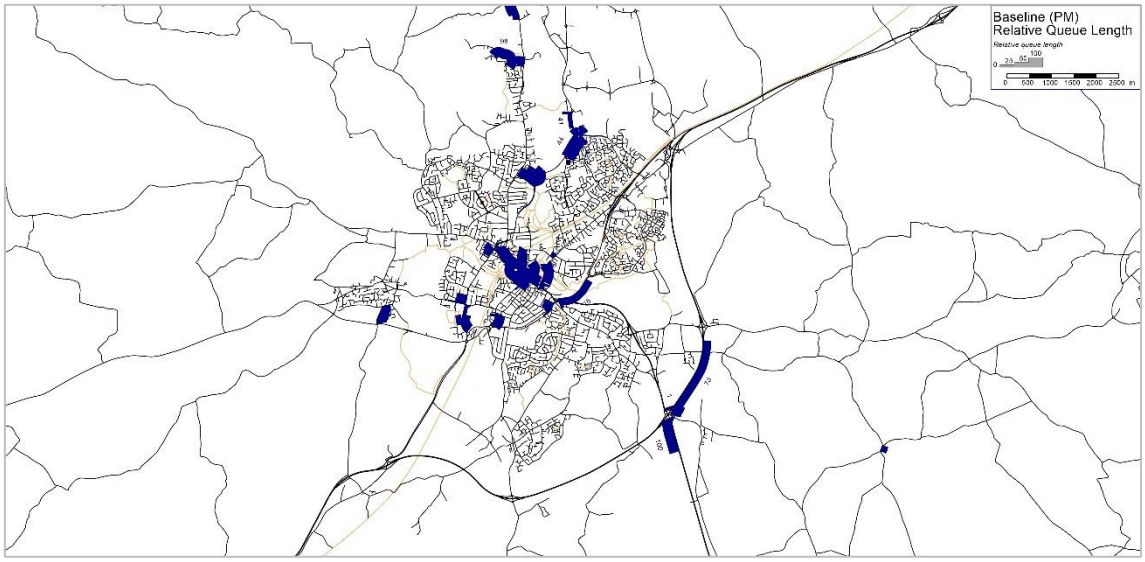

Figure 5-9: Relative queue length plot – Baseline – 2041 PM Peak

Figure 5-9 illustrates the relative queue lengths modelled for the 2041 baseline (without additional Local Plan development) in the PM peak, and shows modelled queuing in the following key locations in Chelmsford:

Modelled Queueing 2041 PM Peak - Key Locations
City Centre junctions along Parkway between A1016 Waterhouse Lane and Odeon Roundabout
Army & Navy Roundabout - A138 Chelmer Road
A12 J17 (Howe Green)
Princes Road (Miami) Roundabout and A1016 Westway Roundabout
Writtle Road junction with A1016 Waterhouse Lane
A1016 Chelmer Valley Road between Nabbotts Farm and Lawn Lane Roundabouts
Valley Bridge Road at junction with B1008 Broomfield Road and with A1016 Chelmer Valley Road

Queues are also shown in the baseline model exiting Writtle south along Margaretting Road at the junction with the A414. This should perhaps be seen as indicative of queuing at junctions through Writtle in general, caused by through-routing between north and south/west Chelmsford via the A414.

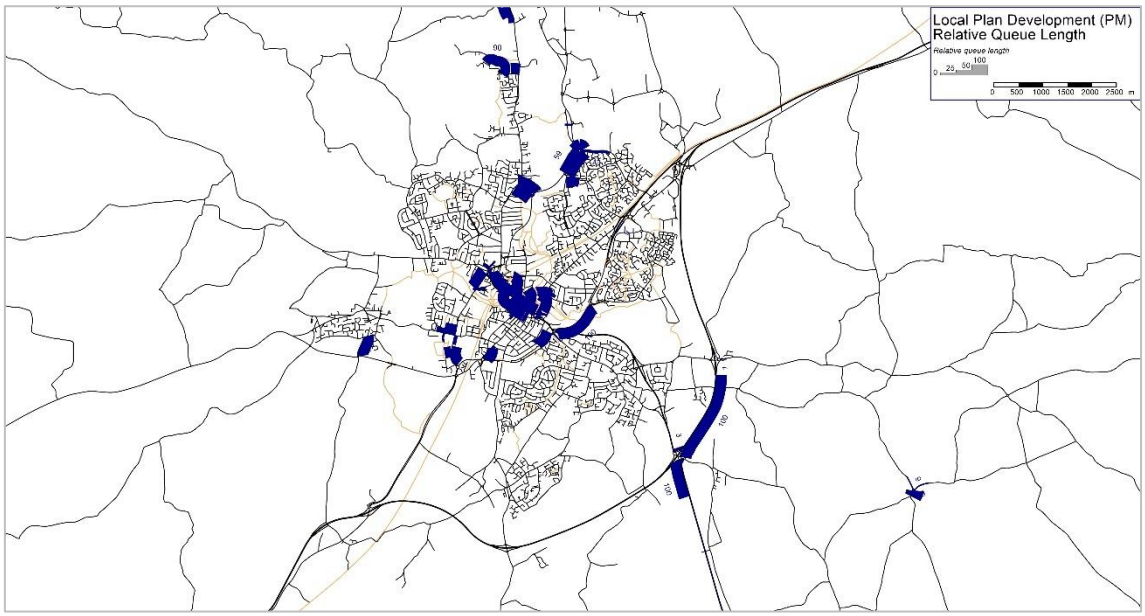

Figure 5-10: Relative queue length plot – Preferred Spatial Approach – 2041 PM Peak

Figure 5-10 illustrates the relative queue lengths modelled for the 2041 Preferred Spatial Approach in the PM peak, and shows modelled queuing in the following key locations in Chelmsford:

Queue Length Analysis - PM Peak	**Key Commentary**
A12	Moderate increase in queuing along A12 southbound carriageway caused by congestion at A12 J17 (Howe Green)
Army & Navy Roundabout	Small increase in queue extents modelled along A138 Chelmer Road
A1016 Chelmer Valley Road	Small increase in queuing shown between Nabbotts Farm and Lawn Lane Roundabouts (and along Lawn Lane itself)
City Centre	Small increase in queue extents modelled on and around A1060 Parkway

5.3 Link Capacity Analysis

Volume/Capacity (V/C) ratio plots are presented in this report to identify links across the strategic modelled network with limited or no spare capacity in the future.

Links with a V/C ratio between 80 and 89 are shown in the model (highlighted in yellow) to be operating with limited spare capacity. It is likely that traffic will be affected by somewhat unstable journey times and an absence of free-flowing traffic conditions.

Links with a V/C ratio between 90 and 99 are shown in the model (highlighted in amber) to be operating with very limited spare capacity. It is likely that concentrated traffic volumes on these links will experience some journey time delay and speed limitations.

Links with a V/C ratio of 100 are shown in the model (highlighted in red) to be operating with no spare capacity, whilst those with a V/C ratio exceeding 100 are shown to have a demand flow that exceeds the available practical capacity. It is likely that heavily concentrated traffic volumes on these links will experience notable journey time delay and highly restricted speeds.

5.3.1 Volume/Capacity Stats: 2041 Baseline

Figure 5-11: Volume/Capacity plot – Baseline – 2041 AM Peak

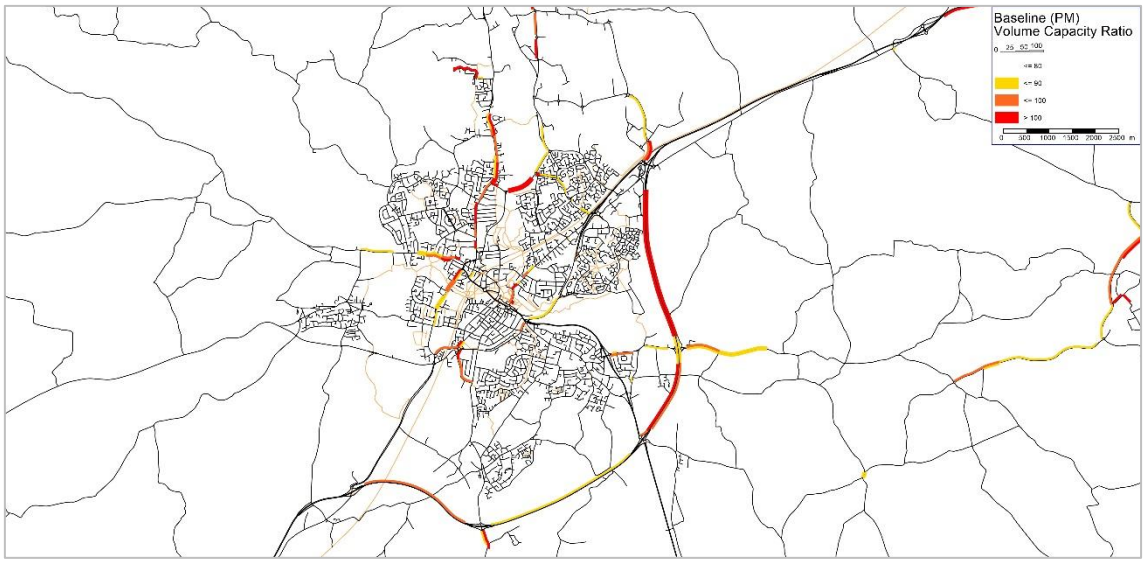

Figure 5-12: Volume/Capacity plot – Baseline – 2041 PM Peak

The 2041 baseline (without additional Local Plan development) shows modelled links with no spare capacity along the following key routes in Chelmsford across the AM and PM peaks:

Modelled Capacity Limitations 2041 Baseline - Key Locations
A12 between J19 Boreham Interchange and J17 Howe Green
A414 westbound between Danbury and Sandon
A131 Essex Regiment Way south of Sheepcotes Roundabout
A1016 Chelmer Valley Road between Lawn Lane and Valley Bridge Roundabouts
RDR/Beaulieu Parkway between CNEB and Boreham Interchange
A1016 Waterhouse Lane / Rainsford Lane
B1008 Main Road, Broomfield

In addition, city centre corridor routes including: Rainsford Road, Springfield Road, Victoria Road and Van Diemans Road; all contain short modelled sections of route with V/C ratios exceeding 100.

Rural links in the vicinity of Broomfield Hospital are also shown with capacity limitations. However, it is important to acknowledge that the road network and zone coverage in the model is less granular in these outlying areas, and that the level of precision attached to traffic flows at specific locations on minor rural links is consequently reduced. It is therefore advised that any observations made concerning network impact in outer areas of the strategic model are caveated as being subject to more detailed modelling being undertaken.

5.3.2 Link Capacity Impact of Preferred Spatial Approach

Figure 5-13: Volume/Capacity plot – Preferred Spatial Approach – 2041 AM Peak

Figure 5-14: Volume/Capacity plot – Preferred Spatial Approach – 2041 PM Peak

In summary, there is little in the way of observable differences between model outputs with and without Local Plan development – albeit with increases in the V/C ratio modelled on links in the vicinity of development along the A12 corridor.

The baseline volume/capacity statistics do, however, highlight the significant capacity pressures modelled along strategic corridor routes such as the A12 and A1016 Chelmer Valley Road. Both routes would be expected to accommodate a proportion of development trips associated with the preferred spatial approach.

With neither route modelled with spare capacity, traffic flows are shown to spread across nearby alternative routes. This is explored further in the following section of the report.

The volume over capacity plots also illustrate a potential capacity issue with the Beaulieu Parkway bridge link over the rail line between the Boreham Interchange and the Beaulieu Rail Station access junction in the baseline AM and PM peak hours.

5.4 Traffic Flow Analysis

The following plots taken from the Chelmsford Forecast Model illustrate the change in traffic flow patterns across the local and strategic road network following the addition of development trips associated with the preferred spatial approach.

Traffic flow increases are shown in red, whilst traffic flow decreases are shown in green.

When viewed in isolation, an increase in traffic flow (whilst undesirable) is not necessarily problematic – so long as there is sufficient network capacity (on links and at junctions) to accommodate the increase. Therefore, the flow difference plots should be viewed alongside the queue length and volume/capacity plots shown earlier in the report to develop a more rounded appraisal of Local Plan development impact.

An increase in modelled traffic flow is understood to be the combined result of the direct introduction of development trips, and the indirect impact of traffic re-routing to avoid areas of worsening congestion on the road network.

A reduction in modelled traffic flow is likely the result of traffic re-routing away from congestion ‘pinch-points’, thereby reducing the volume of upstream and/or downstream traffic along impacted routes in the model.

Summary analysis/commentary is provided for the AM peak and PM peaks combined.

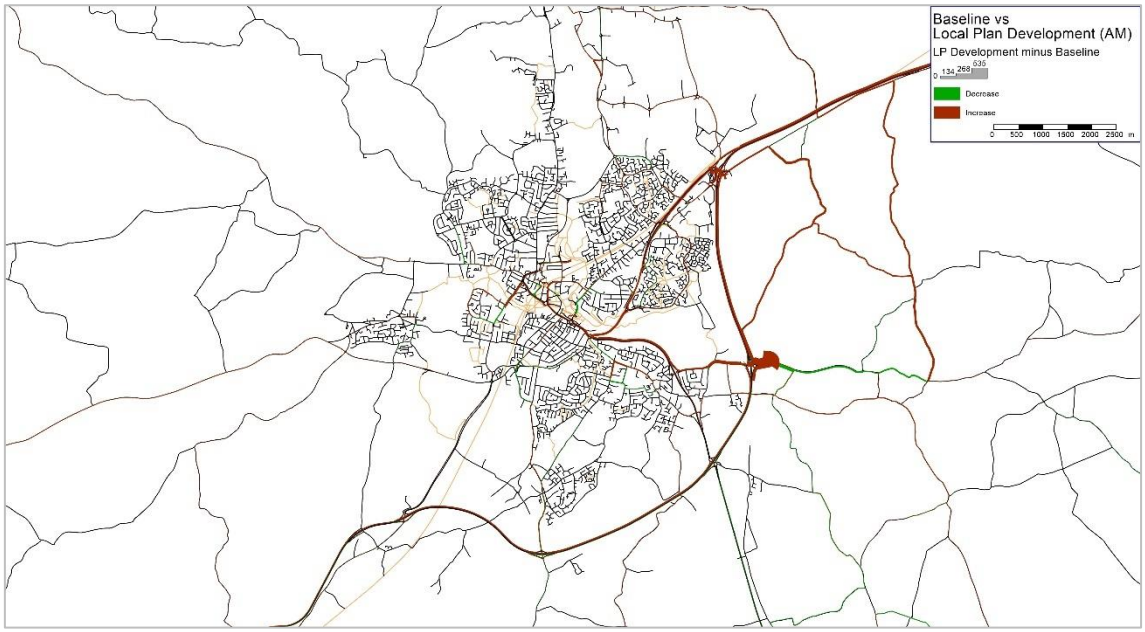

Figure 5-15: 2041 Baseline vs Preferred Spatial Approach flow difference plot – 2041 AM Peak

Figure 5-16: 2041 Baseline vs Preferred Spatial Approach flow difference plot – 2041 PM Peak

Flow Difference Analysis	Key Commentary
A12	Greatest flow increase shown along the A12 carriageway between Junctions 18 and 19 in both peak hours. Notable flow increases also modelled on the A12 north of Junction 19 and south of Junction 18.
A1114 Essex Yeomanry Way	Increase in flow modelled along A1114 Essex Yeomanry Way and through the Army & Navy roundabout.
A138 Chelmer Road	Increase in flows shown along the A138 in the AM Peak along the entire length of route between the Boreham Interchange (A12 J19) and the Army and Navy Roundabout. Similar increase shown between the Boreham Interchange and New Dukes Way roundabout in the PM Peak.
A414	A reduction in peak hour traffic flow modelled along the A414 between the Hammonds Farm development access and Danbury. Caused by a reassignment of traffic flow away from the corridor.
City Centre	Small increase in traffic flow modelled along Parkway.
Rural Routes	Increase in modelled flows noted along routes to the east of the A12 including Hammonds Road and North Hill (through Little Baddow). Increase in flows also shown along Woodhill Road running parallel to the south of the A414 between Sandon and Danbury.

The peak hour flow difference plots effectively show the impact of development trips associated with Hammonds Farm and the employment land adjacent to A12 J18 on traffic flow patterns across the surrounding road network.

As can be seen from the queue length and volume/capacity analysis in earlier sections of this report, network capacity issues are modelled along the A12 between Junction 17 and 19. A significant proportion of development trips might be expected to route along the A12 - both northbound and southbound - from Junction 18, thereby exacerbating congestion along the trunk road. The link flow difference plots show that this will increase the likelihood of traffic re-routing along rural roads to the east of the A12, impacting the villages of Boreham and Little Baddow.

At the same time, development trips will likely have a direct impact on queuing along the A414 on the westbound approach to the A12 Junction 18, and this is shown in the modelling to result in the displacement of background traffic flows from the A414 and onto alternative rural routes through Danbury and Sandon.

5.5 Journey Time Analysis

Journey times for 14 routes have been extracted for both the 2041 baseline scenario and preferred spatial approach, for both the AM and PM peaks. The locations of the identified routes are illustrated in Figure 5-17 below.

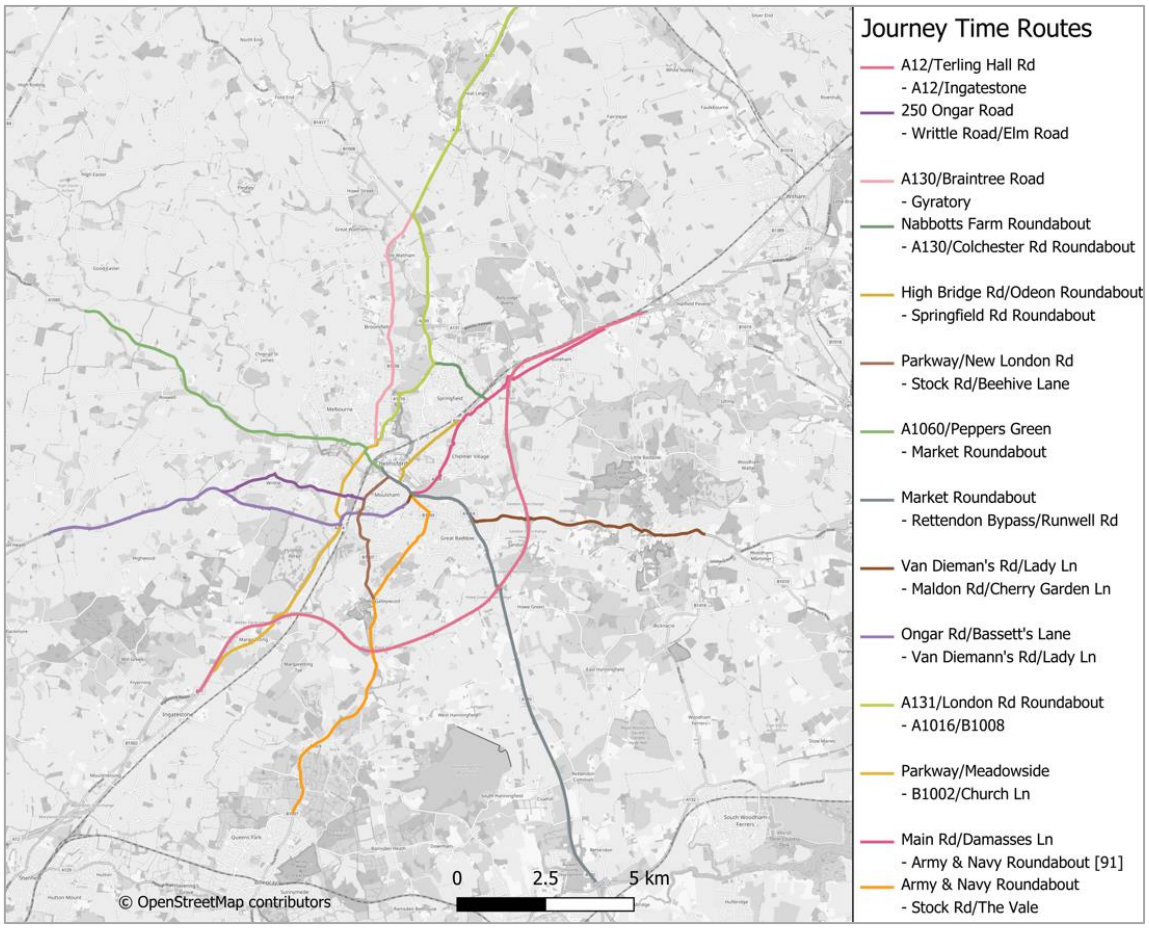

Figure 5-17: Key corridor routes in Chelmsford selected for journey time analysis

Directional journey times for the assessed routes are summarised in AM and PM peak tables found in Appendix E.

Journey time plots and commentary are also included in this section of the report for selected journey time routes expected to be most impacted by Local Plan development traffic - specifically:

- A12 corridor between J15 and J20
- A414 corridor – between Danbury and Great Baddow

- A130/A1114/A1060 corridor – between Chelmsford city centre and Rettendon (northbound in AM Peak only)
- A138 Chelmer Road corridor – between Boreham and Army & Navy Roundabout

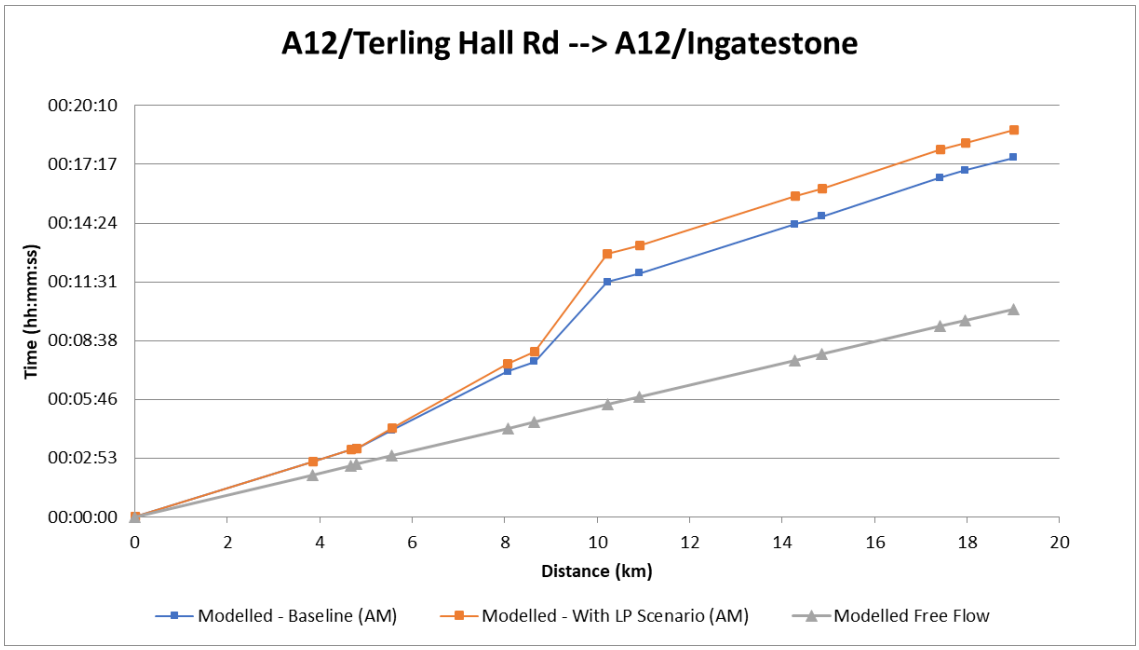

Figure 5-18: Journey Time plot for the A12 between J15 and J20, southbound in the AM Peak

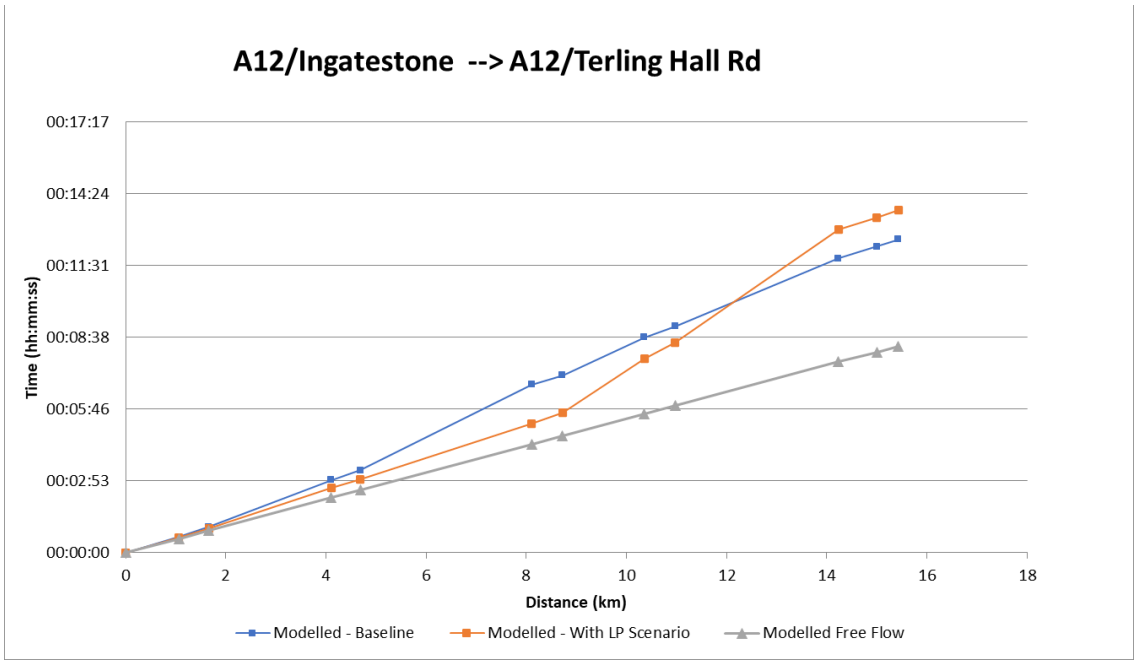

Figure 5-19: Journey Time plot for the A12 between J15 and J20, northbound in the PM Peak

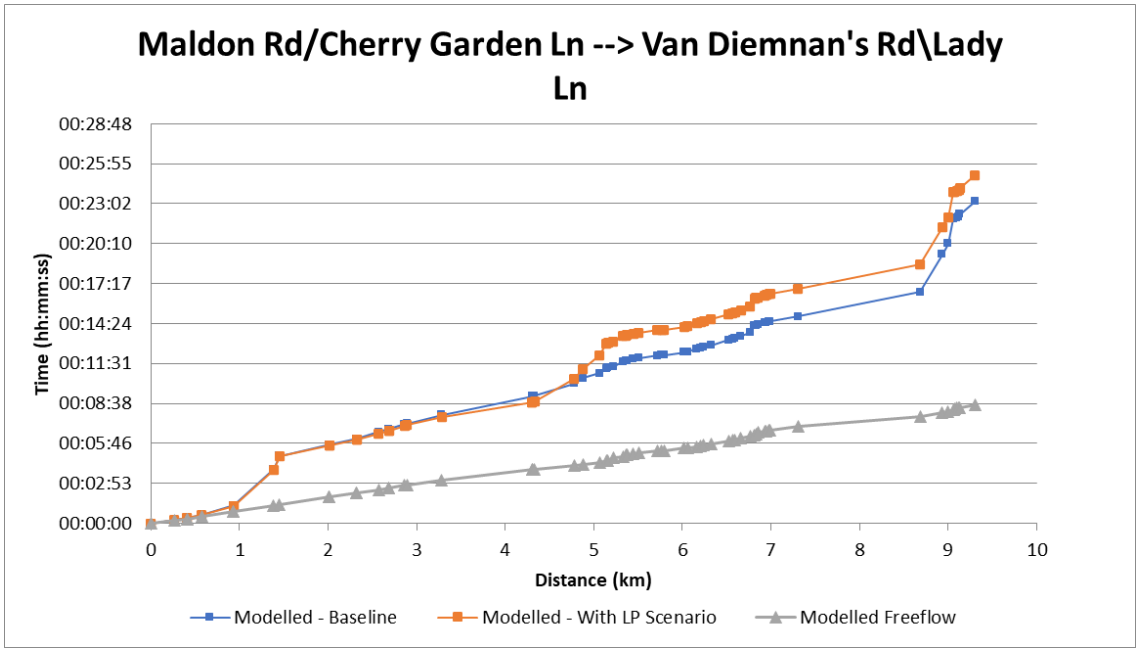

Figure 5-20: Journey Time plot for the A414 corridor, westbound in the AM Peak

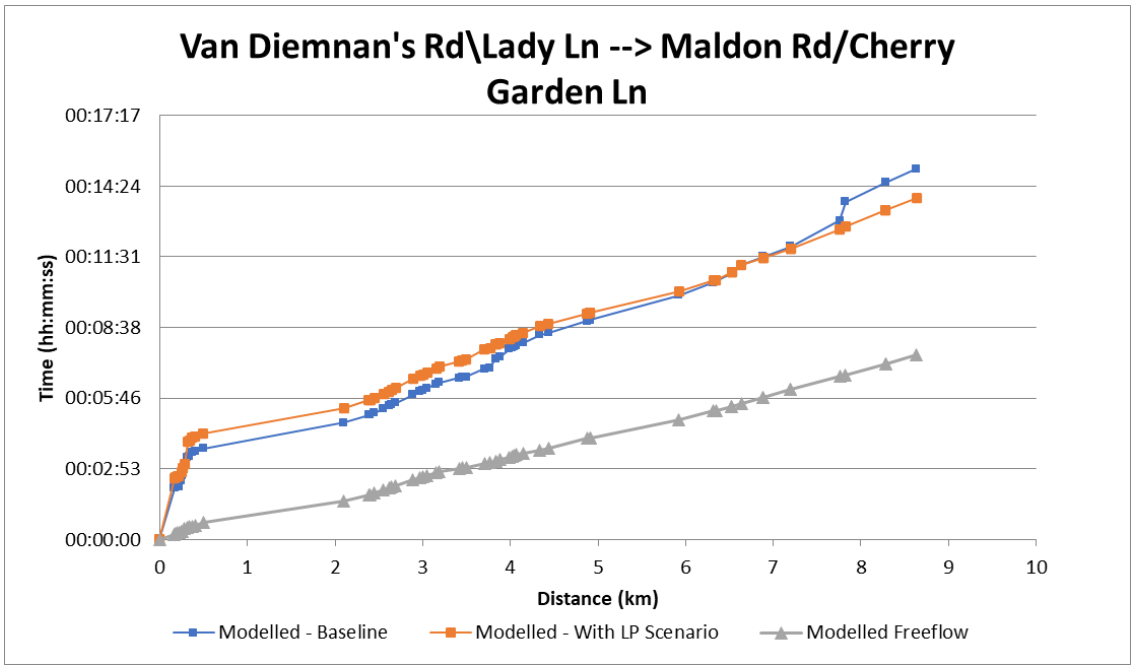

Figure 5-21: Journey Time plot for the A414 corridor, eastbound in the PM Peak

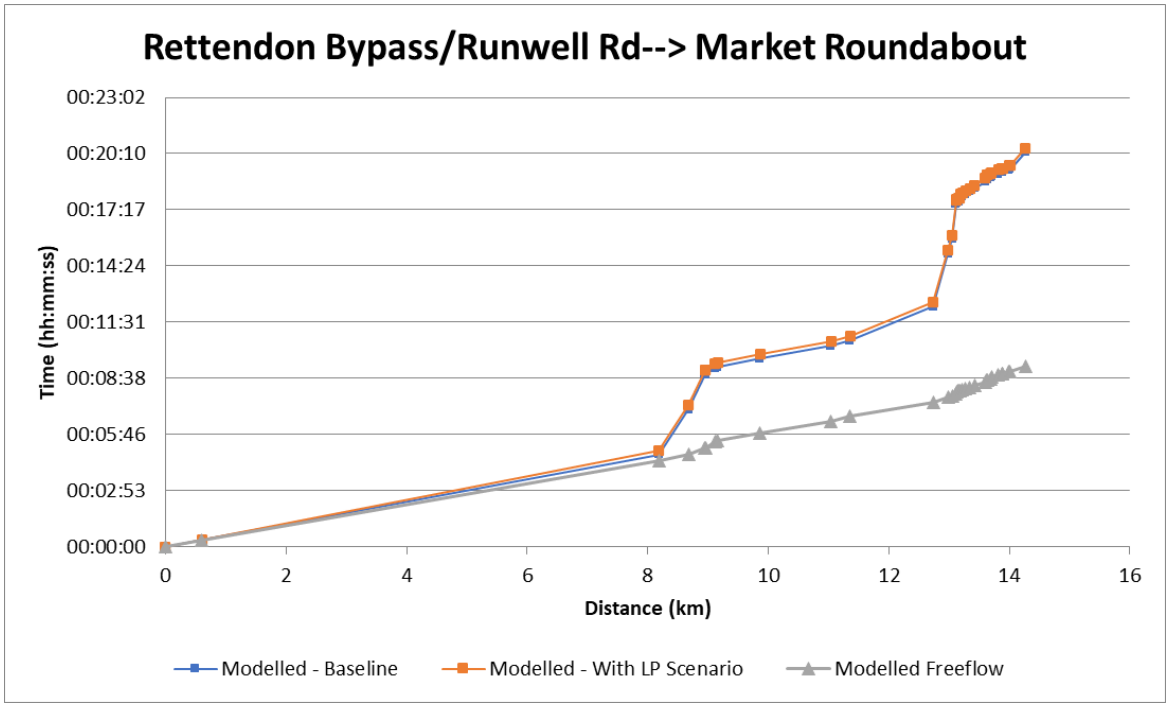

Figure 5-22: Journey Time Plot for the A130 / A1114 / A1060 corridor, northbound in the AM Peak

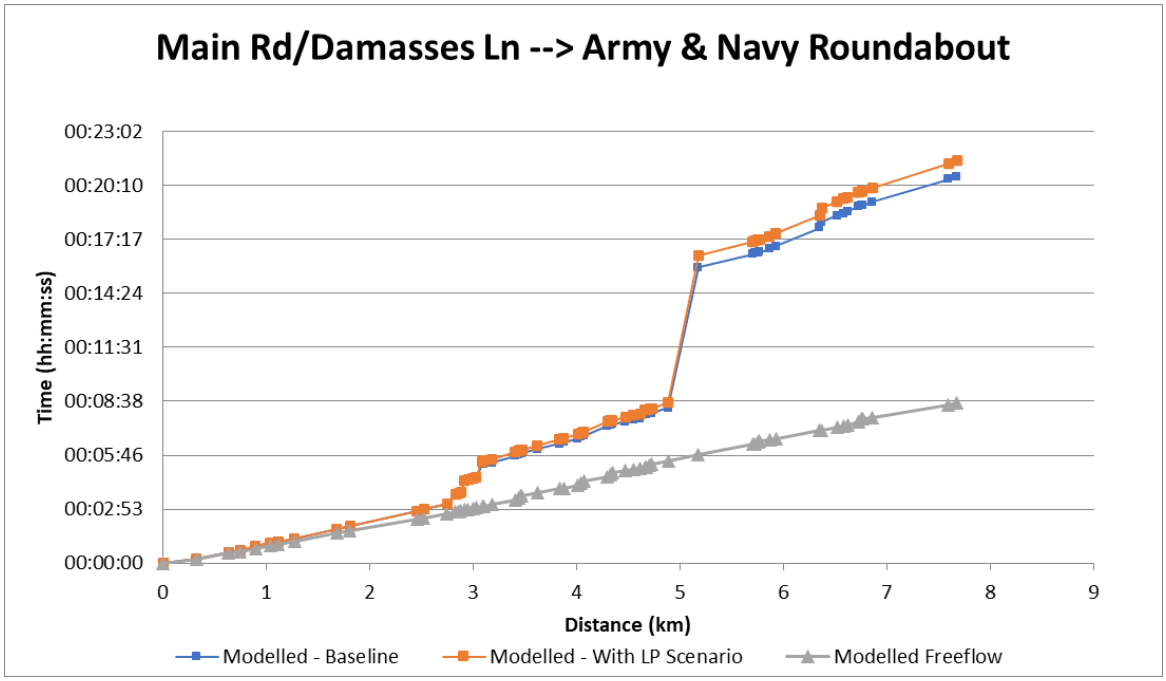

Figure 5-23: Journey Time Plot for the A138 corridor, south-westbound in the AM Peak

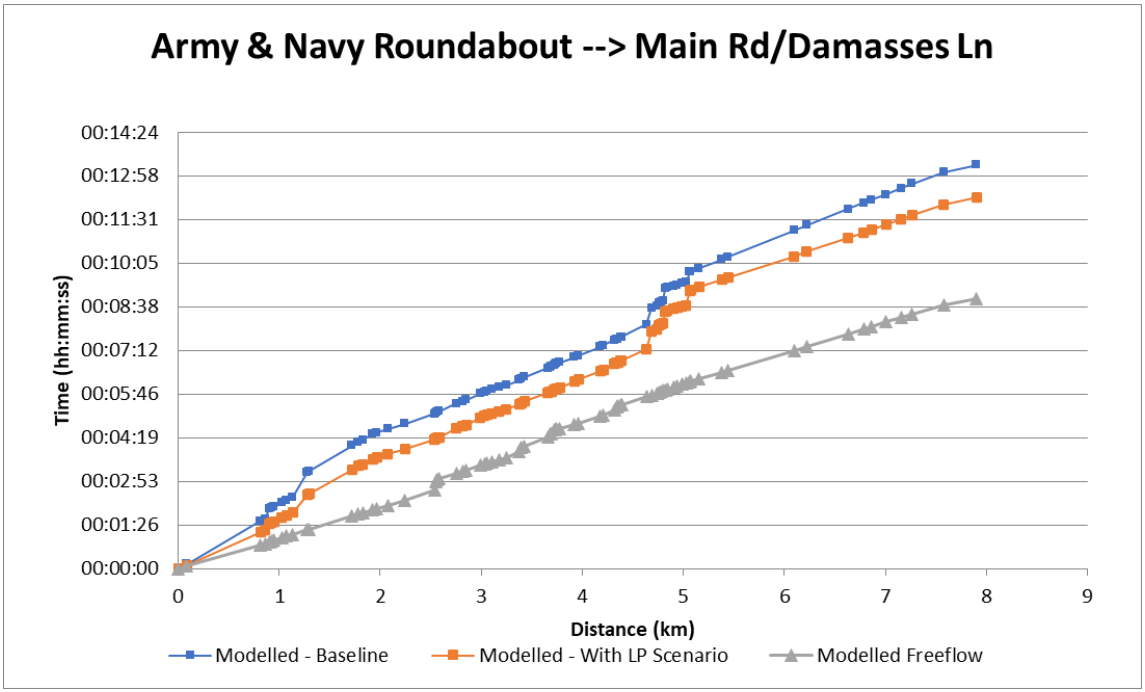

Figure 5-24: Journey Time Plot for the A138 corridor, north-eastbound in the PM Peak

Journey Time Analysis	Key Commentary
A12 Corridor	The addition of Local plan trips in the preferred spatial approach adds approximately two minutes to journey times along the route between J15 and J20 southbound in the AM Peak and northbound in the PM Peak. There are sections in the middle of the northbound route in the PM Peak (in the vicinity of J17-18) where journey times in the baseline exceed those with Local Plan development. This is reflective of congestion modelled along the route in both scenarios, causing variability in route assignment.
A414 Corridor	Local Plan trips are shown to increase journey times along the A414 corridor by around two and half minutes westbound in the AM Peak but do not increase journey times eastbound in the PM Peak. The increase in AM Peak journey times along the route is largely the result of modelled congestion at A12 J18.
A130/A1114/A1060 Corridor	Development flows are shown to have little overall impact on AM Peak journey times northbound along the A130/A1114/A1060 corridor, suggesting that Local Plan impact on junctions along the route, such as Howe Green, is very limited.
A138 Corridor	Journey times along the A138 corridor are largely unimpacted by the addition of Local Plan trips from the preferred spatial approach in both the AM and PM peaks.

In summary:

- The impact of development traffic from the preferred spatial approach on journey times is most keenly felt along the A12 and A414 corridors – in near proximity to the proposed development sites in the vicinity of A12 Junction 18 at Sandon.

- The journey time plots illustrate the impact of a variability in route assignment which can result in baseline journey times exceeding those for the preferred spatial approach on certain routes under congested network conditions. This effect is also demonstrated in the flow difference plots in section 5.4 which show little overall change in city centre traffic flow – likely caused by a broad displacement of background traffic across city centre routes to accommodate additional development flows.

5.6 Summary of Cross-Boundary Impact

To assess the comparative cross-boundary impact of the preferred spatial approach, a review has been undertaken of the forecast flows on key routes travelling in and out of neighbouring Districts and Boroughs.

To carry out this review, inbound and outbound 2041 forecast traffic flows have been extracted from 8 key routes at the point the route crosses the Chelmsford administrative boundary. Figure 5-25 shows the points at which data has been extracted.

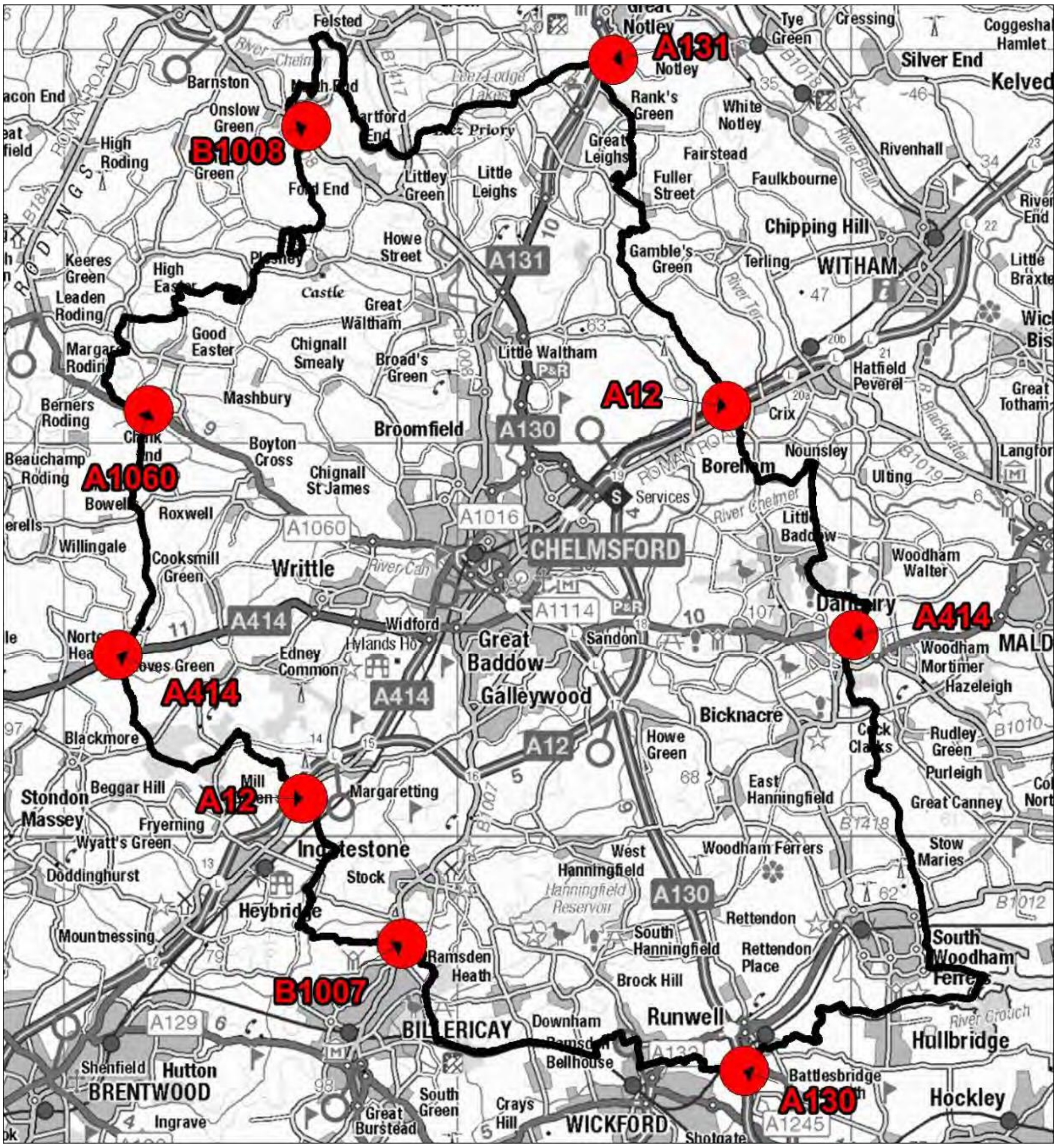

Figure 5-25: Location of cross boundary flow comparisons on key routes between Chelmsford and neighbouring authorities

Whilst the administrative boundary of Chelmsford is located a distance away from the main validated area of the Chelmsford VISUM model, traffic flows along key corridors passing into neighbouring authorities have been largely calibrated to observed count data in the base model. The model can therefore be considered sufficiently robust for forecasting traffic flows at these outer locations to compare the relative cross-boundary impact of the three spatial approaches.

Table 5-1 details the directional vehicle flows on these key corridor routes crossing the Chelmsford administrative boundary (inbound towards Chelmsford and outbound towards neighbouring districts) in the 2041 preferred spatial approach modelled scenario.

Table 5-1: Modelled flows in Baseline Scenario on key routes crossing the Chelmsford administrative boundary

Road	Neighbouring Authority	Baseline			
		AM Directional Flow		PM Directional Flow	
		IB Flow	OB Flow	IB Flow	OB Flow
A131	Braintree	1248	1442	1117	1497
A12 (north)	Braintree	4769	4604	4350	4600
A414 (east)	Maldon	739	563	619	763
A130 (south)	Basildon	2465	2495	2591	2306
B1007	Basildon	950	786	1006	790
A12 (south)	Brentwood	3554	4712	4226	3786
A414 (east)	Epping Forest	525	792	767	541
A1060	Uttlesford	397	440	411	396
B1008	Uttlesford	596	696	623	685

Table 5-2: Modelled directional flow comparisons and % change from Baseline on key routes crossing the Chelmsford administrative boundary

		Preferred Spatial Approach							
		AM Directional Flow				PM Directional Flow			
Road	Neighbouring authority	IB Flow	% change	OB Flow	% change	IB Flow	% change	OB Flow	% change
A131	Braintree	1248	0.0%	1463	1.5%	1256	12.4%	1620	8.2% *
A12 (north)	Braintree	5400	13.2%	4739	2.9%	4474	2.9%	4677	1.7%
A414 (east)	Maldon	731	-1.1%	575	2.1%	634	2.4%	726	-4.8%
A130 (south)	Basildon	2462	-0.1%	2581	3.4%	2609	0.7%	2336	1.3%
B1007	Basildon	960	1.1%	811	3.2%	1034	2.8%	791	0.1%
A12 (south)	Brentwood	3594	1.1%	4795	1.8%	4283	1.3%	3853	1.8%
A414 (east)	Epping Forest	538	2.5%	818	3.3%	784	2.2%	551	1.8%
A1060	Uttlesford	412	3.8%	444	0.9%	427	3.9%	400	1.0%
B1008	Uttlesford	604	1.3%	731	5.0%	652	4.7%	696	1.6%

Colour scale indicates level of change from baseline

** A133 % change in IB an OB flows in PM Peak caused by a local shift in route choice during model assignment*

Analysis shows that cross-boundary connections to the north of Chelmsford via the A12 are most affected by the latest proposed Local Plan development, with the highest modelled increase shown in the AM peak of around 13% from 2041 baseline flows.

It is noted that A131 flows from the direction of Braintree increase by a similar amount in the PM peak. However, this is acknowledged to be caused by a local switch in route choice between the current A131 and the old A131 route along London Road, caused by near-identical journey times along both routes. From a review of development distribution/assignment plots in section 5.1 of this report, it is considered unlikely that development trips associated with the preferred spatial approach will noticeably increase overall flows to/from Braintree District via the A131.

Whilst it might be expected that flows along the A414 to/from Maldon District would increase as a result of development at, and to the south of, Hammonds Farm, model outputs instead suggest there will be a reduction in trips caused by the displacement of traffic flows onto alternative routes.

Table 5-3 below shows the number of trips in the forecast model travelling between the development sites along the A12 corridor (Hammonds Farm and the proposed employment site adjacent to the A12 J18) and Maldon District. The plots presented in section 5.1 of this report provide a further illustration of the distribution of development flows routing to/from Maldon District.

		AM		PM	
		No. of Trips	% of total trips generated	No. of trips	% of total trips generated
Residential Trips	To Maldon	5	10.2%	23	6.1%
	From Maldon	17	5.9%	8	19.0%
Employment Trips	To Maldon	140	21.6%	71	20.2%
	From Maldon	20	7.1%	95	14.5%

Table 5-3: Modelled trips between A12 corridor development sites and Maldon District

To alleviate the cross-boundary impact of development along the A12 corridor, policy requirements will be put in place at Hammonds Farm to maximise the internalisation of trips and active and sustainable travel schemes including a sustainable corridor to Beaulieu Park Station/Sandon Park and Ride; connections over and below the A12 linking with existing and planned interventions; and improvements to the east of the site towards Danbury.

5.7 Forecast Impact on Rural Villages

A small quantum of development contained within the preferred spatial approach has been modelled in the villages of Boreham, Bicknacre, East Hanningfield, Ford End and Boyton Cross. Observations from model outputs suggests that development in these areas is unlikely to have an adverse impact on the road network to the extent that localised peak hour congestion is experienced within the villages.

Modelling does, however, demonstrate the likelihood of development along the A12 corridor causing an increase in traffic volumes along rural routes through villages including Boreham, Little Baddow and Sandon.

It should be noted that the network and zone coverage in the Chelmsford VISUM model across the rural areas of the Chelmsford administrative area is not as detailed as in and around the urban area of Chelmsford itself, and the detailed impact of development traffic at local junctions in rural villages has not been possible to model as part of the broader Local Plan assessment.

There will therefore be a requirement for more detailed local traffic impact modelling to be undertaken by developers as part of future planning application alongside commitment to the delivery of active and sustainable travel policy requirements, as highlighted in the 'Hammonds Farm Transport Technical Report' (Stantec, October 2022)[8].

5.8 Hammonds Farm Full Build Out Review

The quantum of housing proposed on Hammonds Farm by the end of the 2041 Plan review period has been set at 3,000 dwellings. However, it is acknowledged that the total planned on the site is for up to 4,500 dwellings.

Whilst it would be beneficial to model the impact of the full build out of housing on the Hammonds Farm site to evaluate the longer-term development impact on the road network and the scale of potential mitigation required, there are significant challenges in modelling significantly beyond the 2041 Plan review period.

As highlighted in the supplementary papers presented in Appendix A of this report, it is difficult to make a robust prediction on longer-term traffic growth given

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8 https://consult.chelmsford.gov.uk/kseapi/public/submissions/198806/representations/3869302/attachments/772133/file

uncertainties around longer-term economic performance and/or the uptake of new technologies that will govern the way we travel in the future – such as electric vehicles.

At the same time, there are current uncertainties around the iterations of National Highways' Road Investment Strategy, and the sources of funding for larger infrastructure projects (e.g. the Housing Infrastructure Fund). This limits the ability to model robust assumptions around the long-term position on potential infrastructure across the strategic road network in Chelmsford (along the A12 and A130/A131 corridors in particular).

For a traffic impact appraisal to be of value, the full extent of the Hammonds Farm development would therefore be better modelled through the next iteration of a new or review Local Plan, as well as through the planning application process.

5.9 Mode Shift Sensitivity Testing

To model the potential impact of mode shift amongst Local Plan housing and employment trips, a sensitivity test has been undertaken, utilising lower trip rates commensurate with more urban development and a greater provision of passenger transport services. The subsequent reduction in trips has been modelled as an aspirational target, potentially achievable through the provision of robust and attractive sustainable transport infrastructure and services - and their successful uptake.

The sensitivity test has been undertaken with an understanding that trip rates for proposed development within the Chelmsford forecast modelling are already representative of a good level of sustainable and active travel mode uptake. Thus, to achieve the trip reductions modelled for this sensitivity test, the provision and use of additional passenger transport services would need to be significantly higher than typically expected. The outputs presented should therefore be viewed in this context.

Development trip reductions have been calculated using EPTAL (Essex Passenger Transport Accessibility Level) which is a bespoke tool created by Essex Highways and loosely based on the DfT's PTAL process, used to derive trip rates around aspirational targets for sustainable transport provision.

EPTAL contains a database of TRICS surveyed development trip rates grouped by location classification: Rural, Edge of Town, Suburban, Edge of Town Centre and Town/City Centre.

The tool then calculates average trip rates across all surveyed sites for each land-use type within each location classification and determines the associated quantum of local rail and/or bus services required to achieve these trip rates – based on passenger transport provision data from the TRICS surveys.

Using EPTAL, it has been possible to determine average trip rates and a typical level of passenger transport provision for housing and employment sites in a Suburban location. This classification was seen as representative of the location and level of passenger transport provision currently proposed for Chelmsford Local Plan developments in North-East Chelmsford and along the A12 corridor.

Average trip rates and a typical level of bus/rail provision were then determined for housing and employment sites in an Edge of Town Centre location. These values were viewed as a suitable aspirational target for Local Plan development as part of the sensitivity test.

Table 5-4 below shows the trip rates generated by EPTAL for the employment and residential developments for both Suburban and Edge of Town Centre sites and the percentage difference between them.

A 13% decrease in residential trip rates and 6% decrease in employment trip rates was identified by calculating the percentage decrease between the existing and desired land classifications. These factors were then applied to the total number of trips generated by the preferred spatial approach as part of the Sensitivity Test.

Type	Suburban Trip Rates	Edge of Town Trip Rates	% Reduction from Suburban to Edge of Town
Residential Houses: Privately Owned	0.121	0.105	13%
Employment (office)	1.239	1.168	6%

Table 5-4: EPTAL Trip Rates

Figure 5-26 and Figure 5-27 illustrate the traffic flow impact of the Preferred Spatial Approach with reduced levels of demand calculated through EPTAL, compared against the 2041 baseline.

Figure 5-28 and Figure 5-29 illustrate the traffic flow impact of reduced levels of demand calculated through EPTAL, compared against the non-adjusted demand in the Preferred Spatial Approach.

(For clarity, link values have been provided for Figure 5-28 and Figure 5-29 owing to the change in the scale used – which might otherwise appear misleading. It should also be clarified that the plots presented, in this instance, show flow difference through not modelling the EPTAL flow reduction.)

Traffic flow increases are shown in red, whilst traffic flow decreases are shown in green. Section 5.4 provides more detail on the traffic flow plots and an analysis of traffic flows.

Please note that the modelled outputs for the sensitivity test represent a best-case scenario and are dependent on there being a shift in travel behaviour in line with additional service provision. Nevertheless, they provide a preliminary insight into the potential effectiveness of sustainable transport options in mitigating the impact of Local Plan development.

Figure 5-26: Reduced demand sensitivity test vs baseline - flow difference plot – 2041 AM Peak

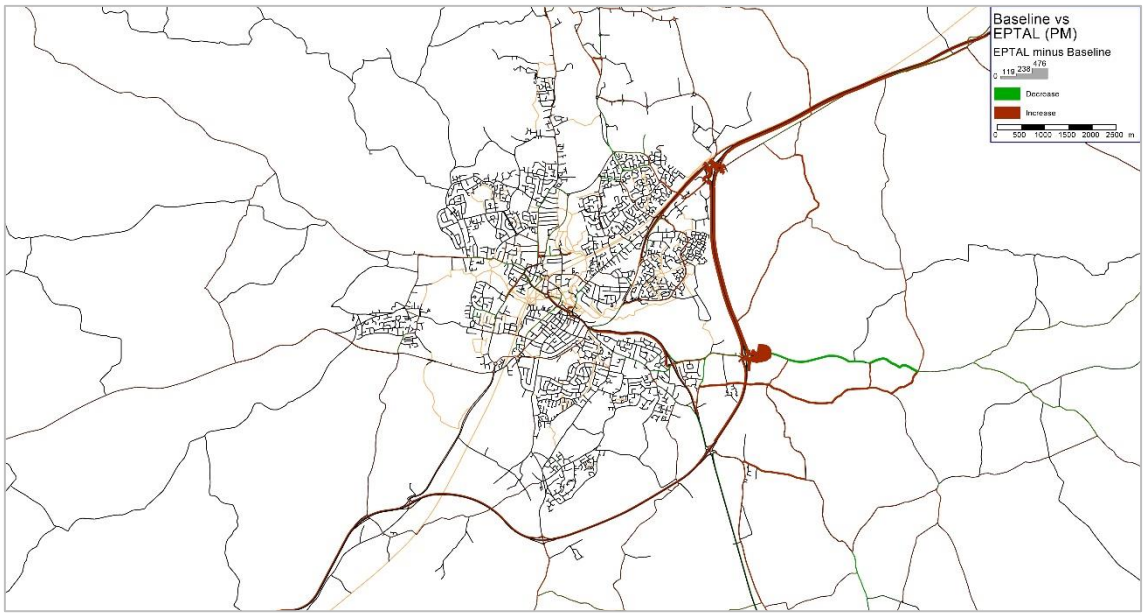

Figure 5-27: Reduced demand sensitivity test vs baseline - flow difference plot - 2041 PM Peak

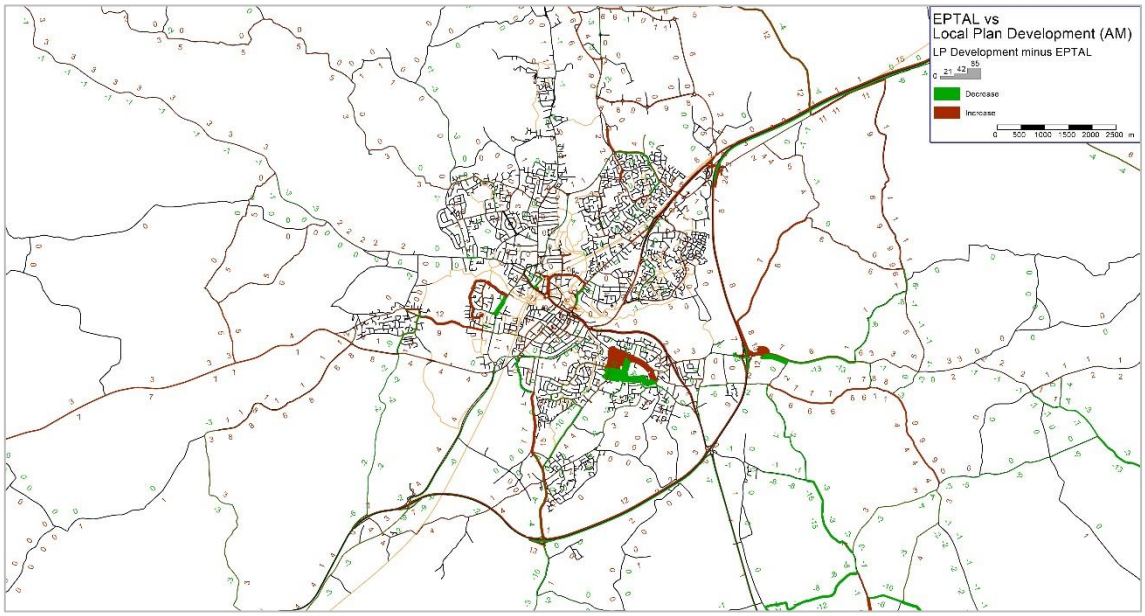

Figure 5-28: Preferred spatial approach – link flow difference without reduced demand – 2041 AM Peak

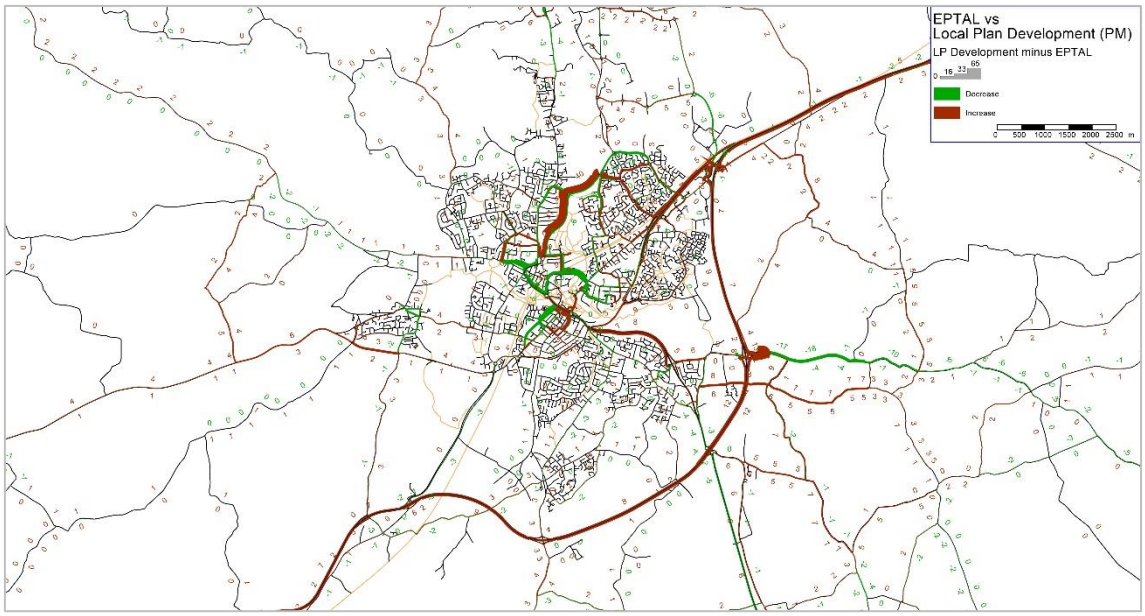

Figure 5-29: Preferred spatial approach – link flow difference without reduced demand – 2041 PM Peak

Taken at face value, the sensitivity test modelled with reduced levels of car/private vehicle demand is shown to have only a small impact, overall, on traffic flows modelled across the Chelmsford road network.

However, the spread of the impact across the wider road network – particularly across rural routes, suggests that the assignment of traffic in the forecast modelling is particularly responsive to congestion along strategic routes.

Should Local Plan development associated with the preferred spatial approach successfully demonstrate a higher proportion of trips being made via sustainable modes, then it is most likely that benefits will be seen through small reductions in traffic volumes travelling along rural routes and through villages such as Little Baddow, Sandon and Boreham.

There will be policy requirements at Hammonds Farm to maximise the internalisation of trips and active and sustainable travel schemes including sustainable corridor to Beaulieu Park Station/Sandon Park and Ride; connections over and below the A12 linking with existing and planned interventions; and improvements to the east of the site towards Danbury.

6 Junction Modelling

6.1 Supporting Evidence of Development Impact at Key Junctions

The scope of modelling for the transport impact appraisal of the preferred spatial approach covers an assessment of the forecast capacities of key junctions in the vicinity of the larger development sites.

The list of junctions identified for capacity modelling, along with the software/package used, are shown in Table 6-1 below.

Grouping	Junction	Model package
Chelmsford North-East	Sheepcotes Roundabout	
	Wheelers Hill Roundabout	
	Pratts Farm Roundabout	
	Belsteads Farm Roundabout	Junctions 10 / ARCADY
	Armistice Way Roundabout	
	Nabbotts Farm Roundabout	
	Beaulieu Parkway/CNEB Roundabout	
	Beaulieu Parkway/Rail Station Access Roundabout	
	Waltham Road / Main Road - Boreham	Junctions 10 / PICADY
A12 Corridor	A12 J17 Howe Green	LinSig
	A12 J18 Sandon	Junctions 10 / ARCADY
	A12 J19 Boreham Interchange	VISUM
City	Army & Navy Roundabout	LinSig
	Odeon Roundabout	Junctions 10 / ARCADY
	Eves Corner, Danbury	Junctions 10 / ARCADY

Table 6-1: Junctions included in capacity impact modelling

As of March 2024, discussions are ongoing with developers of the Chelmsford Garden Community (CGC) sites in north-east Chelmsford with regards to development mitigation. Junction capacity modelling has been undertaken by both Essex Highways and developers' consultants for the Chelmsford North-East junctions listed in Table 6-1, and includes proposed capacity improvements at several of the assessed junctions. These would be expected to be present in the Local Plan baseline modelling.

However, agreement has yet to be reached between ECC and the CGC developer's on the robustness of the models produced, as well as the extent and detail of mitigation to be provided – both in terms of capacity improvements and sustainable transport infrastructure.

It is important that the Chelmsford Local Plan Review evidence base accurately reflects the future position in north-east Chelmsford. Therefore, findings from the junction modelling appraisal of the preferred spatial approach will be documented in an addendum note or incorporated into an expanded version of this evidence base report.

7 Mitigation

7.1 Introduction

Baseline modelling suggests that by 2041, network congestion will likely worsen in key locations in and around Chelmsford. The addition of development traffic associated with the preferred spatial approach, would likely exacerbate existing problems, particularly along the A12 and A414 corridors.

Modelling suggests that proposed Local Plan development may have only a minor impact on traffic conditions in the centre of Chelmsford, likely due to both network constraint modelled 'upstream' along key corridors into and out of the city centre, and a wider dispersal of background traffic flows to accommodate development trips.

New junction infrastructure to mitigate the impact of development has not been assessed as part of this study. Instead, a review of developer proposals is presented in this report alongside recommendations for potential sustainable measures to help manage development flows.

To provide wider context, this section of the report first considers the sustainable accessibility of sites within the preferred spatial approach, and then reviews the impact of forecast modelled traffic congestion on levels of accessibility to existing and proposed public transport services and bus priority infrastructure.

7.1 Sustainable Accessibility Appraisal

As part of the Issues and Options stage of the Chelmsford Local Plan review, Essex Highways undertook a sustainable accessibility assessment of CCC's five initial spatial approaches. The methodology used and findings of this study are summarised in the 'Sustainable Accessibility Mapping & Appraisal Technical Note' issued in July 2022. Following confirmation of CCC's preferred spatial approach, RAG scores for each development site have been derived from the 'settlement areas' assessed previously.

Owing to a recognised difference in the accessibility criteria applicable to residential sites as opposed to employment sites, the RAG scores for Local Plan employment sites represent an average across employment-related criteria only - as shown in Table 7-1 below.

Criteria	Residential	Employment
Accessibility to urban centres	Y	Y
Accessibility to employment locations	Y	N
Accessibility to rail stations (walking & cycling)	Y	Y
Accessibility to rail stations (public transport)	Y	Y
Weekday bus services and frequency	Y	Y
Saturday bus services and frequency	Y	Y
Sunday and night (out of hours) frequency	Y	Y
Walking access to bus stops	Y	Y
UFBB internet connectivity	Y	N
Car driver mode share	Y	N
Accessibility to healthcare	Y	N
Accessibility to nurseries	Y	N
Accessibility to primary schools	Y	N
Accessibility to secondary schools	Y	N

Table 7-1: Criteria used for scoring of residential and employment sites

Table 7-2 below summarises the updated average RAG scores for each development site alongside its size as a percentage of the total new Local Plan housing and employment allocations in the preferred spatial approach. A more detailed breakdown of the scores given can be found in Appendix F.

	Average Sustainable Accessibility Score	% of Total Allocated Housing	% of Total Allocated Employment
Growth Area 1			
Chelmsford Urban Area (Residential)	3.00	20%	-
Chelmsford Urban Area (Employment)	3.00	-	30%
Growth Area 2			
Ford End	1.57	1%	-
Boreham	2.14	-	2%
Little Boyton Hall Farm	1.43	-	4%
North-East Chelmsford	2.57	-	8%
Growth Area 3			
East Chelmsford (inc. Hammonds Farm)	2.21	77%	56%
Bicknacre	1.64	1%	-
East Hanningfield	1.50	1%	-

Table 7-2: Average RAG scores for each development site

It is important to note that the RAG assessment of the East Chelmsford (inc. Hammonds Farm) sites, has been updated to reflect the proposed developer-funded infrastructure at this location. A similar approach was adopted previously for the 'North-East Chelmsford' site, and it is assumed that both will be developed

with active mode and bus infrastructure to offer high levels of sustainable accessibility across walking, cycling and passenger transport modes.

With over three quarters of the total allocation of housing and over half the allocated quantum of employment located in East Chelmsford – predominantly on the Hammonds Farm site, the preferred spatial approach places a focus on development in an area with a potentially good level of sustainable accessibility – subject to the provision of local amenities and sustainable travel infrastructure by developers.

A significant proportion of housing and employment is also allocated on land in the central urban area of Chelmsford, which would be expected to benefit from high levels of sustainable accessibility.

Elsewhere, whilst a proportion of housing and employment is allocated in less sustainable rural locations, as a percentage of the total Local Plan allocation, the quantum of development proposed in these areas is small and as set out in section 5, development in these areas is unlikely to have an adverse impact on the road network.

Overall, the allocation of development in the Local Plan preferred spatial approach provides the opportunity to make good use of existing and potential sustainable accessibility to and from proposed sites.

7.2 Impact on Access to Public Transport

A mapping assessment has been undertaken as part of this study, involving the overlay of forecast queue extents modelled for the preferred spatial approach onto a map of bus routes and bus priority measures (bus lanes etc.) in Chelmsford – both existing and proposed.

The purpose of this analysis is to highlight the potential impact of congestion on bus accessibility into, out of, and around the city centre. This analysis can be cross referenced with the development trip assignment plots shown in section 5.1 to determine where Local Plan development trips are shown to directly impact bus accessibility.

The mapping is presented in Figure 7-1 and Figure 7-2 on the following pages

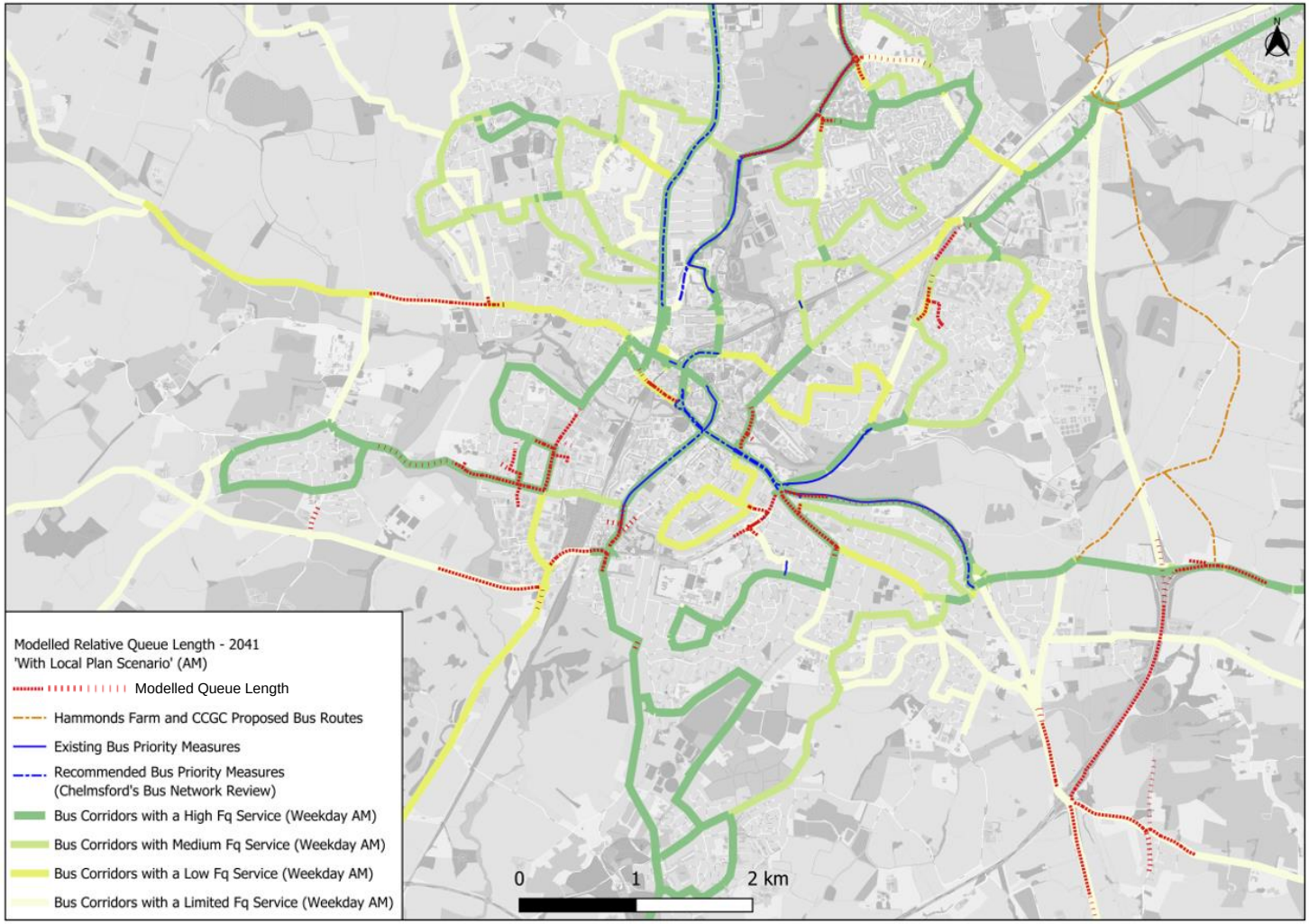

Figure 7-1: Modelled relative queue lengths – 2041 AM Peak with preferred spatial approach – overlayed on bus routes and priority measures

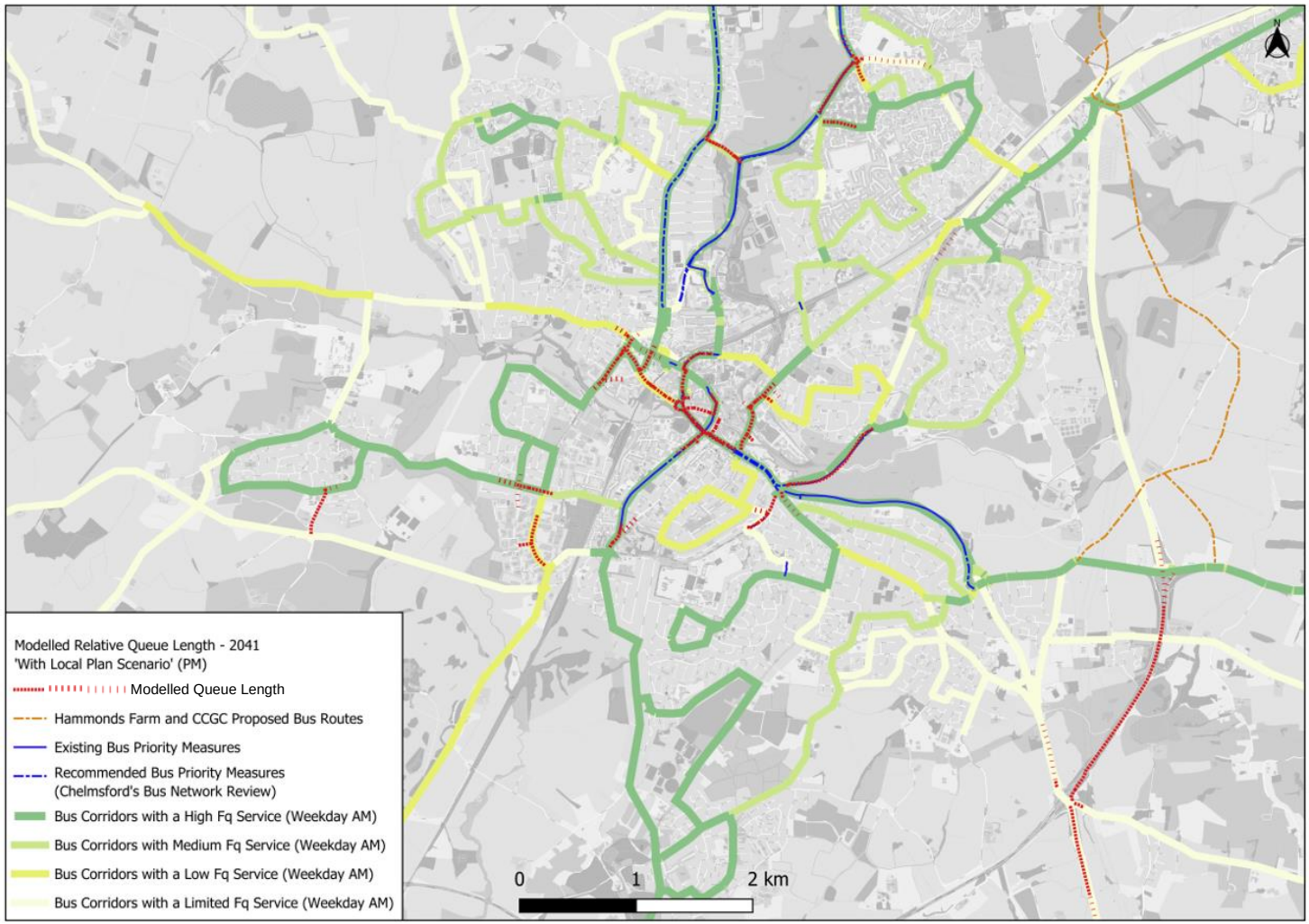

Figure 7-2: Modelled relative queue lengths – 2041 PM Peak with preferred spatial approach – overlayed on bus routes and priority measures

Focusing exclusively on bus corridors in Chelmsford where congestion has the potential to be exacerbated by Local Plan development, the following routes are highlighted:

- A414 westbound approach to A12 Junction 18 (Sandon Interchange)
- A1060 Parkway between Odeon and Market Roundabouts

It is recommended that bus accessibility is monitored along these routes, with consideration given to the possible implementation of bus priority measures - where there is reasonable highway land available.

Potential bus priority infrastructure on the A414 in the vicinity of Hammonds Farm is discussed further in the following section of this report.

7.3 Review of Developer Proposed Mitigation + Recommendations

7.3.1 Chelmsford Garden Community

Whilst the impact of proposed employment on the CGC site as part of the Preferred Spatial Approach is unlikely to be of sufficient size to warrant site-specific mitigation, it is recommended that a link is maintained between the Local Plan Review evidence base and infrastructure proposals in north-east Chelmsford. It is highly likely that the infrastructure delivered to accommodate the CGC development, and the timescales for its delivery, will have a bearing on the capacity of the wider road network, as well as National Highways' long-term proposals for the A12 corridor.

As of March 2024, discussions are ongoing between ECC and the developer consortium to agree on appropriate infrastructure to mitigate the impact of trips to/from the CGG.

Latest documents to support the planning application process for the CGC sites can be found online - https://chelmsfordgardencommunity.co.uk/library/.

7.3.2 Hammonds Farm

Initial proposals to mitigate the traffic impact of development at Hammonds Farm are contained within the Oct 2022 Stantec report 'Hammonds Farm Transport Technical Report[9]' which will be further refined through the ongoing Local Plan,

[9] https://consult.chelmsford.gov.uk/kseapi/public/submissions/198806/representations/3869302/attachments/772133/file

master planning and planning application process, to ensure any measures are deliverable and viable.

The Hammonds Farm development is already required to provide substantive improvements connecting the site across the A12 and linking and enhancing the planned sustainable links being provided by the East Chelmsford developments; Army and Navy improvements and outcomes from the Chelmsford Local Cycling and Walking Infrastructure Plans (LCWIPs).

Central to these proposals are the provision of a bus, walking and cycle-only bridge link over the A12 connecting the development to the western side of the A12 to where Sandon Park and Ride, East Chelmsford site allocations, schools, leisure facilities and the city centre are located. Provision is also made for an Eastern Orbital Route serving as a bus corridor enabling access for proposed new bus services to Beaulieu Rail Station.

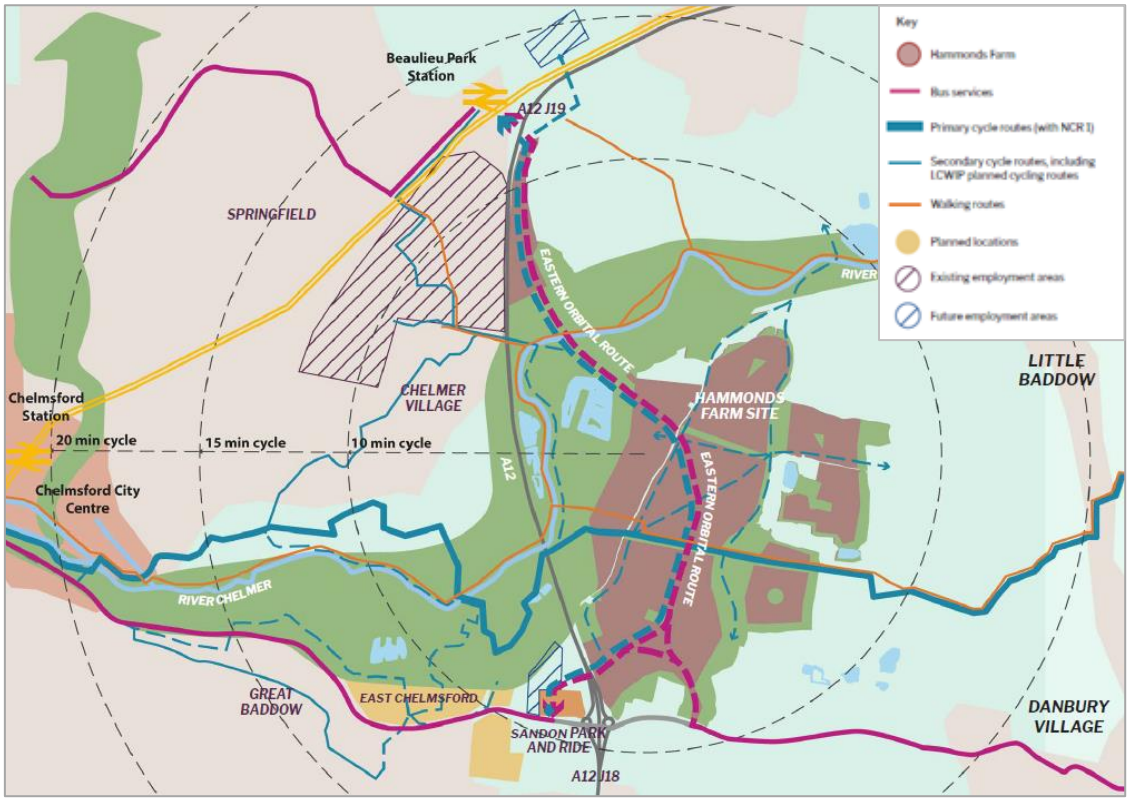

Figure 7-3: Hammonds Farm access strategy

Access proposals outlined in the strategy via the A414 and A12 J19 are of insufficient detail to be modelled specifically and/or be reviewed as part of this study. The design detail around site access proposals is expected to be agreed between the developer and ECC as part of the planning application process.

Access via proposed bridge link and Sandon Park and Ride site

A range of potential options are being investigated to provide connectivity via a new bridge (walking, cycling and bus) between the Hammonds Farm site and the A414 close to Sandon Park and Ride. Any option will consider the potential to link in with emerging proposals regarding the strategic sites in East Chelmsford and improvements identified in the Army and Navy Sustainable Transport Package in order to provide onward connectivity benefits.

The proposed bus, walking and cycle-only bridge link over the A12 is necessary to help deliver the required mode shift away from the car and towards more sustainable modes of travel. This, in turn, would likely help reduce the impact of car trips on the surrounding road network – particularly the modelled pinch-point on the A414 on the approach to the A12 Junction 18.

An important objective of any mitigation proposal will be to help reduce background traffic from Danbury and Maldon away from A12 junction 18, thereby providing capacity for development trips and helping to achieve a nil-detriment impact on flows along the A414. In this location, a key focus will need to be placed on the provision of robust, frequent and attractive sustainable transport options from the site to key attractors (such as the city centre) so that significant mode shift is realised.

To mitigate the impact of congestion along the A414 on the approach to Junction 18, consideration should also be given to the provision of a bus lane on the westbound approach to the Hammonds Farm access junction, supported by priority signals to accommodate buses into and out of the site and beyond into Chelmsford city centre. The bus lane might then be extended up to the A12 Junction 18, with the provision of a bus gate to help bypass queue extents on the approach.

Critical to the planning application process should be a requirement to ensure that background traffic flows along the A414 are not unreasonably delayed by the addition of development trips. This may well require significant highway measures in the vicinity of the site access.

Recommended mitigation for consideration in addition to developer proposals:
• Westbound bus lane on approach to site access with bus priority signals
• Extended westbound bus lane to A12 Junction 18 with bus gate

Bus Access to Beaulieu Rail Station

Bus connectivity to Beaulieu Rail Station would provide inter-connected passenger transport links facilitating longer-distance journeys to/from Hammonds Farm via sustainable modes of travel.

Modelling has, however, raised a potential concern with the capacity of the RDR south of the Beaulieu Rail Station access junction (the exit from Boreham Interchange). With no scope for widening the bridge link over the rail line to provide additional capacity, or a bus lane, to expedite sustainable access to the rail station, usage of bus services between Hammonds Farm and Beaulieu Rail Station may be limited if congestion causes significant journey time delay.

Options are currently being discussed with developers of CGC to help improve the flow of traffic on the approach to the Beaulieu Rail Station access junction. Nevertheless, it is recommended that delays along the route are monitored over time to determine the long-term viability of the route as a bus access link between the Hammonds Farm development and Beaulieu Station.

Should future journey times to Beaulieu Station via the Boreham Interchange increase substantially, consideration should be given to placing additional focus on enhancing the provision of sustainable transport links to the existing rail station in Chelmsford city centre. Services could make use of the existing bus lane along the A1114 Essex Yeomanry Way (Baddow Bypass) and improved access through the redesigned Army and Navy Roundabout. However, PM peak traffic congestion along Parkway in the city centre would need to be managed to help improve travel times for buses heading out of the city centre.

7.4 The A12 corridor and Junction 17 Howe Green

VISUM model outputs demonstrate that the A12 corridor between Junctions 17 and 19 will operate without spare capacity and will likely experience significant congestion by 2041 in a baseline scenario without additional Local Plan development trips.

The A12 Junction 17 at Howe Green is also modelled with significant congestion in the 2041 baseline. Queues on the southbound off-slip are shown in the modelling to extend back along the A12 carriageway. At the same time, northbound congestion along the A12 is observed in reality to contribute towards delays on the northbound on-slip, impeding movements exiting from the junction.

The addition of Local Plan traffic from proposed development at Hammonds Farm and the employment site adjacent to the A12 Junction 18, would be expected to exacerbate forecast congestion along the A12 and, to a lesser extent, through Junction 17 at Howe Green.

A12 carriageway widening between Junctions 15-19 is not considered in National Highways' Road Investment Strategy (RIS3) pipeline for the period 2025-2030, and it is not clear whether National Highways are considering carriageway improvements beyond this period.

Junction 17 at Howe Green has been the subject of Essex Highways studies in the past, looking at possible capacity improvements to accommodate future growth in traffic. There are recognised restrictions on space at the junction that prevent carriageway widening sufficient to provide the capacity to accommodate long-term traffic flows. A redesign of Junction 17 would therefore require coordination with proposals to widen the A12 carriageway at the location.

Howe Green is a recognised congestion hotspot and is a long-term issue to be considered by ECC in partnership with National Highways.

According to NPPF guidance, there is an expectation for local plans and spatial development strategies *"to be underpinned by a clear and transparent evidence base which informs the authority's preferred approach to land use and strategic transport options, and the formulation of policies and allocations that will be subject to public consultation. (National Highways) will expect this process to explore all options to reduce a reliance on the Strategic Road Network for local journeys including a reduction in the need to travel and integrating land use considerations with the need to maximise opportunities for walking, wheeling, cycling, public transport and shared travel*[10]".

Discussion, under the duty to co-operate will continue with National Highways to keep them aware of the impact of the development sites along the A12 and to work collaboratively to inform the scope of sustainable mitigation required to best manage the impact of traffic flows and limit the volume of development trips routing via the A12.

[10] Policy paper: Strategic road network and the delivery of sustainable development https://www.gov.uk/government/publications/strategic-road-network-and-the-delivery-of-sustainable-development/strategic-road-network-and-the-delivery-of-sustainable-development

8 Conclusion

With a focus on development along the A12 corridor, the modelled traffic impact of the preferred spatial approach is largely limited to the A12 corridor, the junctions along it and, to a lesser extent, the A1114 and A138 corridors into Chelmsford City Centre. The minor quantum of development allocated in rural areas of Chelmsford is of insufficient size to likely impact the local road network.

Overall, the allocation of development in the Local Plan preferred spatial approach provides the opportunity to make good use of existing and potential sustainable accessibility to and from proposed sites. However, this will be dependent on the delivery of the bus, cycling and walking infrastructure proposed by developers, as well as additional measures required to provide the necessary connectivity to the wider sustainable transport network. This will be crucial to ensure that the growth in trips associated with the proposed development is managed and does not have a negative impact on the surrounding local area.

Forecast modelling suggests that the impact of traffic flows associated with the preferred spatial approach will have a minor impact along the A12 corridor – relative to background traffic growth. By maximising the potential for sustainable accessibility to and from the sites along the A12 corridor, the impact on the strategic highway network should not be considered severe. However, continued discussions with National Highways will be necessary to best ensure that future development growth in Chelmsford can be supported by the strategic highway network over the long-term.

Appendices

9 Appendix A: Supporting Technical Notes

Below are three supplementary reports which should be read alongside this technical note. These are as follows:

- Appendix A1: TEMPro V7.2 and V8.0 Background Growth Comparison
- Appendix A2: Pre and Post Covid-19 Traffic Flow Comparison
- Appendix A3: Low, Core and High Growth Scenarios

Appendix A1: TEMPro V7.2 and V8.0 Background Growth Comparisons Supplementary Report

1. Introduction

TEMPro (Trip End Model Presentation Program) enables users to access and analyse the datasets from the National Trip End Model (NTEM) in order to forecast traffic growth associated with future housing and employment. For the Chelmsford Local Plan Review modelling, TEMPro has been used to determine background traffic growth in the initial assessment of spatial approaches and the subsequent appraisal of the preferred approach.

The latest version of TEMPro (version 8.0) was released in 2022. Shortly after, Essex Highways undertook a study comparing v8.0 and v7.2 datasets and found that the latest version assumes a significantly lower core scenario growth in housing and development in Chelmsford and surrounding local authorities than previous iterations. The study concluded that v7.2 projections were more in-line with current planning assumptions in Essex over the next 15-20 years. As such, the study recommended that TEMPro v7.2 continue to be used on modelling projects in Essex until further guidance is issued by the DfT on the appropriate application of v8.0 datasets.

This technical note summarises the findings from this study to help support the decision to use v7.2 datasets for the Chelmsford Local Plan Review modelling.

2. Comparison of v7.2 and v8.0

A study was undertaken analysing v7.2 and v8.0 TEMPro data compared to housing requirements and build out in Essex, Southend, and Thurrock[11]. The table below shows the difference in the number of houses in TEMPro v7.2 and v8.0 and how these figures compare to the number of homes required and built between 2018/19 – 2020/21.

Table A1-1: TEMPro v7.2 and v8.0 housing growth forecasts compared to housing requirements and build out in Essex

ONS Code	Area Name	2018/19 to 2020/21 Period			
		Homes required	Homes Built	TEMPro v7.2	TEMPro v8.0
E07000066	Basildon	2,717	1,117	1,540	696
E07000067	Braintree	1,848	2,302	2,248	299
E07000068	Brentwood	1,169	774	474	174

[11] Housing requirements and build out totals sourced from: DLUHC, 2022: 'Housing Delivery Test: 2021 Measurement'

E07000069	Castle Point	912	451	1,245	-18
E07000070	Chelmsford	2,082	2,917	3,214	704
E07000071	Colchester	2,375	3,173	2,957	1,292
E07000072	Epping Forest	2,436	847	651	471
E07000073	Harlow	933	1,936	956	356
E07000074	Maldon	791	1,217	1,100	183
E07000075	Rochford	933	958	1,088	292
E06000033	Southend-on-Sea	3,041	947	1,663	577
E07000076	Tendring	1,420	2,345	2,063	800
E06000034	Thurrock	3,001	1,459	4,029	865
E07000077	Uttlesford	1,848	1,830	1,610	811
ALL	**Essex**	**25,503**	**22,273**	**24,839**	**7,502**

Table A1-1 shows that TEMPro v8.0 consistently underestimated housing growth by a large margin, compared to v7.2, across all districts in Essex. In Chelmsford, v8.0 figures were reported to be 78% less than v7.2. TEMPro v8.0 also recorded an anomalous decline in the number of houses in Castle Point across the three-year period, raising further concerns about its accuracy.

Table A1-2 below shows a more detailed summary of the differences between TEMPro v8.0 and v7.2 figures and the number of homes required and built in Chelmsford district. TEMPro v8.0 figures for Chelmsford were roughly 76% less than what was actually built, whereas TEMPro v7.2 figures were only 10% more than what was built. The study concluded that TEMPro v8.0 could not be reliably used for the period up to 2020/21 as the number of houses were out of sync with observed house building and therefore traffic growth related to the number of households. As such, any growth factors calculated from a base year at, or before 2021 were not likely to provide a reliable estimate of growth.

Table A1-2:: TEMPro v8.0 and TEMPro v7.2 forecasts compared to the number of homes required and homes built.

TEMpro version	TEMPro forecast	Homes Required	Homes Built	% Difference between TEMPro forecast and homes required	% Difference between TEMPro forecast and homes built
V7.2	3,214	2,082	2,917	54%	10%
V8.0	704			-66%	-76%

Figure A1-1 below shows TEMPro forecasts to 2046 for both v7.2 and v8.0.

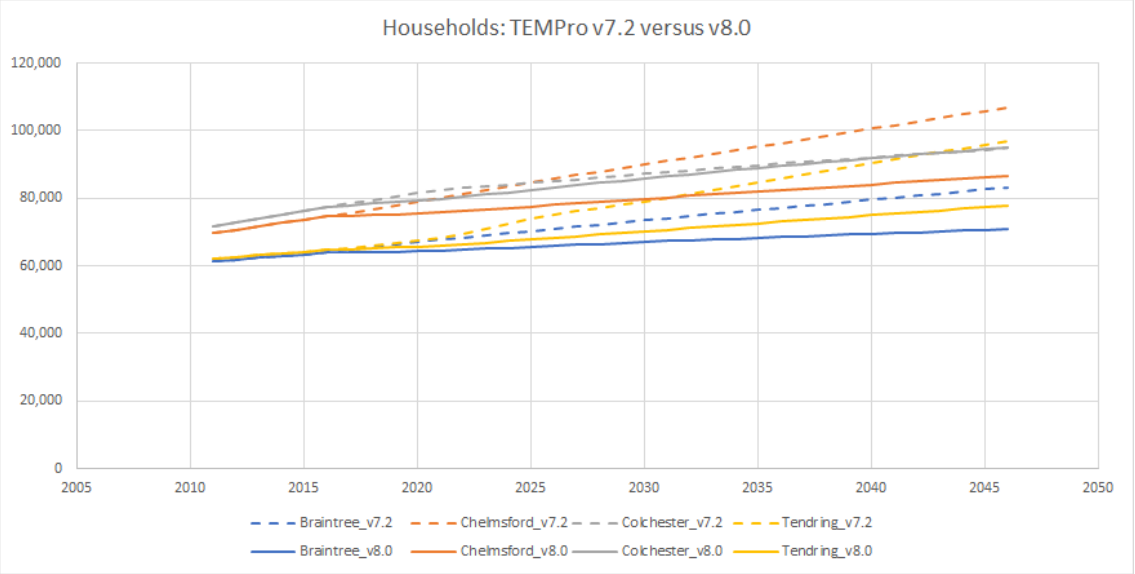

Figure A1-1: TEMPro v7.2 versus v8.0 forecasts for housing growth 2011 - 2046

The number of houses in v7.2 and v8.0 start to deviate from each other around 2017. Whilst v7.2 forecasts follow a straight upward trajectory that is a continuation from 2011, v8.0 forecasts appear to follow a much shallower trajectory from 2017.

Following the trajectories shown in Figure A1-1, the predicted growth in households and jobs in both TEMPro v7.2 and v8.0 over the extended Local Plan Review period 2036-2041 is summarised in Table A1-3 below. When compared with the housing and employment assumptions modelled for the Local Plan Review, v8.0 values are significantly lower.

Table A1-3: 2036-2041 Chelmsford housing and employment projections - Local Plan vs TEMPro v7.2 vs v8.0

	Chelmsford Local Plan Allocation (2036-2041)	TEMPro v7.2	TEMPro v8.0
Growth in Households	6500	5270	2041
Growth in Jobs	4303	1468	506

3. Conclusions

It is recommended that TEMPro v7.2 is used to determine background traffic growth for the local plan modelling appraisal due to the significantly low growth assumed in v8.0 and larger discrepancies between TEMPro v8.0, housing requirements and actual homes built compared to v7.2. This decision is in line with Essex Highways' previous recommendation to continue to use v7.2 datasets for all Chelmsford projects.

Appendix A2: Pre and Post Covid-19 Traffic Flow Comparison Supplementary Report

1. Introduction

The Chelmsford Local Plan Review modelling is underpinned by the Army and Navy VISUM model which is based on 2019 traffic flows. The decision has been made to continue using 2019 data as opposed to updating the base model to reflect current traffic. This decision follows a desktop study comparing pre and post Covid-19 traffic counts. This technical note summarises the outcomes of the desktop study and outlines the justifications for the continued use of 2019 trips for the Chelmsford Local Plan Review modelling.

2. Data Selection

Continuous counter data was extracted for the dates listed below to enable a comparison of pre and post Covid-19 traffic flows:

- Pre-Covid Dates: 1st September – 31st November 2019.
- Post-Covid Dates: 1st March – 30th June 2023.

The most recent data available was obtained for 2023 to represent post-pandemic flows. The year 2019 was used for pre-pandemic flows as this was consistent with the Chelmsford VISUM model base year. The months September to November were used for 2019 covering the period after the removal of the flyover at the Army and Navy roundabout and before the start of the Covid-19 pandemic. Data was extracted for neutral months for both scenarios to ensure consistency across the two samples and reduce the impact of seasonality.

Data was extracted from a total of 8 counters located on key routes in and out of Chelmsford, as shown in Figure A2-1 overleaf.

Figure A2-1: Chelmsford Counter sites selected for the pre/post Covid-19 Traffic Flow Comparison.

Pre and Post Covid-19 traffic flows were compared at each counter location for the three time periods defined below:

- AM Peak: 07:30 – 08:30
- IP: 10:00 – 16:00
- PM Peak: 17:00 – 18:00

These times are consistent with those used in the Army and Navy modelling.

A t-test analysis was carried out to determine whether there were any significant differences between the sampled, pre and post Covid-19 counts. The test considered the difference in the means and, the difference in the variation of the two samples.

Table A2-1 on page 93 shows the pre and post-Covid19 average daily flows (ADF) for each counter location for the times outlined above and, the results of the t-test. Section 3 below summarises the findings of this statistical analysis.

3. Pre and Post Covid-19 comparisons – Summary of Findings

Whilst Table A2-1 on the following page shows that there are statistical differences between pre and post Covid-19 traffic flows at individual count sites, at an aggregate level, there is no significant difference for both the AM and PM peaks. This supports DfT findings that overall volumes are still at pre-pandemic levels and have not yet stabilised. Given that the VISUM model uses count data at an aggregate level, 2019 data is still appropriate for use and provides a reliable, stable base for the modelling.

Updating the base VISUM model would also require new mobile phone origin-destination data to better reflect current travel patterns and behaviours. This would require a significant investment which could not be justified at this time, given the lack of certainty around the stability of traffic patterns.

	Weekday ADF - AM: 07:30 - 08:30				Weekday ADF -IP: 10:00 - 16:00				Weekday ADF -PM: 17:00 - 18:00			
Counter Location	Pre-Covid 19 (Sept - Nov 2019)	Post-Covid 19 (Feb - April 2023)	Statistically Significant Difference	% Difference	Pre-Covid 19 (Sept - Nov 2019)	Post-Covid 19 (Feb - April 2023)	Statistically Significant Difference	% Difference	Pre-Covid 19 (Sept - Nov 2019)	Post-Covid 19 (Feb - April 2023)	Statistically Significant Difference	% Difference
A - A1016 Chelmer Valley Rd	2291	2352	Y	2.6%	1459	1580	Y	8.3%	1924	2054	Y	6.7%
B - A414, Three Mile Hill	2655	2487	Y	-6.3%	1759	1722	Y	-2.1%	2449	14681	Y	499.5%
C - B1137, Springfield Rd	898	842	Y	-6.3%	677	638	Y	-5.8%	767	787	N	2.6%
D - B1008, Broomfield Rd	1443	1272	Y	-11.9%	1196	1151	Y	-3.8%	1491	1399	Y	-6.1%
E - A1060, Roxwell Rd	1583	1718	Y	8.5%	966	1090	Y	12.8%	1594	1628	N	2.1%
F - A1060, Parkway	3061	2993	Y	-2.2%	2717	2638	Y	-2.9%	3057	2853	Y	-6.7%
G - A1114, Gt Baddow By-Pass	2366	2224	Y	-6.0%	1902	1907	N	0.3%	2337	2246	Y	-3.9%
H - A138, Chelmer Rd	2432	2518	Y	3.6%	2325	2315	N	-0.4%	2685	2757	N	2.7%
All Sites	**16358**	**16379**	**N**	**0.1%**	**12766**	**13040**	**Y**	**2.1%**	**15946**	**16059**	**N**	**0.7%**
All Sites (Excluding Three Mile Hill)	**13872**	**13892**	**N**	**0.1%**	**11120**	**10943**	**Y**	**-1.6%**	**13653**	**13724**	**N**	**0.5%**

Table A2-1: Pre and post covid-19 comparison of traffic flows.

ADF – Average Daily Flow (Based on non-neutral month – excluding weekends and bank holiday

4. Conclusion

It is recommended that the 2019 VISUM Army and Navy base models continue to be used for the Chelmsford Local Plan Review Modelling. Whilst there are statistical differences between 2019 and 2023 traffic flows at individual count sites, at the aggregate level there is no significant difference in both the AM and PM peaks. 2019 therefore remains a more reliable base year for forecasting, given that current travel patterns have not yet stabilised and are subject to higher levels of uncertainty.

Appendix A3: Low, Core and High Growth Scenarios Supplementary Report

1. Introduction

There is an increasing acceptance across the industry of the lack of certainty when predicting future traffic growth, influenced by the inherent unpredictability surrounding the uptake of new technologies and changes in future travel behaviour. It is not possible to robustly identify a 'most likely' or expected outcome with any certainty, and the further we forecast into the future, the accuracy of the modelling approach declines and uncertainty increases. Therefore the use of 'alternative' growth scenarios help to establish a range of likely outcomes.

This has led to a range of growth forecasts provided by the Department for Transport (DfT) for use in traffic modelling, which aims to both mitigate and reflect this uncertainty. However, forecasts are by nature uncertain, and even when using unbiased assumptions there is no guarantee that the outturn result of scheme implementation will match the forecast.

As outlined in TAG Unit M1, it is recommended that modifications to the transport network should be, where appropriate, tested under different growth assumptions (referred to as 'alternative scenarios') to highlight any risks to the benefits or impacts of a scheme, and to acknowledge this uncertainty around future traffic forecasts.

However, the guidance also recognises that the use of Alternative Growth Scenarios in modelling should be proportionate to the level of detail required. Therefore, in the case of the Chelmsford Local Plan Review, the decision has been taken to only model a single growth scenario, as this has been deemed sufficient for the modelling and commensurate with the level of detail required for the Local Plan review evidence base.

Whilst alternative growth scenarios won't be explicitly modelled as part of the Local Plan Review evidence base, a supplementary assessment has been undertaken to review the impact of the Alternative Growth Scenarios on traffic flows on key links across Chelmsford, recently modelled as part of the Army and Navy Strategic Outline Business Case.

The outcomes of the additional analysis are documented within this supplementary report.

2. Growth Scenarios

2.1 Core Growth Scenario

The Core Scenario is based on a set of central assumptions. It includes only future land-use and transport network developments which have a high degree of certainty (usually based on existing Local Plan allocations, planning consents and committed transport schemes) and is consistent with TEMPro travel demand forecasts at the sub-regional / district level and DfT's Road Traffic Forecasts (RTF2018) as appropriate.

It is intended to provide a sensible, consistent basis for decision-making given current evidence, and provides a 'common comparator' to assess all projects and options against. The Core Scenario is based on:

- NTEM growth in demand, at a suitable spatial area;
- Sources of local uncertainty that are more likely to occur than not; and
- Appropriate modelling assumptions

As outlined in TAG Unit M4, a core scenario appraisal should always be undertaken when assessing the impact a scheme, or of development, on a transport network.

However, as mentioned previously, there are significant and often unquantifiable uncertainties associated with forecasting travel demand, and therefore other scenarios should be considered in line with the guidance in TAG Unit M4, including Low/High Growth scenarios to reflect uncertainties in the national travel demand forecasts.

2.2 Alternative Growth Scenarios

Alternative growth scenarios are a set of background assumptions incorporating 'with scheme' and 'without scheme' forecasts that may have different supply and/or demand assumptions from the core scenario.

- High Growth – Assumes a greater increase in private transport usage over the Core Scenario due to (for example) advancements in technology that help reduce the relative financial and environmental cost of travel.

- Low Growth – Assumes a greater reduction in private transport usage over the Core Scenario due to (for example) increases in the cost of living and stricter environmental targets being set to manage vehicle emissions.

3. Comparison of Alternative Growth Scenario Outputs from A&N Modelling

As part of the strategic modelling carried out on the options for the Army and Navy junction in Chelmsford, national uncertainty in traffic growth was addressed using the standard TAG High and Low growth scenarios as outlined above.

The below sub-sections illustrate the impact of the alternative growth scenarios when compared with the Core scenario on traffic flows as observed in the Army and Navy forecast modelling.

3.1 Traffic Flow Difference Plots

The figures below provide an overview of the network differences in traffic flows between the Core growth scenario and the alternative (Low and High) growth scenarios in the 2021 Do Something model, across the AM, IP and PM periods.

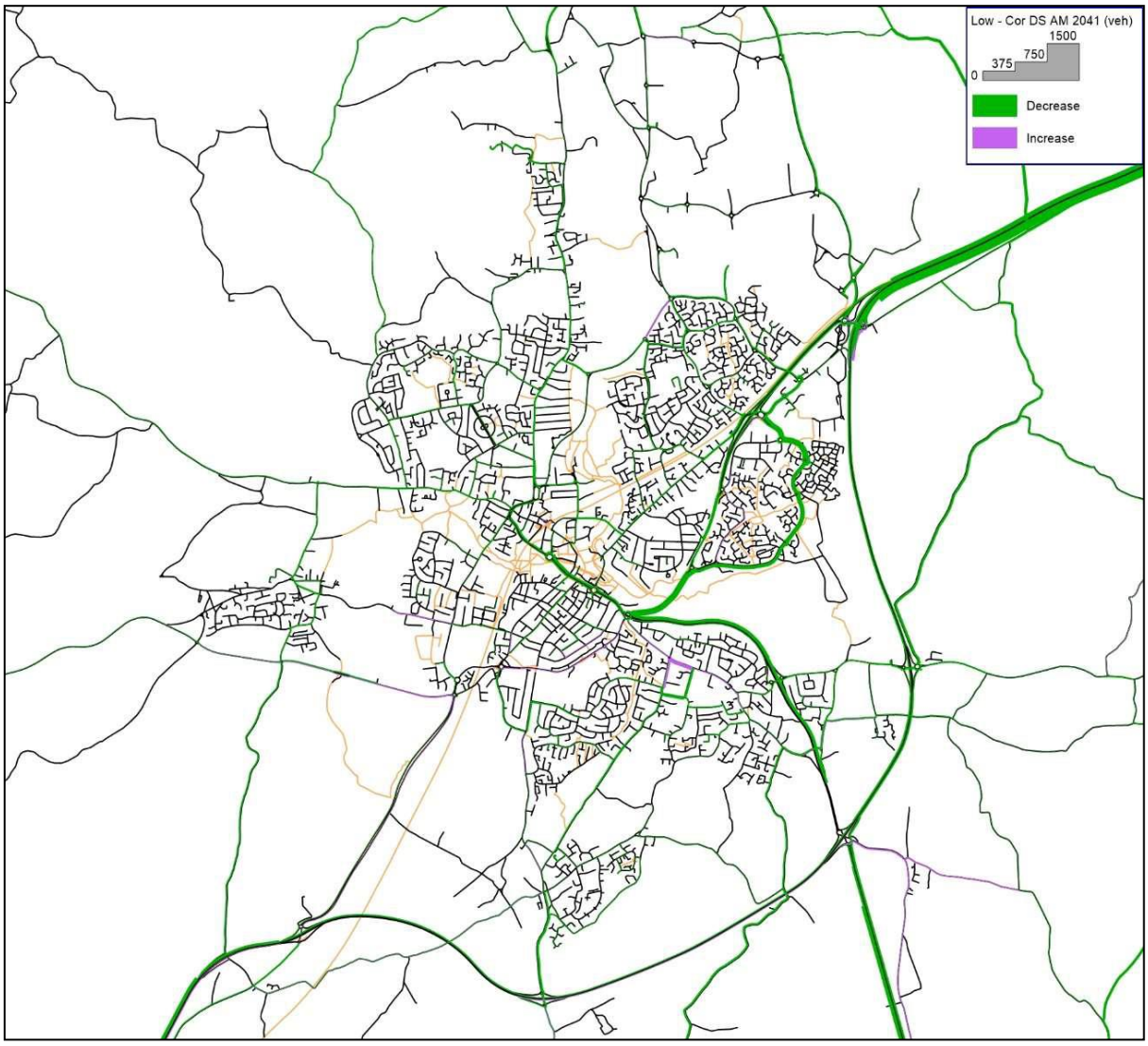

Figure A3-1: Traffic Flow Difference Plots Low Growth vs Core - DS 2041 AM Peak

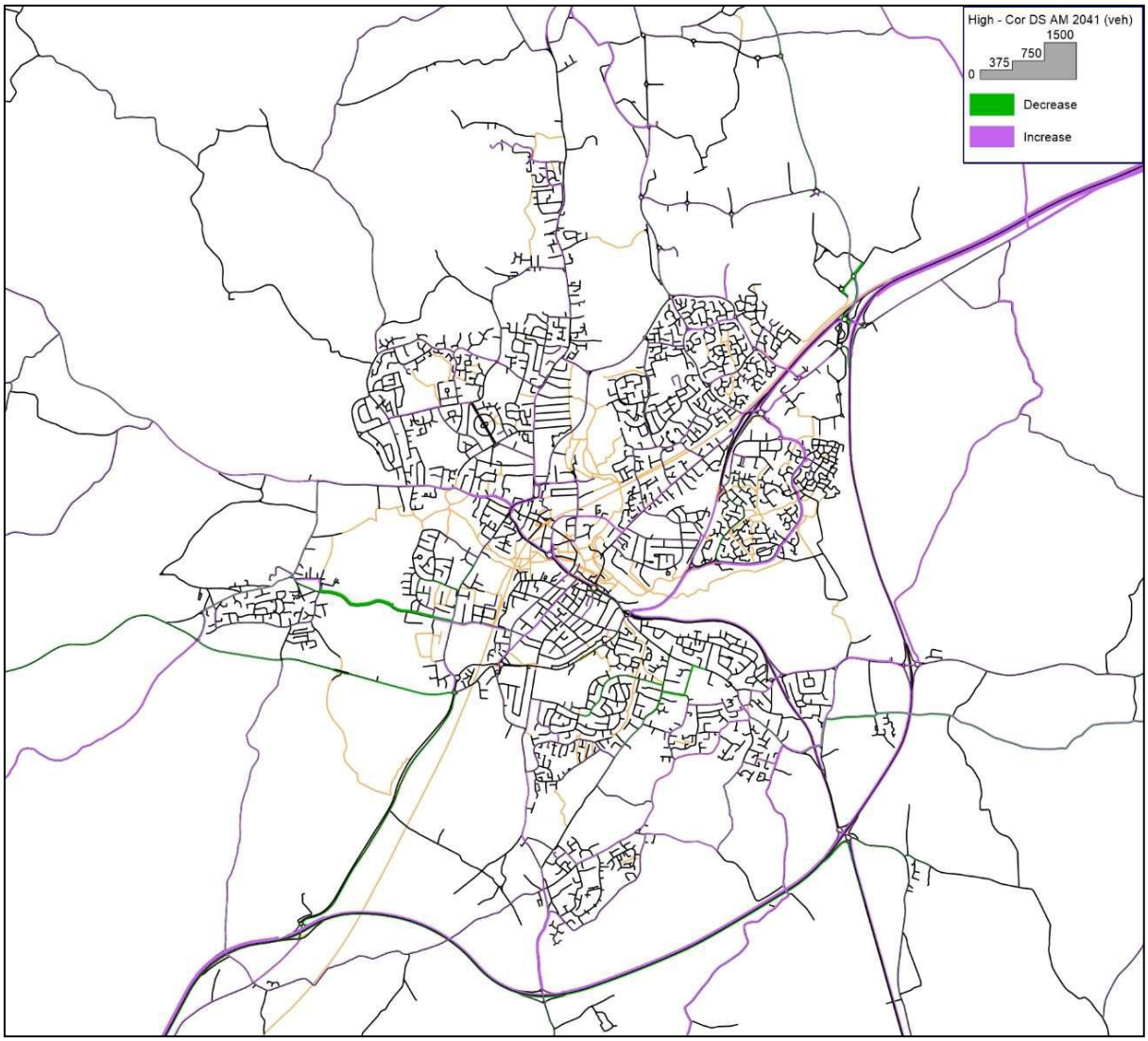

Figure A3-2: Traffic Flow Difference Plots High Growth vs Core - DS 2041 AM Peak

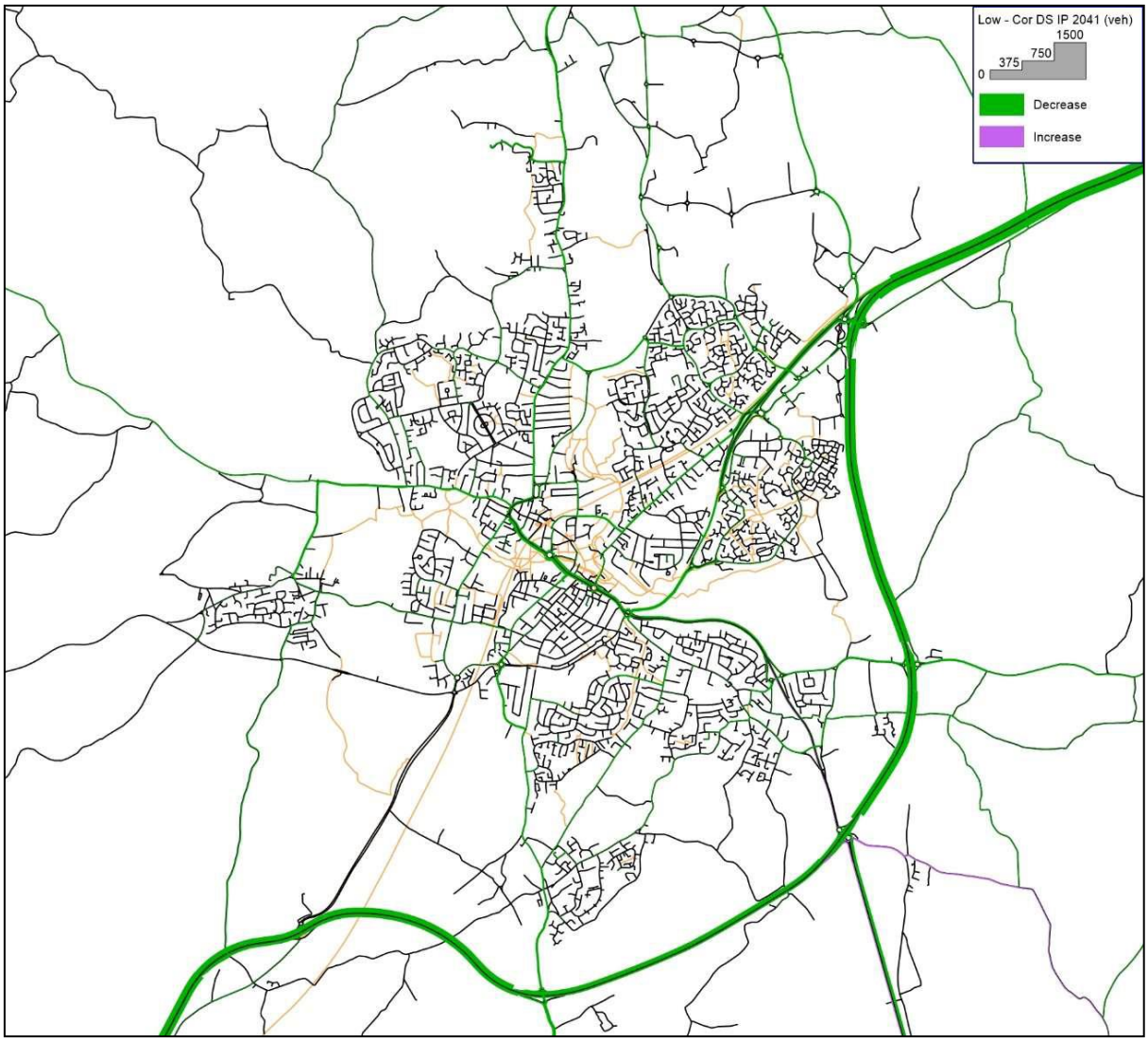

Figure A3-3: Traffic Flow Difference Plots Low Growth vs Core – DS 2041 Inter-peak

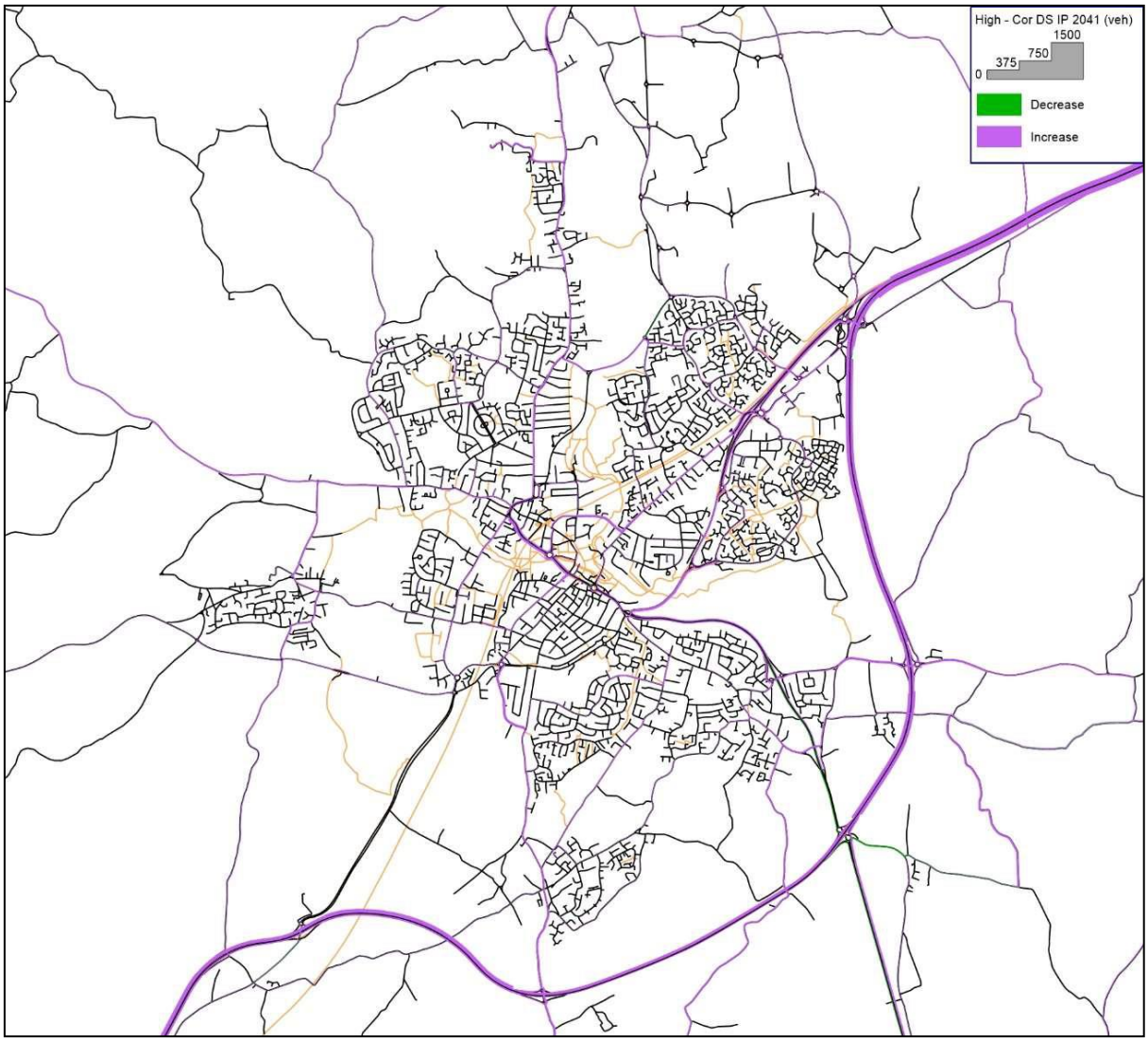

Figure A3-4: Traffic Flow Difference Plots High Growth vs Core - DS 2041 Inter-peak

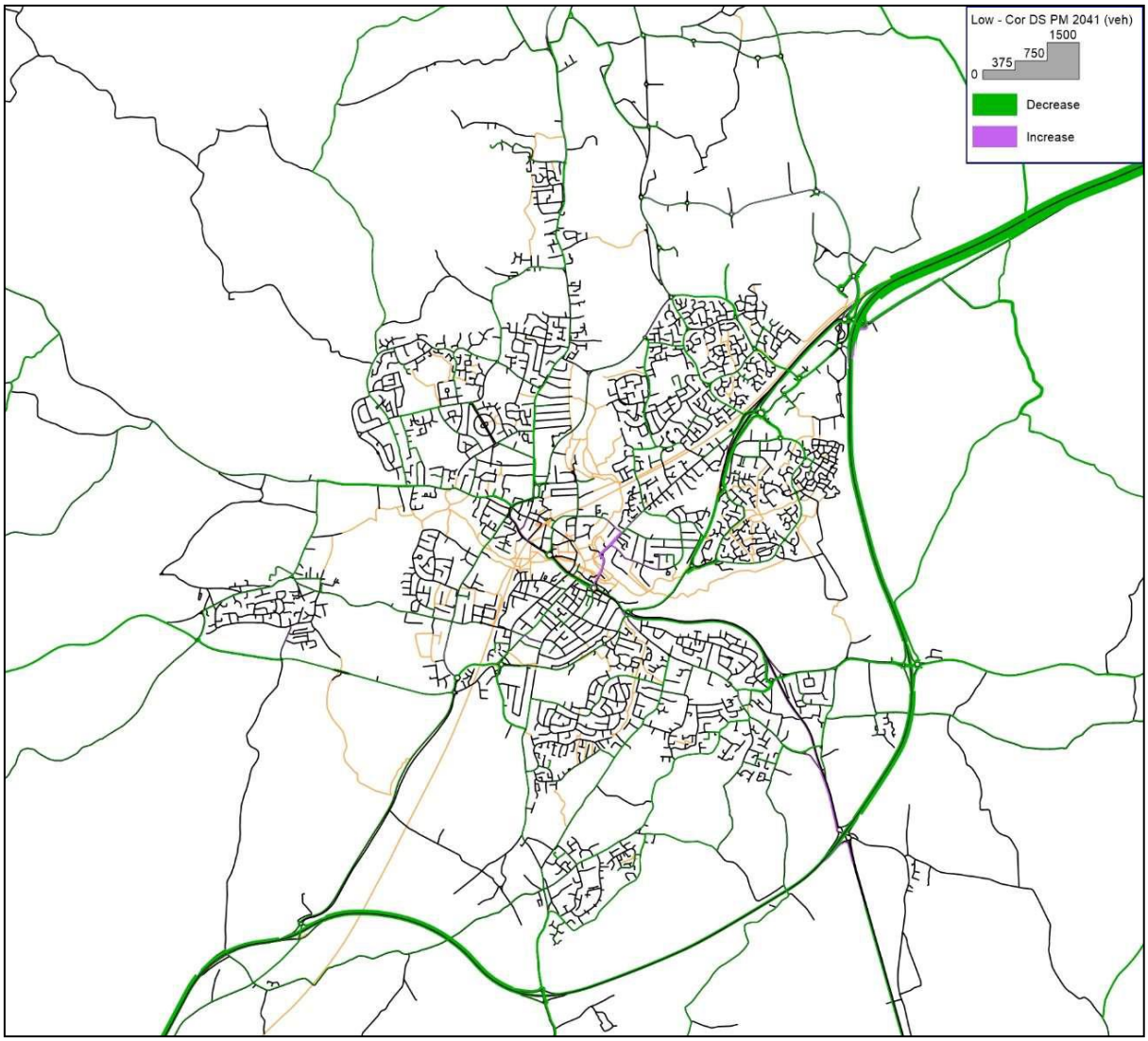

Figure A3-5: Traffic Flow Difference Plots Low Growth vs Core – DS 2041 PM peak

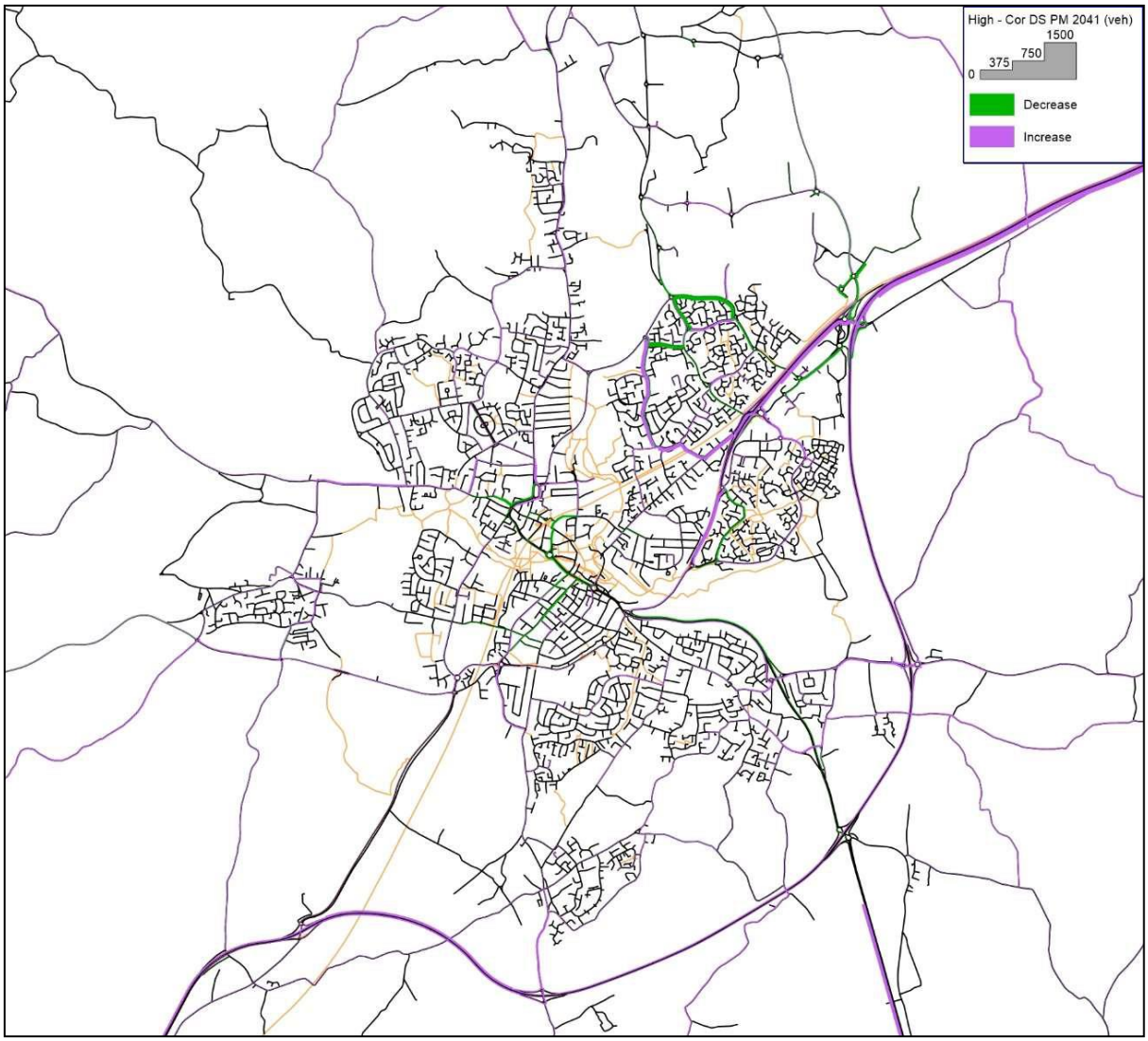

Figure A3-6: Traffic Flow Difference Plots High Growth vs Core – DS 2041 PM peak

The flow difference plots presented above illustrate the impact of both the alternative growth scenarios when compared to the Core scenario.

When comparing the network impact of Low growth compared to the Core scenario, the impact on traffic flows is relatively stable, represented by a reduction in traffic flows in most areas of the network across all periods.

When comparing the network impact of High growth compared to the Core scenario, the traffic flow difference plots indicate that the impact on traffic flows is less significant, with relatively little change along key strategic routes in the peak hours. This indicates that the network is generally at or close to capacity in the peak periods in the 2041 Do Something scenario and that additional traffic under the High growth scenario cannot be accommodated. These car trips are either being reassigned in the model to alternative routes (to reflect traffic rerouting) or being removed from the network (to reflect a change in the time of travel or a shift to alternative modes) because of the variable demand modelled response to network congestion.

The impact of trip reassignment caused by network congestion in the High Growth scenario can be seen in Figure A3-4 and A3-6, where trips are being rerouted away from the key corridors and onto alternative rural routes, such as Hammonds Road to the east of the A12 and Margaretting Road to the west of Hylands Park - both of which experience an increase in vehicle flow.

Under the High growth scenario, some sections of route are shown with a decrease in traffic flow, which can be explained by congestion modelled at locations upstream or downstream resulting in traffic being reassigned away from the route entirely.

3.2 Key Corridor Analysis

The tables below provide a more detailed comparison of modelled traffic flows on key corridors across Chelmsford, in the Low, Core and High growth scenarios, observed in the 2041 Do Something AM, IP and PM models.

Table A3-1: Comparison of modelled traffic flows across Low, Core & High growth scenarios – AM Peak

Corridor	AM Peak Period						
	Core Growth	Low Growth			High Growth		
	Flows	Flows	Diff from core	% diff from core	Flows	Diff from core	% diff from core
Essex Yeomanry Way (EB)	1,421	1,284	137	-11%	1,487	66	4%
Essex Yeomanry Way (WB)	1,465	1,428	37	-3%	1,456	-9	-1%
Chelmer Road (NE)	1,158	1,088	70	-6%	1,185	27	2%
Chelmer Road (EW)	2,325	2,147	178	-8%	2,411	86	4%
Parkway (NW)	2,335	2,291	44	-2%	2,312	-23	-1%
Parkway (SE)	1,609	1,531	78	-5%	1,647	38	2%
Broomfield Road (NB)	615	592	23	-4%	629	14	2%
Broomfield Road (SB)	543	515	28	-5%	568	25	4%
Roxwell Road (WB)	561	527	34	-6%	589	28	5%
Roxwell Road (EB)	777	758	19	-3%	824	47	6%
Three Mile Hill (NB)	1,667	1,648	19	-1%	1,657	-10	-1%
Three Mile Hill (SB)	1,346	1,368	-22	2%	1,306	-40	-3%
	Average difference from core:		54	-4%		21	2%

Table A3-1 illustrates the difference in AM traffic flows in the DS 2041 model under the alternative growth scenarios, when compared with the Core scenario. In the case of all but 1 of the 12 links presented, the Low growth scenario produces a reduction in traffic flows, with the largest reduction seen on Essex Yeomanry Way (EB). The range of impact of the Low growth scenario on observed traffic flows on the key corridors presented in the AM peak is between -11% and +2% difference from the Core scenario.

The impact of the High growth scenario on traffic flows in the AM peak is slightly more variable, with 8 of the 12 corridors seeing an increase in traffic flows as a result, and 4 corridors seeing a decrease in traffic flows. The range of impact of the High growth scenario on observed traffic flows on the key corridors presented in the AM peak is between -3% and +6% difference from the Core scenario.

The analysis shows that the overall impact of the Low Growth scenario on traffic flows across the selected links is more significant than in the High Growth scenario, and this can be explained by the redistribution of trips onto wider areas of the network under the High Growth scenario, as outlined in Section 3.1. As a result, the impact of the High Growth scenario is less visible when only looking at flow changes on key corridors.

Table A3-2: Comparison of modelled traffic flows across Low, Core & High growth scenarios – Inter-Peak

Corridor	Inter-Peak Period						
	Core Growth	Low Growth			High Growth		
	Flows	Flows	Diff from core	% diff from core	Flows	Diff from core	% diff from core
Essex Yeomanry Way (EB)	1,243	1,178	65	-6%	1,293	50	4%
Essex Yeomanry Way (WB)	987	962	25	-3%	1,029	42	4%
Chelmer Road (NE)	1,233	1,186	47	-4%	1,255	22	2%
Chelmer Road (EW)	1,266	1,187	79	-7%	1,354	88	6%
Parkway (NW)	1,582	1,535	47	-3%	1,625	43	3%
Parkway (SE)	1,743	1,652	91	-6%	1,774	31	2%
Broomfield Road (NB)	564	531	33	-6%	605	41	7%
Broomfield Road (SB)	490	462	28	-6%	512	22	4%
Roxwell Road (WB)	588	542	46	-8%	624	36	6%
Roxwell Road (EB)	523	498	25	-5%	536	13	2%
Three Mile Hill (NB)	935	940	-5	1%	945	10	1%
Three Mile Hill (SB)	979	979	0	0%	978	-1	0%
	Average difference from core:		40	-4%		33	3%

Table A3-2 illustrates the difference in Inter-peak traffic flows in the DS 2041 model under the alternative growth scenarios, when compared with the Core scenario. All corridors, with the exception of Three Mile Hill (both directions), see a reduction in traffic flows in the Low growth scenario in the Inter-peak period. The range of impact on observed traffic flows on the key corridors is between -8% and 0% difference from the Core scenario.

The corridor 'Three Mile Hill Southbound' saw no change in modelled traffic flows in the Inter-peak period under the High growth scenario. The range of impact of the High growth scenario on observed traffic flows on the key corridors presented in the Inter-peak period is between 0% and +7% difference from the Core scenario.

Compared to the AM peak period, the impact of the High growth scenario on traffic flows in the Inter-peak period is less varied, with all but one corridor seeing a modelled increase in traffic flows compared to the Core scenario. This is likely due to the overall network being less congested in the inter-peak period, meaning the additional trips in the High Growth scenario can be better accommodated on these key corridors, resulting in a greater increase in flows than in the congested peak periods.

Table A3-3: Comparison of modelled traffic flows across Low, Core & High growth scenarios – PM Peak

Corridor	PM Peak Period						
	Core Growth	Low Growth			High Growth		
	Flows	Flows	Diff from core	% diff from core	Flows	Diff from core	% diff from core
Essex Yeomanry Way (EB)	1,648	1,653	-5	0%	1,595	-53	-3%
Essex Yeomanry Way (WB)	1,431	1,363	68	-5%	1,475	44	3%
Chelmer Road (NE)	1,444	1,383	61	-4%	1,495	51	3%
Chelmer Road (EW)	1,344	1,343	1	0%	1,332	-12	-1%
Parkway (NW)	1,701	1,712	-11	1%	1,709	8	0%
Parkway (SE)	2,202	2,168	34	-2%	2,190	-12	-1%
Broomfield Road (NB)	757	727	30	-4%	745	-12	-2%
Broomfield Road (SB)	562	523	39	-7%	602	40	7%
Roxwell Road (WB)	795	787	8	-1%	805	10	1%
Roxwell Road (EB)	709	672	37	-6%	752	43	6%
Three Mile Hill (NB)	1,245	1,208	37	-3%	1,263	18	1%
Three Mile Hill (SB)	1,409	1,402	7	0%	1,413	4	0%
	Average difference from core:		26	-3%		11	1%

Table A3-3 illustrates the difference in PM peak traffic flows in the DS 2041 model under the alternative growth scenarios, when compared with the Core scenario. Most of the key corridors see a reduction in traffic flows in the Low growth scenario in the PM peak period, with two corridors observing no change in flows and one corridor (Parkway NW) experiencing a slight increase. The range of impact of the Low growth scenario on observed traffic flows on the key corridors presented in the PM peak period is between -7% and 1% difference from the Core scenario.

The impact of the High growth scenario on traffic flows in the PM period is similar to the impact in the AM peak, with 8 of the 12 links experiencing an increase in traffic flows compared to the Core scenario. Two of the links (Parkway NW and Three Mile Hill SB) experienced no impact compared to the Core scenario as a result of the High growth scenario, and two links (Parkway SE and Broomfield Road NB) experienced a slight decrease in traffic flows. The range of difference in traffic flows in the High growth scenario compared to the Core scenario in the PM period is from -3% to +7%.

Again, similar to the AM peak, the impact of the wider distribution of trips across the network in the High Growth scenario means that the overall increase in flows on these key corridors is less significant than the difference between the Low Growth and Core scenario in the PM peak.

The below table provides the range and average difference in observed traffic flows in the AM, Inter-peak and PM periods, in both the alterative growth scenarios when compared to the Core growth scenario.

Table A3-4: Range and average difference in observed traffic flows – alternative vs Core growth scenario

	Range of observed difference (%) in traffic flows from Core scenario		Average observed difference (%) in traffic flows from Core scenario	
	Low Growth	High Growth	Low Growth	High Growth
AM Peak	-11 to +2%	-3 to +6%	-4%	2%
Inter-peak	-8 to 0%	0 to +7%	-4%	3%
PM Peak	-7 to +1%	-3 to +7%	-3%	1%

In the AM peak, the average difference in traffic flows between the Low growth scenario and the Core growth scenario across the 6 key Chelmsford corridors is -4%, and between the High growth scenario and Core growth scenario is +2%.

In the Inter-peak period, the average difference in traffic flows between the Low growth scenario and the Core growth scenario across the 6 key Chelmsford corridors is -4%, and between the High growth scenario and Core growth scenario is +3%.

In the PM peak period, the average difference in traffic flows between the Low growth scenario and the Core growth scenario across the 6 key Chelmsford corridors is -3%, and between the High growth scenario and Core growth scenario is +1%.

4. Conclusion

In conclusion, analysis of the impact of the Alternative growth scenarios on modelled traffic flows in the Chelmsford Army and Navy model provides a high-level indication of the likely difference in modelled traffic flows that would be expected from the Local Plan Review spatial approaches testing, if modelled under both a Low and High growth scenario.

Based on the analysis presented above, under the Low growth scenario, it is possible that we could expect to see a -4% difference in traffic flows from the Core scenario outputs in the AM model, a +3% difference in the Inter-Peak model and a 1% difference in the PM model.

Based on the analysis presented above, under the High growth scenario, it is possible that we could expect to see a +2% difference in traffic flows from the Core scenario outputs in the AM model, a -4% difference in the Inter-Peak model and a -3% difference in the PM model. Due to the reassignment of trips onto the wider network under the High Growth scenario, the change in flows from the Core scenario on the selected routes is less significant than in the Low Growth scenario.

Alongside the modelled Core scenario outputs from the Local Plan Review Spatial Approaches testing, this information will be used to provide an inferred ‘range’ of traffic flow outputs, to address the challenges around forecast modelling and uncertainty, and the requirements outlined in TAG Unit M1.

10 Appendix B: New Development Zones

Development Name	Development Type	Model Zone Number	Proposed Donor Zone No.	Proposed Donor Zone Description	Modelled Loading Point on Network
Adopted Local Plan Sites					
Civic Centre Land Fairfield Road Chelmsford	Housing	362	10	ARU Student Village and Land South of Rectory Ln	Fairfield Road
Land West of Eastwood House Glebe Road Chelmsford	Housing	363	10	ARU Student Village and Land South of Rectory Ln	Glebe Road
Riverside Ice and Leisure Land Victoria Road Chelmsford	Housing	364	10	ARU Student Village and Land South of Rectory Ln	Waterloo Lane
Ashby House Car Parks New Street Chelmsford	Housing	365	10	ARU Student Village and Land South of Rectory Ln	Hoffmans Way
Rectory Lane Car Park West Rectory Lane Chelmsford	Housing	366	10	ARU Student Village and Land South of Rectory Ln	Elms Drive
Lockside Navigation Road Chelmsford	Housing	367	6	Springfiled Park, Land South of Trinity Road Primary School	Navigation Road
Travis Perkins, Navigation Road Chelmsford	Housing				
Danbury	Housing	369	99	Danbury, Land east of Gay Bowers Lane	Maldon Road
Bicknacre - Adopted	Housing	370	119	Bicknacre, Land north of Leighams Road	Priory Road
East of Chelmsford - Land North of Maldon Road	General Industrial	371	26	Chelmsford Business Park, Sheepcotes, Springfield	Maldon Road, opposite Brick Kiln Road
	Warehousing				
North of South Woodham Ferrers	General Industrial	372	103	North of South Woodham Ferrers	Ferrers Road
	Warehousing				
Chelmsford Local Plan Review Development Sites					
Glebe Road Car Park	Housing	373	10	ARU Student Village and Land South of Rectory Ln	Glebe Road
Granary Car Park	Housing	374	7	Springfield, Land east of Bunny Walks and west of Arbour Ln	Victoria Road
Kay-Metzeler brownfield Site	Housing	375	10	ARU Student Village and Land South of Rectory Ln	Brook Street
Land between Hoffmans Way and Brook Street (Marriages Mill)	Housing				Hoffmans Way
Coval Lane Car Park	Housing	376	54	Land east of Waterhouse Ln and north of Writtle Rd	Rainsford Lane junction with Coval Lane
Meadows Shopping Centre Brownfield Site	Housing	377	7	Springfield, Land east of Bunny Walks and west of Arbour Ln	Stub connecting onto Highbridge Road
E2V Teledyne Brownfield Site	Office	378	126	E2V Teledyne	Waterhouse Lane
	General Industrial	379			
Additional Employment (Unallocated) - Site 1 (Victoria Road)	Office	380	2	Victoria Road	Victoria Road
Additional Employment (Unallocated) - Site 2 (Glebe Road)	Office	381	4	Glebe Road	Glebe Road
Additional Employment (Unallocated) - Site 3 (Navigation Road)	Office	382	5	Former Gas Works, Wharf Road	Stub connecting onto Navigation Road
Bicknacre - New	Housing	383	119	Bicknacre, Land north of Leighams Road	Priory Road
Ford End	Housing	384	91	Main Road, Ford End	B1008 - Sandon Hill
East Hanningfield	Housing	385	108	East Hanningfield	The Tye, south of Bicknacre Road
East Chelmsford Garden Community (Hammonds Farm) - Housing	Housing	386	97	Danbury, Land north and south of A414	J19
					Maldon Road
	Office	387	26	Chelmsford Business Park, Sheepcotes, Springfield	J19
	Research and Industrial				Maldon Road
	Warehousing	388			J19
	General Industrial				Maldon Road
NEC Garden Community	Warehousing	389	26	Chelmsford Business Park, Sheepcotes, Springfield	CGC Access 1 (West of Pratt's Farm roundabout)
	Research and Industrial	390			
	Office				
Boreham EA	Warehousing	391	26	Chelmsford Business Park, Sheepcotes, Springfield	Waltham Road
	General Industrial				
Little Boyton Hall Farm	Warehousing	394	85	Broomfield Hospital	Roxwell Road
	General Industrial				
Land adjacent to A12 Junction 18	Office	395	26	Chelmsford Business Park, Sheepcotes, Springfield	Maldon Road, opposite Hammonds Farm development access junction
	Research and Industrial				
	General Industrial	396			
	Warehousing				

Table B-1: New development zones added to the preferred spatial approach modelled scenario – inc. proposed donor zones and network loading points

11 Appendix C: Development Trips

Development Name	Development Type	TRICS Classification (used for modelling)	AM		IP		PM	
			Destinations	Origins	Destinations	Origins	Destinations	Origins
Adopted Local Plan Sites								
Civic Centre Land Fairfield Road Chelmsford	Housing	Assumed Mixed Private/Affordable Housing (C3	9	22	11	12	22	12
Land West of Eastwood House Glebe Road Chelmsford	Housing	Assumed Mixed Private/Affordable Housing (C3	19	42	23	24	42	23
Riverside Ice and Leisure Land Victoria Road Chelmsford	Housing	Assumed Mixed Private/Affordable Housing (C3	14	32	17	18	32	18
Ashby House Car Parks New Street Chelmsford	Housing	Assumed Mixed Private/Affordable Housing (C3	8	17	9	10	17	9
Rectory Lane Car Park West Rectory Lane Chelmsford	Housing	Assumed Mixed Private/Affordable Housing (C3	7	16	9	9	16	9
Lockside Navigation Road Chelmsford	Housing	Assumed Mixed Private/Affordable Housing (C3	12	28	15	16	28	15
Travis Perkins, Navigation Road Chelmsford	Housing	Assumed Mixed Private/Affordable Housing (C3	7	16	9	9	16	9
Danbury	Housing	Assumed Mixed Private/Affordable Housing (C3	9	22	11	12	22	12
Bicknacre - Adopted	Housing	Assumed Mixed Private/Affordable Housing (C3	3	7	4	4	7	4
East of Chelmsford - Land North of Maldon Road	General Industrial	Industrial (B1a)	4	2	3	3	1	2
	Warehousing	Business Park (B1a)	30	4	6	8	3	41
North of South Woodham Ferrers	General Industrial	Industrial (B2)	1	0	1	1	0	1
	Warehousing	Business Park (B1a)	7	1	1	2	1	10
TOTAL Trips Generated - Adopted Local Plan Sites			**130**	**210**	**118**	**126**	**208**	**164**
Chelmsford Local Plan Review Development Sites								
Glebe Road Car Park	Housing	Assumed Mixed Private/Affordable Housing (C3	1	3	1	1	3	1
Granary Car Park	Housing	Assumed Mixed Private/Affordable Housing (C3	6	13	7	7	13	7
Kay-Metzeler brownfield Site	Housing	Assumed Mixed Private/Affordable Housing (C3	17	40	21	22	40	22
Land between Hoffmans Way and Brook Street (Marriages Mill)	Housing	Assumed Mixed Private/Affordable Housing (C3	9	22	11	12	22	12
Coval Lane Car Park	Housing	Assumed Mixed Private/Affordable Housing (C3	4	9	5	5	9	5
Meadows Shopping Centre Brownfield Site	Housing	Assumed Mixed Private/Affordable Housing (C3	33	75	40	42	75	41
E2V Teledyne Brownfield Site	Office	Office (B1a)	119	21	24	26	18	151
	General Industrial	Industrial (B2)	45	23	33	37	17	31
Additional Employment (Unallocated) - Site 1 (Victoria Road)	Office	Office (B1a)	7	1	2	2	1	9
Additional Employment (Unallocated) - Site 2 (Glebe Road)	Office	Office (B1a)	7	1	2	2	1	9
Additional Employment (Unallocated) - Site 3 (Navigation Road)	Office	Office (B1a)	7	1	2	2	1	9
Bicknacre - New	Housing	Assumed Mixed Private/Affordable Housing (C3	4	9	5	5	9	5
Ford End	Housing	Assumed Mixed Private/Affordable Housing (C3	4	9	5	5	9	5
East Hanningfield	Housing	Assumed Mixed Private/Affordable Housing (C3	3	8	4	4	8	4
East Chelmsford Garden Community (Hammonds Farm) - Housing	Housing	Assumed Mixed Private/Affordable Housing (C3	282	647	344	360	645	351
	Office	Business Park (B1a)	260	34	52	66	30	354
	Research and Industrial							
	Warehousing	Industrial (B2)	30	15	22	25	11	21
	General Industrial							
NEC Garden Community	Warehousing	Industrial (B8)	18	9	13	14	7	12
	Research and Industrial	Business Park (B1a)	33	4	7	9	3	44
	Office							
Boreham EA	Warehousing	Industrial (B8)	4	2	3	3	1	3
	General Industrial	Industrial (B2)	4	2	3	3	1	3
Little Boyton Hall Farm	Warehousing	Industrial (B8)	6	3	5	5	2	4
	General Industrial	Industrial (B2)	6	3	5	5	2	4
Land adjacent to A12 Junction 18	Office	Business Park (B1a)	158	21	32	40	18	216
	Research and Industrial							
	General Industrial	Industrial (B2)	27	13	20	22	10	19
	Warehousing	Industrial (B8)	27	13	20	22	10	19
TOTAL Trips Generated - Chelmsford LP Review Sites			**1122**	**1000**	**686**	**745**	**964**	**1360**

Appendix C-1: Volume of Origin and Destination trips calculated to/from additional development included in the assessment of the preferred spatial approach

12 Appendix D: Variable Demand Model Comparison

Figure D-1: AM Peak change in modelled flow in Preferred Spatial Approach modelled scenario as a result of using fixed demand over VDM

Figure D-2: PM Peak change in modelled flow in Preferred Spatial Approach modelled scenario as a result of using fixed demand over VDM

13 Appendix E: Journey Times

Table E-1: AM Peak hour journey times extracted for 14 journey time routes in Chelmsford

All Vehicles Statistics Summary AM					
Description	Direction	Modelled Length of Route (km)	Modelled time - With LP Scenario (mm:ss)	Modelled time - Baseline (mm:ss)	Modelled time - Freeflow (mm:ss)
A12/Terling Hall Rd --> A12/Ingatestone	WB	19.01	18:58	17:36	10:12
A12/Ingatestone --> A12/Terling Hall Rd	EB	15.44	16:03	15:47	10:13
250 Ongar Road --> Writtle Road/Elm Road	EB	3.89	23:30	25:09	05:48
Writtle Road/Elm Road --> 250 Ongar Road	WB	3.86	10:39	10:10	05:37
A130/Braintree Road --> Gyratory	SB	6.74	19:26	19:23	07:27
Gyratory --> A130/Braintree Road	NB	6.68	14:39	14:33	07:32
Nabbotts Farm Roundabout --> A130/Colchester Rd Roundabout	SB	1.89	02:56	02:55	01:45
A130/Colchester Rd Roundabout --> Nabbotts Farm Roundabout	NB	1.92	04:41	04:44	02:09
High Bridge Rd/Odeon Roundabout --> Springfield Rd Roundabou	EB	2.40	05:58	05:54	03:39
Springfield Rd Roundabout --> High Bridge Rd/Odeon Roundabou	WB	2.45	10:23	09:14	03:27
Parkway/New London Rd --> Stock Rd/Beehive Lane	SB	3.99	10:49	10:44	05:13
Stock Rd/Beehive Lane --> Parkway/New London Rd	NB	4.00	11:25	10:22	05:20
A1060/Peppers Green --> Market Roundabout	EB	10.16	18:28	17:50	09:03
Market Roundabout --> A1060/Peppers Green	WB	10.18	17:46	16:55	09:15
Rettendon Bypass/Runwell Rd --> Market Roundabout	NB	14.27	20:47	20:31	09:22
Van Dieman's Rd/Lady Ln --> Maldon Rd/Cherry Garden Ln	EB	8.64	14:06	13:48	07:40
Maldon Rd/Cherry Garden Ln --> Van Dieman's Rd/Lady Ln	WB	9.30	25:27	23:37	08:41
Van Diemnan's Rd\Lady Ln --> Ongar Rd/Bassett's Lane	WB	10.97	15:04	15:10	08:54
Ongar Rd/Bassett's Lane --> Van Diemnan's Rd\Lady Ln	EB	10.93	19:48	19:09	08:35
Parkway/Meadowside --> B1002/Church Ln	SB	8.66	19:08	18:41	08:16
B1002/Church Ln --> Parkway/Meadowside	NB	8.67	16:39	16:34	08:04
Main Rd/Damasses Ln --> Army & Navy Roundabout	WB	7.68	21:29	20:39	08:34
Army & Navy Roundabout --> Main Rd/Damasses Ln	EB	7.90	12:15	12:05	08:55
Army & Navy Roundabout --> Stock Rd/The Vale	SB	6.50	10:37	10:29	07:20
Stock Rd/The Vale --> Army & Navy Roundabout	NB	7.06	21:34	20:57	07:55

Table E-2: PM Peak hour journey times extracted for 14 journey time routes in Chelmsford

All Vehicles Statistics Summary PM					
Description	Direction	Modelled Length of Route (km)	Modelled time - With LP Scenario (mm:ss)	Modelled time - Baseline (mm:ss)	Modelled time - Freeflow (mm:ss)
A12/Terling Hall Rd --> A12/Ingatestone	WB	19.01	18:58	15:44	10:12
A12/Ingatestone --> A12/Terling Hall Rd	EB	15.44	16:03	15:39	10:13
250 Ongar Road --> Writtle Road/Elm Road	EB	3.89	23:30	14:11	05:48
Writtle Road/Elm Road --> 250 Ongar Road	WB	3.86	10:39	11:36	05:37
A130/Braintree Road --> Gyratory	SB	6.74	19:26	13:55	07:27
Gyratory --> A130/Braintree Road	NB	6.68	14:39	21:44	07:32
Nabbotts Farm Roundabout --> A130/Colchester Rd Roundabout	SB	1.89	02:56	02:32	01:45
A130/Colchester Rd Roundabout --> Nabbotts Farm Roundabout	NB	1.92	04:41	03:36	02:09
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Springfield Rd Roundabout --> High Bridge Rd/Odeon Roundabou	WB	2.45	10:23	12:17	03:27
Parkway/New London Rd --> Stock Rd/Beehive Lane	SB	3.99	10:49	11:09	05:13
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A1060/Peppers Green --> Market Roundabout	EB	10.16	18:28	18:55	09:03
Market Roundabout --> A1060/Peppers Green	WB	10.18	17:46	12:18	09:15
Rettendon Bypass/Runwell Rd --> Market Roundabout	NB	14.27	20:47	19:22	09:19
Van Dieman's Rd/Lady Ln --> Maldon Rd/Cherry Garden Ln	EB	8.64	14:06	15:18	07:40
Maldon Rd/Cherry Garden Ln --> Van Dieman's Rd/Lady Ln	WB	9.30	25:27	13:39	08:41
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B1002/Church Ln --> Parkway/Meadowside	NB	8.67	16:39	17:08	08:04
Main Rd/Damasses Ln --> Army & Navy Roundabout	WB	7.68	21:29	16:12	08:34
Army & Navy Roundabout --> Main Rd/Damasses Ln	EB	7.90	12:15	13:19	08:55
Army & Navy Roundabout --> Stock Rd/The Vale	SB	6.50	10:37	09:52	07:20
Stock Rd/The Vale --> Army & Navy Roundabout	NB	7.06	21:34	12:09	07:55

14 Appendix F: Sustainable Accessibility Scores

	GA 1a: Chelmsford Urban Area (Residential)	GA 1b: Chelmsford Urban Area (Employment)	GA 2a: Ford End	GA 2b: Boreham	GA 2c: Little Boyton Hall Farm	GA 2d: North-East Chelmsford	GA 3a: South and East Chelmsford	GA 3b: Bicknacre	GA 3c: East Hanningfield
Accessibility to urban centres	3	3	1	2	2	1	2	1	2
Accessibility to employment locations	3		2				2	2	2
Accessibility to rail stations (walking and cycling)	3	3	1	1	1	3	1	1	1
Accessibility to rail stations (public transport)	3	3	3	3	3	3	3	2	3
Weekday bus services and frequency	3	3	1	3	1	3	3	2	1
Saturday bus services and frequency	3	3	1	3	1	3	2	1	1
Sunday and night (out of hours) frequency	3	3	1	1	1	2	1	1	1
Walking access to bus stops	3	3	2	2	1	3	3	2	1
UFBB internet connectivity	3		3				3	1	1
Car driver mode share	3		1				1	1	1
Accessibility to healthcare	3		1				3	3	2
Accessibility to nurseries	3		1				3	3	3
Accessibility to primary schools	3		3				3	2	1
Accessibility to secondary schools	3		1				1	1	1
Sustainable Access RAG Score	3.00	3.00	1.57	2.14	1.43	2.57	2.21	1.64	1.50

Table F-1: RAG Assessment of Preferred Spatial Approach Development Sites