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Essex Highways

Chelmsford Local Plan Review

Transport Impact Appraisal of Spatial Approaches

December 2023

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Contents

1 Introduction 11
1.1 Study Context 11
2 Glossary of Terms 14
3 Modelling Approach 16
3.1 Strategic Modelling 16
3.2 Chelmsford VISUM Base Model Overview 16
3.3 Supplementary Technical Assessments 22
3.4 Chelmsford VISUM Forecast Model Overview 23
4 Spatial Approaches Modelling 2036-2041 29
4.1 Proposed Development Allocations – 3x Spatial Approaches 29
4.2 Development Trip Distributions 31
4.3 Proposed Development Access Assumptions Modelled 35
5 Model Outputs and Analysis 37
5.1 Distribution of Development Trips 37
5.2 Queue Length Analysis 42
5.3 Link Capacity Analysis 48
5.4 Traffic Flow Analysis 51
5.5 Journey Time Analysis 58
5.6 Summary of Cross Boundary Impact 63
5.7 Forecast Impact on Rural Villages 67
5.8 Forecast Impact on Chelmsford NE Bypass 67
5.9 Modal Shift Sensitivity Testing 69
5.10 Focus Areas for Local Plan Impact Mitigation – Desktop Review 73
6 Summary of Network Performance and Overall Findings 76

Tables

Table 4-1: Detail of three spatial approaches considered in modelling appraisal 29
Table 4-2: Development trip rate assumptions (peak period average hour) 30
Table 4-3: Summary of calculated development trips for each spatial approach (peak period average hour) 31
Table 4-4: Brownfield residential Local Plan development in Chelmsford Urban Area 31
Table 4-5: List of donor zones used for distribution of Local Plan Review development trips 32
Table 5-1: Modelled flows in Baseline Scenario on key routes crossing the Chelmsford administrative boundary 65
Table 5-2: Modelled directional flow comparisons and % change from Baseline on key routes crossing the Chelmsford administrative boundary 65
Table 5-3: Directional traffic flows modelled along the CNEB for the Baseline and 3x Spatial Approaches 68
Table 5-4: EPTAL Trip Rates 70
Table 6-1: Sector Impact Ranking Comparison of Spatial Approaches 76
Table 6-2: Corridor Impact Ranking Comparison of Spatial Approaches 76

Figures

Figure 1-1: Transport evidence to support the various stages of the Local Plan Review 13
Figure 3-1: Chelmsford VISUM Model – Fully Modelled Area 18
Figure 3-2: Cordons and screenlines used in 2019 base model calibration / validation 19
Figure 3-3: Concept image of the Army & Navy Roundabout proposed 'hamburger' layout 23
Figure 3-4: Latest National Highways proposals for the Boreham Interchange 25
Figure 3-5: Chelmsford North-East Bypass proposed design 26
Figure 4-1: Distribution of AM Peak residential departure trips from Beaulieu Park (Donor Zone 87) 32
Figure 4-2: Distribution of PM Peak residential arrival trips from south Springfield (Donor Zone 6) 33
Figure 4-3: Distribution of AM Peak employment arrival trips to Springfield Business Park (Donor Zone 26) 33
Figure 4-4: Distribution of PM Peak employment departure trips from Sandon School (Donor Zone 132) 34
Figure 4-5: Distribution of AM Peak employment arrival trips to Broomfield Hospital (Donor Zone 85) 34
Figure 4-6: Chelmsford Garden Community modelled access points 36
Figure 5-1: Development Trip Assignment for Zone 375 (zone location and ID shown in green) – Land North of Sandon Lodge (Employment) AM Arrivals (SA 1) 37
Figure 5-2: Development Trip Assignment for Zone 370 (zone location and ID shown in green)– NEC Existing Allocation (Housing) AM Departures (SA 1) 38
Figure 5-3: Development Trip Assignment for Zone 381 (zone location and ID shown in green) – NEC Expansion (Housing) AM Departures (SA 1) 38
Figure 5-4: Development Trip Assignment for Zone 382 (zone location and ID shown in green) – NEC Expansion (Employment) AM Arrivals (SA 1) 39

Figure 5-5: Development Trip Assignment for Zone 374 (zone location and ID shown in green) – Hammonds Farm (Housing) AM Departures (SA 2) 39
Figure 5-6: Development Trip Assignment for Zone 375 (zone location and ID shown in green) – Hammonds Farm (Employment) AM Arrivals (SA 2) 40
Figure 5-7: Development Trip Assignment for Zone 369 (zone location and ID shown in green) – Land North of St Swithins Cottages, Howe Green (Employment) AM Arrivals (SA 2)..... 40
Figure 5-8: Relative queue length plot – Baseline – 2041 AM Peak..... 42
Figure 5-9: Relative queue length plot – Spatial Approach 1 – 2041 AM Peak..... 43
Figure 5-10: Relative queue length plot – Spatial Approach 2 – 2041 AM Peak..... 44
Figure 5-11: Relative queue length plot – Spatial Approach 3 – 2041 AM Peak..... 44
Figure 5-12: Relative queue length plot – Baseline – 2041 PM Peak..... 45
Figure 5-13: Relative queue length plot – Spatial Approach 1 – 2041 PM Peak..... 46
Figure 5-14: Relative queue length plot – Spatial Approach 2 – 2041 PM Peak..... 47
Figure 5-15: Relative queue length plot – Spatial Approach 3 – 2041 PM Peak..... 47
Figure 5-16: Volume/Capacity plot – Baseline – 2041 AM Peak 49
Figure 5-17: Volume/Capacity plot – Baseline – 2041 PM Peak 49
Figure 5-18: 2041 Baseline vs Spatial Approach 1 flow difference plot – 2041 AM Peak..... 52
Figure 5-19: 2041 Baseline vs Spatial Approach 2 flow difference plot – 2041 AM Peak..... 52
Figure 5-20: 2041 Baseline vs Spatial Approach 3 flow difference plot – 2041 AM Peak..... 53
Figure 5-21: 2041 Baseline vs Spatial Approach 1 flow difference plot (N. Chelmsford) – 2041 AM Peak..... 53
Figure 5-22: 2041 Baseline vs Spatial Approach 2 flow difference plot (N. Chelmsford) – 2041 AM Peak..... 54
Figure 5-23: 2041 Baseline vs Spatial Approach 3 flow difference plot (N. Chelmsford) – 2041 AM Peak..... 54
Figure 5-24: 2041 Baseline vs Spatial Approach 1 flow difference plot – 2041 PM Peak..... 55
Figure 5-25: 2041 Baseline vs Spatial Approach 2 flow difference plot – 2041 PM Peak..... 55
Figure 5-26: 2041 Baseline vs Spatial Approach 3 flow difference plot – 2041 PM Peak..... 56
Figure 5-27: 2041 Baseline vs Spatial Approach 1 flow difference plot (N. Chelmsford) – 2041 PM Peak..... 56
Figure 5-28: 2041 Baseline vs Spatial Approach 2 flow difference plot (N. Chelmsford) – 2041 PM Peak..... 57
Figure 5-29: 2041 Baseline vs Spatial Approach 3 flow difference plot (N. Chelmsford) – 2041 PM Peak..... 57
Figure 5-30: Key corridor routes in Chelmsford selected for journey time analysis..... 59
Figure 5-31: Journey Time Plot for the A12 between J15 and J20, Southbound in the AM Peak 60
Figure 5-32: Journey Time Plot for the A12 between J15 and J20, Northbound in the PM Peak 60
Figure 5-33: Journey Time Plot for the B1008, Broomfield Road, Southbound in the AM Peak 61
Figure 5-34: Journey Time Plot for the B1008, Broomfield Road, Northbound in the PM Peak. 61
Figure 5-35: Journey Time Plot for the A130/A131 Corridor (via ERW and Chelmer Valley Road), Southbound in the AM Peak..... 62
Figure 5-36: Journey Time Plot for the A130/A131 Corridor (via ERW and Chelmer Valley Road), Northbound in the PM Peak 62
Figure 5-37: Location of cross boundary flow comparisons on key routes between Chelmsford and neighbouring authorities..... 64

Figure 5-38: 2041 Spatial Approach 1 Sensitivity Test vs Baseline flow difference plot – 2041 AM Peak 71
Figure 5-39: 2041 Spatial Approach 1 Sensitivity Test vs Baseline flow difference plot - 2041 PM Peak 71
Figure 5-40: Spatial Approach 1 Sensitivity Test vs Spatial Approach 1 flow difference plot - 2041 AM Peak 72
Figure 5-41: Spatial Approach 1 Sensitivity Test vs Spatial Approach 1 flow difference plot – 2041 PM Peak 72

Appendices

7 Appendix A: Supporting Technical Notes........ 79
8 Appendix B: New Development Zones 101
9 Appendix C: Development Loading Points........ 102
10 Appendix D: Development Trips........ 104
11 Appendix E: Volume over Capacity Plots 105
12 Appendix F: Journey Time Tables and Graphs 108

Executive Summary

- Chelmsford City Council (CCC) have commenced a review of their Local Plan adopted in May 2020, extending the Plan period by five years from 2036 to 2041. At this point in time the review anticipates accommodating a further 6,500 homes and just over 130,000 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 three selected spatial approaches, identified following the Issues and Options consultation.

- The three spatial approaches identified by CCC are as follows:
  - Spatial Approach 1 – Growing the existing strategy.
  - Spatial Approach 2 – Exploring a new settlement and employment locations.
  - Spatial Approach 3 – Exploring growth along transport corridors.

- 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 and across neighbouring authority boundaries.

  2) The effectiveness of mitigation measures identified in the adopted Local Plan in accommodating additional development traffic.

  3) The likely trigger points for the required dualling of the proposed Chelmsford NE Bypass beyond the current Plan period (2036).

  4) Potential mode shift linked to the expansion of Park and Ride sites, the development of Bus Rapid Transit in north Chelmsford and the new rail station at Beaulieu Park (currently under construction).

- It is intended for the findings of this modelling study to be considered alongside the documented findings from the earlier sustainable accessibility mapping and appraisal of sites[1].

- 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. As such, the outputs from this stage of the modelling, although comparable across the options tested for this study, will likely represent a worst-case estimate of traffic conditions.

- The 2041 baseline forecast model 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 Chelmsford North-East Bypass is modelled as a single carriage link between the Radial Distributor Road/Beaulieu Parkway and the A131 at Chatham Green.

- 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
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
Valley Bridge Rd at junction with B1008 Broomfield Rd and A1016 Chelmer Valley Rd
A1060 Roxwell Road westbound on approach to junction with Lordship Road
Boreham Interchange between Drovers Way and Generals Lane Roundabouts

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

- Spatial Approaches 1 and 3 are shown to have a greater impact on junctions to the north of Chelmsford – particularly along the A1016

[1] Chelmsford Local Plan Review: Sustainable Accessibility Mapping & Appraisal: Technical Note – Essex Highways, 15th July 2022.

Chelmer Valley Road corridor, whilst Spatial Approach 2 is modelled as having a greater impact on junctions along the A12 corridor.

- Owing to congestion modelled along routes into Chelmsford, the city centre itself is modelled with little overall change to queue lengths across all options tested.

- In terms of baseline link capacity, it is noticeable that corridors such as the A12 and A1016 Chelmer Valley Road are already stretched to capacity without the addition of Local Plan development. Similarly, the Radial Distributor Road/Beaulieu Parkway in the vicinity of the proposed Beaulieu Rail Station access and on the approach to the Boreham Interchange, is modelled with no spare capacity.

- With the addition of Local Plan development traffic to an already congested baseline network, a wider reassignment of traffic to local and rural routes is observed in the modelling. With Spatial Approach 2, wider routing of traffic away from congested strategic corridors results in more traffic routing through the villages of Boreham, Sandon, Howe Green and Great Baddow. With Spatial Approach 3 (and to a lesser extent, Spatial Approach 1), wider routing is modelled through the villages of Boreham, Broomfield and Great Waltham.

- Journey time impact along strategic corridor routes in and around Chelmsford varies little between the three spatial approaches. However, Spatial Approach 3 is shown to have a greater impact overall. The most significant increase in journey times is observed between Wheeler's Hill Roundabout and Broomfield Road gyratory and is present across all three spatial approaches.

- Analysis shows that the cross-boundary impact of Local Plan development traffic is, in general, relatively minor. However, connections to the north and northwest of Chelmsford are most affected, with the A131 border with Braintree showing a modelled increase in traffic flows across all three spatial approaches.

- The impact on morning peak hour flows on the A131 is most significant under Spatial Approach 3, with an increase over the baseline of 13% - with a large proportion of development trips generated by proposed employment sites in North-East Chelmsford.

- Modelled flows along the northern section of the Chelmsford North-East Bypass are shown to fall significantly below the capacity of a typical single carriageway link. Southbound flows on the approach to the roundabout junction with the Radial Distributor Road/Beaulieu Parkway are shown to reach link capacity under Spatial Approach 1, whilst with Spatial Approaches 1 and 3 modelled, the southbound section of route through to the Boreham Interchange is shown to exceed the capacity of the link.

- Until wider capacity limitations along the A12 and at the Boreham Interchange are addressed – encouraging longer-distance strategic traffic movements along the A130/A131 corridor, modelling suggests that local flows along the Chelmsford North-East Bypass will be of insufficient volume to warrant carriageway widening.

- In terms of overall network impact (severity and breadth) and without considering the scope for mitigation, Spatial Approach 2 is modelled as having the smallest impact, and Spatial Approach 3 as having the largest. Spatial Approach 1 is characterised as having a broader, but less pronounced impact on the road network.

- A sensitivity test was undertaken using Spatial Approach 1 with lower trip rates applied to Local Plan development to represent an aspirational modal-shift scenario. Trip rate reductions of 13% for residential and 6% for employment development were calculated using TRICS survey data. These reductions would be dependent on the provision of sustainable transport services and infrastructure in Chelmsford, and the promotion and successful uptake of sustainable and active modes for peak hour journeys.

- Findings from the sensitivity test suggest that an increase in passenger transport provision and uptake, if successful, could help to partially mitigate the impact of Local Plan development traffic at the Boreham Interchange and along the A12 – thereby reducing the volume of traffic re-routing through villages such as Boreham and Sandon.

- It can be argued that existing and proposed sustainable transport infrastructure in North-East Chelmsford, including the bus priority measures along the A1016 Chelmer Valley Road will help accommodate additional trips travelling into the city centre generated by new development in the area – notably under Spatial Approaches 1 and 3.

However, a heavy focus on development in North-East Chelmsford will likely add to significant pressures on the capacity of proposed junctions and links at the Boreham Interchange and in the vicinity of the proposed Beaulieu Rail Station.

- Development along the A12 corridor associated with Spatial Approach 2 will likely place additional capacity pressure on Junctions 17, 18 and 19, and may also lead to queues extending back along the trunk road carriageway. Close liaison with National Highways is therefore recommended going forward, particularly if development along the A12 corridor is taken forward as part of the preferred spatial approach.

1 Introduction

1.1 Study Context

Chelmsford City Council (CCC) have commenced a review of their Local Plan adopted in May 2020, extending the Plan period by five years from 2036 to 2041. At this point in time the review anticipates accommodating a further 6,500 homes and just over 130,000 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 three selected spatial approaches, identified following the Issues and Options consultation. See section 4 of this report for more detail on the three spatial approaches. 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, it is intended for the findings of this modelling study to be considered alongside the documented findings from the earlier sustainable accessibility mapping and appraisal of sites[2].

It is not necessarily the case that the findings and conclusions from this traffic impact modelling will align with those from the sustainable accessibility review. For example, development sites in rural areas may be assessed as having a low traffic impact, but will unlikely be located in areas with good levels of sustainable accessibility and alternatives to car use.

It is therefore strongly recommended that the selection of sites comprising a Preferred Spatial Approach takes into account both the extent of future network impact but also the availability of sustainable infrastructure and services (either existing or potential) in the vicinity, that could help reduce the level of car use and mitigate development impact.

[2] Chelmsford Local Plan Review: Sustainable Accessibility Mapping & Appraisal: Technical Note – Essex Highways, 15th July 2022.

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 support CCC in their identification of a Preferred Spatial Approach to take forward to the next stage of the Local Plan review process (Pre-Submission).

The study specifically looks at the following:

1) The impact of additional development traffic on the future capacity of links and junctions on the local road network and across neighbouring authority boundaries,
2) The effectiveness of mitigation measures identified in the adopted Local Plan in accommodating additional development traffic,
3) The likely trigger points for the required dualling of the proposed Chelmsford NE Bypass beyond the current Plan period (2036),
4) Mode shift – particularly linked to the expansion of Park and Ride Sites, and the development of Bus Rapid Transit in north Chelmsford and the new rail station at Beaulieu Park.

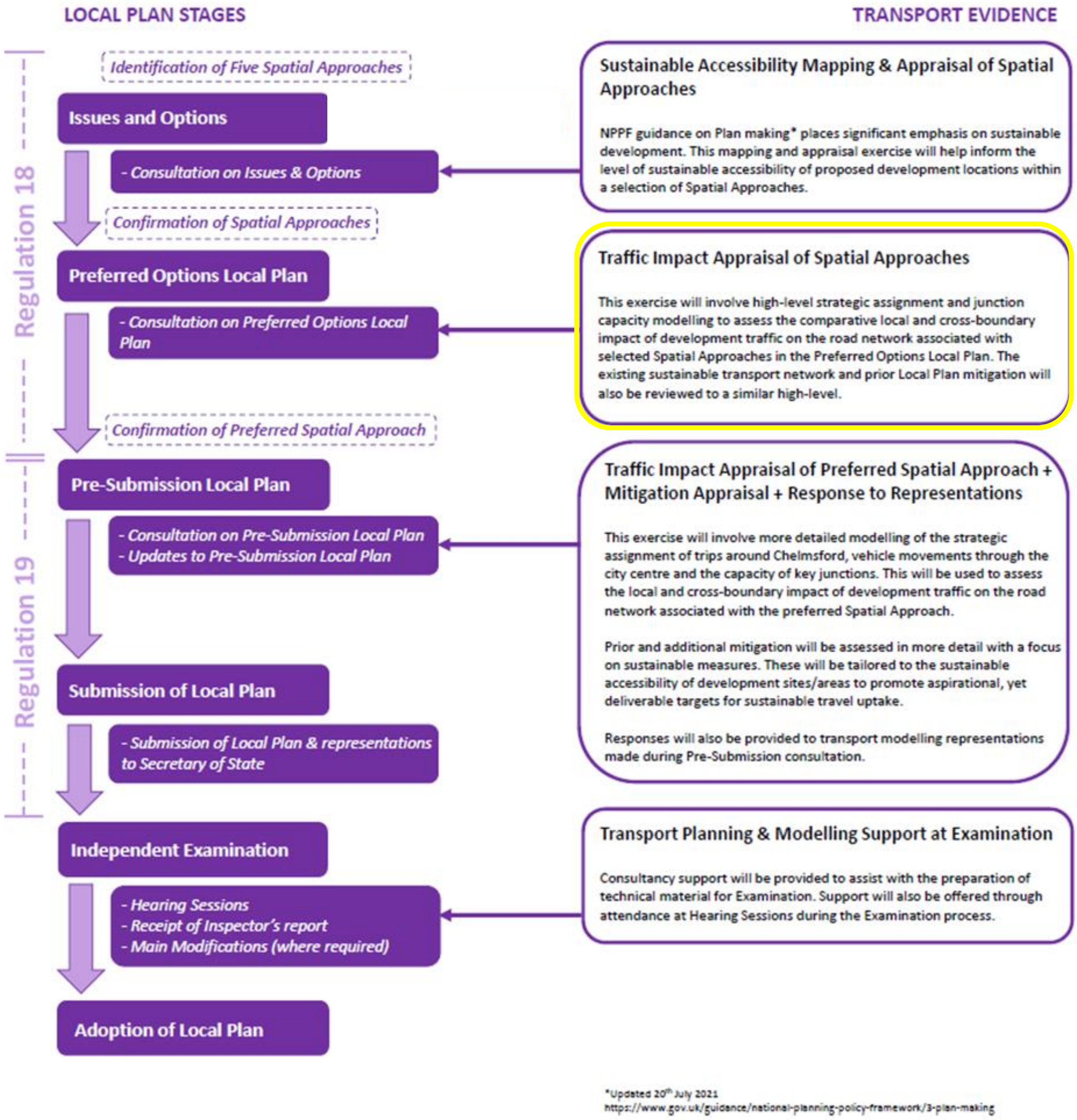

Figure 1-1: Transport evidence to support the various stages of the Local Plan Review

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.

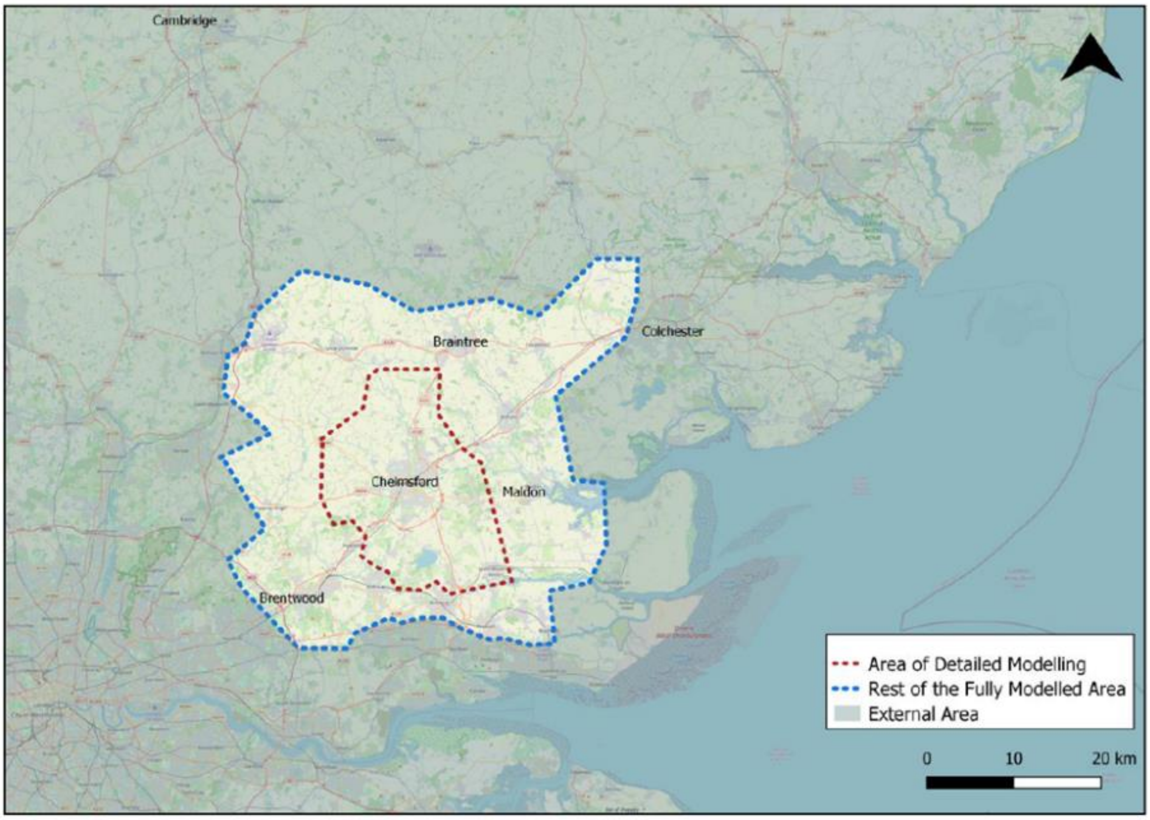

Figure 3-1: Chelmsford VISUM Model – Fully Modelled Area

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.

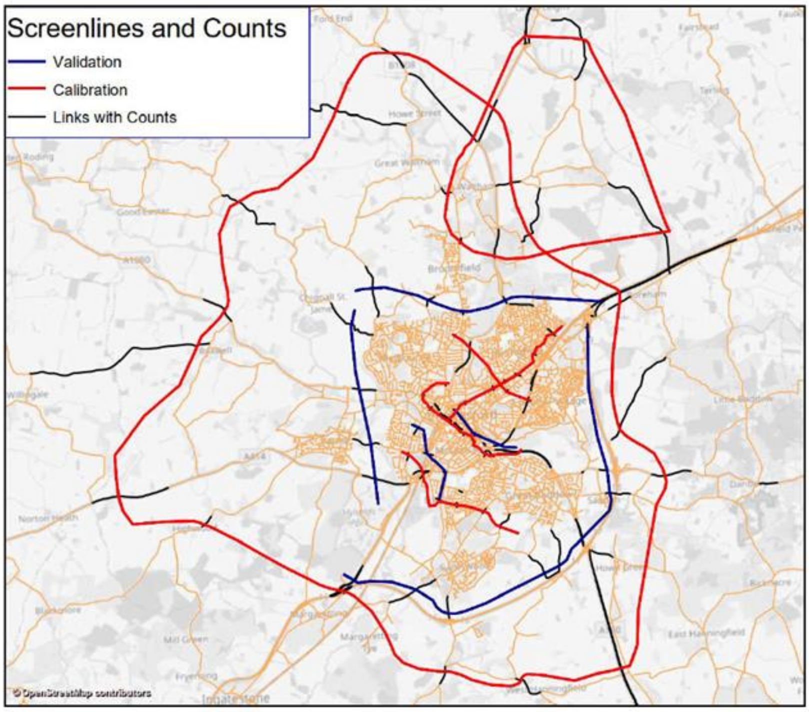

Figure 3-2: Cordons and screenlines used in 2019 base model calibration / validation

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 appraisal of Local Plan spatial approaches owing to the longer timescales required in obtaining model outputs. Instead, the comparative appraisal of approaches 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 comparison of all modelled scenarios will enable a robust assessment of each Spatial Approach and help to inform the identification of the Preferred Spatial Approach.

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'.

For the purposes of this study, the P&R model has been run for each assessed 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

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[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 April 2023 consultation with updated traffic signal timings from National Highways modelling)
- Radial Distributor Road (RDR) & Northern Radial Distributor Road (NRDR)
- Full CNEB (Sections 1 & 2 including A131 dualling)
- 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 Chelmsford North-East Bypass

The CNEB has been modelled as a single-lane carriageway connecting the RDR to a new junction on the A131 Braintree Road at Chatham Green. An at-grade roundabout has been modelled along the route, providing a connection to the NRDR. The section of the A131 between the Chatham Green junction and Deres Bridge junction has been dualled. The proposed layout of the CNEB, as modelled, is shown in Figure 3-5 on page 25.

As of December 2023 (at the time of issuing this report), it is understood that proposals for the CNEB have been revised such that only Section 1A of the CNEB will be constructed by 2041. The latest proposals for the scheme will be incorporated into the modelling of the Preferred Spatial Approach.

3.4.3 Boreham Interchange (A12 Junction 19)

As of December 2023, 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 overleaf.

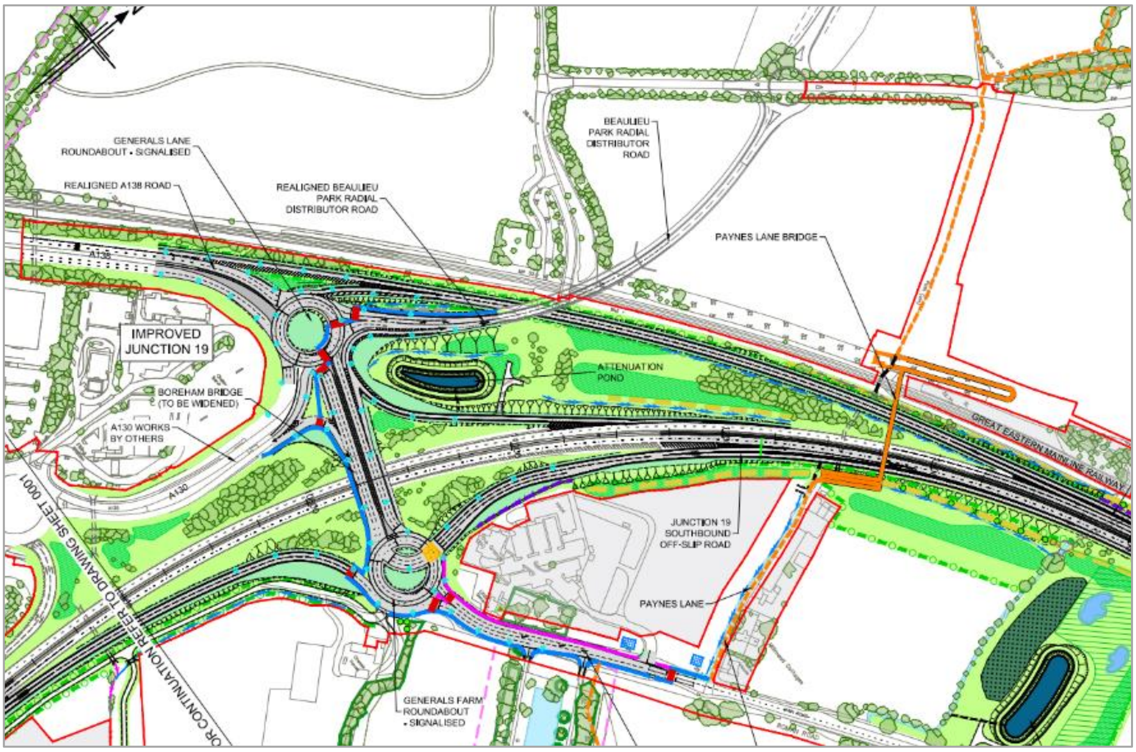

Figure 3-4: Latest National Highways proposals for the Boreham Interchange[4]

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 Radial Distributor Road and the A138.

[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

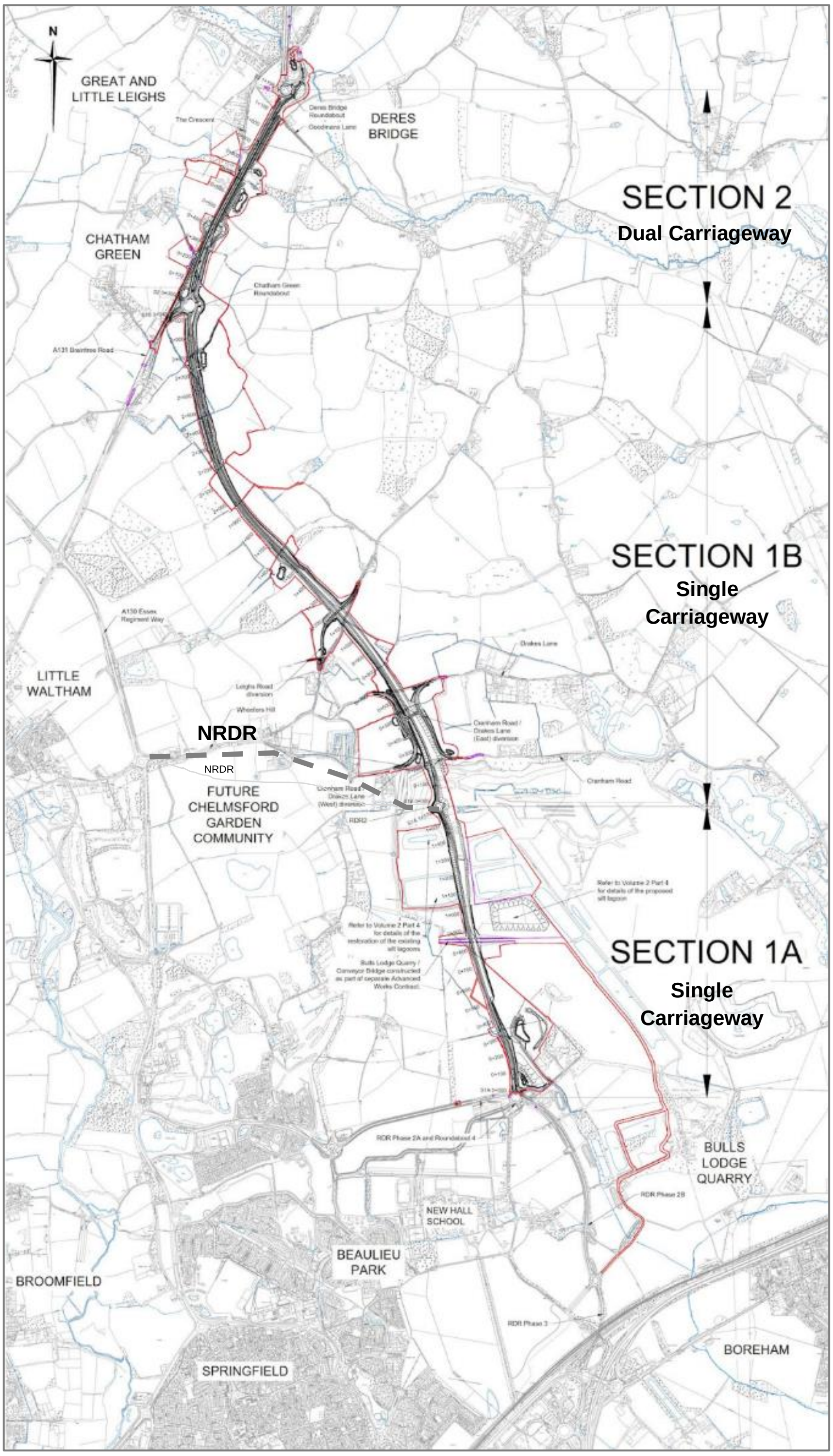

Figure 3-5: Chelmsford North-East Bypass proposed design[5]

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

3.4.4 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 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(g) (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.

3.4.5 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

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

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 Spatial Approaches Modelling 2036-2041

4.1 Proposed Development Allocations – 3x Spatial Approaches

Development allocations associated with three spatial approaches were confirmed with Chelmsford City Council in May 2023 and are shown in Table 4-1 below.

Location	Spatial Approach 1			Spatial Approach 2			Spatial Approach 3		
	Growing the existing strategy			Exploring a new settlement and employment locations			Exploring growth along transport corridors		
	Housing (dwellings)	Office (m2)	Business/ Industrial (m2)	Housing (dwellings)	Office (m2)	Business/ Industrial (m2)	Housing (dwellings)	Office (m2)	Business/ Industrial (m2)
Brownfield sites in Chelmsford Urban Area	850			250			550		
North East Chelmsford Existing allocation	3,250			3,250			3,250		
NEC expansion	2,100	3,955	40,675				1,000		30,283
Key Service Settlements (Bicknacre)	100						100		
Service Settlements (East Hanningfield)	100						100		
Service Settlements (Ford End)	100						100		
Settlements with good proximity to transport corridors (Chatham Green)							1,400	5,950	30,283
New Strategic Settlement/Garden Community (Hammonds Farm)				3,000	4,455	45,425			
New site at Land North Of Sandon Lodge (J18 of A12)		4,955	40,675						
New site at Land North Of St Swithins Cottages (J17 of A12)					4,455	45,425		2,960	30,284
Little Boyton Hall Farm			6,000						
Boreham Employment Area			3,500						
E2V Teledyne		15,465	15,465		15,465	15,465		15,465	15,465
TOTALS	**6,500**	**24,375**	**106,315**	**6,500**	**24,375**	**106,315**	**6,500**	**24,375**	**106,315**

Table 4-1: Detail of three spatial approaches considered in modelling appraisal

Spatial Approach 1 (SA1) provides a spread of development across sites in North Chelmsford and along the A12, as well as a greater quantum of development on brownfield sites in the city centre. It also makes provision for a number of small development sites in outlying rural areas across the wider Chelmsford area.

Spatial Approach 2 (SA2) is, in part, characterised by a focus of development along the A12 corridor at Hammonds Farm, adjacent to A12 J18 and at St. Swithins Cottages, Howe Green, adjacent to A12 J17.

Spatial Approach 3 (SA3) accommodates the greatest amount of development located to the north of Chelmsford, covering the NEC existing allocation and expansion, and development at Chatham Green.

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 C 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 Privately Owned Houses	Per Dwelling	0.091	0.14	0.351	0.276	0.129	0.152
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 (peak period average hour)

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 three spatial approaches can be found in Appendix D of this report, whilst a summary can be found in Table 4-3 overleaf.

	Trip Arrivals (Vehicles)			Trip Departures (Vehicles)		
	AM	IP	PM	AM	IP	PM
Spatial Approach 1	1,586	1,106	2,217	1,890	1,096	2,275
Spatial Approach 2	1,584	1,121	2,353	1,926	1,101	2,296
Spatial Approach 3	1,585	1,114	2,285	1,908	1,099	2,285

Table 4-3: Summary of calculated development trips for each spatial approach (peak period average hour)

The overall quantum of development trips modelled has been calculated with little variability across spatial approaches. Therefore, any difference in network impact between the approaches tested is expected to be influenced predominantly by the location of the development.

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. An equal housing split across the identified sites was assumed in the absence of confirmed numbers.

Chelmsford Urban Area Brownfield	Spatial Approach 1	Spatial Approach 2	Spatial Approach 3
Residential (Dwellings)			
Meadows Shopping Centre (Residential)	283	83	183
Police Headquarters (Residential)	283	83	183
Kay-Metzeler (Residential)	283	83	183
Total	**850**	**250**	**550**

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 added 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. Table 4-5 below lists the donor zones used for a selection of new Local Plan developments located outside of the city centre.

Local Plan Review Development Sites with Donor Zone Distributions	Development Type	Distribution based on Model Area	New Model Zone ID	Donor Zone ID
New site at Land North of St Swithins Cottages, Howe Green	Employment	Sandon School, Sandon	369	132
North East Chelmsford Existing Allocation	Residential	Beaulieu Park residential area	370	87
Chatham Green	Employment	Broomfield Hospital and nearby schools	371	85
Hammonds Farm	Residential	Springfield residential area	374	6
	Employment	Sandon School, Sandon	375	132
New site at Land North of Sandon Lodge	Employment	Sandon School, Sandon	375	132
North East Chelmsford Expansion	Residential	Beaulieu Park residential area	381	87
	Employment	Broomfield Hospital and nearby schools	382	85
Boreham EA	Employment	Springfield Business Park	382	26
Little Boyton Hall Farm	Employment	Broomfield Hospital and nearby schools	384	85

Table 4-5: List of donor zones used for distribution of Local Plan Review development trips

The distribution of trips to/from Sandon School in the VISUM model was based on journey-to-work patterns for teachers and other employees at the school, rather than the distribution of trips for student drop-offs and pick-ups.

4.2.2 Trip Distribution Analysis

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

Figure 4-1 and Figure 4-2 illustrate the modelled distributions to/from residential donor zones in Beaulieu Park and south Springfield. Figure 4-3 to Figure 4-5Figure 4-4 illustrate the modelled distributions to/from employment donor zones in north Springfield, Sandon and Broomfield.

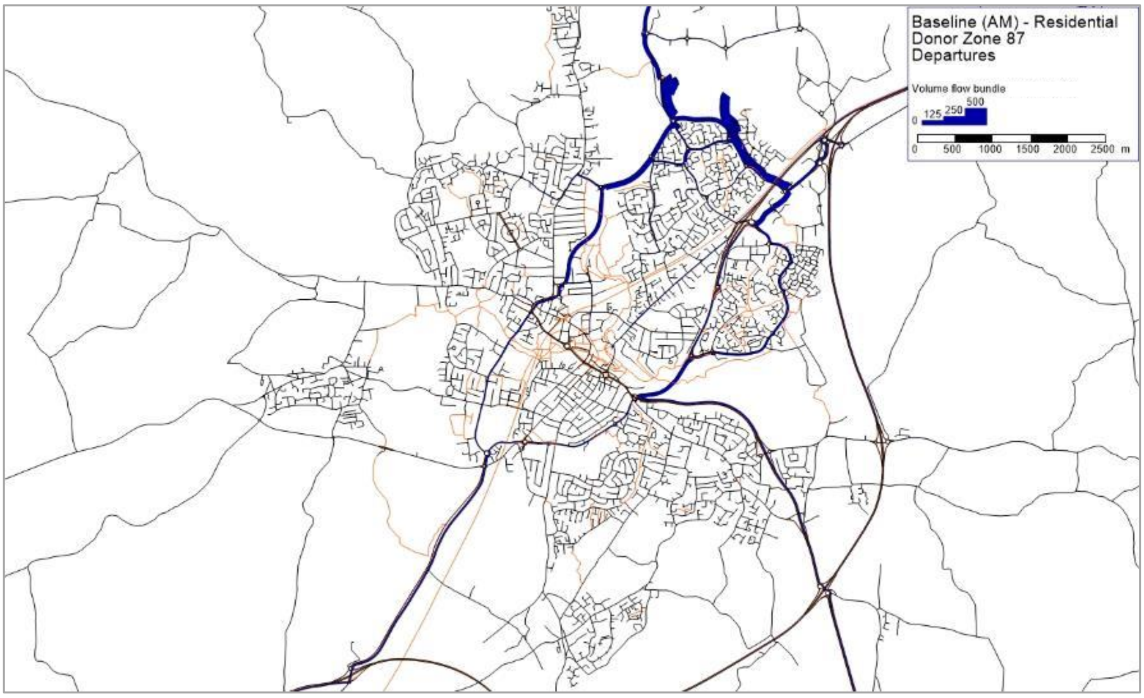


Figure 4-1: Distribution of AM Peak residential departure trips from Beaulieu Park (Donor Zone 87)

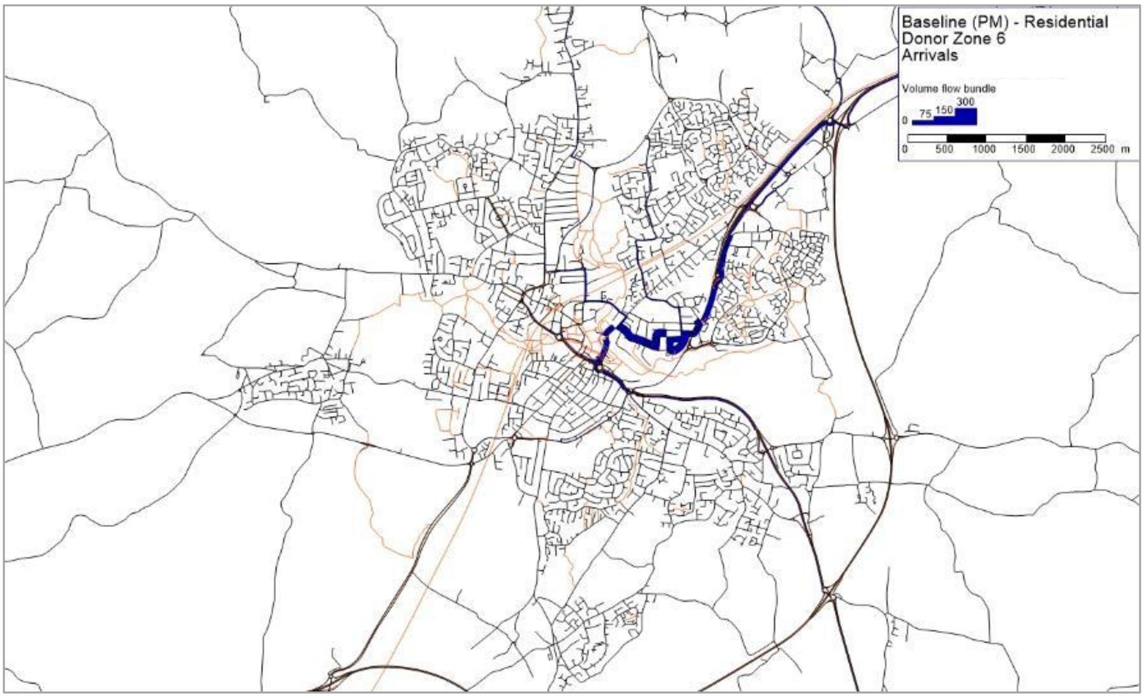


Figure 4-2: Distribution of PM Peak residential arrival trips from south Springfield (Donor Zone 6)

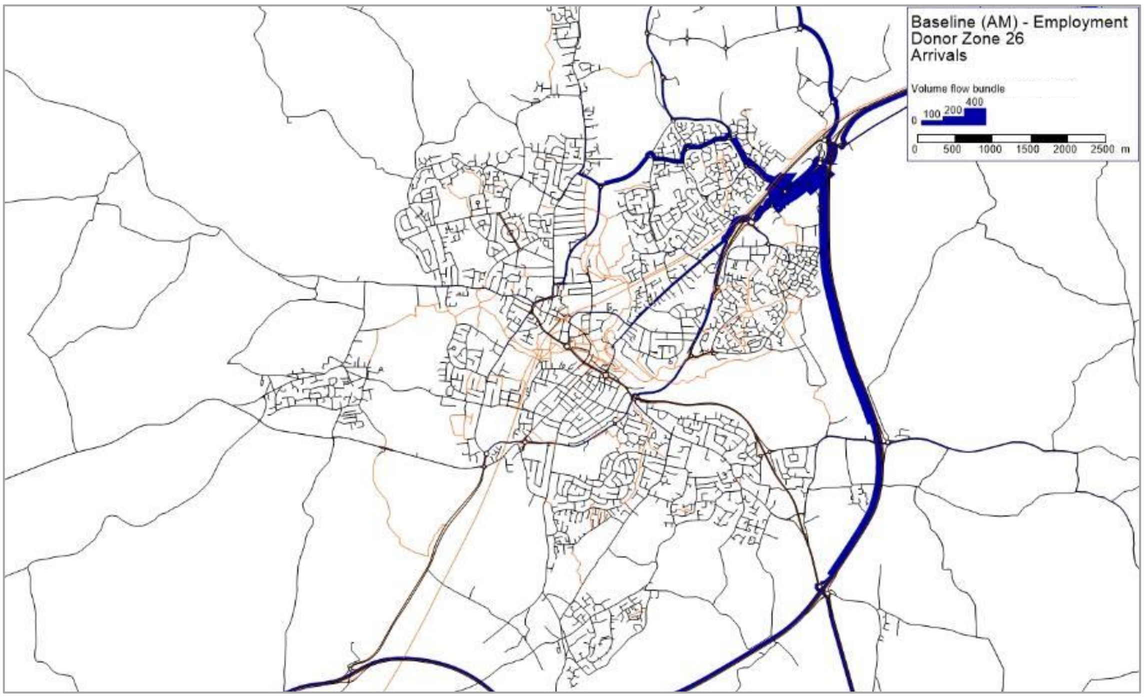


Figure 4-3: Distribution of AM Peak employment arrival trips to Springfield Business Park (Donor Zone 26)

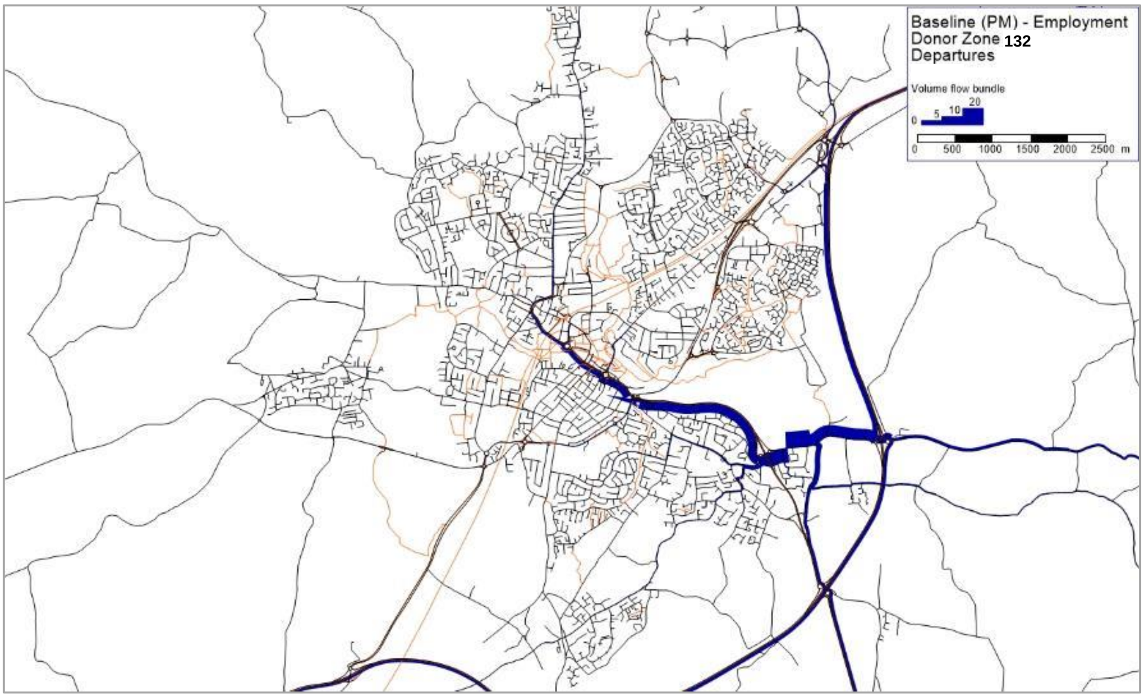


Figure 4-4: Distribution of PM Peak employment departure trips from Sandon School (Donor Zone 132)

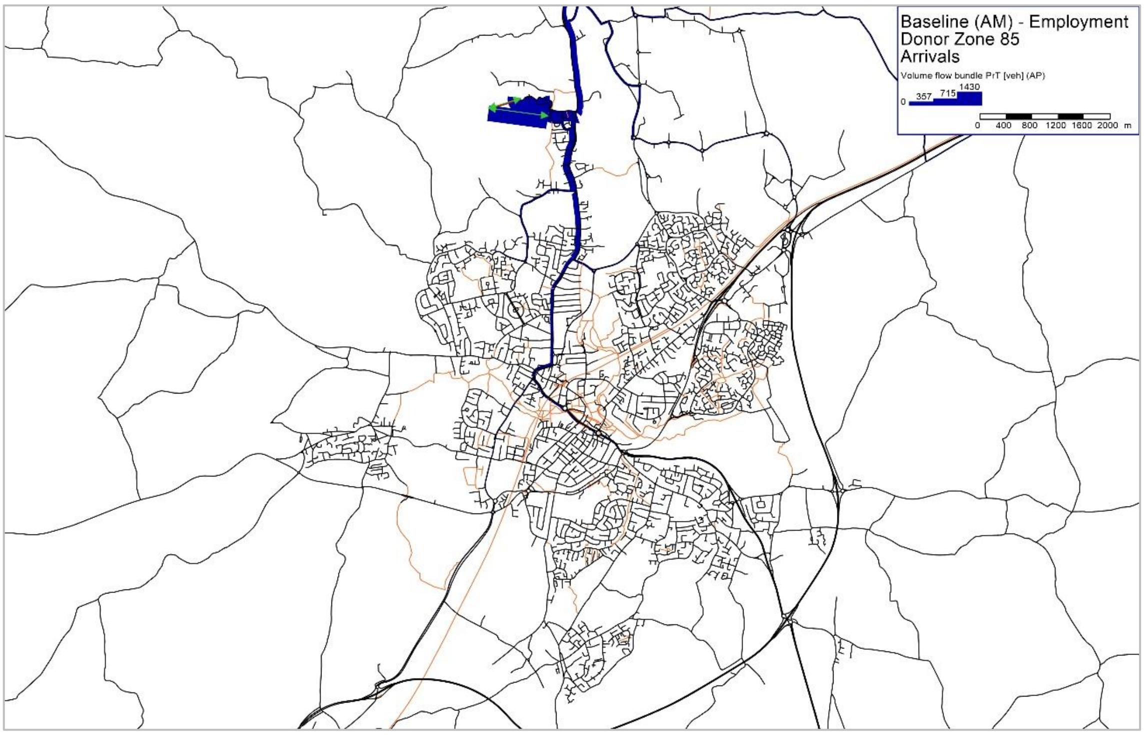


Figure 4-5: Distribution of AM Peak employment arrival trips to Broomfield Hospital (Donor Zone 85)

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 C 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 bus-only access link in the model.

4.3.2 Chelmsford Garden Community Access

As of December 2023 (at the time of issuing this report) the developer consortium for the Chelmsford Garden Community have provided detail on access and infrastructure proposals for the development in their masterplan submitted for consultation in 2022.

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. Accesses proposed along the NRDR have been consolidated into two main junctions along the route. From a strategic modelling perspective, more precise detail would not have had a material impact on overall findings.

Effort was taken to model the distribution of development trips onto the surrounding road network to a reasonable degree of accuracy, based on the location of development in proximity to suitable access points. However, the loading points for development trips were also determined by the prevalence of congestion in the nearby vicinity. Figure 4-6 shows these developments in context along with the proposed infrastructure measures.

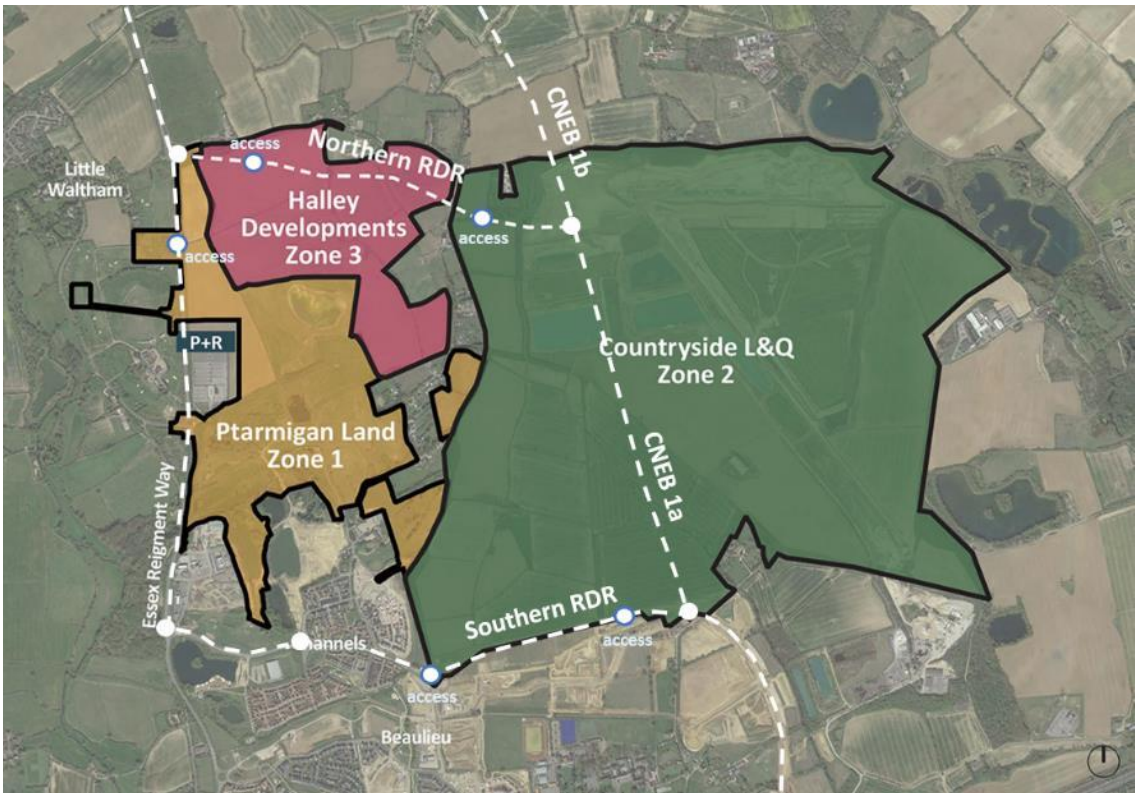


Figure 4-6: Chelmsford Garden Community modelled access points

5 Model Outputs and Analysis

The following section provides analysis of the model outputs created for all three spatial approaches. 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.

5.1 Distribution of Development Trips

Figures 5-1 to 5-7 show the distribution of trips across the network to and from the main development sites in each of the spatial approaches 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. In addition, where main development sites are present in both spatial approaches 1 and 3, only information for Spatial Approach 1 has been shown (as the distribution will be the same).

Figure 5-1: Development Trip Assignment for Zone 375 (zone location and ID shown in green) – Land North of Sandon Lodge (Employment) AM Arrivals (SA 1)

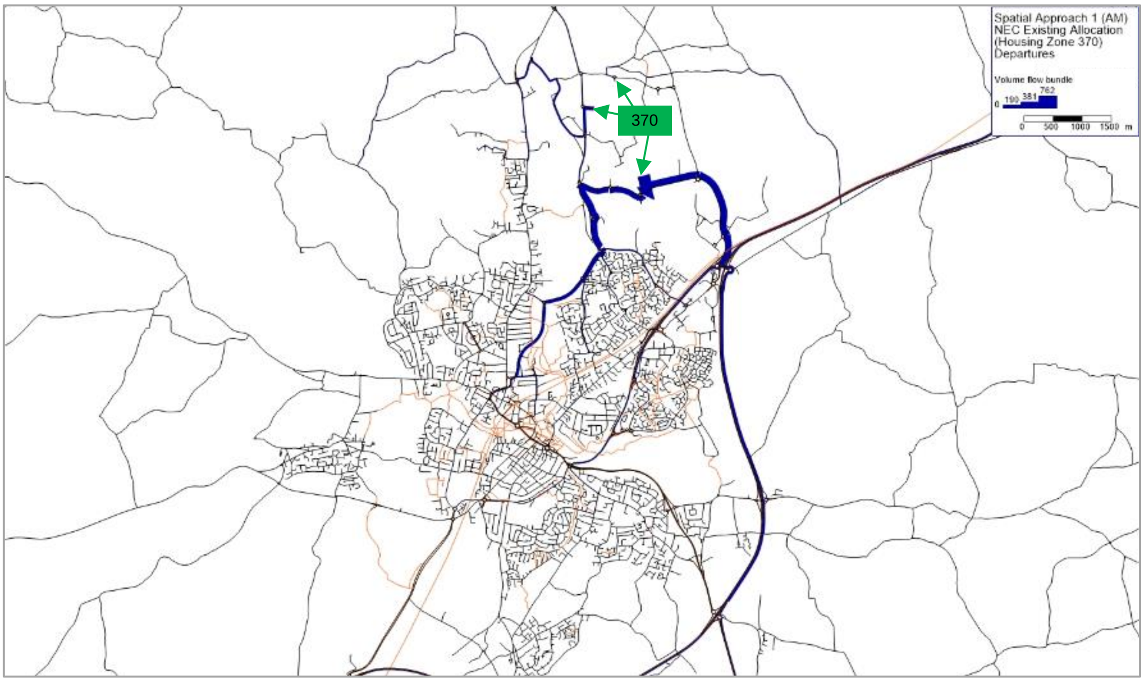


Figure 5-2: Development Trip Assignment for Zone 370 (zone location and ID shown in green)– NEC Existing Allocation (Housing) AM Departures (SA 1)

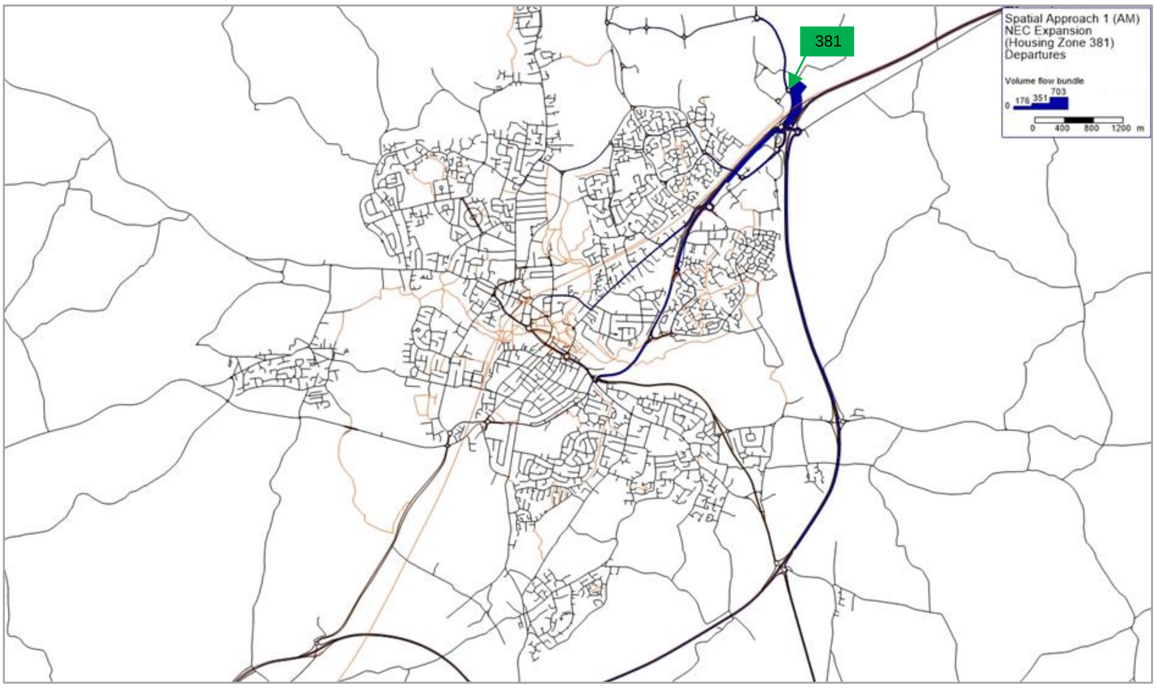


Figure 5-3: Development Trip Assignment for Zone 381 (zone location and ID shown in green) – NEC Expansion (Housing) AM Departures (SA 1)

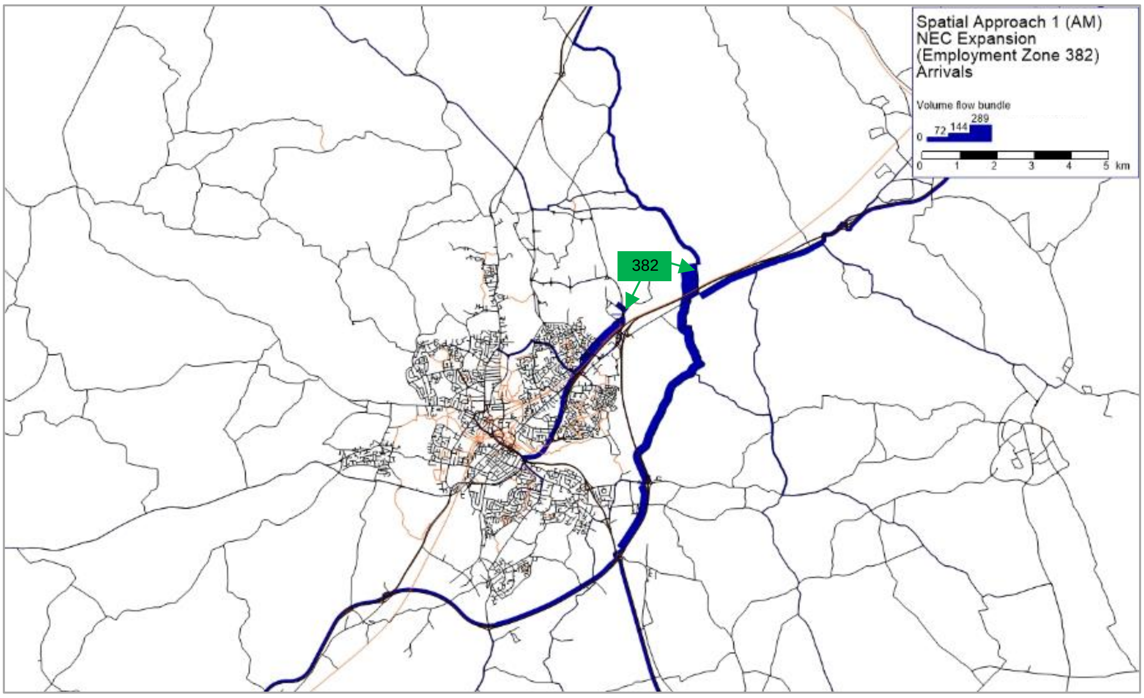


Figure 5-4: Development Trip Assignment for Zone 382 (zone location and ID shown in green) – NEC Expansion (Employment) AM Arrivals (SA 1)

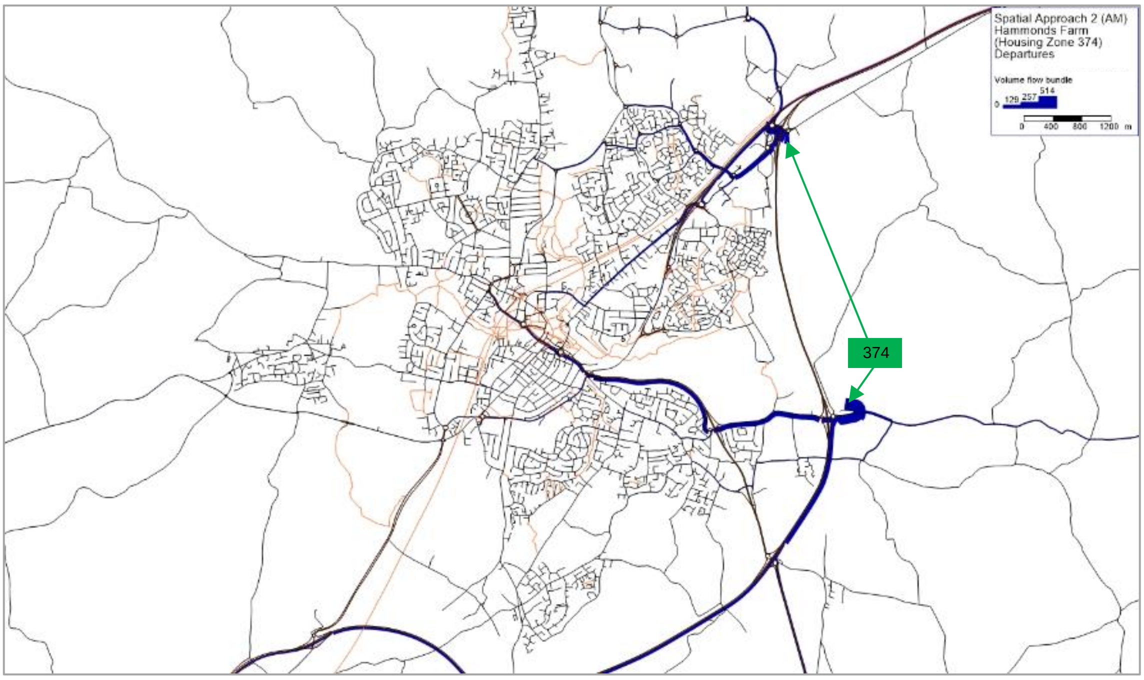


Figure 5-5: Development Trip Assignment for Zone 374 (zone location and ID shown in green) – Hammonds Farm (Housing) AM Departures (SA 2)

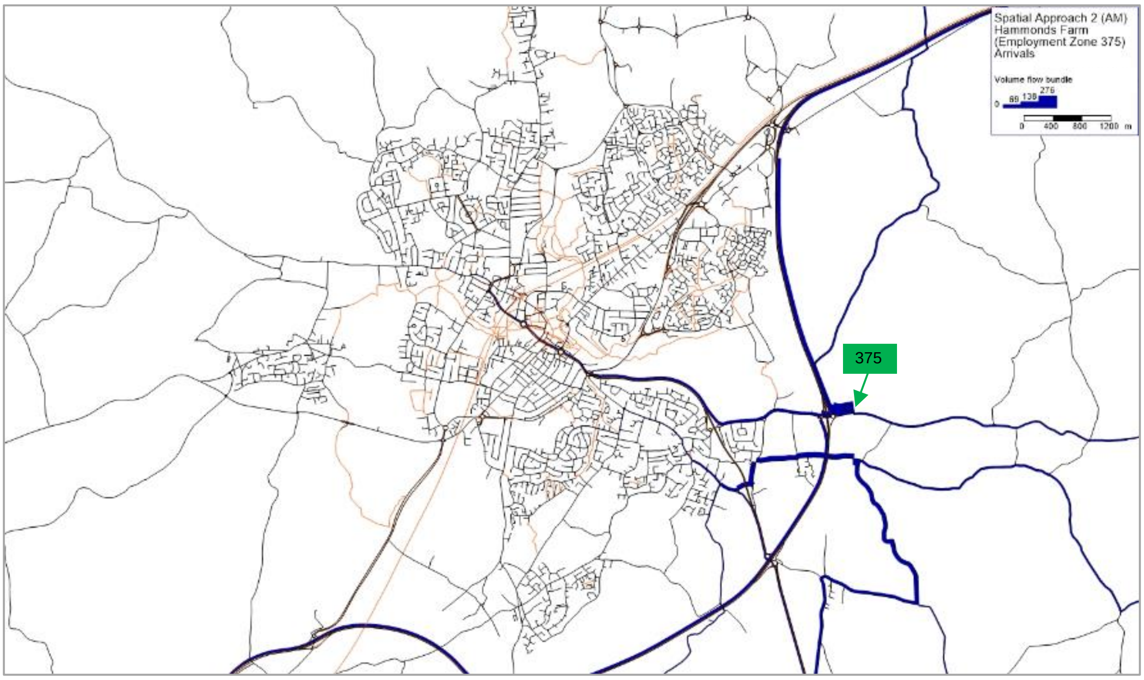


Figure 5-6: Development Trip Assignment for Zone 375 (zone location and ID shown in green) – Hammonds Farm (Employment) AM Arrivals (SA 2)

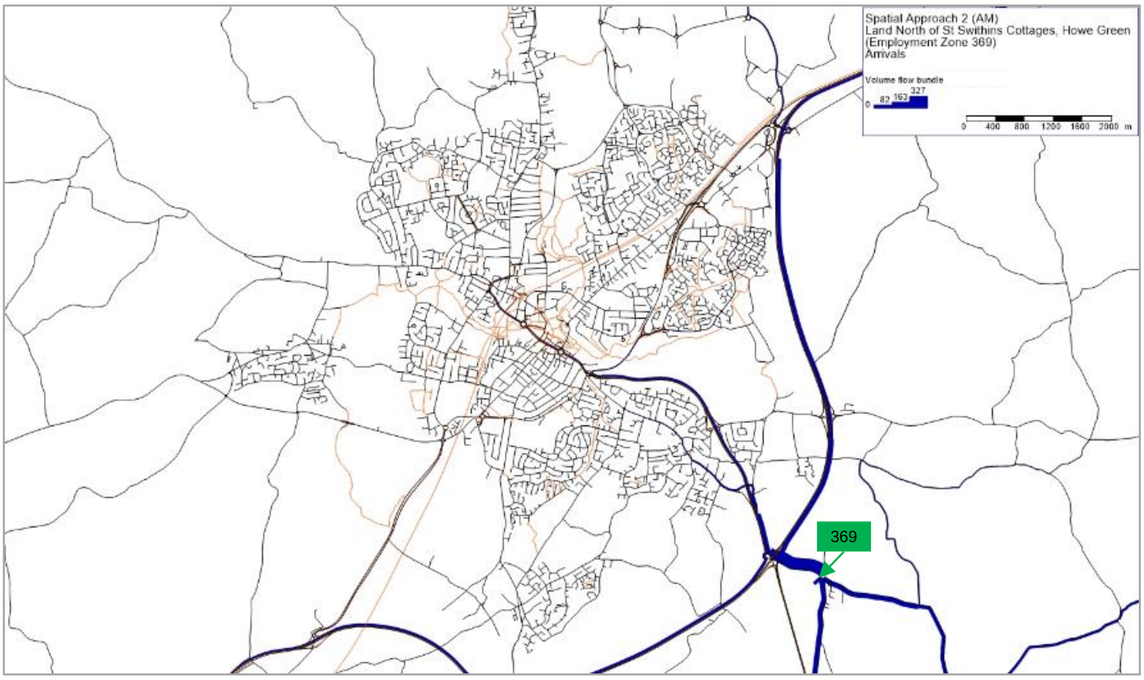


Figure 5-7: Development Trip Assignment for Zone 369 (zone location and ID shown in green) – Land North of St Swithins Cottages, Howe Green (Employment) AM Arrivals (SA 2)

Distribution of Development Trips	Key Commentary
Residential Sites	
NEC Existing Allocation (Zone 370) and NEC Expansion (Zone 381)	Trips are focused in the northern area of Chelmsford, travelling away from the site in the AM peak to nearby employment sites predominantly in the city centre, and to wider employment destinations outside of Chelmsford to the north and south.
Hammonds Farm (Zone 374)	Trips are focused to the east of Chelmsford, travelling away from the site in the AM peak to employment destinations in Chelmsford city centre and to wider employment destinations outside of Chelmsford, predominantly to the south.
Employment Sites	
NEC Expansion (Zone 382)	Trip origins are more widespread, with the majority originating from further afield to the north (Braintree direction), northeast (Colchester) and southwest of Chelmsford, as well as from within the city centre.
Hammonds Farm (Zone 375)	Employment trips to the site are more widespread than residential trips, with a number travelling to the site from the east (Maldon direction), and from further afield from the northeast (Colchester direction via the A12) and south of Chelmsford (via the A130), as well as from within the city centre. Compared with the employment site to the north of Chelmsford, Hammonds Farm has fewer trips originating in and around Braintree.
Land North of Sandon Lodge Employment Site (Zone 375)	Similar to the Hammonds Farm employment site, trip origins to the site are more focused to the south and east of Chelmsford, and from within the city centre itself.
Land North of St Swithins Cottages, Howe Green (Zone 369)	Similar to the Hammonds Farm and Sandon Lodge employment sites, a greater proportion of trips travel to the Howe Green employment site from the east and southeast of Chelmsford, and from further afield to the northeast (Colchester direction), southwest, and from within the town centre

In summary:

- A review of the development distribution plots demonstrates a relatively even and sensible spread of trips across the wider network for both residential and employment sites modelled.
- The distributions, having been taken from ‘donor zones’ in the model, are ultimately based on Census 2011 journey to work data and seem appropriate for use with the Local Plan developments.
- The distribution of employment trips tends to be more widespread across the network. Residential trips tend to be more localised, with all residential

sites seeing a significant proportion of trips travelling into the city centre in the AM peak.

- The distribution of residential trips from sites to the north and east of Chelmsford follow a similar pattern, with all sites showing a significant proportion of trips travelling into the city centre and to wider employment destinations to the north and south of Chelmsford.
- Employment sites to the north of Chelmsford have a higher number of trips travelling to the site from areas to the north, such as Braintree, whereas employment sites to the east have a greater number of trips travelling to the site via the A12 and A130 corridors, and nearby settlements such as Danbury, Bicknacre and East Hanningfield.

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 5-8 to Figure 5-15 show the relative queue length plots for all three spatial approaches for both the AM and PM peaks.

5.2.1 Relative Queue Lengths: 2041 AM Peak

Figure 5-8: Relative queue length plot – Baseline – 2041 AM Peak

The 2041 baseline without additional Local Plan development (Figure 5-8) 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
A1060 Roxwell Road westbound on approach to junction with Lordship Road

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

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 at the Boreham Interchange and the prevalence of queuing on the alternative A1016 Chelmer Valley Road route into Chelmsford from the north.

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 5-9: Relative queue length plot – Spatial Approach 1 – 2041 AM Peak

Figure 5-10: Relative queue length plot – Spatial Approach 2 – 2041 AM Peak

Figure 5-11: Relative queue length plot – Spatial Approach 3 – 2041 AM Peak

Queue Length Analysis - AM Peak	Key Commentary
Spatial Approach 1	Queue length increases over the baseline largely confined to junctions along the A1016 Chelmer Road extending back along A130 Essex Regiment Way
Spatial Approach 2	Notable increase in queuing along A12 southbound carriageway caused by congestion at A12 J17 (Howe Green)
	Smaller increase in queue lengths modelled along A130 Essex Regiment Way compared with Spatial Approaches 1 and 3
	Generals Farm junction at Boreham Interchange modelled with some additional queuing
Spatial Approach 3	Largest increase in modelled queue lengths extending back along A130 Essex Regiment Way
	Build up of queues along the RDR in vicinity of Beaulieu rail station access
General	Baseline queue lengths modelled at junctions in city centre largely unaffected by additional development across the three approaches

5.2.2 Relative Queue Lengths: 2041 PM Peak

Figure 5-12: Relative queue length plot – Baseline – 2041 PM Peak

The 2041 baseline without additional Local Plan development shows modelled queuing in the following key areas in Chelmsford:

Modelled Queueing 2041 PM Peak - Key Locations
City Centre junctions along Parkway between A1016 Waterhouse Lane and Odeon Rbt
Army & Navy Roundabout - Baddow Road, 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 Rd and with A1016 Chelmer Valley Rd
Boreham Interchange between Drovers Way and Generals Lane Roundabouts

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 5-13: Relative queue length plot – Spatial Approach 1 – 2041 PM Peak

Figure 5-14: Relative queue length plot – Spatial Approach 2 – 2041 PM Peak

Figure 5-15: Relative queue length plot – Spatial Approach 3 – 2041 PM Peak

Queue Length Analysis - PM Peak	Key Commentary
Spatial Approach 1	Queue length increases over the baseline is focused on the Boreham Interchange and junctions along the A1016 Chelmer Road extending back along A130 Essex Regiment Way.
Spatial Approach 2	Notable increase in queues modelled through Howe Green from A12 J17.
	Smallest increase in queues at key locations north of Chelmsford, including the Boreham Interchange, and in the city centre.
Spatial Approach 3	Largest increase in queues at key locations north of Chelmsford, including the Boreham Interchange, and along B1008 Broomfield Road.
	Increase in queue lengths through Howe Green from A12 J17.
General	Baseline queue lengths modelled at junctions in city centre largely unaffected by additional development across the three spatial approaches.

In terms of junction impact at key locations across Chelmsford, modelling suggests that Spatial Approach 2 may have a marginally smaller impact on queuing at key junctions on the strategic road network over Spatial Approach 1. Spatial Approach 3 is shown to likely have the greatest impact on queue lengths over the baseline. This assessment however, cannot take into consideration the perceived 'severity' of impact related to queuing along corridors such as the A12 compared with (for example) the A1016 Chelmer Valley Road.

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. Only the Baseline V/C plots are shown here to highlight the routes within Chelmsford that are already over capacity, before adding the Local Plan development. The V/C plots for all three spatial approaches can be found in Appendix E.

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

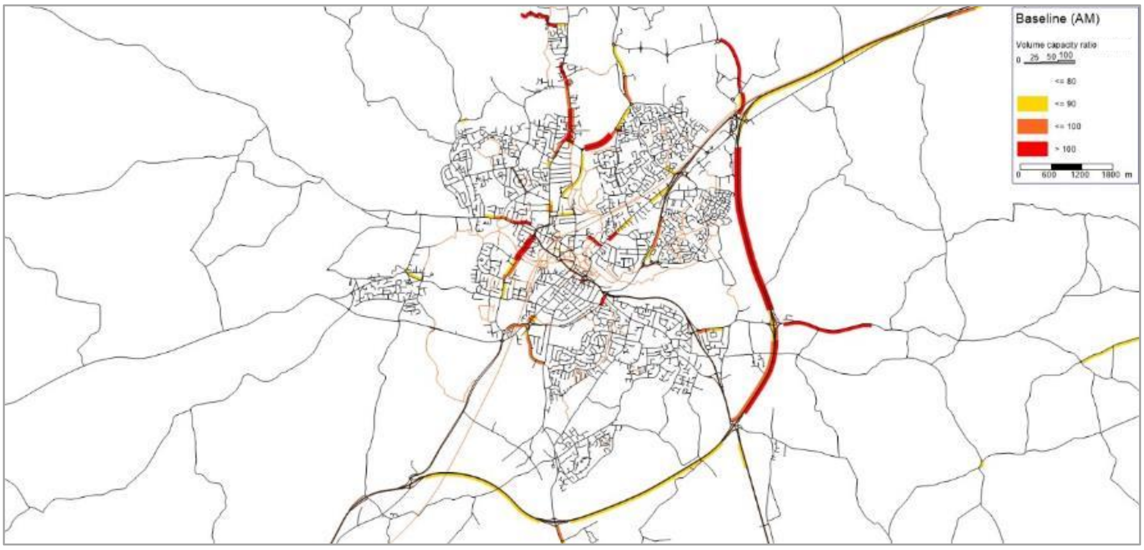


Figure 5-16: Volume/Capacity plot – Baseline – 2041 AM Peak

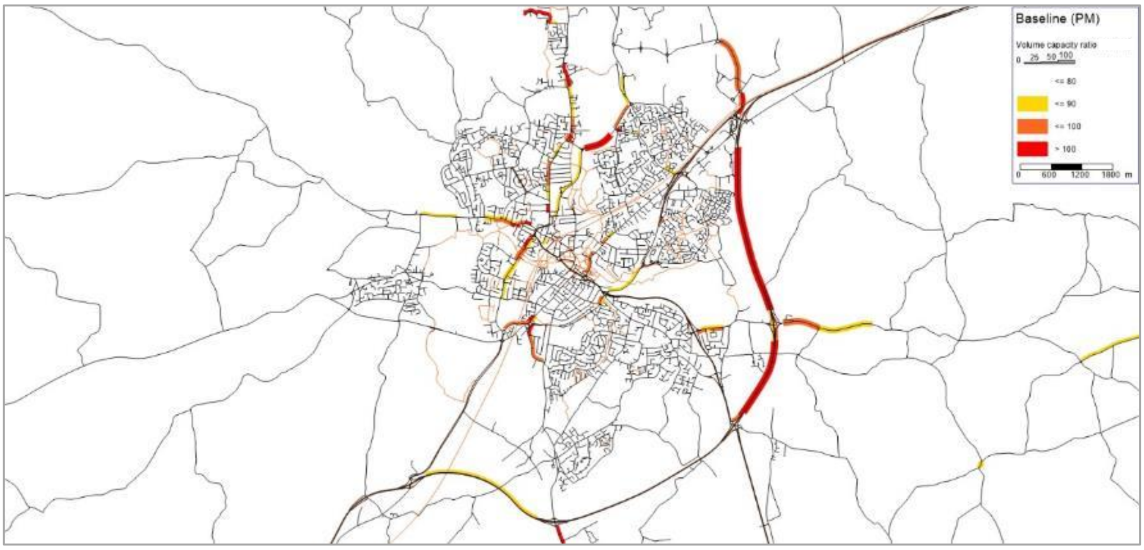


Figure 5-17: Volume/Capacity plot – Baseline – 2041 PM Peak

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
A1016 Waterhouse Lane / Rainsford Lane
B1008 Main Road, Broomfield
A1016 Chelmer Valley Road between Lawn Lane and Valley Bridge Roundabouts
RDR/Beaulieu Parkway between CNEB and Boreham Interchange

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. Whilst not of significant importance as a focus area for this Local Plan assessment, observations made concerning network impact north of Broomfield or in outer areas of the strategic model should nevertheless bear the above in mind.

5.3.2 Link Capacity Impact of Spatial Approaches

Peak hour V/C plots for each spatial approach can be found in Appendix E of this report.

In summary, there is little in the way of observable differences between model outputs across the three spatial approaches, with minor increases in the V/C ratio modelled on links in the vicinity of proposed development.

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 significant proportion of development trips – with a greater focus on the A12 with Spatial Approach 2 and a greater focus on the A1016 with Spatial Approach 1 and Spatial Approach 3.

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.

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 in the central and northern areas of Chelmsford following the addition of development trips associated with the three spatial approaches.

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.

5.4.1 Link Flow Differences: Baseline vs Spatial Approaches – 2041 AM Peak

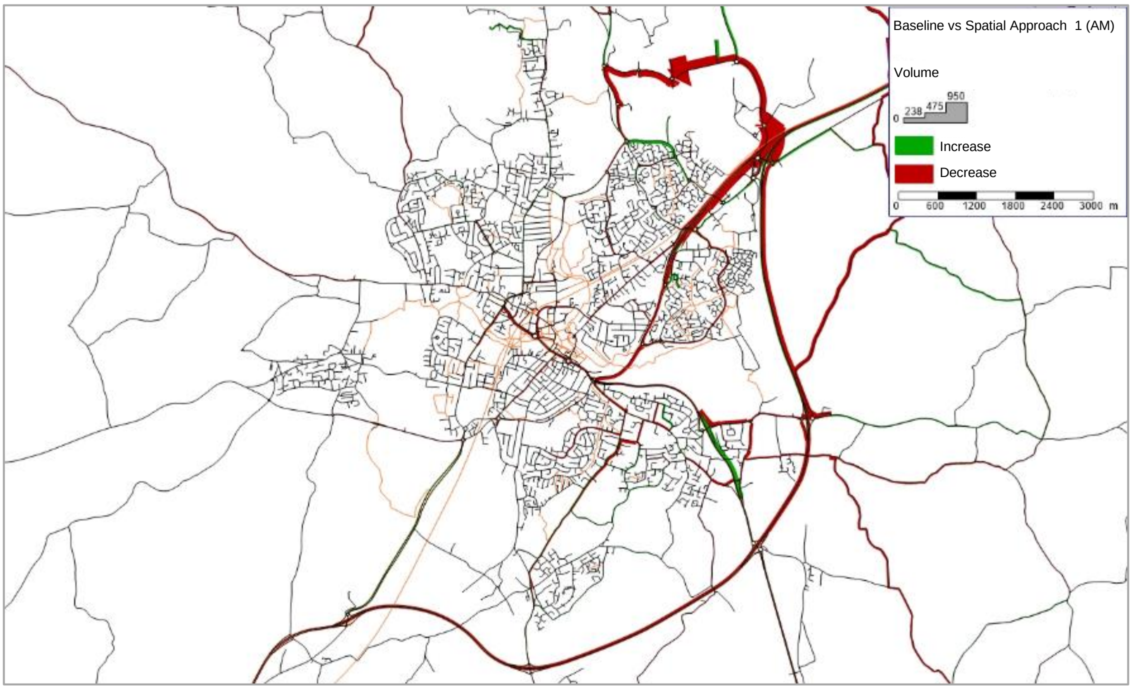


Figure 5-18: 2041 Baseline vs Spatial Approach 1 flow difference plot – 2041 AM Peak

Figure 5-19: 2041 Baseline vs Spatial Approach 2 flow difference plot – 2041 AM Peak

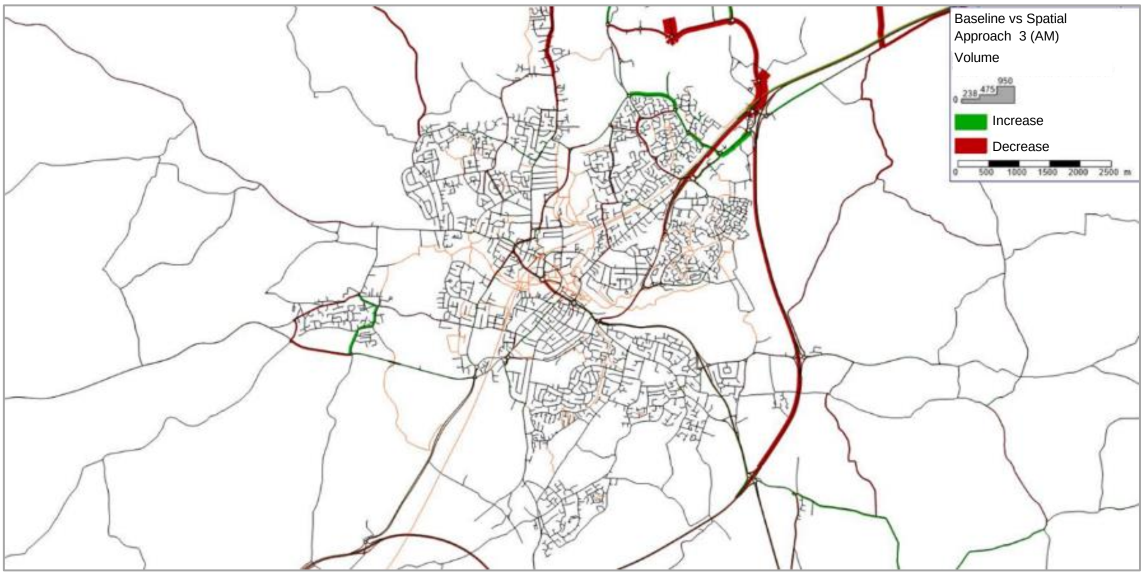


Figure 5-20: 2041 Baseline vs Spatial Approach 3 flow difference plot – 2041 AM Peak

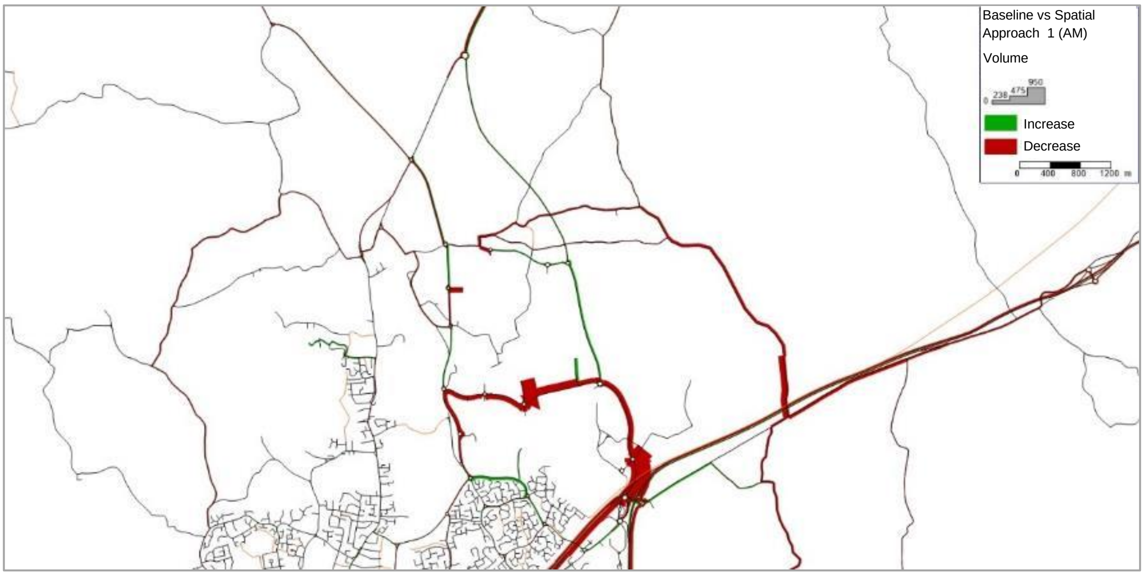


Figure 5-21: 2041 Baseline vs Spatial Approach 1 flow difference plot (N. Chelmsford) – 2041 AM Peak

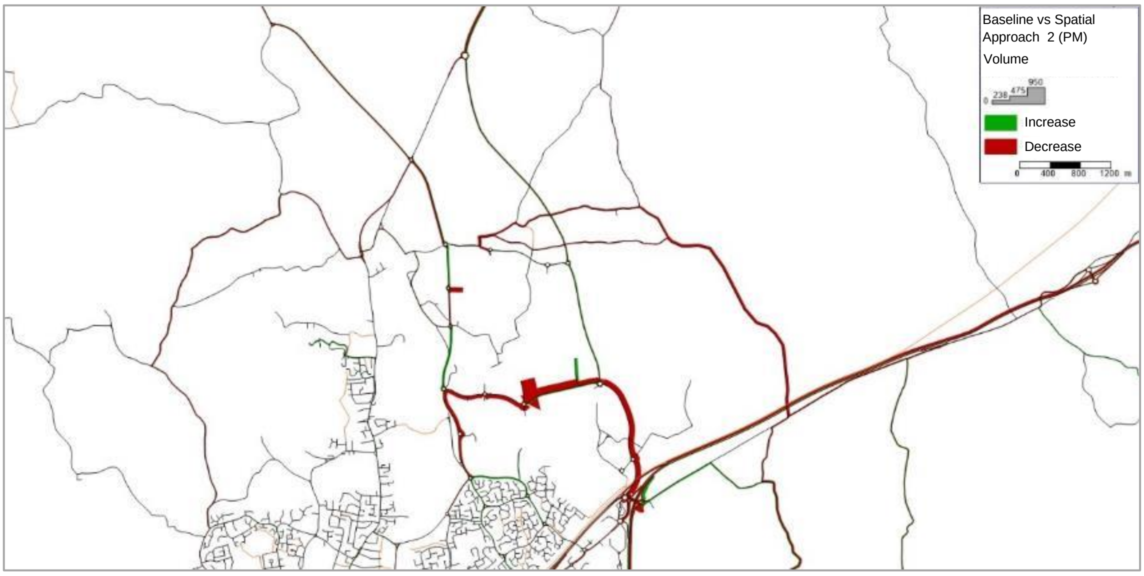


Figure 5-22: 2041 Baseline vs Spatial Approach 2 flow difference plot (N. Chelmsford) – 2041 AM Peak

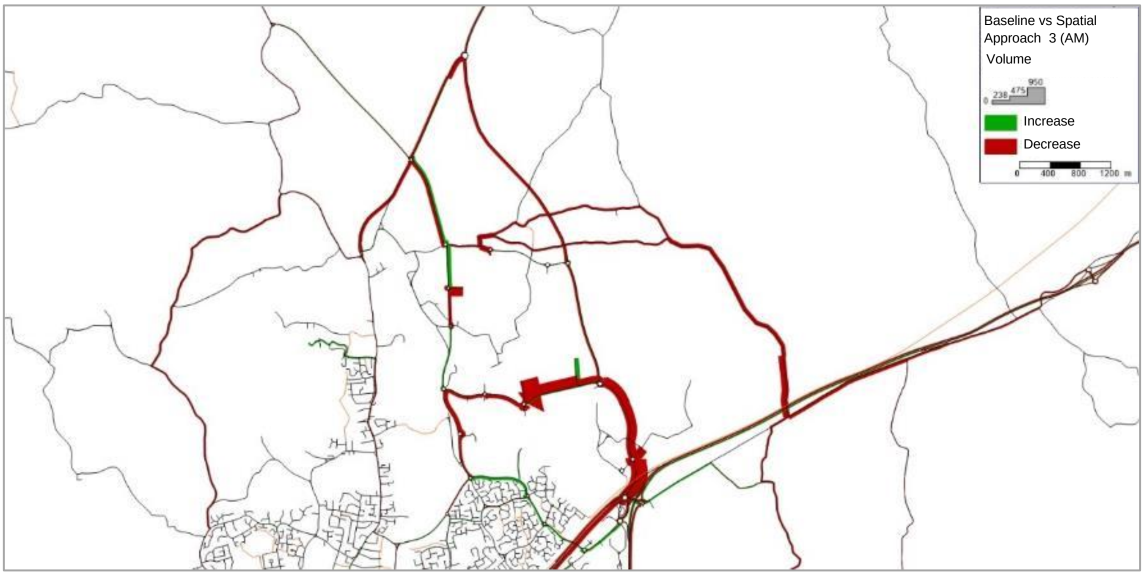


Figure 5-23: 2041 Baseline vs Spatial Approach 3 flow difference plot (N. Chelmsford) – 2041 AM Peak

5.4.2 Link Flow Differences: Baseline vs Spatial Approaches – 2041 PM Peak

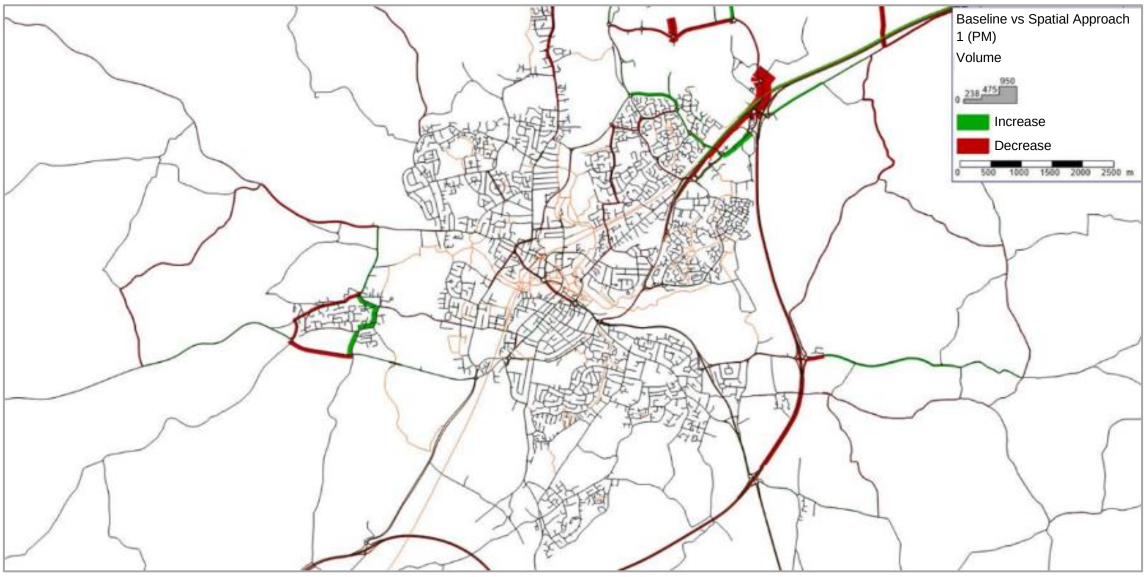


Figure 5-24: 2041 Baseline vs Spatial Approach 1 flow difference plot – 2041 PM Peak

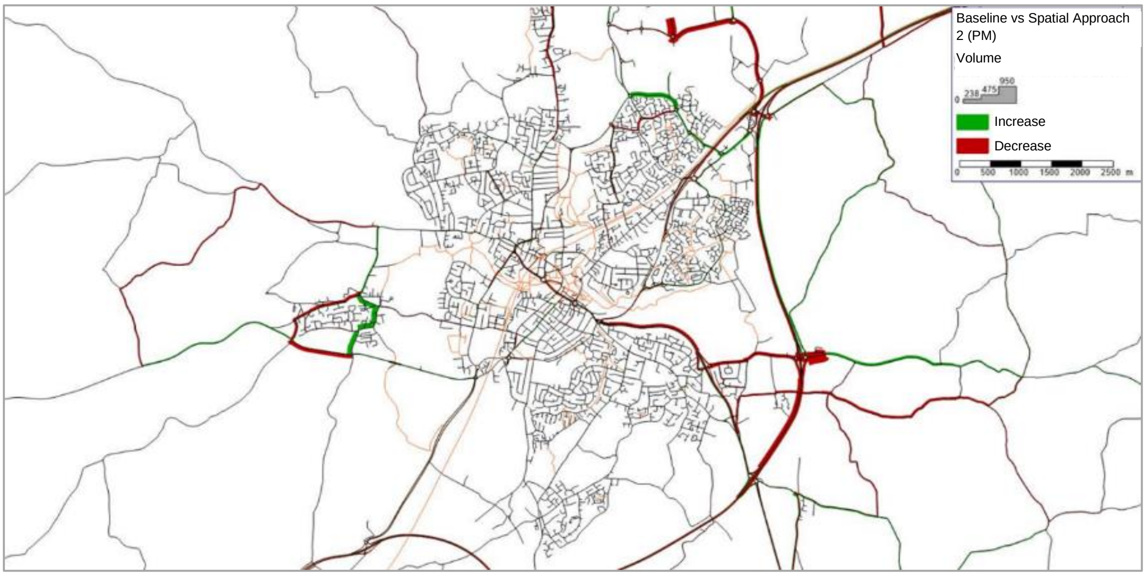


Figure 5-25: 2041 Baseline vs Spatial Approach 2 flow difference plot – 2041 PM Peak

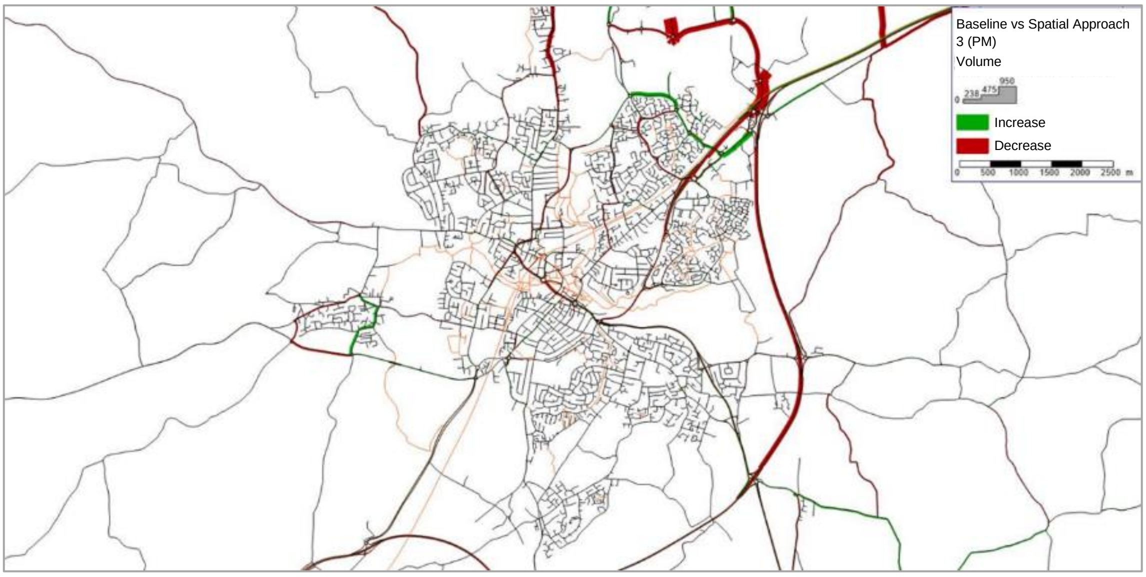


Figure 5-26: 2041 Baseline vs Spatial Approach 3 flow difference plot – 2041 PM Peak

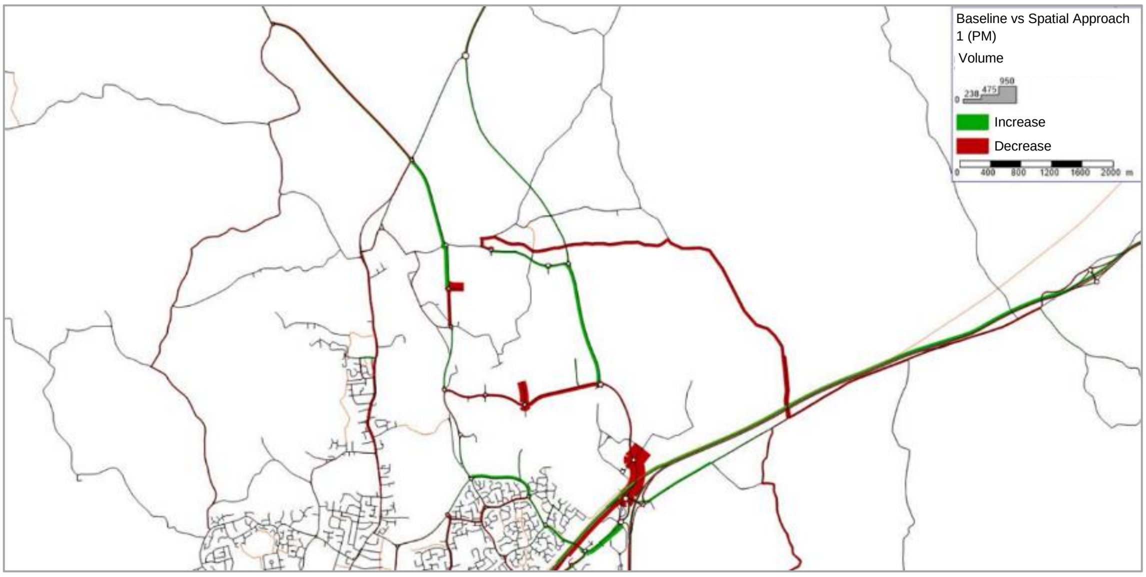


Figure 5-27: 2041 Baseline vs Spatial Approach 1 flow difference plot (N. Chelmsford) – 2041 PM Peak

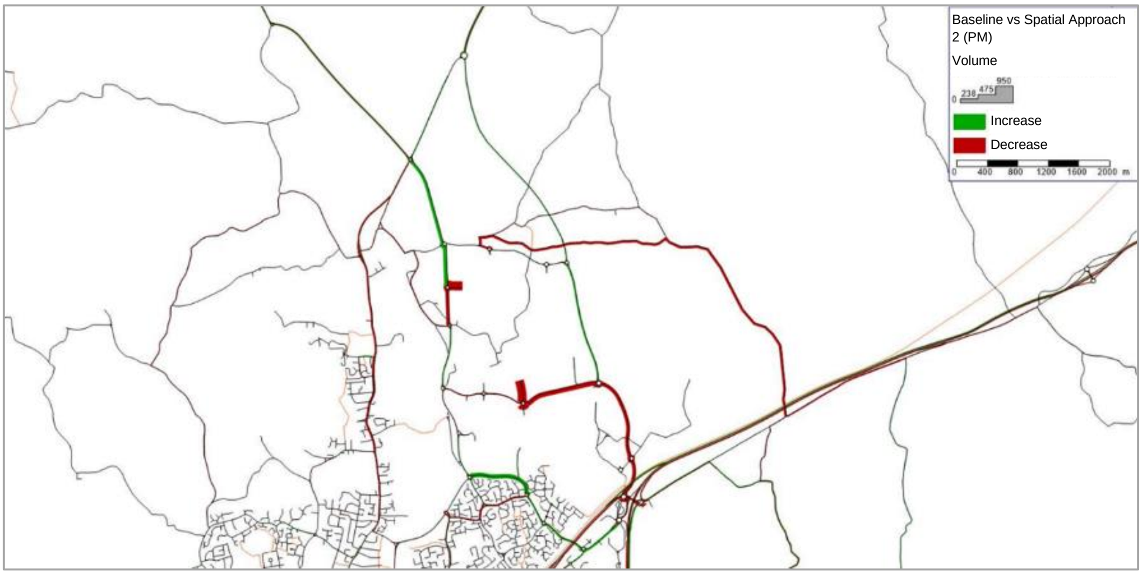


Figure 5-28: 2041 Baseline vs Spatial Approach 2 flow difference plot (N. Chelmsford) – 2041 PM Peak

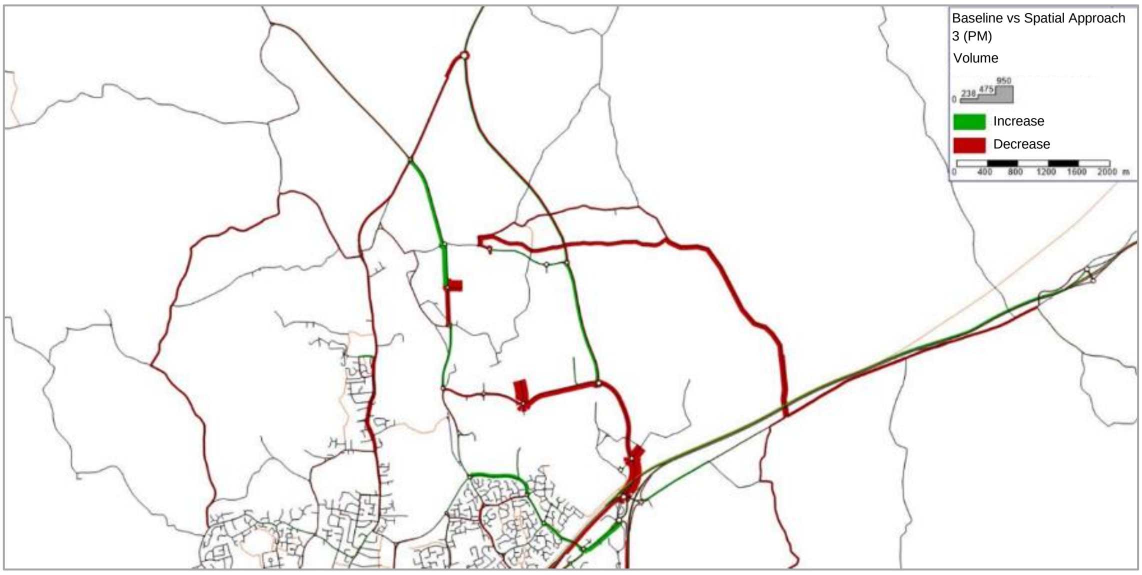


Figure 5-29: 2041 Baseline vs Spatial Approach 3 flow difference plot (N. Chelmsford) – 2041 PM Peak

Flow Difference Analysis	Key Commentary
Spatial Approach 1	Changes in traffic flow are spread most widely across the urban area of Chelmsford in the AM peak.
Spatial Approach 2	Trip reassignment along rural routes immediately east of the A12 is prominent across the AM and PM peaks, impacting the villages of Boreham, Sandon and Howe Green.
	Increases in traffic flow modelled through Great Baddow.
Spatial Approach 3	Trip reassignment along local and rural routes to the north of Chelmsford is prominent in the AM and PM peaks, impacting the villages of Boreham, Great Waltham and Broomfield.
General	Baseline traffic flows modelled in the city centre largely unaffected by additional development across the three spatial approaches.

Overall, there is an apparent correlation between:

a) The concentration of development in North Chelmsford and along the A12 corridor and;
b) An increase in modelled queue lengths at nearby junctions already stretched to capacity in the baseline, and;
c) The prevalence of trip reassignment to local and/or rural routes away from strategic corridors with over-capacity junctions.

5.5 Journey Time Analysis

Journey times for 18 directional routes have been extracted from each of the 2041 development spatial approaches and the baseline scenario, for both the AM and PM peaks. The selected routes represent key corridors within Chelmsford and have been segmented for analysis at key junctions. Appendix F1 lists the segmented sections for all 18 routes alongside their journey times. The locations of the identified routes are illustrated in Figure 5-30 overleaf.

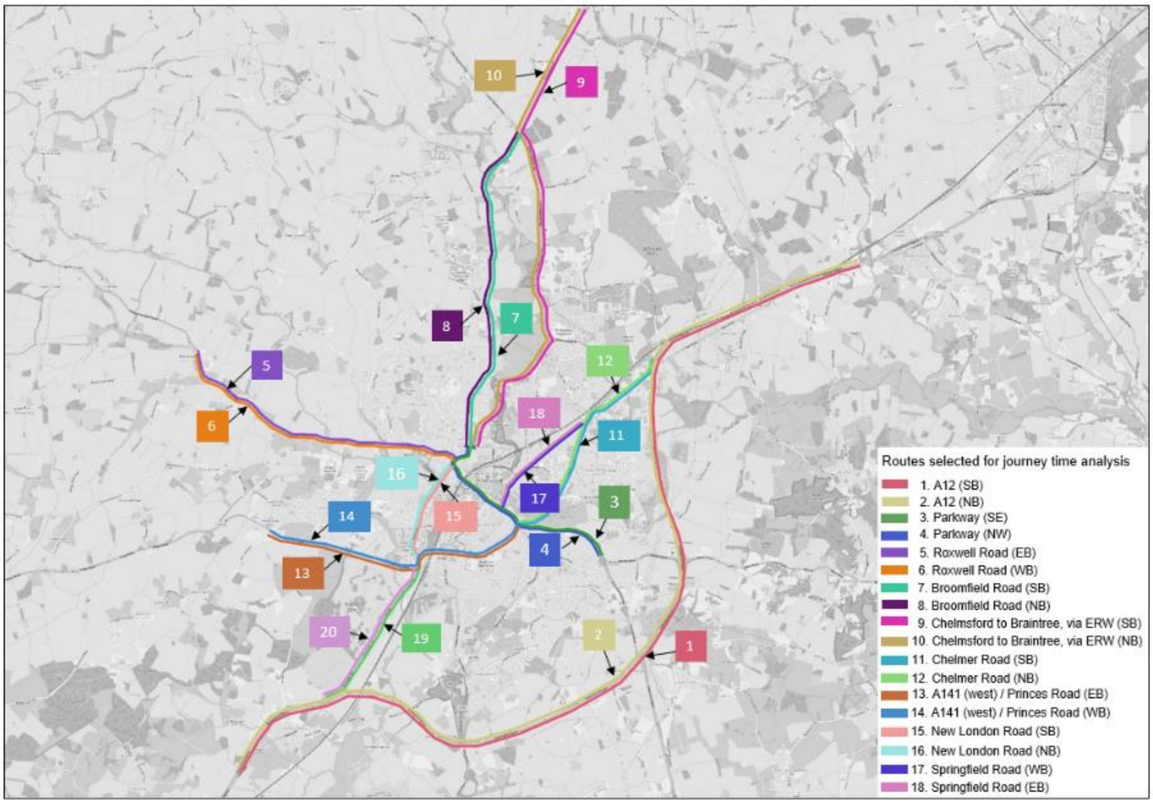


Figure 5-30: Key corridor routes in Chelmsford selected for journey time analysis

Journey time routes expected to be most impacted by Local Plan development traffic include:

- A12 corridor between J15 and J20
- B1008 Broomfield Road corridor
- A130/A131 corridor (via Essex Regiment Way and Chelmer Valley Road)

Directional journey times for all 18 routes are summarised in Table F1 in Appendix F. Appendix F also includes charts illustrating comparative journey times along a selection of routes between the three spatial approaches.

Charts are also provided overleaf for the routes highlighted above.

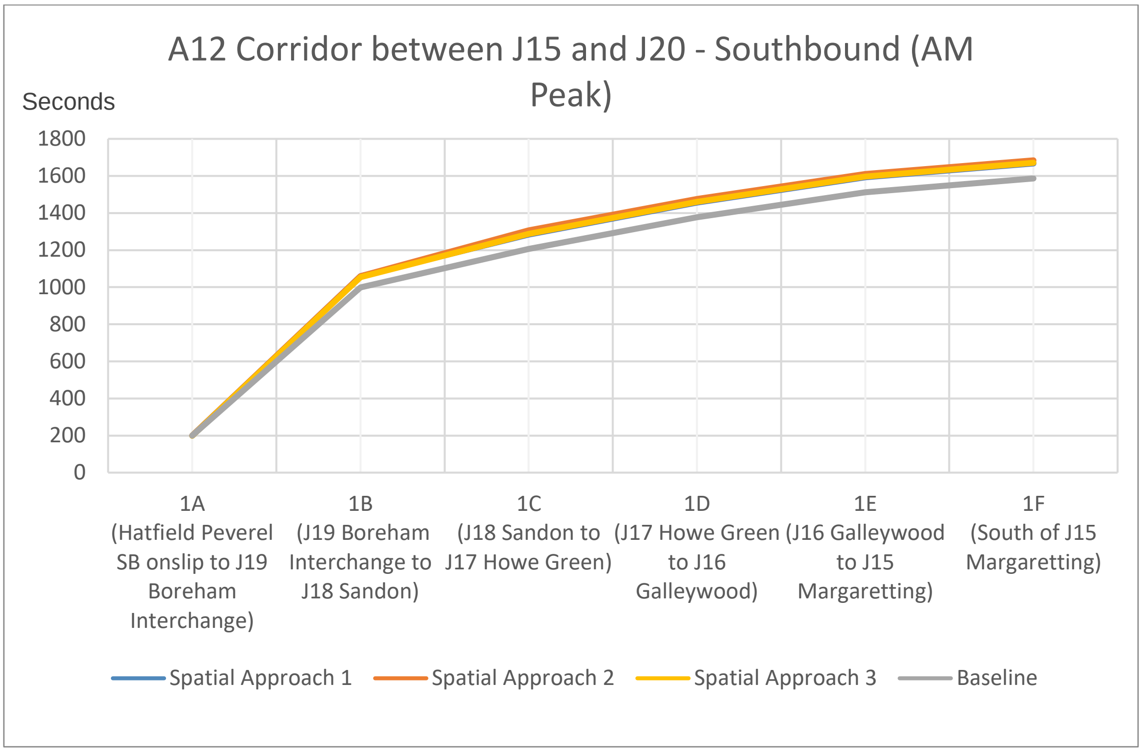


Figure 5-31: Journey Time Plot for the A12 between J15 and J20, Southbound in the AM Peak

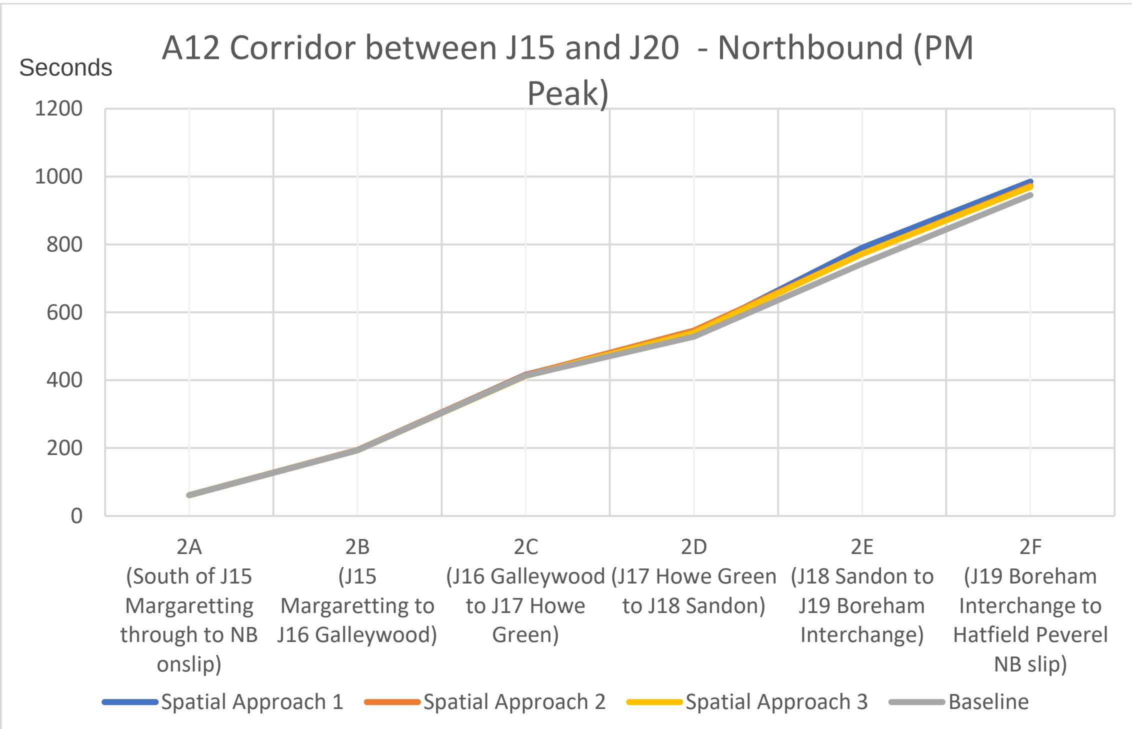


Figure 5-32: Journey Time Plot for the A12 between J15 and J20, Northbound in the PM Peak

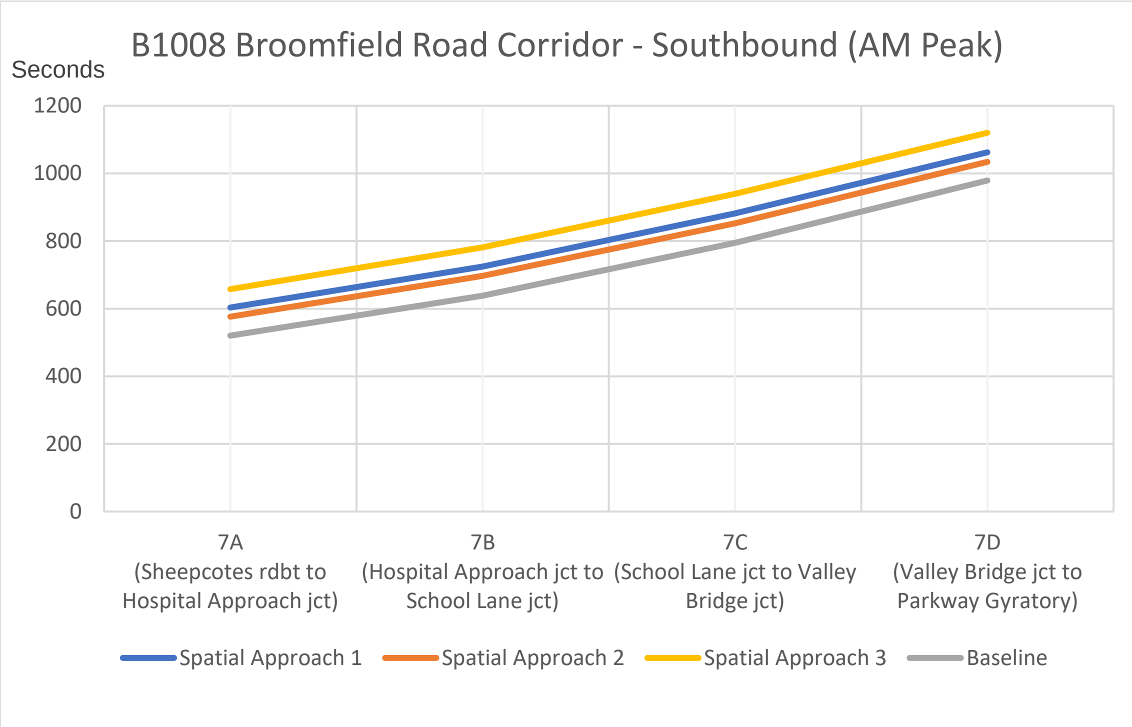


Figure 5-33: Journey Time Plot for the B1008, Broomfield Road, Southbound in the AM Peak

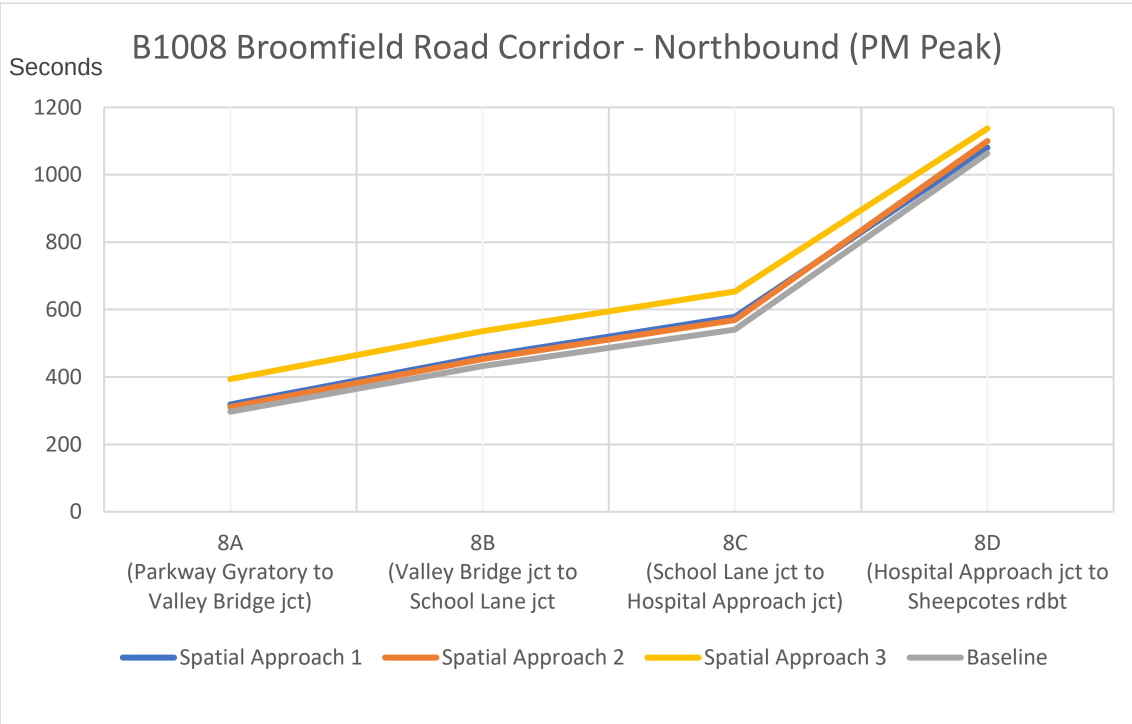


Figure 5-34: Journey Time Plot for the B1008, Broomfield Road, Northbound in the PM Peak

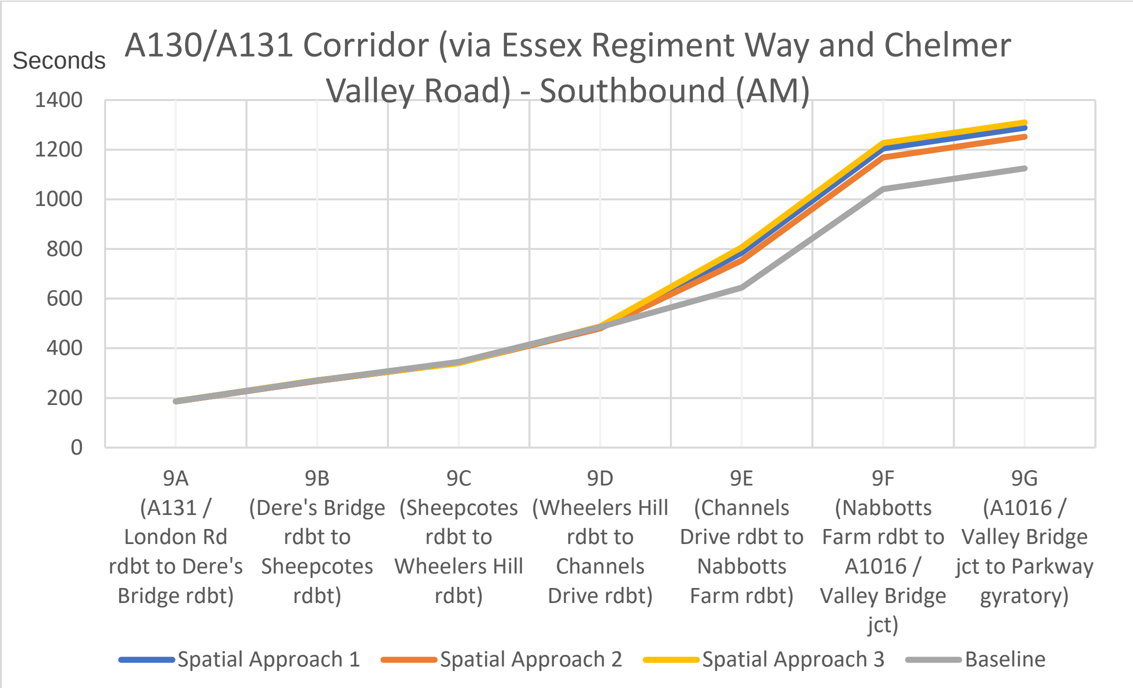


Figure 5-35: Journey Time Plot for the A130/A131 Corridor (via ERW and Chelmer Valley Road), Southbound in the AM Peak

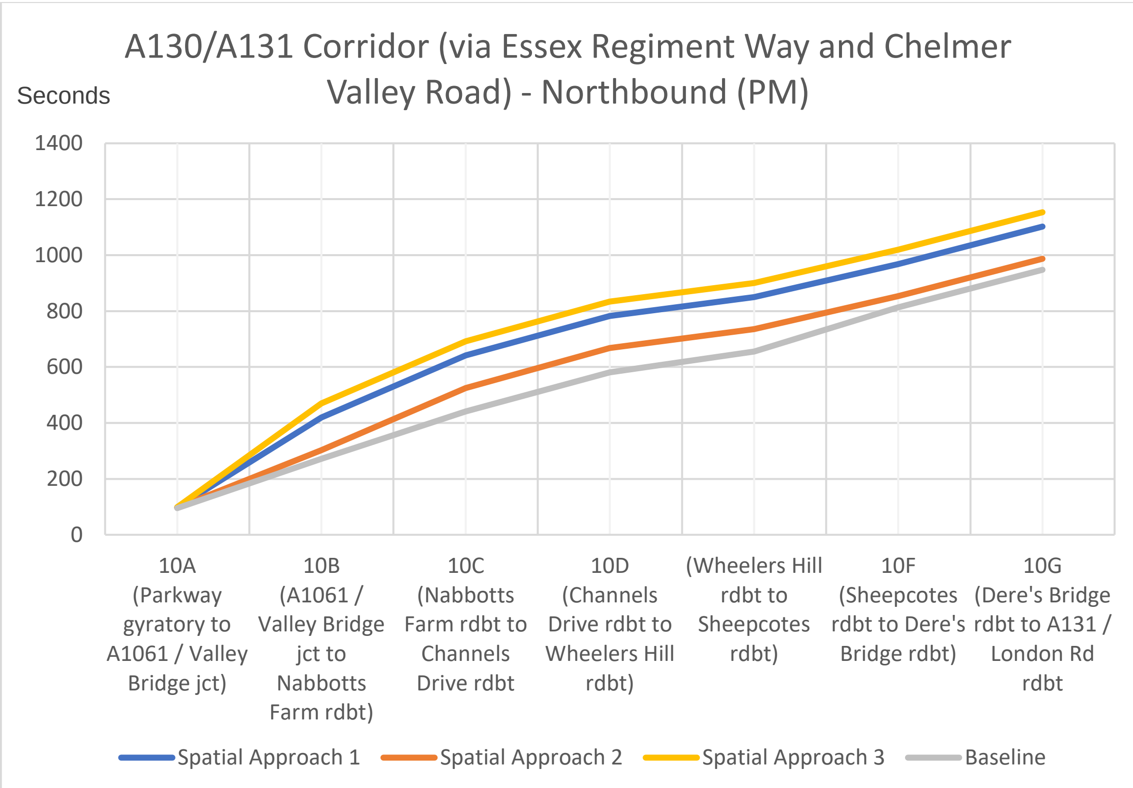


Figure 5-36: Journey Time Plot for the A130/A131 Corridor (via ERW and Chelmer Valley Road), Northbound in the PM Peak

Journey Time Analysis	Key Commentary
A12 Corridor	All three spatial approaches increase journey times along the A12, Southbound, between J19, Boreham Interchange and south of J15, Margaretting.
	Differences between the journey times for all three spatial approaches in the PM peak are slight.
B1008 Broomfield Road Corridor	Spatial Approach 3 has the greatest impact on journey times in both the AM and PM peaks.
	Differences between the journey times for Spatial Approach 1 and Spatial Approach 3 are slight.
A130/A131 Corridor	All three spatial approaches increase journey times between Wheeler's Hill Roundabout and Broomfield Road gyratory in the AM peak.
	Spatial Approach 2 has a lower impact on journey times, particularly in the PM peak (up to 200 seconds less than Spatial Approaches 1 and 3 for some sections).

In summary:

- The impact on journey times does not vary significantly between the three spatial approaches across most of the identified routes listed in Appendix F1.
- For the key routes identified above Spatial Approach 3 has the greatest impact on journey times.
- The greatest increase in journey times is observed between Wheeler's Hill Roundabout and Broomfield Road gyratory. This increase is present in all three spatial approaches.

5.6 Summary of Cross-Boundary Impact

To assess the comparative cross-boundary impact of the three Local Plan Review spatial approaches, a review has been undertaken of the forecast flows on key routes travelling in and out of neighbouring Districts and Boroughs across each of the approaches.

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 5-37 shows the points at which data has been extracted.

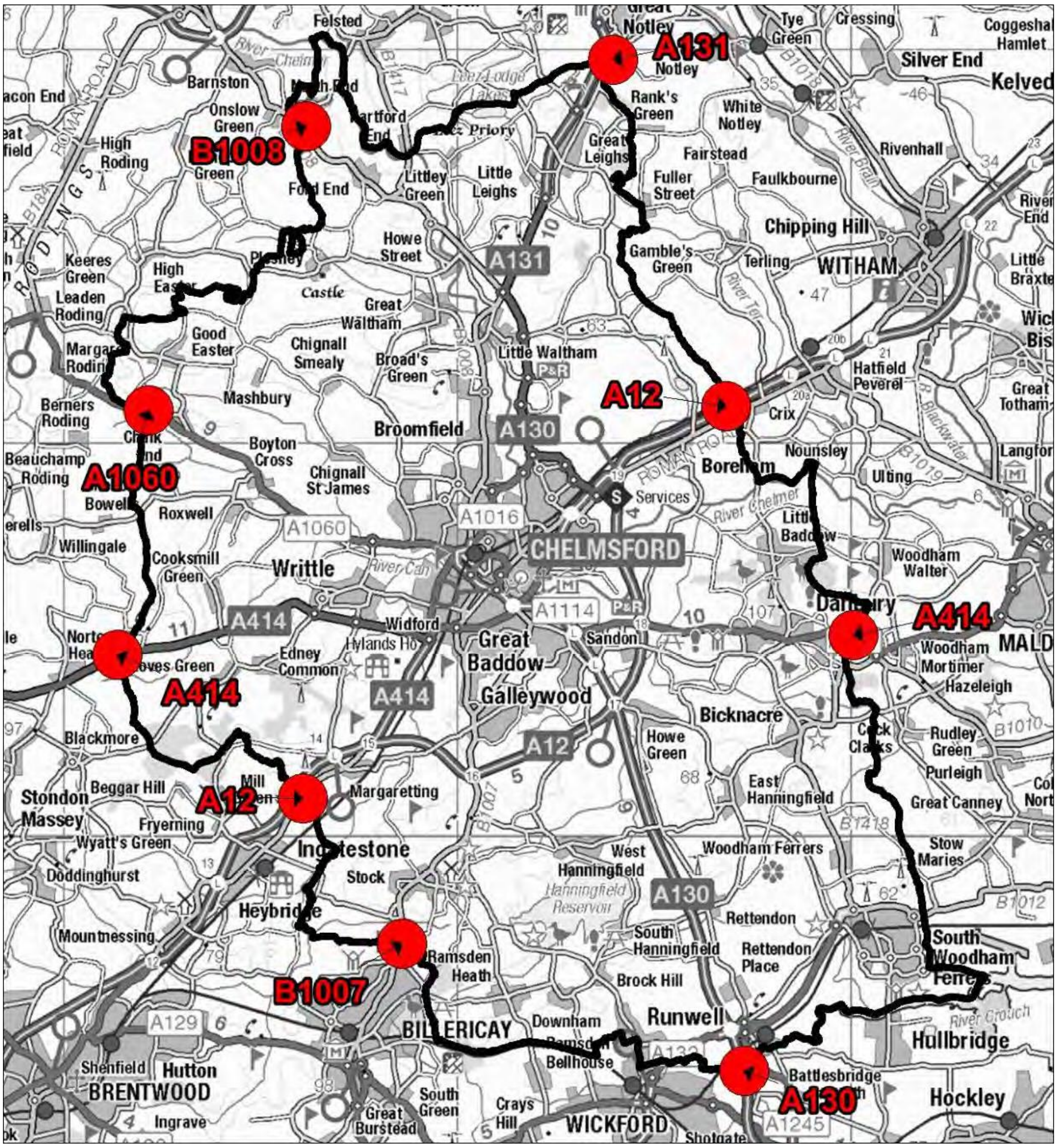


Figure 5-37: Location of cross boundary flow comparisons on key routes between Chelmsford and neighbouring authorities

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, modelled in each of the three Chelmsford Local Plan Review spatial approaches in 2041.

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	1,428	1,603	1,474	1,569
A12 (north)	Braintree	5,327	4,060	4,186	4,313
A414 (east)	Maldon	894	741	886	934
A130 (south)	Basildon	2,522	2,115	2,535	2,136
B1007	Basildon	973	656	964	711
A12 (south)	Brentwood	3,736	4,118	4,022	3,681
A414 (east)	Epping Forest	573	680	703	534
A1060	Uttlesford	410	341	363	393
B1008	Uttlesford	636	657	604	676

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

Road	Neighbouring Authority	Spatial Approach 1								Spatial Approach 2								Spatial Approach 3							
		AM Directional Flow				PM Directional Flow				AM Directional Flow				PM Directional Flow				AM Directional Flow				PM Directional Flow			
		IB		OB		IB		OB		IB		OB		IB		OB		IB		OB		IB		OB	
		Flow	%	Flow	%	Flow	%	Flow	%	Flow	%	Flow	%	Flow	%	Flow	%	Flow	%	Flow	%	Flow	%	Flow	%
A131	Braintree	1,545	8.2%	1,489	-7.1%	1,500	1.8%	1,570	0.1%	1,557	9.0%	1,485	-7.4%	1,495	1.4%	1,561	-0.5%	1,613	13.0%	1,476	-7.9%	1,495	1.4%	1,578	0.6%
A12 (north)	Braintree	5,275	-1.0%	4,165	2.6%	4,228	1.0%	4,157	-3.6%	5,284	-0.8%	4,198	3.4%	4,248	1.5%	4,258	-1.3%	5,253	-1.4%	4,134	1.8%	4,197	0.3%	4,206	-2.5%
A414 (east)	Maldon	907	1.5%	729	-1.6%	860	-2.9%	930	-0.4%	854	-4.5%	734	-0.9%	889	0.3%	902	-3.4%	878	-1.8%	732	-1.2%	885	-0.1%	921	-1.4%
A130 (south)	Basildon	2,532	0.4%	2,121	0.3%	2,558	0.9%	2,133	-0.1%	2,541	0.8%	2,025	-4.3%	2,557	0.9%	2,130	-0.3%	2,530	0.3%	2,062	-2.5%	2,556	0.8%	2,128	-0.4%
B1007	Basildon	988	1.5%	676	3.0%	971	0.7%	720	1.3%	988	1.5%	680	3.7%	973	0.9%	705	-0.8%	985	1.2%	673	2.6%	972	0.8%	708	-0.4%
A12 (south)	Brentwood	3,773	1.0%	4,152	0.8%	4,032	0.2%	3,757	2.1%	3,779	1.2%	4,138	0.5%	4,039	0.4%	3,735	1.5%	3,771	0.9%	4,164	1.1%	4,027	0.1%	3,740	1.6%
A414 (west)	Epping Forest	585	2.1%	682	0.3%	705	0.3%	551	3.2%	573	0.0%	680	0.0%	705	0.3%	541	1.3%	586	2.3%	680	0.0%	704	0.1%	552	3.4%
A1060	Uttlesford	443	8.0%	336	-1.5%	367	1.1%	422	7.4%	421	2.7%	340	-0.3%	369	1.7%	405	3.1%	432	5.4%	358	5.0%	382	5.2%	414	5.3%
B1008	Uttlesford	619	-2.7%	680	3.5%	648	7.3%	640	-5.3%	612	-3.8%	676	2.9%	637	5.5%	643	-4.9%	631	-0.8%	683	4.0%	641	6.1%	661	-2.2%

**Colour scale indicates level of change from baseline*

Analysis shows that cross-boundary connections to the north and north-west of Chelmsford are most affected by the latest proposed Local Plan development, with the A131 border with Braintree showing the highest modelled increase in flows across all three spatial approaches in the AM peak.

This forecast increase in inbound traffic flow on the A131 during the AM peak is likely because of the increases in employment sites across Chelmsford under each of the spatial approaches, generating additional employment trips inbound from Braintree.

The impact on AM inbound flows on the A131 is particularly significant under Spatial Approach 3, with an increase of 13% compared to the baseline flows, which represents the highest percentage increase on the cross-boundary corridors across all three spatial approaches. This is likely due to employment growth being focused to the north-east of Chelmsford. However, the impact of Spatial Approach 3 on outbound traffic flows here is less significant.

Routes crossing the Chelmsford administrative boundary into Uttlesford are also impacted by higher flows due to the additional Local Plan development, particularly under Spatial Approaches 1 and 3, and are forecast both in the inbound and outbound direction.

Cross-boundary connections to the east and south of Chelmsford are less affected by the Local Plan development, with outputs showing only a minor increase in flows on the A414 bordering Maldon under Spatial Approach 1 in the AM, inbound, and in Spatial Approach 2 in PM, inbound. The increase in AM inbound flows here under Spatial Approach 1 is likely due to additional trips travelling across the administrative boundary from the east to the employment site north of Sandon Lodge, which is located to the southeast of this cross-boundary location. This can be seen in Figure 5-1, which shows the assignment of trips along the A414 to this site in the AM Peak. The increase in PM inbound flows on the A414 bordering Maldon district under Spatial Approach 2 is as a result of additional residential trips travelling on the A414 to the Hammonds Farm site from the east. However, overall, the impact of these new development sites on forecast increases in trips on the A414 at the border with Maldon is relatively minor.

In some cases, the impact of additional Local Plan development trips has resulted in a reduction in vehicle flows compared with the baseline on these cross-boundary routes, which is likely due to congestion in certain areas causing re-routing across the network.

Of the three spatial approaches, it is noted that development associated with Spatial Approach 3 comprises a greater percentage of overall flow on the A1060 compared with other spatial approaches. However, this is explained by the fact that background flows on this corridor are comparatively low in the peak hours.

5.7 Forecast Impact on Rural Villages

Across the three spatial approaches, a small quantum of development has been modelled in the villages of 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.

It should, however, 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. For this reason, comparative analysis within this report has been focused on areas to the north of Chelmsford and along the A12 corridor.

Should development sites in outlying rural areas be taken forward as part of the Preferred Spatial Approach, these will be considered further in the evidence base reporting. However, there will be a requirement for more detailed local traffic impact modelling to be undertaken by developers as part of future transport assessments.

5.8 Forecast Impact on the Chelmsford North-East Bypass

5.8.1 Current Layout Assumption + Proposed Phased Delivery

The latest modelling of Local Plan spatial approaches has been undertaken in parallel with a study commissioned by ECC to consider the wider network impact of a phased delivery of the Chelmsford North-East Bypass.

Findings from the study are expected to support the delivery of the southern section of the bypass - Phase 1A (see Figure 3-5), up to 2041. The bypass will then link with the proposed developer-funded Northern Radial Distributor Road (NRDR), to provide connectivity with the A130 Essex Regiment Way.

As of August 2023, the new proposed approach to delivery of the CNEB has yet to be confirmed and has therefore not been included in the forecast network assumptions for the assessment of the Local Plan spatial approaches. Discussions will be held with ECC/CCC prior to modelling of the preferred spatial approach to ensure that the most up-to-date assumptions on the delivery of the CNEB in the 2041 forecast year are modelled.

For now, it is recommended that outputs and findings from the two parallel studies are not compared directly.

5.8.2 Forecast Link Flows

Modelled 2041 directional traffic flows were obtained along the CNEB in the Baseline and for the three assessed spatial approaches. Outputs were recorded by sub-dividing the route into four sections as follows:

- Northern Section (1b) – Junction at Chatham Green to junction with NRDR
- Mid-Section (1a) – Junction with NRDR to junction with RDR
- Southern Section – RDR to Beaulieu Rail Station access junction
- Boreham Interchange Approach

Modelled flows are shown in Table 5-3 below.

CNEB Sections	Baseline		Spatial Approach 1		Spatial Approach 2		Spatial Approach 3	
	AM	PM	AM	PM	AM	PM	AM	PM
Northern Section (NB)	651	831	678	722	697	782	819	763
Northern Section (SB)	836	809	792	803	790	806	822	905
Mid Section (NB)	779	1222	800	1044	808	1137	904	1085
Mid Section (SB)	1297	1035	1994	1032	1235	1035	1261	1093
Southern section (NB)	1247	1519	1336	1517	1290	1654	1406	1650
Southern section (SB)	1680	1598	1912	1677	1972	1677	2088	1739
Boreham Interchange Approach (NB)	1418	1510	1677	1884	1448	1648	1677	1820
Boreham Interchange Approach (SB)	1768	1804	2611	2282	2053	1882	2427	2187

Table 5-3: Directional traffic flows modelled along the CNEB for the Baseline and 3x Spatial Approaches

The colour scheme used in Table 5-3 provides an indication of capacity pressure along the different sections of the CNEB based on an assumption that a single-lane carriageway might typically accommodate between 1900 and 2100 vehicles per hour.

Modelled flows along the northern section of the CNEB (Section 1b) are shown to fall significantly below the capacity of a typical single carriageway link. Southbound flows on the approach to the roundabout junction with the RDR/Beaulieu Parkway are shown to reach link capacity under Spatial Approach 1, whilst with spatial approaches 1 and 3 modelled, the southbound section of route through to the Boreham Interchange is shown to exceed the capacity of the link.

5.8.3 A Case for Bypass Carriageway Widening

It can be expected that the additional Local Plan development proposed in North-East Chelmsford associated with Spatial Approaches 1 and 3 would likely generate traffic volumes sufficient to exceed the capacity of the Beaulieu Parkway/RDR link through to the Boreham Interchange. Under these circumstances, it is likely that the new bridge link over the rail line would become a network constraint with little scope to widen the carriageway at this point.

Additional capacity pressures modelled at the Boreham Interchange and on the A12 carriageway between J17 and J19 would likely cause further constraints for strategic movements, such that there would be little scope for attracting further trips to the CNEB along its northern section.

Until these wider capacity limitations are addressed, modelling suggests that predominantly local traffic flows along the CNEB will be of insufficient volume to warrant carriageway widening.

5.9 Mode Shift Sensitivity Testing

To model the potential impact of mode shift amongst Local Plan housing and employment trips, a sensitivity test using Spatial Approach 1 as an example, was undertaken. This utilised lower trip rates commensurate with more urban development and a greater provision of passenger transport services. The subsequent reduction in trips was modelled as an aspirational target, potentially achievable through the provision of additional passenger transport services - and their successful uptake.

The sensitivity test was undertaken with an understanding that trip rates for proposed development within the Chelmsford forecast modelling were 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 were 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 was 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 Spatial Approach 1 as part of the Sensitivity Test.

Table 5-4: EPTAL Trip Rates

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%

The following plots from the Chelmsford Model illustrate the changes in traffic flows for the sensitivity test. 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 for all spatial approaches.

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.

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

5.9.1 Link Flow Differences: Spatial Approach 1 Sensitivity Test vs Baseline – 2041 AM Peak

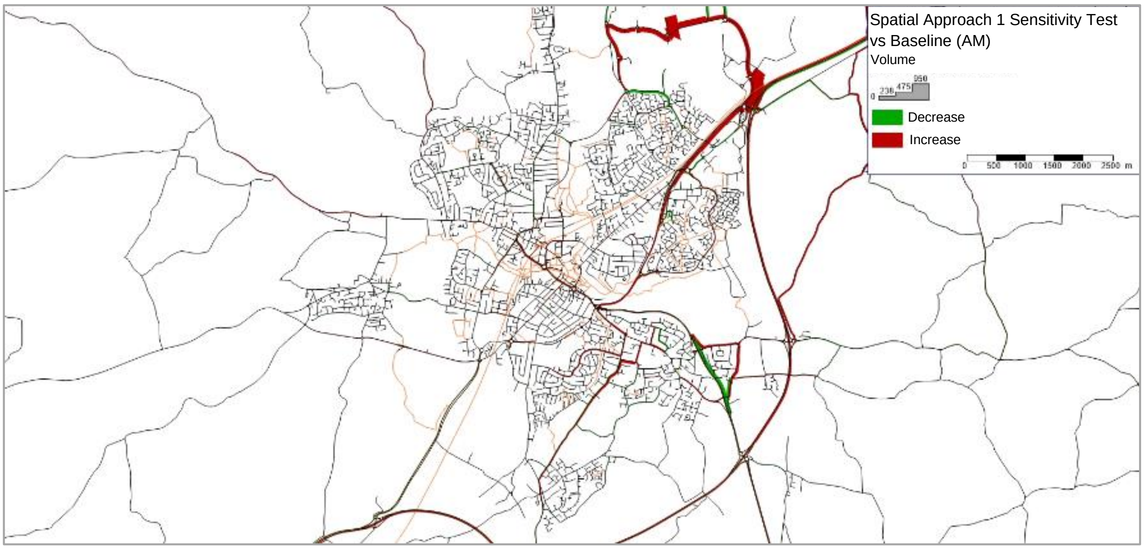


Figure 5-38: 2041 Spatial Approach 1 Sensitivity Test vs Baseline flow difference plot – 2041 AM Peak

5.9.2 Link Flow Differences: Spatial Approach 1 Sensitivity Test vs Baseline - 2041 PM Peak

Figure 5-39: 2041 Spatial Approach 1 Sensitivity Test vs Baseline flow difference plot - 2041 PM Peak

5.9.3 Link Flow Differences: Spatial Approach 1 Sensitivity Test vs SA 1 – 2041 AM Peak

Figure 5-40: Spatial Approach 1 Sensitivity Test vs Spatial Approach 1 flow difference plot - 2041 AM Peak

5.9.4 Link Flow Differences: Spatial Approach 1 Sensitivity Test vs Spatial Approach 1 – 2041 PM Peak

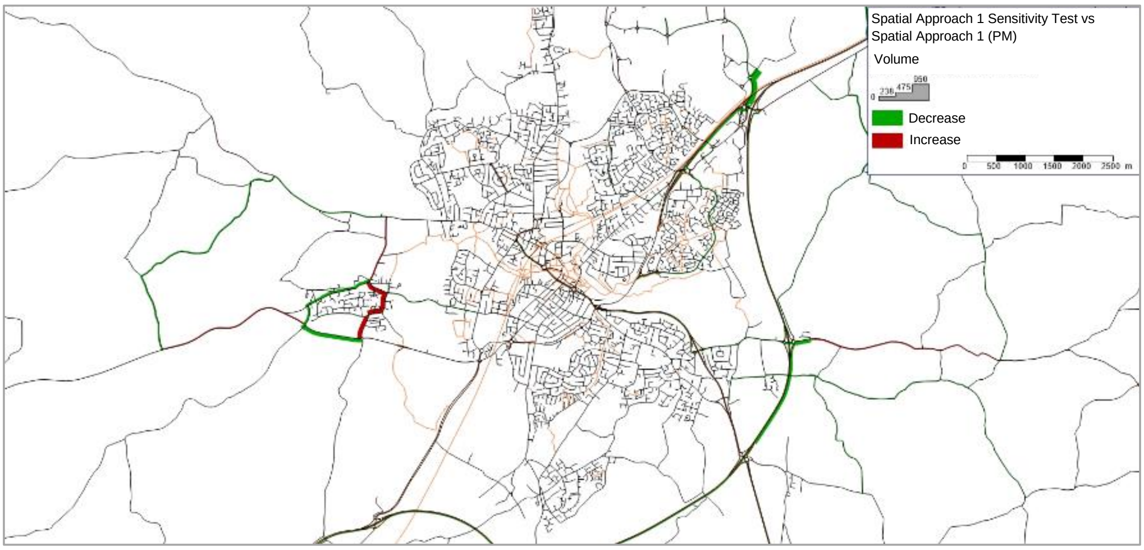


Figure 5-41: Spatial Approach 1 Sensitivity Test vs Spatial Approach 1 flow difference plot – 2041 PM Peak

Flow Difference Analysis	Key Commentary
Sensitivity Test vs Baseline	Increases in traffic mostly concentrated in NE Chelmsford, particularly around the CNEB in the AM peak.
	Decreases in the PM peak along the A130 and along the A12 travelling northeast.
Sensitivity Test vs Spatial Approach 1	Decreases in traffic widespread across Chelmsford's urban area, particularly noticeable around the CNEB in both the AM and PM peaks.
	Reduction in route reassignment through Boreham, particularly in the AM peak.

When compared with the baseline, the sensitivity test with Spatial Approach 1 shows that traffic increases can still be expected around the Boreham Interchange. However, Figure 5-40 and Figure 5-41 illustrate that an increase in passenger transport provision could help to reduce the volume of traffic routing through the junction and along the A12 in both the AM and PM peaks. It is expected that the outcomes of this sensitivity test, including traffic reductions along the A12, the A130 and around the CNEB, would be consistent across Spatial Approaches 2 and 3.

Sensitivity testing suggests that an increase in passenger transport uptake amongst Local Plan development trips across all Spatial Approaches, could help to mitigate the impact of reassigned traffic flows through villages such as Boreham and Sandon as a means of avoiding congestion on strategic routes in the vicinity of Local Plan development.

5.10 Focus Areas for Local Plan Impact Mitigation – Desktop Review

Baseline modelling suggests that by 2041, network congestion will likely occur in key locations in and around Chelmsford. Dependent on the spatial allocation of development across the three spatial approaches, congestion in these key locations might be expected to worsen.

In other locations, the addition of Local Plan development traffic might be expected to introduce peak hour congestion – typically at junctions near to proposed development.

Modelling suggests that proposed Local Plan development may have only a minor impact on traffic conditions in the centre of Chelmsford, likely due to network constraint modelled 'upstream' along key corridors into and out of the city centre. It is worth noting that by addressing network constraints on the periphery of Chelmsford, additional pressures could be placed on the capacities of junctions in the city centre – thereby expanding the potential scope for mitigation.

Dependent on the location of sites comprising the Preferred Spatial Approach, the following junctions and strategic corridors on the edge of the urban area of Chelmsford may be in-scope for consideration as part of Local Plan development mitigation going forward.

Chelmer Valley Road Corridor

- With a particular focus on **Lawn Lane roundabout**. The corridor already has capacity issues in the baseline, but Local Plan development traffic worsen queues back along Essex Regiment Way in all spatial approaches.
    - With the availability of bus priority measures along the corridor, congestion along the route may be seen as an opportunity to incentivise the use of existing or expanded bus services for travel into the city from the north.
    - There may also be a need to consider further capacity improvements at Lawn Lane junction (if possible / practical).

Boreham Interchange (with latest National Highway design)

- **Generals Farm roundabout** is modelled with congestion in the AM peak as a result of Local Plan development associated with Hammonds Farm in Spatial Approach 2.
    - Should Spatial Approach 2 be taken forward as a preferred approach, further investigation may be required to determine whether signal times could be reconfigured before considering changes to the layout of the junction (if possible / practical).

- **Drovers Way and Generals Lane roundabouts** in the PM peak. These are already modelled as a minor capacity issue in the baseline, and Local Plan development trips across all spatial approaches worsen queues back along approach arms including A130 Colchester Road, A132 Chelmer Road and the A12 northbound off-slip.
    - Further investigation may be required to determine whether signal times could be reconfigured before considering changes to the layout of the junction (if possible / practical).

Beaulieu Rail Station Access

- The rail station access to/from the RDR is flagged in the modelling as a potential pinch-point for congestion, particularly in the AM peak with Spatial Approach 3.
    - Should Spatial Approach 3 be taken forward as a preferred approach, capacity improvements may need to be considered at the junction to facilitate unimpeded access to the rail station.

A12 J17 at Howe Green

- The A12 southbound off-slip is modelled with queues extending back to the main carriageway with spatial approaches 2 & 3.
    - Should either Spatial Approach 2 or 3 be taken forward as a preferred approach, further investigation may be required to determine whether signal times could be reconfigured before considering changes to the layout of the junction (if possible / practical).

A12 Corridor between J17 and J19

- The A12 corridor between Howe Green and the Boreham Interchange is shown to be at capacity in the baseline modelling. The addition of development traffic associated with all three spatial approaches results in an increase in wide-scale route reassignment to rural links serving as an alternative to the A12.
    - It is recommended that NH are involved in discussions going forward regarding the traffic impact of proposed Local Plan development on the strategic and local/rural road network.

Army & Navy Roundabout and approach arms

- Despite capacity improvements at the Army & Navy Roundabout, modelling suggests that moderate queue lengths may still be expected along most approaches in a 2041 baseline scenario. Whilst the impact of Local Plan development trips at the junction appears to be very limited across the spatial approaches modelled, it is worth noting that Spatial Approach 2 is likely to result in the greatest volume of Local Plan traffic routing through the junction, and displacing background traffic flows.

6 Summary of Network Performance and Overall Findings

Table 6-1 and Table 6-2 summarise the peak hour traffic impact of proposed local plan development across the three spatial approaches for geographic sectors and key corridors across Chelmsford.

Table 6-1: Sector Impact Ranking Comparison of Spatial Approaches

	AM Peak			PM Peak		
Sector	Spatial Approach 1	Spatial Approach 2	Spatial Approach 3	Spatial Approach 1	Spatial Approach 2	Spatial Approach 3
Northeast (Springfield, Boreham)	2	1	3	3	1	2
Northwest (Broomfield, Melbourne)	2	1	3	2	1	3
City Centre	=1	=1	=1	=1	=1	=1
Southeast (Great Baddow)	=1	3	=1	=1	3	=1
Southwest (Widford)	2	1	3	=1	=1	=1
West (Writtle)	=1	=1	=1	=1	=1	=1
East of A12 (Little Baddow, East Hanningfield)	2	3	1	2	3	1

**Where '=' is listed, this suggests there is no difference in network performance between the spatial approaches*

Table 6-2: Corridor Impact Ranking Comparison of Spatial Approaches

		AM Peak			PM Peak		
Corridor	Direction	Spatial Approach 1	Spatial Approach 2	Spatial Approach 3	Spatial Approach 1	Spatial Approach 2	Spatial Approach 3
B1008 - Main Road (Broomfield)	Inbound	=1	=1	3	=1	=1	3
	Outbound	=1	=1	=1	=1	=1	3
A1016 - Chelmer Valley Road	Inbound	2	1	3	2	1	3
	Outbound	=1	=1	=1	2	1	3
A138 - Chelmer Road	Inbound	=1	=1	=1	3	1	2
	Outbound	=1	=1	=1	=1	=1	=1
A12	Southbound	=1	3	=1	=1	=1	=1
	Northbound	=1	=1	=1	=1	3	=1
A1114 - Essex Yeomanry Way	Inbound	=1	=1	=1	=1	=1	=1
	Outbound	=1	=1	=1	=1	=1	=1
A1060 - Parkway	Inbound (NW)	=1	=1	=1	=1	=1	=1
	Outbound (SE)	=1	=1	=1	=2	=2	1
B1009 - New London Road	Inbound	=1	=1	=1	=1	=1	=1
	Outbound	=2	1	=2	=2	1	=2
A1016 - Waterhouse Lane	Inbound	=1	=1	=1	=1	=1	=1
	Outbound	=1	=1	=1	=1	=1	=1
A1060 - Rainsford Road	Inbound	=1	=1	=1	=2	=2	1
	Outbound	3	1	2	=2	=2	1

- Spatial Approach 3 is shown in the modelling to have the greatest impact on the local and strategic road network – most notably in the north of Chelmsford. This results in wider route reassignment to local routes through Broomfield and Melbourne. Spatial Approach 3 is also shown to have the greatest overall cross-boundary impact, with percentage flow increases most notable on the A131 to/from Braintree District.

- Spatial Approach 2 is modelled as having the smallest overall network impact. However, the option has the greatest impact on the A12 corridor which, due to existing congestion along the route, results in queues extending along the trunk road carriageway and wider route reassignment occurring across rural areas to the east.

- Spatial Approach 1 is characterised as having a broader, but less pronounced impact on the overall road network in and around Chelmsford.

- Chelmsford city centre and areas to the south and west are less impacted by development traffic. Modelling suggests that bottlenecks caused by congestion along corridor routes into Chelmsford from the north and east help to limit the volume of additional trips reaching the city centre during peak hours.
.

- From a mitigation perspective, existing and proposed sustainable infrastructure in North-East Chelmsford (such as the bus priority measures along the Chelmer Valley Road corridor, Bus Rapid Transit services and Beaulieu Rail Station), has the potential to encourage and accommodate a greater volume of sustainable trips made to/from Local Plan developments in the area.

- However, modelling suggests that additional development in the north of Chelmsford will likely place additional capacity pressure on the Boreham Interchange and routes to/from the proposed Beaulieu Rail Station.

- As a result of network congestion modelled at the Boreham Interchange and along the A12, limiting strategic traffic flows, analysis suggests that local movements along the CNEB will be of insufficient volume to warrant carriageway widening – based on the infrastructure assumptions included in this assessment.

Appendices

7 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 will be used in 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[7]. 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
E07000069	Castle Point	912	451	1,245	-18

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

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.

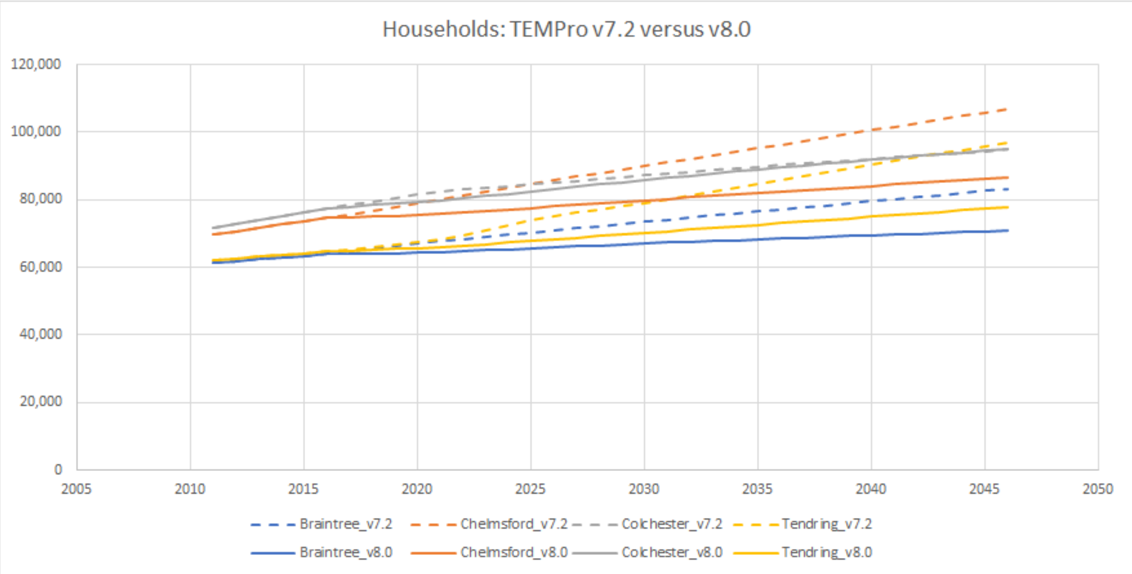


Figure A1-1: TEMPro v7.2 versus v8.0 forecasts for housing growth 2011 - 2046

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. The Chelmsford Local Plan Allocation growth in jobs figure has been calculated by applying employment density factors to the sqm employment data provided by CCC. 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 86 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 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.

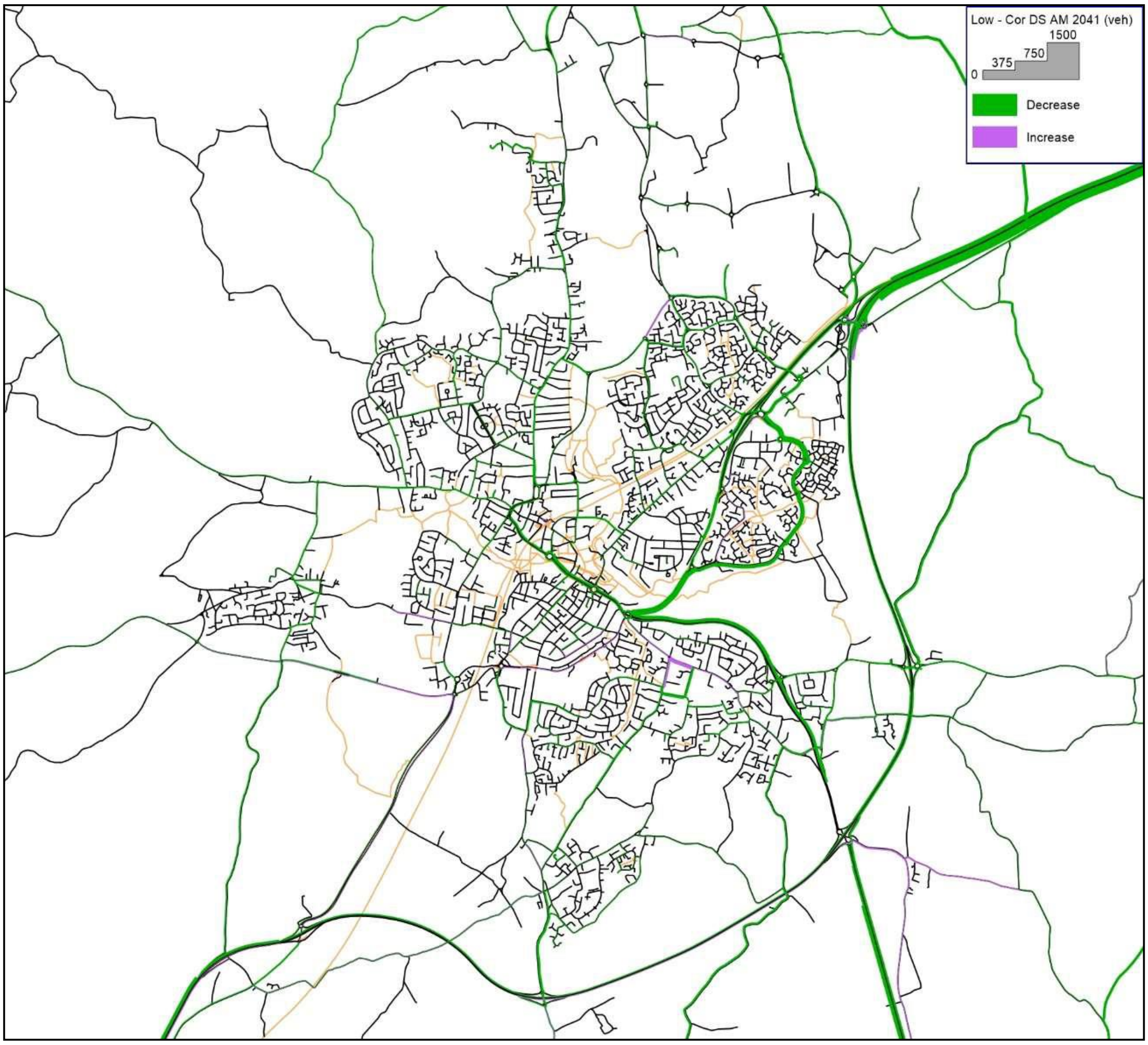


Figure A3-1: Traffic Flow Difference Plots Low Growth vs Core - DS 2041 AM Peak

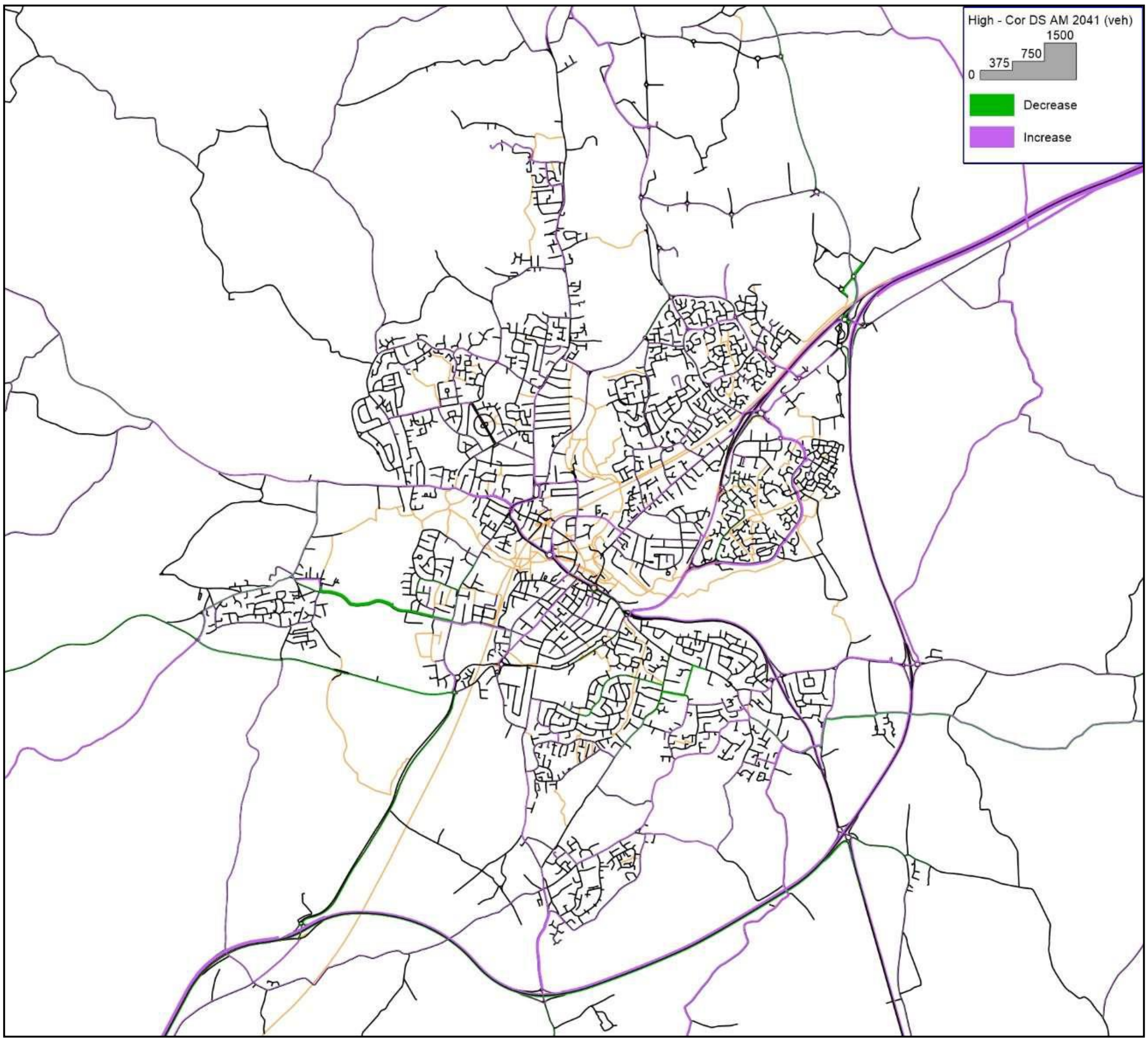


Figure A3-2: Traffic Flow Difference Plots High Growth vs Core - DS 2041 AM Peak

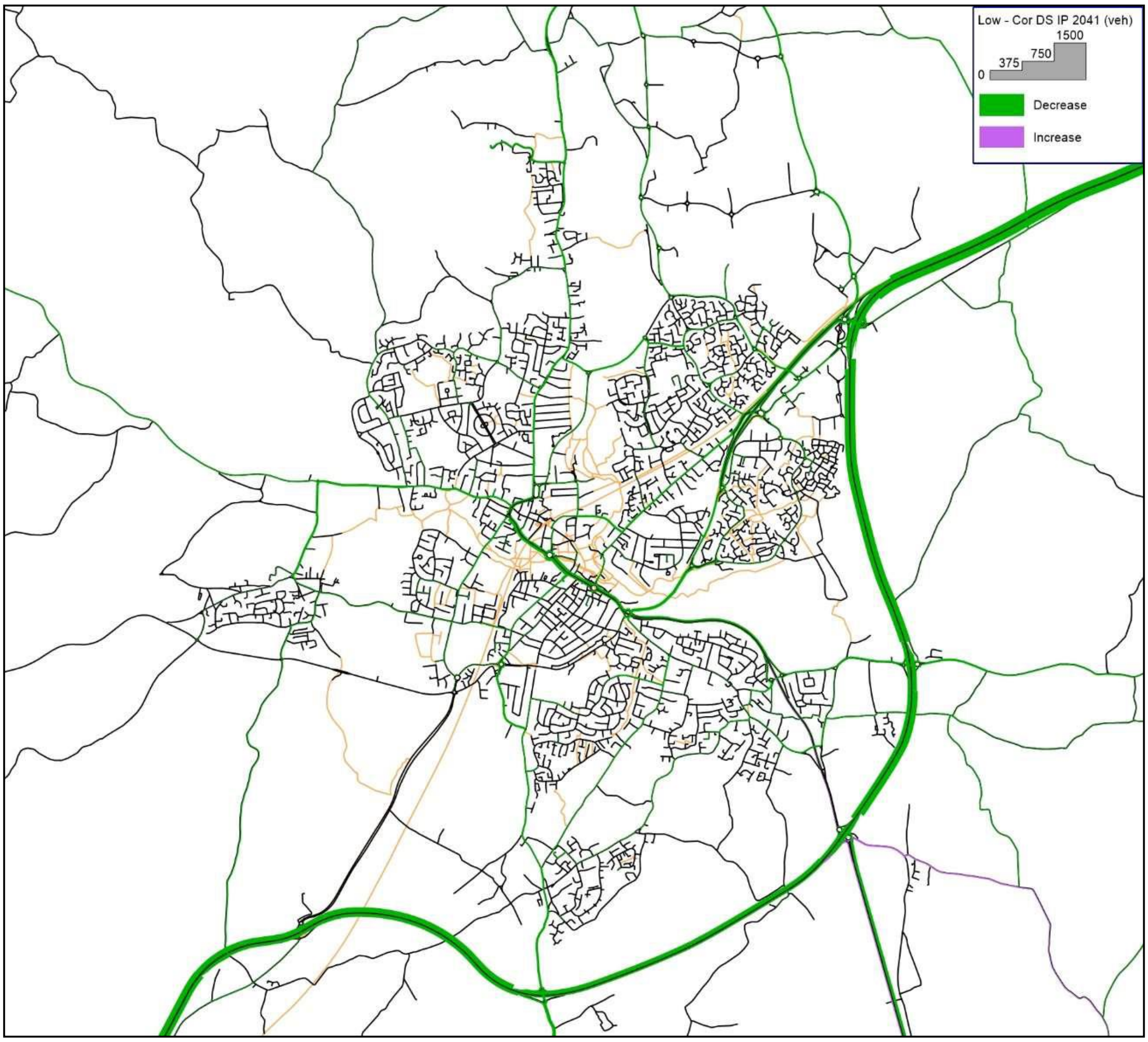


Figure A3-3: Traffic Flow Difference Plots Low Growth vs Core – DS 2041 Inter-peak

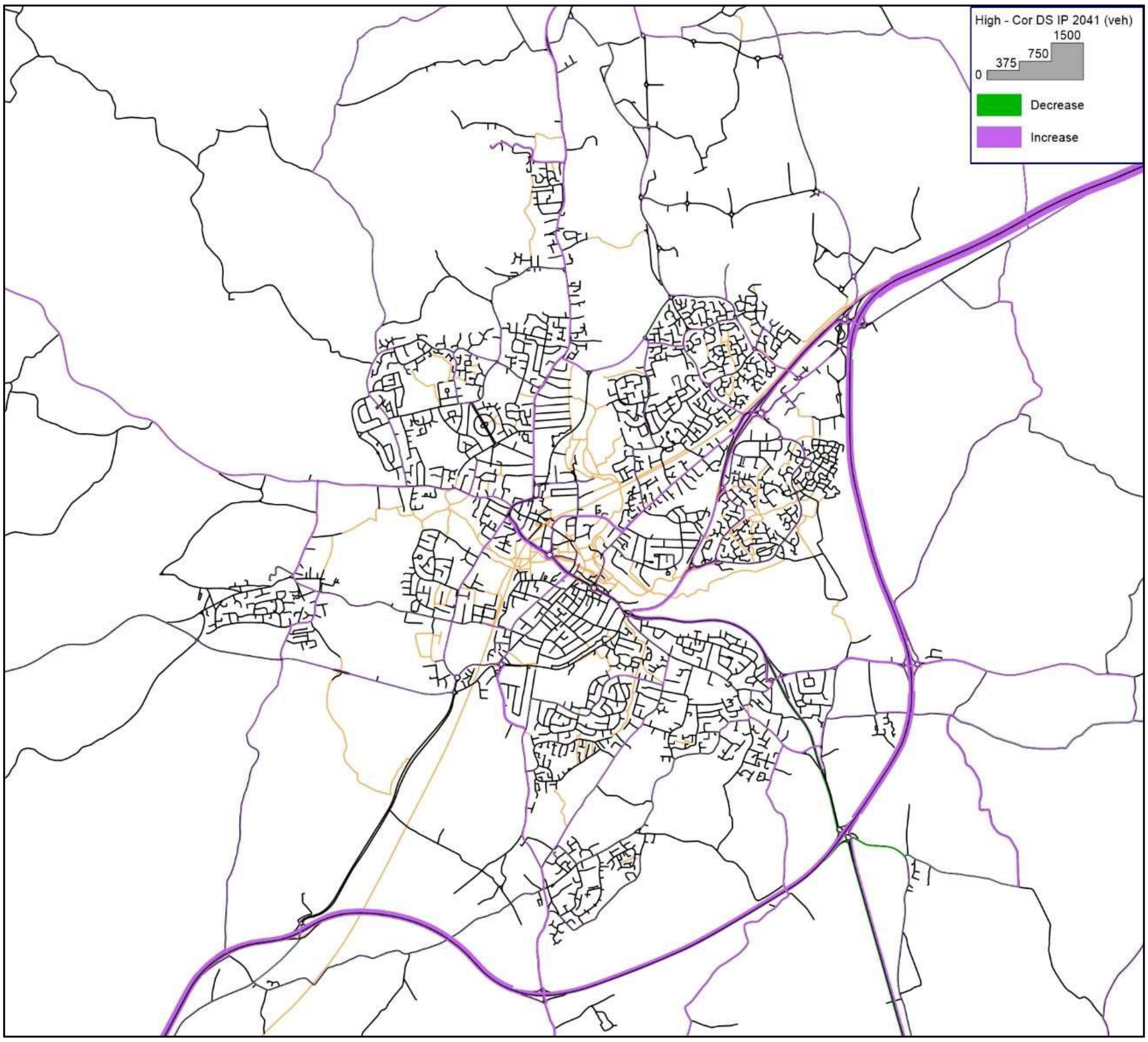


Figure A3-4: Traffic Flow Difference Plots High Growth vs Core - DS 2041 Inter-peak

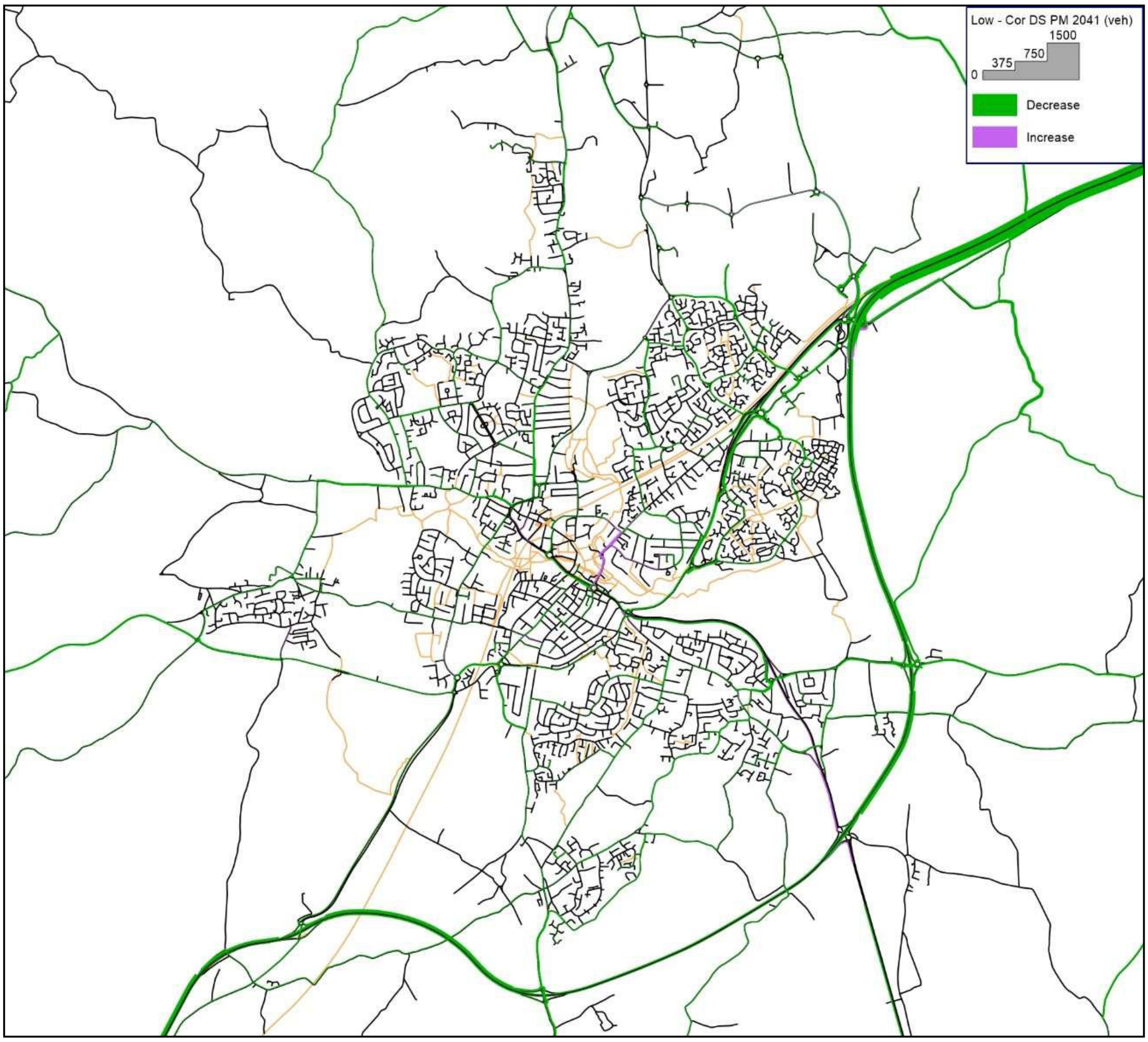


Figure A3-5: Traffic Flow Difference Plots Low Growth vs Core – DS 2041 PM peak

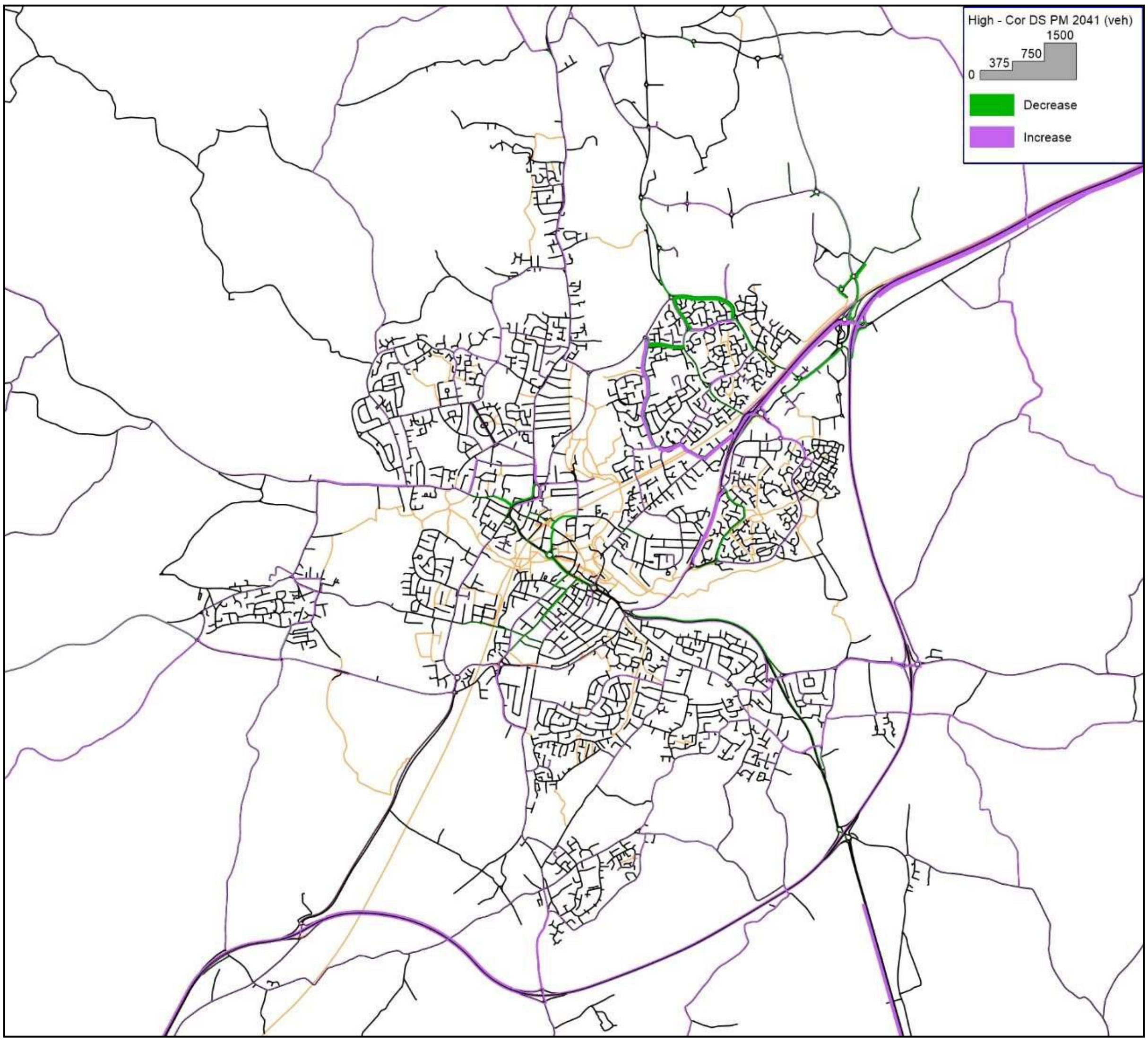


Figure A3-6: Traffic Flow Difference Plots High Growth vs Core – DS 2041 PM peak

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.

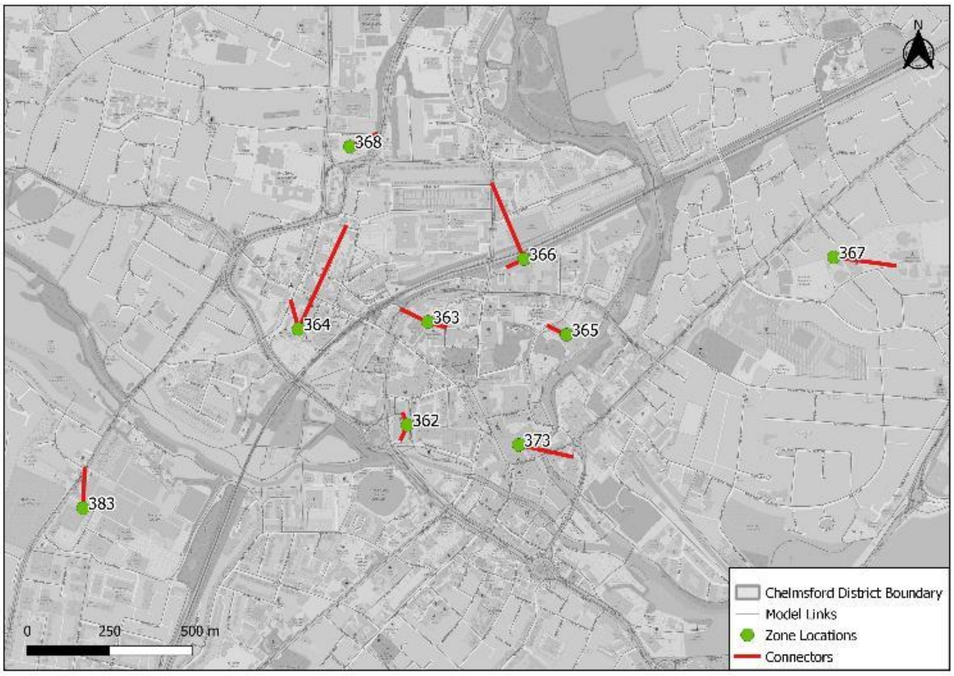
Alongside the modelled Core scenario outputs from the Local Plan Review Spatial Approaches testing, this information will be used to provide an inferred ‘range’ of traffic flow outputs, to address the challenges around forecast modelling and uncertainty, and the requirements outlined in TAG Unit M1.

8 Appendix B: New Development Zones

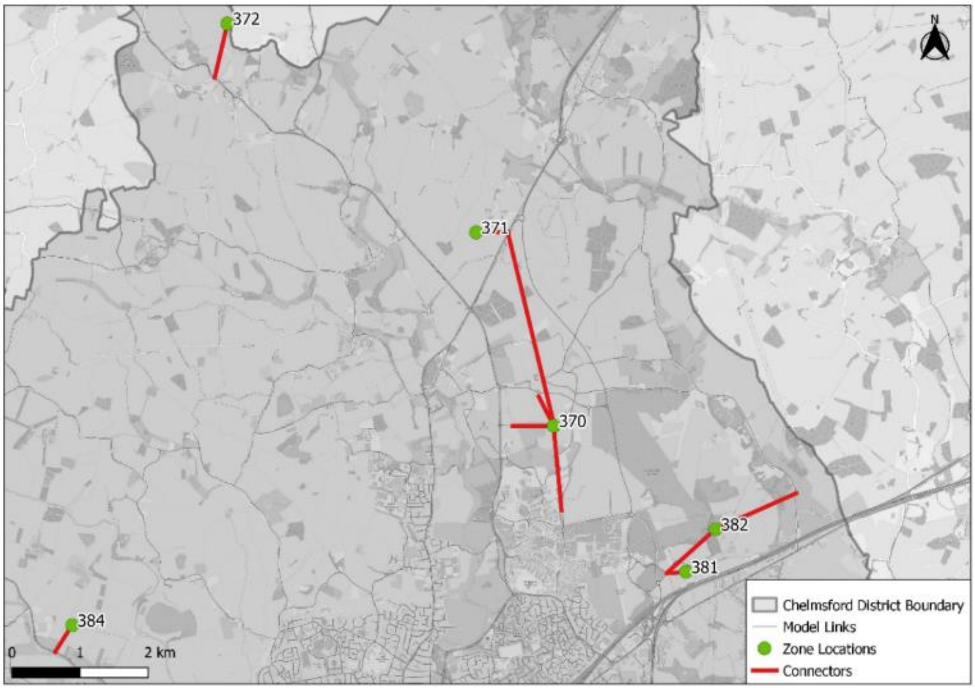
Zone ID	Distribution Zone	Type	Developments	Loading Locations
362	1	HH	Hill & Abbott First Floor Threadneedle House 9-10 Market Road Chelmsford	Chelmsford Multi-Storey Car Park
363	2	HH	1 Legg Street, Chelmsford Site at Victoria House 101-105 Victoria Road Chelmsford	Legg Street Victoria Road
364	4	HH	Civic Centre, Chelmsford* Land West of Eastwood House Glebe Road Chelmsford*	Coval Lane Glebe Road
365	8	HH	Riverside Ice and Leisure Land Victoria Road Chelmsford*	Waterloo Lane
366	9	HH	Kay Metzeler, Brook Street Brownfield Site Ashby House, New Street*	Brook Street New Street
367	12	HH	Police Headquarters Brownfield Site	Kingston Crescent
368	42	HH	Rectory Lane Car Park, West Rectory Lane*	Elms Drive
369	64	Jobs	Land North of St Swithins Cottages, Howe Green (J17 of A12)	Southend Road
370	89	HH	North-East Chelmsford Existing Allocation Chatham Green Small Settlement	Development access rdbt on RDR Development access rdbt between Wheelers Hill and Pratts Farm Lane Development access rdbt on RDR2 Braintree Road
371	85	Jobs	Chatham Green Small Settlement	Braintree Road
372	91	HH	Ford End Service Settlement	Sandon Hill
373	95	HH	Meadows Shopping Centre Brownfield Site	Stub connecting to Bond Street/Springfield Road Rdbt
374	6	HH	Hammonds Farm	J19 Maldon Road
375	132	Jobs	Hammonds Farm Land North of Sandon Lodge	Woodhill Road Maldon Road
376	97	HH	Danbury Key Service Settlement	Maldon Road
377	106	HH	Former Runwell Hospital (St Lukes) Runwell Chase Runwell	Runwell Road
378	107	HH	Morelands Industrial Estate, Tileworks Lane, Rettendon	South Hanningfield Road
379	108	HH	East Hanningfield Service Settlement	Old Tye Road
380	119	HH	Bicknacre Service Settlement	Priory Road/Bicknacre Road Main Road
381	87	HH	NEC Expansion	RDR Rdbt j/w Beaulieu Station
382	26	Jobs	NEC Expansion Boreham EA	RDR Rdbt j/w Beaulieu Station Waltham Road
383	126	Jobs	Advanced Manufacturing & Innovation District (former E2V site)	Waterhouse Lane
384	85	Jobs	Little Boyton Hall Farm	Roxwell Road

* Sites from the adopted Local Plan that have been modelled specifically in the Chelmsford Visum forecast model (as opposed to being modelled as background growth) since it was last updated (2019).

9 Appendix C: Development Loading Points



Appendix C 1: Chelmsford Local Plan Review New Development Zone Locations and Connectors in Chelmsford's Urban Centre.



Appendix C 2: Chelmsford Local Plan Review New Development Zone Locations and Connectors in North Chelmsford.

Appendix C 3: Chelmsford Local Plan Review New Development Zone Locations and Connectors in East Chelmsford.

Appendix C 4: Chelmsford Local Plan Review New Development Zone Locations and Connections in South Chelmsford.

10 Appendix D: Development Trips

Zone ID	Spatial Approach 1						Spatial Approach 2						Spatial Approach 3						Sensitivity Test (Based on Spatial Approach 1)					
	HBEB		HBW		HBO		HBEB		HBW		HBO		HBEB		HBW		HBO		HBEB		HBW		HBO	
	Productions	Attractions	Productions	Attractions	Productions	Attractions	Productions	Attractions	Productions	Attractions	Productions	Attractions	Productions	Attractions	Productions	Attractions	Productions	Attractions	Productions	Attractions	Productions	Attractions	Productions	Attractions
362	5	0	38	0	65	0	5	0	38	0	65	0	5	0	38	0	65	0	5	0	33	0	56	0
363	14	0	98	0	168	0	14	0	98	0	168	0	14	0	98	0	168	0	12	0	85	0	146	0
364	24	0	169	0	290	0	24	0	169	0	290	0	24	0	169	0	290	0	7	0	50	0	85	0
365	12	0	86	0	147	0	12	0	86	0	147	0	12	0	86	0	147	0	11	0	74	0	128	0
366	30	0	207	0	355	0	13	0	93	0	159	0	21	0	150	0	257	0	20	0	140	0	241	0
367	23	0	161	0	277	0	7	0	47	0	81	0	15	0	104	0	179	0	20	0	140	0	241	0
368	6	0	43	0	73	0	6	0	43	0	73	0	6	0	43	0	73	0	0	0	0	0	0	0
369	0	0	0	0	0	0	0	144	0	2304	0	144	0	96	0	1536	0	96	0	0	0	0	0	0
370	365	0	2555	0	4379	0	365	0	2555	0	4379	0	522	0	3655	0	6266	0	318	0	2223	0	3810	0
371	0	0	0	0	0	0	0	0	0	0	0	0	0	101	0	1621	0	101	0	0	0	0	0	0
372	11	0	79	0	135	0	0	0	0	0	0	0	11	0	79	0	135	0	10	0	68	0	117	0
373	23	0	161	0	277	0	7	0	47	0	81	0	15	0	104	0	179	0	20	0	140	0	241	0
374	0	0	0	0	0	0	337	0	2358	0	4042	0	0	0	0	0	0	0	0	0	0	0	0	0
375	0	131	0	2090	0	131	0	144	0	2304	0	144	0	0	0	0	0	0	0	0	0	0	0	0
376	11	0	79	0	135	0	11	0	79	0	135	0	11	0	79	0	135	0	10	0	68	0	117	0
377	26	0	184	0	315	0	26	0	184	0	315	0	26	0	184	0	315	0	23	0	160	0	274	0
378	10	0	72	0	124	0	10	0	72	0	124	0	10	0	72	0	124	0	9	0	63	0	108	0
379	11	0	79	0	135	0	0	0	0	0	0	0	11	0	79	0	135	0	10	0	68	0	117	0
380	11	0	79	0	135	0	0	0	0	0	0	0	11	0	79	0	135	0	10	0	68	0	117	0
381	236	0	1651	0	2830	0	0	0	0	0	0	0	112	0	786	0	1347	0	205	0	1436	0	2462	0
382	0	139	0	2230	0	139	0	0	0	0	0	0	0	91	0	1451	0	91	0	7	0	106	0	7
383	0	45	0	718	0	45	0	45	0	718	0	45	0	45	0	718	0	45	0	26	0	415	0	26
384	0	18	0	288	0	18	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	270	0	17

Appendix D 1: Productions and Attractions for new development zones added into the Chelmsford Local Plan Review model for all three spatial approaches.

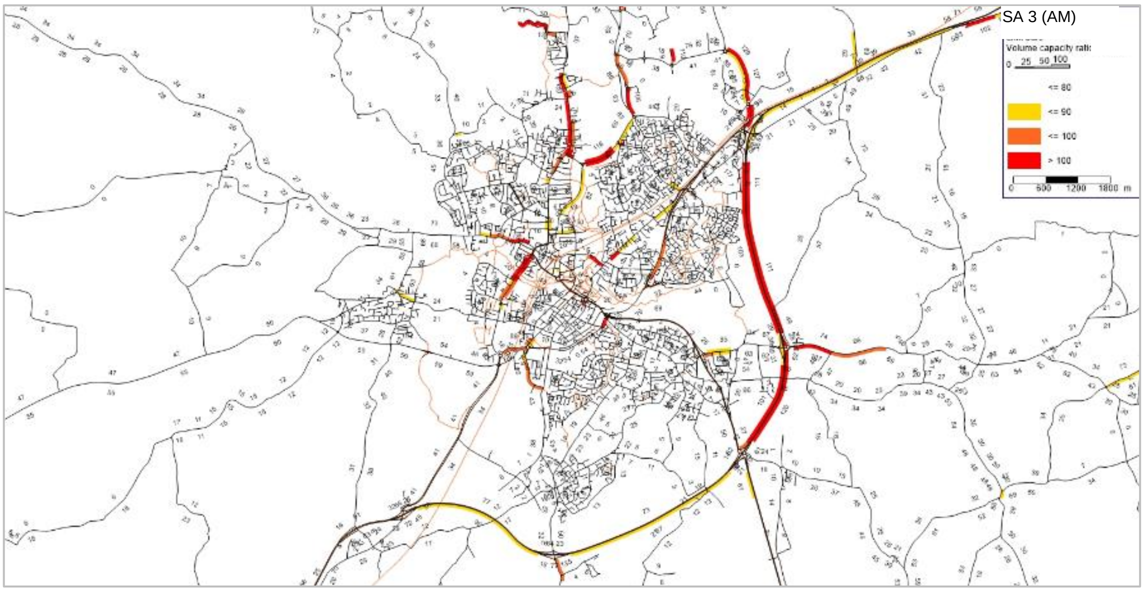
11 Appendix E: Volume over Capacity Plots

Appendix E 1: Volume over Capacity Plot for Spatial Approach 1, AM Peak

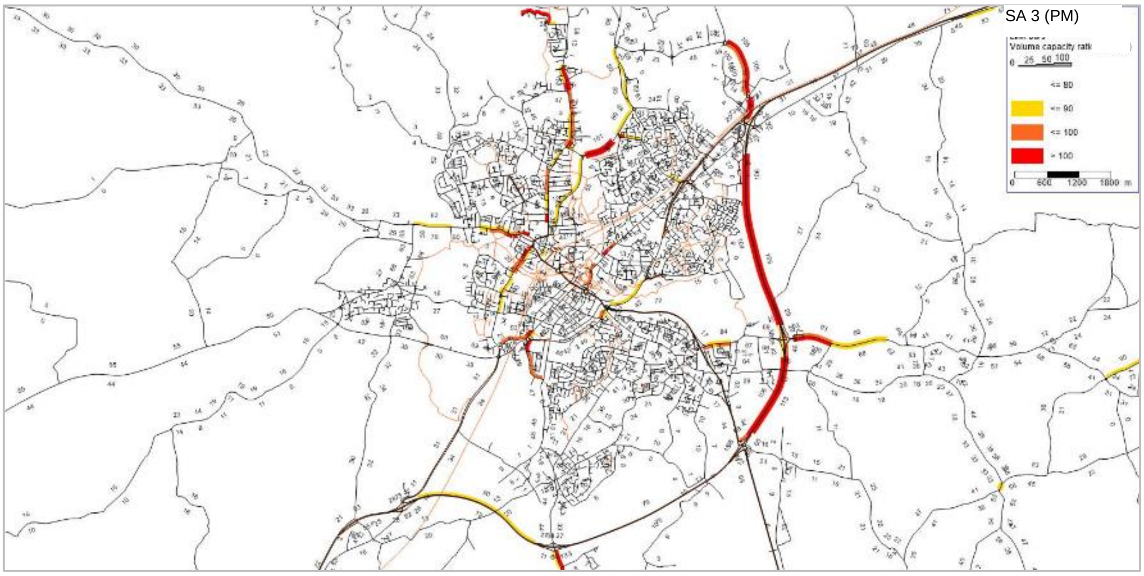
Appendix E 2: Volume over Capacity Plot for Spatial Approach 1, PM Peak

Appendix E 3: Volume over Capacity Plot for Spatial Approach 2, AM Peak

Appendix E 4: Volume over Capacity Plot for Spatial Approach 2, PM Peak



Appendix E 5: Volume over Capacity Plot for Spatial Approach 3, AM Peak



Appendix E 6: Volume over Capacity Plot for Spatial Approach 3, PM Peak

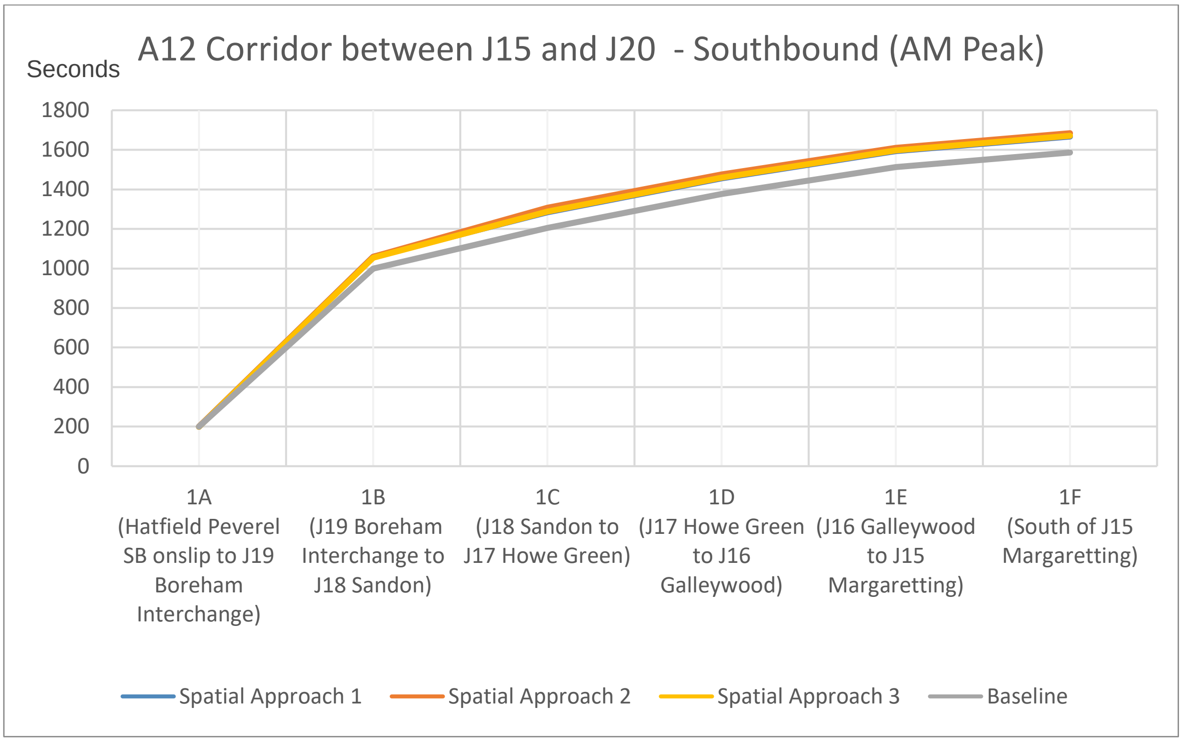
12 Appendix F: Journey Times - Tables and Graphs

The table in Appendix F1 summarises the journey times for all 18 sectioned routes for both the AM and PM peaks. Appendices F2 to F17 showcase the journey times in a graph format for the key routes identified in Section 1.12.

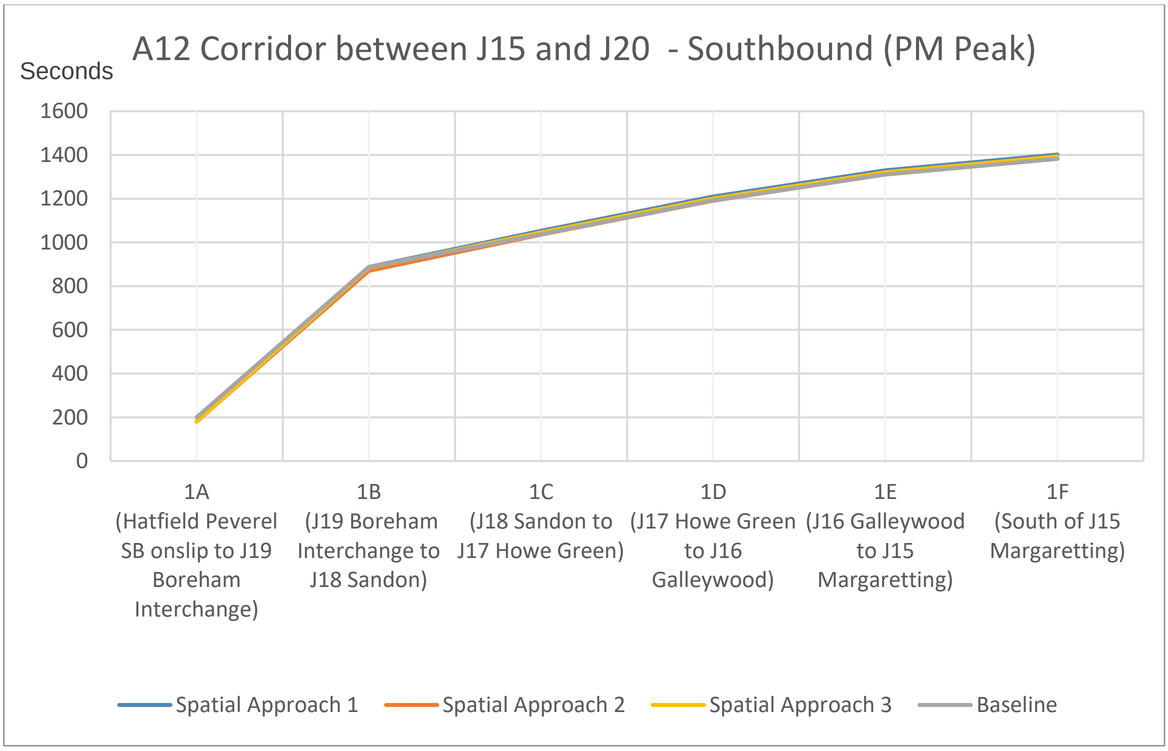
Route	Sectic	Section	Link Length (m)	Spatial Approach 1 AM JT	Spatial Approach 1 PM JT	Spatial Approach 2 AM JT	Spatial Approach 2 PM JT	Spatial Approach 3 AM JT	Spatial Approach 3 PM JT	Baseline (AM AM JT	Baseline (AM PM JT
A12 Southbound	1A	Boreham onslip through to south of Boreham interchange	4801	199	180	200	180	199	180	200	200
	1B	South of Boreham interchange through to south of J18 Danbury	3843	860	707	860	690	856	704	799	688
	1C	South of J18 Danbury through to south of J17 Howe Green	2275	225	166	247	165	233	162	207	149
	1D	South of J17 through to south of J16	3948	173	156	169	156	172	156	171	155
	1E	South of J16 through to south of J15 Three Mile Hill	3103	137	120	135	120	137	120	136	119
	1F	South of J15 Three Mile Hill	2043	74	72	74	72	74	72	74	72
A12 Northbound	2A	South of J15 Three Mile Hill through to northbound onslip	1659	60	61	60	61	60	61	60	61
	2B	North of J15 through to north of J16	3028	121	133	121	133	121	132	119	132
	2C	North of J16 through to north of J17 Howe Green	4038	163	222	163	221	163	219	160	220
	2D	North of J17 through to north of J18 Danbury	2252	188	123	179	131	180	127	172	116
	2E	North of J18 through to north of J19 Boreham Interchange	4458	341	251	333	227	350	233	362	215
	2F	North of J19 through to Boreham onslip	4071	151	195	152	199	151	197	150	202
Parkway (SE)	3A	Parkway gyratory to Waterhouse Lane junction	596	41	39	41	39	41	39	41	39
	3B	South of Waterhouse Lane junction to south of Victoria Rd Rdbt	647	55	241	52	242	52	225	52	247
	3C	South of Victoria Rdbt to south of High Bridge Rd Rdbt	614	57	194	56	194	56	193	56	195
	3D	South of High Bridge Rdbt to South of A&N rdbt	582	51	56	52	56	51	56	51	56
	3E	South of A&N to south of Sandon slip	1703	71	72	70	74	70	72	70	71
Parkway (NW)	4A	Sandon slip to A&N	1767	348	84	353	85	357	83	382	84
	4B	A&N to High Bridge Rdbt	413	46	42	46	42	46	42	46	42
	4C	High Bridge Rdbt to Victoria Rd Rdbt	645	54	151	53	151	53	142	54	155
	4E	Victoria Rd Rdbt to Waterhouse Lane Jct	649	47	47	46	47	46	47	46	47
	4F	Waterhouse Lane Jct to Parkway gyratory	758	51	57	51	57	51	58	51	57
Roxwell Rd (EB)	5A	Roxwell Road (Boyton Cross to Old Roxwell Road	3186	172	170	171	169	172	169	171	168
	5B	Old Roxwell Road to Lordship Road	590	26	26	26	26	26	26	26	26
	5C	Lordship Road to Chignall Road	1077	76	81	76	80	76	80	77	80
	5D	Chignall Road to Parkway	1239	184	169	184	168	183	168	187	169
Roxwell Rd (WB)	6A	Parkway to Chignall Road	1292	145	167	142	165	145	166	143	167
	6B	Chignall Road to Lordship Road	1005	347	71	297	70	303	71	263	71
	6C	Lordship Road to Old Roxwell Road	614	26	26	26	26	26	26	26	26
	6D	Old Roxwell Road to Boyton Cross	542	31	31	31	31	31	31	31	31
Broomfield Rd (SB)	7A	Braintree Rd Rdbt to Hospital Approach	2835	603	189	576	188	658	196	520	188
	7B	Hospital Approach to School Lane	1308	121	194	120	193	123	198	119	193
	7C	School Lane to Valley Bridge	1120	157	260	156	257	159	337	156	232
	7D	Valley Bridge to Parkway Gyratory	1586	181	188	182	186	181	187	185	189
Broomfield Rd (NB)	8A	Parkyway Gyratory to Valley Bridge	1559	210	318	209	311	211	394	212	297
	8B	Valley Bridge to School Lane	1061	176	142	177	142	195	142	188	136
	8C	School Lane to Hospital Approach	1233	175	118	175	116	177	118	176	108
	8D	Hospital Approach to Braintree Rd Rdbt	2844	173	502	173	531	176	484	173	523
Chelmsford to Braintree (via Essex Regiment Way) SB	9A	Notley Green Rdbt to Great Notley rdbt	5269	186	184	186	184	187	184	187	184
	9B	Great Notley Rdbt to Braintree Rd Rdbt	1487	82	69	83	69	84	72	83	70
	9C	Braintree Rd rdbt to Wheelers Hill Rdbt	1174	72	99	73	83	69	98	75	88
	9D	Wheelers Hill Rdbt to Channels Drive Rdbt	1829	140	120	138	120	147	118	141	122
	9E	Channels Drive Rdbt to White Hart Lane	1226	304	298	273	262	319	331	158	157
	9F	White Hart Lane to Valley Bridge	1424	420	303	415	297	419	226	398	293
	9G	Valley Bridge to Parkway Gyratory	1464	84	71	84	71	83	71	83	72
Chelmsford to Braintree (via Essex Regiment Way) NB	10A	Parkway Gyratory to Valley Bridge	1457	76	98	76	97	76	99	75	95
	10B	Valley Bridge to White Hard Lane Rdbt	1315	158	321	136	206	160	371	137	177
	10C	White Hart Lane Rdbt to Channels Drive Rdbt	1220	99	222	99	222	99	222	101	169
	10D	Channels Drive Rdbt to Wheelers Hill Rdbt	1872	127	141	124	143	153	142	128	139
	10E	Wheelers Hill to Braintree Rd Rdbt	1156	70	68	71	68	76	67	67	75
	10F	Braintree Rd Rdbt to Great Notley Rdbt	2764	113	118	113	118	116	119	113	159
	10G	Great Notley Rdbt to Notley Green	3906	133	134	133	134	133	134	132	134
Chelmer Road (SB)	11A	Boreham Interchange to Royal Mail rdbt	1493	122	331	125	198	120	292	122	115
	11B	Royal Mail Rdbt to Chelmer Village Rdbt	1999	223	198	219	195	215	201	216	199
	11C	Chelmer Village Rdbt to A&N	874	86	381	82	250	84	336	80	389
Chelmer Road (NB)	12A	A&N to Chelmer Village Rdbt	926	87	105	84	102	87	106	86	101
	12B	Chelmer Village to Royal Mail Rdbt	2084	187	191	183	190	187	192	184	189
	12C	Royal Mail Rdbt to Boreham Interchange	1632	118	477	118	373	118	429	118	181
A141 (west) / Princes Road (EB)	13A	Highwood Rd Rdbt to Margaretting Rd Rdbt	1014	45	48	45	47	45	47	45	48
	13B	Margaretting Rd Rdbt to Widford Rdbt	2041	423	108	396	108	427	107	396	108
	13C	Widford Rdbt to Princes Rd Rdbt	763	66	84	66	83	66	83	66	83
	13D	Princes Rd Rdbt to A&N	1646	463	350	461	348	449	319	487	309
A141 (west) / Princes Road (WB)	14A	A&N to Princes Rd Rdbt	1725	181	137	181	138	181	137	177	138
	14B	Princes Rd Rdbt to Widford Rdbt	690	132	58	155	58	155	58	110	58
	14C	Widord Rdbt to Margaretting Rd Rdbt	2021	101	93	101	93	101	93	100	94
	14D	Margaretting Rd Rdbt to Highwood Rd Rdbt	1014	47	47	47	47	47	46	47	45
New London Road (SB)	15A	Parkway to Writte Road jct	916	115	110	113	110	114	110	114	109
	15B	Writtle Road to Princes Road Rdbt	413	233	120	183	118	212	124	198	204
New London Road (NB)	16A	Princes Road Rdbt to Writtle Rd jct	339	45	49	45	49	45	48	45	49
	16B	Writtle Rd jct to Parkway	942	129	157	129	150	128	135	129	156
Springfield Rd (WB)	17A	Parkway to Springfield Road Rdbt	316	29	38	29	37	29	37	30	39
	17B	Springfield Rd Rdbt to Victoria Road	333	40	45	40	45	40	45	40	45
	17C	Victoria Rd to Sandford Rd	360	43	51	42	50	42	50	41	49
	17D	Sandford Rd to Aldi Rdbt	1301	143	145	141	144	142	144	140	145
Springfield Rd (EB)	18A	Aldi Rdbt to Sandford Rd	1345	172	148	171	147	171	147	169	146
	18B	Sandford Rd to Victoria Rd	360	53	39	51	39	52	39	49	39
	18C	Victoria Rd to Springfield Rd Rdbt	360	41	120	41	128	41	115	42	166
	18D	Springfield Rd Rdbt to Parkway	388	43	219	41	224	42	221	41	226

Table F 1: Journey Times extracted for the 18 sectioned Journey Time routes in Chelmsford.

A12 Journey Time Plots - Southbound

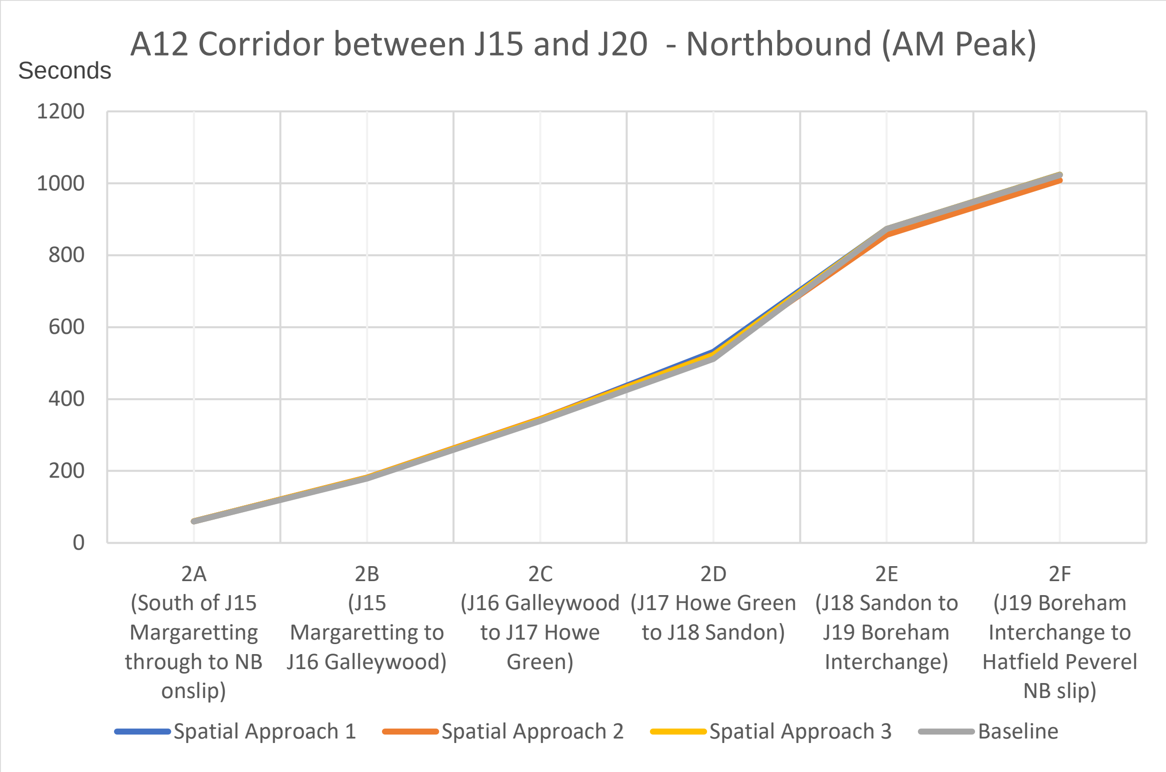


Appendix F 1: Journey Time Plot for A12 Southbound in the AM Peak

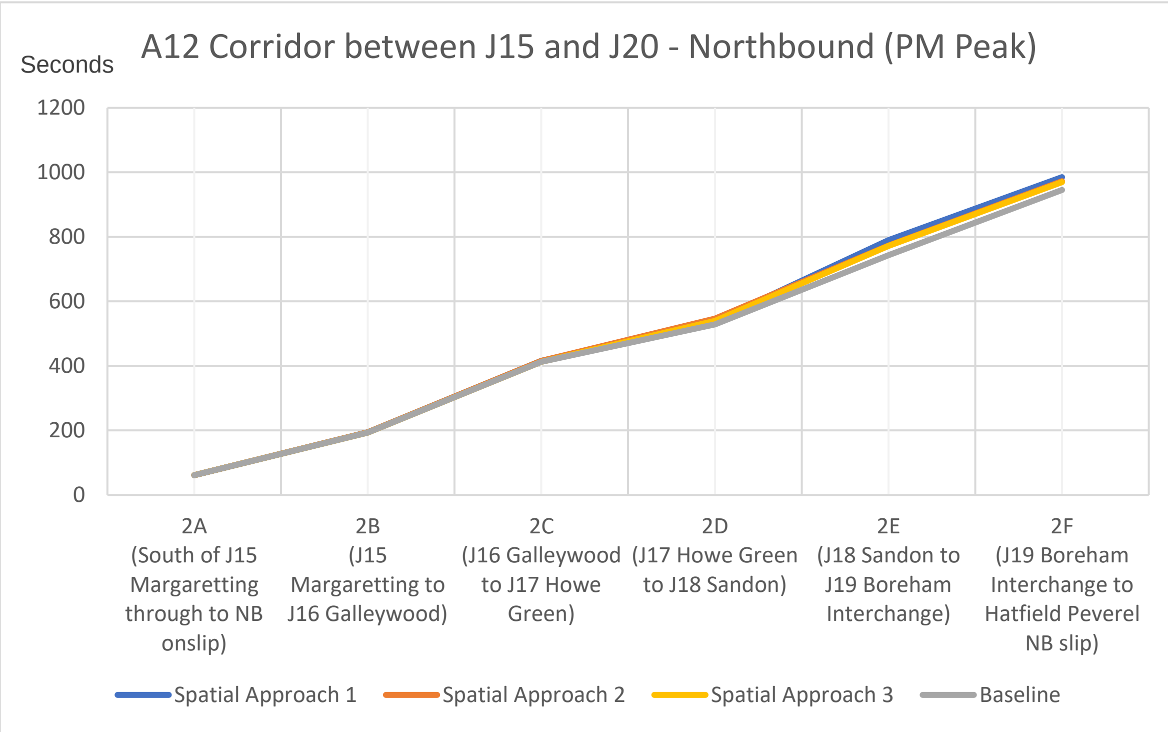


Appendix F 2: Journey Time Plot for A12 Southbound in the PM Peak

A12 Journey Time Plots – Northbound

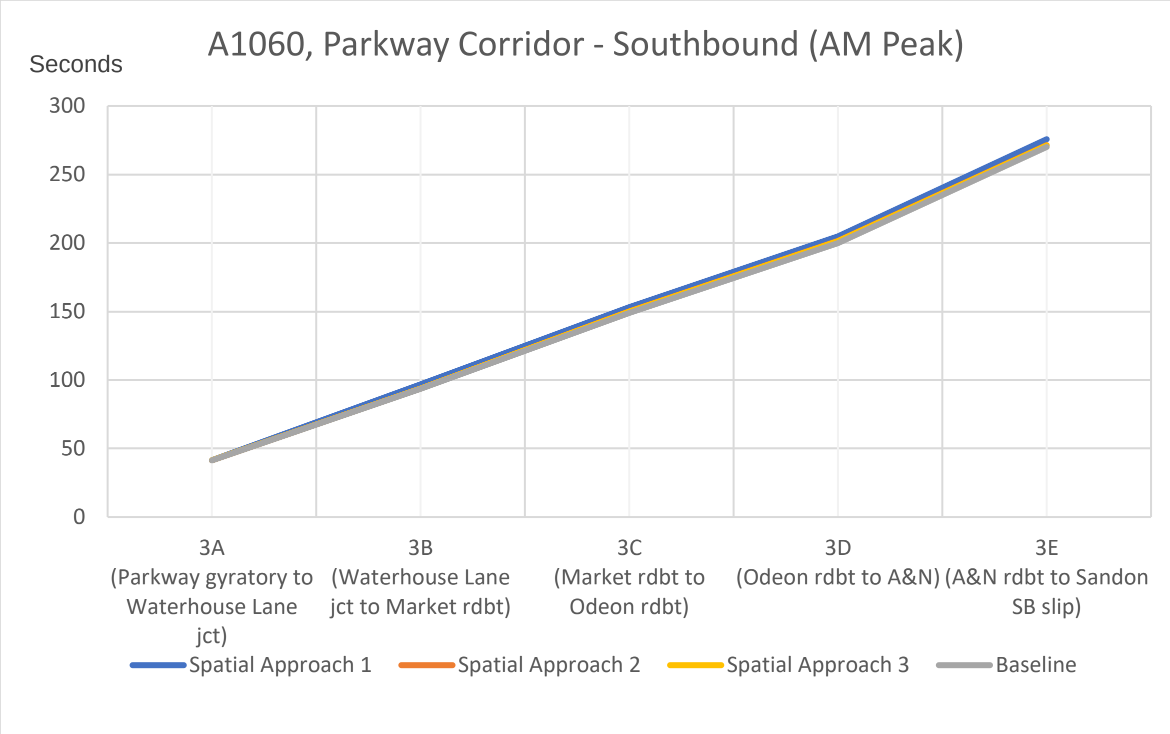


Appendix F 3: Journey Time Plot for A12 Northbound in the AM Peak

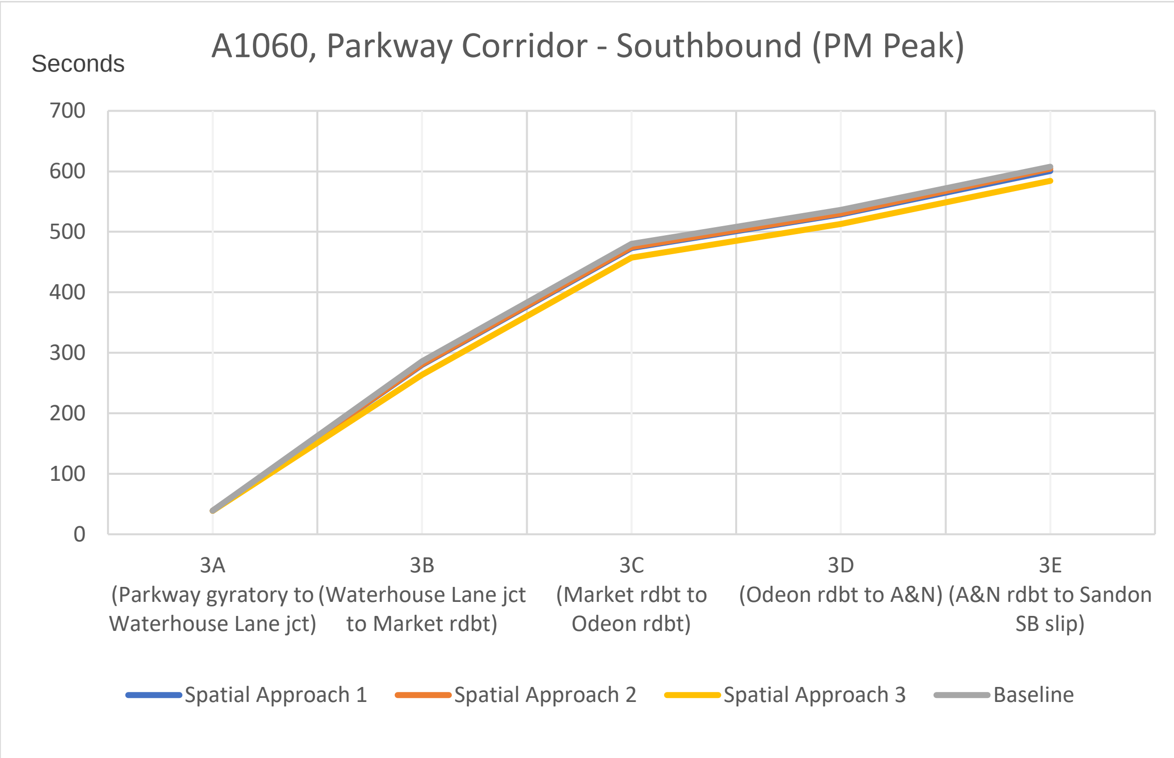


Appendix F 4: Journey Time Plot for A12 Northbound in the PM Peak

Parkway Journey Time Plots – Southbound

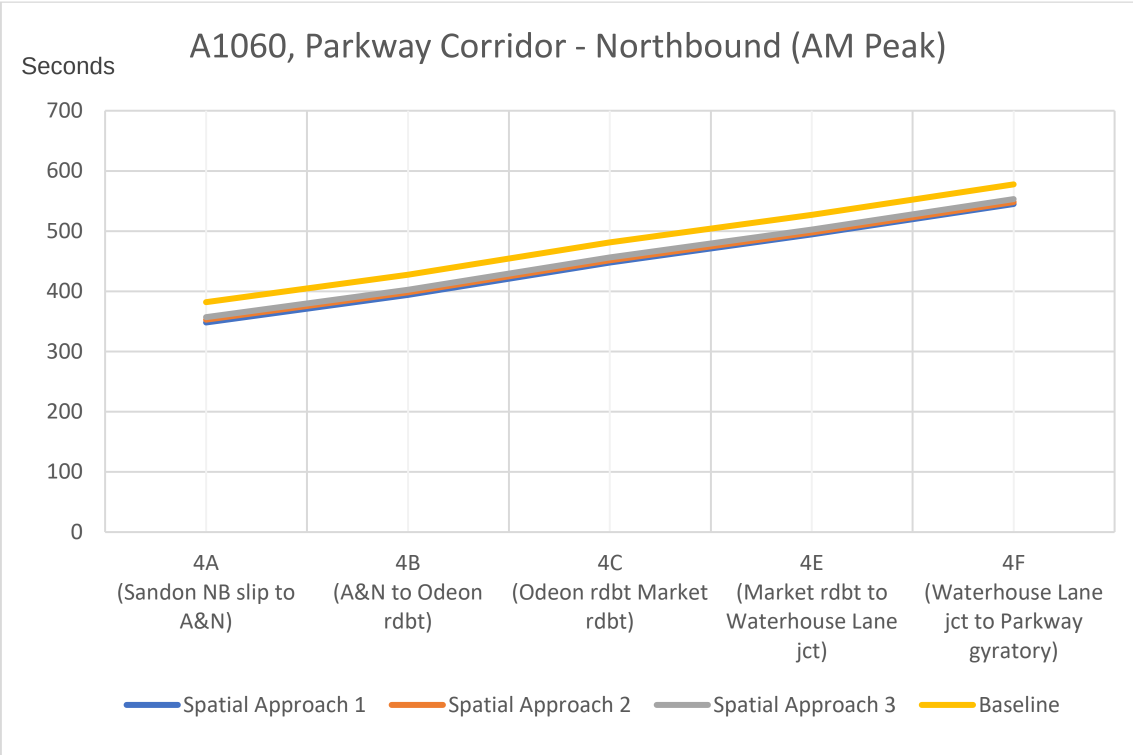


Appendix F 5: Journey Time Plot for Parkway Southbound in the AM Peak

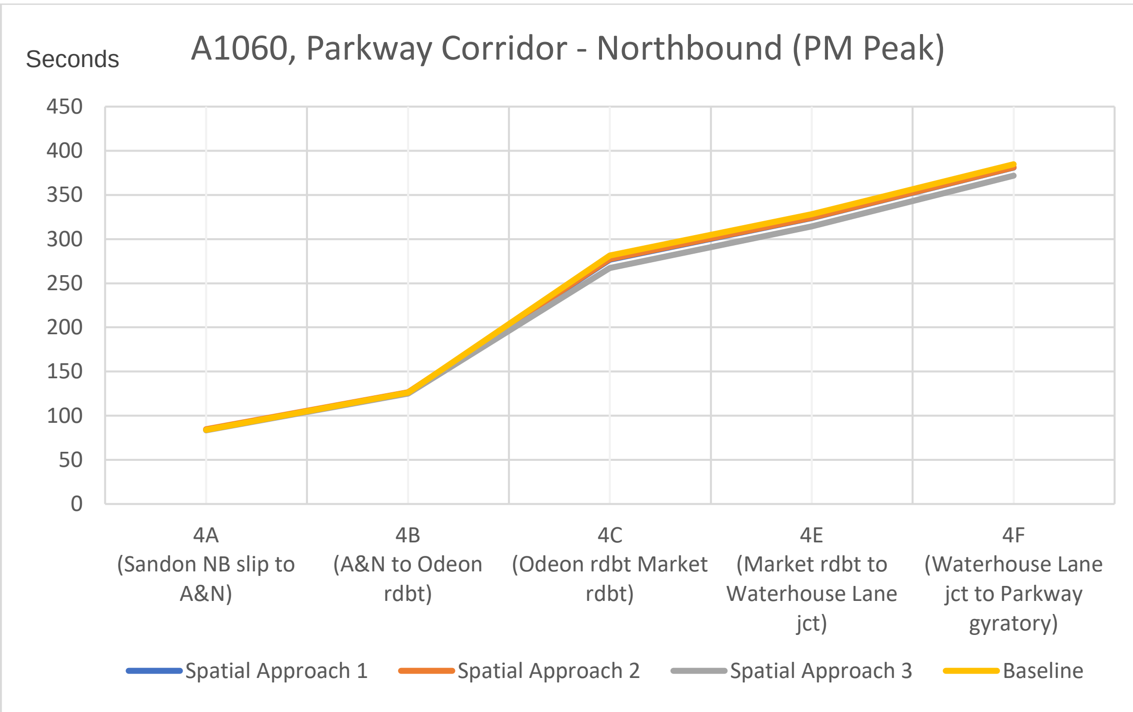


Appendix F 6: Journey Time Plot for Parkway Southbound in the PM Peak

Parkway Journey Time Plots - Northbound

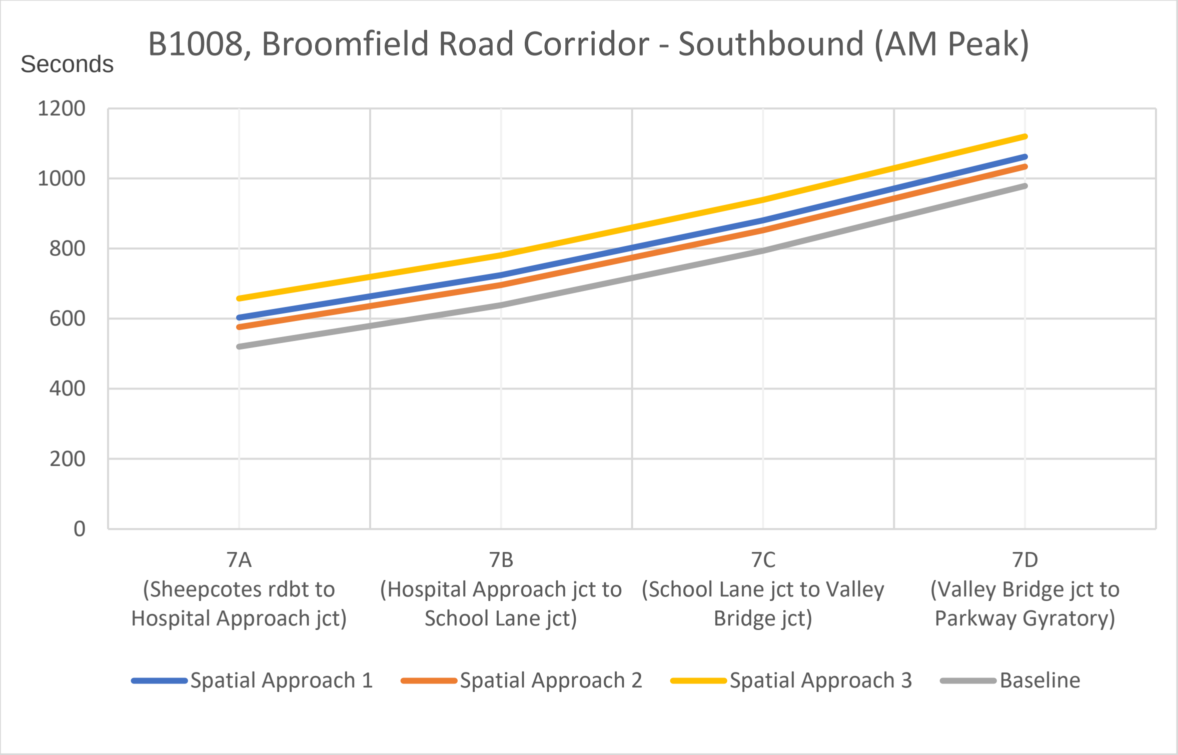


Appendix F 7: Journey Time Plot for Parkway Northbound in the AM Peak

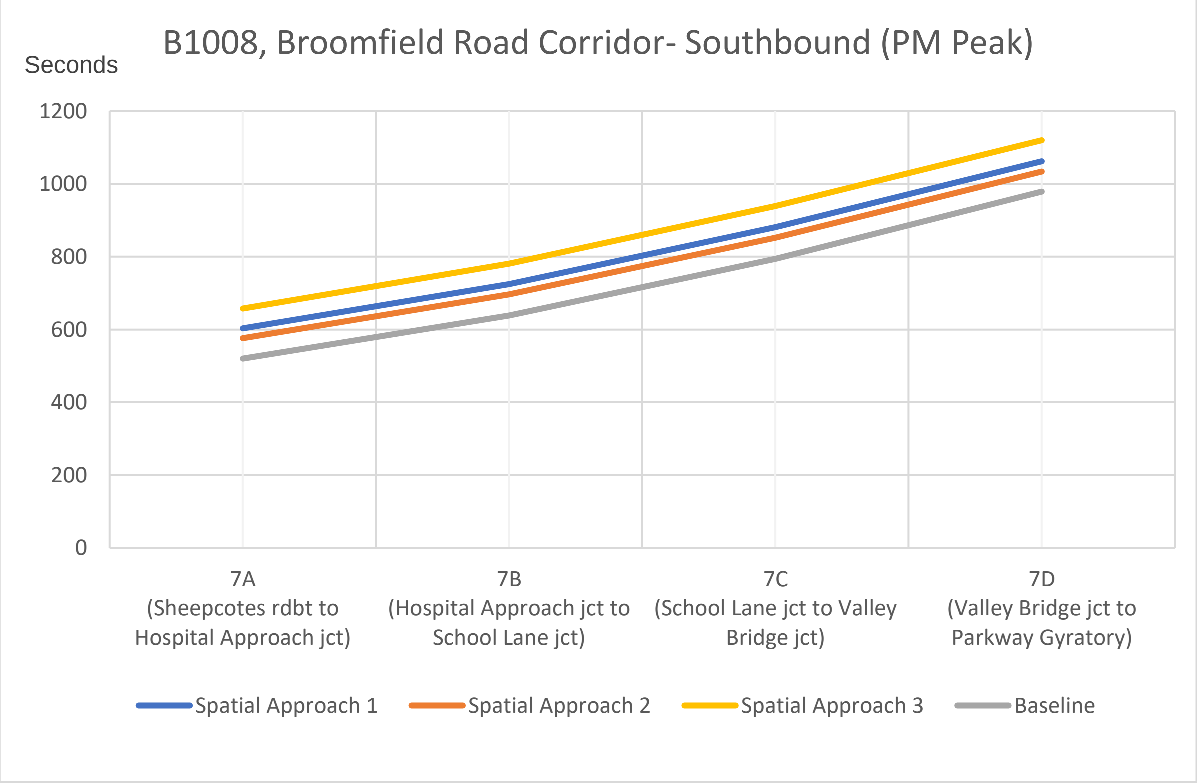


Appendix F 8: Journey Time Plot for Parkway Northbound in the PM Peak

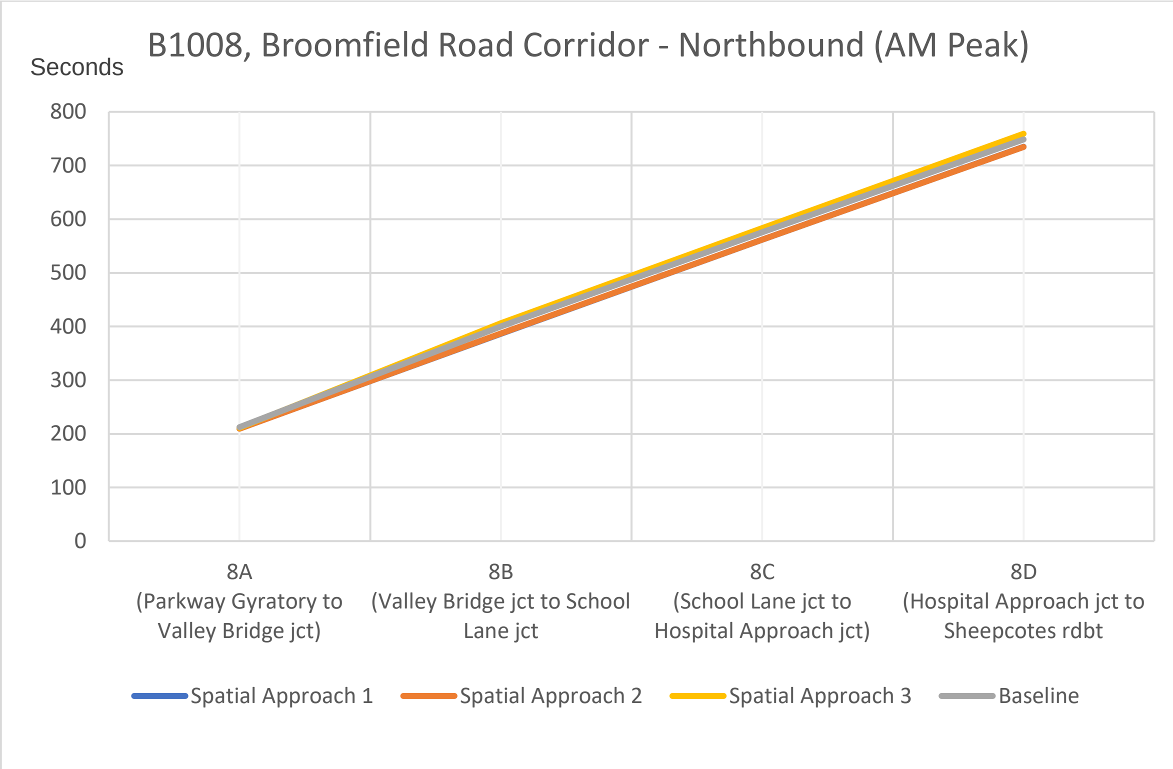
Broomfield Road Journey Time Plots - Southbound



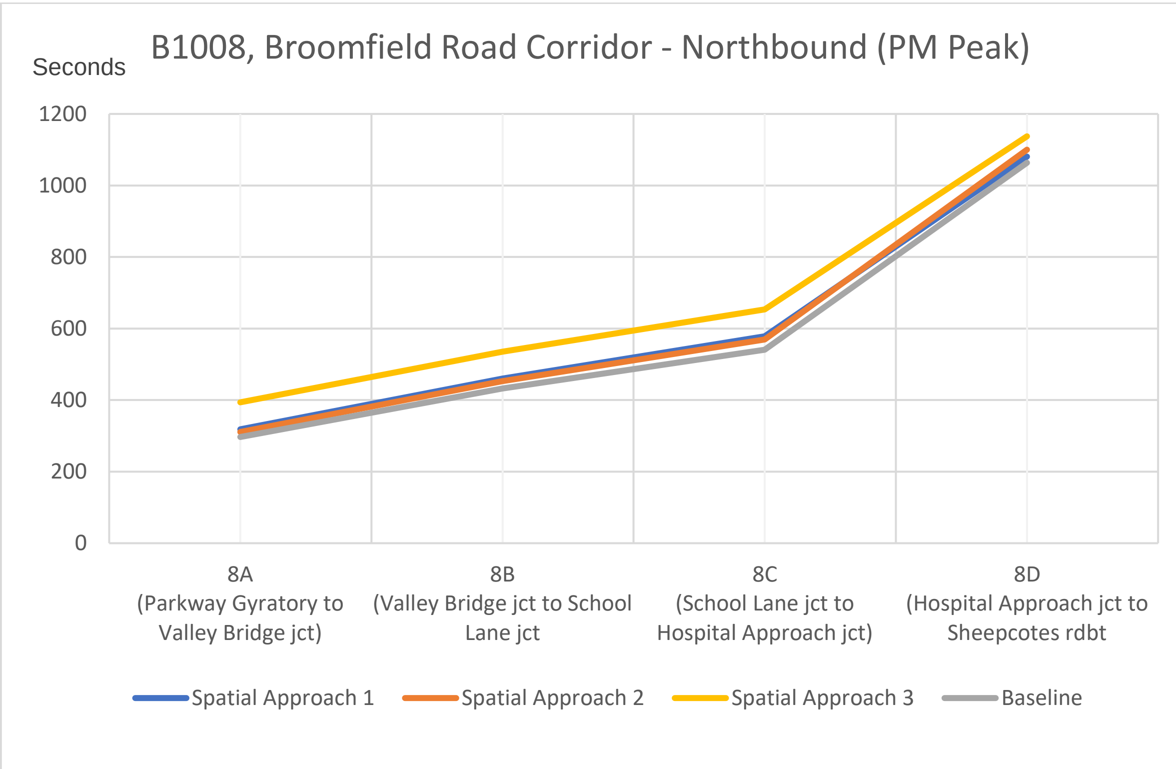
Appendix F 9: Journey Time Plot for Broomfield Road Southbound in the AM Peak



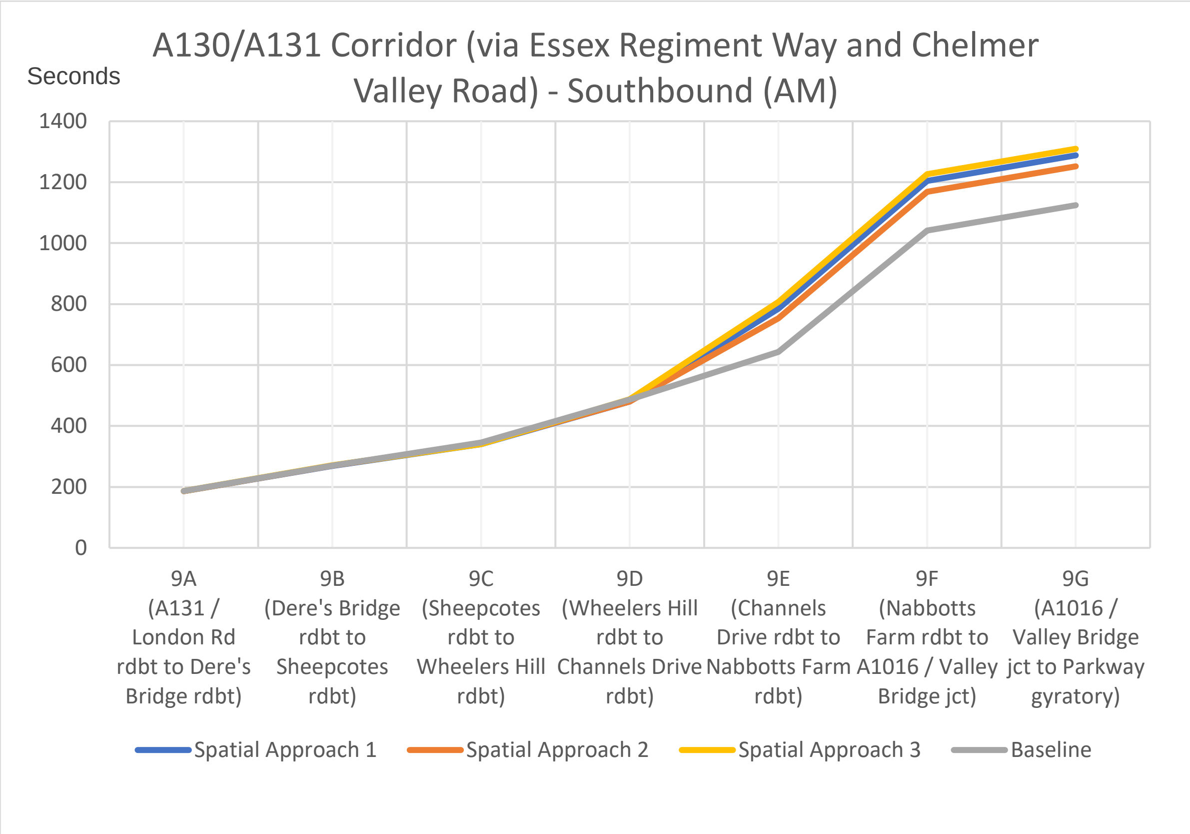
Appendix F 10: Journey Time Plot for Broomfield Road Southbound in the PM Peak



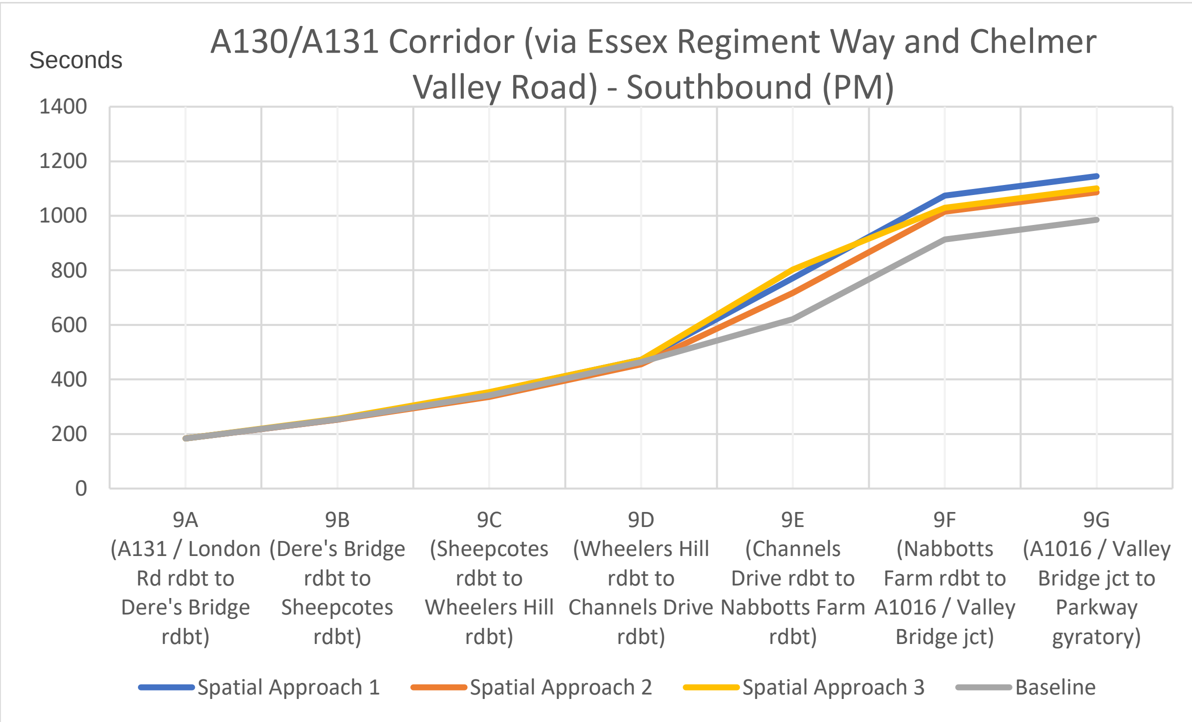
Appendix F 11: Journey Time Plot for Broomfield Northbound in the AM Peak



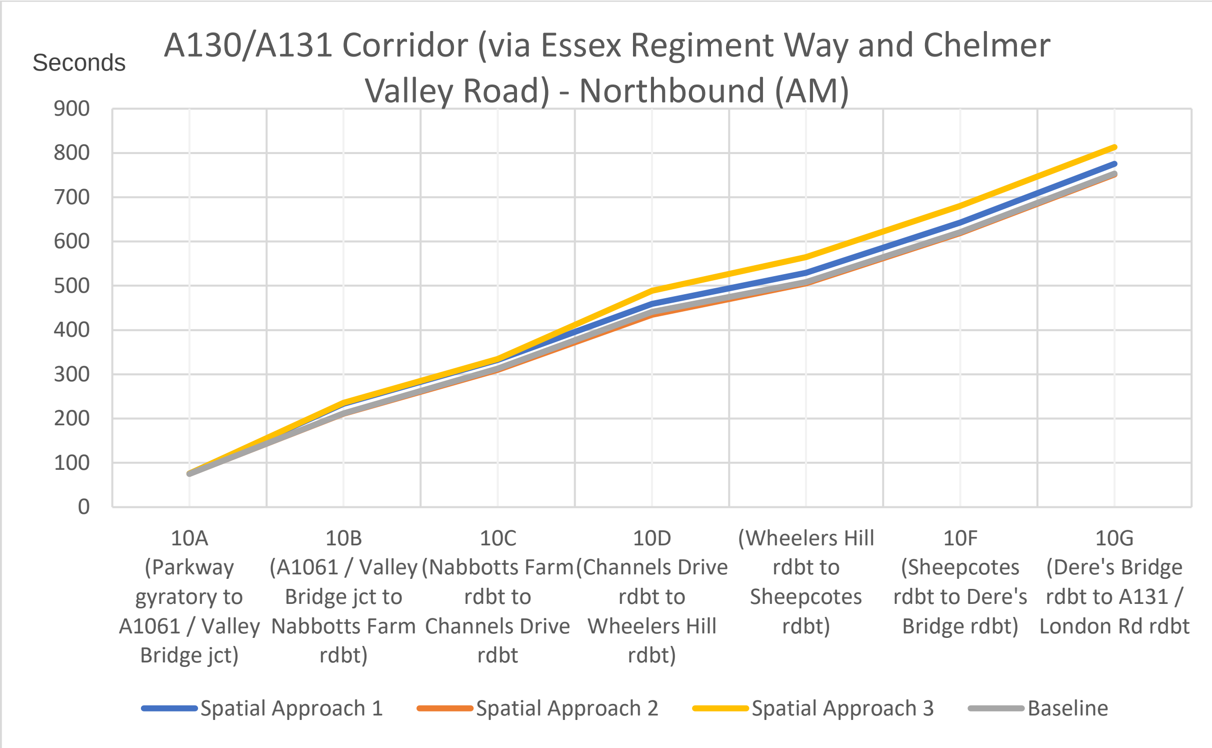
Appendix F 12: Journey Time Plot for Broomfield Northbound in the PM Peak



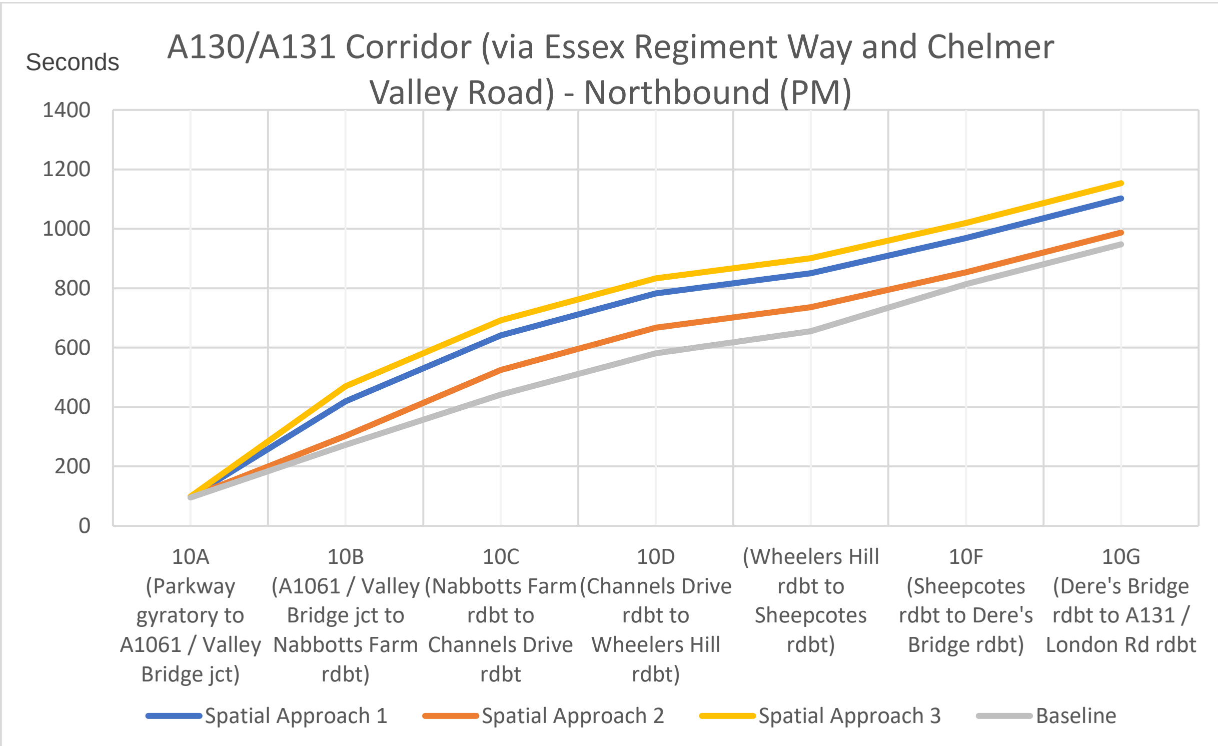
Appendix F 13: Journey Time Plot for Chelmsford to Braintree (via ERW) Southbound in the AM Peak



Appendix F 14: Journey Time Plot for Chelmsford to Braintree (via ERW) Southbound in the PM Peak



Appendix F 15: Journey Time Plot for Chelmsford to Braintree (via ERW) Northbound in the AM Peak



Appendix F 16: Journey Time Plot for Chelmsford to Braintree (via ERW) Northbound in the PM Peak