

North Essex Model – Technical Report

2023 Present Day Update

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Document Control Sheet

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Executive Summary

The Colchester Transport Model (CTM) was built with a 2019 base year, covering Colchester City as the area of detailed modelling, with the neighbouring districts of Tendring and Braintree part of the fully modelled area. This model was developed over a period of two years and was calibrated and validated to a high standard following the Department for Transport (DfT) Transport Analysis Guidance (TAG) – with over 85% of links and journey times meeting the criteria in all time periods.

All three planning authorities in North Essex (Colchester, Tendring and Braintree) are in the process of updating their Local Plans and are preparing transport evidence to support reviews of spatial options for development. The area of detailed modelling has been expanded to include parts of Braintree and Tendring, along with expansion around Colchester to include Marks Tey and J25 on the A12. As such, the North Essex Model (NEMo) now covers a much wider, strategic area than the CTM.

Additionally, it is widely accepted that traffic patterns and behaviours have changed since Covid-19, which was backed up by an initial review of high-level traffic data in the three council areas. Hence, NEMo has been adjusted to reflect recent traffic and public transport data.

At all times during the model extension and update, DfT TAG guidance has been followed, however, only partial guidance is provided on how to adjust transport models to account for Covid-19. Throughout, a proportionate and pragmatic approach has been taken guided by the purpose to which the model intends to be used, that is testing of Local Plan spatial options.

It should be noted that, akin to all transport models, there is an element of risk and uncertainty involved, especially when changes are implemented together, rather than separately one at a time. In an ideal world, the network enhancements would not have been done at the same time as updating the model to account for Covid, however, the councils' timescales for the Local Plan updates did not allow for this.

Unlike the original CTM build, and most transport model builds, data was collated rather than collected using available data, via Essex Highways' data collection team. Data available in all three council areas was selected and averaged to a 2023 neutral weekday. The data collation exercise presented challenges related to an overall abundance of count data which required sifting to identify the more reliable counts. Primary traffic count data sources consist of continuous, Vivacity and ATC counts since they were considered the most

reliable sources. Where these sources were unavailable, junction counts were utilised instead. The traffic count data revealed that the PM peak hour was shifted forward by half an hour and is now between 1630-1700.

Following TAG guidance for Covid-19 model updates, matrix estimation was not undertaken at any point in the NEMo expansion and update. Whilst only model validation is reported, a wider range of data was used as part of the update, especially in those parts of the model where the network detail was enhanced.

The focus for the validation of NEMo has been on establishing the realism of traffic and delay along key strategic routes and ensuring that route choices between key places are sensible. To adjust traffic levels from 2019 to 2023 values, car, LGV and HGV matrices have been adjusted by applying global factors, in line with TAG advice. An additional adjustment has also been applied within Braintree.

The update of the model has also adjusted the public transport network and demand to the 2023 situation. This has included updates to rail and bus services; and changes to the level of public transport demand to reflect latest information. Whilst data on public transport use is sparser than traffic data it was, nevertheless, considered worthwhile to apply high level adjustments to reflect known changes in rail and bus use. The bus journey time validation has improved over the CTM; and modelled rail usage validates well against station usage data.

NEMo, which encompasses a large geographic area at different levels of detail, is considered suitable to test a range of strategic and specific interventions in relation to Local Plan spatial options. However, it is acknowledged that whilst NEMo is fit for testing the Local Plan spatial options, as specific developments and mitigation measures come forward, it would be appropriate to complement NEMo by microsimulation models to provide a higher level of assurance.

This report sets out the changes and updates for NEMo and presents the updated validation information for the present-day base year model. Any elements that were not updated, have not been included within this technical report, and remain consistent with those presented in the CTM 2019 base year report.

1 Introduction

1.1 Background

Colchester, Tendring and Braintree planning authorities are in the process of updating their Local Plans. Several existing transport models cover the north Essex region:

- Colchester Transport Model (CTM) – validated to a 2019 base year using VISUM and EMME software
- Essex Countywide Model – validated to a 2017 base year using VISUM software
- Braintree A120 Model – validated to a 2016 base year using SATURN software.

From these options, the Colchester Transport Model (CTM) emerges as the most suitable choice for updating the Local Plans due to its wider coverage area encompassing all three districts and the inclusion of a public transport assignment model as well as a highway model. While the CTM's level of detail reduces somewhat when extending into Tendring and Braintree, it provides a more solid foundation than the alternatives.

Additionally, the CTM has been reviewed in terms of traffic changes since the 2019 base year, looking at the potential impacts COVID-19 has had.

1.2 CTM Updates

In order to identify the enhancements required, a review of the CTM was carried out from the perspective of meeting the Local Plan requirements related to a strategic level transport assessment of alternative spatial planning options. Unlike Colchester, which benefits from a detailed network and zoning system, including modelled junction capacity, the networks in Tendring and Braintree are less defined and do not model junctions in detail. This is because the CTM was primarily built for the purposes of modelling and testing schemes in Colchester and its environs.

In addition, the COVID-19 pandemic has demonstrably impacted travel behaviour. The Department for Transport (DfT) acknowledges that COVID-19 has had a long-term effect on travel patterns, rendering pre-2020 transport models potentially inaccurate.

Consequently, the following actions to enhance the CTM to meet Local Plan requirements were needed:

- Partial Network Enhancements: The CTM base model network around Tendring and Braintree was updated to incorporate detailed junction capacity modelling in targeted areas where significant Local Plan development is expected. In addition, rail and bus services were updated to reflect latest timetables.
- Implementation of Post-COVID Adjustments: The CTM model has been adjusted to reflect recent traffic and public transport data.

This document will therefore concentrate on the North Essex Model (NEMo), from which the CTM has been expanded to cover Braintree and Tendring.

1.3 Purpose of Document

This document sets out how the NEMo has been enhanced in order to support transport assessment of Local Plan updates in Colchester, Tendring and Braintree.

This Technical Report documents the changes and updates that have been undertaken, alongside presenting validation information for the base model.

The report should be read in full, with no excerpts out of context to be representative of the report and its findings as a whole. This report has been prepared exclusively for Essex County Council (via Essex Highways) and no liability is accepted for any use or reliance on the report by third parties.

1.4 Related Documents

This document is an Addendum to the CTM Model Development and Validation Report and only contains information on the changes and updates undertaken as part of this study.

1.5 Document Structure

Following this introduction, the structure of this report is as follows:

- Chapter 2– Provides information about the sources and processing of traffic counts and journey times used for model development.
- Chapter 3 – Delivers the details of the public transport data used in model development.
- Chapter 4 – Provides an overview of the model's key design considerations.
- Chapter 5 – Summarises information about the key characteristics of the model.
- Chapter 6 – Provides the details of the highway network development.

- Chapter 7 – Provides the details of the public transport network development.
- Chapter 8 – Documents the process of the highway model validation.
- Chapter 9 – Documents the process of the public transport model validation.
- Chapter 10 – Summarises the model development and standards achieved.

2 Highway Data

2.1 Introduction

This section describes the various sources of traffic count and public transport data and journey travel time data to be used as part of the validation of the 2023 present day North Essex Model. It also outlines the processing (data cleaning and factoring) undertaken to the data prior to input and use within the model.

As previously mentioned, no new data was collected as part of this study, making use of existing data sets already available.

2.2 Highway Traffic Counts

A large amount of highway count data was available and used in the 2023 present day model. These sources can be summarised as follows:

- Data from continuous counters operated by Essex Highways for ECC.
- Data from continuous sensors provided by VivaCity for ECC. Automatic Traffic Count (ATC) data and Manual Classified Link Counts (MCC) collected by Essex Highways on an ad-hoc basis.
- Continuous counter data for the Strategic Road Network available from the WebTRIS site.
- A small number of one day counts collected by the Department for Transport (DfT).

The data obtained from these sources and used in the study was brought to a common base year using factors that take into account daily, monthly and annual variation. The counts were adjusted to represent an average weekday in neutral months in 2023, utilising factors from the continuous traffic counters operated by Essex Highways for ECC and converted to peak hour based on factors derived from local data. Further details of data processing and definitions are discussed in the Section 2.3.

Neutral periods have been defined as Mondays to Thursdays from March through to November (excluding August), provided adequate lighting is available, and avoiding the weeks before/after Easter, the Thursday before and all of the week of a bank holiday, and the school holidays.

2.2.1 Essex Continuous Counter Data

ECC continuous counter data is collected by permanently installed inductive loops which are programmed to record flow data by direction. There were 56

sites identified which classify vehicles across Essex. The locations of the counters used within the update are shown in Figure 2-1 below. Colchester town, Braintree and Tendring are covered by continuous counters to a limited extent, with some areas missing, like Harwich and Clacton.

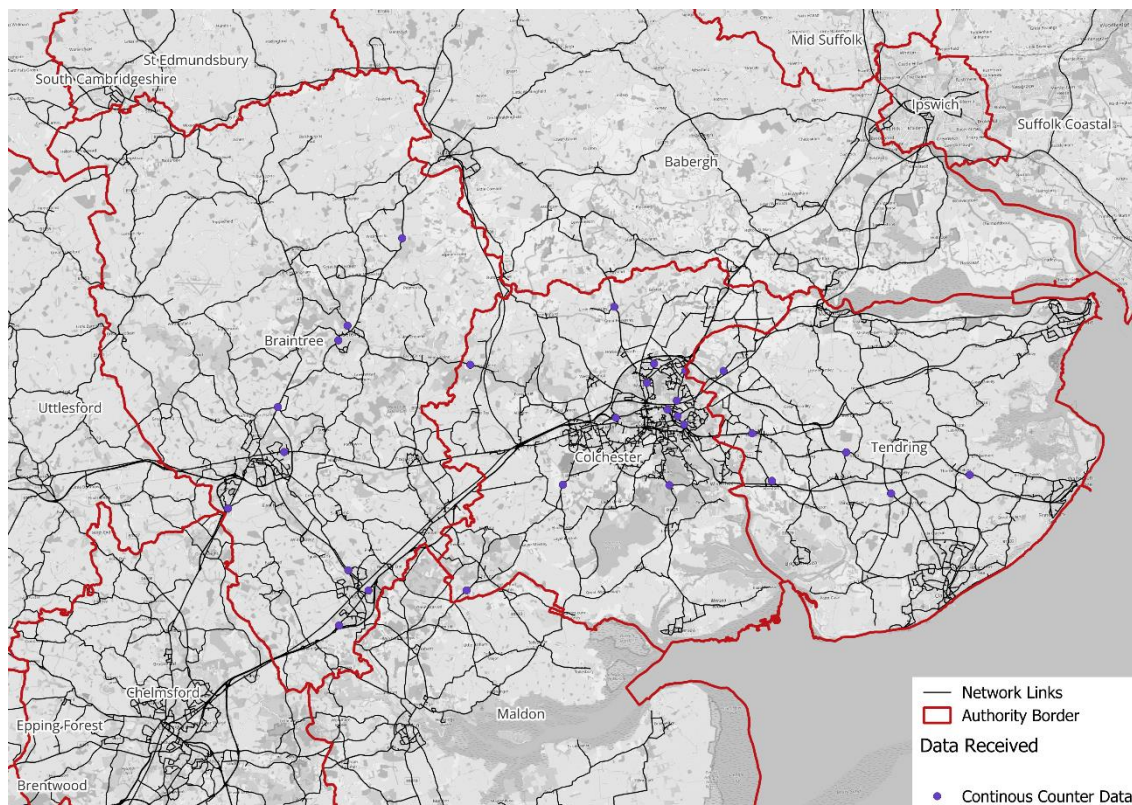


Figure 2-1: Locations of Continuous Counters used in 2023 present day CTM update

The inductive continuous counter loops classify vehicles by length and ground clearance, also detecting the engine which enables the identification of buses. The data was reported in user classes specified in Table 2-1.

Table 2-1: Continuous Counter Vehicle Classifications

	Motor Cycle	Car/ Light Van	Car/ Light Van + Trailer	Heavy Van	Light Goods Vehicle	Rigid Truck	Rigid Truck + Trailer	Artic HGV	Mini Bus	Bus
Length (m)	< 2.8	2.8 to 5.2	5.2 to 6.5			6.5 to 12	12 to 16	14.5 +	7.5 to 9.5	14.5
Reported	Not included	Cars & LGV1s	LGVs & MGVs			HGVs			PSVs	

2.2.2 VivaCity Continuous Sensors

VivaCity has a number of sensors installed in Essex. These sensors are attached to existing infrastructure (such as light posts) and use AI to detect and classify a wide range of transport modes. There were 50 sites identified for use in the 2023 present day update, with the locations shown in Figure 2-2. Whilst the coverage is good in Colchester town centre, Braintree is covered by continuous counters to a more limited extent and no counts are available in Tendring.

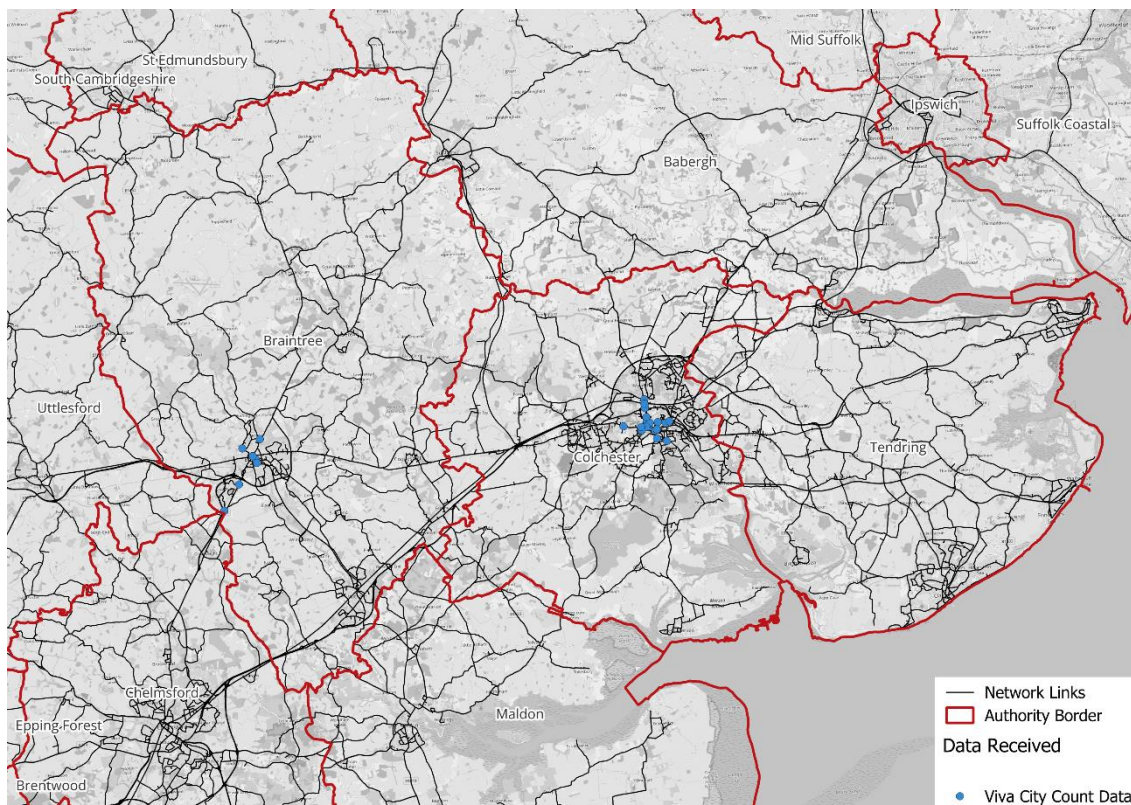


Figure 2-2: Location of VivaCity Sensors used in 2023 present day CTM update

The VivaCity sensors classify vehicles using AI. The data was reported in user classes specified in Table 2-2.

Table 2-2: VivaCity Vehicle Classifications

	Car	LGV	OGV1	OGV2	PSV	MC	PC
Classification	Car	Up to 3.5 tonnes	Over 3.5 tonnes 2-3 rigid axles	4+ rigid axles 3+ articulated axles	Buses & coaches	Motorcycle	Pedal cycle
Reported	Car	LGV	HGV		PSV	Not modelled	

2.2.3 Multi-Day LNK Count Data

These consist of one or two days manual counts done by video and enumerator, making the vehicle classification very accurate. Available were a total of 40 locations around Braintree and Colchester, with no coverage at all in Tendring.

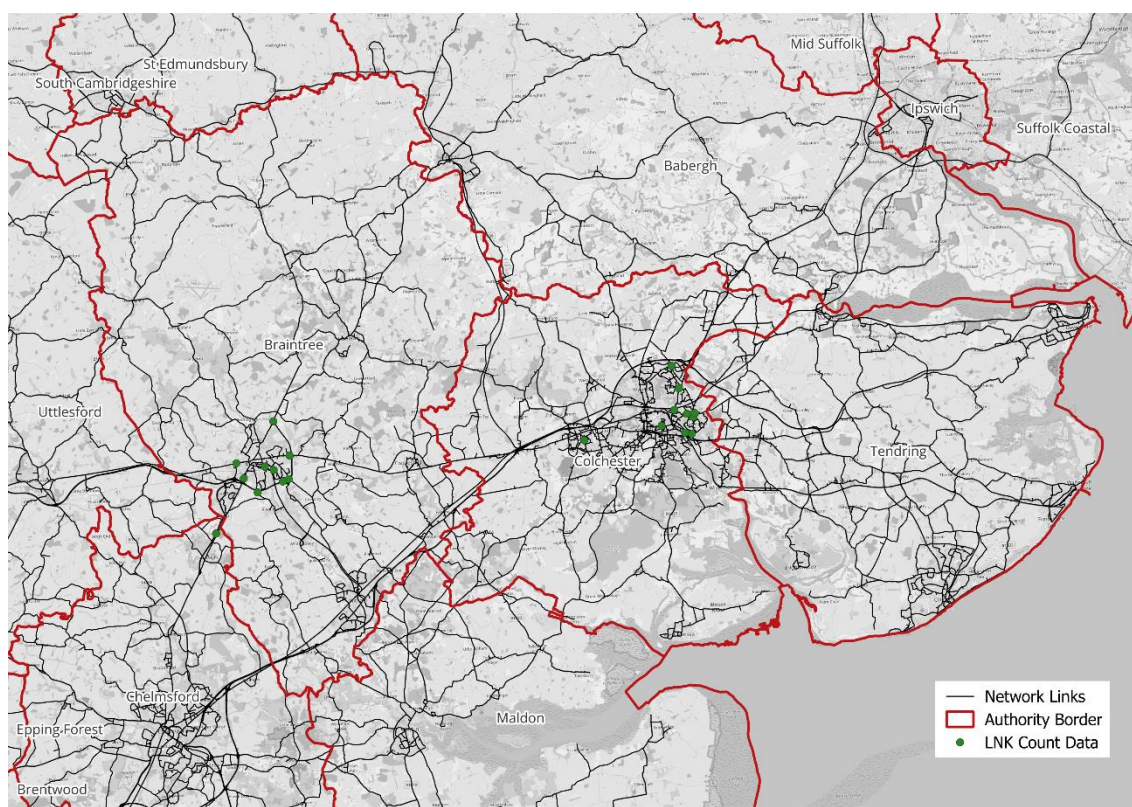


Figure 2-3: Location of LNK Counts used in 2023 present day CTM update

2.2.4 Automatic Traffic Count Data

Automatic Traffic Count (ATC) data was collected by pneumatic tubes for various studies. About 92 of these counts were used from the Essex Highways database, with locations shown in Figure 2-4 below. In most cases the data was collected for two consecutive weeks. The pneumatic tubes do not classify vehicles accurately, therefore only traffic flow data was extracted at these count locations. Despite that, the coverage is good across the three districts.

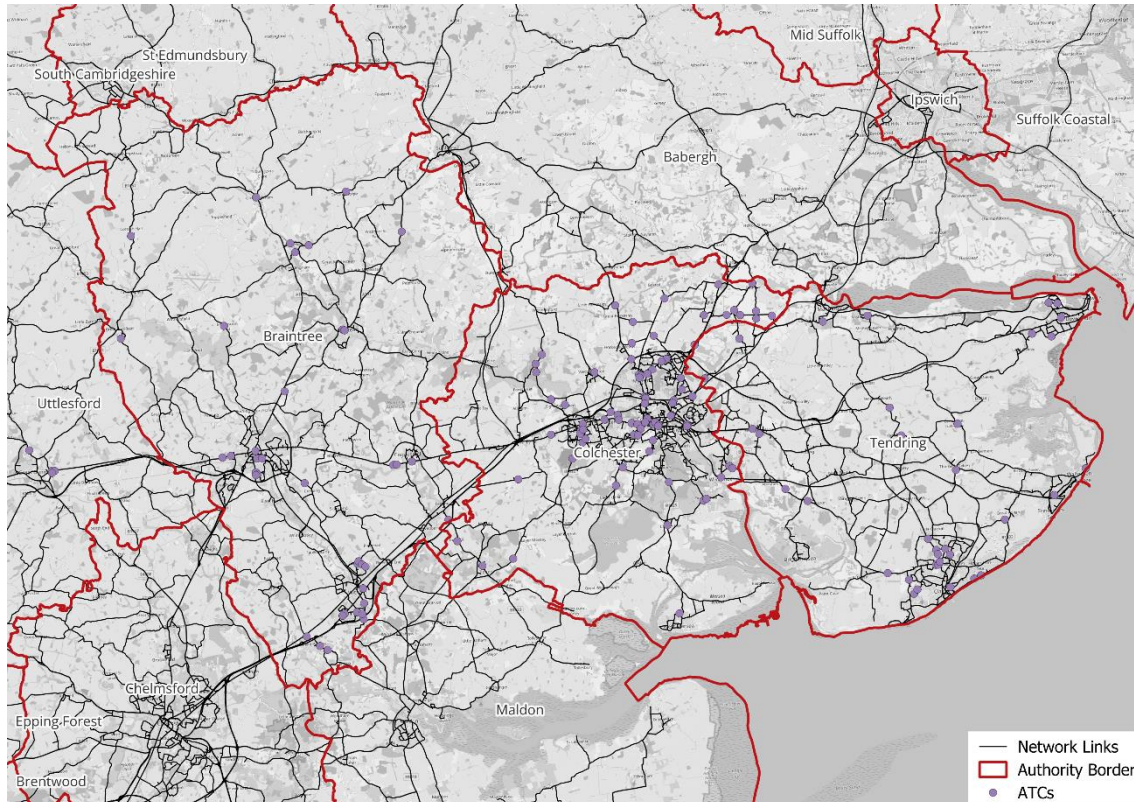


Figure 2-4: Location of ATCs used in 2023 present day CTM update

2.2.5 Junction Count Data

This is a large source of data with 301 available locations. The data was collected for one day or consecutive days, in most cases on neutral days. The coverage is good across the three districts, hence these counts were mainly used to cover areas where more reliable counts were not available.

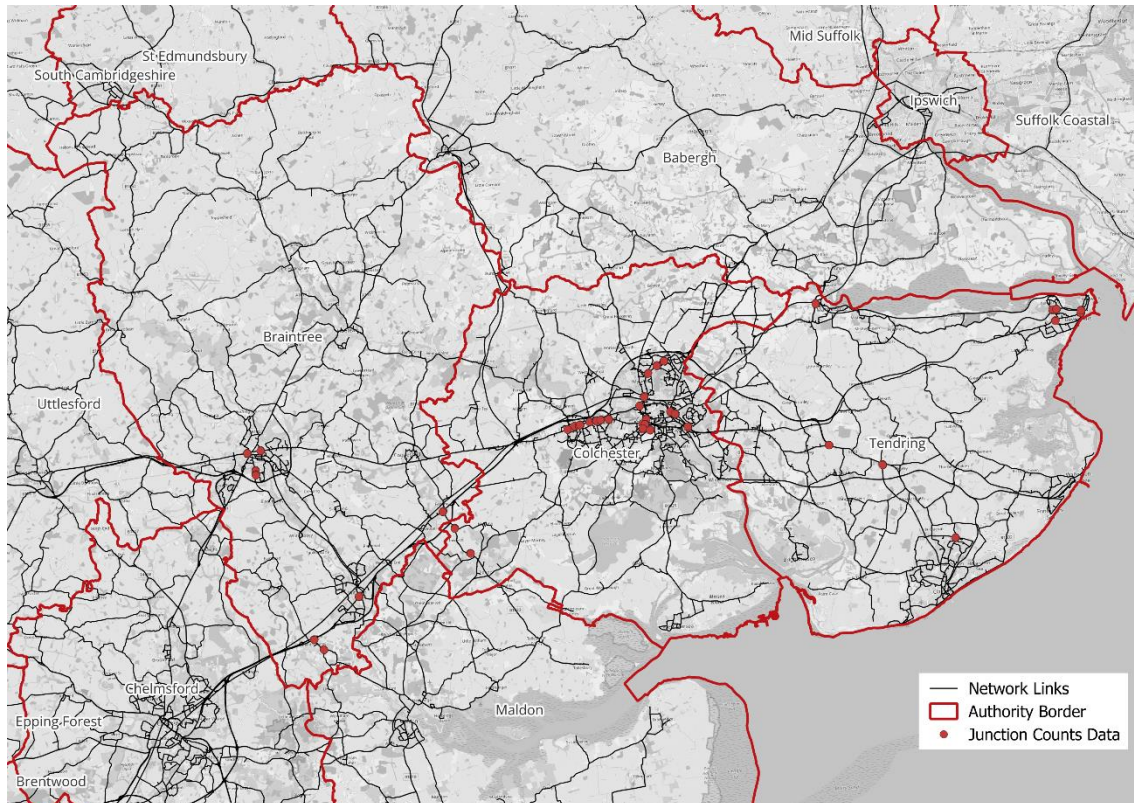


Figure 2-5: Location of Junction Counts used in 2023 present day CTM update

2.2.6 National Highways TRIS Data

National Highways data, available from the TRIS website, is also collected by inductive loops and classified by vehicle types. In most cases, the system is set up to count on slip roads and within junctions, so that one set of counts provide the flow on the slip road and by adding or subtracting the flow on the main road, flows upstream or downstream of the junction can be derived. Unfortunately, if there is data failure on any of the components that need to be added or subtracted, it jeopardises any data that needs to be derived as well. To make best use of the available data, it was extracted to standard sheets separately by direction. As a result of the set-up, there are occasions where data is available in only one direction. These 30 locations are mapped in Figure 2-6 below. Coverage is good on the A120 in Braintree, and on the A12 but only until the west of Colchester. No data was available for the A12 around Colchester, with no data in Tendring.

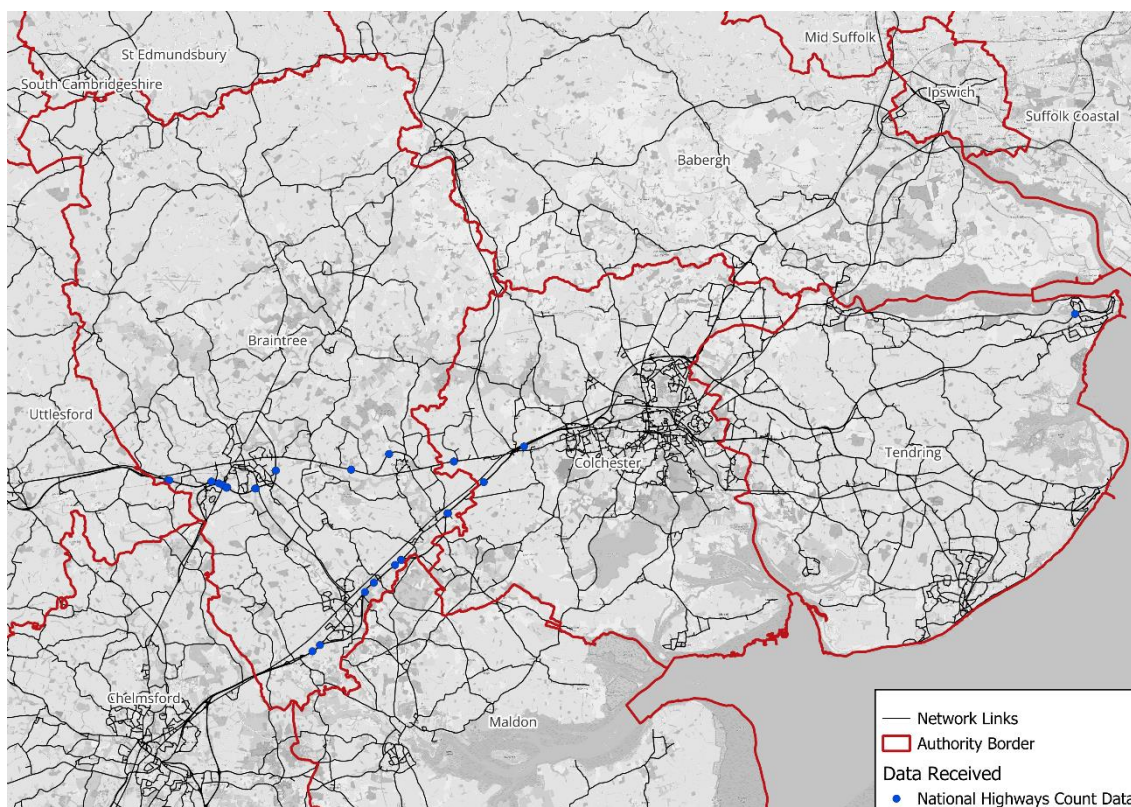


Figure 2-6: Location of National Highways TRIS Data used in 2023 present day CTM update

The TRIS data is less specific on vehicle classes and only reports it by categories of vehicle lengths. These classes are summarised in Table 2-3.

Table 2-3: NH TRIS Data Vehicle Classifications

Length	Class Reported
0 - 520 cm	Cars and Light Goods Vehicles Class 1
521 - 660 cm	Light Goods Vehicles and Medium Goods Vehicles
661+cm	Heavy Goods Vehicles and Public Service Vehicles

2.2.7 Department for Transport Data

These are collected by the Department for Transport (DfT). These are all one day counts and 26 locations were available for the North Essex major and minor road network. There are a small number of counts located in Colchester and Tendring, however there is no data available for Braintree.

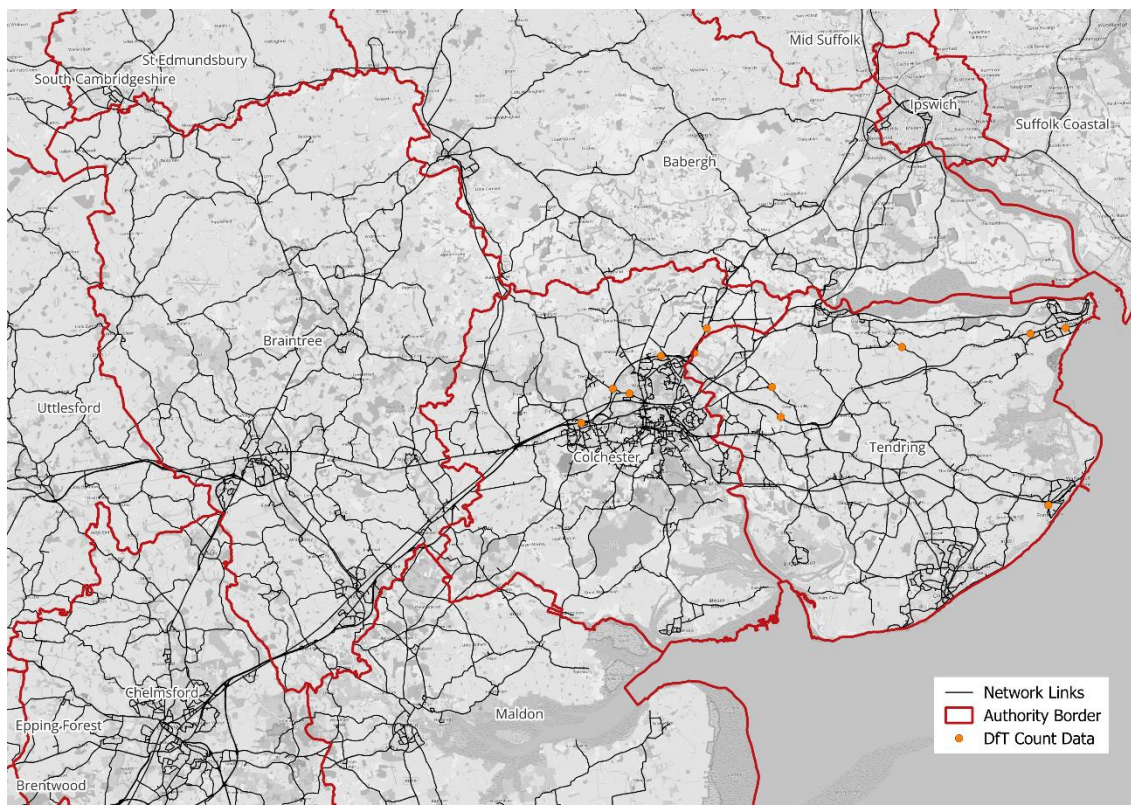


Figure 2-7: Location of DfT Counts used in 2023 present day CTM update

2.3 Model Classification

The datasets described above offer various types of classification, with the following table summarising the vehicle classifications for car and LGV.

Table 2-4: Vehicle Classifications

Vehicle Type	Description	Examples
Car	2-axle, 4-tyre Rigid chassis Trailers included	Three or four wheeled vehicles Non-commercial pick-ups Cars with trailers & caravans Light ambulances Non-commercial 4x4s
LGV 1 (Car-based)	Under 1.5t 2-axle, 4-tyre Rigid chassis Trailers included	Inc. Astra vans, Escort vans, etc Sign-written commercial pick-up vehicles
LGV2 (Transit-type)	1.5t - 3.5t 2-axle, 4-tyre Rigid chassis	Single tyres only on rear axle No reflective plates on rear Trailers included

To maintain consistency with the model classifications from the 2019 CTM build and the subsequent car matrix, cars and LGV1s were grouped together. Some data sources required factors to combine these classifications. Below are the details of the car and LGV1 combination for each data source.

- Continuous counters – Cars and LGV1s were grouped together in the data provided by Essex Highways, so no further analysis was required.
- VivaCity continuous sensors – Cars and LGVs were grouped together in the received data. The LGVs were split into LGV1 and LGV2 using data from the junction counts (excluding minor roads), with LGV1 then combined with cars.
- Multi-day LNK count data – Cars, LGV1s, and LGV2s were provided separately in this dataset, so the only change required was to combine cars with LGV1s.
- ATC data – Only the total vehicle count was provided in the data from Essex Highways. Therefore, no disaggregation of classification has been done.
- MCC data - – Cars, LGV1s, and LGV2s were provided separately in this dataset, so the only change required was to combine cars with LGV1s.
- WebTRIS continuous counter data - Cars and LGV1s were grouped together in the data provided by National Highways, so no further analysis was required.
- DfT one day counts - Cars and LGVs were grouped together in the received data. The LGVs were split into LGV1 and LGV2 using data from the junction counts (excluding minor roads), with LGV1 then combined with cars.

2.4 Traffic Flow Changes

2.4.1 Introduction

All of the traffic counts that have been collated as part of the NEMo update, as described in the sections above, have been compared back to the data collected as part of the 2019 CTM model build. This comparison was only undertaken when a traffic count had exactly the same location in both the 2019 and 2023 data, and as such not all of the traffic count locations in 2023 had the suitable comparison. These 2023 only counts were used as an independent set of counts in the model validation. As described in Section 2.8, the PM peak hour shifts to 1630-1730 in 2023, in 2019 the PM peak hour was defined as 1700-

1800. The count comparison in the PM peak hour compares the individual peak hours (i.e. 1630-1730 for 2023 and 1700-1800 for 2019).

This section presents the comparisons between the 2019 and 2023 traffic counts, split by district and vehicle type (car, LGV and HGV).

2.4.2 Colchester Comparison

Tables 2-4, Table 2-5 and Table 2-6 show the comparisons in Colchester between 2019 and 2023 for cars, LGVs and HGVs, respectively. As expected, Colchester had the most comparable count data to use.

Across all links in Colchester, the traffic counts for cars increased by 5% and 3% during the AM and IP peak hours, respectively, and remained stable in the PM peak hour. However, on an individual link basis, both decreases and increases were observed for all peak hours. The largest increase in cars was on the A137 Harwich Rd / A133 St Andrews Ave Roundabout (88% during the AM peak and 74% during the PM peak). Conversely, the largest decrease was on Greenstead Roundabout (-50% and -40% respectively) in the AM and PM peak hours.

For LGVs in Colchester, increases in 2023 were observed compared to 2019: 18%, 15% and 27% for the AM, IP and PM peaks, respectively, with individual link showing both increases and decreases. The largest increase in LGVs was on Tollgate Roundabout (177%) during the AM peak, and on A133 Cowdray Avenue (280%) during the PM peak hour. The largest decrease in LGVs was on A133 St Andrews Avenue (-45%) during the AM peak and at A12 J25 to J24 (-59%) during the PM peak hour.

HGVs in Colchester noted overall decreases in traffic counts, with 9%, 13% and 15% reductions in the AM, IP and PM peak hours, respectively. Despite this, individual links presented both decreases and increases. The largest increase was on Maldon Road Roundabout (100%) during the AM peak hour and on B1025 Mersea Rd (187%) during the PM peak hour. Conversely, the largest decrease was on A134 Southway / Headgate / B1026 Butt Road (-60%) during the AM peak hour and A1124 London Road / Halstead Road (-100%) during the PM peak hour. However, across all time periods for these sites, low volumes of HGVs were observed in both the 2019 and 2023 data. Therefore, while the percentage difference is large, the material change in flow is minimal when compared to other traffic counts.

Table 2-5: Traffic Flow Change 2019-2023, Colchester – Cars

Colchester Links	2019			2023			Difference			% Difference		
	AM	IP	PM	AM	IP	PM	AM	IP	PM	AM	IP	PM
A1124 Colchester Rd WAKES COLNE	860	475	869	740	480	826	-120	5	-43	-14%	1%	-5%
A1124 London Rd / Halstead Rd (W) COLCHESTER	1,057	1,134	1,268	1,185	1,199	1,230	128	65	-38	12%	6%	-3%
A12 between County Boundary and J29 ARDLEIGH	4,505	3,185	4,772	3,269	2,441	3,679	-1236	-745	-1093	-27%	-23%	-23%
A12 between J28 & J29 COLCHESTER	4,809	3,723	5,779	4,106	2,966	4,593	-703	-757	-1186	-15%	-20%	-21%
A12 J25 to J24 BRAINTREE	1,683	1,426	2,577	2,158	1,501	1,911	475	75	-666	28%	5%	-26%
A120 Salmon's Ln to Bracks Ln BRAINTREE	861	589	814	771	556	763	-90	-33	-51	-10%	-6%	-6%
A1232 Ipswich Rd (N) COLCHESTER	1,418	1,138	1,967	1,292	1,006	1,512	-126	-132	-455	-9%	-12%	-23%
A1232 Ipswich Rd / A133 Cowdray Ave Rbt COLCHESTER	971	829	1,246	1,140	939	1,202	169	110	-44	17%	13%	-4%
A1232 Ipswich Rd COLCHESTER	1,221	1,073	1,450	1,582	1,304	1,676	361	231	226	30%	22%	16%
A133 Cowdray Ave COLCHESTER	1,340	1,258	1,153	1,907	1,713	1,599	567	455	446	42%	36%	39%
A133 Cymbeline Way COLCHESTER	2,119	1,921	2,167	2,247	1,904	2,208	128	-17	41	6%	-1%	2%
A133 St Andrews Ave COLCHESTER	1,228	1,321	1,548	1,473	1,298	1,610	245	-23	62	20%	-2%	4%
A134 Military Road Magdalen Street COLCHESTER	884	695	718	842	618	629	-42	-77	-89	-5%	-11%	-12%
A134 Nayland Rd GT HORKESELEY	902	478	815	878	489	849	-24	11	34	-3%	2%	4%
A134 Southway / Headgate / B1026 Butt Rd (S) COLCHESTER	809	508	562	707	468	599	-102	-40	37	-13%	-8%	7%
A134 Station Way Eastside COLCHESTER	2,166	1,838	2,373	2,573	2,311	2,804	407	473	431	19%	26%	18%
A137 Harwich Rd / A133 St Andrews Ave Rbt (NW) COLCHESTER	1,075	1,169	1,287	2,019	1,949	2,239	944	780	952	88%	67%	74%
A137 Harwich Rd / A133 St Andrews Ave Rbt (SE) COLCHESTER	820	952	1,106	1,530	1,360	1,633	710	408	527	87%	43%	48%
B1022 Maldon Rd BIRCH	988	529	928	914	573	1,093	-74	44	165	-8%	8%	18%
B1022 Maldon Rd TIPTREE	1,187	739	1,277	1,041	739	1,195	-146	0	-82	-12%	0%	-6%
B1025 Mersea Rd BLACKHEATH	639	516	604	612	496	603	-27	-20	-1	-4%	-4%	0%
Brook St COLCHESTER	629	576	797	880	756	1,058	251	180	261	40%	31%	33%
Greenstead Rbt (NW) COLCHESTER	825	966	1,070	1,381	1,277	1,633	556	311	563	67%	32%	53%
Greenstead Rbt (SE) COLCHESTER	2,236	1,905	2,248	2,215	1,859	2,486	-21	-46	238	-1%	-2%	11%
Greenstead Rbt (SW) COLCHESTER	2,063	1,928	2,225	1,897	1,708	2,144	-166	-220	-81	-8%	-11%	-4%
Greenstead Rbt (W) COLCHESTER	474	368	454	238	237	274	-236	-131	-180	-50%	-36%	-40%
Maldon Rd Rbt (NW) Colchester	102	105	131	126	105	132	24	0	1	24%	0%	1%
Mersea Rd COLCHESTER	933	881	1,066	1,001	878	1,013	68	-3	-53	7%	0%	-5%
Tollgate roundabout (E) COLCHESTER	1,338	1,355	1,535	1,458	1,393	1,623	120	38	88	9%	3%	6%

Table 2-6: Traffic Flow Change 2019-2023, Colchester – LGVs

Colchester Links	2019			2023			Difference			% Difference		
	AM	IP	PM	AM	IP	PM	AM	IP	PM	AM	IP	PM
A1124 Colchester Rd WAKES COLNE	95	76	71	105	83	91	10	7	20	11%	9%	28%
A1124 London Rd / Halstead Rd (W) COLCHESTER	89	72	54	99	99	80	10	27	26	11%	38%	48%
A12 between County Boundary and J29 ARDLEIGH	574	502	463	933	664	610	359	161	147	63%	32%	32%
A12 between J28 & J29 COLCHESTER	837	591	601	1,002	637	742	165	46	141	20%	8%	23%
A12 J25 to J24 BRAINTREE	633	446	628	355	241	258	-279	-205	-370	-44%	-46%	-59%
A120 Salmon's Ln to Bracks Ln BRAINTREE	79	53	38	95	62	52	16	9	14	21%	17%	36%
A1232 Ipswich Rd (N) COLCHESTER	240	176	155	295	231	273	55	55	118	23%	31%	76%
A1232 Ipswich Rd / A133 Cowdray Ave Rbt COLCHESTER	103	56	66	99	90	81	-4	34	15	-4%	61%	23%
A1232 Ipswich Rd COLCHESTER	184	129	97	265	173	148	81	44	51	44%	34%	52%
A133 Cowdray Ave COLCHESTER	177	116	52	195	174	197	18	58	145	10%	50%	280%
A133 Cymbeline Way COLCHESTER	214	196	117	261	238	175	47	42	58	22%	21%	50%
A133 St Andrews Ave COLCHESTER	352	260	171	195	160	121	-157	-99	-50	-45%	-38%	-29%
A134 Military Road Magdalen Street COLCHESTER	83	66	43	85	67	43	2	1	0	2%	1%	1%
A134 Nayland Rd GT HORKESELEY	105	77	60	125	85	93	20	8	33	19%	11%	55%
A134 Southway / Headgate / B1026 Butt Rd (S) COLCHESTER	49	41	29	65	45	39	16	4	10	33%	9%	34%
A134 Station Way Eastside COLCHESTER	143	120	102	184	171	139	41	51	37	29%	42%	36%
A137 Harwich Rd / A133 St Andrews Ave Rbt (NW) COLCHESTER	151	111	56	255	220	162	104	109	106	69%	98%	189%
A137 Harwich Rd / A133 St Andrews Ave Rbt (SE) COLCHESTER	122	110	55	238	185	112	116	75	57	95%	68%	104%
B1022 Maldon Rd BIRCH	103	60	62	97	66	100	-6	6	38	-6%	10%	61%
B1022 Maldon Rd TIPTREE	144	93	105	157	103	133	13	10	28	9%	11%	26%
B1025 Mersea Rd BLACKHEATH	95	67	58	112	76	74	17	9	16	18%	14%	28%
Brook St COLCHESTER	57	60	46	112	105	83	55	45	37	97%	74%	80%
Greenstead Rbt (NW) COLCHESTER	118	109	56	228	162	114	110	53	58	93%	48%	104%
Greenstead Rbt (SE) COLCHESTER	223	183	128	314	221	222	91	38	94	41%	21%	73%
Greenstead Rbt (SW) COLCHESTER	343	250	160	338	242	220	-5	-8	60	-1%	-3%	38%
Greenstead Rbt (W) COLCHESTER	65	53	30	54	47	33	-11	-6	3	-17%	-12%	10%
Maldon Rd Rbt (NW) Colchester	8	11	5	9	11	7	1	0	2	13%	0%	40%
Mersea Rd COLCHESTER	82	62	59	91	80	58	9	18	-1	11%	29%	-1%
Tollgate roundabout (E) COLCHESTER	65	70	39	180	119	107	115	49	68	177%	70%	174%

Table 2-7: Traffic Flow Change 2019-2023, Colchester – HGVs

Colchester Links	2019			2023			Difference			% Difference		
	AM	IP	PM	AM	IP	PM	AM	IP	PM	AM	IP	PM
A1124 Colchester Rd WAKES COLNE	24	23	7	24	22	10	0	-1	3	1%	-5%	41%
A1124 London Rd / Halstead Rd (W) COLCHESTER	10	11	4	14	14	0	4	3	-4	40%	23%	-100%
A12 between County Boundary and J29 ARDLEIGH	700	797	443	504	501	262	-196	-297	-181	-28%	-37%	-41%
A12 between J28 & J29 COLCHESTER	592	559	323	570	554	333	-23	-5	10	-4%	-1%	3%
A12 J25 to J24 BRAINTREE	288	327	159	273	256	122	-15	-71	-36	-5%	-22%	-23%
A120 Salmon's Ln to Bracks Ln BRAINTREE	119	90	41	96	90	45	-23	0	4	-20%	0%	9%
A1232 Ipswich Rd (N) COLCHESTER	49	64	22	38	37	20	-11	-27	-2	-23%	-43%	-8%
A1232 Ipswich Rd / A133 Cowdray Ave Rbt COLCHESTER	10	11	4	10	13	3	0	2	-1	0%	17%	-25%
A1232 Ipswich Rd COLCHESTER	42	40	14	42	41	18	0	1	4	-1%	3%	29%
A133 Cowdray Ave COLCHESTER	37	32	12	36	39	18	-1	7	6	-2%	21%	50%
A133 Cymbeline Way COLCHESTER	70	64	20	54	59	19	-16	-5	-1	-22%	-8%	-7%
A133 St Andrews Ave COLCHESTER	62	67	17	38	45	16	-24	-23	-1	-38%	-34%	-5%
A134 Military Road Magdalen Street COLCHESTER	25	20	8	16	15	6	-9	-5	-2	-36%	-24%	-31%
A134 Nayland Rd GT HORKESELEY	33	32	11	31	33	15	-2	1	4	-6%	2%	33%
A134 Southway / Headgate / B1026 Butt Rd (S) COLCHESTER	10	9	1	4	8	1	-6	-1	0	-60%	-15%	0%
A134 Station Way Eastside COLCHESTER	18	26	6	33	31	7	15	5	1	81%	20%	21%
A137 Harwich Rd / A133 St Andrews Ave Rbt (NW) COLCHESTER	45	56	16	67	84	24	22	28	8	49%	49%	50%
A137 Harwich Rd / A133 St Andrews Ave Rbt (SE) COLCHESTER	38	48	12	47	69	22	9	21	10	24%	43%	83%
B1022 Maldon Rd BIRCH	24	21	4	23	28	5	-1	7	1	-3%	33%	35%
B1022 Maldon Rd TIPTREE	26	23	9	26	23	11	0	0	2	1%	-1%	27%
B1025 Mersea Rd BLACKHEATH	13	14	2	16	16	6	3	2	4	22%	11%	187%
Brook St COLCHESTER	8	10	1	8	9	2	0	-1	1	-3%	-13%	128%
Greenstead Rbt (NW) COLCHESTER	37	47	12	62	64	19	25	17	7	68%	35%	58%
Greenstead Rbt (SE) COLCHESTER	51	51	11	73	68	10	22	17	-1	43%	34%	-9%
Greenstead Rbt (SW) COLCHESTER	66	74	21	65	81	22	-1	7	1	-2%	9%	5%
Greenstead Rbt (W) COLCHESTER	6	6	1	8	5	2	2	-1	1	33%	-17%	100%
Maldon Rd Rbt (NW) Colchester	1	1	0	2	0	0	1	-1	0	100%	-67%	
Mersea Rd COLCHESTER	15	12	3	9	10	2	-6	-2	-1	-42%	-18%	-25%
Tollgate roundabout (E) COLCHESTER	8	8	12	11	14	2	3	6	-10	38%	77%	-83%

2.4.3 Braintree Comparison

Tables 2-7, Table 2-8 and Table 2-9 show the comparisons in Braintree between 2019 and 2023 for cars, LGVs and HGVs, respectively. Braintree had fewer comparable count data available than Colchester.

Across all links in Braintree, the traffic counts for cars decreased in all peaks by 7%, 8% and 12% for the AM, IP and PM peaks, respectively. However, on an individual link basis, both decreases and increases were observed for all peak hours. During the AM peak, the largest increase was only 6% on the A120 A131 Pannors to B1417 link. The largest increase in the PM peak, of 49%, was observed on the A120 London Road eastbound on-slip. The largest decrease in the AM peak was only 13% on the A12 between J23 and J24, while during the IP and PM peak hours, the largest decreases were 30% and 37%, both on the A131 Great Leighs Bypass.

For LGVs in Braintree, increases in 2023 were observed compared to 2019: 14%, 7% and 25% for the AM, IP and PM peaks, respectively. The largest increase was noted on the A12 Oak Road to J22 in all three peaks (98%, 67% and 150%), whilst the largest decreases were all observed on the A131 Great Leigh Bypass in all three peaks (-45%, -32% and -31%).

HGVs in Braintree noted overall decreases in traffic counts, with 1%, 7% and 3% reductions in the AM, IP and PM peak hours, respectively. Both decreases and increases were observed on individual links. The A120 London Road eastbound on-slip had the largest increase in all peaks (144%, 123% and 218% respectively). The largest decreases for the AM and IP were observed on A1124 Hedingham Road (-33% and -37% respectively), and on the A12 between J23 and J24 during the PM peak (-36%). As noted in Colchester, low volumes of HGVs were observed in both the 2019 and 2023 data. Therefore, while the percentage difference is large, the material change in flow is minimal when compared to other traffic counts for the increases shown on A120 London Road eastbound on-slip and A1224 Hedingham Road.

Table 2-8: Traffic Flow Change 2019-2023, Braintree – Cars

Braintree Links	2019			2023			Difference			% Difference		
	AM	IP	PM	AM	IP	PM	AM	IP	PM	AM	IP	PM
A1124 Hedingham Rd HALSTEAD	465	308	506	427	305	464	-38	-3	-42	-8%	-1%	-8%
A12 between J23 and J24 BRAINTREE	4,128	3,064	4,715	3,574	2,644	3,621	-554	-420	-1094	-13%	-14%	-23%
A12 J22 SB Off-slip BRAINTREE	647	273	364	573	261	346	-74	-12	-18	-11%	-4%	-5%
A12 J23 NB Off-slip BRAINTREE	292	237	386	278	233	450	-14	-4	64	-5%	-1%	17%
A12 Oak Rd to J22 BRAINTREE	3,016	1,748	2,269	2,681	1,586	2,089	-335	-162	-180	-11%	-9%	-8%
A120 A131 Panners EB Off-slip BRAINTREE	411	369	975	410	373	878	-1	4	-97	0%	1%	-10%
A120 A131 Panners to B1417 BRAINTREE	1,870	936	1,169	1,980	923	1,190	110	-12	21	6%	-1%	2%
A120 B1417 to A131 Panners BRAINTREE	1,086	1,066	2,146	1,039	1,030	1,941	-47	-36	-205	-4%	-3%	-10%
A120 between Watery Ln and West St BRAINTREE	1,819	1,312	1,933	1,761	1,290	1,877	-58	-22	-56	-3%	-2%	-3%
A120 between West St to B1024 Colne Rd	1,536	1,123	1,603	1,458	1,090	1,621	-78	-33	18	-5%	-3%	1%
A120 London Rd EB On-slip BRAINTREE	216	145	75	222	153	111	6	8	36	3%	5%	49%
A120 London Rd to A131 Panners BRAINTREE	1,521	881	935	1,434	815	885	-87	-66	-50	-6%	-8%	-5%
A131 Gt Leighs Bypass BRAINTREE	2,278	1,730	3,081	2,075	1,207	1,954	-203	-523	-1127	-9%	-30%	-37%
A131 High Garrett BRAINTREE	1,596	1,093	1,584	1,537	1,103	1,590	-59	10	6	-4%	1%	0%
A131 Mount Hill HALSTEAD	832	636	911	860	693	901	28	57	-10	3%	9%	-1%
B1018 Cressing Rd WITHAM	1,099	703	1,093	990	681	1,004	-109	-22	-89	-10%	-3%	-8%

Table 2-9: Traffic Flow Change 2019-2023, Braintree - LGVs

Braintree Links	2019			2023			Difference			% Difference		
	AM	IP	PM	AM	IP	PM	AM	IP	PM	AM	IP	PM
A1124 Hedingham Rd HALSTEAD	77	54	55	78	61	69	1	7	14	2%	13%	25%
A12 between J23 and J24 BRAINTREE	527	424	385	585	417	432	58	-7	47	11%	-2%	12%
A12 J22 SB Off-slip BRAINTREE	62	40	30	80	44	36	18	4	6	29%	11%	20%
A12 J23 NB Off-slip BRAINTREE	25	22	20	34	26	35	9	4	15	36%	16%	73%
A12 Oak Rd to J22 BRAINTREE	235	181	130	466	302	325	231	121	195	98%	67%	150%
A120 A131 Panners EB Off-slip BRAINTREE	42	46	64	55	57	89	13	11	25	32%	24%	39%
A120 A131 Panners to B1417 BRAINTREE	156	88	50	229	111	98	74	23	49	47%	26%	98%
A120 B1417 to A131 Panners BRAINTREE	99	109	123	135	137	176	36	28	53	36%	25%	43%
A120 between Watery Ln and West St BRAINTREE	155	120	94	159	124	101	4	4	7	3%	3%	8%
A120 between West St to B1024 Colne Rd	161	125	99	201	143	135	40	18	36	25%	14%	37%
A120 London Rd EB On-slip BRAINTREE	15	11	5	16	13	8	1	2	3	10%	14%	59%
A120 London Rd to A131 Panners BRAINTREE	161	96	58	174	103	81	13	7	23	8%	8%	40%
A131 Gt Leighs Bypass BRAINTREE	339	231	268	185	157	185	-154	-73	-83	-45%	-32%	-31%
A131 High Garrett BRAINTREE	217	169	168	226	172	193	9	3	25	4%	2%	15%
A131 Mount Hill HALSTEAD	134	105	92	128	105	113	-6	0	21	-5%	0%	23%
B1018 Cressing Rd WITHAM	135	114	87	140	107	92	5	-7	5	4%	-6%	6%

Table 2-10: Traffic Flow Change 2019-2023, Braintree - HGVs

Braintree Links	2019			2023			Difference			% Difference		
	AM	IP	PM	AM	IP	PM	AM	IP	PM	AM	IP	PM
A1124 Hedingham Rd HALSTEAD	19	20	7	13	13	7	-6	-7	0	-33%	-37%	-1%
A12 between J23 and J24 BRAINTREE	616	660	358	462	463	229	-154	-197	-129	-25%	-30%	-36%
A12 J22 SB Off-slip BRAINTREE	45	43	19	68	44	21	23	1	2	52%	3%	10%
A12 J23 NB Off-slip BRAINTREE	24	21	9	33	35	26	9	14	17	39%	67%	187%
A12 Oak Rd to J22 BRAINTREE	327	294	164	341	279	135	14	-15	-29	4%	-5%	-17%
A120 A131 Panners EB Off-slip BRAINTREE	52	57	31	51	61	52	-1	4	21	-2%	6%	68%
A120 A131 Panners to B1417 BRAINTREE	187	146	62	236	150	71	48	4	8	26%	3%	14%
A120 B1417 to A131 Panners BRAINTREE	133	151	82	129	166	115	-4	15	33	-3%	10%	40%
A120 between Watery Ln and West St BRAINTREE	203	171	84	206	198	107	3	27	23	2%	16%	27%
A120 between West St to B1024 Colne Rd	197	169	79	181	178	96	-16	9	17	-8%	5%	21%
A120 London Rd EB On-slip BRAINTREE	10	10	2	24	22	6	14	12	4	144%	123%	218%
A120 London Rd to A131 Panners BRAINTREE	157	136	54	173	134	53	16	-2	-1	10%	-1%	-2%
A131 Gt Leighs Bypass BRAINTREE	89	73	24	126	93	32	37	20	8	41%	27%	34%
A131 High Garrett BRAINTREE	60	67	20	59	62	19	-1	-5	-1	-2%	-8%	-5%
A131 Mount Hill HALSTEAD	40	41	11	37	36	12	-3	-5	1	-6%	-11%	13%
B1018 Cressing Rd WITHAM	48	53	19	38	41	16	-10	-12	-3	-21%	-23%	-17%

2.4.4 Tendring Comparison

Table 2-11, Table 2-12 and Table 2-13 show the comparisons in Tendring between 2019 and 2023 for cars, LGVs and HGVs, respectively. Tendring has the smallest number of comparable count data than Colchester and Braintree.

Across all links in Tendring, the traffic counts for cars didn't vary significantly, with no change during the AM peak, a 2% decrease in the IP and a 1% increase in the PM peak. However, on an individual link basis, both decreases and increases were observed for all peak hours. The largest increase in flow was noted in the AM peak on A137 Coks Hill / B1352 Station Road (25%). The IP and PM peaks did not experience significant individual increases.

For LGVs in Tendring, most counts showed increases in flow. Overall, there were 10%, 14% and 35% increases in the AM, IP and PM peaks, respectively. The largest increase was observed on A137 Coks Hill / B1352 Station Road (59%) during the PM peak.

HGVs in Tendring showed a mixture of increases and decreases on individual links, with overall changes of 8%, -2% and 41% in the AM, IP and PM peaks, respectively. The largest increase in flow was observed during the PM peak on A137 Coks Hill / B1352 Station Road (217%), with the largest decrease on B1027 Colchester Road (-60%) during the IP. As before, actual HGV numbers and changes are relatively small.

Table 2-11: Traffic Flow Change 2019-2023, Tendring - Cars

Tendring Links	2019			2023			Difference			% Difference		
	AM	IP	PM	AM	IP	PM	AM	IP	PM	AM	IP	PM
A133 Colchester Rd GT BENTLEY	1,890	1,631	2,168	1,817	1,590	2,098	-73	-41	-70	-4%	-2%	-3%
A133 Elmstead Market COLCHESTER	1,056	794	1,178	1,034	773	1,102	-22	-21	-76	-2%	-3%	-6%
A133 North of A133 Colchester Road COLCHESTER	1,302	782	891	1,192	675	862	-110	-107	-29	-8%	-14%	-3%
A137 Colchester Rd ARDLEIGH	525	324	526	513	336	519	-12	12	-7	-2%	4%	-1%
A137 Coks Hill / B1352 Station Rd (NW) MANNINGTREE	1,035	704	1,244	1,292	759	1,403	257	55	159	25%	8%	13%
A137 Coks Hill / B1352 Station Rd (SE) MANNINGTREE	234	149	264	217	136	244	-17	-14	-20	-7%	-9%	-8%
A137 Coks Hill / B1352 Station Rd (SW) MANNINGTREE	842	637	1,068	984	667	1,227	142	30	159	17%	5%	15%
B1027 Colchester Rd ALRESFORD	859	517	804	793	532	807	-66	15	3	-8%	3%	0%
B1033 Frinton Rd THORPE LE SOKEN	785	696	835	723	655	813	-62	-41	-22	-8%	-6%	-3%

Table 2-12: Traffic Flow Change 2019-2023, Tendring - LGVs

Tendring Links	2019			2023			Difference			% Difference		
	AM	IP	PM	AM	IP	PM	AM	IP	PM	AM	IP	PM
A133 Colchester Rd GT BENTLEY	343	244	183	391	294	287	48	50	104	14%	21%	57%
A133 Elmstead Market COLCHESTER	122	78	73	129	100	93	7	22	20	6%	28%	27%
A133 North of A133 Colchester Road COLCHESTER	191	127	97	242	142	116	51	15	19	27%	12%	20%
A137 Colchester Rd ARDLEIGH	77	57	66	70	48	52	-7	-9	-14	-9%	-16%	-22%
A137 Coks Hill / B1352 Station Rd (NW) MANNINGTREE	145	83	80	152	98	127	7	15	47	5%	18%	59%
A137 Coks Hill / B1352 Station Rd (SE) MANNINGTREE	24	13	15	18	13	18	-6	0	3	-25%	-3%	20%
A137 Coks Hill / B1352 Station Rd (SW) MANNINGTREE	132	76	71	124	89	104	-8	13	33	-6%	16%	46%
B1027 Colchester Rd ALRESFORD	81	67	58	106	73	79	25	6	21	31%	9%	36%
B1033 Frinton Rd THORPE LE SOKEN	109	88	76	119	95	98	10	7	22	9%	8%	29%

Table 2-13: Traffic Flow Change 2019-2023, Tendring – HGVs

Tendring Links	2019			2023			Difference			% Difference		
	AM	IP	PM	AM	IP	PM	AM	IP	PM	AM	IP	PM
A133 Colchester Rd GT BENTLEY	80	84	22	70	69	21	-10	-15	-1	-13%	-17%	-4%
A133 Elmstead Market COLCHESTER	24	22	6	30	29	9	5	7	3	21%	34%	47%
A133 North of A133 Colchester Road COLCHESTER	40	57	19	53	58	21	13	1	2	33%	2%	11%
A137 Colchester Rd ARDLEIGH	17	16	6	13	12	6	-4	-4	0	-24%	-24%	-5%
A137 Coks Hill / B1352 Station Rd (NW) MANNINGTREE	35	29	7	45	35	15	10	6	8	29%	21%	114%
A137 Coks Hill / B1352 Station Rd (SE) MANNINGTREE	0	0	0	0	1	1	0	1	1			
A137 Coks Hill / B1352 Station Rd (SW) MANNINGTREE	35	30	6	47	37	19	12	7	13	34%	24%	217%
B1027 Colchester Rd ALRESFORD	13	16	1	7	6	2	-6	-10	1	-50%	-60%	104%
B1033 Frinton Rd THORPE LE SOKEN	28	26	4	30	26	6	2	0	2	6%	1%	54%

2.5 Traffic Count Data Cleaning and Processing

2.5.1 Overview

Transport Analysis Guidance (TAG) Unit M1.2¹ section 2.4.4 says that surveys should typically be carried out during a 'neutral', or representative, month avoiding main and local holiday periods, local school holidays and half terms, and other abnormal traffic periods.

This section looks at the processing count data into neutral period 2023 data.

2.5.2 Removal of Outliers

The first step of the data analysis was to remove unreliable data from the surveys for each location. To start with, all the data collected between Friday and Sunday (inclusive) was excluded from the neutral month data to provide a Monday to Thursday (representative weekday) dataset. Outliers were then removed from the final data that would be used in the North Essex Model, where data (days) for the same survey (location) is excluded if it does not meet the 95% "Confidence Interval Criterion" (see 2.5.3).

2.5.3 95% Confidence Interval Criterion

The 95% confidence interval criterion is used to exclude any unreliable data (days) from a survey location by simply excluding days for which the observed peak hour traffic volume falls outside of the area defined by 95% limits (or 1.96 times the standard deviation) of the mean (assuming a normal distribution of the data) illustrated in Figure 2-8.

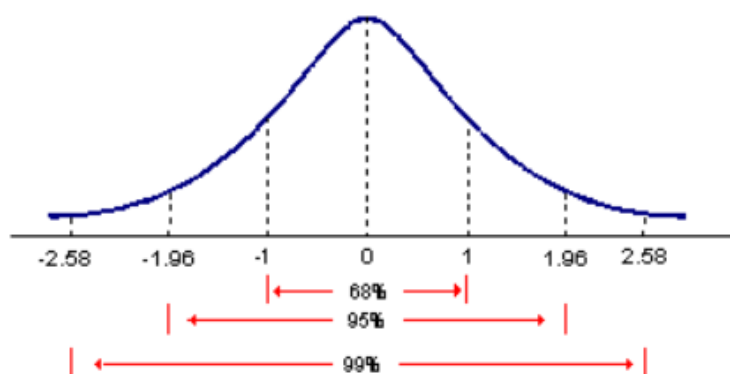


Figure 2-8: Confidence Interval Data Areas

¹ <https://assets.publishing.service.gov.uk/media/664db4debd01f5ed32793ffc/tag-m1-2-data-sources-and-surveys.pdf>

Any data (days) for a survey location lying outside of the above ranges was excluded from the survey, giving a new average flow for the surveyed period.

2.5.4 Normalisation (Daily and Annual) Factoring and Vehicle Classification

After cleaning of the data, counts were factored to a 2023 neutral month, Monday to Thursday hourly traffic flows for modelled links and vehicle classes. The factoring of the traffic count data included the following steps:

- Use the daily factor to project each cleaned daily Monday to Thursday traffic count to a neutral day.
- Use the annual factor to project the neutral day Monday to Thursday count to the base year (2023) of the model.
- Use vehicle proportions to convert the total traffic flow into the modelled vehicle classes (Cars, LGVs, HGVs and PSVs), where Manual Classified Counts (MCC) is available.

2.5.5 Verification of Vehicle Classification Proportions

Where an MCCC was completed at the same location as an unclassified count, classifications are also obtained. Only where an MCC, CC or NH data is available have classifications been used. For the CC or NH data, the classifications are averages of the daily data obtained. Where there are MCCs in conjunction with ATCs, the classification as observed by the manual counts was then applied to the flow of the ATCs.

2.6 Analysis of Final Traffic Count Datasets

2.6.1 Final Traffic Count Database

The total number of count locations allocated to modelled links after processing was 305. These primarily consist of Continuous (54), Vivacity (32), LNK (30) and ATC (56) counts supported with National Highways (25), DfT (16) and Junction Counts (92) where the continuous count data was unavailable. The final count locations are shown in Figure 2-9 for the fully modelled area. Figure 2-10 to Figure 2-12 show the survey locations focussed on Colchester, Tendring and Braintree respectively.

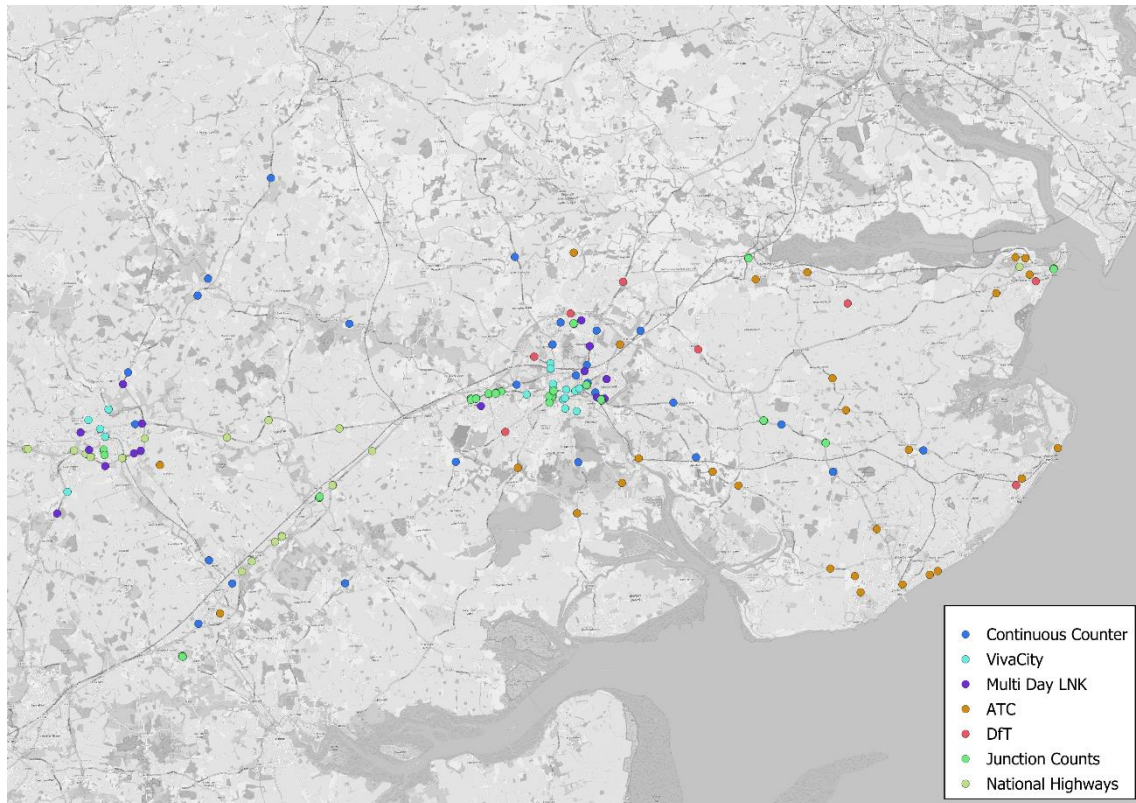


Figure 2-9: Final Traffic Count Locations – Fully Modelled Area



Figure 2-10: Final Traffic Count Locations – Colchester

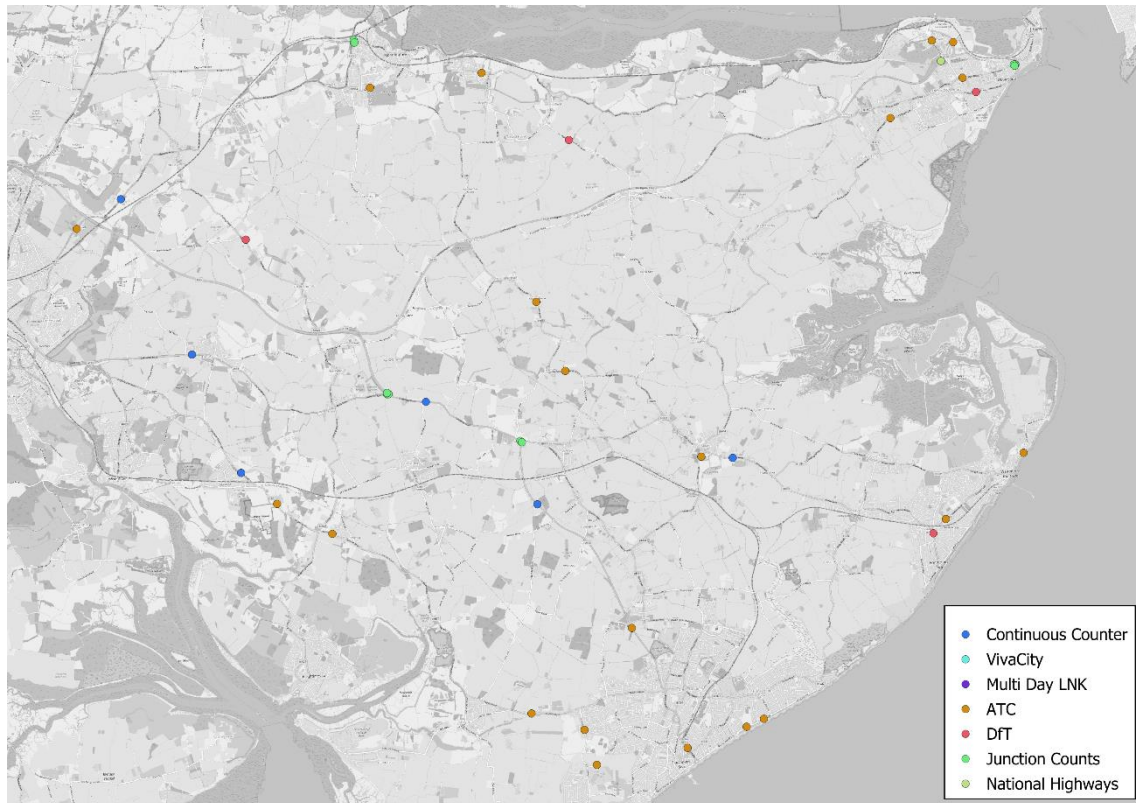


Figure 2-11: Final Traffic Count Locations – Tendring

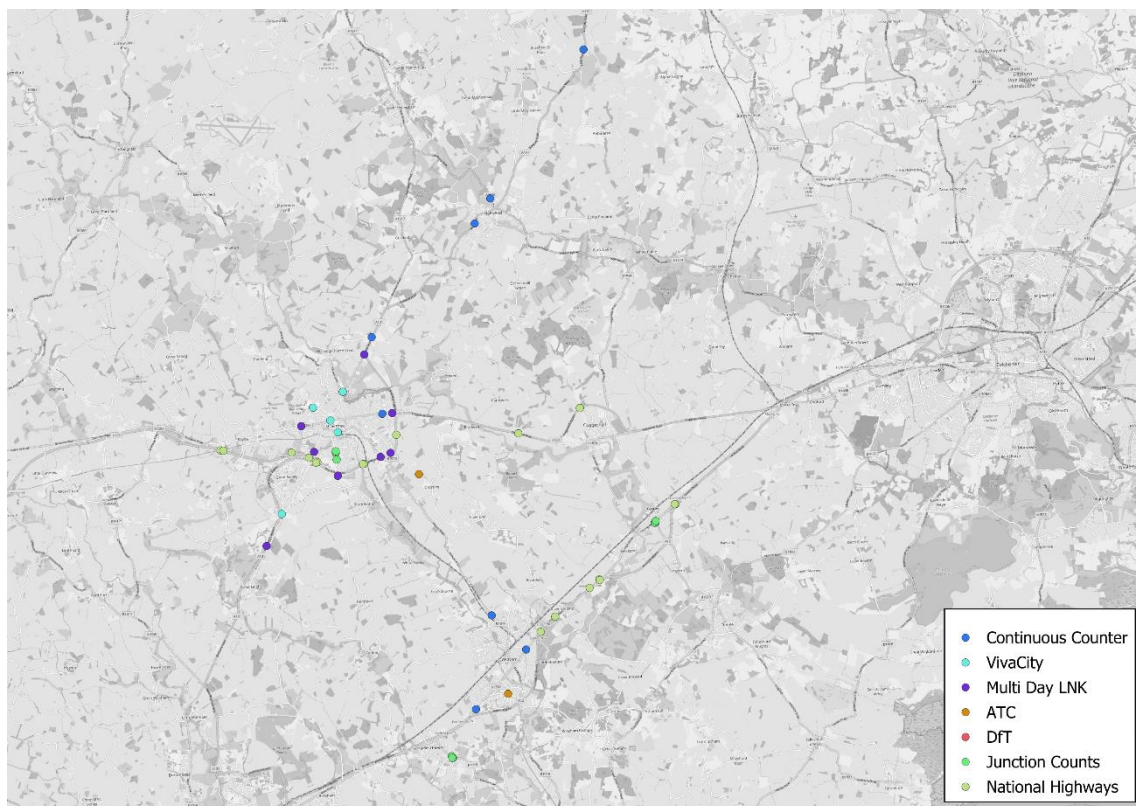


Figure 2-12: Final Traffic Count Locations – Braintree

2.7 Screenlines

A total of eight screenlines and cordons have been created for the validation of the highway model. As mentioned previously, unlike traditional model builds, previously collected data was used rather than specifying the location of the traffic counts. As far as possible, the screenlines and cordons have been designed to be consistent with the previous screenlines and cordons used in the CTM development, and to be TAG compliant (5 links or more, high flow routes, comparisons by vehicle type, and by each modelled period). These screenlines and cordons are listed in Table 2-14 and shown in Figure 2-13 below.

It is acknowledged that some of the screenlines have gaps, and because of this, the model validation focused on the overall link flows.

Table 2-14: Screenlines in the NEMo Highway Assignment Model

Screenline	Direction	No. of Counts
Braintree	In	6
Braintree	Out	6
Witham	In	3
Witham	Out	3
Colchester West	EB	3
Colchester West	WB	3
Colchester South	In	4
Colchester South	Out	4
Colchester North	In	5
Colchester North	Out	5
Colchester Cordon	In	6
Colchester Cordon	Out	6
Tendring	EB	4
Tendring	WB	4
Harwich	In	2
Harwich	Out	2

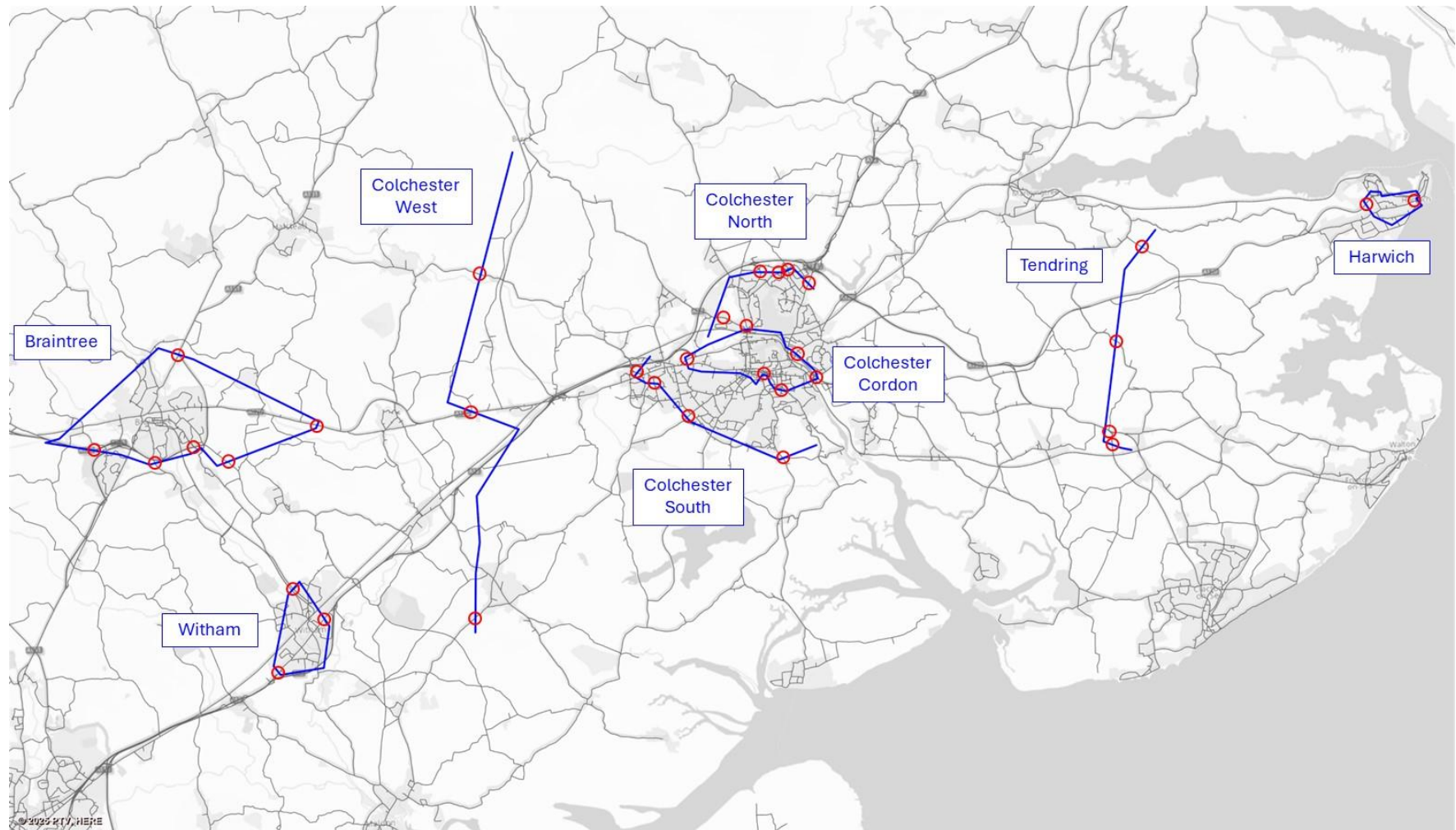


Figure 2-13: Screenlines and Cordons

2.8 Journey Time Data

This section describes the locations and journey time routes that have been analysed for the purposes of establishing baseline conditions to inform the transport model development. The journey time data is used to check and compare the delays and travel times calculated by the model with observed data as part of a model validation process.

The journey time data for the North Essex Model was taken from 2023 GPS data provided via the DfT and is based on data gathered using satellite navigation devices installed in cars and other vehicles. The journey time data for use in the North Essex Model reflects Average Weekday Traffic (AWT) using Monday to Thursday data for neutral months in 2023.

A total of 16 routes in Colchester, Tendring and Braintree were defined. The figure below shows the routes where journey time data were extracted.

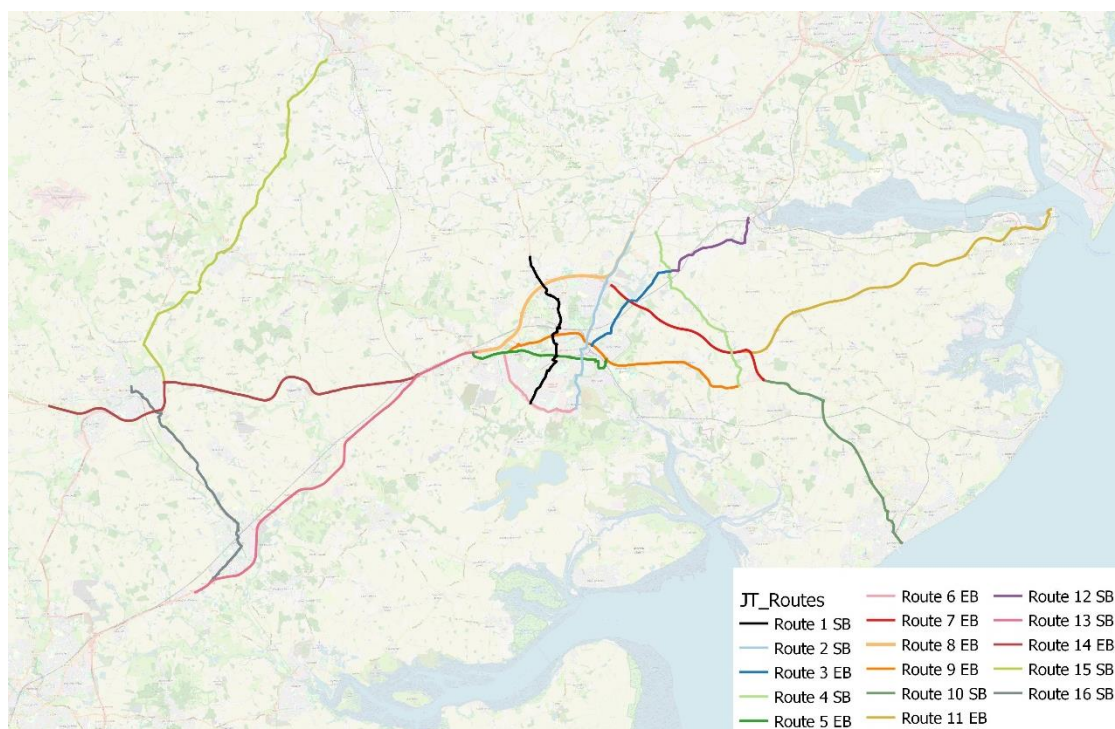


Figure 2-14: Journey Time Routes

The observed time for each peak hour for the journey time routes is shown in Table 2-15 below, and graphically in Figure 2-15.

Table 2-15: Average Observed Journey Times

Route Location	Route No	Direction	Length (m)	AM JT (mm:ss)	IP JT (mm:ss)	PM JT (mm:ss)
A134 Colchester	1	A134 Colchester - Northbound	9660	23:19	18:41	22:46
	1	A134 Colchester - Southbound	9833	23:40	19:13	21:45
Ipswich Colchester	2	Ipswich Colchester - Northbound	10873	25:22	19:53	23:41
	2	Ipswich Colchester - Southbound	10841	23:43	18:41	26:58
A137 Colchester	3	A137 Colchester - Eastbound	6296	08:30	08:50	08:57
	3	A137 Colchester - Westbound	6288	09:22	09:12	09:21
B1029 Colchester	4	B1029 Colchester - Northbound	10501	14:01	14:25	13:13
	4	B1029 Colchester - Southbound	10501	14:32	15:19	14:59
Lexden Road	5	Lexden Road - Eastbound	8238	21:19	18:36	25:58
	5	Lexden Road - Westbound	8374	23:16	18:47	24:23
Straight Road	6	Straight Road - Eastbound	6053	10:19	10:26	11:53
	6	Straight Road - Westbound	6050	12:06	10:33	10:50

Route Location	Route No	Direction	Length (m)	AM JT (mm:ss)	IP JT (mm:ss)	PM JT (mm:ss)
A120 Colchester	7	A120 Colchester - Eastbound	10383	06:48	06:40	09:14
	7	A120 Colchester - Westbound	10275	07:15	06:55	06:46
A12 Colchester	8	A12 Colchester - Eastbound	11691	07:53	07:45	08:31
	8	A12 Colchester - Westbound	11695	18:25	08:16	12:30
A133	9	A133 - Eastbound	14143	21:30	19:54	25:52
	9	A134 - Westbound	14060	27:37	19:23	24:28
A133	10	A133 - Northbound	12929	18:34	15:40	16:06
	10	A134 - Southbound	12954	14:37	14:46	15:42
A120 Tendring	11	A120 Tendring - Eastbound	20247	20:27	19:00	19:15
	11	A120 Tendring - Westbound	19970	18:43	18:32	17:29
A137 Tendring	12	A137 Tendring - Northbound	6244	09:30	07:48	08:43
	12	A137 Tendring - Southbound	6297	09:02	08:22	08:44

Route Location	Route No	Direction	Length (m)	AM JT (mm:ss)	IP JT (mm:ss)	PM JT (mm:ss)
A12 Braintree	13	A12 Braintree - Northbound	21595	17:05	16:30	24:02
	13	A12 Braintree - Southbound	21670	19:56	14:57	15:13
A120 Braintree	14	A120 Braintree - Eastbound	23027	25:25	23:30	36:31
	14	A120 Braintree - Westbound	22949	29:33	22:06	22:34
A131	15	A131 - Northbound	22374	29:54	26:47	32:36
	15	A132 - Southbound	22331	29:17	26:55	29:55
B1018	16	B1018 - Northbound	14126	24:00	22:35	25:38
	16	B1018 - Southbound	14221	26:05	23:01	24:35

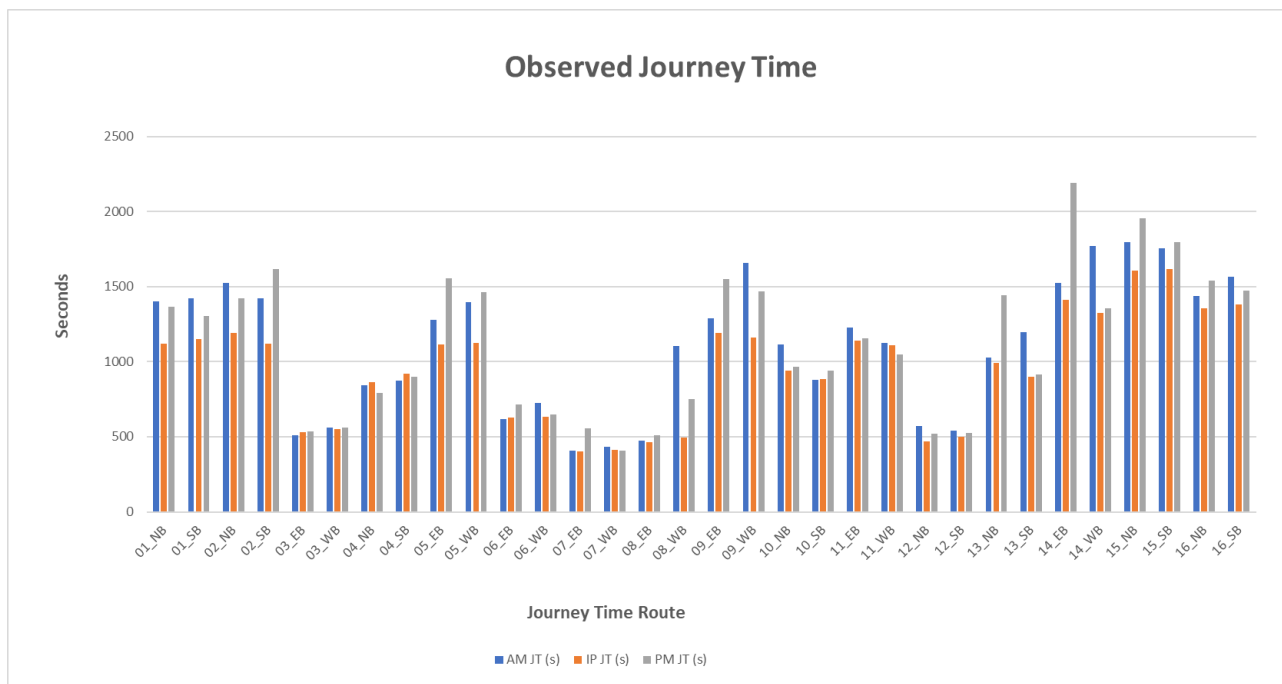


Figure 2-15: Average Observed Journey Times

2.9 Time Period Analysis

The highest flow for each half-hourly segment was analysed within all of the traffic count datasets used. This analysis showed that the PM peak hour in 2023 is half an hour earlier than 2019. Table 2-16 below shows the AM and PM peak hours in both 2019, and the updated 2023 peak hours.

Table 2-16: Peak Hour Analysis

	AM Peak Hour	PM Peak Hour
2019	0730-0830	1700-1800
2023	0730-0830	1630-1730

3 Public Transport Data

3.1 Introduction

This section discusses the observed data used in the validation of the public transport assignment model, which was readily available from ECC. These are:

- Office of Rail and Road (ORR) Station Usage data.
- Rail Car park capacities used in the rail station calibration.
- <http://trains.im/> web site used for rail journey time validation.
- ECC Web-based maps² used for bus route geometry validation.
- 2023 BUS ATCO–CIF timetable files used for bus journey time validation.

Apart from these sources, there is no other suitable public transport data (particularly disaggregated bus data by route or stop). These data sources are described in further detail below.

3.1.1 Rail Data

The only publicly available source of rail passenger demand data is the station usage statistics published by ORR. This publication is based on the rail industry LENNON database of ticket sales and provides annual figures station entries and exits by ticket type for each station in Great Britain. The data is available by financial year (start of April to end March). The 2022/23 dataset was the only available dataset at the time of the data collation and used to calibrate the daily rail demand matrix.

Overall, within the county of Essex, a 64% reduction in season ticket entry and exits was observed, and a 11% increase in other tickets, leading to an overall usage decrease of 31%. These observations relate to anecdotal evidence that people are no longer commuting into their place of work five days a week after Covid and are not buying season tickets.

Table 3-1 to Table 3-3 below shows, for each train station in the three districts, the % change in station usage between 2019/2019 to 2022/2023.

The four train stations in the district of Colchester, show similar patterns as shown through Essex, with daily decreases ranging from reductions of 27% to 37%.

² <http://www.essexbus.info/map.html>

Table 3-1: Colchester Rail Station Usage Change 2018/19 – 2022/23

Station	Other Tickets Change	Season Tickets Change	Daily Change
Colchester BR	+14%	-59%	-27%
Colchester Town	+14%	-59%	-27%
Marks Tey	+34%	-66%	-37%
Wivenhoe	0%	-65%	-33%

Within the Tendring district, the daily change reductions range from a 3% decrease to a 38% decrease in station usage.

Table 3-2: Tendring Rail Station Usage Change 2018/19 – 2022/23

Station	Other Tickets Change	Season Tickets Change	Daily Change
Clacton-on-Sea	2%	-41%	-13%
Frinton-on-Sea	-2%	-53%	-23%
Thorpe-le-Soken	30%	-47%	-12%
Great Bentley	9%	-47%	-22%
Alresford	44%	-37%	-3%
Harwich International	4%	-44%	-16%
Wrabness	11%	-63%	-37%
Mistley	-15%	-55%	-38%
Manningtree	1%	-63%	-32%

Within the district of Braintree, the reductions are more marked, ranging from a 46% decrease to a 17% increase in station usage. The increase in patronage at Braintree Freeport is most likely attributed to the large increase in other tickets, representing people travelling there for the retail use of this station near the shopping centre.

Table 3-3: Braintree Rail Station Usage Change 2018/19 – 2022/23

Station	Other Tickets Change	Season Tickets Change	Daily Change
Braintree	+10%	-56%	-30%
Braintree Freeport	+41%	-30%	+17%
Bures	+12%	-61%	-28%
Chappel & Wakes Colne	-8%	-59%	-30%
Cressing	+50%	-40%	-2%
Hatfield Peverel	+43%	-64%	-36%
Kelvedon	+23%	-68%	-46%
White Notley	+31%	-79%	-36%
Witham	+17%	-60%	-34%

The ORR data is available at an annual level and a conversion to daily data is necessary. The annual rail data divides into 13 four-week 'rail periods' otherwise known as 'rail months.' The same set of factors were used to convert average period data to average weekday data as those in the 2019 base year model.

Table 3-4 below shows the 2022/23 annual usage data obtained from the Office of Rail and Road as well as the figures converted to 2023 average weekday.

Table 3-4: Rail Station Usage

Station Description	2023 Annual Station Usage				2023 Average Weekday		
	Other Tickets		Season Tickets		Daily Total		
	Entries	Exits	Entries	Exits	Entries	Exits	Total
Alresford (Essex)	21,238	21,238	10,487	10,487	107	107	214
Braintree	171,854	171,854	90,537	90,537	889	889	1,778
Braintree Freeport	45,071	45,071	9,582	9,582	180	180	360
Bures	16,520	16,520	6,014	6,014	75	75	151
Chappel & Wakes Colne	10,936	10,936	3,152	3,152	47	47	94
Chelmsford	2,147,496	2,147,496	744,796	744,796	9,664	9,664	19,328
Clacton-On-Sea	277,483	277,483	75,475	75,475	1,171	1,171	2,342
Colchester BR	1,221,522	1,221,522	474,849	474,849	5,688	5,688	11,377
Colchester Town	211,513	211,513	82,222	82,222	985	985	1,970
Cressing	13,319	13,319	6,328	6,328	66	66	133
Frinton-On-Sea	62,478	62,478	17,243	17,243	265	265	529
Great Bentley	21,026	21,026	11,404	11,404	110	110	220
Harwich International	36,030	36,030	11,584	11,584	159	159	317
Hatfield Peverel	89,508	89,508	54,190	54,190	489	489	978
Hythe (Essex)	115,452	115,452	17,383	17,383	435	435	870
Ipswich	1,145,775	1,145,775	195,512	195,512	4,402	4,402	8,805
Kelvedon	144,312	144,312	96,741	96,741	824	824	1,648
Kirby Cross	15,942	15,942	8,512	8,512	83	83	166
Manningtree	297,107	297,107	94,458	94,458	1,305	1,305	2,610
Marks Tey	132,019	132,019	68,956	68,956	681	681	1,361
Mistley	14,952	14,952	9,027	9,027	82	82	163
Sudbury Suffolk	110,869	110,869	28,398	28,398	461	461	923
Thorpe-Le-Soken	41,971	41,971	17,553	17,553	200	200	400
Walton-on-the-Naze	45,088	45,088	10,612	10,612	184	184	368
Weeley	13,010	13,010	3,311	3,311	54	54	108
White Notley	3,353	3,353	711	711	13	13	27
Witham	508,857	508,857	300,033	300,033	2,751	2,751	5,503
Wivenhoe	106,078	106,078	33,380	33,380	465	465	929
Wrabness	6,579	6,579	3,424	3,424	34	34	68

The largest stations in the FMA are Chelmsford with approximately 19,000 daily passengers and Colchester with approximately 11,000 daily passengers. Most of the other stations are smaller, reflecting the size of the places where they are located and the lower level of service at these stations.

Additionally, analysis has been undertaken comparing the 2018/2019 and 2022/2023 ORR data. The tables below first show the absolute difference between the data, followed by the relative difference.

Table 3-5: Absolute change in Rail Station Usage 2019-2023

Station Description	2023 Annual Station Usage				2023 Average Weekday		
	Other Tickets		Season Tickets		Daily Total		
	Entries	Exits	Entries	Exits	Entries	Exits	Total
Alresford (Essex)	6,518	6,518	-6,290	-6,290	-3	-3	-6
Braintree	15,461	15,461	-117,061	-117,061	-387	-387	-775
Braintree Freeport	13,021	13,021	-4,155	-4,155	26	26	52
Bures	1,817	1,817	-9,499	-9,499	-30	-30	-59
Chappel & Wakes Colne	-966	-966	-4,626	-4,626	-20	-20	-40
Chelmsford	241,853	241,853	-1,812,849	-1,812,849	-5,994	-5,994	-11,989
Clacton-On-Sea	6,453	6,453	-53,167	-53,167	-178	-178	-356
Colchester BR	153,498	153,498	-683,716	-683,716	-2,061	-2,061	-4,122
Colchester Town	26,579	26,579	-118,389	-118,389	-357	-357	-714
Cressing	4,420	4,420	-4,278	-4,278	-2	-2	-3
Frinton-On-Sea	-1,467	-1,467	-19,264	-19,264	-76	-76	-154
Great Bentley	1,782	1,782	-9,924	-9,924	-31	-31	-63
Harwich International	1,336	1,336	-9,194	-9,194	-30	-30	-61
Hatfield Peverel	27,111	27,111	-97,051	-97,051	-276	-276	-551
Hythe (Essex)	33,941	33,941	-33,964	-33,964	-18	-18	-36
Ipswich	13,153	13,153	-379,879	-379,879	-1,377	-1,377	-2,753
Kelvedon	27,184	27,184	-210,005	-210,005	-697	-697	-1,394
Kirby Cross	4,567	4,567	-2,504	-2,504	5	5	11
Manningtree	2,661	2,661	-164,198	-164,198	-605	-605	-1,209
Marks Tey	33,387	33,387	-134,863	-134,863	-396	-396	-793
Mistley	-2,655	-2,655	-11,049	-11,049	-49	-49	-100
Sudbury Suffolk	7,551	7,551	-35,421	-35,421	-108	-108	-216
Thorpe-Le-Soken	9,656	9,656	-15,676	-15,676	-28	-28	-55
Walton-on-the-Naze	-1,795	-1,795	-10,859	-10,859	-46	-46	-93
Weeley	3,129	3,129	-4,262	-4,262	-6	-6	-12
White Notley	796	796	-2,755	-2,755	-8	-8	-15
Witham	75,550	75,550	-441,408	-441,408	-1,406	-1,406	-2,812
Wivenhoe	459	459	-61,621	-61,621	-228	-228	-458
Wrabness	633	633	-5,804	-5,804	-20	-20	-39

Table 3-6: Relative change in Rail Station Usage 2019-2023

Station Description	2023 Annual Station Usage				2023 Average Weekday		
	Other Tickets		Season Tickets		Daily Total		
	Entries	Exits	Entries	Exits	Entries	Exits	Total
Alresford (Essex)	44%	44%	-37%	-37%	-3%	-3%	-3%
Braintree	10%	10%	-56%	-56%	-30%	-30%	-30%
Braintree Freeport	41%	41%	-30%	-30%	17%	17%	17%
Bures	12%	12%	-61%	-61%	-28%	-28%	-28%
Chappel & Wakes Colne	-8%	-8%	-59%	-59%	-30%	-30%	-30%
Chelmsford	13%	13%	-71%	-71%	-38%	-38%	-38%
Clacton-On-Sea	2%	2%	-41%	-41%	-13%	-13%	-13%
Colchester BR	14%	14%	-59%	-59%	-27%	-27%	-27%
Colchester Town	14%	14%	-59%	-59%	-27%	-27%	-27%
Cressing	50%	50%	-40%	-40%	-2%	-2%	-2%
Frinton-On-Sea	-2%	-2%	-53%	-53%	-22%	-22%	-23%
Great Bentley	9%	9%	-47%	-47%	-22%	-22%	-22%
Harwich International	4%	4%	-44%	-44%	-16%	-16%	-16%
Hatfield Peverel	43%	43%	-64%	-64%	-36%	-36%	-36%
Hythe (Essex)	42%	42%	-66%	-66%	-4%	-4%	-4%
Ipswich	1%	1%	-66%	-66%	-24%	-24%	-24%
Kelvedon	23%	23%	-68%	-68%	-46%	-46%	-46%
Kirby Cross	40%	40%	-23%	-23%	6%	6%	7%
Manningtree	1%	1%	-63%	-63%	-32%	-32%	-32%
Marks Tey	34%	34%	-66%	-66%	-37%	-37%	-37%
Mistley	-15%	-15%	-55%	-55%	-38%	-38%	-38%
Sudbury Suffolk	7%	7%	-56%	-56%	-19%	-19%	-19%
Thorpe-Le-Soken	30%	30%	-47%	-47%	-12%	-12%	-12%
Walton-on-the-Naze	-4%	-4%	-51%	-51%	-20%	-20%	-20%
Weeley	32%	32%	-56%	-56%	-10%	-10%	-10%
White Notley	31%	31%	-79%	-79%	-36%	-36%	-36%
Witham	17%	17%	-60%	-60%	-34%	-34%	-34%
Wivenhoe	0%	0%	-65%	-65%	-33%	-33%	-33%
Wrabness	11%	11%	-63%	-63%	-37%	-37%	-37%

The key changes in the ORR 2023 rail station usage comparison to 2019 are summarised below:

- 64% reduction in season ticket entry/exits
- 11% increase in other ticket entry/exits

- Overall usage - 31% decrease
- Largest decreases shown in Chelmsford, Kelvedon, Colchester, Ipswich, Manningtree and Witham
- Very small increases shown in Braintree Freeport and Kirby Cross.

3.1.2 Bus Data

Bus counts or ticket sales data are usually difficult to obtain due to commercial confidentiality. Electronic Ticket Collection (ETC) data for bus operators was requested via ECC. Only 2 routes were supplied by the operators in the area:

- Route 93 Ipswich to Colchester
- Route 754 Sudbury to Colchester

These routes are shown in Figure 3-1 below.

Other routes were not supplied by the operators in the area due to commercial confidentiality.

However, aggregated regional and countywide information on bus passenger journeys is publicly available via the DfT³. Data table BUS01a shows that passenger journeys in the East of England decreased by 21% between 2019 and 2023; and data table BUS01e reports that's journeys in the county of Essex decreased by 24% over the same time period. Table BUS01a also estimates that local bus journeys in non-metropolitan areas decreased by 24% and in urban areas with rural surrounds by 28%.

Consequently, a reduction in local bus journeys falling between 20-30% would be reasonable to expect in the modelled area. However, due to the lack of disaggregated data by bus route or stop, the level of validation possible is limited.

³ <https://www.gov.uk/government/statistical-data-sets/bus-statistics-data-tables#local-bus-passenger-journeys-bus01>

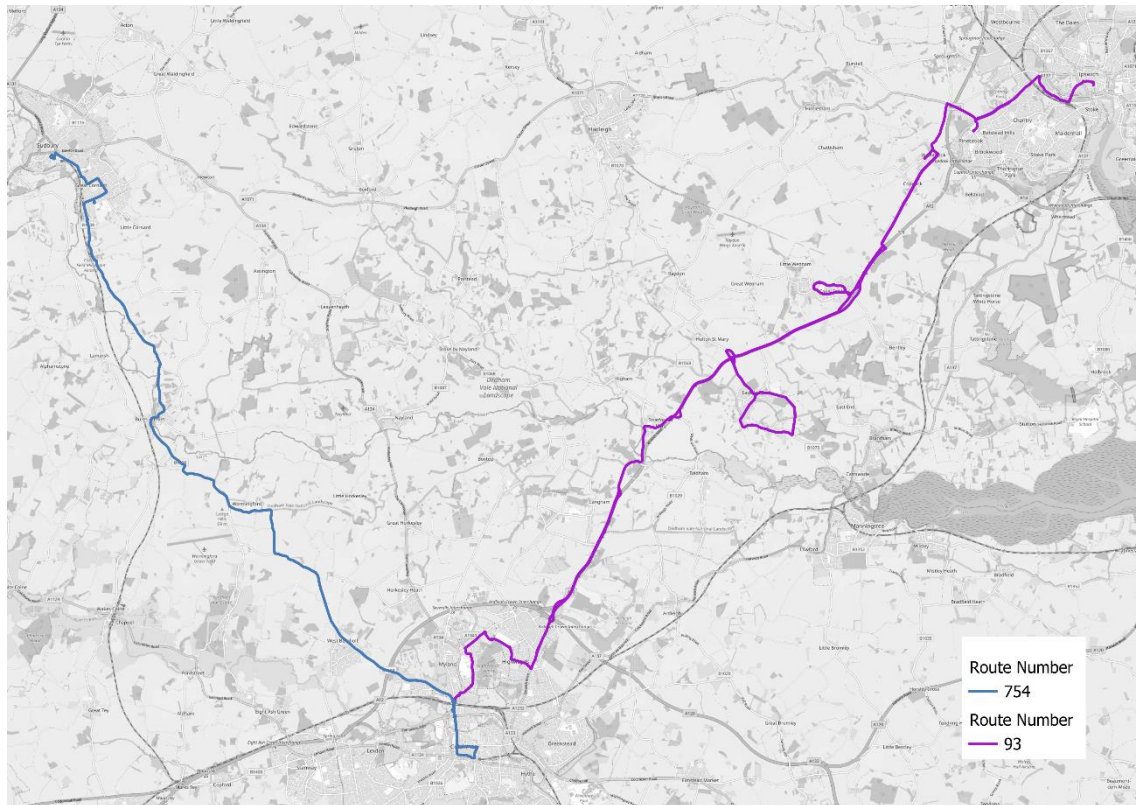


Figure 3-1: Map showing Bus Route ETC data

4 Overview of the Model

4.1 Introduction

The following sections only report changes within the NEMo and should be read in conjunction with the CTM Model Development and Validation Report.

4.2 Key Model Design Considerations

4.2.1 Software

In the NEMo, the software platform has been updated to VISUM 2022, and continues to offer:

- The speed with which highway networks can be coded in VISUM, and the software's ability to carry out highway assignments for many scenarios.
- The data-handling and visualisation capabilities of VISUM.
- Easy extraction of results to spreadsheet and database formats for analysis.
- Automated extraction of data to corridor simulation models developed in PTV VISSIM software (important efficiency for the potential junction schemes).

The public transport model has been updated to INRO's EMME 23 software package.

The Variable Demand Model (VDM) has also been coded in EMME software.

4.2.2 Base Year and Time Periods

As described in Section 1.2, the NEMo is being updated to a present-day base of 2023, using the TAG guidance for proportionate updating due to COVID-19.

The modelled time periods are summarised in Table 4-1. The data analysis from the 2023 data collation showed that the PM peak hour is half an hour earlier than during the 2019 base year, moving from 1700-1800 to 1630-1730.

Table 4-1: Modelled Time Periods

Period	Highway	Public Transport
AM peak period	Peak hour (0730-0830)	Peak hour generalised cost reflective of peak hour bus journey times consistent with highway (average hour PT demand).
Inter-peak period	Average hour	Average hour
PM peak period	Peak hour (1630-1730)	Peak hour generalised cost reflective of peak hour bus journey times consistent with highway (average hour PT demand).

The model is representative of an average weekday in a neutral month in 2023. The Variable Demand Model (VDM), described in a separate report, will operate at a daily Production-Attraction (PA) format and similarly represent an average weekday in a neutral month.

4.2.3 Study Area

As introduced in Section 1.2, the Area of Detailed Modelling (AoDM) was extended into parts of Tendring and Braintree to account for modelling the proposed Local Plan development allocations.

Within Braintree, the AoDM was extended to cover Braintree, Halstead and Witham.

For Tendring, this extension covered Frating, Weeley and Horsely Cross.

Small sections within Colchester were also updated including Marks Tey and Tiptree.

The modelled areas are presented in Figure 4-1 to Figure 4-3.

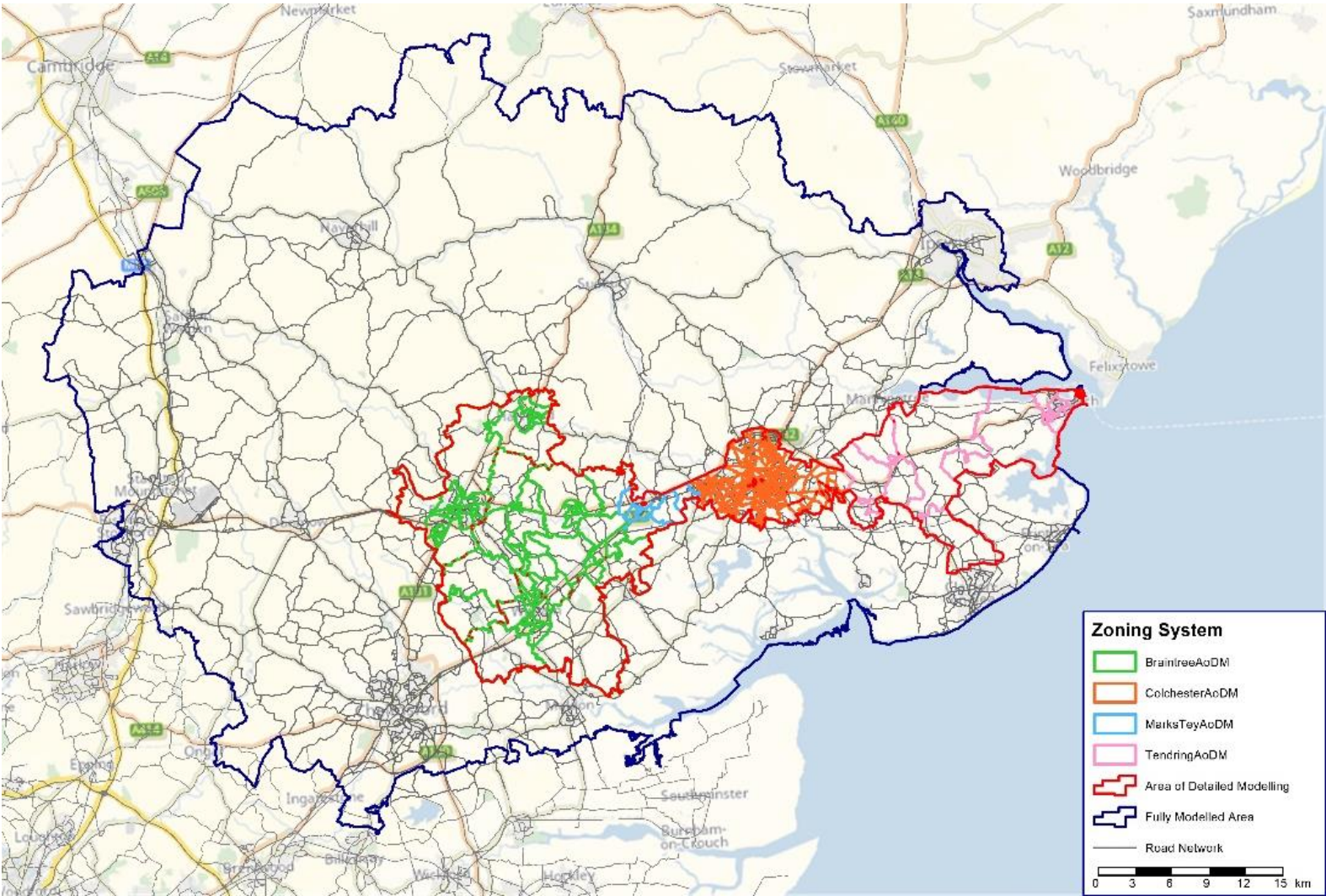


Figure 4-1: Modelled Areas

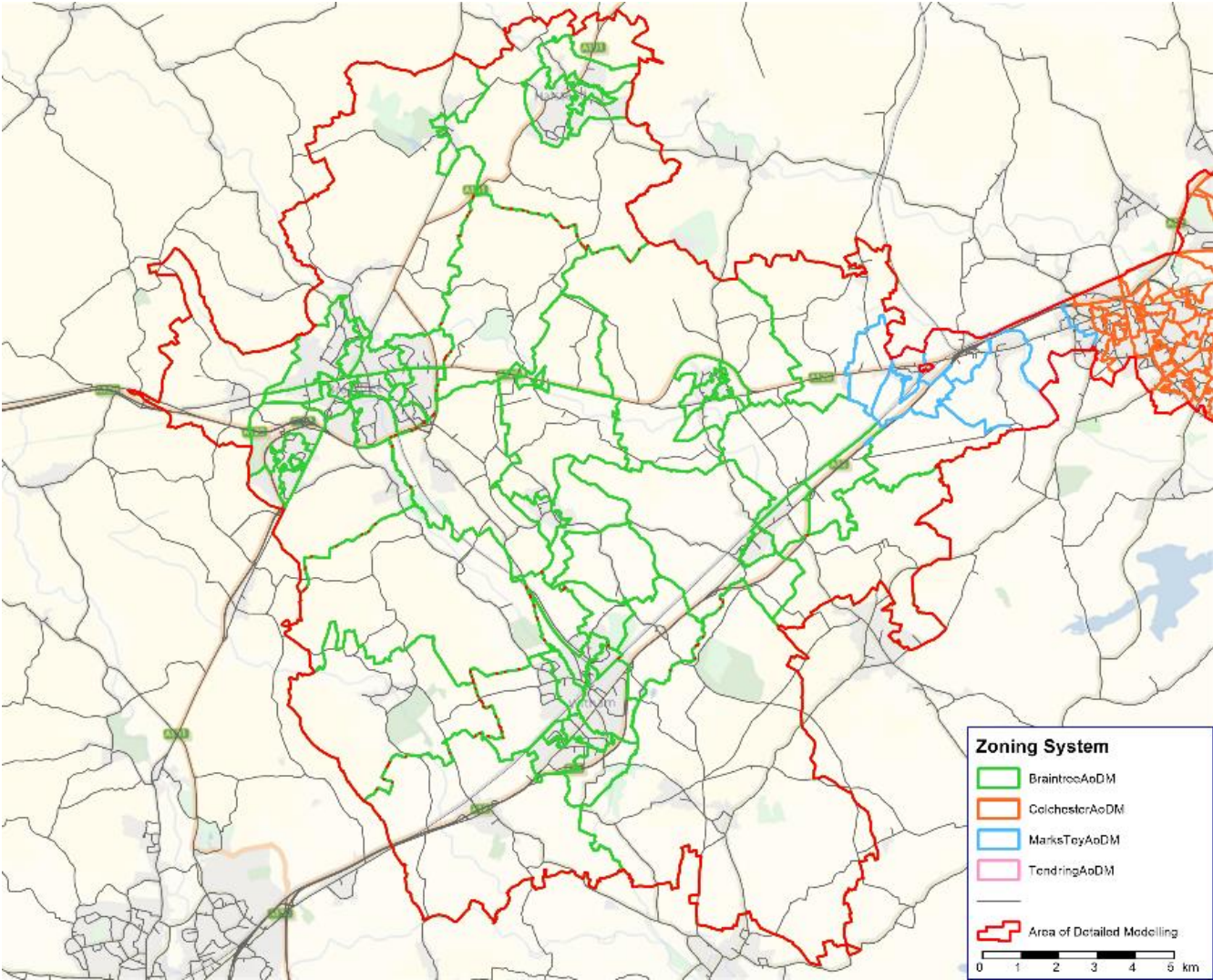


Figure 4-2: Modelled Areas – Braintree

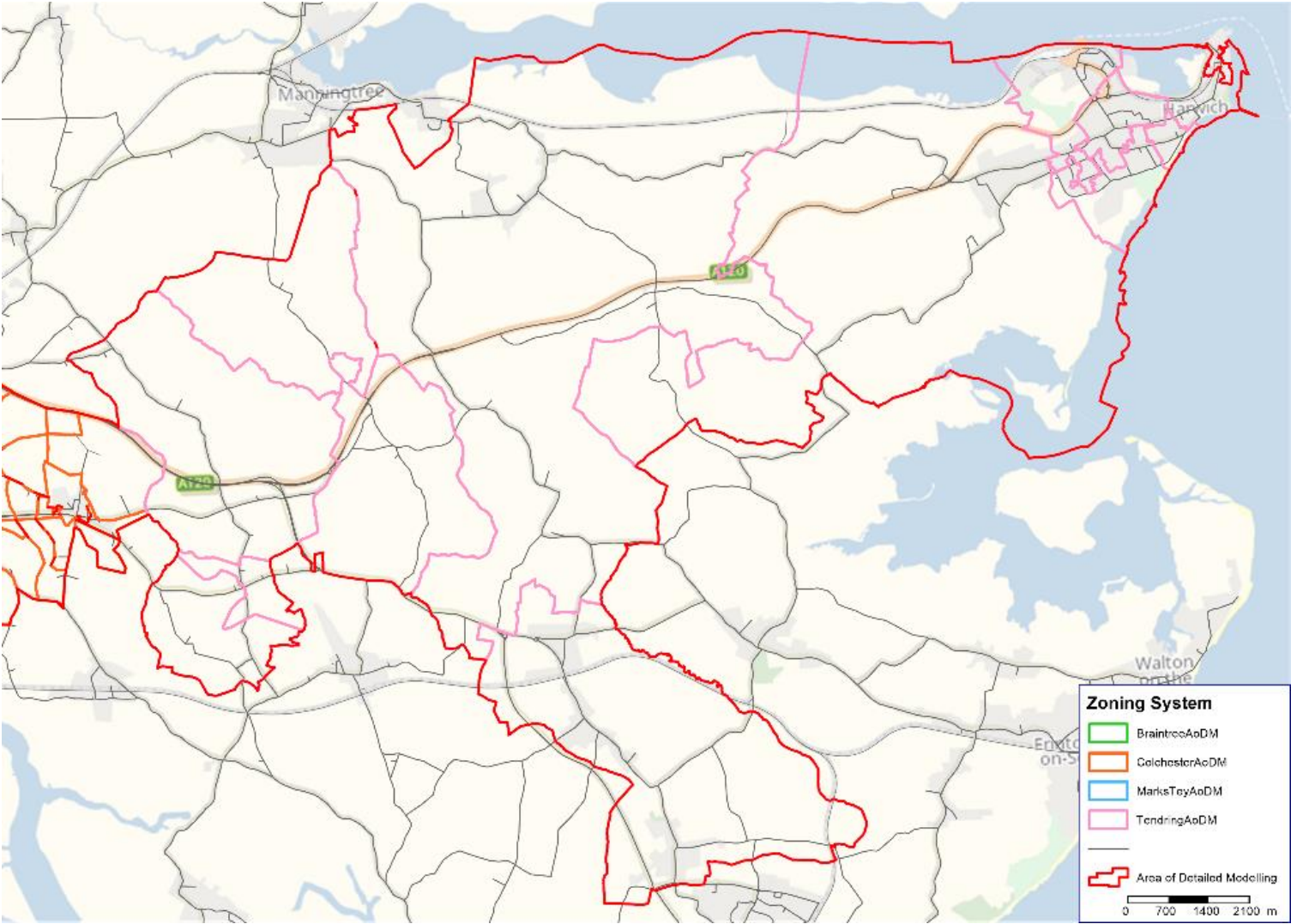


Figure 4-3: Modelled Areas – Tendring

5 Key Features of the Model

5.1 Summary

The key characteristics of the model are summarised below in Table 5-1.

Table 5-1: Key CTM present-day model features

Characteristic	Model Coverage
Model Structure	Peak hour highway assignment model. Peak period public transport assignment model. 24-hour production-attraction incremental pivot-point variable demand model.
Software Platform(s)	Highway assignment model: VISUM version 2022. Public transport assignment model: EMME version 23 Variable demand model: EMME with Excel VBA front-end
Assignment Methodologies	Highway assignment model: VISUM Assignment with ICA using the equilibrium LUCE algorithm. Public transport assignment model: Multiclass Frequency-based Optimal Strategies algorithm, without crowding
Time Periods	<u>Highway Assignment Model</u> AM peak hour (07:30 to 08:30). Inter-peak period representing an average hour (between 10:00 and 16:00). PM peak hour (16:30 to 17:30). <u>Public Transport Model</u> AM peak average hour. Inter-peak average hour. PM peak average hour. <u>Variable Demand Model (VDM)</u> 24-hour.
Trip Matrices (car transport modes)⁴	Car Commute Car Business Car Other LGV HGV

⁴ Note that these are AM, inter- and PM peak hour origin-destination (OD) vehicle matrices used in the highway assignment. The VDM uses 24-hour production-attraction matrices disaggregated by trip purpose. The present year update is revalidating the OD matrices and network. Following the present year update of the model in peak hours, subsequent work will reflect any changes in the 24-hour PA matrices used in the VDM. This work will be undertaken and reported in the forecast updates.

Characteristic	Model Coverage
Trip Matrices (public transport modes)⁵	Rail: National Rail Bus
Base Year	Neutral month 2023

5.2 Zoning and Sectoring System

The zoning system in Colchester has remained consistent since the 2019 base year model, but some changes have been made to the Braintree and Tendring areas of detailed modelling.

TAG Unit M3.1 recommends that the design of the zoning system should be closely related to the level of detail in the assignment networks. Zones should be smallest in the AoDM, becoming larger for the Rest of the FMA and progressively much larger for the External Area. Following this, point zones and respective connectors were added to better represent the areas and the distribution of trips. New connectors were also added to existing zones, since some zones were considered too large for the purpose of local modelling.

The new zoning system is shown in Figure 5-1 and the sectoring system is shown in Figure 5-2.

The Colchester zoning system used in the Highway Assignment Model was reviewed to assess its suitability in terms of their size and the level of disaggregation required for the modelled density of PT network access points (rail stations and bus stops) within the FMA. It was concluded that the zoning system used in the Highway Assignment Model was appropriate for the PT model.

⁵ These hourly OD matrices are used in the public transport assignment. It is relevant to note that there is an overlap between rail and bus matrices creating a category of rail-bus users (completing a trip using both rail and bus legs). This is relevant because altering the rail OD matrix impacts the bus matrix as the overlap is affected.

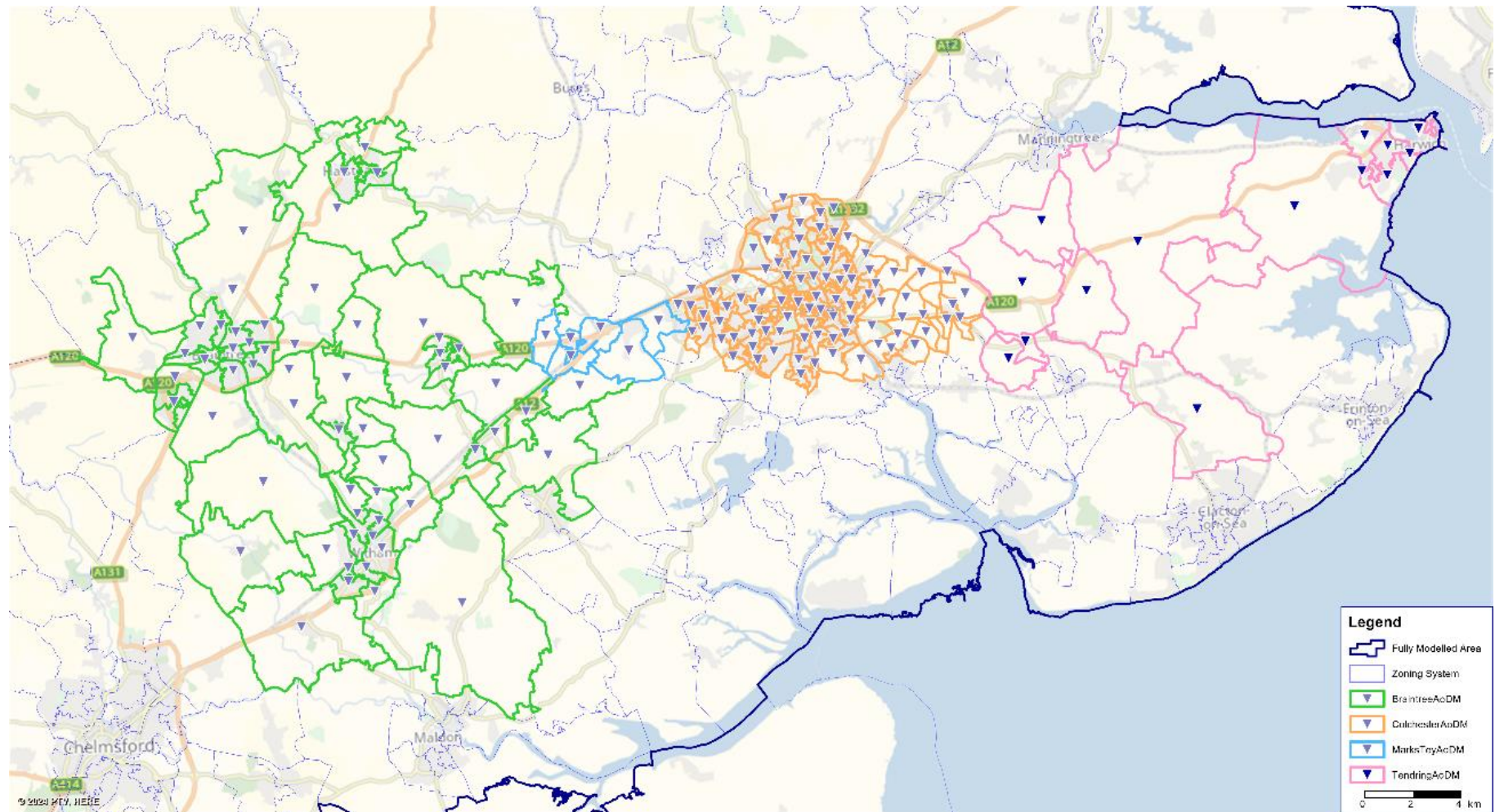


Figure 5-1: Colchester Model Zoning System

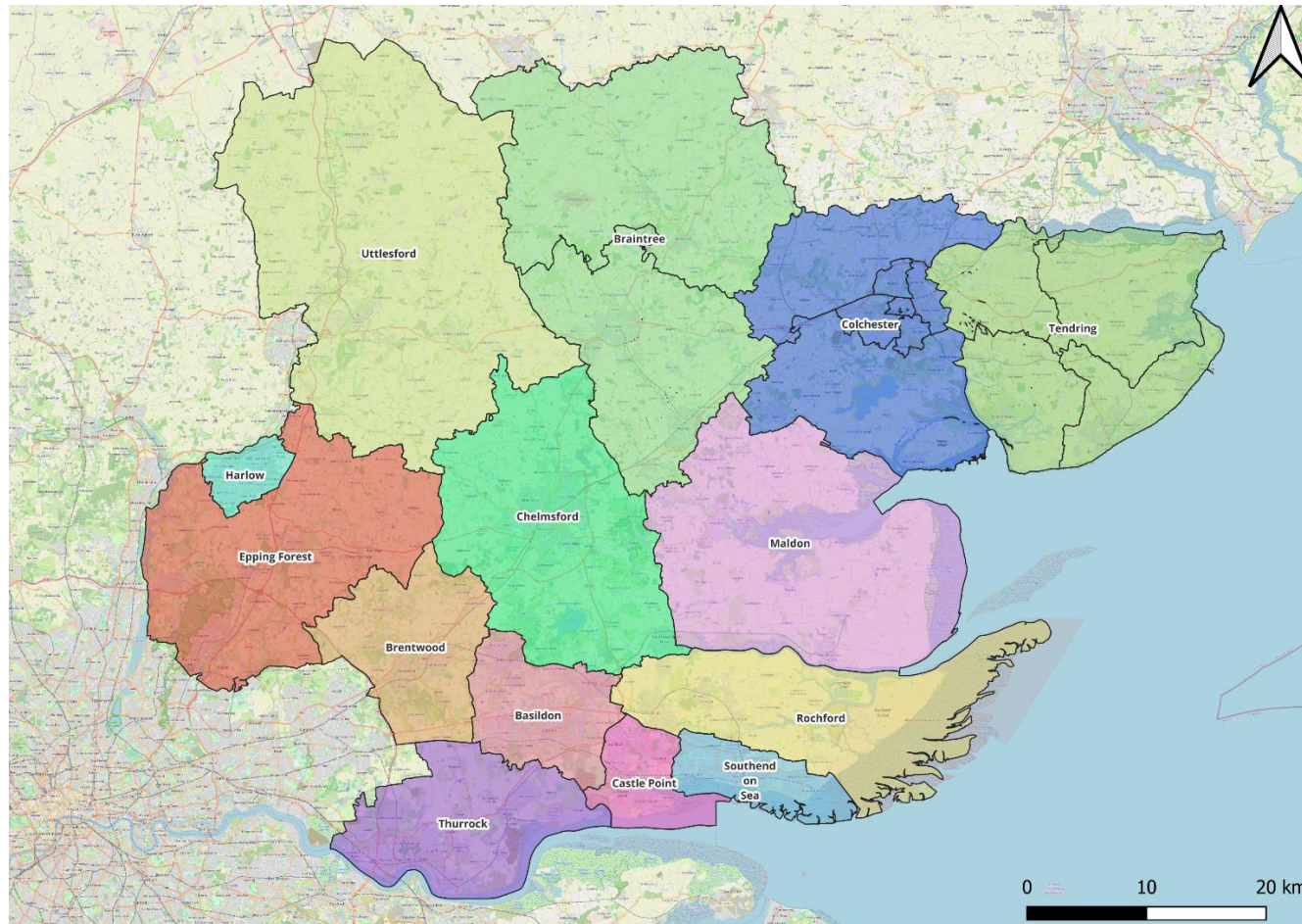


Figure 5-2: Colchester Model Sectoring System

5.3 Network Structure – Highway Network

As mentioned previously, the AoDM was extended into parts of Braintree and Tendring. Figure 5-3 to Figure 5-6 shows the revised extents of the junction simulation (along with individual plots for all three districts), whilst Figure 5-7 shows the revised extent of the link capacity restraint.

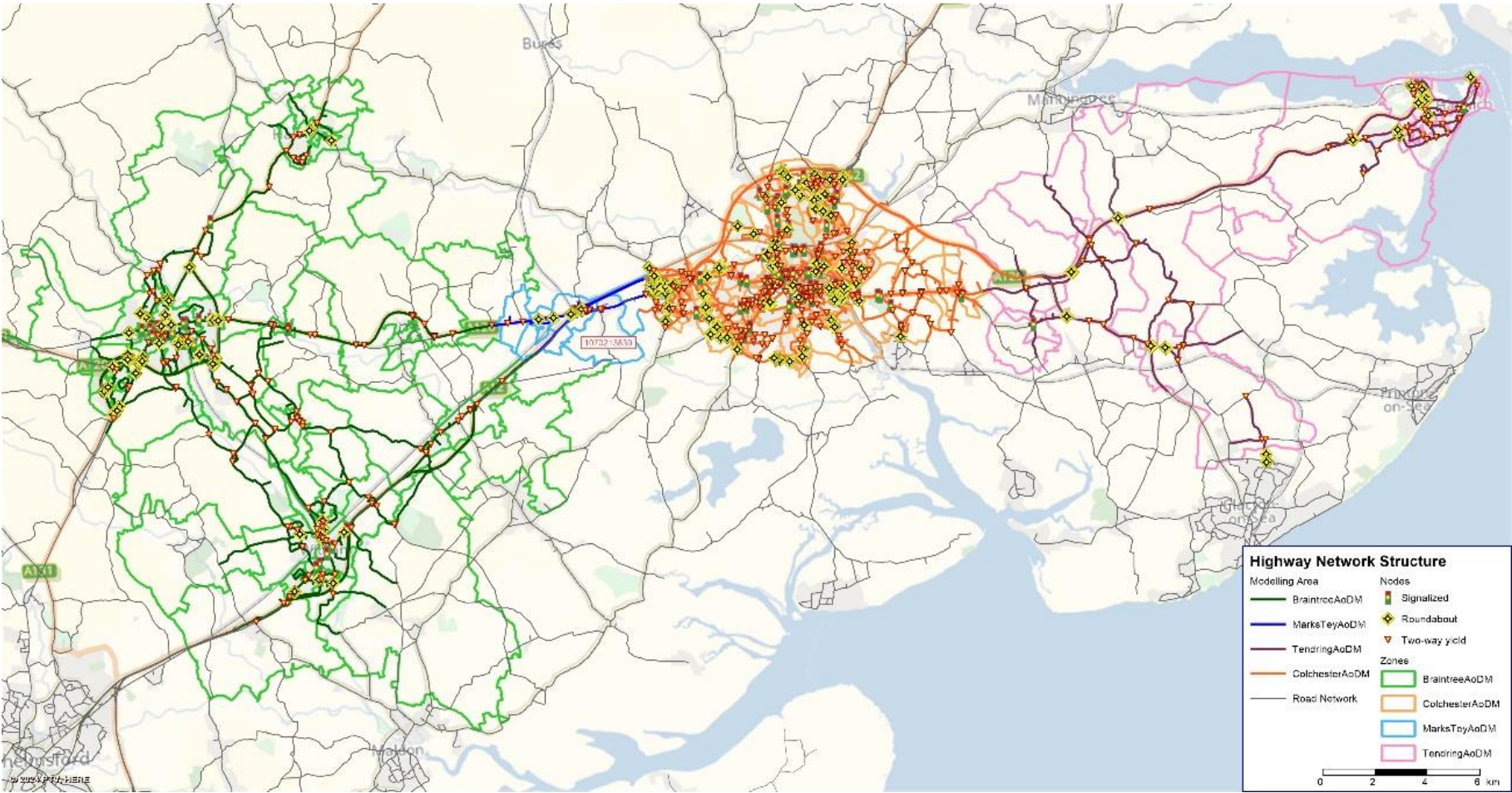


Figure 5-3: Highway Simulation Area

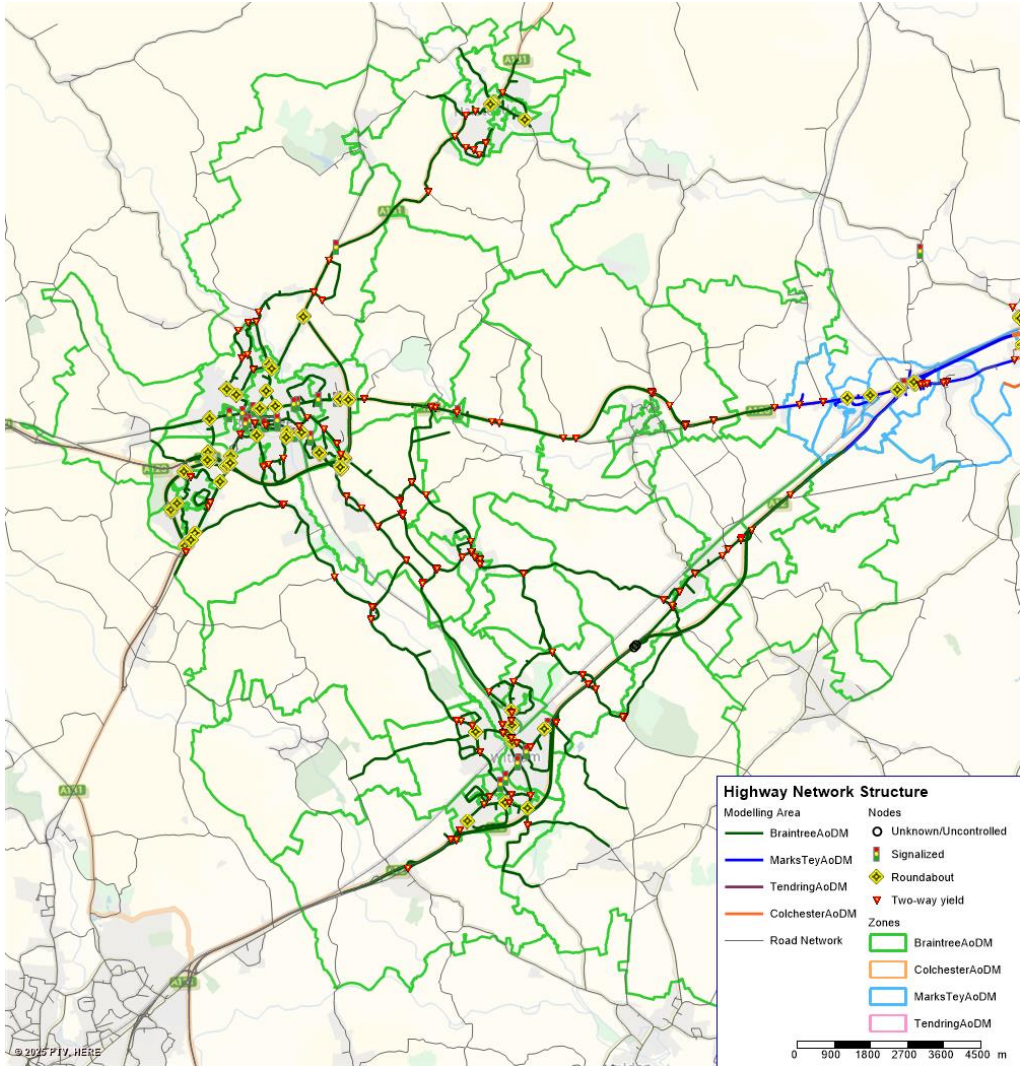


Figure 5-4: Highway Simulation Area – Braintree

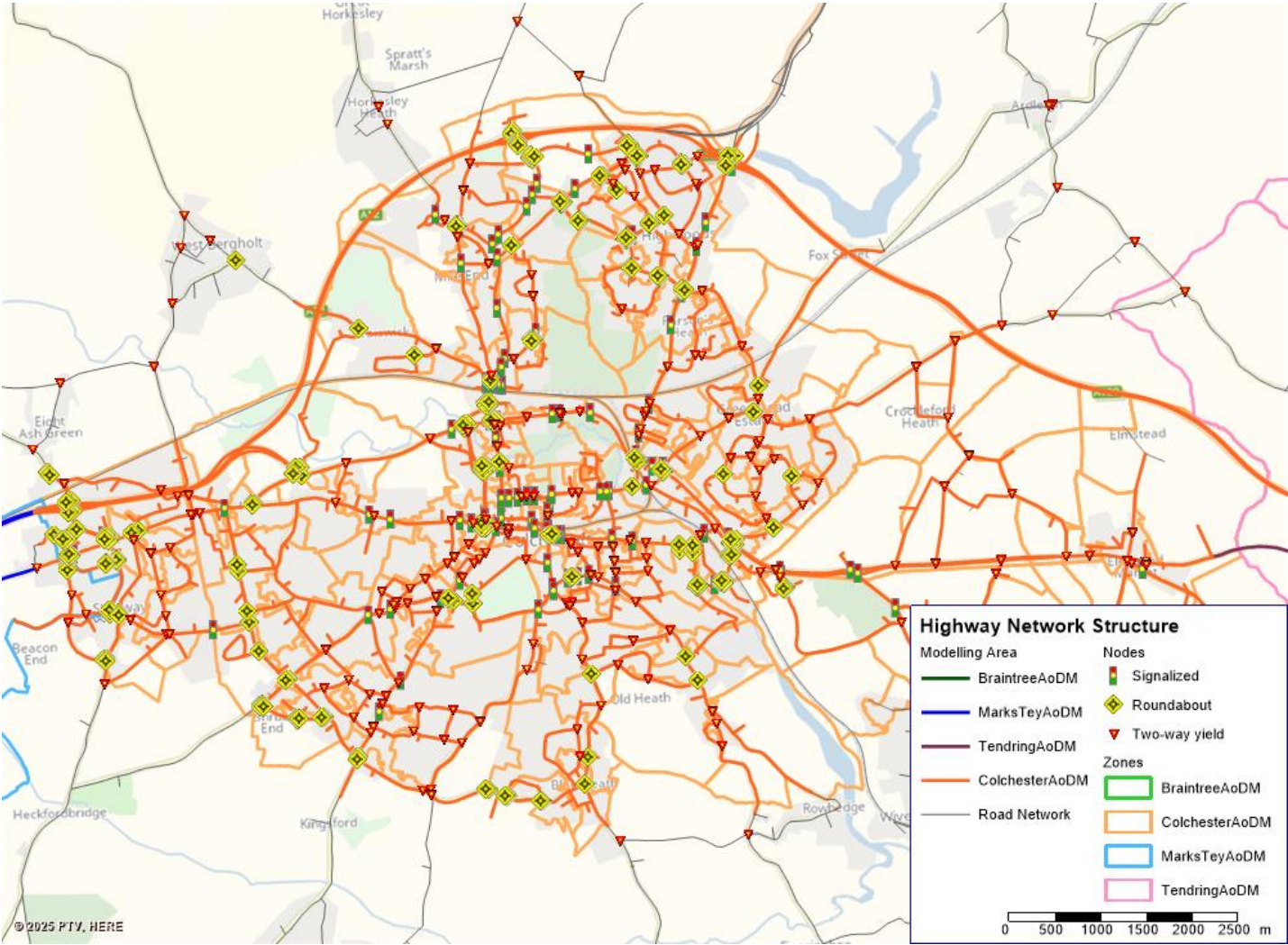


Figure 5-5: Highway Simulation Area – Colchester

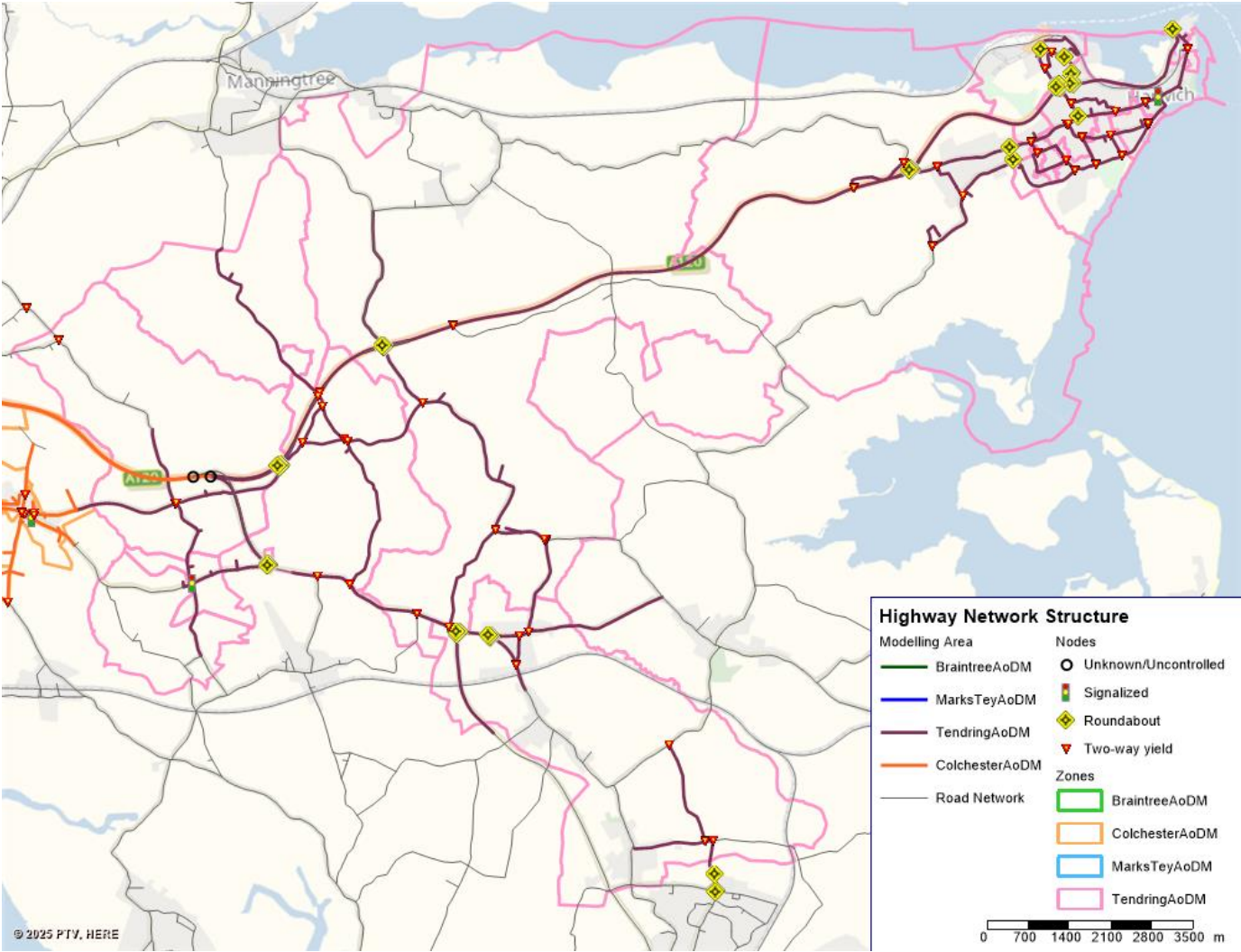


Figure 5-6: Highway Simulation Area - Tendring

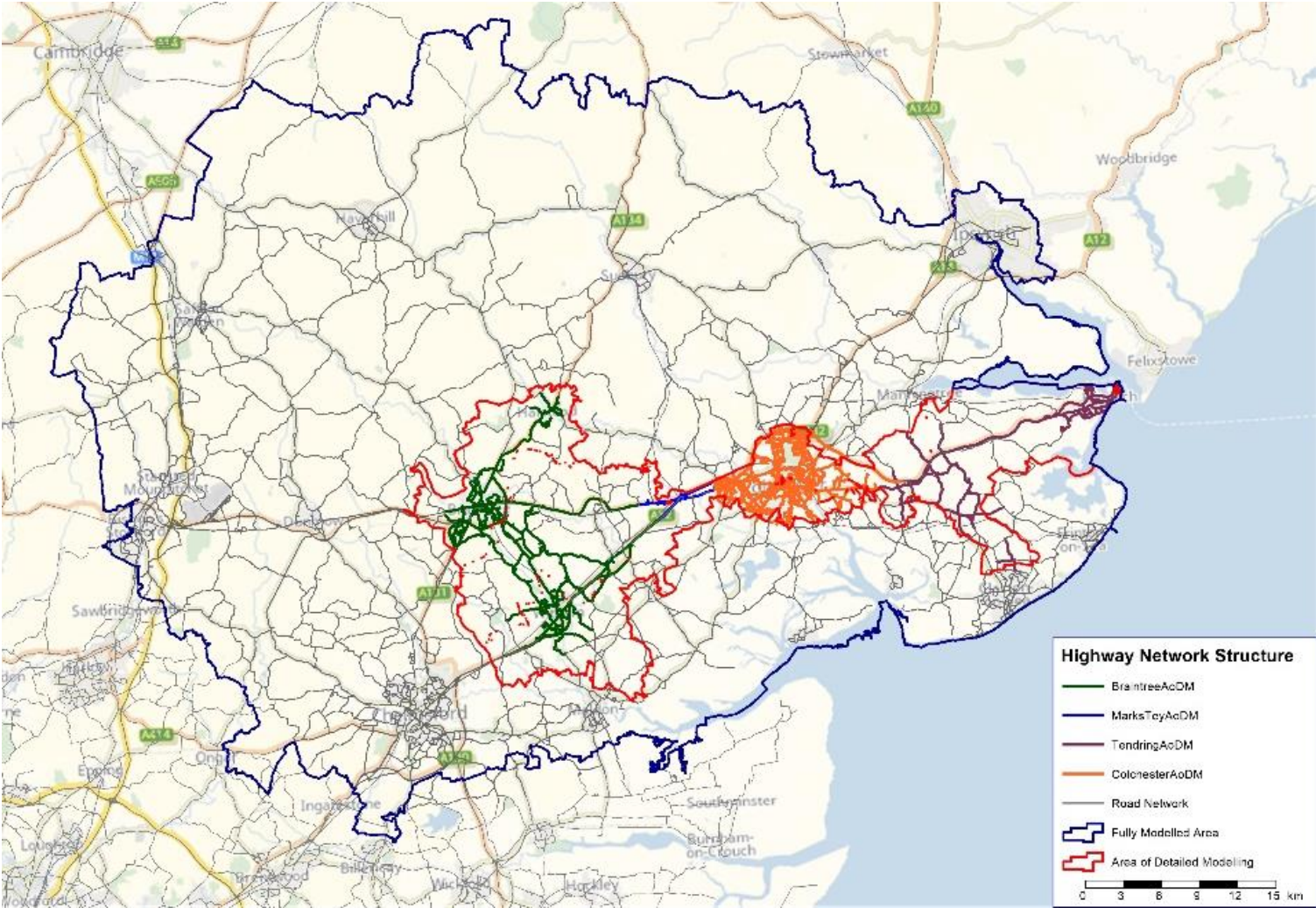


Figure 5-7: Highway Capacity Restraint Area

5.4 Network Structure – Public Transport Network and Timetables

The public transport network consists of two layers:

- The bus network, which has a one-to-one correspondence with the highway network. Bus services are routed directly on the highway links to facilitate the transfer of highway speeds into the bus assignment model during the operation of the model. While bus services adhere to timetables, within the AoDM, buses can experience delays due to highway congestion. More details are provided in Section 9.
- The rail network, which covers the entire UK rail network coded directly from timetable data. A high level of detail away from the FMA is still available, as it is obtained automatically from electronic timetables even if it is not used in the model.

The full detail of the public transport network development is provided below.

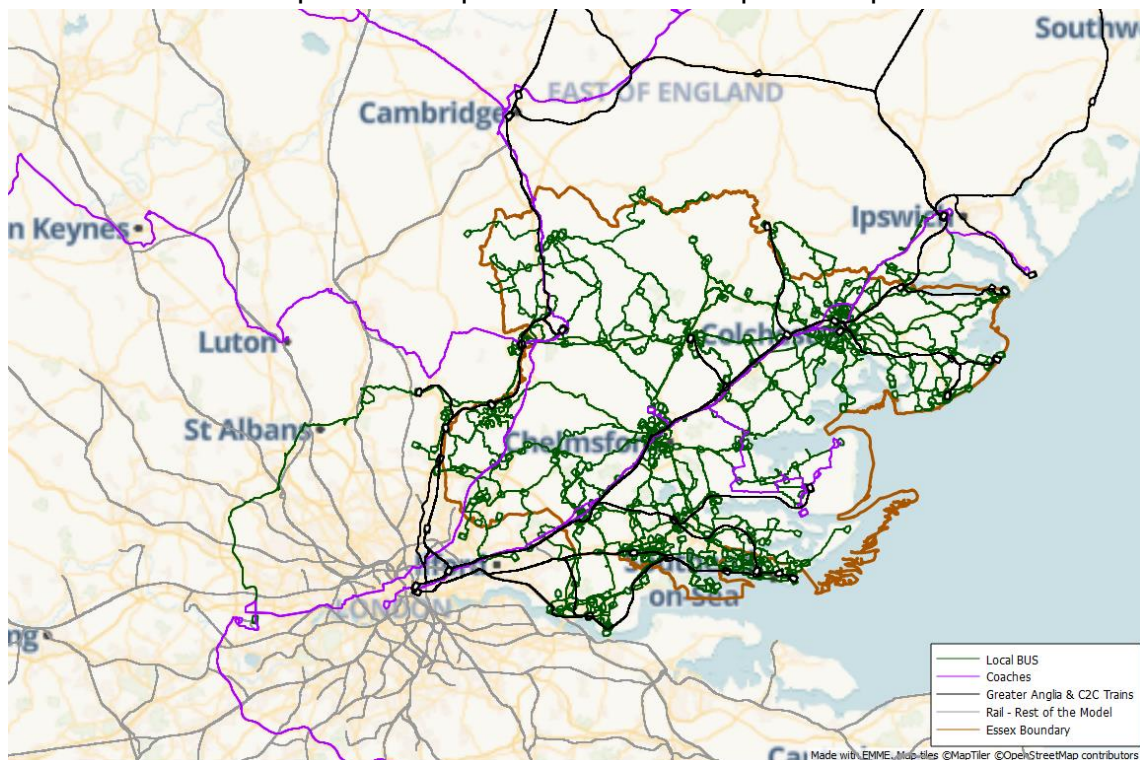


Figure 5-8: Public Transport Model Diagram by Mode

5.5 Centroid Connectors

For the updated areas within Braintree and Tendring, a review of the centroid connectors was undertaken, following the same principal as the Colchester AoDM. As recommended in TAG, zone connectors should represent 'real'

access points for traffic within the AoDM. Cul-de-sac nodes on the local road network were coded and chosen as the spigot ends for centroid connectors. Generally, a single connector formed a starting point for network coding, however, in some locations where alternative loading points are clearly viable and zone size does not merit further disaggregation, more than one connector was used. These connectors have been adjusted, or additional connectors created, during the model calibration and validation process.

The changes in Braintree and Tendring are shown in Figure 5-9 and Figure 5-10 respectively. Existing connectors are represented in blue, new connectors in green and deleted connectors in red.

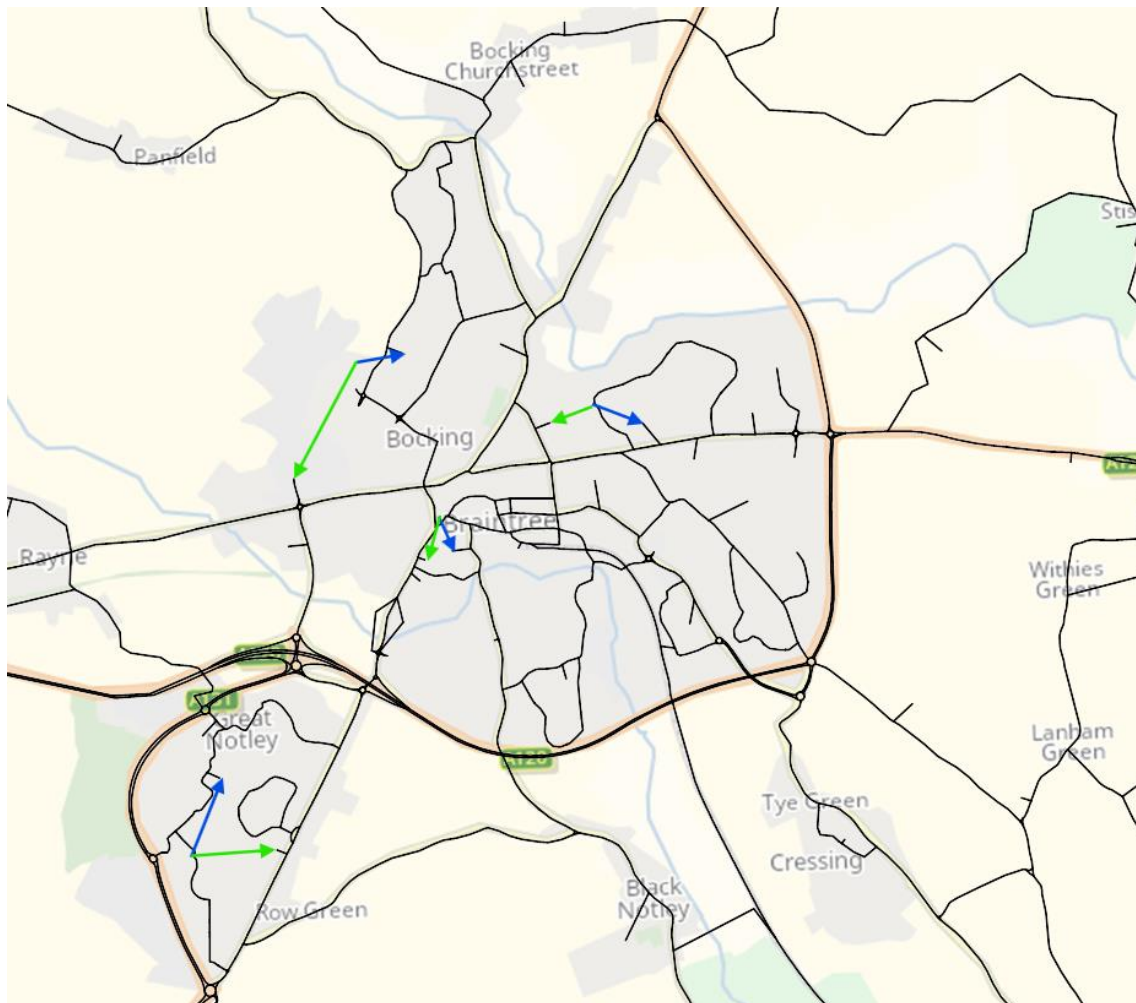


Figure 5-9: Braintree Simulation Area Zone Centroid Connectors



Figure 5-10: Harwich Simulation Area Zone Centroid Connectors



Figure 5-11: Clacton Simulation Area Zone Centroid Connectors

The centroid connectors define how trips to and from zones are allocated to the PT network from the zone centroid (centre of gravity of the zone). The PT zone connectors depend on the geographical location of the zone and the mode they connect to. Connectors between zone centroids and fixed points such as bus stops, and rail stations are added to represent a realistic loading point. These connectors have remained unchanged.

5.6 Time Periods

NEMo represents a “neutral” 2023 weekday. The assignment models cover three time periods of the typical weekday:

- AM peak hour (07:30 – 08:30).
- Inter-peak (average hour between 10:00 and 16:00).
- PM peak hour (16:30 – 17:30).

These modelled hours were derived by analysis of traffic counts throughout the study area to ascertain which hours contained the highest overall volume of traffic and the hours where the traffic volume was observed to be the highest at the majority of survey locations (this analysis is detailed in Section 2.9).

For public transport, the demand is for average AM, interpeak and PM hours. Hence, an equivalent adjustment to that applied to the highways PM peak hour (which changed from the 2019 CTM) was not required.

The time periods within which the average hours fall are:

- AM: 7am – 10am
- Inter-peak: 10am – 4pm
- PM: -- 4pm -7pm

5.7 Generalised Cost Formulations and Parameter Values

5.7.1 Highway Assignment

Within the highway model assignment, three parameters are defined for each user class to calculate generalised cost – Value of Time (VoT) (in pence per minute (PPM)), Vehicle Operating Cost (VOC) (in pence per kilometre (PPK)), and any tolls (in pence) associated with each user class, and which may also vary by time of day.

These three parameters are used in the following formula to determine the generalised cost:

$$GeneralisedCost_{minutes} = JourneyTime_{minutes} + \left(\frac{ppk}{ppm}\right) * JourneyDistance_{km} + \left(\frac{1}{ppm}\right) * Toll_{pence}$$

In NEMo, a link toll has been included to represent the Dartford Crossing, however, given that it is outside of the FMA, it is included only for completeness.

The values of PPM and PPK parameters used in CTM are based TAG Databook (May 2024 v1.23), the latest available at the time of validating the model. As per the 2019 base year, the HGV VoT is doubled.

Vehicle operating costs were derived using National Highways methodology. Average speeds were extracted from an interim version of the highway assignment model for use in this calculation. The average speeds used are shown in Table 5-2, and the final VoT and VOC values for the 2023 base year are provided in

Table 5-3.

Table 5-2: Average Speeds by Time Period for PPK Calculation

Time Period	Modelled Average Speed in AoDM (kph)		
	Car	LGV	HGV
AM	51.56	51.50	51.08
IP	53.52	53.44	52.83
PM	51.38	51.32	50.89

Table 5-3: Highway Generalised Cost Parameters

Time Period	User Class	2023 Base Year TAG Databook Value		2023 Base Year VISUM Units	
		VoT (PPM)	VOC (PPK)	VoT (PPS)	VOC (PPM)
AM	UC1 Car Commute	20.91	6.42	0.3486	0.0064
	UC2 Car Business	31.18	12.72	0.5197	0.0127
	UC3 Car Other	14.43	6.42	0.2405	0.0064
	LGV	23.19	13.74	0.3865	0.0137
	HGV	48.44	43.11	0.8074	0.0431
IP	UC1 Car Commute	21.25	6.35	0.3542	0.0063
	UC2 Car Business	31.96	12.56	0.5326	0.0126
	UC3 Car Other	15.37	6.35	0.2562	0.0063
	LGV	23.19	13.65	0.3865	0.0136
	HGV	48.44	42.52	0.8074	0.0425
PM	UC1 Car Commute	20.99	6.43	0.3498	0.0064
	UC2 Car Business	31.63	12.73	0.5272	0.0127
	UC3 Car Other	15.11	6.43	0.2518	0.0064
	LGV	23.19	13.75	0.3865	0.0137

	HGV	48.44	43.18	0.8074	0.0432
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5.7.2 Public Transport Assignment

The generalised cost for public transport trips consists of different components:

$$PTGeneralisedCost_{minutes} = 2 * Walktime + 2.5 * WaitTime + 1 * Invehicle\ Time + BoardingPenalty$$

Each component can be given its own weight or coefficient in order to convert them to common units and to ensure that the relative importance of each component for passengers is reflected. The components are:

- In-vehicle time.
- Wait time (time spent waiting for services).
- Walk time (time spent walking on-street, PT and zone access and egress).
- Boarding penalty (penalty associated with inconvenience of interchanging).

Please note that boarding penalties are implemented at node level. These penalties will be applied to any interchange between transit services, whether for rail or bus modes.

The components are weighted in line with the recommendations in TAG unit 3.2, Table 1. The weights are summarised in Table 5-4 below.

Table 5-4: Public Transport Generalised Cost Weights

Generalised Cost Component	Coefficient (weighting)
In-vehicle time	1.0
Walk time	2.0
Wait time	2.5
Boarding Penalty	1.0

As the PT assignment model does not include monetary costs and value of time is not used in the assignment generalised cost (fares are included in the generalised cost in the demand model), their journey purpose segments are combined for input into the assignment as a single all-purpose passenger demand matrix.

Bus and rail fares are included in the VDM, based on the in-vehicle distance and the number of boardings obtained for the respective user classes from the assignment.

A boarding penalty of 5 minutes was defined at node level to reflect the inconvenience of transfer and minimise excessive transfers in places with a high transit frequency such as major roads or transit corridors.

6 Highway Network Development

6.1 Network Basis

Highway network data geometry and classification in the updated model was adapted from the CTM, which in turn was adapted from the Essex Countywide Model.

Within the new sections that make the new AoDM, the network was enhanced using the following approach:

- Comprehensive update of junction signals
- Reviewing highway link data in the new AoDM and updating directionality, capacities and link types

The details of the additional AoDM network are set out in this chapter.

6.2 Junction Modelling

All highway junctions within the updated AoDM are explicitly modelled. Junctions have been coded using VISUM Intersection Capacity Analysis (ICA), applying the principles of the Highway Capacity Manual (HCM 2010) for signalised and give-way junctions and the TRL/Kimber method for priority roundabouts. CTM classifies all nodes in the AoDM as either:

- “Unknown” – junctions with no capacity restrictions and no coding are required.
- Two-way yield – junctions where sub-ordinate arms feed traffic to major arms.
- Roundabouts.
- Uncontrolled merges.
- Signalised junctions (including rail level crossings).

The locations of all the coded junctions (3161 in total) are presented in Figure 6-1.

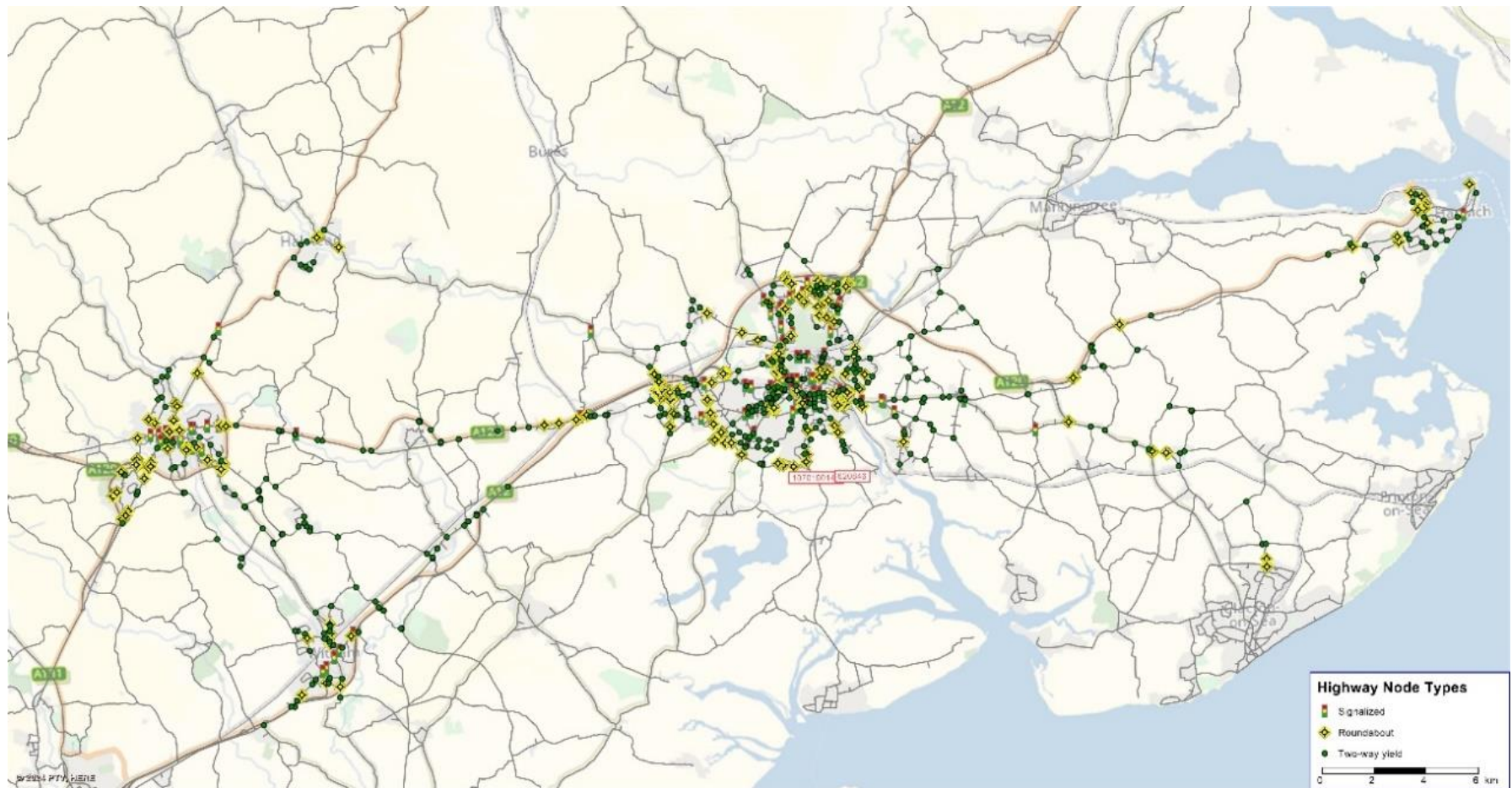


Figure 6-1: Coded Junctions by Type

In the updated AoDM, the attributes needed for the ICA nodes were updated using junction control sheets provided by ECC, and by using Street View in Google Maps. Signal timings were also checked and updated in Colchester. Pre-calibration checks were then carried out following TAG Unit M3.1 guidance, which is outlined in Table 8-1.

All updated ICA nodes were coded following the same procedures as undertaken in the CTM Base Year model build, 2019.

6.3 Updated Schemes

A check was undertaken on schemes in the modelled area that have been built since 2019, with the following included in the updated model.

- Ipswich Road to Harwich Road Highway Improvements
- Frating – Weeley
- St John Street - 1 lane per direction - WB only for buses, cyclists and permitted vehicles
- High Street closed to traffic - for access only
- A134 Station Rd - Removal of the bus lane.

M11 J7A was also built between 2019 and 2023, however, due to its location and minimal route choice interaction with the FMA, it was felt that this scheme would not influence traffic and hasn't been included within the updated model.

7 Public Transport Network Development

7.1 Introduction

The public transport model was constructed using EMME software version The NEMO public transport network includes two components:

- The bus network, which is consistent with the VISUM highway model for buses and coaches.
- The rail network, which covers Great Britain and is connected to the bus network in Essex.

Additionally, the EMME network has been modified and made consistent with the VISUM network.

7.2 Bus Network

7.2.1 Timetable Coding

The modelled bus network across Essex is represented at high level and has been based on ATCO-CIF timetable files available from the Essex Open Data⁵ website maintained by Essex County Council (ECC). The ATCO-CIF files are updated regularly by the council and the version available at the time was Essex Bus Network (CIF), dated 24 June 2024. This version was used as an approximation of the 2023 timetable given that the bus timetables do not differ significantly year-on-year. The ATCO files include geographic information about bus stops in Essex, the name and code of each bus stop served by the bus line route, the frequency of each line, time between stops, and the days when the service operates. The file includes information for all bus services in Essex and for coaches that run through Essex.

An automated process has been developed to convert the CIF data into a format suitable for EMME. The process operates in two main steps: time period classification and bus route pattern optimization. In the first step the time period to which the bus service belongs is defined by the time of its arrival or passing through Colchester. The remaining bus routes that do not cross any part of the Colchester network area were allocated to time period according to the route origin departure time specified in the CIF timetables.

The second step identifies similar bus services of a given bus operating company and merges them into routes that run along the same path, with the same stopping pattern. For each service on the route, times between stops have been averaged and average frequencies for the route calculated. The coding has been updated for all bus services operating in Essex.

7.3 Rail Network

The Rail network, services frequencies, stop-to-stop journey times and stopping pattern was coded in accordance with the spring 2023 National Rail CIF files. The rail services that run across Essex are the Greater Anglia Trains (on Great Eastern Main Line) and C2C on Essex Thameside. Although the entire national timetable is coded in the model the greatest level of detail is coded on routes of these two operators.

7.4 Walk Links

Walk links have been reviewed in the new AoDM locations. Where the original highway network links are one-way street, checks were made to ensure walk in the opposite direction is possible. In addition, walk links are coded to connect stations with the on-street walk network to allow a full range of interchange possibilities between public transport services.

8 Highway Assignment Validation

8.1 Introduction

For the NEMo model update, TAG Unit M4, Appendix B guidance has been followed, using the first option on how to make proportionate adjustments to transport models in relation to changes in travel patterns due to the COVID-19 pandemic. This first option *“creates a forecast to the present day by applying adjustments to include a COVID-19 impact, based on observed data. This forecast can be used as a new base year as a substitute basis for scheme forecast.”*

The DfT has recognised that the current guidance included in TAG Unit 4, Appendix B can be open to interpretation, with only a limited existing body of evidence to provide help. As such, during the October 2023 TAG Conference, advice was provided from the DfT on how to implement the present-day base year approach.

This advice covers the approach, providing what adjustments can be made to the matrices, which are summarised below:

- Adjustments to matrices should be applied globally as a default
- Collection of a large number of counts
- Adjustments from counts should be done on an aggregate basis
- Adjustments will vary according to vehicle type
- Adjustments may also vary according to trip purpose
- Adjustments may also vary by modelled period

This advice also covers what adjustments shouldn't be made to the matrices, as summarised below:

- Adjusting trips within different areas of the model
- Applying adjustments in multiple areas
- Adjusting trips using matrix estimation

8.2 Approach to Highway Model Update

The rest of this section discusses the present-day base year update, the changes that have been made and the model outputs compared to the observed counts.

The post matrix estimated matrices that were developed for the 2019 base year model were used as the starting point for adjustments.

8.3 Network Checks

In line with best practice and TAG, the network has been systematically checked before the model validation commenced. The VISUM functionality to find and correct network errors has been applied to the following items in Table 8-1.

Table 8-1: VISUM Network Checks Prior to Model Validation

Network Check	Explanation of Check and Potential Issue
Isolated nodes	Find nodes without links
Turns and main turns which do not make sense	Find turns/main turns which are open to a transport system/vehicle type whereas their 'from link' or 'to link' are closed to this transport system/vehicle type
Zones not connected for Private Transport (PrT)	Find zones without a zone connector to network Check existence and transport system of connectors For zones with proportional distribution, also the shares are checked
Check for network consistency	Find pairs of zones between which no route path could be found
Dead-end roads for Private Transport (PrT)	Check network for dead-end roads (which are links to not-connected one-leg nodes with closed U-turn via this node and/or closed opposite link direction)
Links with Capacity = 0 or Free Flow Speed = 0	Find open links with capacity = 0 or modelled free flow speed = 0
Viability for Intersection Capacity Analysis (ICA)	Check nodes for Intersection Capacity Analysis (ICA) viability (turn types, signalisation, topology, etc)

The items set out in Table 8-1 in the NEMo network have been checked after the local enhancements in Braintree and Tendring were updated. Additional checking has followed and focused on the coded attributes of the links, including link speeds and number of lanes and capacity.

8.4 Route Choice

TAG Unit M3.1 advises that the plausibility of routes should be checked as part of pre-calibration, and throughout the calibration process, as modelled routing

forms a key part of ensuring that journey times and vehicle flows are realistic. The checks recommended by TAG were undertaken at an early stage of the base model update, and replicate the routes used for the 2019 base year, alongside the introduction of new routes in Braintree and Tendring.

The modelled routes have been checked against local knowledge and routes suggested by Google Maps to assess plausibility. Route plausibility was assessed by examining shortest paths (based on congested travel time) and minimum generalised cost (impedance) routes through the network. Where routing in the model differed from expectations, it has been investigated and appropriate network corrections implemented. The OD pairs analysed are shown. The full set of comparisons is provided in Appendix A. No anomalies have been revealed in the final checks.

8.5 Matrix Changes

8.5.1 Global District Factors

Throughout the validation process, trial and error was undertaken to update the model to the revised 2023 counts. As noted above, matrix estimation wasn't used at any point during the NEMo validation. The following global factors were used during model validation to adjust the matrices to match the updated 2023 counts. These factors were derived from counts only when the same count was undertaken in 2019 (more detail is provided in Section 2.3), and only when this count was used as part of the validation process. Not all of the counts had 2019 equivalents, which has provided the independent validation required by TAG.

The factors below, for car, LGV and HGV, were applied at the district level. Where the trip was Internal to Internal within one single district, the factors within the table were used. For Internal to External, or External to Internal contained within the three districts, averages of the relevant factors were used, e.g. Colchester to Braintree LGV used the average of 1.18 and 1.14 = 1.16, for the AM peak. For Internal to External where the internal trip is within the three districts, the internal factor was used.

Table 8-2: Matrix Changes Global Factors

Time Period	Vehicle Class	District		
		Braintree	Colchester	Tendring
AM	Car	0.93	1.05	1.00
	LGV	1.14	1.18	1.10
	HGV	0.99	0.91	1.08
IP	Car	0.92	1.03	0.98
	LGV	1.07	1.15	1.14
	HGV	0.93	0.87	0.98
PM	Car	0.88	1.00	1.01
	LGV	1.25	1.27	1.35
	HGV	0.97	0.85	1.41

8.5.2 Braintree Screenline Factor

Following the implementation of global factors, the Braintree screenline was further reviewed because the modelled data was consistently lower than the observed data.

At all count locations on the screenline (as shown in Figure 2-13), analysis was undertaken in the model to determine the origin-destination pairs for the trips passing through these locations. For these trips only in the matrix, additional correction factors were applied for all trips, as follows:

- AM peak hour: 1.08
- IP: 1.15
- PM peak hour: 1.16.

8.5.3 Summary of Changes

The tables below show the absolute and relative change in the matrix totals from the 2019 CTM matrices to the final NEMo matrices and are split as per the sector system shown in Section 5.2, with all external sectors grouped together. The tables are split by peak hour and car / LGV / HGV.

The largest changes observed across car for all peak hours are increases in trips to and from Harlow and Uttlesford. This is due to the factors applied to trips crossing the Braintree screenline.

The largest relative change in LGVs is seen in the Braintree south sector, aligning with the LGV factors applied. The HGV matrices show only small relative changes during all peak hours.

At the overall matrix level, increases in LGVs are observed for all peak hours (1% for the AM peak and IP, and 4% for the PM peak). The overall matrix totals for car and HGVs remain the same between 2019 and 2023 for all peak periods.

Table 8-3: AM Peak Matrix Absolute Change – 2019 – 2023 Car

AM	Basildon	Braintree_N	Braintree_S	Brentwood	Castle Point	Chelmsford	Colchester_C	Colchester_N	Colchester_NE	Colchester_NW	Colchester_S	Colchester_SE	Colchester_SW	Epping Forest	Harlow	Maldon	Rochford	Southend-on-sea	Tendring_NE	Tendring_NW	Tendring_SE	Tendring_SW	Thurrock	Uttlesford	External	Total
Basildon	0	0	-1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Braintree_N	1	-88	-3	0	0	5	0	0	-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-5	-22	-116
Braintree_S	-2	-4	-122	-1	0	5	2	3	2	2	8	1	2	2	4	-2	-1	-1	0	0	0	0	0	24	17	-63
Brentwood	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Castle Point	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Chelmsford	0	3	5	0	0	0	1	2	2	2	3	1	2	1	2	0	0	0	0	0	0	0	0	4	8	35
Colchester_C	0	0	1	0	0	0	11	1	9	3	5	8	16	0	0	1	0	0	0	1	1	1	1	0	0	61
Colchester_N	0	0	7	1	0	2	5	16	7	8	7	3	10	1	0	2	0	0	0	1	1	0	0	2	11	84
Colchester_NE	0	0	1	0	0	0	17	6	56	15	8	8	25	6	0	1	0	0	2	3	4	2	0	1	10	160
Colchester_NW	0	0	1	0	0	1	6	7	24	17	6	4	9	0	0	1	0	0	2	3	5	2	0	1	16	104
Colchester_S	1	0	8	1	0	4	19	8	20	10	52	14	29	1	0	11	1	0	1	2	4	2	0	3	13	202
Colchester_SE	0	0	1	0	0	0	23	3	14	4	12	30	26	0	0	1	0	0	0	2	2	1	0	1	4	123
Colchester_SW	0	-1	2	0	0	1	45	9	47	14	26	25	118	0	0	4	0	0	1	2	4	2	0	2	13	314
Epping Forest	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Harlow	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	4
Maldon	0	0	-3	0	0	0	3	2	2	1	9	1	5	0	0	0	0	0	0	0	0	0	0	2	2	25
Rochford	0	0	-1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Southend-on-sea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Tendring_NE	0	0	0	0	0	0	2	1	6	3	1	0	2	0	0	0	0	0	5	1	1	0	0	0	1	22
Tendring_NW	0	0	0	0	0	0	3	2	4	3	1	2	2	0	0	0	0	0	0	2	0	0	0	0	1	20
Tendring_SE	0	-1	0	0	0	0	3	1	11	7	3	2	4	0	0	0	0	0	1	0	21	1	0	0	2	55
Tendring_SW	0	0	0	0	0	0	2	1	7	3	3	2	3	0	0	0	0	0	0	0	2	2	0	0	1	26
Thurrock	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Uttlesford	0	-3	18	0	0	1	1	1	1	1	2	1	1	0	0	1	0	0	0	0	0	0	0	0	2	25
External	3	-15	17	1	0	6	13	8	15	15	7	5	12	0	0	1	1	2	1	1	1	0	1	3	5	104
Total	4	-111	-66	1	1	25	153	71	228	108	154	107	266	5	8	21	1	2	14	16	46	15	1	38	88	1198

Table 8-4: AM Peak Matrix Relative Change – 2019 – 2023 Car

AM	Basildon	Braintree_N	Braintree_S	Brentwood	Castle Point	Chelmsford	Colchester_C	Colchester_N	Colchester_NE	Colchester_NW	Colchester_S	Colchester_SE	Colchester_SW	Epping Forest	Harlow	Maldon	Rochford	Southend-on-sea	Tendring_NE	Tendring_NW	Tendring_SE	Tendring_SW	Thurrock	Uttlesford	External	Total
Basildon	0%	3%	-1%	0%	0%	0%	3%	3%	3%	3%	3%	3%	3%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Braintree_N	3%	-7%	0%	1%	3%	4%	-1%	-1%	-1%	-1%	-1%	-1%	-1%	-1%	-1%	0%	1%	2%	-3%	-3%	-3%	-3%	1%	-2%	-3%	-3%
Braintree_S	-1%	-1%	-2%	-2%	-1%	0%	2%	2%	2%	2%	2%	2%	2%	2%	4%	0%	-2%	-2%	0%	0%	0%	-1%	-1%	4%	1%	-1%
Brentwood	0%	3%	0%	0%	0%	0%	3%	3%	3%	3%	3%	3%	3%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Castle Point	0%	2%	-1%	0%	0%	0%	3%	3%	3%	3%	3%	3%	3%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Chelmsford	0%	3%	0%	0%	0%	0%	3%	3%	3%	3%	3%	3%	3%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%
Colchester_C	3%	-1%	2%	3%	3%	3%	5%	5%	5%	5%	5%	5%	5%	5%	11%	3%	3%	3%	3%	3%	3%	3%	3%	11%	3%	4%
Colchester_N	3%	0%	3%	3%	3%	3%	5%	5%	5%	5%	5%	5%	5%	9%	11%	3%	3%	3%	3%	3%	3%	3%	3%	10%	3%	4%
Colchester_NE	3%	-1%	2%	3%	3%	3%	5%	5%	5%	5%	5%	5%	5%	4%	11%	3%	3%	3%	3%	3%	3%	3%	3%	11%	3%	4%
Colchester_NW	3%	-1%	2%	3%	3%	3%	5%	5%	5%	5%	5%	5%	5%	4%	11%	3%	3%	3%	3%	3%	3%	3%	3%	10%	3%	4%
Colchester_S	3%	-1%	2%	3%	3%	3%	5%	5%	5%	5%	5%	5%	5%	5%	11%	3%	3%	3%	3%	3%	3%	3%	3%	11%	3%	4%
Colchester_SE	3%	-1%	2%	3%	3%	3%	5%	5%	5%	5%	5%	5%	5%	7%	11%	3%	3%	3%	3%	3%	3%	3%	3%	10%	3%	5%
Colchester_SW	3%	-1%	2%	3%	3%	3%	5%	5%	5%	5%	5%	5%	5%	5%	11%	3%	3%	3%	3%	3%	3%	3%	3%	11%	3%	5%
Epping Forest	0%	0%	2%	0%	0%	0%	4%	7%	3%	6%	4%	4%	5%	0%	0%	0%	0%	0%	3%	1%	1%	2%	0%	0%	0%	0%
Harlow	0%	1%	4%	0%	0%	0%	11%	11%	11%	11%	11%	11%	11%	0%	0%	0%	0%	0%	8%	8%	8%	8%	0%	0%	0%	0%
Maldon	0%	0%	0%	0%	0%	0%	3%	3%	3%	3%	3%	3%	3%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	2%	0%	0%
Rochford	0%	1%	-1%	0%	0%	0%	3%	3%	3%	3%	3%	3%	3%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Southend-on-sea	0%	2%	-1%	0%	0%	0%	3%	3%	3%	3%	3%	3%	3%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Tendring_NE	0%	-3%	0%	0%	0%	0%	3%	3%	3%	3%	3%	3%	3%	4%	8%	0%	0%	0%	0%	0%	0%	0%	0%	8%	0%	1%
Tendring_NW	0%	-3%	0%	0%	0%	0%	3%	3%	3%	3%	3%	3%	3%	2%	8%	0%	0%	0%	0%	0%	0%	0%	0%	8%	0%	1%
Tendring_SE	0%	-3%	0%	0%	0%	0%	3%	3%	3%	3%	3%	3%	3%	2%	8%	0%	0%	0%	0%	0%	0%	0%	0%	8%	0%	1%
Tendring_SW	0%	-3%	0%	0%	0%	0%	3%	3%	3%	3%	3%	3%	3%	3%	8%	0%	0%	0%	0%	0%	0%	0%	0%	8%	0%	1%
Thurrock	0%	0%	0%	0%	0%	0%	3%	3%	3%	3%	3%	3%	3%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Uttlesford	0%	-2%	4%	0%	0%	0%	11%	10%	11%	11%	11%	11%	11%	0%	0%	2%	0%	0%	8%	8%	8%	8%	0%	0%	0%	0%
External	0%	-3%	2%	0%	0%	0%	3%	3%	3%	3%	3%	3%	3%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Total	0%	-4%	-1%	0%	0%	0%	4%	4%	4%	4%	4%	5%	4%	0%	0%	0%	0%	0%	1%	1%	1%	1%	0%	0%	0%	0%

Table 8-5: IP Absolute Change – 2019 – 2023 Car

IP	Basildon	Braintree_N	Braintree_S	Brentwood	Castle Point	Chelmsford	Colchester_C	Colchester_N	Colchester_NE	Colchester_NW	Colchester_S	Colchester_SE	Colchester_SW	Epping Forest	Harlow	Maldon	Rochford	Southend-on-sea	Tendring_NE	Tendring_NW	Tendring_SE	Tendring_SW	Thurrock	Uttlesford	External	Total
Basildon	0	-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2
Braintree_N	0	-73	14	0	0	6	-1	-1	-1	-1	-1	0	-1	0	0	1	0	0	0	0	0	-1	0	0	-2	-71
Braintree_S	0	12	41	0	0	18	1	3	2	1	8	0	2	3	3	1	0	0	0	0	0	0	0	34	30	160
Brentwood	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Castle Point	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Chelmsford	0	9	44	0	0	0	0	1	1	0	2	0	1	1	1	0	0	0	0	0	0	0	0	5	10	75
Colchester_C	0	-1	2	0	0	0	6	2	8	2	6	8	15	0	0	1	0	0	0	0	0	0	0	1	4	54
Colchester_N	0	-1	4	0	0	1	1	6	3	3	3	1	3	0	0	1	0	0	0	0	0	0	0	1	5	32
Colchester_NE	0	-1	1	0	0	0	8	2	21	8	5	5	11	0	0	0	0	0	0	0	1	0	0	1	4	69
Colchester_NW	0	-1	2	0	0	1	3	4	13	10	4	2	6	0	0	0	0	0	0	0	1	0	0	1	8	56
Colchester_S	0	-1	9	0	0	1	7	4	7	3	22	5	11	0	0	4	0	0	0	0	1	0	0	3	7	84
Colchester_SE	0	0	1	0	0	0	9	1	6	2	5	11	10	0	0	0	0	0	0	0	0	0	0	0	2	47
Colchester_SW	0	-1	2	0	0	0	17	4	15	7	11	9	45	0	0	2	0	0	0	0	0	0	0	1	5	120
Epping Forest	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	6
Harlow	0	0	5	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	9
Maldon	0	1	1	0	0	0	1	1	1	0	4	0	2	0	0	0	0	0	0	0	0	0	0	1	1	13
Rochford	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Southend-on-sea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Tendring_NE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-15	-1	-4	-1	0	0	-1	-21
Tendring_NW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-1	-6	-1	0	0	0	-2	-9
Tendring_SE	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	-5	-1	-68	-9	0	0	-1	-81
Tendring_SW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-1	0	-8	-7	0	0	0	-15
Thurrock	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Uttlesford	0	-1	43	0	0	1	1	2	1	1	3	0	1	0	0	1	0	0	0	0	1	0	0	0	5	60
External	2	-11	41	0	0	5	4	6	6	6	7	2	6	0	1	2	1	1	-1	-2	-1	0	0	6	13	95
Total	3	-67	215	1	1	34	58	37	83	47	81	45	114	5	7	13	1	1	-22	-10	-79	-16	1	53	80	689

Table 8-6: IP Relative Change – 2019 – 2023 Car

IP	Basildon	Braintree_N	Braintree_S	Brentwood	Castle Point	Chelmsford	Colchester_C	Colchester_N	Colchester_NE	Colchester_NW	Colchester_S	Colchester_SE	Colchester_SW	Epping Forest	Harlow	Maldon	Rochford	Southend-on-sea	Tendring_NE	Tendring_NW	Tendring_SE	Tendring_SW	Thurrock	Uttlesford	External	Total
Basildon	0%	7%	1%	0%	0%	0%	1%	1%	1%	1%	1%	1%	1%	0%	0%	0%	0%	0%	-1%	-1%	-1%	-1%	0%	0%	0%	0%
Braintree_N	5%	-8%	3%	6%	4%	9%	-3%	-2%	-3%	-3%	-2%	-3%	-3%	2%	3%	3%	3%	5%	-5%	-5%	-5%	-5%	4%	-1%	-3%	-3%
Braintree_S	0%	3%	1%	0%	0%	2%	3%	3%	2%	2%	3%	2%	2%	5%	9%	0%	-1%	0%	1%	0%	1%	0%	0%	9%	5%	2%
Brentwood	0%	6%	0%	0%	0%	0%	1%	1%	1%	1%	1%	1%	1%	0%	0%	0%	0%	0%	-1%	-1%	-1%	-1%	0%	0%	0%	0%
Castle Point	0%	8%	1%	0%	0%	0%	1%	1%	1%	1%	1%	1%	1%	0%	0%	0%	0%	0%	-1%	-1%	-1%	-1%	0%	1%	0%	0%
Chelmsford	0%	9%	4%	0%	0%	0%	3%	2%	3%	2%	2%	2%	3%	0%	1%	0%	0%	0%	-1%	0%	0%	0%	0%	2%	1%	1%
Colchester_C	1%	-2%	3%	1%	1%	2%	3%	3%	3%	3%	3%	3%	3%	4%	17%	1%	1%	1%	1%	1%	1%	1%	1%	16%	3%	3%
Colchester_N	1%	-2%	3%	1%	1%	2%	3%	3%	3%	3%	3%	3%	3%	10%	17%	1%	1%	1%	1%	1%	1%	1%	1%	16%	2%	3%
Colchester_NE	1%	-2%	3%	1%	1%	2%	3%	3%	3%	3%	3%	3%	3%	3%	17%	1%	1%	1%	1%	1%	1%	1%	1%	16%	2%	2%
Colchester_NW	1%	-2%	3%	1%	1%	2%	3%	3%	3%	3%	3%	3%	3%	3%	17%	1%	1%	1%	1%	1%	1%	1%	1%	16%	2%	2%
Colchester_S	1%	-2%	3%	1%	1%	2%	3%	3%	3%	3%	3%	3%	3%	4%	17%	1%	1%	1%	1%	1%	1%	1%	1%	17%	3%	3%
Colchester_SE	1%	-2%	2%	1%	1%	1%	3%	3%	3%	3%	3%	3%	3%	4%	17%	1%	1%	1%	1%	1%	1%	1%	1%	16%	3%	3%
Colchester_SW	1%	-2%	3%	1%	1%	2%	3%	3%	3%	3%	3%	3%	3%	3%	17%	1%	1%	1%	1%	1%	1%	1%	1%	16%	2%	3%
Epping Forest	0%	3%	7%	0%	0%	0%	4%	9%	3%	3%	6%	4%	5%	0%	0%	0%	0%	0%	2%	2%	2%	2%	0%	0%	0%	0%
Harlow	0%	4%	9%	0%	0%	0%	17%	17%	17%	17%	17%	17%	17%	0%	0%	0%	0%	0%	14%	14%	14%	14%	0%	0%	0%	0%
Maldon	0%	3%	0%	0%	0%	0%	1%	1%	1%	1%	1%	1%	1%	0%	0%	0%	0%	0%	-1%	-1%	-1%	-1%	0%	3%	1%	0%
Rochford	0%	6%	0%	0%	0%	0%	1%	1%	1%	1%	1%	1%	1%	0%	0%	0%	0%	0%	-1%	-1%	-1%	-1%	0%	0%	0%	0%
Southend-on-sea	0%	5%	0%	0%	0%	0%	1%	1%	1%	1%	1%	1%	1%	0%	0%	0%	0%	0%	-1%	-1%	-1%	-1%	0%	0%	0%	0%
Tendring_NE	-1%	-5%	1%	-1%	-1%	-1%	1%	1%	1%	1%	1%	1%	1%	1%	14%	-1%	-1%	-1%	-2%	-2%	-2%	-2%	-1%	14%	-1%	-1%
Tendring_NW	-1%	-5%	1%	-1%	-1%	-1%	1%	1%	1%	1%	1%	1%	1%	1%	14%	-1%	-1%	-1%	-2%	-2%	-2%	-2%	-1%	14%	-1%	-1%
Tendring_SE	-1%	-5%	1%	-1%	-1%	-1%	1%	1%	1%	1%	1%	1%	1%	1%	14%	-1%	-1%	-1%	-2%	-2%	-2%	-2%	-1%	13%	-1%	-1%
Tendring_SW	-1%	-5%	0%	-1%	-1%	-1%	1%	1%	1%	1%	1%	1%	1%	1%	14%	-1%	-1%	-1%	-2%	-2%	-2%	-2%	-1%	13%	0%	-1%
Thurrock	0%	4%	1%	0%	0%	0%	1%	1%	1%	1%	1%	1%	1%	0%	0%	0%	0%	0%	-1%	-1%	-1%	-1%	0%	0%	0%	0%
Uttlesford	0%	-1%	10%	0%	0%	0%	16%	16%	16%	17%	17%	16%	16%	0%	0%	3%	0%	0%	13%	14%	14%	13%	0%	0%	0%	1%
External	0%	-2%	6%	0%	0%	1%	2%	3%	2%	2%	4%	3%	2%	0%	0%	1%	0%	0%	-1%	-1%	0%	0%	0%	0%	0%	0%
Total	0%	-3%	3%	0%	0%	0%	3%	3%	2%	2%	3%	3%	3%	0%	0%	0%	0%	0%	-1%	-1%	-1%	-1%	0%	1%	0%	0%

Table 8-7: PM Peak Matrix Absolute Change – 2019 – 2023 Car

PM	Basildon	Braintree_N	Braintree_S	Brentwood	Castle Point	Chelmsford	Colchester_C	Colchester_N	Colchester_NE	Colchester_NW	Colchester_S	Colchester_SE	Colchester_SW	Epping Forest	Harlow	Maldon	Rochford	Southend-on-sea	Tendring_NE	Tendring_NW	Tendring_SE	Tendring_SW	Thurrock	Uttlesford	External	Total	
Basildon	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	4	
Braintree_N	0	-182	-4	0	0	6	-2	-3	-5	-2	-3	-2	-5	0	0	1	0	0	-1	-1	-2	-1	0	-8	-38	-250	
Braintree_S	-2	-3	-163	0	-1	-14	-1	-4	-2	-2	-6	-1	-3	2	3	-7	-2	-1	0	0	-1	0	0	35	29	-143	
Brentwood	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	
Castle Point	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	
Chelmsford	0	15	63	0	0	0	0	1	0	0	1	0	1	1	3	0	0	0	0	0	0	0	0	8	21	114	
Colchester_C	0	-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	2	
Colchester_N	0	-3	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	3	
Colchester_NE	0	-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	2	1	0	1	2	5	
Colchester_NW	0	-3	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	2	1	0	2	4	8
Colchester_S	0	-4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	3	4	7	
Colchester_SE	0	-2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	2	
Colchester_SW	0	-4	-1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	0	1	3	3	
Epping Forest	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	
Harlow	0	0	10	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	15	
Maldon	0	0	-7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	-4	
Rochford	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Southend-on-sea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Tendring_NE	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	13	1	4	1	0	0	1	22
Tendring_NW	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	5	1	1	0	0	2	13
Tendring_SE	0	0	0	0	0	0	0	0	1	1	1	0	1	0	0	0	0	0	4	1	63	6	0	0	3	83	
Tendring_SW	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1	0	5	6	0	0	1	15
Thurrock	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Uttlesford	0	-8	66	0	0	2	1	3	2	1	4	1	2	0	0	3	0	0	0	0	1	1	0	0	7	86	
External	0	-42	64	1	0	7	2	4	2	1	6	2	4	1	1	4	0	0	3	3	4	2	0	6	10	86	
Total	-1	-242	35	0	0	2	2	4	2	2	6	2	3	5	9	1	-1	0	26	14	82	20	0	53	59	81	

Table 8-8: PM Peak Matrix Relative Change – 2019 – 2023 Car

PM	Basildon	Braintree_N	Braintree_S	Brentwood	Castle Point	Chelmsford	Colchester_C	Colchester_N	Colchester_NE	Colchester_NW	Colchester_S	Colchester_SE	Colchester_SW	Epping Forest	Harlow	Maldon	Rochford	Southend-on-sea	Tendring_NE	Tendring_NW	Tendring_SE	Tendring_SW	Thurrock	Uttlesford	External	Total
Basildon	0%	5%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	1%	1%	1%	0%	0%	0%	0%
Braintree_N	5%	-12%	-1%	6%	1%	6%	-6%	-6%	-6%	-6%	-6%	-6%	-6%	-1%	0%	1%	2%	4%	-5%	-5%	-5%	-5%	2%	-4%	-5%	-7%
Braintree_S	-3%	-1%	-3%	-1%	-3%	-1%	-1%	-1%	-2%	-2%	-2%	-2%	-2%	2%	7%	-1%	-3%	-3%	-1%	-1%	-1%	-1%	-1%	8%	4%	-1%
Brentwood	0%	3%	-1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	1%	1%	1%	0%	0%	0%	0%
Castle Point	0%	6%	2%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	1%	1%	1%	0%	0%	0%	0%
Chelmsford	0%	7%	4%	0%	0%	0%	1%	2%	1%	1%	1%	1%	1%	0%	1%	0%	0%	0%	2%	1%	1%	1%	0%	2%	1%	1%
Colchester_C	0%	-6%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	3%	16%	0%	0%	0%	1%	1%	1%	1%	0%	16%	1%	0%
Colchester_N	0%	-6%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	8%	16%	0%	0%	0%	1%	1%	1%	1%	0%	15%	1%	0%
Colchester_NE	0%	-6%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	16%	0%	0%	0%	1%	1%	1%	1%	0%	16%	0%	0%
Colchester_NW	0%	-6%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	5%	16%	0%	0%	0%	1%	1%	1%	1%	0%	16%	1%	0%
Colchester_S	0%	-6%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	2%	16%	0%	0%	0%	1%	1%	1%	1%	0%	16%	2%	0%
Colchester_SE	0%	-6%	-1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	3%	16%	0%	0%	0%	1%	1%	1%	1%	0%	16%	1%	0%
Colchester_SW	0%	-6%	-1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	3%	16%	0%	0%	0%	1%	1%	1%	1%	0%	16%	1%	0%
Epping Forest	0%	-1%	6%	0%	0%	0%	2%	7%	2%	1%	4%	4%	4%	0%	0%	0%	0%	0%	5%	3%	4%	4%	0%	0%	0%	0%
Harlow	0%	0%	8%	0%	0%	0%	16%	16%	16%	16%	16%	16%	16%	0%	0%	0%	0%	0%	17%	17%	17%	17%	0%	0%	0%	0%
Maldon	0%	1%	-1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	1%	1%	1%	0%	2%	0%	0%
Rochford	0%	3%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	1%	1%	1%	0%	0%	0%	0%
Southend-on-sea	0%	5%	-1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	1%	1%	1%	0%	0%	0%	0%
Tendring_NE	1%	-5%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	5%	17%	1%	1%	1%	1%	1%	1%	1%	1%	17%	1%	1%
Tendring_NW	1%	-5%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	3%	17%	1%	1%	1%	1%	1%	1%	1%	1%	17%	1%	1%
Tendring_SE	1%	-5%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	2%	17%	1%	1%	1%	1%	1%	1%	1%	1%	17%	1%	1%
Tendring_SW	1%	-5%	0%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	3%	17%	1%	1%	1%	1%	1%	1%	1%	1%	17%	1%	1%
Thurrock	0%	4%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	1%	1%	1%	0%	0%	0%	0%
Uttlesford	0%	-3%	8%	0%	0%	0%	16%	15%	16%	15%	16%	16%	16%	0%	0%	3%	0%	0%	16%	16%	16%	16%	0%	0%	0%	1%
External	0%	-5%	5%	0%	0%	0%	1%	1%	0%	0%	2%	1%	1%	0%	0%	1%	0%	0%	1%	1%	1%	1%	0%	0%	0%	0%
Total	0%	-6%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	1%	1%	1%	0%	0%	0%	0%

Table 8-9: AM Peak Matrix Absolute Change – 2019 – 2023 LGV

AM	Basildon	Braintree_N	Braintree_S	Brentwood	Castle Point	Chelmsford	Colchester_C	Colchester_N	Colchester_NE	Colchester_NW	Colchester_S	Colchester_SE	Colchester_SW	Epping Forest	Harlow	Maldon	Rochford	Southend-on-sea	Tendring_NE	Tendring_NW	Tendring_SE	Tendring_SW	Thurrock	Uttlesford	External	Total
Basildon	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
Braintree_N	0	18	7	0	0	2	0	1	0	0	1	1	2	0	0	0	0	0	0	0	0	0	0	1	9	44
Braintree_S	1	7	104	0	0	14	1	2	1	1	4	2	11	1	1	4	0	0	0	0	0	0	0	6	20	182
Brentwood	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Castle Point	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Chelmsford	0	2	19	0	0	0	0	1	0	0	1	1	3	0	0	0	0	0	0	0	0	0	0	0	1	27
Colchester_C	0	0	1	0	0	0	4	1	4	1	3	4	7	0	0	0	0	0	1	1	1	1	0	0	3	32
Colchester_N	0	1	4	0	0	1	2	16	3	2	9	3	23	0	0	0	0	0	1	1	1	1	0	0	7	76
Colchester_NE	1	3	9	0	0	2	4	8	19	4	11	6	6	0	1	1	0	0	1	2	2	1	0	1	10	93
Colchester_NW	0	0	2	0	0	0	1	2	3	4	2	1	2	0	0	0	0	0	0	0	1	0	0	0	5	26
Colchester_S	0	1	10	0	0	1	4	8	6	2	32	7	17	0	0	6	0	0	1	1	2	1	0	1	7	108
Colchester_SE	0	0	1	0	0	0	4	1	6	1	5	10	8	0	0	0	0	0	1	1	2	1	0	0	4	45
Colchester_SW	0	2	4	0	0	1	5	5	4	1	10	7	23	0	0	0	0	0	0	0	1	0	0	0	3	70
Epping Forest	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Harlow	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Maldon	0	1	11	0	0	0	0	0	0	0	6	1	1	0	0	0	0	0	0	0	0	0	0	0	1	22
Rochford	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Southend-on-sea	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Tendring_NE	0	0	1	0	0	0	1	1	1	0	2	1	1	0	0	0	0	0	8	4	2	0	0	0	3	25
Tendring_NW	0	0	0	0	0	0	1	1	2	0	1	1	1	0	0	0	0	0	3	4	3	0	0	0	2	20
Tendring_SE	0	0	2	0	0	0	1	1	1	1	2	2	1	0	0	0	0	0	2	3	31	2	0	0	4	53
Tendring_SW	0	0	1	0	0	0	0	0	1	0	2	1	1	0	0	0	0	0	1	1	5	5	0	0	1	20
Thurrock	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Uttlesford	0	1	6	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	9
External	0	9	23	0	0	1	4	8	8	3	7	6	11	0	0	0	0	0	2	2	3	0	0	0	1	89
Total	3	48	213	1	1	23	32	58	62	21	99	54	120	2	2	14	1	1	21	20	56	13	1	10	80	957

Table 8-10: AM Peak Matrix Relative Change – 2019 – 2023 LGV

AM	Basildon	Braintree_N	Braintree_S	Brentwood	Castle Point	Chelmsford	Colchester_C	Colchester_N	Colchester_NE	Colchester_NW	Colchester_S	Colchester_SE	Colchester_SW	Epping Forest	Harlow	Maldon	Rochford	Southend-on-sea	Tendring_NE	Tendring_NW	Tendring_SE	Tendring_SW	Thurrock	Uttlesford	External	Total
Basildon	0%	13%	9%	0%	0%	0%	9%	9%	9%	9%	9%	9%	9%	0%	0%	0%	0%	0%	5%	5%	5%	5%	0%	0%	0%	0%
Braintree_N	14%	14%	20%	13%	14%	14%	16%	16%	16%	16%	16%	16%	16%	8%	9%	12%	12%	12%	12%	12%	12%	12%	13%	8%	7%	12%
Braintree_S	11%	20%	19%	11%	10%	11%	21%	21%	20%	21%	19%	21%	20%	12%	15%	10%	10%	12%	16%	16%	16%	17%	11%	15%	14%	17%
Brentwood	0%	11%	8%	0%	0%	0%	9%	9%	9%	9%	9%	9%	9%	0%	0%	0%	0%	0%	5%	5%	5%	5%	0%	0%	0%	0%
Castle Point	0%	14%	9%	0%	0%	0%	9%	9%	9%	9%	9%	9%	9%	0%	0%	0%	0%	0%	5%	5%	5%	5%	0%	0%	0%	0%
Chelmsford	0%	14%	10%	0%	0%	0%	9%	9%	10%	9%	9%	10%	10%	0%	0%	0%	0%	0%	5%	5%	5%	6%	0%	0%	0%	1%
Colchester_C	9%	16%	19%	9%	9%	9%	18%	18%	18%	18%	18%	18%	18%	11%	18%	9%	9%	9%	14%	14%	14%	14%	9%	17%	10%	16%
Colchester_N	9%	16%	18%	9%	9%	9%	18%	18%	18%	18%	18%	18%	18%	10%	18%	9%	9%	9%	14%	14%	14%	14%	9%	15%	9%	16%
Colchester_NE	9%	16%	19%	9%	9%	9%	18%	18%	18%	18%	18%	18%	18%	10%	18%	9%	9%	9%	14%	14%	14%	14%	9%	16%	10%	16%
Colchester_NW	9%	16%	19%	9%	9%	9%	18%	18%	18%	18%	18%	18%	18%	11%	18%	9%	9%	9%	14%	14%	14%	14%	9%	17%	9%	15%
Colchester_S	9%	16%	18%	9%	9%	9%	18%	18%	18%	18%	18%	18%	18%	10%	18%	9%	9%	9%	14%	14%	14%	14%	9%	17%	10%	16%
Colchester_SE	9%	16%	18%	9%	9%	9%	18%	18%	18%	18%	18%	18%	18%	10%	18%	9%	9%	9%	14%	14%	14%	14%	9%	15%	10%	16%
Colchester_SW	9%	16%	19%	9%	9%	9%	18%	18%	18%	18%	18%	18%	18%	10%	18%	9%	9%	9%	14%	14%	14%	14%	9%	15%	10%	17%
Epping Forest	0%	12%	10%	0%	0%	0%	9%	10%	9%	11%	10%	10%	10%	0%	0%	0%	0%	0%	7%	5%	6%	6%	0%	0%	0%	0%
Harlow	0%	10%	15%	0%	0%	0%	18%	18%	18%	18%	18%	18%	18%	0%	0%	1%	0%	0%	14%	14%	13%	13%	0%	0%	0%	0%
Maldon	0%	11%	10%	0%	0%	0%	9%	9%	9%	9%	9%	9%	9%	1%	2%	0%	0%	0%	5%	5%	5%	5%	0%	3%	1%	2%
Rochford	0%	13%	9%	0%	0%	0%	9%	9%	9%	9%	9%	9%	9%	0%	0%	0%	0%	0%	5%	5%	5%	5%	0%	0%	0%	0%
Southend-on-sea	0%	12%	10%	0%	0%	0%	9%	9%	9%	9%	9%	9%	9%	0%	0%	0%	0%	0%	5%	5%	5%	5%	0%	0%	0%	0%
Tendring_NE	5%	12%	14%	5%	5%	5%	14%	14%	14%	14%	14%	14%	14%	6%	14%	5%	5%	5%	10%	10%	10%	10%	5%	10%	5%	10%
Tendring_NW	5%	12%	14%	5%	5%	5%	14%	14%	14%	14%	14%	14%	14%	5%	14%	5%	5%	5%	10%	10%	10%	10%	5%	9%	5%	10%
Tendring_SE	5%	12%	14%	5%	5%	5%	14%	14%	14%	14%	14%	14%	14%	6%	13%	5%	5%	5%	10%	10%	10%	10%	5%	12%	6%	10%
Tendring_SW	5%	12%	15%	5%	5%	6%	14%	14%	14%	14%	14%	14%	14%	6%	14%	5%	5%	5%	10%	10%	10%	10%	5%	11%	5%	11%
Thurrock	0%	12%	9%	0%	0%	0%	9%	9%	9%	9%	9%	9%	9%	0%	0%	0%	0%	0%	5%	5%	5%	5%	0%	0%	0%	0%
Uttlesford	0%	8%	15%	0%	0%	0%	16%	15%	15%	16%	17%	16%	15%	0%	0%	1%	0%	0%	12%	9%	11%	10%	0%	0%	0%	1%
External	0%	7%	11%	0%	0%	0%	10%	9%	9%	9%	10%	10%	11%	0%	0%	0%	0%	0%	5%	5%	5%	5%	0%	0%	0%	0%
Total	0%	12%	15%	0%	0%	1%	16%	16%	16%	15%	16%	16%	16%	0%	0%	1%	0%	0%	10%	10%	10%	11%	0%	1%	0%	1%

Table 8-11: IP Matrix Absolute Change – 2019 – 2023 LGV

IP	Basildon	Braintree_N	Braintree_S	Brentwood	Castle Point	Chelmsford	Colchester_C	Colchester_N	Colchester_NE	Colchester_NW	Colchester_S	Colchester_SE	Colchester_SW	Epping Forest	Harlow	Maldon	Rochford	Southend-on-sea	Tendring_NE	Tendring_NW	Tendring_SE	Tendring_SW	Thurrock	Uttlesford	External	Total
Basildon	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
Braintree_N	0	7	5	0	0	2	0	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	1	4
Braintree_S	0	5	68	0	0	10	1	2	1	1	4	1	9	1	0	3	0	0	0	0	0	0	0	5	14	126
Brentwood	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Castle Point	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Chelmsford	0	2	17	0	0	0	0	0	0	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	1
Colchester_C	0	0	1	0	0	0	3	1	3	1	3	3	4	0	0	0	0	0	0	0	1	1	0	0	0	2
Colchester_N	0	0	3	0	0	0	1	10	2	1	9	2	20	0	0	0	0	0	1	1	1	1	0	0	0	4
Colchester_NE	0	1	8	0	0	2	3	6	14	4	15	4	4	0	1	1	0	0	1	2	2	1	0	1	6	74
Colchester_NW	0	0	2	0	0	0	1	2	3	4	3	1	2	0	0	0	0	0	0	0	1	0	0	0	3	23
Colchester_S	0	1	6	0	0	1	3	5	4	1	20	5	12	0	0	4	0	0	1	1	2	1	0	0	4	72
Colchester_SE	0	0	1	0	0	0	3	1	5	1	4	7	5	0	0	0	0	0	0	0	1	1	1	0	0	2
Colchester_SW	0	0	3	0	0	0	4	3	3	1	9	5	15	0	0	0	0	0	0	0	1	1	0	0	0	2
Epping Forest	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Harlow	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Maldon	0	1	5	0	0	0	0	0	0	0	4	0	1	0	0	0	0	0	0	0	0	0	0	0	1	12
Rochford	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Southend-on-sea	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Tendring_NE	0	0	1	0	0	0	0	1	1	0	2	0	1	0	0	0	0	0	8	2	2	0	0	0	2	21
Tendring_NW	0	0	0	0	0	0	1	1	2	0	1	1	0	0	0	0	0	0	3	4	2	0	0	0	2	18
Tendring_SE	0	0	2	0	0	0	1	1	1	1	3	1	1	0	0	0	0	0	2	2	31	4	0	0	3	54
Tendring_SW	0	0	0	0	0	0	0	0	1	0	2	1	0	0	0	0	0	0	1	0	5	5	0	0	0	16
Thurrock	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Uttlesford	0	1	7	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	10
External	0	4	21	0	0	1	1	5	5	2	7	3	8	0	0	1	0	0	2	2	4	1	0	0	2	70
Total	1	23	157	1	0	17	21	39	46	18	88	36	86	2	2	11	0	0	19	16	53	14	1	9	54	715

Table 8-12: IP Matrix Relative Change – 2019 – 2023 LGV

IP	Basildon	Braintree_N	Braintree_S	Brentwood	Castle Point	Chelmsford	Colchester_C	Colchester_N	Colchester_NE	Colchester_NW	Colchester_S	Colchester_SE	Colchester_SW	Epping Forest	Harlow	Maldon	Rochford	Southend-on-sea	Tendring_NE	Tendring_NW	Tendring_SE	Tendring_SW	Thurrock	Uttlesford	External	Total
Basildon	0%	14%	7%	0%	0%	0%	8%	8%	8%	8%	8%	8%	8%	0%	0%	0%	0%	0%	7%	7%	7%	7%	0%	0%	0%	0%
Braintree_N	16%	7%	18%	14%	17%	17%	11%	11%	11%	11%	12%	11%	11%	11%	9%	13%	13%	13%	11%	11%	11%	11%	15%	6%	5%	9%
Braintree_S	10%	18%	17%	11%	9%	11%	21%	20%	19%	21%	16%	20%	19%	11%	18%	8%	9%	12%	19%	18%	18%	20%	12%	18%	16%	16%
Brentwood	0%	9%	5%	0%	0%	0%	8%	8%	8%	8%	8%	8%	8%	0%	0%	0%	0%	0%	7%	7%	7%	7%	0%	0%	0%	0%
Castle Point	0%	16%	7%	0%	0%	0%	8%	8%	8%	8%	8%	8%	8%	0%	0%	0%	0%	0%	7%	7%	7%	7%	0%	0%	0%	0%
Chelmsford	0%	17%	11%	0%	0%	0%	9%	8%	10%	9%	8%	9%	10%	0%	0%	0%	0%	0%	7%	7%	7%	13%	0%	1%	1%	1%
Colchester_C	8%	12%	18%	8%	8%	8%	15%	15%	15%	15%	15%	15%	15%	10%	24%	8%	8%	8%	15%	15%	15%	15%	8%	21%	9%	14%
Colchester_N	8%	11%	16%	8%	8%	8%	15%	15%	15%	15%	15%	15%	15%	8%	24%	8%	8%	8%	15%	15%	15%	15%	8%	20%	8%	14%
Colchester_NE	8%	12%	18%	8%	8%	8%	15%	15%	15%	15%	15%	15%	15%	8%	24%	8%	8%	8%	15%	15%	15%	15%	8%	21%	9%	14%
Colchester_NW	8%	13%	18%	8%	8%	8%	15%	15%	15%	15%	15%	15%	15%	8%	24%	8%	8%	8%	15%	15%	15%	15%	8%	22%	8%	14%
Colchester_S	8%	13%	14%	8%	8%	8%	15%	15%	15%	15%	15%	15%	15%	8%	24%	8%	8%	8%	15%	15%	15%	15%	8%	22%	9%	14%
Colchester_SE	8%	12%	17%	8%	8%	8%	15%	15%	15%	15%	15%	15%	15%	8%	24%	8%	8%	8%	15%	15%	15%	15%	8%	19%	9%	14%
Colchester_SW	8%	12%	17%	8%	8%	8%	15%	15%	15%	15%	15%	15%	15%	8%	24%	8%	8%	8%	15%	15%	15%	15%	8%	18%	9%	15%
Epping Forest	0%	14%	10%	0%	0%	0%	8%	8%	8%	8%	9%	9%	9%	0%	0%	0%	0%	0%	12%	8%	8%	9%	0%	0%	0%	0%
Harlow	0%	10%	18%	0%	0%	0%	24%	24%	24%	24%	24%	24%	24%	0%	0%	2%	0%	0%	23%	23%	23%	22%	0%	0%	0%	0%
Maldon	0%	11%	8%	0%	0%	0%	8%	8%	8%	8%	8%	8%	8%	0%	2%	0%	0%	0%	7%	7%	7%	7%	0%	2%	1%	2%
Rochford	0%	15%	7%	0%	0%	0%	8%	8%	8%	8%	8%	8%	8%	0%	0%	0%	0%	0%	7%	7%	7%	7%	0%	0%	0%	0%
Southend-on-sea	0%	12%	9%	0%	0%	0%	8%	8%	8%	8%	8%	8%	8%	0%	0%	0%	0%	0%	7%	7%	7%	7%	0%	0%	0%	0%
Tendring_NE	7%	11%	16%	7%	7%	7%	15%	15%	15%	15%	15%	15%	15%	10%	23%	7%	7%	7%	14%	14%	14%	14%	7%	15%	8%	13%
Tendring_NW	7%	11%	16%	7%	7%	7%	15%	15%	15%	15%	15%	15%	15%	7%	23%	7%	7%	7%	14%	14%	14%	14%	7%	15%	7%	13%
Tendring_SE	7%	11%	15%	7%	7%	7%	15%	15%	15%	15%	15%	15%	15%	8%	23%	7%	7%	7%	14%	14%	14%	14%	7%	19%	8%	13%
Tendring_SW	7%	11%	17%	7%	7%	7%	15%	15%	15%	15%	15%	15%	15%	7%	23%	7%	7%	7%	14%	14%	14%	14%	7%	17%	7%	14%
Thurrock	0%	11%	7%	0%	0%	0%	8%	8%	8%	8%	8%	8%	8%	0%	0%	0%	0%	0%	7%	7%	7%	7%	0%	0%	0%	0%
Uttlesford	0%	7%	18%	0%	0%	0%	20%	18%	19%	21%	21%	20%	19%	0%	0%	2%	0%	0%	19%	13%	18%	17%	0%	0%	0%	1%
External	0%	5%	11%	0%	0%	0%	9%	8%	8%	8%	9%	9%	10%	0%	0%	1%	0%	0%	7%	7%	7%	7%	0%	0%	0%	0%
Total	0%	9%	14%	0%	0%	1%	14%	14%	14%	14%	14%	14%	14%	0%	0%	1%	0%	0%	13%	13%	13%	14%	0%	1%	0%	1%

Table 8-13: PM Peak Matrix Absolute Change – 2019 – 2023 LGV

PM	Basildon	Braintree_N	Braintree_S	Brentwood	Castle Point	Chelmsford	Colchester_C	Colchester_N	Colchester_NE	Colchester_NW	Colchester_S	Colchester_SE	Colchester_SW	Epping Forest	Harlow	Maldon	Rochford	Southend-on-sea	Tendring_NE	Tendring_NW	Tendring_SE	Tendring_SW	Thurrock	Uttlesford	External	Total
Basildon	0	1	6	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8
Braintree_N	0	25	9	0	0	2	0	2	1	0	2	1	4	0	0	1	0	0	0	0	0	0	0	2	12	60
Braintree_S	1	12	145	1	0	14	1	3	2	1	8	1	9	1	0	9	0	0	1	0	1	0	0	7	22	242
Brentwood	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Castle Point	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Chelmsford	0	4	28	0	0	0	0	0	1	0	2	0	2	0	0	0	0	0	0	0	0	0	0	0	1	40
Colchester_C	0	0	2	0	0	0	4	1	5	1	5	4	5	0	0	1	0	0	1	1	1	1	1	0	3	37
Colchester_N	0	2	5	0	0	1	1	14	3	2	8	2	9	0	0	1	0	0	1	2	1	0	0	0	7	58
Colchester_NE	1	2	13	0	0	2	3	7	19	4	15	5	6	0	0	1	0	0	2	3	3	3	0	1	7	99
Colchester_NW	0	0	4	0	0	0	1	3	3	5	3	1	2	0	0	0	0	0	1	1	1	0	0	0	4	32
Colchester_S	0	1	8	0	0	1	3	4	4	1	34	6	12	0	0	7	0	0	1	1	2	2	0	0	4	90
Colchester_SE	0	0	1	0	0	0	3	1	5	1	7	10	7	0	0	1	0	0	1	1	2	1	0	0	3	45
Colchester_SW	0	2	6	0	0	1	5	5	4	2	14	8	26	0	0	1	0	0	1	1	2	1	0	0	3	81
Epping Forest	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Harlow	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Maldon	0	1	9	0	0	0	0	0	0	0	6	0	1	0	0	0	0	0	0	0	0	0	0	0	0	19
Rochford	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Southend-on-sea	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Tendring_NE	0	0	2	0	0	1	0	1	1	0	3	1	1	0	0	0	0	0	19	5	5	1	0	0	4	45
Tendring_NW	0	0	0	0	0	0	1	1	5	1	2	1	1	0	0	0	0	0	8	9	5	1	0	0	5	40
Tendring_SE	0	1	4	0	0	1	1	2	2	1	5	2	2	0	0	0	0	0	5	4	77	7	0	0	7	122
Tendring_SW	0	0	1	0	0	0	0	1	2	0	3	1	1	0	0	0	0	0	1	1	5	12	0	0	2	32
Thurrock	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Uttlesford	0	2	9	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	14
External	0	13	38	0	0	1	3	8	10	3	10	5	9	0	0	1	0	0	8	6	9	3	0	0	2	128
Total	3	67	299	1	1	25	28	53	69	26	128	50	99	2	1	23	1	1	50	36	116	34	1	11	84	1209

Table 8-14: PM Peak Matrix Relative Change – 2019 – 2023 LGV

PM	Basildon	Braintree_N	Braintree_S	Brentwood	Castle Point	Chelmsford	Colchester_C	Colchester_N	Colchester_NE	Colchester_NW	Colchester_S	Colchester_SE	Colchester_SW	Epping Forest	Harlow	Maldon	Rochford	Southend-on-sea	Tendring_NE	Tendring_NW	Tendring_SE	Tendring_SW	Thurrock	Uttlesford	External	Total
Basildon	0%	23%	18%	0%	0%	0%	13%	13%	13%	13%	13%	13%	13%	0%	0%	0%	0%	0%	18%	18%	18%	18%	0%	0%	0%	0%
Braintree_N	27%	25%	39%	24%	28%	27%	26%	26%	26%	26%	27%	26%	26%	17%	18%	24%	27%	25%	30%	30%	30%	30%	26%	15%	14%	23%
Braintree_S	19%	40%	38%	21%	18%	21%	37%	35%	35%	37%	32%	36%	35%	22%	29%	19%	18%	21%	39%	38%	39%	41%	22%	29%	26%	33%
Brentwood	0%	23%	16%	0%	0%	0%	13%	13%	13%	13%	13%	13%	13%	0%	0%	0%	0%	0%	18%	18%	18%	18%	0%	0%	0%	0%
Castle Point	0%	27%	18%	0%	0%	0%	13%	13%	13%	13%	13%	13%	13%	0%	0%	0%	0%	0%	18%	18%	18%	18%	0%	0%	0%	0%
Chelmsford	0%	27%	20%	0%	0%	0%	14%	13%	14%	14%	14%	15%	14%	0%	0%	0%	0%	0%	18%	18%	18%	21%	0%	0%	1%	2%
Colchester_C	13%	26%	35%	13%	13%	13%	27%	27%	27%	27%	27%	27%	27%	15%	31%	13%	13%	13%	31%	31%	31%	31%	13%	30%	15%	25%
Colchester_N	13%	26%	31%	13%	13%	14%	27%	27%	27%	27%	27%	27%	27%	15%	31%	13%	13%	13%	31%	31%	31%	31%	13%	27%	14%	24%
Colchester_NE	13%	26%	34%	13%	13%	13%	27%	27%	27%	27%	27%	27%	27%	14%	31%	13%	13%	13%	31%	31%	31%	31%	13%	27%	14%	25%
Colchester_NW	13%	27%	35%	13%	13%	13%	27%	27%	27%	27%	27%	27%	27%	17%	31%	13%	13%	13%	31%	31%	31%	31%	13%	29%	14%	24%
Colchester_S	13%	27%	30%	13%	13%	13%	27%	27%	27%	27%	27%	27%	27%	14%	31%	13%	13%	13%	31%	31%	31%	31%	13%	29%	15%	24%
Colchester_SE	13%	27%	33%	13%	13%	13%	27%	27%	27%	27%	27%	27%	27%	15%	31%	13%	13%	13%	31%	31%	31%	31%	13%	26%	14%	25%
Colchester_SW	13%	26%	33%	13%	13%	13%	27%	27%	27%	27%	27%	27%	27%	14%	31%	13%	13%	13%	31%	31%	31%	31%	13%	25%	15%	26%
Epping Forest	0%	20%	20%	0%	0%	0%	14%	14%	14%	14%	14%	15%	14%	0%	0%	0%	0%	0%	20%	18%	19%	19%	0%	0%	0%	0%
Harlow	0%	18%	25%	0%	0%	0%	31%	31%	31%	31%	31%	31%	31%	0%	0%	0%	0%	0%	37%	37%	36%	35%	0%	0%	0%	0%
Maldon	0%	24%	18%	0%	0%	0%	13%	13%	13%	13%	13%	13%	13%	1%	2%	0%	0%	0%	18%	18%	18%	18%	0%	2%	1%	3%
Rochford	0%	22%	17%	0%	0%	0%	13%	13%	13%	13%	13%	13%	13%	0%	0%	0%	0%	0%	18%	18%	18%	18%	0%	0%	0%	0%
Southend-on-sea	0%	22%	20%	0%	0%	0%	13%	13%	13%	13%	13%	13%	13%	0%	0%	0%	0%	0%	18%	18%	18%	18%	0%	0%	0%	0%
Tendring_NE	18%	31%	37%	18%	18%	18%	31%	31%	31%	31%	31%	31%	31%	20%	37%	18%	18%	18%	35%	35%	35%	35%	18%	27%	18%	31%
Tendring_NW	18%	31%	37%	18%	18%	18%	31%	31%	31%	31%	31%	31%	31%	18%	37%	18%	18%	18%	35%	35%	35%	35%	18%	27%	18%	31%
Tendring_SE	18%	31%	37%	18%	18%	18%	31%	31%	31%	31%	31%	31%	31%	18%	36%	18%	18%	18%	35%	35%	35%	36%	18%	32%	18%	33%
Tendring_SW	18%	31%	39%	18%	18%	18%	31%	31%	31%	31%	31%	31%	31%	18%	37%	18%	18%	18%	35%	35%	35%	35%	18%	30%	18%	32%
Thurrock	0%	23%	18%	0%	0%	0%	13%	13%	13%	13%	13%	13%	13%	0%	0%	0%	0%	0%	18%	18%	18%	18%	0%	0%	0%	0%
Uttlesford	0%	15%	29%	0%	0%	0%	28%	26%	27%	28%	29%	26%	26%	0%	0%	3%	0%	0%	33%	26%	31%	29%	0%	0%	0%	2%
External	0%	14%	22%	0%	0%	0%	15%	14%	14%	14%	16%	16%	17%	0%	0%	1%	0%	0%	18%	18%	18%	18%	0%	0%	0%	0%
Total	0%	23%	30%	0%	0%	2%	25%	23%	24%	24%	24%	25%	25%	0%	0%	3%	0%	0%	30%	30%	32%	32%	0%	1%	0%	1%

Table 8-15: AM Peak Matrix Absolute Change – 2019 – 2023 HGV

AM	Basildon	Braintree_N	Braintree_S	Brentwood	Castle Point	Chelmsford	Colchester_C	Colchester_N	Colchester_NE	Colchester_NW	Colchester_S	Colchester_SE	Colchester_SW	Epping Forest	Harlow	Maldon	Rochford	Southend-on-sea	Tendring_NE	Tendring_NW	Tendring_SE	Tendring_SW	Thurrock	Uttlesford	External	Total
Basildon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Braintree_N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Braintree_S	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	5
Brentwood	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Castle Point	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chelmsford	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Colchester_C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-1	-2
Colchester_N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-1
Colchester_NE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-1	-2
Colchester_NW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-1	-1
Colchester_S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-1	-3
Colchester_SE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-1
Colchester_SW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-2
Epping Forest	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Harlow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Maldon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rochford	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Southend-on-sea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tendring_NE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	5	8
Tendring_NW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2
Tendring_SE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	2	0	0	0	2	6
Tendring_SW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Thurrock	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Uttlesford	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
External	0	0	3	0	0	0	-1	0	-1	-1	-1	0	0	0	0	0	0	0	3	0	2	1	0	0	2	8
Total	0	0	5	0	0	1	-3	-1	-2	-2	-2	-1	-2	0	0	0	0	0	5	2	6	2	0	1	11	21

Table 8-16: AM Peak Matrix Relative Change – 2019 – 2023 HGV

AM	Basildon	Braintree_N	Braintree_S	Brentwood	Castle Point	Chelmsford	Colchester_C	Colchester_N	Colchester_NE	Colchester_NW	Colchester_S	Colchester_SE	Colchester_SW	Epping Forest	Harlow	Maldon	Rochford	Southend-on-sea	Tendring_NE	Tendring_NW	Tendring_SE	Tendring_SW	Thurrock	Uttlesford	External	Total
Basildon	0%	6%	4%	0%	0%	0%	-5%	-5%	-5%	-5%	-5%	-5%	-5%	0%	0%	0%	0%	0%	4%	4%	4%	4%	0%	0%	0%	0%
Braintree_N	5%	-1%	5%	3%	5%	6%	-5%	-5%	-5%	-5%	-5%	-5%	-5%	3%	4%	4%	5%	5%	3%	3%	3%	3%	3%	2%	1%	1%
Braintree_S	2%	5%	4%	1%	2%	4%	-4%	-4%	-4%	-4%	-4%	-4%	-4%	6%	7%	4%	2%	2%	5%	5%	5%	5%	1%	7%	5%	3%
Brentwood	0%	4%	3%	0%	0%	0%	-5%	-5%	-5%	-5%	-5%	-5%	-5%	0%	0%	0%	0%	0%	4%	4%	4%	4%	0%	0%	0%	0%
Castle Point	0%	6%	4%	0%	0%	0%	-5%	-5%	-5%	-5%	-5%	-5%	-5%	0%	0%	0%	0%	0%	4%	4%	4%	4%	0%	0%	0%	0%
Chelmsford	0%	6%	5%	0%	0%	0%	-5%	-5%	-5%	-5%	-5%	-5%	-5%	0%	0%	0%	0%	0%	4%	4%	4%	4%	0%	0%	0%	0%
Colchester_C	-5%	-5%	-4%	-5%	-5%	-5%	-9%	-9%	-9%	-9%	-9%	-9%	-9%	-4%	3%	-5%	-5%	-5%	-1%	-1%	-1%	-1%	-5%	2%	-4%	-5%
Colchester_N	-5%	-5%	-4%	-5%	-5%	-5%	-9%	-9%	-9%	-9%	-9%	-9%	-9%	-3%	3%	-5%	-5%	-5%	-1%	-1%	-1%	-1%	-5%	0%	-4%	-5%
Colchester_NE	-5%	-5%	-4%	-5%	-5%	-5%	-9%	-9%	-9%	-9%	-9%	-9%	-9%	-4%	3%	-5%	-5%	-5%	-1%	-1%	-1%	-1%	-5%	1%	-4%	-5%
Colchester_NW	-5%	-5%	-4%	-5%	-5%	-5%	-9%	-9%	-9%	-9%	-9%	-9%	-9%	-4%	3%	-5%	-5%	-5%	-1%	-1%	-1%	-1%	-5%	1%	-4%	-5%
Colchester_S	-5%	-5%	-4%	-5%	-5%	-5%	-9%	-9%	-9%	-9%	-9%	-9%	-9%	-4%	3%	-5%	-5%	-5%	-1%	-1%	-1%	-1%	-5%	1%	-4%	-5%
Colchester_SE	-5%	-5%	-4%	-5%	-5%	-5%	-9%	-9%	-9%	-9%	-9%	-9%	-9%	-4%	3%	-5%	-5%	-5%	-1%	-1%	-1%	-1%	-5%	1%	-4%	-6%
Colchester_SW	-5%	-5%	-4%	-5%	-5%	-5%	-9%	-9%	-9%	-9%	-9%	-9%	-9%	-4%	3%	-5%	-5%	-5%	-1%	-1%	-1%	-1%	-5%	1%	-4%	-5%
Epping Forest	0%	4%	6%	0%	0%	0%	-4%	-2%	-5%	-4%	-4%	-4%	-4%	0%	0%	0%	0%	0%	4%	4%	4%	4%	0%	0%	0%	0%
Harlow	0%	5%	7%	0%	0%	0%	3%	3%	3%	3%	3%	3%	3%	0%	0%	1%	0%	0%	12%	12%	12%	12%	0%	0%	0%	0%
Maldon	0%	4%	4%	0%	0%	0%	-5%	-5%	-5%	-5%	-5%	-5%	-5%	0%	2%	0%	0%	0%	4%	4%	4%	4%	0%	3%	1%	0%
Rochford	0%	6%	4%	0%	0%	0%	-5%	-5%	-5%	-5%	-5%	-5%	-5%	0%	0%	0%	0%	0%	4%	4%	4%	4%	0%	0%	0%	0%
Southend-on-sea	0%	6%	4%	0%	0%	0%	-5%	-5%	-5%	-5%	-5%	-5%	-5%	0%	0%	0%	0%	0%	4%	4%	4%	4%	0%	0%	0%	0%
Tendring_NE	4%	3%	5%	4%	4%	4%	-1%	-1%	-1%	-1%	-1%	-1%	-1%	4%	12%	4%	4%	4%	8%	8%	8%	8%	4%	8%	4%	4%
Tendring_NW	4%	3%	5%	4%	4%	4%	-1%	-1%	-1%	-1%	-1%	-1%	-1%	4%	12%	4%	4%	4%	8%	8%	8%	8%	4%	9%	4%	5%
Tendring_SE	4%	3%	5%	4%	4%	4%	-1%	-1%	-1%	-1%	-1%	-1%	-1%	4%	12%	4%	4%	4%	8%	8%	8%	8%	4%	9%	4%	5%
Tendring_SW	4%	3%	5%	4%	4%	4%	-1%	-1%	-1%	-1%	-1%	-1%	-1%	4%	12%	4%	4%	4%	8%	8%	8%	8%	4%	9%	4%	5%
Thurrock	0%	3%	3%	0%	0%	0%	-5%	-5%	-5%	-5%	-5%	-5%	-5%	0%	0%	0%	0%	0%	4%	4%	4%	4%	0%	0%	0%	0%
Uttlesford	0%	2%	6%	0%	0%	0%	2%	0%	1%	1%	1%	1%	1%	0%	0%	3%	0%	0%	8%	9%	9%	9%	0%	0%	0%	0%
External	0%	1%	5%	0%	0%	0%	-4%	-4%	-4%	-4%	-4%	-4%	-4%	0%	0%	1%	0%	0%	4%	4%	4%	4%	0%	0%	0%	0%
Total	0%	1%	3%	0%	0%	0%	-5%	-5%	-5%	-5%	-5%	-5%	-5%	0%	0%	0%	0%	0%	5%	6%	6%	5%	0%	0%	0%	0%

Table 8-17: IP Matrix Absolute Change – 2019 – 2023 HGV

IP	Basildon	Braintree_N	Braintree_S	Brentwood	Castle Point	Chelmsford	Colchester_C	Colchester_N	Colchester_NE	Colchester_NW	Colchester_S	Colchester_SE	Colchester_SW	Epping Forest	Harlow	Maldon	Rochford	Southend-on-sea	Tendring_NE	Tendring_NW	Tendring_SE	Tendring_SW	Thurrock	Uttlesford	External	Total
Basildon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Braintree_N	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Braintree_S	0	0	1	0	0	1	-1	0	-1	0	-1	0	-1	0	0	0	0	0	0	0	0	0	0	0	4	2
Brentwood	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Castle Point	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chelmsford	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3
Colchester_C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-1	-3
Colchester_N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-1
Colchester_NE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-1	-4
Colchester_NW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-1	-2
Colchester_S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-1	-3
Colchester_SE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-1
Colchester_SW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-1	-2
Epping Forest	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Harlow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Maldon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rochford	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Southend-on-sea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tendring_NE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-1
Tendring_NW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tendring_SE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-2
Tendring_SW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Thurrock	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Uttlesford	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
External	0	0	4	0	0	0	-1	0	-1	0	-1	0	-1	0	0	1	0	0	0	0	0	0	0	0	4	5
Total	0	0	6	0	0	0	-4	-1	-3	-2	-3	-1	-3	0	0	1	0	0	-1	0	-2	0	0	1	5	-8

Table 8-18: IP Matrix Relative Change – 2019 – 2023 HGV

IP	Basildon	Braintree_N	Braintree_S	Brentwood	Castle Point	Chelmsford	Colchester_C	Colchester_N	Colchester_NE	Colchester_NW	Colchester_S	Colchester_SE	Colchester_SW	Epping Forest	Harlow	Maldon	Rochford	Southend-on-sea	Tendring_NE	Tendring_NW	Tendring_SE	Tendring_SW	Thurrock	Uttlesford	External	Total
Basildon	0%	8%	4%	0%	0%	0%	-6%	-6%	-6%	-6%	-6%	-6%	-6%	0%	0%	0%	0%	0%	-1%	-1%	-1%	-1%	0%	0%	0%	0%
Braintree_N	7%	-7%	5%	3%	7%	10%	-10%	-9%	-10%	-10%	-9%	-10%	-10%	7%	8%	8%	7%	7%	-4%	-4%	-4%	-4%	4%	3%	0%	1%
Braintree_S	-1%	4%	4%	0%	-1%	4%	-7%	-7%	-7%	-7%	-7%	-7%	-7%	9%	11%	5%	-1%	-1%	-2%	-2%	-2%	-2%	0%	10%	5%	1%
Brentwood	0%	4%	7%	0%	0%	0%	-6%	-6%	-6%	-6%	-6%	-6%	-6%	0%	0%	0%	0%	0%	-1%	-1%	-1%	-1%	0%	0%	0%	0%
Castle Point	0%	8%	4%	0%	0%	0%	-6%	-6%	-6%	-6%	-6%	-6%	-6%	0%	0%	0%	0%	0%	-1%	-1%	-1%	-1%	0%	0%	0%	0%
Chelmsford	0%	10%	8%	0%	0%	0%	-6%	-6%	-6%	-6%	-6%	-6%	-6%	0%	0%	0%	0%	0%	-1%	-1%	-1%	-1%	0%	0%	1%	1%
Colchester_C	-6%	-9%	-5%	-6%	-6%	-6%	-13%	-13%	-13%	-13%	-13%	-13%	-13%	-5%	8%	-6%	-6%	-6%	-7%	-7%	-7%	-7%	-6%	6%	-5%	-8%
Colchester_N	-6%	-9%	-6%	-6%	-6%	-6%	-13%	-13%	-13%	-13%	-13%	-13%	-13%	-3%	8%	-6%	-6%	-6%	-7%	-7%	-7%	-7%	-6%	2%	-5%	-7%
Colchester_NE	-6%	-8%	-5%	-6%	-6%	-6%	-13%	-13%	-13%	-13%	-13%	-13%	-13%	-6%	8%	-6%	-6%	-6%	-7%	-7%	-7%	-7%	-6%	5%	-5%	-7%
Colchester_NW	-6%	-9%	-5%	-6%	-6%	-6%	-13%	-13%	-13%	-13%	-13%	-13%	-13%	-6%	8%	-6%	-6%	-6%	-7%	-7%	-7%	-7%	-6%	5%	-5%	-6%
Colchester_S	-6%	-8%	-6%	-6%	-6%	-6%	-13%	-13%	-13%	-13%	-13%	-13%	-13%	-6%	8%	-6%	-6%	-6%	-7%	-7%	-7%	-7%	-6%	5%	-5%	-7%
Colchester_SE	-6%	-8%	-6%	-6%	-6%	-6%	-13%	-13%	-13%	-13%	-13%	-13%	-13%	-6%	8%	-6%	-6%	-6%	-7%	-7%	-7%	-7%	-6%	5%	-6%	-8%
Colchester_SW	-6%	-8%	-6%	-6%	-6%	-6%	-13%	-13%	-13%	-13%	-13%	-13%	-13%	-6%	8%	-6%	-6%	-6%	-7%	-7%	-7%	-7%	-6%	4%	-5%	-7%
Epping Forest	0%	5%	10%	0%	0%	0%	-5%	0%	-6%	-6%	-5%	-6%	-6%	0%	0%	0%	0%	0%	-1%	0%	0%	-1%	0%	0%	0%	0%
Harlow	0%	7%	11%	0%	0%	0%	8%	8%	7%	8%	8%	8%	8%	0%	0%	0%	0%	0%	14%	14%	13%	13%	0%	0%	0%	0%
Maldon	0%	6%	5%	0%	0%	0%	-6%	-6%	-6%	-6%	-6%	-6%	-6%	0%	2%	0%	0%	0%	-1%	-1%	-1%	-1%	0%	4%	1%	0%
Rochford	0%	8%	4%	0%	0%	0%	-6%	-6%	-6%	-6%	-6%	-6%	-6%	0%	0%	0%	0%	0%	-1%	-1%	-1%	-1%	0%	0%	0%	0%
Southend-on-sea	0%	8%	4%	0%	0%	0%	-6%	-6%	-6%	-6%	-6%	-6%	-6%	0%	0%	0%	0%	0%	-1%	-1%	-1%	-1%	0%	0%	0%	0%
Tendring_NE	-1%	-4%	-1%	-1%	-1%	-1%	-7%	-7%	-7%	-7%	-7%	-7%	-7%	-1%	14%	-1%	-1%	-1%	-2%	-2%	-2%	-2%	-1%	7%	-1%	-1%
Tendring_NW	-1%	-4%	0%	-1%	-1%	-1%	-7%	-7%	-7%	-7%	-7%	-7%	-7%	0%	14%	-1%	-1%	-1%	-2%	-2%	-2%	-2%	-1%	9%	-1%	-2%
Tendring_SE	-1%	-4%	-1%	-1%	-1%	-1%	-7%	-7%	-7%	-7%	-7%	-7%	-7%	-1%	13%	-1%	-1%	-1%	-2%	-2%	-2%	-2%	-1%	8%	-1%	-2%
Tendring_SW	-1%	-3%	0%	-1%	-1%	-1%	-7%	-7%	-7%	-7%	-7%	-7%	-7%	-1%	14%	-1%	-1%	-1%	-2%	-2%	-2%	-2%	-1%	8%	-1%	-1%
Thurrock	0%	4%	5%	0%	0%	0%	-6%	-6%	-6%	-6%	-6%	-6%	-6%	0%	0%	0%	0%	0%	-1%	-1%	-1%	-1%	0%	0%	0%	0%
Uttlesford	0%	2%	10%	0%	0%	0%	6%	2%	4%	4%	4%	5%	4%	0%	0%	4%	0%	0%	6%	8%	7%	8%	0%	0%	0%	0%
External	0%	-1%	8%	0%	0%	0%	-5%	-5%	-5%	-4%	-5%	-5%	-5%	0%	0%	2%	0%	0%	-1%	-1%	-1%	-1%	0%	0%	0%	0%
Total	0%	0%	4%	0%	0%	0%	-8%	-8%	-8%	-7%	-8%	-8%	-7%	0%	0%	1%	0%	0%	-1%	-2%	-2%	-2%	0%	0%	0%	0%

Table 8-19: PM Peak Matrix Absolute Change – 2019 – 2023 HGV

PM	Basildon	Braintree_N	Braintree_S	Brentwood	Castle Point	Chelmsford	Colchester_C	Colchester_N	Colchester_NE	Colchester_NW	Colchester_S	Colchester_SE	Colchester_SW	Epping Forest	Harlow	Maldon	Rochford	Southend-on-sea	Tendring_NE	Tendring_NW	Tendring_SE	Tendring_SW	Thurrock	Uttlesford	External	Total
Basildon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Braintree_N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Braintree_S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-2
Brentwood	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Castle Point	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chelmsford	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Colchester_C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-2
Colchester_N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-1
Colchester_NE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-2
Colchester_NW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-1
Colchester_S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-1
Colchester_SE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-1
Colchester_SW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-1
Epping Forest	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Harlow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Maldon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rochford	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Southend-on-sea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tendring_NE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	2
Tendring_NW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Tendring_SE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	1	3
Tendring_SW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Thurrock	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Uttlesford	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
External	0	0	0	0	0	0	-1	0	-1	-1	0	0	0	0	0	0	0	0	0	2	0	1	0	0	0	0
Total	0	0	-2	0	0	-1	-2	-1	-1	-1	-1	-1	-1	0	0	0	0	0	3	1	3	1	0	0	-1	-5

Table 8-20: PM Peak Matrix Relative Change – 2019 – 2023 HGV

PM	Basildon	Braintree_N	Braintree_S	Brentwood	Castle Point	Chelmsford	Colchester_C	Colchester_N	Colchester_NE	Colchester_NW	Colchester_S	Colchester_SE	Colchester_SW	Epping Forest	Harlow	Maldon	Rochford	Southend-on-sea	Tendring_NE	Tendring_NW	Tendring_SE	Tendring_SW	Thurrock	Uttlesford	External	Total
Basildon	0%	0%	0%	0%	0%	0%	-8%	-8%	-8%	-8%	-8%	-8%	-8%	0%	0%	0%	0%	0%	4%	-8%	4%	4%	4%	0%	0%	0%
Braintree_N	0%	-1%	-1%	0%	0%	0%	-8%	-8%	-8%	-8%	-8%	-8%	-8%	0%	0%	0%	0%	0%	3%	3%	3%	3%	0%	0%	0%	-1%
Braintree_S	0%	-1%	-1%	0%	0%	0%	-8%	-8%	-8%	-8%	-8%	-8%	-8%	0%	0%	0%	0%	0%	3%	3%	3%	3%	0%	0%	0%	-2%
Brentwood	0%	0%	0%	0%	0%	0%	-8%	-8%	-8%	-8%	-8%	-8%	-8%	0%	0%	0%	0%	0%	4%	4%	4%	4%	0%	0%	0%	0%
Castle Point	0%	0%	0%	0%	0%	0%	-8%	-8%	-8%	-8%	-8%	-8%	-8%	0%	0%	0%	0%	0%	4%	4%	4%	4%	0%	0%	0%	0%
Chelmsford	0%	0%	0%	0%	0%	0%	-8%	-8%	-8%	-8%	-8%	-8%	-8%	0%	0%	0%	0%	0%	4%	4%	4%	4%	0%	0%	0%	0%
Colchester_C	-8%	-8%	-8%	-8%	-8%	-8%	-16%	-16%	-16%	-16%	-16%	-16%	-16%	-8%	-8%	-8%	-8%	-8%	-4%	-4%	-4%	-4%	-8%	-8%	-8%	-9%
Colchester_N	-8%	-8%	-8%	-8%	-8%	-8%	-16%	-16%	-16%	-16%	-16%	-16%	-16%	-8%	-8%	-8%	-8%	-8%	-4%	-4%	-4%	-4%	-8%	-8%	-8%	-9%
Colchester_NE	-8%	-8%	-8%	-8%	-8%	-8%	-16%	-16%	-16%	-16%	-16%	-16%	-16%	-8%	-8%	-8%	-8%	-8%	-4%	-4%	-4%	-4%	-8%	-8%	-8%	-9%
Colchester_NW	-8%	-8%	-8%	-8%	-8%	-8%	-16%	-16%	-16%	-16%	-16%	-16%	-16%	-8%	-8%	-8%	-8%	-8%	-4%	-4%	-4%	-4%	-8%	-8%	-8%	-9%
Colchester_S	-8%	-8%	-8%	-8%	-8%	-8%	-16%	-16%	-16%	-16%	-16%	-16%	-16%	-8%	-8%	-8%	-8%	-8%	-4%	-4%	-4%	-4%	-8%	-8%	-8%	-9%
Colchester_SE	-8%	-8%	-8%	-8%	-8%	-8%	-16%	-16%	-16%	-16%	-16%	-16%	-16%	-8%	-8%	-8%	-8%	-8%	-4%	-4%	-4%	-4%	-8%	-8%	-8%	-10%
Colchester_SW	-8%	-8%	-8%	-8%	-8%	-8%	-16%	-16%	-16%	-16%	-16%	-16%	-16%	-8%	-8%	-8%	-8%	-8%	-4%	-4%	-4%	-4%	-8%	-8%	-8%	-9%
Epping Forest	0%	0%	0%	0%	0%	0%	-8%	-8%	-8%	-8%	-8%	-8%	-8%	0%	0%	0%	0%	0%	4%	3%	4%	4%	0%	0%	0%	0%
Harlow	0%	0%	0%	0%	0%	0%	-8%	-8%	-8%	-8%	-8%	-8%	-8%	0%	0%	0%	0%	0%	4%	3%	4%	4%	0%	0%	0%	0%
Maldon	0%	0%	0%	0%	0%	0%	-8%	-8%	-8%	-8%	-8%	-8%	-8%	0%	0%	0%	0%	0%	4%	4%	4%	4%	0%	0%	0%	0%
Rochford	0%	0%	0%	0%	0%	0%	-8%	-8%	-8%	-8%	-8%	-8%	-8%	0%	0%	0%	0%	0%	4%	4%	4%	4%	0%	0%	0%	0%
Southend-on-sea	0%	0%	0%	0%	0%	0%	-8%	-8%	-8%	-8%	-8%	-8%	-8%	0%	0%	0%	0%	0%	4%	4%	4%	4%	0%	0%	0%	0%
Tendring_NE	4%	3%	3%	4%	4%	4%	-4%	-4%	-4%	-4%	-4%	-4%	-4%	4%	4%	4%	4%	4%	7%	7%	7%	7%	4%	4%	4%	4%
Tendring_NW	4%	3%	3%	4%	4%	4%	-4%	-4%	-4%	-4%	-4%	-4%	-4%	4%	4%	4%	4%	4%	7%	7%	7%	7%	4%	3%	4%	5%
Tendring_SE	4%	3%	3%	4%	4%	4%	-4%	-4%	-4%	-4%	-4%	-4%	-4%	4%	4%	4%	4%	4%	7%	7%	7%	7%	4%	4%	4%	5%
Tendring_SW	4%	3%	3%	4%	4%	4%	-4%	-4%	-4%	-4%	-4%	-4%	-4%	4%	4%	4%	4%	4%	7%	7%	7%	7%	4%	4%	4%	5%
Thurrock	0%	0%	0%	0%	0%	0%	-8%	-8%	-8%	-8%	-8%	-8%	-8%	0%	0%	0%	0%	0%	4%	4%	4%	4%	0%	0%	0%	0%
Uttlesford	0%	0%	0%	0%	0%	0%	-8%	-8%	-7%	-8%	-7%	-7%	-8%	0%	0%	0%	0%	0%	4%	3%	4%	3%	0%	0%	0%	0%
External	0%	0%	0%	0%	0%	0%	-8%	-8%	-8%	-8%	-8%	-8%	-8%	0%	0%	0%	0%	0%	4%	4%	4%	4%	0%	0%	0%	0%
Total	0%	-2%	-2%	0%	0%	0%	-10%	-9%	-9%	-9%	-9%	-10%	-10%	0%	0%	0%	0%	0%	4%	5%	5%	5%	0%	0%	0%	0%

8.6 Assignment Convergences

Achieving a good level of convergence is important for transport assignment because it increases confidence that modelled differences between scenarios are not a result of large changes between iterations, known as 'model noise'. The stability of the modelled flows must therefore be confirmed at the appropriate level before the model can be used to assess any forecasts, schemes or interventions. The convergence analysis in NEMo has been carried out using the following measures of convergence recommended in TAG:

- Proximity to the assignment objective.
- Stability of model outputs between consecutive iterations.

Proximity relates to how close the model is to a converged solution, which varies depending on the preferences of the user or software package being used. In the PTV VISUM software package Version 22 this equates to how close the model is to Wardrop's 'First Principle of Equilibrium' and is measured using the Gap function. TAG Unit M3.1 Paragraph 3.4.5 explains this principle as "Traffic arranges itself on networks such that the cost of travel on all routes used between each OD pair is equal to the minimum cost of travel and all unused routes have equal or greater cost." That is to say that "every road user selects his route in such a way that the generalised cost on all alternative routes is the same, and that switching to a different route would increase personal travel time user optimum)". Gap (denoted δ) is defined as follows:

$$\delta = \frac{\sum T_{pij} (C_{pij} - C^*_{ij})}{\sum T_{ij} C^*_{ij}}$$

Where:

- T_{pij} is the flow on route p from origin i to destination j.
- T_{ij} is the total travel from i to j.
- C_{pij} is the (congested) cost of travel from i to j on path p.
- C^*_{ij} is the minimum cost of travel from i to j.

The gap value therefore represents the excess cost incurred by failing to travel on the route with the lowest generalised cost and is expressed relative to that minimum route cost. The excess cost is summed over each route between each origin-destination (OD) pair and multiplied by the number of trips between each OD pair. This is divided by the minimum cost summed over each route between each OD pair, also multiplied by the number of trips between each OD pair.

The stability measure evaluates the magnitude of flow and cost changes on links between iterations. That is to say that these checks are undertaken to

have confidence that, if the model assignment were to continue for one additional iteration, that the flows and costs on each link would not change significantly. TAG unit M3.1 provides the convergence criteria that traffic models should aim to achieve in order to provide stable, consistent and robust results. These are presented in Table 8-21.

Table 8-21: TAG Convergence Measures

Measure	Acceptability Guideline
Delta and %GAP	Less than 0.1% or at least stable with convergence fully documented and all other criteria met
Percentage of links with flow change <1%	Four consecutive iterations greater than 98% (or higher)
Percentage of links with cost change <1%	Four consecutive iterations greater than 98% (or higher)

Convergence statistics for the final base model assignments are shown in Table 8-22.

Table 8-22: Convergence Statistics

Time Period	Iteration No.	Proximity indicator: Gap (%)	Percentage of Links with Flow Change <1% Compared to Previous Iteration	Percentage of Links with Cost Change <1% Compared to Previous Iteration	Percentage of Turns with Flow Change <1% Compared to Previous Iteration	Percentage of Turns with Cost Change <1% Compared to Previous Iteration
AM	Final – 3	13	0.00002	99.5%	99.8%	99.3%
	Final – 2	14	0.00003	99.2%	99.8%	99.1%
	Final - 1	15	0.00002	99.7%	99.9%	99.6%
	Final	16	0.00002	99.9%	99.9%	99.7%
IP	Final – 3	9	0.00001	99.4%	99.9%	99.3%
	Final – 2	10	0.00001	99.7%	100.0%	99.6%
	Final - 1	11	0.00001	99.7%	100.0%	99.7%
	Final	12	0.00001	99.7%	99.9%	99.6%
PM	Final – 3	12	0.00005	98.1%	99.6%	98.1%
	Final – 2	13	0.00004	98.6%	99.7%	98.5%
	Final - 1	14	0.00005	99.2%	99.8%	99.1%
	Final	15	0.00005	99.5%	99.9%	99.3%

The data in Table 8-22 excludes any links with a final assigned flow of less than 1 vehicle. This is so the results could not be skewed by links with 0 (or very low) flow in all iterations.

The above results show that the base model has achieved a very good level of convergence. More than 98% of links have cost and flow changes <1% throughout the final 4 iterations for all AM Peak, Inter Peak and PM Peak. Overall, this analysis provides confidence that modelled differences between scenarios when using the model for forecasting will not be a result of large changes between iterations, known as ‘model noise’.

8.7 Validation Counts

TAG Unit M3.1 provides guidelines on the validation criteria for individual links. The criteria for assessing the acceptability of the assignment are defined in Table 8-23 below and makes reference to the Geoffrey E. Havers (GEH) Statistic measuring the difference between modelled and observed flows (criteria 2). Criteria 1 is often referred to as Design Manual for Road and Bridges (DMRB) criteria.

Table 8-23: Link Validation Criteria and Acceptability Guidelines

Criteria	Description	Aspirational Quality Standards
1	Individual flows within 100 veh/h of counts for flows less than 700 veh/h	>85% of cases
	Individual flows within 15% of counts for flows from 700 to 2,700 veh/h	>85% of cases
	Individual flows within 400 veh/h of counts for flows more than 2,700 veh/h	>85% of cases
2	GEH < 5 for individual flows	>85% of cases

TAG Unit M3.1 Paragraph 3.3.10 states that these two measurement criteria are “broadly consistent and link flows that meet either criterion should be regarded as satisfactory”. TAG specifies the following guidance within Unit M3.1 Paragraph 3.3.12:

- The above criteria should be applied to both link flows and turning movements.
- The acceptability guidelines should be applied to link flows but may be difficult to achieve for turning movements.
- The comparisons should be presented for cars and total vehicles but not for light and other goods vehicles unless sufficiently accurate link counts have been obtained.
- The comparisons should be presented separately for each modelled period.
- It is recommended that comparisons using both measures are reported.

The above guidance has been followed in the reporting of highway model validation results within this chapter, apart from the flow validation of turning movements. As noted in TAG, these are difficult to achieve in strategic highway assignment models and detailed junction modelling typically follows using

junction micro-simulation models. The nature of turning count data (usually 1-day Manual Classified Counts) also limits the reliability of such comparisons.

It is also worth noting that standard base year modelling use screenlines and cordons within model calibration and validation. For the present day base year update of NEMo, these have not been used since:

- Using existing available data made it challenging to define screenlines and cordons that had either more than five links in, and / or from the same data source
- Matrices were not being developed as part of this process, nor was matrix estimation undertaken.

Table 8-24 shows a summary of the number and proportion of links meeting either of the criteria defined above. Further detail is given in Appendix B including a breakdown into individual vehicle classes. This table shows for all time periods, the validation counts are slightly below the required 85% but are within the range of 78% - 84%.

The updates to the NEMo model have included a large extension of the AoDM, with the TAG thresholds being better suited to smaller, less complex models. Given the scale and complexity of the NEMo model, a certain level of flexibility in relation to the TAG thresholds is considered acceptable.

Table 8-24: Summary of the Proportion of Validation Links within Criteria

Measure	AM Peak			
	Cars	LGV	HGV	Total Vehicles
No. links with modelled flows meeting criteria	187	232	237	233
% links with modelled flows meeting criteria	78%	97%	99%	79%
Measure	Inter Peak			
	Cars	LGV	HGV	Total Vehicles
No. links with modelled flows meeting criteria	201	236	239	248
% links with modelled flows meeting criteria	84%	98%	100%	84%
Measure	PM Peak			
	Cars	LGV	HGV	Total Vehicles
No. links with modelled flows meeting criteria	191	236	239	231
% links with modelled flows meeting criteria	80%	98%	100%	78%

The following table breaks down the validation links and shows the number and proportion meeting the two separate measures – i.e. GEH or DMRB (criteria 2 and 1 from Table 8-23).

Table 8-25: Proportion of Validation Links within Different Criteria Types

Measure	Peak Hour	No. links with modelled flows meeting criteria				% links with modelled flows meeting criteria			
		Cars	LGV	HGV	Total vehicles	Cars	LGV	HGV	Total vehicles
GEH	AM	164	204	213	199	68%	85%	89%	67%
	IP	177	213	213	216	74%	89%	89%	73%
	PM	156	208	210	194	65%	87%	88%	66%
DMRB	AM	177	232	237	217	74%	97%	99%	73%
	IP	192	236	239	240	80%	98%	100%	81%
	PM	177	236	239	218	74%	98%	100%	74%
Either Criteria	AM	187	232	237	233	78%	97%	99%	79%
	IP	201	236	239	248	84%	98%	100%	84%
	PM	191	236	239	231	80%	98%	100%	78%

The tables below show the link validation by individual district. Within Colchester, for either criterion, all time periods are 83%, which is only slightly below the required 85%. The validation of the Colchester counts is the highest within the individual three districts, which is not unexpected as Colchester was the original AoDM and was developed in detail for the 2019 base year.

Table 8-26: Summary of the Proportion of Validation Links within Criteria – Colchester

Measure	Peak Hour	No. links with modelled flows meeting criteria				% links with modelled flows meeting criteria			
		Cars	LGV	HGV	Total vehicles	Cars	LGV	HGV	Total vehicles
GEH	AM	85	107	120	99	66%	84%	94%	72%
	IP	90	113	120	97	70%	88%	94%	70%
	PM	80	114	121	89	63%	89%	95%	64%
DMRB	AM	92	122	127	107	72%	95%	99%	78%
	IP	100	125	128	109	78%	98%	100%	79%
	PM	97	126	128	106	76%	98%	100%	77%
Either Criteria	AM	100	122	127	115	78%	95%	99%	83%
	IP	108	125	128	115	84%	98%	100%	83%
	PM	103	126	128	114	80%	98%	100%	83%

Tendring again shows a reasonable level of validation, for either criteria between 77% and 85%. Due to the availability of data in Tendring, a number of observed counts were only available which didn't split the data into vehicle types. As such, there are more counts available for total vehicles rather than split into cars, LGV and HGV, which explains why the total vehicles percentage pass is out of kilter with that for individual car, LGV and HGV flows.

Table 8-27: Summary of the Proportion of Validation Links within Criteria – Tendring

Measure	Peak Hour	No. links with modelled flows meeting criteria				% links with modelled flows meeting criteria			
		Cars	LGV	HGV	Total vehicles	Cars	LGV	HGV	Total vehicles
GEH	AM	35	36	42	56	80%	82%	95%	65%
	IP	35	39	44	62	80%	89%	100%	72%
	PM	31	35	39	58	70%	80%	89%	67%
DMRB	AM	37	43	44	63	84%	98%	100%	73%
	IP	38	44	44	71	86%	100%	100%	83%
	PM	35	44	44	65	80%	100%	100%	76%
Either Criteria	AM	37	43	44	67	84%	98%	100%	78%
	IP	39	44	44	73	89%	100%	100%	85%
	PM	38	44	44	66	86%	100%	100%	77%

Braintree has the lowest level of validation, and the levels reported were only achieved by the factoring described in Section 8.5.2. However, the overall level of validation is still reasonable and falls between 71% and 83%.

Table 8-28: Summary of the Proportion of Validation Links within Criteria – Braintree

Measure	Peak Hour	No. links with modelled flows meeting criteria				% links with modelled flows meeting criteria			
		Cars	LGV	HGV	Total vehicles	Cars	LGV	HGV	Total vehicles
GEH	AM	44	61	51	44	65%	90%	75%	61%
	IP	52	61	49	57	76%	90%	72%	79%
	PM	45	59	50	47	66%	87%	74%	65%
DMRB	AM	48	67	66	47	71%	99%	97%	65%
	IP	54	67	67	60	79%	99%	99%	83%
	PM	45	66	67	47	66%	97%	99%	65%
Either Criteria	AM	50	67	66	51	74%	99%	97%	71%
	IP	54	67	67	60	79%	99%	99%	83%
	PM	50	66	67	51	74%	97%	99%	71%

8.8 Screenline Validation

The validation and the assessment of the suitability of the trip matrices in the updated NEMO model has been undertaken by comparing the assigned flows with observed counts on screenlines and cordons, using the same criteria as described in Table 8-23.

Table 8-29 to Table 8-31 below shows the performance of the highway model for the screenlines, for all vehicles, for each of the peaks. During the AM peak and IP, 88% of screenlines met either of the TAG criteria, with 81% during the PM peak.

Table 8-29: Screenline Validation Summary, All Vehicles, AM Peak

Screenline	Direction	Observed	Modelled	Difference	GEH	Either Criteria Met
Braintree	In	4597	4745	147	2.15	✓
Braintree	Out	5491	5161	-331	4.53	✓
Witham	In	1620	1830	210	5.06	✓
Witham	Out	2316	2089	-227	4.83	✓
Colchester West	EB	1785	2070	284	6.47	x
Colchester West	WB	2088	2301	212	4.53	✓
Colchester South	In	1620	1741	121	2.96	✓
Colchester South	Out	1636	1882	247	5.88	x
Colchester North	In	3000	3154	153	2.76	✓
Colchester North	Out	2693	3095	402	7.47	✓
Colchester Cordon	In	3677	3886	209	3.40	✓
Colchester Cordon	Out	3281	3473	192	3.31	✓
Tendring	EB	2302	2546	243	4.95	✓
Tendring	WB	2770	3020	251	4.66	✓
Harwich	In	485	593	108	4.65	✓
Harwich	Out	591	715	124	4.85	✓

Table 8-30: Screenline Validation Summary, All Vehicles, IP

Screenline	Direction	Observed	Modelled	Difference	GEH	Either Criteria Met
Braintree	In	3891	3852	-40	0.64	✓
Braintree	Out	3858	3744	-115	1.86	✓
Witham	In	1434	1637	203	5.18	✓
Witham	Out	1389	1413	24	0.63	✓
Colchester West	EB	1475	1586	110	2.82	✓
Colchester West	WB	1409	1555	146	3.80	✓
Colchester South	In	1245	1337	92	2.55	✓
Colchester South	Out	1251	1409	158	4.34	✓
Colchester North	In	2004	2139	134	2.95	✓
Colchester North	Out	2068	2476	408	8.56	x
Colchester Cordon	In	2588	2688	100	1.94	✓
Colchester Cordon	Out	2749	2780	31	0.59	✓
Tendring	EB	2093	2152	59	1.29	✓
Tendring	WB	2074	2234	160	3.44	✓
Harwich	In	529	434	-95	4.34	✓
Harwich	Out	556	393	-163	7.50	x

Table 8-31: Screenline Validation Summary, All Vehicles, PM Peak

Screenline	Direction	Observed	Modelled	Difference	GEH	Either Criteria Met
Braintree	In	5575	5419	-156	2.10	✓
Braintree	Out	4999	4696	-303	4.35	✓
Witham	In	2217	2440	223	4.61	✓
Witham	Out	1697	1747	50	1.21	✓
Colchester West	EB	2172	2085	-87	1.88	✓
Colchester West	WB	1769	2041	272	6.23	x
Colchester South	In	1618	1443	-175	4.46	✓
Colchester South	Out	1563	2001	438	10.37	x
Colchester North	In	2909	2978	69	1.27	✓
Colchester North	Out	2837	3464	627	11.17	x
Colchester Cordon	In	2943	3136	193	3.50	✓
Colchester Cordon	Out	3389	3582	193	3.26	✓
Tendring	EB	2999	2986	-14	0.25	✓
Tendring	WB	2572	2756	184	3.56	✓
Harwich	In	682	735	54	2.02	✓
Harwich	Out	593	540	-53	2.21	✓

8.9 Journey Time Validation

As a check on the quality of the network and the assignment, modelled and observed journey times along routes were compared against the acceptability criterion defined in Table 8-32.

Table 8-32: Journey Time Validation Criterion and Quality Guidelines

Criterion for Cordon/Screenline Flow Validation	Aspirational Quality Standards
Modelled times along routes should be within 15% of surveyed times (or 1 minute, if higher than 15%)	>85% of cases

TAG Unit M3.1 Paragraph 3.3.16 states that for validation of journey times by vehicle type, it is necessary to obtain observed journey times by vehicle type to a level of accuracy which will allow a meaningful validation. The observed journey time data was obtained from GPS data and does not contain sufficient accuracy to validate journey times by vehicle type. As such the model has been validated solely on car journey time data without separating out the journey times for goods vehicles or other vehicle classes.

The GPS data was collated and processed to form journey time routes for the Colchester Model validation process. A total of 16 bi-directional routes (giving 32 journey time routes for validation in total) have been specified for the North Essex Model and are presented in Figure 2-14. These journey time validation routes have been designed to cover as wide a range of route types as possible and cover the detailed modelled area as evenly as possible.

TAG unit M3.1 suggests that journey time routes should neither be excessively long (greater than 15km) or too short (less than 3km) and that they should not take longer to travel than about 40 minutes (so as to fit comfortably within the modelled peak hour). The summary of the validation routes and results are shown below in Table 8-33. It is noted that some of the routes exceed 15kms in length, but the margin by which these routes are above the maximum suggested journey time route length is not deemed to have a detrimental effect on their effectiveness for journey time validation. The observed journey times are also all below 40 minutes and so fit well within the modelled peak hour as required. The details for each route are shown in Table 8-34 to Table 8-36.

Table 8-33: Journey Times Comparison, Summary

Time Period	Number of Routes	Within 15%	% of Routes Meeting Criteria	Within 20%	% of Routes Within 20%
AM	32	22	69%	26	81%
IP	32	20	63%	30	94%
PM	32	21	66%	23	72%

During the AM peak, route 8 westbound on the A12 had the highest difference of -52% between observed and modelled journey times. In 2023, roadworks were present on this route, which affected the journey time validation. The A120 around Braintree was also difficult to validate against observed journey time data due to issues with link validation in Braintree.

The IP journey times show a proportionate pattern between observed and modelled data. The differences are mainly due to count validation. However, from the point where the observed data matches the modelled data, the modelled journey times follow the same pattern as the observed data. No queues or delays are present on these routes.

During the PM peak, similar to the AM peak, route 8 westbound on the A12 had the highest difference of -37% between observed and modelled journey times, again due to the roadworks. The A120 around Braintree also showed the same issues as observed in the AM peak, making it difficult to validate against observed journey time data due to issues with link validation in Braintree.

Table 8-34: Journey Times Comparison, AM Peak

Route No.	Description	AM Observed time [min:sec]	AM Modelled time [min:sec]	Difference [%]	Pass Validation Criteria
1	A134 Colchester - Northbound	23:19	20:27	-12%	✓
	A134 Colchester - Southbound	23:40	21:24	-10%	✓
2	Ipswich Colchester - Northbound	25:22	24:30	-3%	✓
	Ipswich Colchester - Southbound	23:43	21:01	-11%	✓
3	A137 Colchester - Eastbound	08:30	07:42	-9%	✓
	A137 Colchester - Westbound	09:22	08:08	-13%	✓
4	B1029 Colchester - Northbound	14:01	12:37	-10%	✓
	B1029 Colchester - Southbound	14:32	12:07	-17%	✗
5	Lexden Road - Eastbound	21:19	20:07	-6%	✓
	Lexden Road - Westbound	23:16	18:45	-19%	✗
6	Straight Road - Eastbound	10:19	10:15	-1%	✓
	Straight Road - Westbound	12:06	10:34	-13%	✓
7	A120 Colchester - Eastbound	06:48	06:09	-10%	✓
	A120 Colchester - Westbound	07:15	06:20	-13%	✓
8	A12 Colchester - Eastbound	07:53	08:26	7%	✓
	A12 Colchester - Westbound	18:25	08:49	-52%	✗
9	A133 - Eastbound	21:30	21:35	0%	✓
	A133 - Westbound	27:37	20:18	-26%	✗
10	A133 - Northbound	14:37	14:06	-3%	✓
	A133 - Southbound	18:34	17:01	-8%	✓
11	A120 Tendring - Eastbound	20:27	15:33	-24%	✗
	A120 Tendring - Westbound	18:43	17:16	-8%	✓
12	A137 Tendring - Northbound	09:30	07:11	-24%	✗
	A137 Tendring - Southbound	09:02	07:39	-15%	✓
13	Ipswich Colchester - Northbound	17:05	17:28	2%	✓
	Ipswich Colchester - Southbound	19:56	19:28	-2%	✓
14	A12 Braintree - Northbound	25:25	20:44	-18%	✗

Route No.	Description	AM Observed time [min:sec]	AM Modelled time [min:sec]	Difference [%]	Pass Validation Criteria
	A12 Braintree - Southbound	29:33	22:31	-24%	×
15	A120 Braintree - Eastbound	29:54	22:58	-23%	×
	A120 Braintree - Westbound	29:17	25:31	-13%	✓
16	A131 - Northbound	24:00	20:49	-13%	✓
	A132 - Southbound	26:05	21:45	-17%	×

Table 8-35: Journey Times Comparison, IP

Route No.	Description	AM Observed time [min:sec]	AM Modelled time [min:sec]	Difference [%]	Pass Validation Criteria
1	A134 Colchester - Northbound	18:41	18:00	-4%	✓
	A134 Colchester - Southbound	19:13	17:46	-8%	✓
2	Ipswich Colchester - Northbound	19:53	19:46	-1%	✓
	Ipswich Colchester - Southbound	18:41	18:25	-1%	✓
3	A137 Colchester - Eastbound	08:50	07:26	-16%	×
	A137 Colchester - Westbound	09:12	07:30	-19%	×
4	B1029 Colchester - Northbound	14:25	11:44	-19%	×
	B1029 Colchester - Southbound	15:19	11:43	-24%	×
5	Lexden Road - Eastbound	18:36	16:48	-10%	✓
	Lexden Road - Westbound	18:47	16:29	-12%	✓
6	Straight Road - Eastbound	10:26	09:40	-7%	✓
	Straight Road - Westbound	10:33	09:27	-10%	✓
7	A120 Colchester - Eastbound	06:40	06:06	-9%	✓
	A120 Colchester - Westbound	06:55	05:49	-16%	×
8	A12 Colchester - Eastbound	07:45	07:14	-7%	✓
	A12 Colchester - Westbound	08:16	07:28	-10%	✓
9	A133 - Eastbound	19:54	18:20	-8%	✓
	A133 - Westbound	19:23	17:11	-11%	✓
10	A133 - Northbound	14:46	12:54	-13%	✓
	A133 - Southbound	15:40	13:23	-15%	✓
11	A120 Tendring - Eastbound	19:00	15:22	-19%	×
	A120 Tendring - Westbound	18:32	15:18	-17%	×
12	A137 Tendring - Northbound	07:48	06:47	-13%	✓
	A137 Tendring - Southbound	08:22	06:47	-19%	×
13	Ipswich Colchester - Northbound	16:30	15:57	-3%	✓
	Ipswich Colchester - Southbound	14:57	15:28	3%	✓
14	A12 Braintree - Northbound	23:30	19:24	-17%	×

Route No.	Description	AM Observed time [min:sec]	AM Modelled time [min:sec]	Difference [%]	Pass Validation Criteria
	A12 Braintree - Southbound	22:06	19:01	-14%	✓
15	A120 Braintree - Eastbound	26:47	21:29	-20%	×
	A120 Braintree - Westbound	26:55	20:47	-23%	×
16	A131 - Northbound	22:35	18:58	-16%	×
	A132 - Southbound	23:01	19:34	-15%	✓

Table 8-36: Journey Times Comparison, PM Peak

Route No.	Description	AM Observed time [min:sec]	AM Modelled time [min:sec]	Difference [%]	Pass Validation Criteria
1	A134 Colchester - Northbound	22:46	20:27	-10%	✓
	A134 Colchester - Southbound	21:45	20:26	-6%	✓
2	Ipswich Colchester - Northbound	23:41	22:36	-5%	✓
	Ipswich Colchester - Southbound	26:58	21:33	-20%	✗
3	A137 Colchester - Eastbound	08:57	07:50	-12%	✓
	A137 Colchester - Westbound	09:21	07:59	-15%	✓
4	B1029 Colchester - Northbound	13:13	12:20	-7%	✓
	B1029 Colchester - Southbound	14:59	12:21	-18%	✗
5	Lexden Road - Eastbound	25:58	19:38	-24%	✗
	Lexden Road - Westbound	24:23	18:50	-23%	✗
6	Straight Road - Eastbound	11:53	10:44	-10%	✓
	Straight Road - Westbound	10:50	10:13	-6%	✓
7	A120 Colchester - Eastbound	09:14	06:38	-28%	✗
	A120 Colchester - Westbound	06:46	05:51	-13%	✓
8	A12 Colchester - Eastbound	08:32	08:30	0%	✓
	A12 Colchester - Westbound	12:30	07:54	-37%	✗
9	A133 - Eastbound	25:52	22:06	-15%	✓
	A133 - Westbound	24:28	20:17	-17%	✗
10	A133 - Northbound	15:42	16:16	4%	✓
	A133 - Southbound	16:06	15:07	-6%	✓
11	A120 Tendring - Eastbound	19:15	16:26	-15%	✓
	A120 Tendring - Westbound	17:29	15:20	-12%	✓
12	A137 Tendring - Northbound	08:43	07:31	-14%	✓
	A137 Tendring - Southbound	08:44	07:37	-13%	✓
13	Ipswich Colchester - Northbound	24:02	18:04	-25%	✗
	Ipswich Colchester - Southbound	15:13	16:28	8%	✓
14	A12 Braintree - Northbound	36:31	24:24	-33%	✗

Route No.	Description	AM Observed time [min:sec]	AM Modelled time [min:sec]	Difference [%]	Pass Validation Criteria
	A12 Braintree - Southbound	22:34	20:09	-11%	✓
15	A120 Braintree - Eastbound	32:36	23:41	-27%	×
	A120 Braintree - Westbound	29:55	22:54	-23%	×
16	A131 - Northbound	25:38	23:54	-7%	✓
	A132 - Southbound	24:35	21:07	-14%	✓

Comparison of the observed journey times to the modelled journey times show that for all time periods, the model falls short of the TAG recommendations for within 15% difference. However, all peak hours improve when looking at a difference of 20%, with the IP achieving a 94% pass, and the AM peak 81%, and the PM peak 72%.

Throughout all of 2023, the A12, between J25 (Marks Tey) and J26 (Stanway) had reconstruction works being undertaken, which involved narrow lanes and a speed reduction. This construction zone expanded to allow traffic to slow down appropriately so didn't just cover the area between J25 and J26. This has been represented in NEMo. This roadworks would have had a knock-on effect of travel times and routing on the SRN and Colchester and would influence the reliability of the observed journey times.

Whilst NEMo has introduced reduced speeds and lower capacity on the A12 section, this has not had too much of an impact on route choice and would contribute to the lower levels of journey time validation in NEMo compared to the CTM.

In addition to the comparisons above, Appendix C shows the journey time graphs (plotting time against distance for the modelled and observed data) for all routes in the model. As above, the majority of the routes show a good match in journey times along the whole length of these routes, not just as a comparison of total times.

8.10 Comparison to CTM

Figure 8-1 and Figure 8-2 show the flow difference between the NEMo and the old CTM in the Colchester area. There is a noticeable decrease on the High Street since it has been closed to traffic and a general slight increase in the rest of the network. In the AM peak, there is a decrease of about 100 vehicles on the

A12 Westbound direction, that traffic is now using the parallel A133 route. During both peak hours, the A12 north-west of Colchester is showing an increase in traffic, even with the J25-J26 roadworks, as mentioned above.

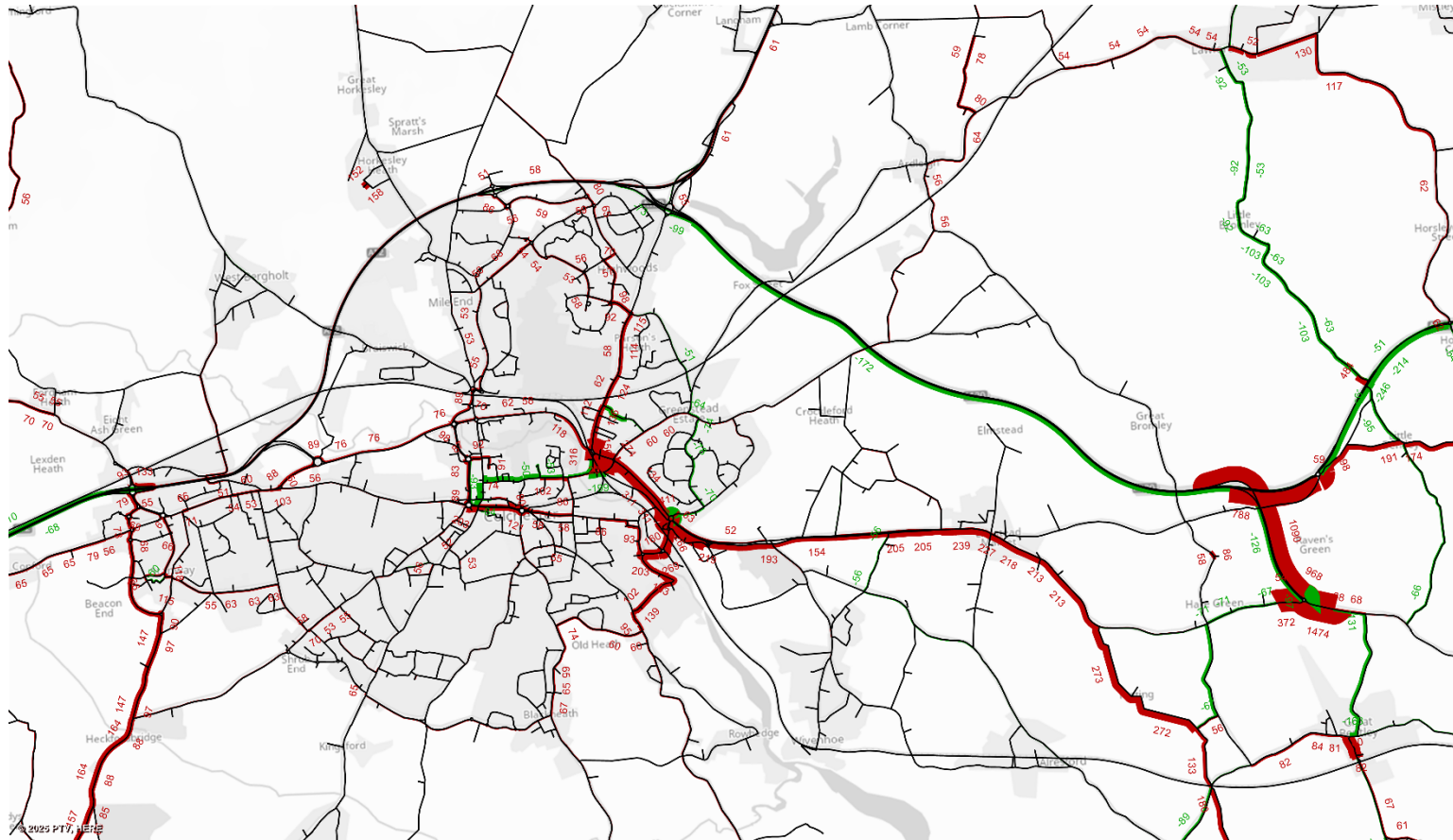


Figure 8-1: Flow Difference Plot – 2023 NEMo vs 2019 CTM – AM Peak



Figure 8-2: Flow Difference Plot – 2023 NEMo vs 2019 CTM – PM Peak

9 Public Transport Validation

9.1 Introduction

The public transport assignment in the 2019 CTM was validated in accordance with TAG Unit 3-2 “Public Transport Assignment Modelling”. This comprised three types of checks:

- Network and service validation.
- Validation of trip matrix.
- Assignment validation.

Accordingly, the NEMo revalidation process considers checks for each of these aspects – with the constraint of using aggregated bus journey data which is not disaggregated by route or stop.

9.2 Network Validation

Section 7 summarised the changes to the bus and rail networks that were made.

9.2.1 Uncongested Bus Journey Times

TAG recommends that the validation checks should focus on the accuracy of the modelled journey times or speeds of the public transport journeys.

Generally, public transport journey times are defined by the accuracy of the coded timetables. In addition, in the North Essex Model, the bus speeds are linked to highway speeds to allow the impact of congestion on bus journey times in model forecasts.

9.2.2 Congested Bus Journey Times

The in-vehicle time within the core model area which use the highway congested journey times, was calibrated against the timetable journey times.

The detailed methodology and process for this is contained in the CTM Model Development and Validation Report.

The resulting modelled journey times have been compared with the timetabled times in Table 9-1 below.

Table 9-1: Modelled vs Timetabled Bus Journey Times

Criteria	Full Model	%	Colchester	%
AM Peak				
Total Bus Transit Lines Passing	606	98.1%	141	97.2%
Total Bus Transit Lines Failed	10	1.6%	4	2.8%
Total Transit Lines	618	99.7%	145	100.0%
Inter-peak				
Total Transit lines Passing	529	94.0%	120	90.9%
Total Transit Lines Failed	34	6.0%	12	9.1%
Total Transit Lines	563	100.0%	132	100.0%
PM Peak				
Total Transit lines Passing	465	97.7%	110	95.7%
Total Transit Lines Failed	11	2.3%	5	4.3%
Total Transit Lines	476	100.0%	115	100.0%

Overall, the calibrated time function returns 98.1% (97.2% within Colchester) of bus routes within 15% or less than one-minute difference from the timetabled times in the AM peak. Inter-peak and PM peak network results are equally good with the Colchester area reaching 90.9% and 95.7% fit respectively. Table 9-2 shows the modelled vs timetable difference for journey time bands.

Table 9-2: Modelled vs Timetabled Journey Times by Band

Journey Time Difference [%]		Full Model	%	Colchester Area	%
AM Peak					
>=0	<=5	591	95.6%	140	96.6%
>5	<=10	7	1.1%	1	0.7%
>10	<=15	8	1.3%	0	0.0%
>15	<=20	1	0.2%	0	0.0%
>20	<=100	9	1.5%	4	2.8%
Total		616	99.7%	145	100%
>=0	<=5	509	90.4%	117	88.6%
>5	<=10	14	2.5%	3	2.3%
>10	<=15	6	1.1%	0	0.0%
>15	<=20	1	0.2%	0	0.0%
>20	<=100	31	5.5%	10	7.6%
Total		561	99.6%	130	98.5%
>=0	<=5	441	92.6%	108	93.9%
>5	<=10	12	2.5%	2	1.7%
>10	<=15	12	2.5%	0	0.0%
>15	<=20	1	0.2%	0	0.0%
>20	<=100	8	1.7%	3	2.6%
Total		474	99.6%	113	98.3%

The analysis between the modelled and the observed bus journey times in Table 9-2 shows that the majority of the bus services remains within the 0 and 5% threshold for the whole model and the Colchester area across all time periods.

9.2.3 Average Congested Bus Speeds by Bus Operator

The modelled bus transport services were inspected for unexpected, congested speeds. The following image, Figure 9-1, shows the minimum, average and maximum speeds per operator, ordered by 'average of average' speed.

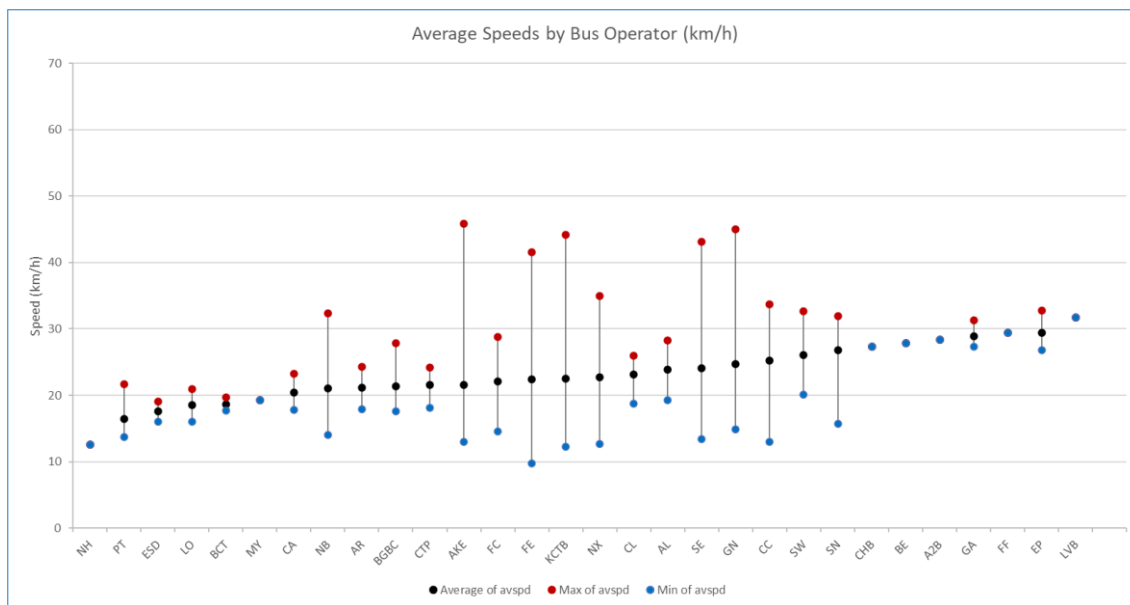


Figure 9-1: Average Congested Bus Speeds by Bus Operator

This analysis shows a satisfactory spread of range speeds by operator. As expectable the National Express coach services denote the higher average speed and it was found legitimate due to the fact that these services will share the fastest highway routes.

9.2.4 Maximum Average Speed on Public Transport Links

The maximum average speed at links were inspected for bus and coach modes ensuring that the modelled transit speeds will concur with the congested transit time functions.

Figure 9-2 shows the maximum average speed on bus and coach links showing a maximum average speed not more than 96km/h.



Figure 9-2: Maximum Average Link Speed, Bus and Coach

9.2.5 Bus Route Geometry

The bus route geometry was checked, and updated where necessary, for the bus routes summarised in Table 9-3.

Table 9-3: Key Bus Routes

Service	Description
P&R	Colchester High Street-Park & Ride
1	Hamlet Drive-Worthington Way
2	Great Horkesley-Highwoods Square
4	Hythe-Sainsburys Lane
8	Gosfield Road-Highwoods Square
11	Railway Station-Railway Station
67	High Street-Osborne Street
70	Market Hill-Osborne Street
75	New Times-Osborne Street
76	Stanwell Street-Jackson Road
93	Burnes-Osborne Street
754	Burnes-Osborne Street

The validation of bus routes was achieved by comparing the mapping of the routes held by ECC and comparing with those coded in the model through the automated processes. The figure below shows an example of the validation of the Park & Ride bus route. The full set of figures is presented in Appendix D.

Observed



Modelled

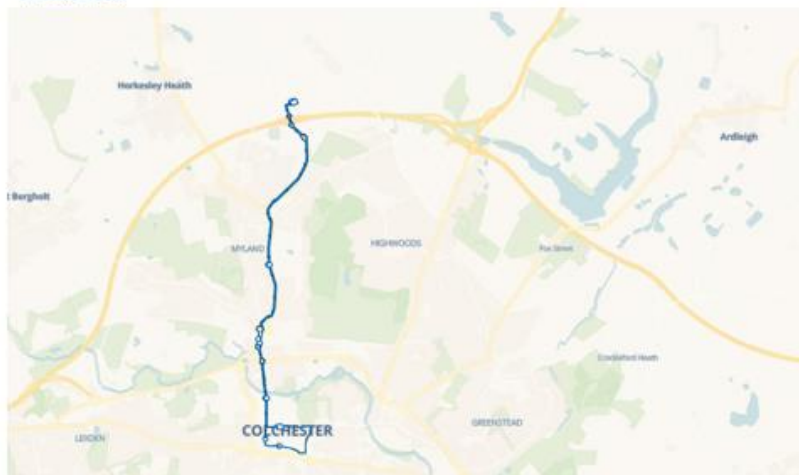


Figure 9-3: Example Bus Route Validation

9.2.6 Rail Network Validation

Rail modelled journey times between stops were updated based on the CIF timetables in 2023, from the following source: <https://www.realtimetrains.co.uk/>. As the rail mode is physical separated from other modes, no further adjustments were necessary.

The validation of the modelled and observed journey times of the Greater Anglia services to and from Liverpool Street Station is presented in Table 9-4 and Table 9-5 respectively, with other destinations to/from Colchester shown in Table 9-6.

The 2023 PM rail journey times validation showed a couple of rail services that failed the journey time criteria; however, the majority of the PM rail services between Colchester and London and other locations showed good performance. Both the AM and IP validation is good.

Table 9-4: Validation of Rail Journey Times to London

Line description	Train	Observed [min]	Modelled [min]	Diff [min]	Diff [%]	Criteria
AM Peak						
Clacton-on-Sea - London Liverpool Street	1N11	99.0	94.0	-5	-5.05%	Pass
Clacton-on-Sea - London Liverpool Street	1N13	91.0	95.5	4.5	4.95%	Pass
Clacton-on-Sea - London Liverpool Street	1N15	95.0	100.5	5.5	5.79%	Pass
Clacton-on-Sea - London Liverpool Street	1N29	96.0	107.0	11	11.46%	Pass
Norwich - London Liverpool Street	1P03	112.0	116.5	4.51	4.03%	Pass
Ipswich - London Liverpool Street	1Y05	80.0	87.0	7	8.75%	Pass
Ipswich - London Liverpool Street	1Y95	81.0	92.0	11	13.58%	Pass
Colchester Town - London Liverpool Street	1F91	66-86	73.0	-	-	Pass
Clacton-on-Sea - London Liverpool Street	1N07	94.0	93.0	-1	-1.06%	Pass
Clacton-on-Sea - London Liverpool Street	1N03	96.0	102.5	6.5	6.77%	Pass
Colchester Town - London Liverpool Street	1F25	66-86	78.5	-	-	Pass
Colchester Town - London Liverpool Street	1F07	81.0	78.5	-2.5	-3.09%	Pass
Harwich - London Liverpool Street	1A27	111.0	96.5	-14.5	-13.06%	Pass
Inter-peak						
Clacton-on-Sea - London Liverpool Street	1N37	86	87.5	1.5	1.74%	Pass
Norwich - London Liverpool Street	1P19	109	111.0	1.99	1.83%	Pass
Norwich - London Liverpool Street	1P21	109	104.5	-4.49	-4.12%	Pass
Ipswich - London Liverpool Street	1Y43	81	82.5	1.5	1.85%	Pass
Colchester Town - London Liverpool Street	1F35	68	71.5	3.49	5.13%	Pass
Colchester Town - London Liverpool Street	2F51	69	72.0	3	4.35%	Pass
PM Peak						
Norwich - London Liverpool Street	1P45	108	106.5	-1.5	-1.39%	Pass
Norwich - London Liverpool Street	1P47	111	115.0	4.0	3.60%	Pass
Norwich - London Liverpool Street	1P55	110	112.5	2.5	2.27%	Pass
Clacton-on-Sea - London Liverpool Street	2N13	88	90.0	2	2.27%	Pass
Colchester Town - London Liverpool Street	2F71	74	76.5	2.5	3.38%	Pass
Ipswich - London Liverpool Street	1Y49	88	84.5	-3.51	-3.99%	Pass
Clacton-on-Sea - London Liverpool Street	1N51	86	88.5	2.5	2.91%	Pass
Braintree - London Liverpool Street	1F61	62	60.5	-1.5	-2.42%	Pass
Braintree - London Liverpool Street	1F57	62	62.5	0.49	0.79%	Pass
Colchester - London Liverpool Street	1F55	57	60.5	3.5	6.14%	Pass
Colchester Town - London Liverpool Street	1F53	71	71.0	0.01	0.01%	Pass
Colchester Town - London Liverpool Street	1F49	71	73.5	2.5	3.52%	Pass

Line description	Train	Observed [min]	Modelled [min]	Diff [min]	Diff [%]	Criteria
Norwich - London Liverpool Street	1P57	107	110.0	3	2.80%	Pass

Table 9-5: Validation of Rail Journey Times from London

Line description	Train	Observed [min]	Modelled [min]	Diff [min]	Diff [%]	Criteria
AM Peak						
London Liverpool Street - Clacton-on-Sea	1N06	88.0	92.0	4.01	4.56%	Pass
London Liverpool Street - Clacton-on-Sea	1N16	86.0	91.0	5	5.81%	Pass
London Liverpool Street - Norwich	1P06	107.0	109.5	2.52	2.36%	Pass
London Liverpool Street - Norwich	1P10	105.0	109.5	4.5	4.29%	Pass
London Liverpool Street - Norwich	1P12	108.0	114.5	6.52	6.04%	Pass
London Liverpool Street - Ipswich	1Y10	82.0	85.5	3.5	4.27%	Pass
London Liverpool Street - Colchester	1F14	76.0	72.0	-4	-5.26%	Pass
London Liverpool Street - Colchester	2F30	71.0	73.5	2.5	3.52%	Pass
London Liverpool Street - Ipswich	1Y08	82.0	87.5	5.5	6.71%	Pass
London Liverpool Street - Clacton-on-Sea	1N12	88.0	91.5	3.5	3.98%	Pass
London Liverpool Street - Colchester Town	1F08	72.0	76.0	4	5.56%	Pass
London Liverpool Street - Norwich	1P08	109.0	114.0	5	4.59%	Pass
Inter-peak						
London Liverpool Street - Norwich	1P18	104	106.0	2.01	1.93%	Pass
London Liverpool Street - Norwich	1P20	111	111.0	0	0.00%	Pass
London Liverpool Street - Norwich	1P40	110	108.5	-1.5	-1.36%	Pass
London Liverpool Street - Colchester Town	2F68	71	71.5	0.5	0.70%	Pass
London Liverpool Street - Ipswich	1Y22	82	83.5	1.5	1.83%	Pass
London Liverpool Street - Clacton-on-Sea	1N28	86	87.5	1.5	1.74%	Pass
PM Peak						
London Liverpool Street - Norwich	1P42	108	113.0	5.00	4.63%	Pass
London Liverpool Street - Norwich	1P46	108	104.0	-4.00	-3.70%	Pass
London Liverpool Street - Ipswich	1Y48	76	80.5	4.50	5.92%	Pass
London Liverpool Street - Ipswich	1Y24	83	85.5	2.50	3.01%	Pass
London Liverpool Street - Clacton-on-Sea	1N50	88	95.5	7.50	8.52%	Pass
London Liverpool Street - Clacton-on-Sea	1N46	91	93.0	1.99	2.19%	Pass
London Liverpool Street - Clacton-on-Sea	1N44	87	97.5	10.50	12.07%	Pass
London Liverpool Street - Clacton-on-Sea	1N40	93	93.0	0.00	0.00%	Pass
London Liverpool Street - Clacton-on-Sea	1N38	88	92.5	4.50	5.11%	Pass

Line description	Train	Observed [min]	Modelled [min]	Diff [min]	Diff [%]	Criteria
London Liverpool Street - Colchester Town	1F44	78	73.5	-4.50	-5.77%	Pass
London Liverpool Street - Colchester Town	1F32	75	71.5	-3.51	-4.68%	Pass
London Liverpool Street - Harwich International	1A94	83	89.5	6.50	7.83%	Pass

Table 9-6: Colchester Services Journey Time Validation

Line description	Train	Observed [min]	Modelled [min]	Diff [min]	Diff [%]	Criteria
AM Peak						
Clacton-on-Sea - Colchester	1N25	28	28.0	0	0.00%	Pass
Walton-on-Waze - Colchester	2F13	55	52.0	-3	-5.45%	Pass
Walton-on-Waze - Colchester	2N27	42	36.0	-6	-14.29%	Pass
Colchester Town - Colchester	2F21	7	9.5	2.5	35.71%	Fail
Braintree - Colchester	2F00	36-53	33.5	-2.5	-6.94%	Pass
Colchester - Walton-on-Naze	2F12	57	54.0	-3	-5.26%	Pass
Colchester - Colchester Town	2F20	7	8.5	1.5	21.43%	Fail
Inter-peak						
Colchester - Walton-on-Naze	2F26	57	57.5	0.5	0.88%	Pass
Colchester - Colchester Town	2F28	7	8.5	1.5	21.43%	Fail
Walton-on-Waze - Colchester	2F29	54	53.5	-0.5	-0.93%	Pass
Colchester Town - Colchester	2F25	7	8.5	1.5	21.43%	Fail
PM Peak						
Walton-on-Waze - Colchester	2F65	55	53.5	-1.5	-2.73%	Pass
Colchester Town - Colchester	2F75	7	8.5	1.5	21.43%	Fail
Colchester - Walton-on-Naze	2F62	57	58.5	1.5	2.63%	Pass
Colchester - Colchester Town	2F78	7	9.5	2.5	35.71%	Fail
Ingatestone - Colchester	2F66	60	60.5	0.5	0.83%	Pass

The next section describes the steps undertaken to calibrated and validate the assignment models.

9.2.7 Model Zones Connected

Updated and new model zones were checked to verify that these zones are reachable by the public transport network, ensuring that all public transport trips to and from zones will successfully be assigned, and avoiding excessive generalised costs from the model.

9.3 Changes to the Public Transport Matrices

Section 3 explained that rail station usage data was obtained but the only intelligence on bus patronage was gleaned from aggregated regional and countywide data. An overall decrease in rail usage across the county of 31% was recorded; meanwhile it could be expected that bus journeys could have decreased between 20-30%.

The footnotes in Section 4.1 explain that the model uses rail and bus matrices – which overlap to provide three categories of users:

- rail only users
- bus only users
- combined rail and bus users

The 24-hour rail matrix was updated to converge on the new station usage data. This process does not alter the underlying matrix distribution and involves applying an algorithm to iterate on the target value for entries and exits for each station. The next section presents analysis showing how closely the altered rail matrices match entries and exits over a typical 24-hour period. The 24-hour matrices are then divided by factors calculated for the CTM to derive average AM, inter- and PM peak rail patronage.

The altered rail matrix, however, impacts the bus matrix because of the overlap. We observed that the bus patronage had decreased by 29%. This was within the range of 20-30% that was expected. Although it is at the higher end of the reduction expected, this was considered preferable to being at the higher end. This is because the public transport model can be used to advise on viability of public transport changes; for which it is better to build in caution into forecasts.⁶

Accordingly, after the process of altering rail matrices, no further changes were considered required – that is, both rail and bus use had been acceptably adjusted to reflect 2023 levels.

⁶ As the public transport model does not include crowding, lower than actual public transport demand will not unrealistically attract new users to public transport.

9.4 Validation Results

9.4.1 Rail Station Benchmark Calibration/Validation

Office of Rail and Road (ORR) Rail Station Usage data was used as a benchmark of rail boarders and alighters by rail station within Essex. Table 9-7 shows the comparison between the ORR data and the modelled rail demand for the stations served by the Greater Anglia trains in the CTM Fully Modelled Area.

Table 9-7: Observed and Modelled Rail Demand

Station Description	Observed Daily Rail Station Usage			24hr Adjusted Rail Demand			Criteria	
	Entries	Exits	Total	Entries	Exits	Total	% Diff	GEH
COLCHESTER BR	5,688	5,688	11,377	5,868	6,192	12,060	6.0%	6.3
COLCHESTER TOWN	985	985	1,970	975	691	1,665	-15.5%	7.1
CHELMSFORD	9,664	9,664	19,328	9,831	9,571	19,402	0.4%	0.5
MARKS TEY	681	681	1,361	667	963	1,630	19.7%	6.9
WITHAM	2,751	2,751	5,503	2,765	2,737	5,502	0.0%	0.0
WIVENHOE	465	465	929	501	434	935	0.6%	0.2
MANNINGTREE	1,305	1,305	2,610	1,290	1,326	2,616	0.2%	0.1
KELVEDON	824	824	1,648	805	802	1,608	-2.4%	1.0
HYTHE(ESSEX)	435	435	870	452	288	739	-15.0%	4.6
BRAINTREE	889	889	1,778	604	725	1,329	-25.2%	11.4
BRAINTREE FREEPORT	180	180	360	205	157	362	0.4%	0.1
IPSWICH	4,402	4,402	8,805	4,389	4,389	8,778	-0.3%	0.3
CLACTON-ON-SEA	1,171	1,171	2,342	1,175	1,169	2,344	0.1%	0.0
BURES	75	75	151	62	88	150	-0.8%	0.1
CHAPPEL& WAKES COLNE	47	47	94	47	46	93	-0.5%	0.0
CRESSING	66	66	133	67	64	131	-1.3%	0.1
HATFIELD PEVEREL	489	489	978	489	473	962	-1.7%	0.5
SUDBURY SUFFOLK	461	461	923	435	409	844	-8.6%	2.7
WHITE NOTLEY	13	13	27	16	11	27	0.7%	0.0
ALRESFORD (ESSEX)	107	107	214	122	55	177	-17.7%	2.7
GREAT BENTLEY	110	110	220	114	105	218	-0.8%	0.1

Station Description	Observed Daily Rail Station Usage			24hr Adjusted Rail Demand			Criteria	
THORPE-LE-SOKEN	200	200	400	170	207	377	-5.7%	1.2
WRABNESS	34	34	68	31	34	65	-4.3%	0.4
HARWICH INT.	159	159	317	172	146	318	0.3%	0.1
FRINTON-ON-SEA	265	265	529	272	258	530	0.1%	0.0
MISTLEY	82	82	163	72	85	157	-3.6%	0.5
KIRBY CROSS	83	83	166	81	87	168	1.2%	0.2
WALTON-ON-THE-NAZE	184	184	368	183	185	368	-0.1%	0.0
WEELEY	54	54	108	54	35	89	-17.8%	1.9
TOTAL	31,870	31,870	63,741	31,912	31,733	63,645	-0.1%	0.4

Overall, the rail calibration results show a good performance between the observed counts and the modelled results across all stations. It is worth recognising calibration at Colchester town centre rail station has been challenging due to the fact that there is a high bus frequency link between Colchester main Station and Colchester Town.

9.4.2 High-Level Bus Validation at Colchester Town Centre

The performance of the bus trip matrices was assessed against the available bus data from 2019. Since the number of bus trips in the bus matrix reduced by approximately 29%, we would expect to see change in the order of 30%, noting that there will be local variations.

The new bus matrices were assigned to the network, which allowed the extraction of bus boarders and alighters in Colchester Town Centre for the cordoned bus stops presented in the Figure 9-4.

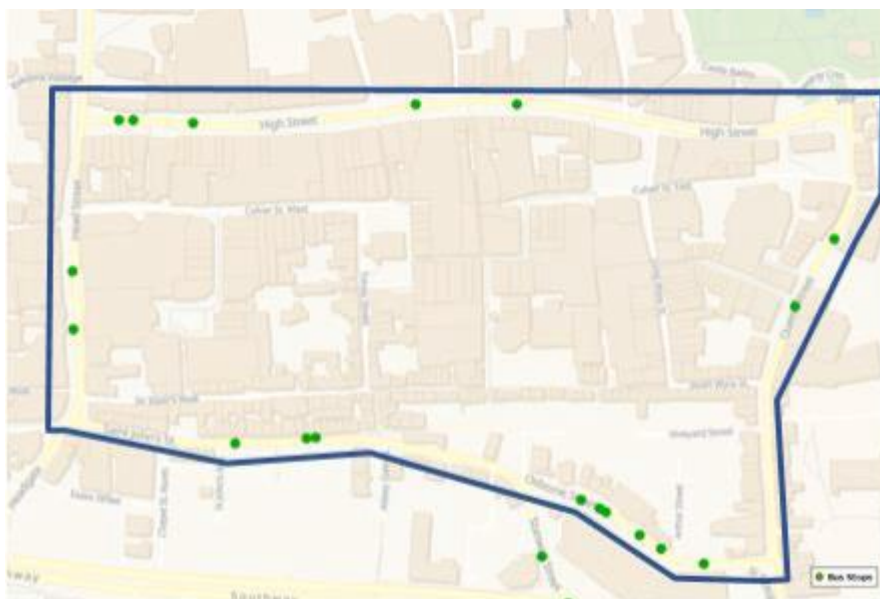


Figure 9-4 - Colchester Town Centre bus stops

The assigned demand from the area corresponding to this data was then extracted from the model and the figures compared against the observed data. Table 9-8 shows an overall model total boardings difference of -33.6% compared to the observed boardings at Colchester Town Centre in 2019. This significant decrease aligns with the changes made to the matrix in the bus boardings, as these modes of transport are often interconnected.

Table 9-8 – Comparison of Colchester Town Centre Bus Boardings (2019 vs Model)

Description	Boards	Alights	Total
Colchester Town Centre Observed (2019)	13,960	13,960	27,920
Colchester Town Centre Modelled	10,095	8,441	18,536
Difference: Observed vs Modelled	-27.69%	-39.54%	-33.61%

10 Summary of Model Development and Standards Achieved

10.1 Summary of Model Development

The North Essex Model has been updated in line with current best practice and informed by reliable data sources. The updates included:

- Traffic counts
- Braintree AoDM
- Tendring AoDM
- New zones in the AoDM
- Update connectors
- Updated PPM/PPK values according to latest TAG
- PT updates

The model has been developed in line with the principles set out in TAG and validate to a good standard. The summary of standards achieved is presented in the next section.

10.2 Summary of Standards Achieved

10.2.1 Highway Assignment Model

The work outlined in Chapter 8 gives confidence that the Highway Assignment Model network is free of serious gaps that could significantly affect conclusions drawn from assignment and forecasting results.

The highway validation standards achieved (compared to TAG guidance) for the traffic volume and journey time benchmarks showed:

- The validation counts perform slightly below the required TAG criteria, but within the range of 78-84%
- Journey times perform slightly below the required TAG criteria when looking at a 15% difference. Analysis of a 20% difference shows more routes meeting this criterion.

The updates to NEMo have included a large extension of the AoDM, with the TAG thresholds being better suited to smaller, less complex models. Given the scale and complexity of the NEMo model, a certain level of flexibility in relation to the TAG thresholds is considered acceptable.

It has been demonstrated that the development of the North Essex Model has been constructed in a manner consistent with guidance. TAG principles have

been followed to enable reporting of the highway assignment model validation quality in a way consistent with that set out in Unit M3.1, and Unit 4, Appendix B. Table 10-1 below summarises how the model has actually performed against those standards.

Table 10-1: Summary of Achieved Highway Model Standards

Model Element	Criterion	Acceptability Guideline	Actual model performance
Assignment convergence	Delta and %GAP	Less than 0.1%	GAP value of less than 0.1% met in all time periods.
Link validation	Within 100 veh/hr of counts for flows less <700 veh/hr	> 85% of cases	AM peak: > 78% criteria met for car flows and 79% for total vehicles Interpeak: > 84% criteria met for car flows and total vehicles PM peak: > 80% criteria met for car flows and 78% for total vehicles.
	Within 15% of counts for flows 700-2,700 veh/hr	> 85% of cases	
	Within 400 veh/hr of counts for flows >2,700 veh/hr	> 85% of cases	
	GEH < 5 for individual flows	> 85% of cases	
Journey times	Modelled times along routes should be within 15% of surveyed time, or 1 minute if higher	> 85% of cases	69%, 63% and 66% of journey time routes in the AM, IP and PM respectively are within criteria.
Journey times	Modelled times within 20% of surveyed time, or 1 minute if higher		81%, 94% and 72% of journey time routes in the AM, IP and PM respectively are within criteria.

10.2.2 Public Transport Assignment Model

The extensive network validation checks undertaken and presented in this document during the model update provide high confidence in the quality and reliability of the generalised costs skims obtained from this model.

Modelled journey times on the bus network including congested highway auto times perform well in agreement with journey time validation criteria. Speed checks show a reasonable range without outrageous results or outliers across all networks. Modelled journey times on the rail network meets the expectations for all Colchester train services from and to London as presented in the public transport validation section.

The summary is provided in Table 10-2.

Table 10-2: Summary of Achieved Public Transport Model Standards

Model Element	Criterion	Acceptability Guideline	Actual model performance
Journey times	Modelled times along routes should be within 15% of timetables time, or 1 minute if higher	> 85% of cases	97%, 91% and 96% of journey time routes in the AM, IP and PM respectively are within criteria.

10.3 Conclusion

NEMo encompasses a large geographic area at different levels of detail so is not expected to reach levels of validation achieved in smaller, less complex models. With this in mind, the overall level of validation is considered acceptable to test strategic and specific interventions in relation to Local Plan spatial options. Overall, the representation of highway and public transport use reflects real conditions and changes since 2019; and the model is considered to provide a sound basis to use to test overall impact of spatial options and strategic transport interventions.

It is acknowledged that whilst NEMo is fit for testing the Local Plan spatial options, as specific developments and mitigation measures come forward, it would be appropriate to complement NEMo by microsimulation models to provide an even higher level of assurance.

Appendices (available separately)

Appendix A: Route Choice Comparisons

Appendix B: Link Validation

Appendix C: Journey Time Validation

Appendix D: Bus Route Validation