TECHNICAL NOTE

BSTM2 Present Year Validation (PYV)

SUBJECT
Present Year (2024) Data Analysis and Trends

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Client signoff

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1. Introduction

1.1 Background

In March 2024, AtkinsRéalis was commissioned by Buckinghamshire Council (BC) to update the Buckinghamshire Strategic Transport Model (BSTM) including the addition of public transport proxy representation, variable demand model and additional data in certain areas. At the time of the commission, it was decided that the baseline year would be retained as 2019 and the work to update this model, known as the BSTM2, was completed in March 2025. Following this, a period of BETA testing was planned before adoption scheduled for Autumn 2025. However, before adoption, additional advice from BC was received to ensure the model best supports the range of teams and uses. As a result, it was recommended the BSTM2 baseline year should be updated to 2024 for which AtkinsRéalis provided several high-level options for how this could be undertaken.

Following internal discussions with BC, it was agreed that the Present Year Validation (PYV) approach would be used to validate the BSTM2 model against 2024 conditions, while retaining the 2019 baseline. This option represented the most suitable way to make the needed model updates to support development management purposes in line with Local Plan timescales.

1.2 Purpose

BSTM2 PYV will be broadly conducted in three phases as mentioned below:

- Phase 1 - Traffic data collection and processing;
- Phase 2 - 2024 PYV; and
- Phase 3 - Model Forecast for 2045.

This current technical note summarises the outcome from Phase 1 of the BSTM2 PYV, which includes processing and analysis of traffic and travel data for 2024. Phase 1 covers the following:

- Purchasing and processing of TomTom journey time data for twenty (20) two-way routes;
- Collating and processing of 51 traffic count sites in 2019 (or adjacent years) for pre-COVID-19 situation;
- Collating and processing of 51 traffic count sites in 2024 (or adjacent years) for post-COVID-19 situation;
- Analysing the National Travel Survey (NTS) data to understand the travel behaviour post-COVID-19;
- Comparisons of 2024 traffic data against 2019 traffic data to understand the differences; and
- Model updates recommended to develop BSTM2 2024 PYV.

1.3 Document structure

The remainder of this report is structured as follows:

- Section 2 - Study area;
- Section 3 - Data collection;
- Section 4 - Data processing;
- Section 5 - Data comparison - 2019 vs 2024; and
- Section 6 - Conclusions.

2. Study area

The BSTM2 PYV study area aligns with the existing BSTM2 study area as shown in Figure 2-1. This figure highlights both the Area of Detailed Modelling (AoDM) and the Fully Modelled Area (FMA). Table 2-1 provides an overview of the model functions associated with each area type.

The analysis and comparison of traffic counts and journey time data, outlined in the following sections, is focused on five Areas of Model Improvement (AoMIs) within the AoDM, including Aylesbury, High Wycombe, Marlow, Bourne End, and Buckingham, as illustrated in Figure 2-2.

Table 2-1 - Geographical coverage and model functionality by area type

Area Type	Areas Covered	Detail level
Internal: Area of Detailed Modelling (AoDM)	Within the Buckinghamshire unitary authority boundary	This is the area over which significant impacts of interventions are certain and the modelling detail in this area would be characterised by: representation of all trip movements; small zones; very detailed networks; and junction modelling using Intersection Capacity Analysis (ICA);
Rest of Fully Modelled Area (RoFMA)	Outside and nearby the Buckinghamshire unitary authority boundary (average distance 20 km)	Area over which the impacts of interventions are considered to be quite likely, but relatively weak in magnitude and would be characterised by: representation of all trip movements; somewhat larger zones and less network detail than for the AoDM; the traffic delay calculation is only based on volume delay function (VDF) at links.
Bulge Area	Milton Keynes, Bicester, Slough, West Drayton	Areas that lie on edge of AoDM and have higher network density than compared to RoFMA. The characteristics of network elements are same as RoFMA.
Wider External Area	Rest of Country	Area where impacts of interventions would be so small as to be reasonably assumed to be negligible and would be characterised by a buffer network representing a large proportion of the rest of Great Britain, a partial representation of demand (trips to, from and across the Fully Modelled Area); large zones; skeletal networks and fixed speed modelling.

Figure 2-1 - BSTM2 PYV Fully Modelled Area

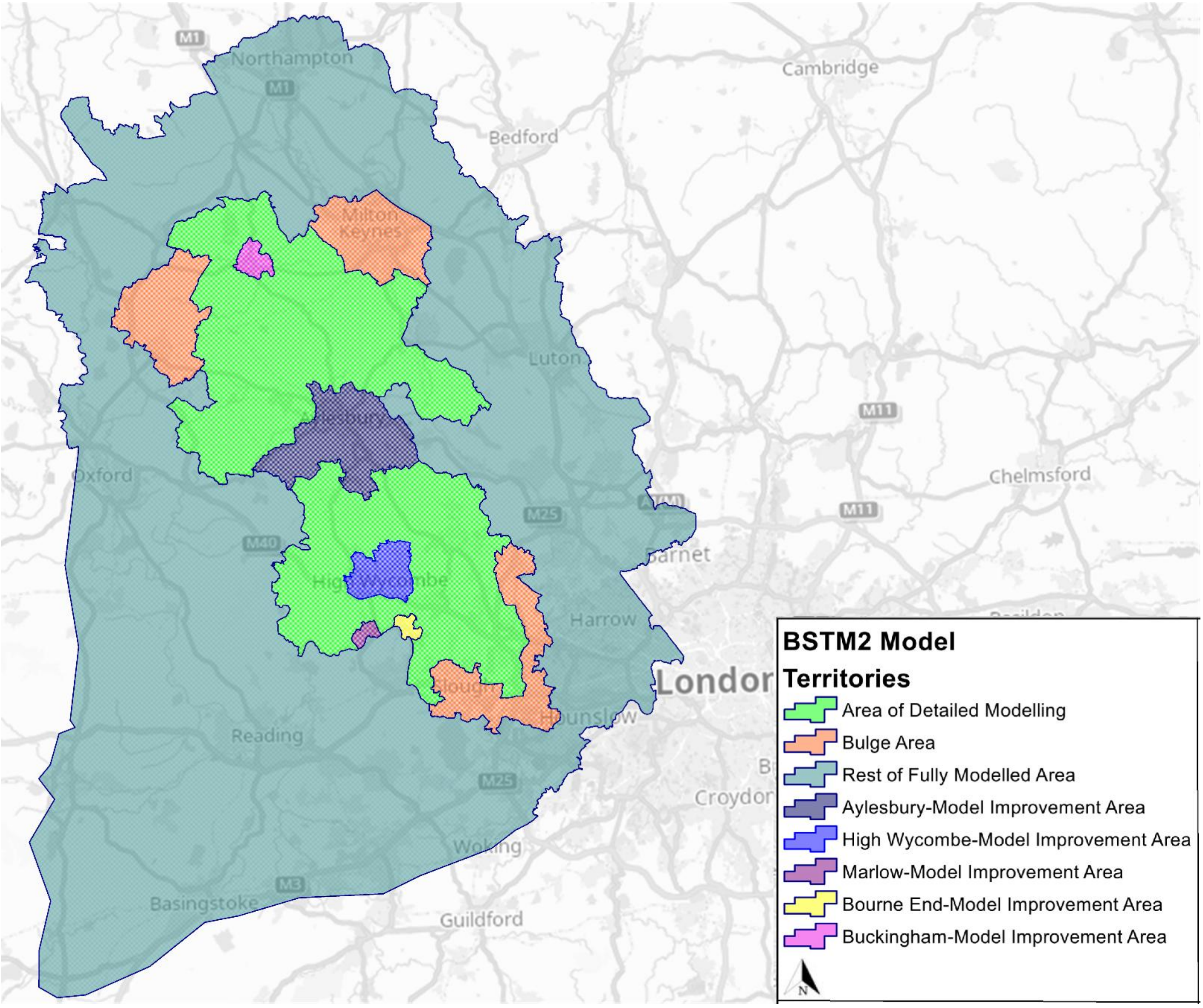

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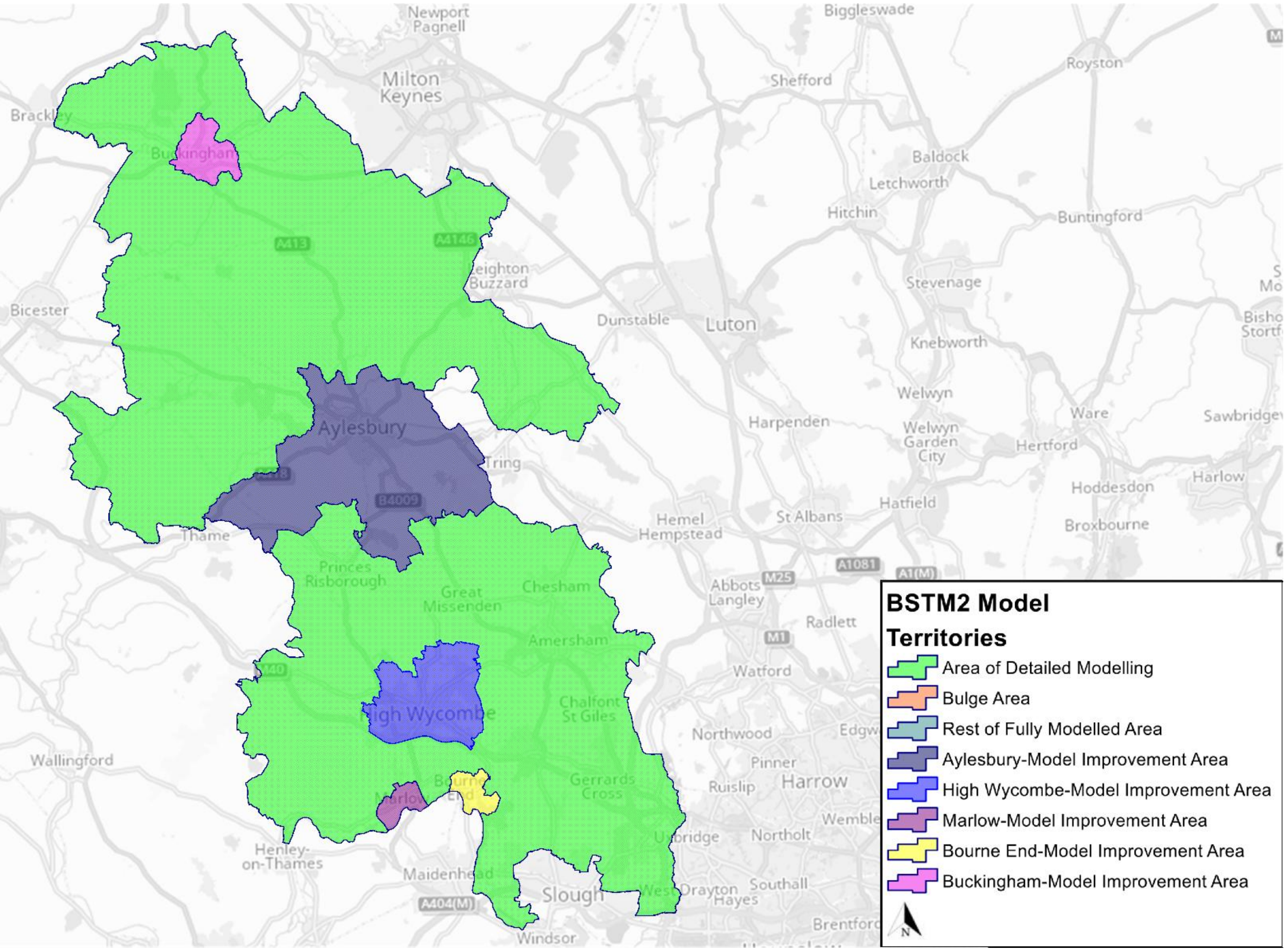
Figure 2-2 - BSTM2 PYV Area of Detailed Modelling



3. Data collection

3.1 Traffic count data

This study utilises multiple survey datasets to examine changes in traffic conditions between 2019 and 2024. This timeframe captures both pre- and post-COVID-19 traffic patterns, providing a comprehensive perspective on how mobility and congestion have evolved. An overview of the data sources and their application in constructing screenlines is presented in this section.

3.1.1 Data sources

Traffic count data for this study was sourced from BC. Most Automatic Traffic Counts (ATC) were retrieved from TagMaster, BC's online repository, while Classified Traffic Counts (CTC) were provided via direct file transfer from BC. To address data gaps near Marlow, additional traffic data was obtained from WebTRIS, a traffic data platform developed by National Highways in the UK.

The analysis incorporates traffic data from the aforementioned sources for both 2019 and 2024. ATC data includes traffic volumes over a full 24-hour period, whereas CTC data covers a 12-hour timeframe.

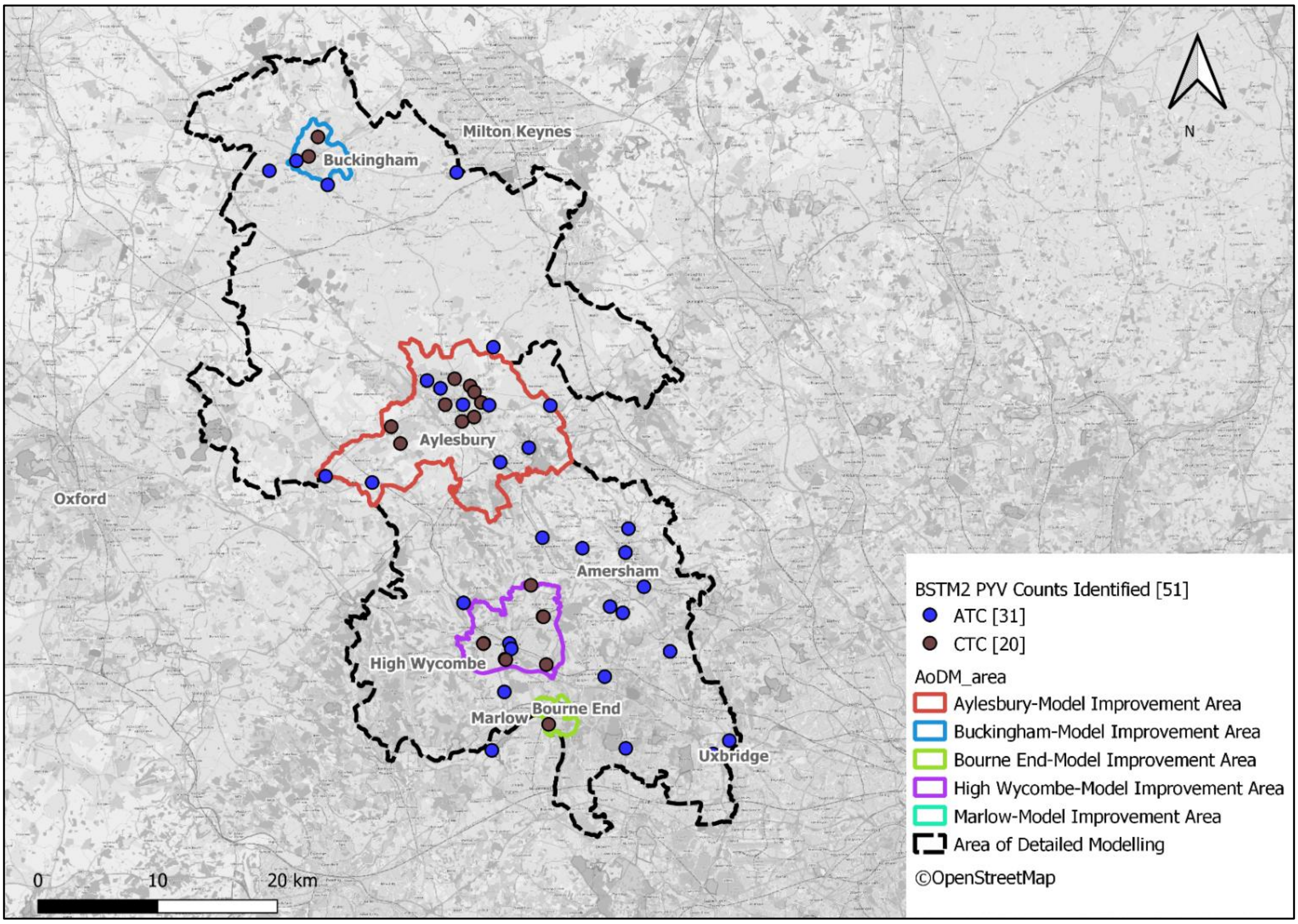
3.1.2 Identification of count locations

As part of the BSTM2 PYV study, traffic data was collected at 51 count locations mainly within the AoMIs to evaluate changes in traffic conditions pre- and post-COVID-19. These locations were used to establish screenlines and cordons within the study area. Pre-COVID-19 data was mainly sourced from 2019 or adjacent years, while post-COVID-19 data reflects baseline conditions in 2024. To ensure consistency, only locations with matching traffic counts available for both 2019 and 2024 were included in the analysis. Table 3-1 summarises the number of count locations included in the current study, with their geographical distribution shown in Figure 3-1.

Table 3-1 - Identified count locations

Count Type	Data Source	Selected Counts (overall Buckinghamshire)	Selected Counts (within AoMIs)
ATC	BC TagMaster/ WebTRIS	31	18
CTC	BC	20	20
Total		**51**	**38**

Figure 3-1 - Locations of selected traffic counts



3.1.3 Screenline identification

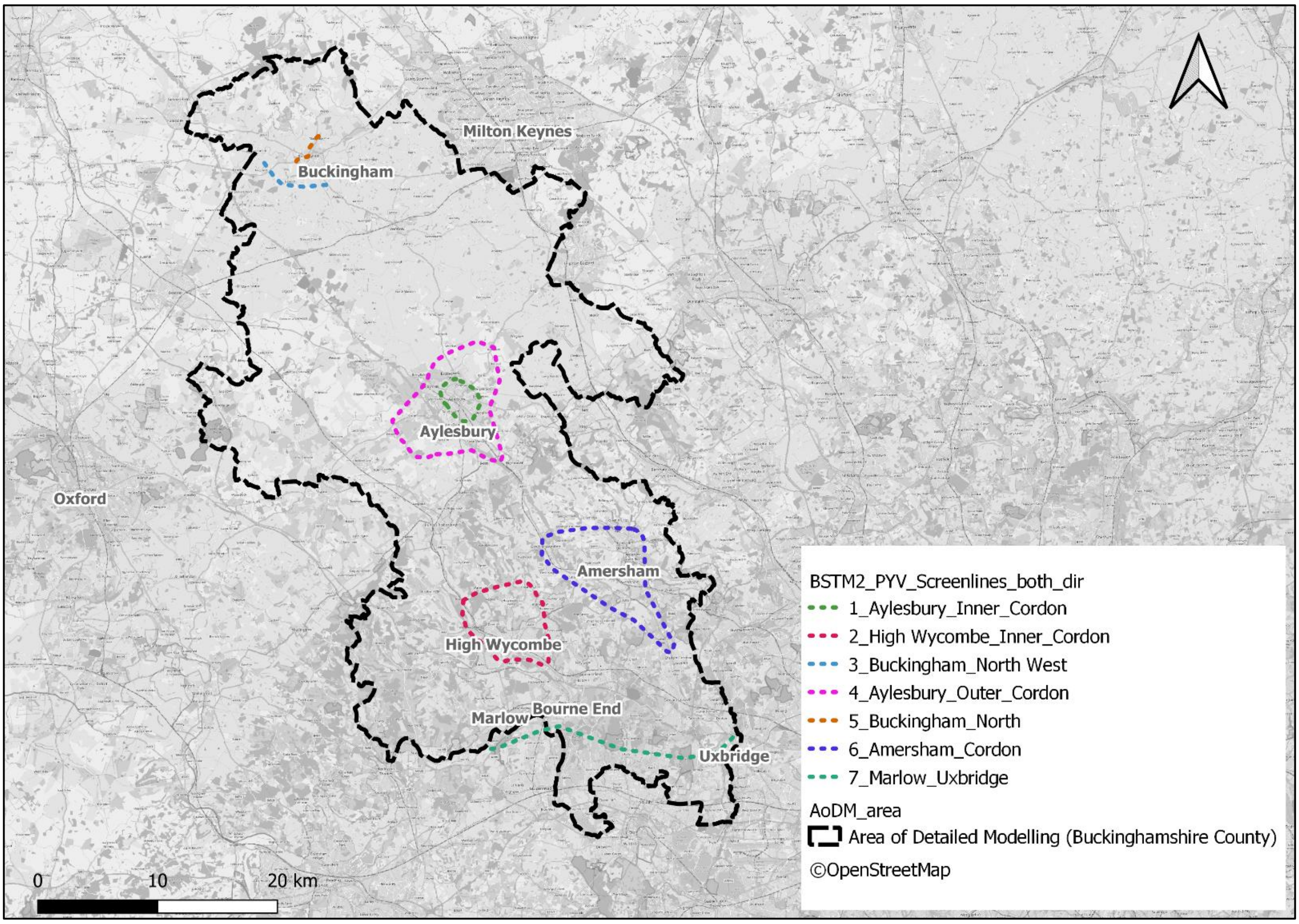
Screenlines are widely used to assess directional travel patterns and monitor traffic volumes across key corridors or boundaries within a study area. In this study, screenlines have been defined primarily to integrate observed traffic counts and enhance calibration accuracy. While observed data is not available for every road intersecting the screenlines, the study includes most major roads to ensure broad and representative coverage. These screenlines serve as effective means for validating modelled traffic flows against observed data.

A total of seven bidirectional screenlines were defined for the study, comprising of two cordons in Aylesbury, one cordon in High Wycombe, two screenlines in Buckingham, one cordon in Amersham, and one near Marlow. Table 3-2 lists the screenlines included in the study along with the number of associated count locations for each. Figure 3-2 shows the screenlines identified for BSTM2 PYV.

Table 3-2 - BSTM2 PYV screenlines

S No.	Screenline Name	Area	No. of Counts
1	1_1_Aylesbury_Inner_Cordon_In	Aylesbury	8
2	1_2_Aylesbury_Inner_Cordon_Out	Aylesbury	8
3	2_1_High_Wycombe_inner_Cordon_In	High Wycombe	9
4	2_2_High_Wycombe_inner_Cordon_Out	High Wycombe	9
5	3_1_Buckingham_North	Buckingham	2
6	3_2_Buckingham_South	Buckingham	2
7	4_1_Aylesbury_Outer_Cordon_In	Aylesbury	6
8	4_2_Aylesbury_Outer_Cordon_Out	Aylesbury	6
9	5_1_Buckingham_North_West	Buckingham	3
10	5_2_Buckingham_South_East	Buckingham	3
11	6_1_Amersham_Cordon_In	Outside AoMIs	6
12	6_2_Amersham_Cordon_Out	Outside AoMIs	6
13	7_1_Marlow_Uxbridge_North	Outside AoMIs	5
14	7_2_Marlow_Uxbridge_South	Outside AoMIs	5

Figure 3-2 - BSTM2 PYV screenlines



3.1.4 Count adjustment and seasonality factors

Adjustment factors from the original BSTM model were applied to traffic counts collected prior to 2019, due to the lack of complete data for that year. To normalise counts data to neutral month (June), seasonality factors were derived in BSTM using a consistent dataset spanning 2015 to 2019. These factors have been carried forward into BSTM2 and applied in the BSTM2 PYV as detailed in Table 3-3 and Table 3-4, respectively. It is important to clarify that 'Major Roads' refer to A-roads and Motorways, while 'Minor Roads' include B-roads and roads of lower classification.

The traffic count data used in BSTM2 PYV is exclusively from 2024, with the majority collected during neutral months to reflect typical traffic conditions. Where neutral month data was unavailable, seasonality factors from BSTM were applied to adjust the counts accordingly.

Table 3-3 - Pre 2019 counts uplift factors by road type

Year	Uplift Factors to 2019	
	Minor Road	Major Road
2015	1.042	1.022
2016	1.037	1.019
2017	1.032	1.016
2018	1.026	1.006

Table 3-4 - Seasonality factors by month of the year

Seasonality Factors			
Month	Factor	Month	Factor
Jan	1.052	Jul	1.035
Feb	1.066	Aug	1.249
Mar	1.000	Sep	1.000
Apr	1.135	Oct	1.000
May	1.090	Nov	1.000
Jun	1.000	Dec	1.218

3.2 Journey time data

Journey time data is critical for the validation of transport models. It is used to compare the travel times and delays generated by the model with observed data from existing conditions. For the BSTM2 PYV, the major critical corridors in and around AoMIs were identified and listed below.

- Aylesbury: A413, A418, A41, A4157 and B443;
- High Wycombe: A404, A40, A4128, and A4010;
- Buckingham: A421, A413, and A422; and
- Marlow and Bourne End: A4155, B482 and A4094.

The DfT’s TAG Unit M3.1, section 4.3.3, states that validation routes should not be excessively long (over 15 km) or excessively short (under 3 km). Based on this 20 two-way routes were defined and their observed journey time data was collected from TomTom for the AM peak hour (0800-0900), Inter-Peak period (1000-1600), and PM peak hour (1700-1800) for all neutral days (excluding Monday, Friday, Saturday and Sunday) in 2024.

The 20 two-way journey time routes are shown in Figure 3-3 to Figure 3-6. Further details about the routes start and end points, directions, distances, journey times are discussed in Section 4.2 of the report.

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Figure 3-3 - BSTM2 PYV journey time routes - all areas

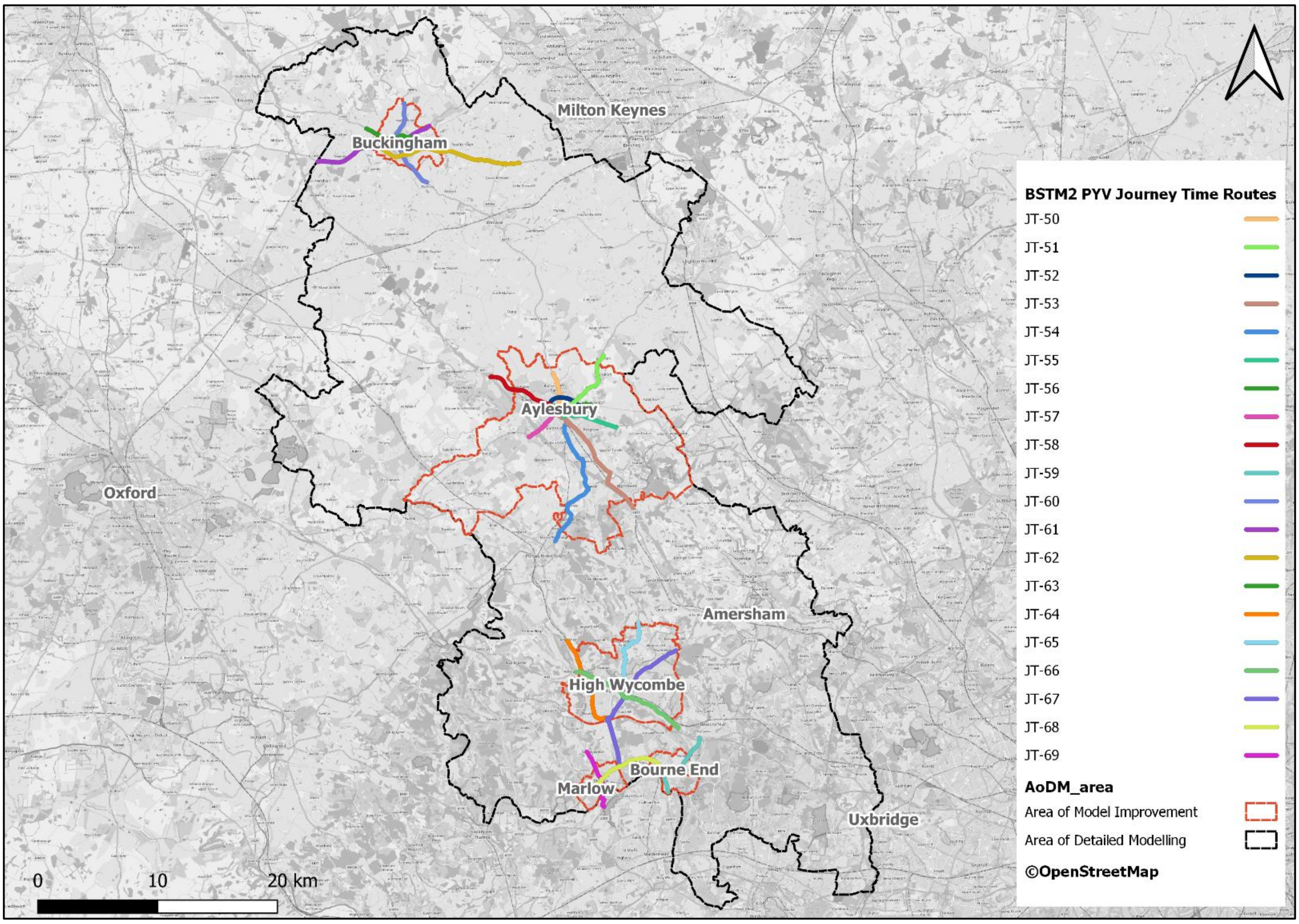

Figure 3-4 - BSTM2 PYV journey time routes - Aylesbury

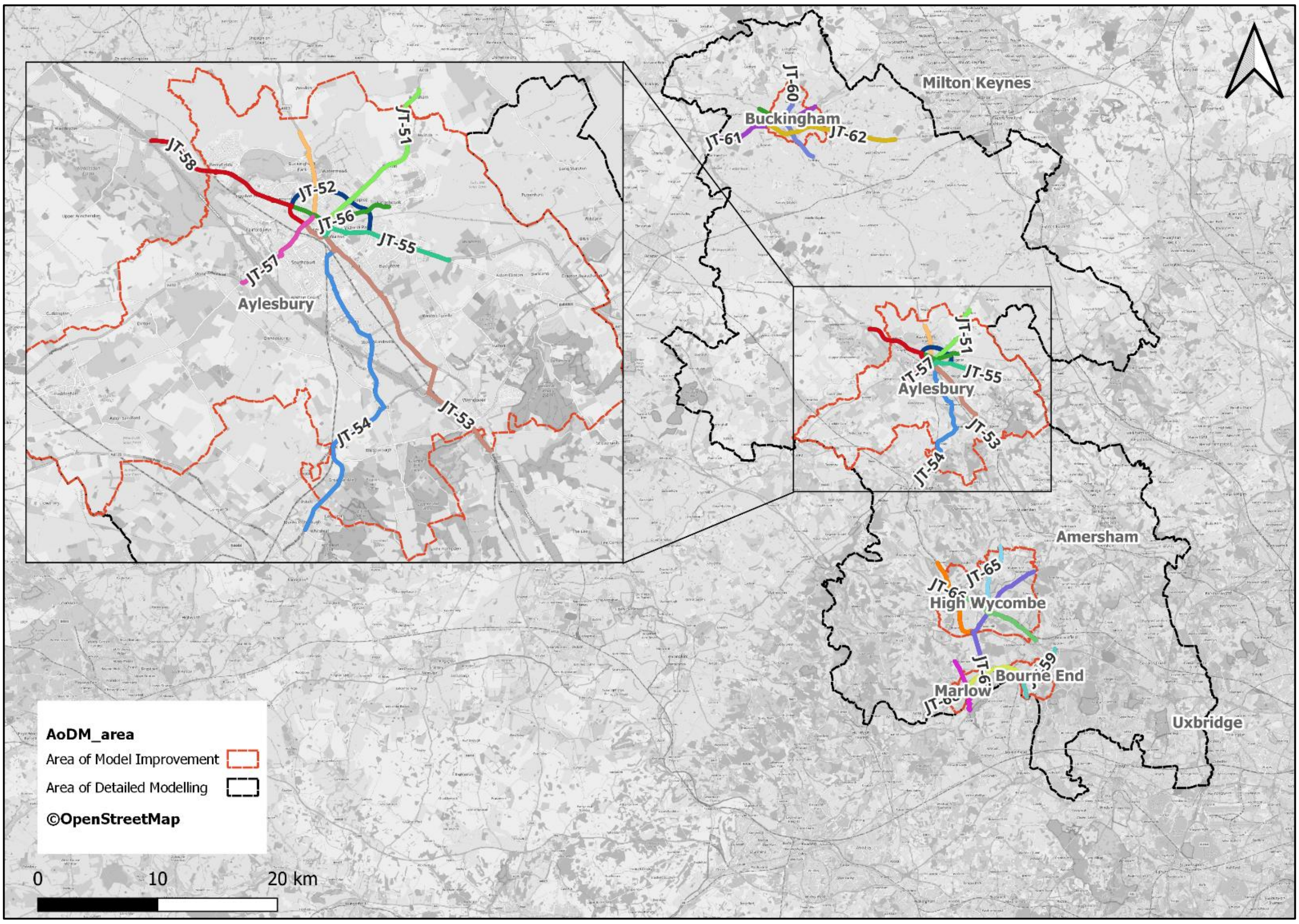

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Figure 3-5 - BSTM2 PYV journey time routes - Buckingham

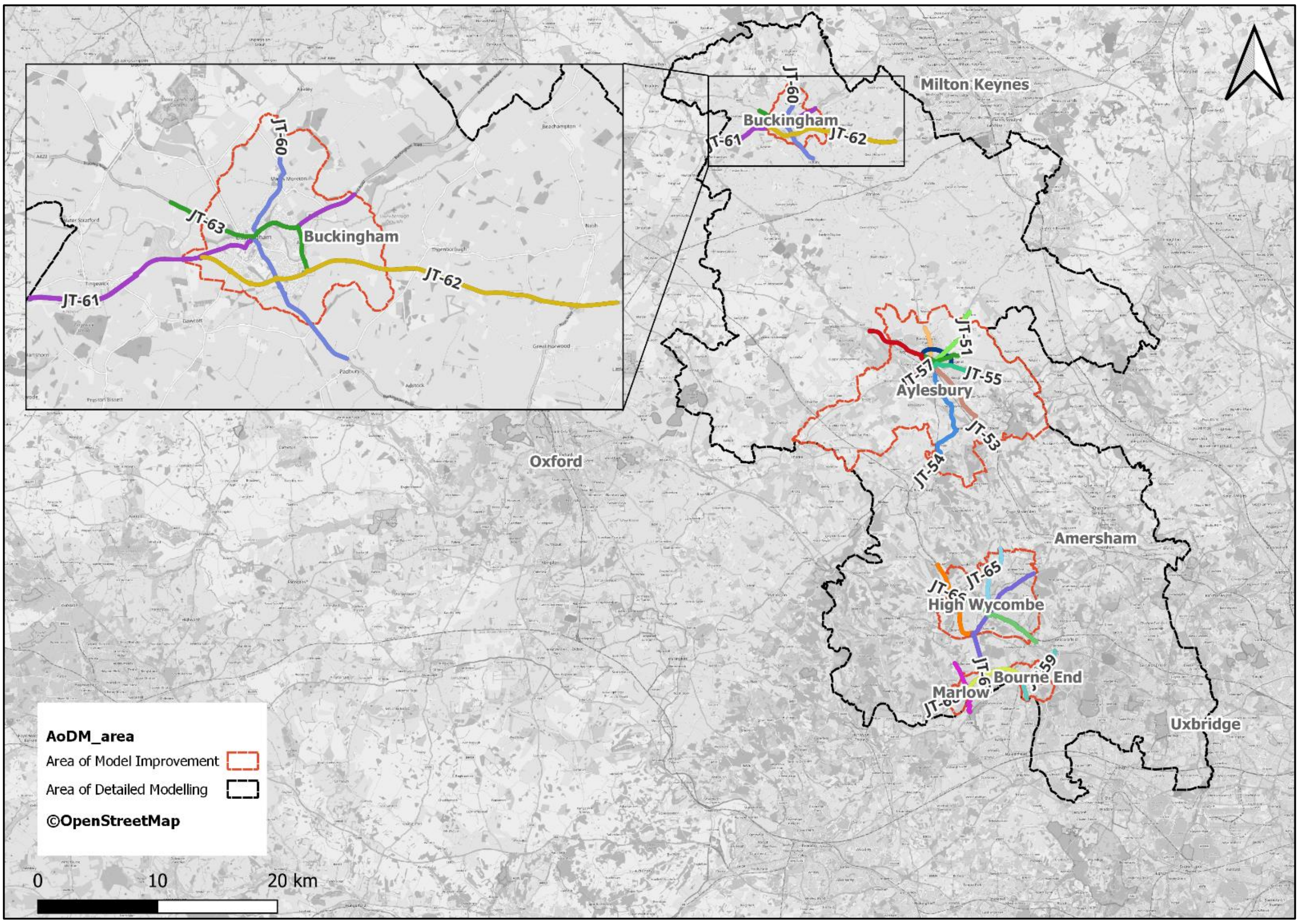
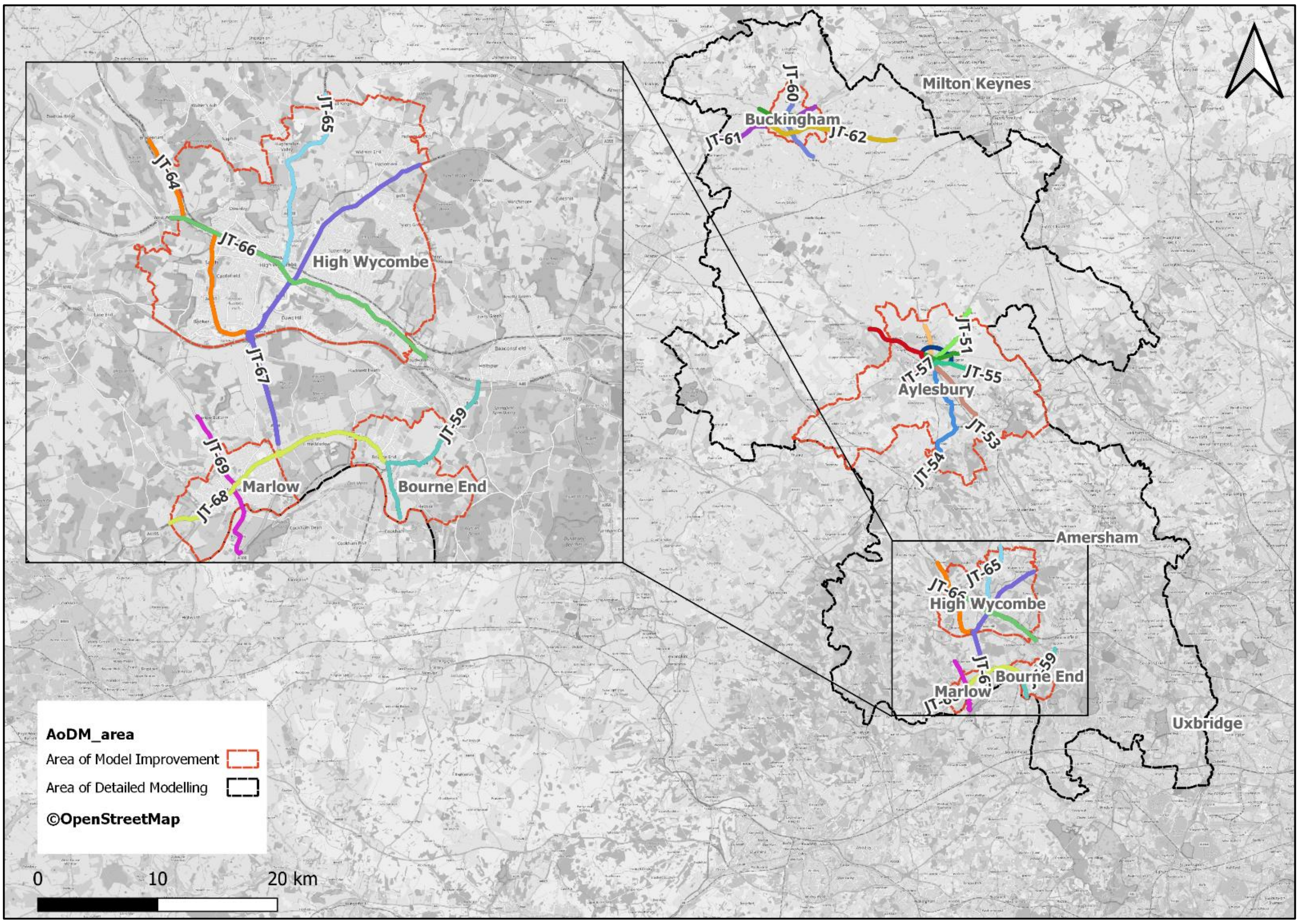


Figure 3-6 - BSTM2 PYV Journey Time Routes - High Wycombe, Marlow and Bourne End



3.3 Travel Data

The National Travel Survey (NTS) is an annual travel diary survey conducted across England designed to provide regular, up-to-date data on personal travel and monitor changes in travel behaviour over time. The survey provides detailed information on different types of travel: where people travel from and to, distance, purpose and mode. The NTS records personal and socio-economic information to distinguish between different types of people, and the differences in the way they travel and how often they do so.

NTS data is available from 2002 up to 2023 and covers personal travel data by a sample of residents of England, collected via interviews and a seven-day travel diary. At the time of writing this technical note, the full NTS dataset for 2024 has not yet been published while several summary tables from NTS 2024 were released on 27th August 2025. A comparison of NTS 2023 and NTS 2024 data for trips per person per year by purpose at England level is summarised in Table 3-5 which indicate insignificant growth changes between the two years. Accordingly, in the absence of full NTS dataset for 2024, NTS 2023 travel data is more suitable for use in this study.

Table 3-5 - NTS 2023 & 2024 comparison by trip purpose at England (trips per person per year)

Trip Purpose	England			
	2023	2024	Absolute difference	% Difference
HBW	117	111	-6	-5.1%
HBEB	20	24	4	20.0%
HBEd	122	120	-2	-1.6%
HBPS	247	250	3	1.2%
HBL	329	340	11	3.3%
Total	**835**	**845**	**10**	**1.2%**

For the purposes of BSTM2 PYV, NTS standard licence has been used to analyse the travel data. The standard licence version contains detailed travel, demographic and socio-economic data with the geographic level limited to region level. The survey data has been obtained so that NTS data related specifically to the BSTM2 can be used, where sample sizes permit, to provide:

- Trip rates by person type;
- Trip length profiles by purpose and mode;
- Mode choice profiles by purpose; and
- Time of day profiles by purposes, and mode.

National aggregate statistics from NTS, published online by the Department for Transport (DfT), were downloaded and analysed as part of this study. Section 4.3 outlines the methodology used to derive key considerations for the BSTM2 PYV. A detailed analysis of the raw NTS was undertaken during model development and is discussed in Section 4.3. During the development of the BSTM2 model, it was demonstrated to BC that the sample sizes for both Buckinghamshire and the South-East region were limited. As a result, NTS samples from across England were used to analyse travel behaviours. This approach has been retained in the BSTM2 PYV study to assess post-COVID-19 travel patterns and compare them with pre-COVID-19 ones, as discussed in Section 4.3. The available NTS sample data is presented in the next section.

3.3.1 NTS samples

The weighted trips by survey year and across different geographic levels have been summarised to assess the sample sizes available for further analysis. Figure 3-7 and Figure 3-8 show a significant reduction in weighted trip counts in 2022 both at national and regional levels, compared to 2019 and 2023. This decline suggests that the residual effects of the COVID-19 continued to influence travel behaviour and mobility patterns well into 2022. Given this anomaly, all subsequent analyses and comparisons of pre-COVID-19 and post-COVID-19 travel trends have been conducted using data from the 2023 NTS exclusively, as it more accurately reflects stabilised post-COVID-19 conditions. The year-wise weighted trip counts for England are represented in Figure 3-7.

Figure 3-8 shows the area type-wise sample size at national and South-East level per year from 2011 to 2023 (1 = Urban, 2 = Rural, 3 = Scotland). NTS changed its coverage to just England post 2012, thus, there are no samples from Scotland beyond 2012.

Figure 3-7 - England level and South-East level yearly weighted trips

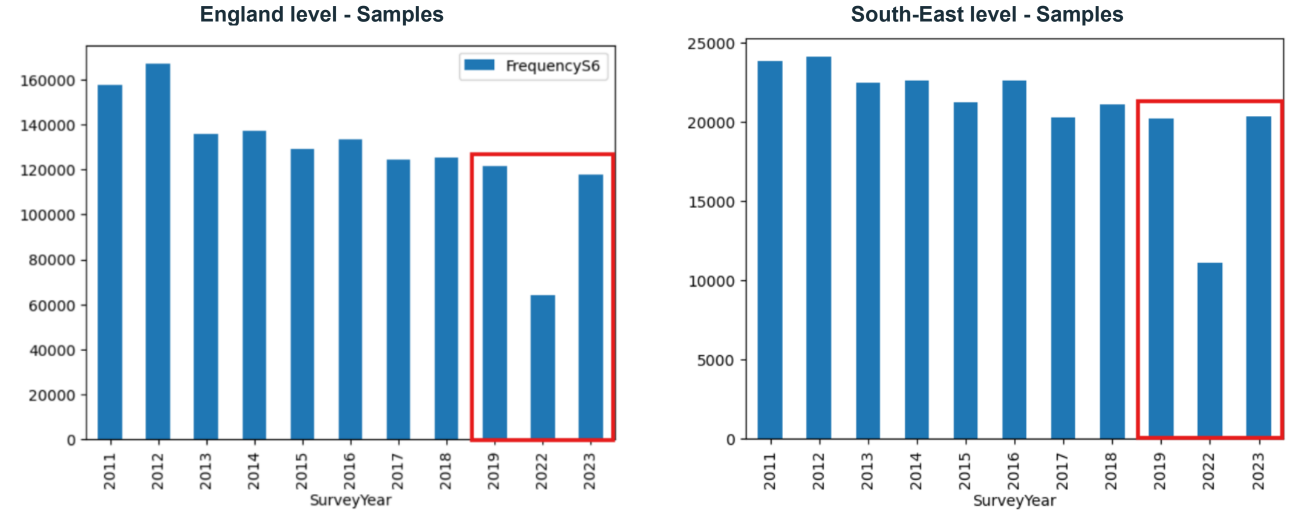


Figure 3-8 - England level and South-East level yearly weighted trips - area type wise

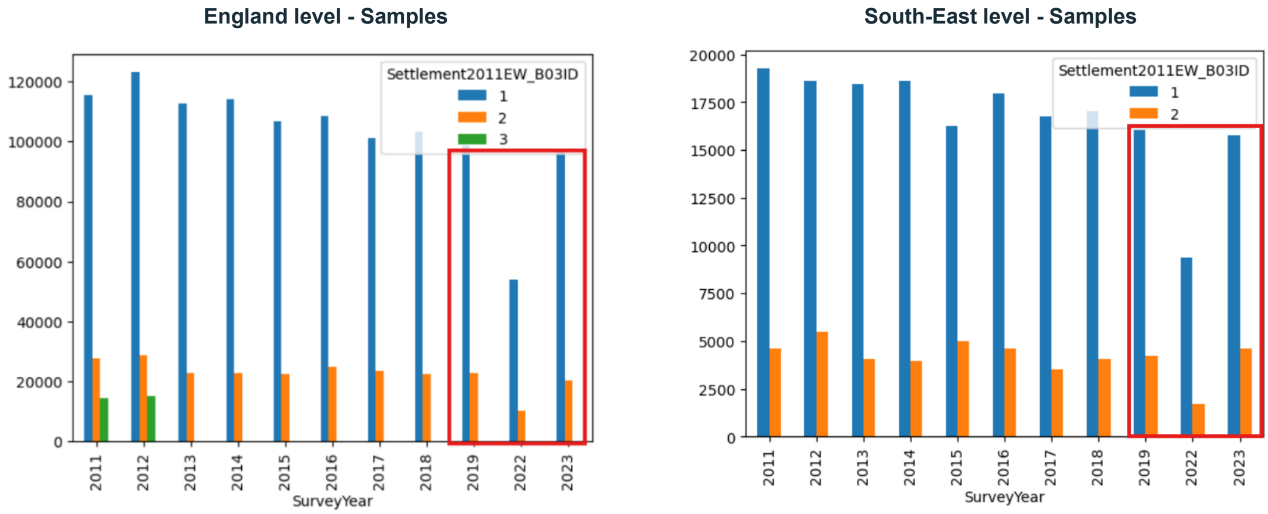


Table 3-6 presents the weighted trip data, corrected for biases at both the national and South-East levels, covering the years 2011 to 2023. As shown in the table, the South-East sample includes approximately 20,000 trips. However, when further disaggregated by mode and purpose, this sample size becomes insufficient for statistically reliable analysis of certain segments. Due to these limitations in the South-East NTS sample, England-level data has been used for further analysis and comparison. This approach is supported by previous findings in BSTM2, where trip rates at the South-East and England levels were found to be comparable.

Table 3-6 - NTS Samples at national and South-East level

Survey Year	National Level	Regional Level (South-East)	South-East Share
2011	157,624	23,854	15.1%
2012	166,931	24,096	14.4%
2013	135,579	22,497	16.6%
2014	137,004	22,602	16.5%
2015	129,012	21,244	16.5%
2016	133,377	22,586	16.9%
2017	124,494	20,264	16.3%
2018	125,486	21,085	16.8%
2019	121,459	20,241	16.7%
2022	64,048	11,094	17.3%
2023	117,818	20,363	17.3%
Total	**1,412,833**	**229,926**	**16.3%**

4. Data processing

4.1 Traffic data

31 ATC counts and 17 CTC counts were processed and analysed for neutral weekdays (Tuesday to Thursday) during neutral months (June and October), avoiding half-term holidays, to ensure data quality and consistency for model calibration and validation. Wherever classified traffic volumes were not available, notably in 2019, the vehicle type split from the nearest comparable count location was used to estimate the classified volume.

The following model time periods, originally used in BSTM2, were retained for count data processing as they continue to represent peak hours in a neutral day of a neutral month in 2024:

- AM Peak hour (08:00 to 09:00) - representing the busiest hour of the AM peak period;
- Inter-peak hour - an average hour representation across 6 hours of the day between 10:00-16:00; and
- PM Peak hour (17:00 to 18:00) - representing the busiest hour of the PM Peak period.

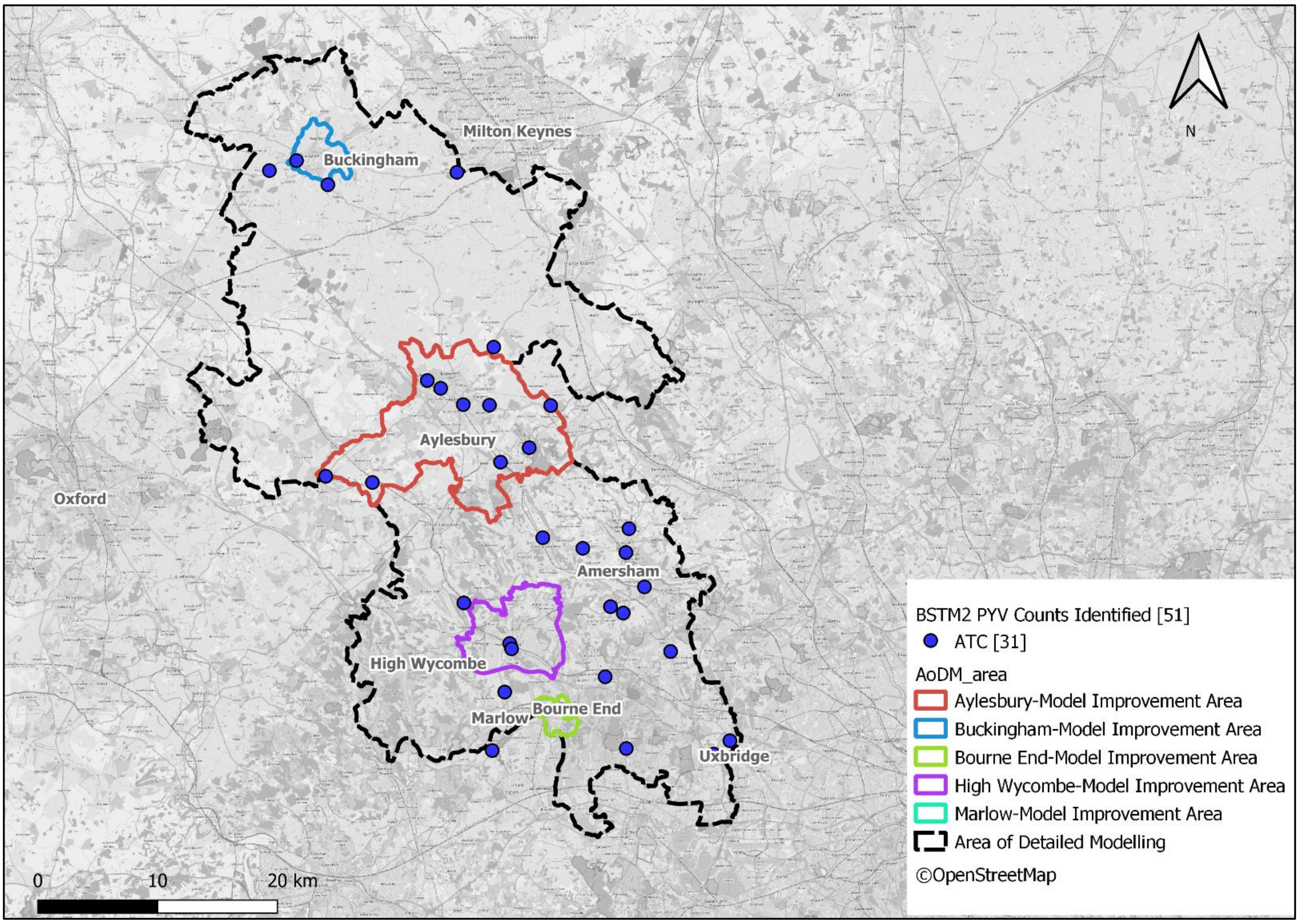
These time periods reflect typical urban travel patterns and are used to capture variations in traffic volumes, modal shares, and network performance across different times of the day. Aligning with BSTM2 ensures consistency in data interpretation and facilitates comparative analysis.

4.1.1 Data Cleaning

Since large sets of ATC data are likely to contain observational errors and variability, it is useful to identify and filter data points that deviate significantly from expected values, based on the distribution of each dataset. To this end, each data source with multiple days of data was cleaned to remove outliers. The data was grouped by site, direction, and hour excluding weekends and blank entries. A confidence level test was then applied to define an acceptable interval for each group. Data points falling within this interval were retained, while those outside were considered unsuitable and removed.

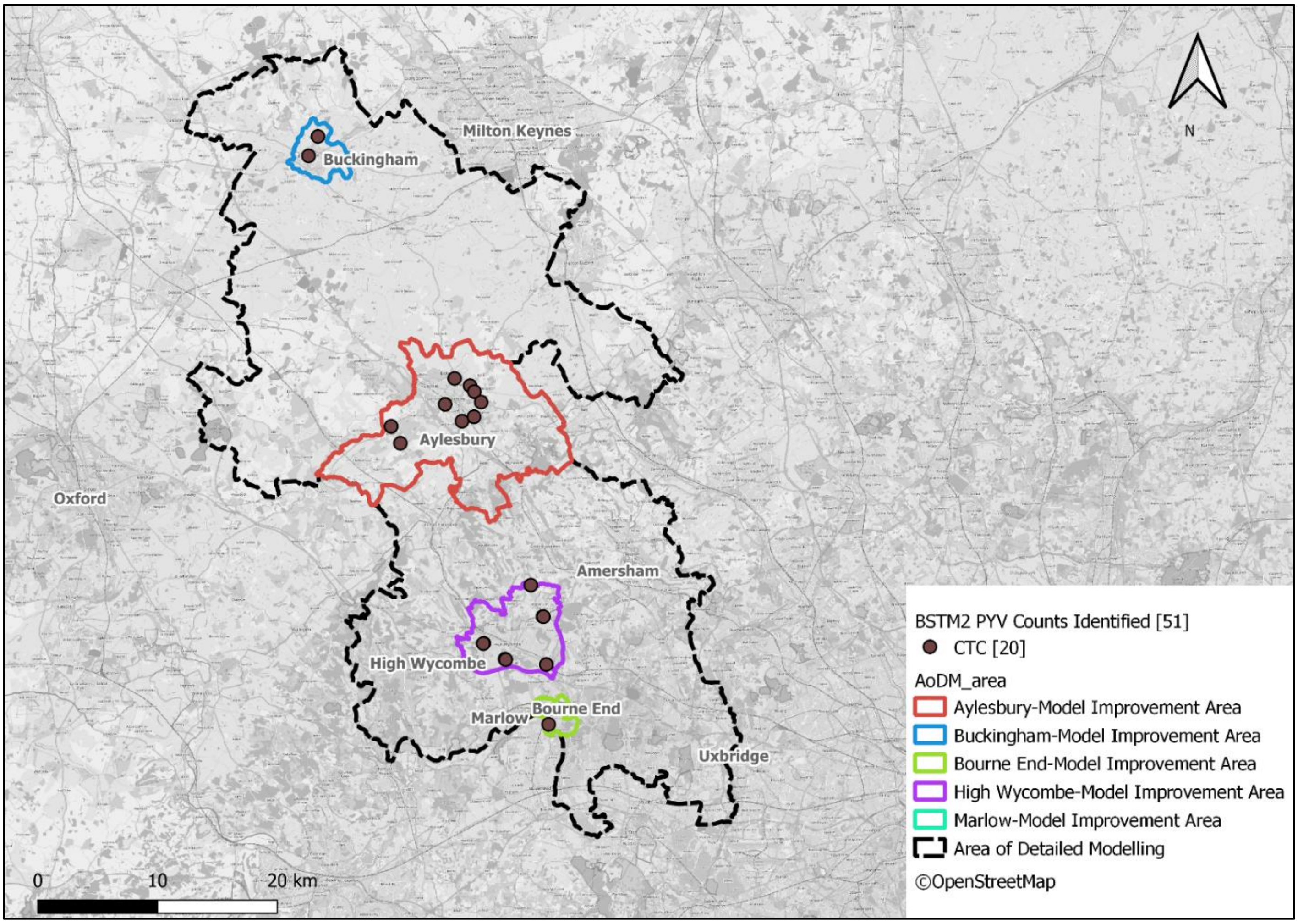
The ATC data locations identified for BSTM2 PYV for both 2019 and 2024 are shown in Figure 4-1. For each site, peak hour and peak period observed traffic flows for Tuesday to Thursday were calculated. Mondays and Fridays were explicitly excluded from the average as traffic flows on these days can deviate from that of a typical weekday. Due to the absence of traffic count data around Marlow, two additional counts were obtained from WebTRIS.

Figure 4-1 - ATC Count locations identified for BSTM2 PYV



The CTC data locations identified for BSTM2 PYV for both 2019 and 2024 are shown in Figure 4-2. For each site, peak hour and peak period observed traffic flows for a single weekday (i.e., 12 hours) for both 2019 and 2024 were calculated.

Figure 4-2 - CTC Count locations identified for BSTM2 PYV



4.1.2 12-hour traffic

The 12-hour weekday traffic data collected for present year 2024 across 51 count locations shows a total vehicular traffic of 897,047 vehicles. This includes 633,819 vehicles from 31 ATCs and 263,228 vehicles from 20 CTCs. Full 24-hour traffic data is available at the 31 ATCs, with the 12-hour traffic volume representing 78% of the daily traffic.

4.1.3 Peak period traffic

Weekday traffic data has been analysed for the peak periods considered in BSTM2 model (i.e., AM peak period 07:00 to 10:00, Inter-peak period 10:00 to 16:00 and PM peak period 16:00 to 19:00). Table 4-1 presents the summary of peak period traffic data in 2024 for identified count sites on an average weekday. It is observed that PM peak period records marginally higher vehicle movements compared to AM peak period with a total of 242,589 vehicle movements (i.e. constituting 28% of 12-hour traffic) across the study area.

Table 4-1 - Peak period traffic for 2024

Data Source	AM (3 Hours)	IP (6 Hours)	PM (3 Hours)	No. of Counts
ATC	170,858	287,134	175,827	31
CTC	71,349	120,769	71,110	20
Total	242,207	407,903	246,937	51
% of 12-hour Traffic	27%	45%	28%	

4.1.4 Peak hour traffic

Peak hour traffic data has been analysed for peak hours considered in BSTM2 model (i.e., AM peak hour 08:00 to 09:00, average Inter-peak hour between 10:00 and 16:00 and PM peak hour 17:00 to 18:00) as presented in Table 4-2. It has been observed that both the AM and PM peak hours exhibit similar levels of total traffic, each accounting for approximately 35% of their respective peak period volumes across the study area.

Table 4-2 - Peak hour Traffic for 2024

Data Source	AM Peak Hour	IP Peak Hour	PM Peak Hour	No. of Counts
ATC	59,771	47,856	61,819	31
CTC	26,118	20,128	25,292	20
Total	85,890	67,984	87,111	51
% share of Traffic w.r.t Peak Period	35%	17%	35%	

4.1.5 Traffic flow conversion factors

To support accurate demand modelling, peak hour to peak period conversion factors were extracted from observed weekday traffic data and are presented in Table 4-3.

Table 4-3 - BSTM2 PYV traffic flow conversion Factors

Time Period	Conversion Factors
	2024
AM	2.82
IP	6.00
PM	2.84

4.1.6 Vehicle type distribution

Table 4-4 presents the overall vehicle type distribution covering cars, light goods vehicles (LGVs), and heavy goods vehicles (HGVs) during the peak hour for the baseline year 2024 across major and minor roads. Overall, there are 38 traffic counts on major roads and 13 on minor roads. Traffic count data predominantly is collected on major roads, with vehicle type distributions showing minimal variation across all 51 count locations. In contrast, data from minor roads reflects a lower proportion of LGVs and HGVs, which is the expected traffic pattern for such road types.

Table 4-4 - Peak hour Vehicle Distribution for 2024

Road Type	Count Type	AM Peak Hour			IP Peak Hour			PM Peak Hour			No. of Counts
		Car	LGV	HGV	Car	LGV	HGV	Car	LGV	HGV	
Major	ATC	82%	11%	7%	79%	12%	9%	89%	8%	4%	25
	CTC	89%	8%	3%	84%	11%	5%	90%	8%	2%	13
	Total	84%	10%	6%	80%	12%	8%	89%	8%	3%	38
Minor	ATC	90%	8%	2%	88%	10%	2%	93%	7%	1%	6
	CTC	88%	8%	4%	82%	12%	5%	92%	7%	1%	7
	Total	89%	8%	3%	85%	11%	4%	92%	7%	1%	13

4.2 Journey time data

TomTom observed journey time data for 20 two-way routes was analysed to obtain route lengths and travel times, which will be used to validate the modelled journey times. TomTom data, available through its Traffic Stats platform, allows users to define specific routes and retrieve average speeds, average travel times, and sample sizes (i.e., the number of GPS probe points) for both the entire route and each individual segment.

The dataset used for the journey time analysis, organised by route, included the following fields:

- Route ID;
- Distance along route (m);
- Cumulative travel time (s) for all three peak periods (AM, IP and PM);
- Speed limit (kph); and
- Street name.

The 20 routes was coded in BSTM2 PYV, and a comparison between the observed and modelled route lengths was carried out to ensure consistency as shown in Table 4-5. It is noted that there are minimal differences between the observed and modelled lengths due to the way in which the start and end point of the route are represented between TomTom and the model.

Table 4-5 - Journey time routes observed and modelled length comparison

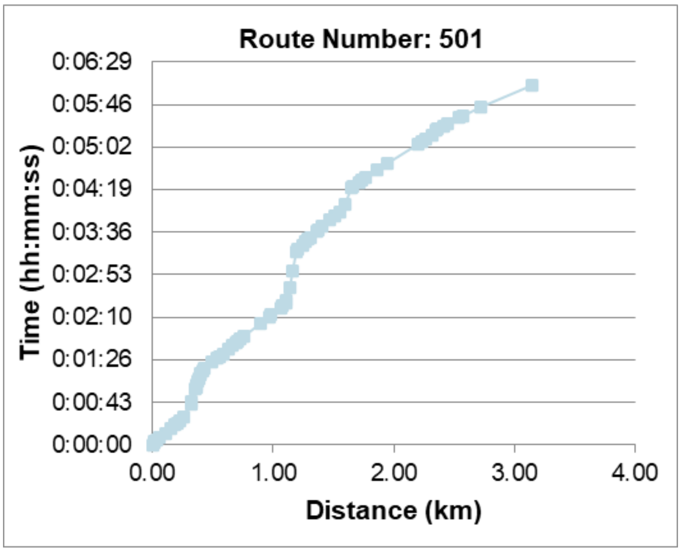
Route	Description	Direction	Observed Length (km)	Modelled Length (km)	Observed time	% Difference in route length
501	A4156, Oxford Road/ Gatehouse Road/ Friarage Road Roundabout --> A413/ New Road	NB	3.14	3.14	00:06:05	0.05%
502	A413/ New Road --> A4156, Oxford Road/ Gatehouse Road/ Friarage Road Roundabout	SB	3.15	3.14	00:12:14	0.40%
511	A413, Upper Hundreds Way/ Cambridge Street Roundabout --> A418/ Bennetts Lane	NB	5.54	5.48	00:10:51	1.17%
512	A418/ Bennetts Lane --> A413, Upper Hundreds Way/ Cambridge Street Roundabout	SB	5.56	5.47	00:12:19	1.65%
521	A41 Tring Road/ A4157 --> A41 Bicester Road/ Gatehouse Road/ Haydon Road Roundabout	NWB	3.52	3.51	00:11:40	0.16%
522	A41 Bicester Road/ Gatehouse Road/ Haydon Road Roundabout --> A41 Tring Road/ A4157	SEB	3.51	3.51	00:13:50	0.14%
531	A413 London Road/ Hale Road --> A412 Oxford Road/ Gatehouse Road Roundabout	NB	9.87	9.84	00:19:19	0.28%
532	A412 Oxford Road/ Gatehouse Road Roundabout --> A413 London Road/ Hale Road	SB	9.81	9.78	00:18:57	0.30%
541	A4010 Aylesbury Road/ Mill Lane --> A413 Walton Street/ Friarage Road/ Exchange Street Roundabout	NB	11.32	11.33	00:22:26	0.08%
542	A413 Walton Street/ Friarage Road/ Exchange Street Roundabout --> A4010 Aylesbury Road/ Mill Lane	SE	11.47	11.49	00:23:09	0.20%
551	A413 Walton Street/ Friarage Road/ Exchange Street Roundabout --> A41 Aston Clinton Road/ Aylesbury Road	SE	4.23	4.24	00:11:46	0.24%
552	A41 Aston Clinton Road/ Aylesbury Road --> A413 Walton Street/ Friarage Road/ Exchange Street Roundabout	NW	4.17	4.13	00:13:54	0.95%
561	Broughton/ Bellingham Way --> A41 Bicester Road/ Gatehouse Road/ Haydon Road Roundabout	NW	3.42	3.40	00:10:59	0.58%
562	A41 Bicester Road/ Gatehouse Road/ Haydon Road Roundabout --> Broughton/ Bellingham Way	SE	3.38	3.37	00:09:33	0.14%
571	A418 Oxford Road/ Portway Road --> Oxford Road/ Bicester Road/ Buckingham Street	EB	3.14	3.18	00:09:15	1.11%

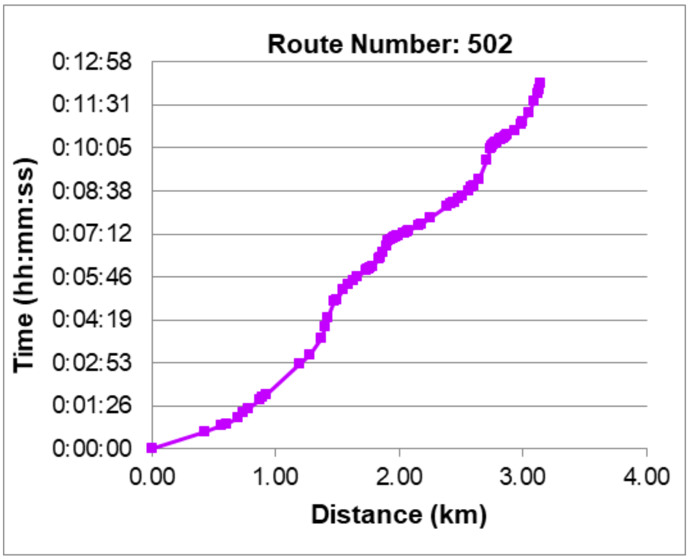
Route	Description	Direction	Observed Length (km)	Modelled Length (km)	Observed time	% Difference in route length
572	Oxford Road/ Bicester Road/ Buckingham Street --> A418 Oxford Road/ Portway Road	WB	3.21	3.24	00:08:54	0.94%
581	A41 Gatehouse Road/ A418 Oxford Road/ Oxford Road --> A41 Roundabout, Waddesdon	NB	5.85	5.86	00:10:32	0.08%
582	A41 Roundabout, Waddesdon --> A41 Gatehouse Road/ A418 Oxford Road/ Oxford Road	SB	5.92	5.91	00:15:34	0.16%
591	Ferry Lane/Riversdale --> White Hill/ Wooburn Green Lane	NB	5.82	5.82	00:09:57	0.13%
592	White Hill/ Wooburn Green Lane --> Ferry Lane/Riversdale	SB	5.84	5.83	00:09:59	0.14%
601	A413 near Church Lane/ Bryne Lane --> A413 Buckingham Road near Akeley Road junction	NB	7.19	7.18	00:14:08	0.14%
602	A413 Buckingham Road near Akeley Road junction --> A413 near Church Lane/ Bryne Lane	SB	7.19	7.18	00:12:20	0.24%
611	A421/ Sandpit Hill Roundabout, Tingewick --> Standford Road near PSP Auctions Buckingham	EB	9.23	9.28	00:12:35	0.53%
612	Standford Road near PSP Auctions Buckingham --> A421/ Sandpit Hill Roundabout, Tingewick	WB	9.33	9.37	00:12:35	0.40%
621	A421/ Tingewick Road Roundabout --> A421/ Coates Grounds	EB	11.16	11.09	00:12:37	0.66%
622	A421/ Coates Grounds --> A421/ Tingewick Road Roundabout	WB	11.12	11.06	00:12:22	0.52%
631	A413/ A421 Roundabout near Bernwood Jubilee Way --> A422 Brackley Road near Radclive-cum-Chackmore	NWB	4.73	4.74	00:08:20	0.22%
632	A422 Brackley Road near Radclive-cum-Chackmore --> A413/ A421 Roundabout near Bernwood Jubilee Way	SEB	4.77	4.78	00:08:29	0.13%
641	Handy Cross Interchange --> A4010 Wycombe Road/ Bradenham Wood Lane	NB	7.52	7.52	00:12:41	0.11%
642	A4010 Wycombe Road/ Bradenham Wood Lane --> Handy Cross Interchange	SB	7.51	7.49	00:17:53	0.19%
651	Oxford Road/ Abbey Way/ Oxford Street Roundabout --> Missenden Road/ Stag Lane	NB	6.02	6.03	00:11:11	0.06%

Route	Description	Direction	Observed Length (km)	Modelled Length (km)	Observed time	% Difference in route length
652	Missenden Road/ Stag Lane --> Oxford Road/ Abbey Way/ Oxford Street Roundabout	SB	6.00	6.01	00:11:56	0.15%
661	London Road/ Knaves Beech Way Roundabout --> High Street/ Church Lane	NWB	9.03	9.00	00:21:35	0.36%
662	High Street/ Church Lane --> London Road/ Knaves Beech Way Roundabout	SEB	9.08	9.01	00:27:38	0.76%
671	Westhorpe Interchange --> Amersham Road/ Gravelly Way	NEB	10.98	11.02	00:28:14	0.38%
672	Amersham Road/ Gravelly Way --> Westhorpe Interchange	SWB	10.79	10.80	00:26:00	0.08%
681	Henley Road near Beechrood Drive --> Station Road/ The Parade/ Cores End Road	EB	7.84	7.85	00:15:03	0.09%
682	Station Road/ The Parade/ Cores End Road --> Henley Road near Beechrood Drive	WB	7.84	7.85	00:16:41	0.16%
691	A404/ Marlow Road --> AB482 Marlow Road near Rogers Tree and Garden Services	NB	4.71	4.71	00:12:55	0.08%
692	AB482 Marlow Road near Rogers Tree and Garden Services --> A404/ Marlow Road	SB	4.74	4.74	00:11:55	0.05%

Time-versus-distance graphs were generated for each JT route to provide a visual reference supporting the validation process. These will be used to compare with the modelled journey times, and hence areas of delay, along the route as part of the validation check later in this study. Figure 4-3 illustrates an examples of the time versus distance graph for two journey time routes, Route 501 and 502, in the AM peak hour. Route 501 begins at the A4156 junction (Oxford Road/Gatehouse Road/Friarage Road Roundabout) in Aylesbury and ends at A413/New Road junction, north of Aylesbury, with Route 502 representing the reverse direction. The graphs present the time taken to make the journey with respect to distance. As part of the validation, these observed times will be compared to the modelled times to depict the model performance.

Figure 4-3 - Time vs Distance Plot - JT Route 501 and 502 - AM Peak





4.3 Travel data

4.3.1 Trip rates

As mentioned in Section 3.3, NTS 2023 data was used to calculate trip rates for this study. NTS data consists of travel information for household residents between years 2011 and 2023 stored in a relational database of 13 tables. For the purposes of processing, combined data between 2011 and 2019 was used for pre-COVID-19 analysis (in line with BSTM2) and data from 2023 was used for post-COVID-19 analysis. Out of 13 tables, four tables namely Trips, Individuals, Day and Households, were processed for this purpose. The processed trips and individuals were verified against published totals to validate the process.

4.3.1.1 Home-based trip rates

The home-based trip rate required is the number of trips (productions) per person per neutral weekday (24-hour). For BSTM2 model, trip rates were calculated for all home-based trip purposes for different population categories. The population categories were based on the household size, car availability and age of the individual making the trip. Trip rates were calculated for a neutral weekday in England. For education-based trips, escort trips made by adults were also included in the trip rate calculations, meaning these escort trips are part of education trips. Trips of those aged 75+ and child categories are not included in the trip rate calculation numbers of commute and business trips.

Given that the 2023 trip rates are derived from a comparatively smaller sample size than the combined 2011–2019 dataset, the reliability of trip rates at the population category level is relatively low. Thus, trip rates for 2023 have been calculated at purpose level and compared with the combined trip rates from 2011–2019. The resulting factors will be applied to BSTM2 2019 trip rates by population categories associated with each purpose to get the BSTM2 PYV trip rates.

Table 4-6 - Demand segmentation (for each car availability status)

Traveller types	Trip purpose						
	HBW	HBEB	HBEd	HBPS	HBL	NHBEB	NHBO
Primary (5-11)			✓				
Secondary (12-16)			✓				
Tertiary (17-18)			✓				
Children_0-15	n/a	n/a	(HBPS)	✓	✓	n/a	✓
Student_16-74	n/a	n/a	(HBPS)	✓	✓	n/a	✓
FullTime_16-74	✓	✓	(HBPS)	✓	✓	✓	✓
PartTime_16-74	✓	✓	(HBPS)	✓	✓	✓	✓
Other_16-74	n/a	n/a	(HBPS)	✓	✓	n/a	✓
75+	n/a	n/a	(HBPS)	✓	✓	n/a	✓

n/a - segments not considered as trip numbers small by definition
(PB) - HBEd trips generated by those aged under 5 and over 18 transferred to HBPS and excluded from demand strata for HBEd;
HBW- Home-Based Work; HBEB- Home-Based Employers' Business; HBEd- Home-Based Education; HBPS- Personal Business & Shopping;
HBL- Home-Based Leisure ; NHBEB- Non-Home-Based Employers' Business ; NHBO- Non-Home-Based Other

Treatment of education escort trips

A high number of nursery and school trips made by younger age groups are usually expected to be escorted by adults. It is thus essential to capture these escort trips made by adults to truly reflect the trip making pattern made by children. Thus, for the population categories linked with education purpose, escort education trips made by adults (19+) have been extracted and redistributed amongst nursery, school and tertiary education categories.

The methodology adopted to capture escort trips for education is as follows:

- All education escort trips made by individuals up to the age of 18 were dropped.
- All adults above the age of 18 were extracted along with the household ID of the individuals making these trips. If the extracted households linked with these escort trips did not have an individual below the age of 18 making an education trip, the trips were dropped.
- For the trips from households where education trips were being made by children, adult escort trips were classified into 3 categories - nursery escort, school escort and tertiary escort, depending on the age of the child making education trip in the household. If a household has children in more than one category, the escort trips were assigned to the lowermost category.

Thus, for the three education levels - nursery, school and tertiary, the total trips include trips made by the children themselves plus the education escort trip made by adults above age 18 in the same household category. In the university student category, the trips made by the adult themselves are only considered.

Table 4-7 presents the overall trip rates by purpose and by area type (Urban and Rural) for 2023.

Table 4-7 - Year-wise change in trip rates by purpose and area type - England level

Purpose	Trip Rates - 2023		
	Urban	Rural	Overall
HBW	0.48	0.43	0.47
HBEB	0.05	0.07	0.05
HBEd	0.90	0.91	0.90
HBPS	0.32	0.34	0.32
HBL	0.23	0.28	0.24

4.3.1.2 Non-home-based trip rates

Non-home-based trip rates (Gamma factors as termed in NTEM) were computed to estimate the number of non-home-based trips generated per home-based trip attraction across various purposes. All from-home based trips were classified into five categories - HBW, HBEB, HBL, HBPS, HBEd, and all non-home-based trips classified into two categories - NHBEB and NHBO in line with BSTM2 model structure. These seven categories of trips were summarised based on number of trips within the same tour and the non-home-based trips that were attached to the preceding home-based trip categories within the same tour to determine the home-based trip purpose and calculate trip rates.

Table 4-8 presents the proportions of non-home-based trips generated for a home-based trip, indicating that non-home-based business trips linked to home-based business travel are the most common, as reflected by the highest gamma factor in 2023. This is followed by non-home-based other trips associated with home-based shopping and leisure travel.

Table 4-8 - NHB trip rates (Gamma Factors) for 2023 - England level

NHB trips per HB Attractions	Gamma Factors - 2023
NHBEB / HBW	0.0374
NHBEB / HBEB	0.3154
NHBEB / HBEd	0.0021
NHBEB / HBPS	0.0074
NHBEB / HBL	0.0038
NHBO / HBW	0.1705
NHBO / HBEB	0.1431
NHBO / HBEd	0.1185
NHBO / HBPS	0.2261
NHBO / HBL	0.2092

4.3.2 Mode share

Trip characteristics from the NTS were also utilised to examine mode shares by trip purpose, to understand how travel behaviour and modal preferences have shifted in the post-COVID-19 period, elaborated in Section 5.2.2. Table 4-9 below shows the average mode share by purpose for 2023.

Car has the dominant share for all the home-based and non-home-based trip purposes except for education. For education purpose, car and walk both have equally significant shares. Rail has very small share for most purposes except for employer's business and commute trips. Likewise, cycle too has a very small share of trips for most purposes. Bus shares are generally low for all trip purposes except education.

Table 4-9 - Mode share for 2023 - England level

Mode Share	Car	Bus	Rail	Walk	Cycle
HBW	67.9%	7.1%	10.9%	10.4%	3.7%
HBEB	75.4%	5.1%	10.3%	8.1%	1.1%
HBEd	37.6%	13.6%	3.7%	42.8%	2.3%
HBPS	61.6%	5.2%	1.8%	30.5%	0.9%
HBL	72.8%	4.4%	4.2%	15.8%	2.7%
NHBEB	74.4%	3.1%	3.7%	17.8%	0.9%
NHBO	69.9%	3.9%	2.8%	22.5%	1.0%
Total	64.4%	6.0%	4.6%	23.0%	1.9%

4.3.3 Trip Length Distribution

The trip length distribution of pre-COVID-19 and post-COVID-19 NTS data has been analysed to examine changes in travel behaviour over time. Figure 4-4 and Figure 4-5 show the trip length distributions by mode of HBW and HBPS, respectively. Home-base work trips are accommodated mainly under the bands ranging from 2 miles to 15 miles, which matches with the peak shares for car, bus and cycle. Walk trips are dominant only under the <2-mile band and fall sharply thereafter. Rail peaks at 15-25 miles category which is due to commuters travelling outside the region.

The change in trip length distribution pre- and post-COVID-19 is discussed in detail in Section 5.2.3

Figure 4-4 - Trip length distribution of HBW purpose for 2023 - England level

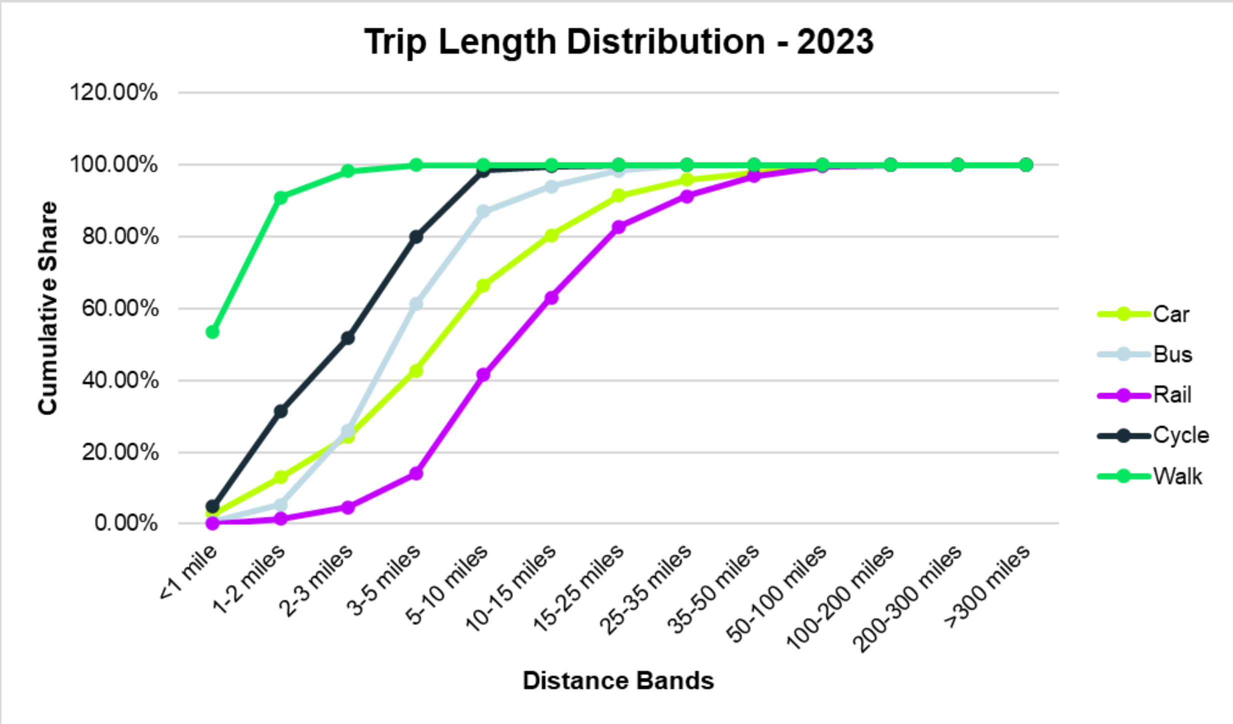
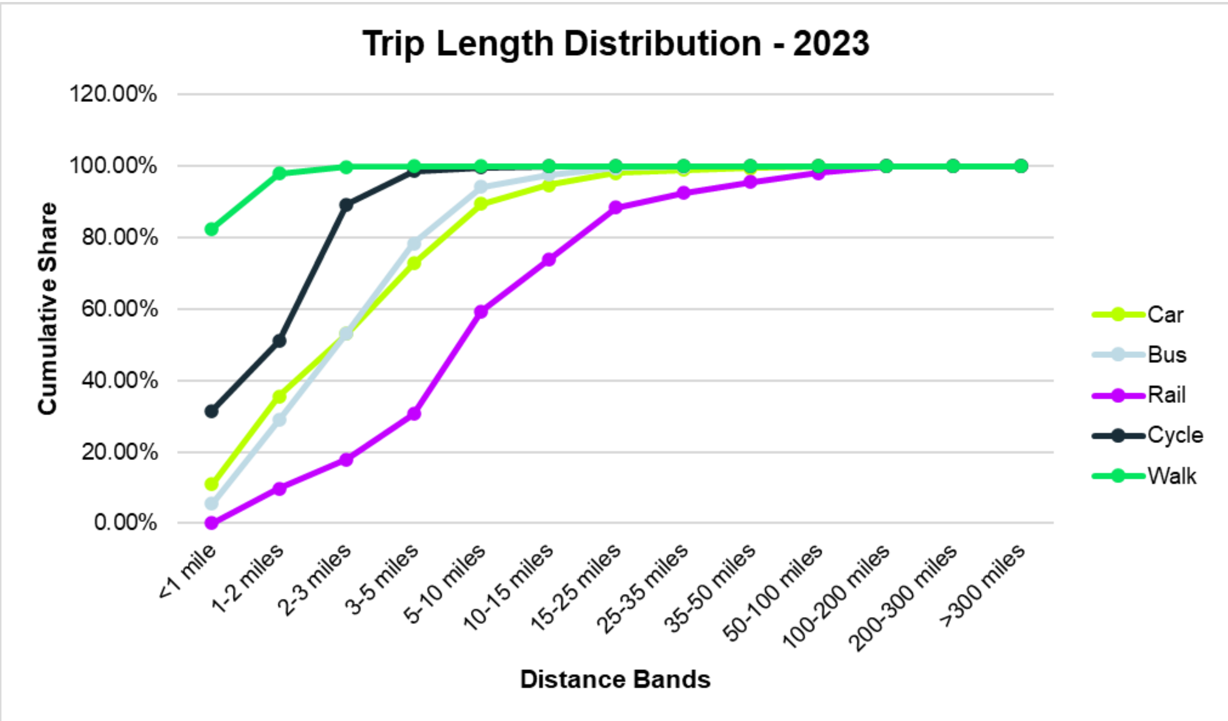


Figure 4-5 - Trip length distribution of HBPS purpose for 2023 - England level



4.3.4 From home (FH) factor by time period

The FH proportions from NTS are analysed to examine the shift in trips between peak periods across the different trip purposes. This analysis helps to understand how travel behaviour has evolved post-COVID-19, particularly in terms of when people are choosing to travel from home for different activities.

Table 4-10 shows the from-home trip proportions by time period for 2023. The from-home proportions indicate that most commute and education trips predominantly begin in the morning (AM), while shopping, leisure, and all non-home-based trips typically start during the inter-peak (IP) period. The from-home proportions do not vary significantly across the different modes. The OP from-home factors are excluded, as the BSTM2 model focuses only on three time periods i.e., AM, IP, and PM. As a result, the overall modal proportions shown in the below table do not sum to 100%.

It is to be noted that the NTS sample size at mode and purpose level disaggregation is less than 300 for most cases. As per NTS guidance provided by DfT, for trip and stage estimates, samples of under 300 should not be used, whilst samples of under 1,000 should be used cautiously. Hence, the from-home factors from the current NTS data are considered unreliable. Therefore, it is proposed to retain the FH factors from BSTM2 in the BSTM2 PYV.

Table 4-10 - From home (FH) factor by time period for 2023 - England level

Purposes	Bus			Car			Cycle			Rail			Walk		
	AM	IP	PM	AM	IP	PM	AM	IP	PM	AM	IP	PM	AM	IP	PM
FHBW	53%	17%	3%	56%	12%	7%	57%	15%	2%	72%	6%	2%	57%	20%	4%
FHBEB	56%	27%	4%	51%	23%	8%	50%	42%	8%	55%	23%	4%	32%	50%	10%
FHBEd	95%	4%	0%	96%	2%	2%	95%	5%	0%	93%	2%	0%	98%	2%	1%
FHBPS	30%	62%	7%	33%	48%	15%	44%	35%	16%	48%	46%	3%	34%	49%	12%
FHBL	18%	63%	14%	18%	40%	30%	16%	43%	28%	28%	36%	27%	15%	38%	30%
NHBEB	29%	60%	7%	27%	55%	15%	15%	53%	22%	30%	52%	11%	20%	64%	4%
NHBO	18%	57%	21%	21%	54%	19%	19%	39%	24%	18%	39%	35%	12%	63%	14%
	Sample size >1000														
	Sample Size <1000 and >300														
	Sample Size <300														

4.3.5 To home (TH) factor by time period

To-home time of day (or the phi) factors from NTS give the proportion of from-home (FH) trips by time period that have the corresponding to-home (TH) trip in each time period. This analysis focuses on how the return trips to home has shifted between peak periods, offering insights into evolving patterns in daily mobility.

Table 4-11 shows the to-home trip proportions by time period for 2023. The to-home trip proportions indicate that trips originating in the AM, IP, and OP periods mostly end during the IP and PM periods. Trips that begin in the PM are primarily observed to end in the OP and PM periods.

Similar to the FH proportions, the TH proportions are derived based on limited samples available for NTS 2023 at time period, purpose and mode level. Given the sample size limitations, it is proposed to continue using the TH factors from the BSTM2 Update in the BSTM2 PYV model.

Table 4-11 - To home (TH) factor by time period for 2023 - England level

Purpose/ Mode		TH Factors – 2023 (%)															
		AM_AM	AM_IP	AM_PM	AM_OP	IP_AM	IP_IP	IP_PM	IP_OP	OP_AM	OP_IP	OP_PM	OP_OP	PM_AM	PM_IP	PM_PM	PM_OP
HBW	Bus	0.0%	9.6%	72.2%	18.2%	0.0%	6.3%	17.4%	76.3%	0.0%	34.9%	47.0%	18.1%	0.0%	0.0%	0.0%	100.0%
	Car	4.7%	16.1%	71.1%	8.1%	0.0%	23.9%	32.6%	43.5%	5.1%	28.1%	47.9%	18.9%	0.0%	0.0%	69.0%	31.0%
	Cycle	0.3%	15.6%	65.8%	18.3%	0.0%	5.8%	40.7%	53.5%	0.0%	44.3%	44.1%	11.7%	0.0%	0.0%	0.0%	100.0%
	Rail	0.0%	4.3%	60.7%	35.0%	0.0%	6.1%	22.9%	71.0%	0.0%	10.0%	58.0%	32.0%	0.0%	0.0%	0.0%	100.0%
	Walk	1.6%	25.6%	67.2%	5.5%	0.0%	39.7%	24.9%	35.3%	11.3%	55.3%	31.8%	1.6%	0.0%	0.0%	0.0%	100.0%
HBEB	Bus	0.0%	52.7%	28.8%	18.5%	0.0%	45.2%	31.3%	23.5%	0.0%	0.0%	59.7%	40.3%	0.0%	0.0%	0.0%	100.0%
	Car	3.5%	34.9%	58.3%	3.3%	0.0%	52.5%	38.6%	8.9%	8.2%	34.5%	35.0%	22.3%	0.0%	0.0%	25.1%	74.9%
	Cycle	0.0%	17.4%	82.6%	0.0%	0.0%	52.4%	17.0%	30.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%
	Rail	0.0%	15.0%	63.1%	21.9%	0.0%	20.4%	41.5%	38.1%	0.0%	0.0%	71.1%	28.9%	0.0%	0.0%	0.0%	100.0%
	Walk	32.6%	48.0%	14.8%	4.6%	0.0%	39.3%	60.7%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%
HBEd	Bus	0.8%	43.5%	54.8%	0.9%	0.0%	35.7%	52.1%	12.1%	0.0%	15.6%	84.4%	0.0%	0.0%	0.0%	0.0%	0.0%
	Car	1.0%	71.4%	27.1%	0.5%	0.0%	70.3%	29.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	47.8%	52.2%
	Cycle	0.0%	81.3%	18.7%	0.0%	0.0%	33.8%	66.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Rail	0.0%	21.4%	76.7%	1.9%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	86.6%	13.4%	0.0%	0.0%	0.0%	0.0%
	Walk	0.9%	84.8%	13.8%	0.5%	0.0%	88.3%	11.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
HBPS	Bus	16.6%	71.7%	10.2%	1.5%	0.0%	66.4%	29.2%	4.5%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	21.6%	78.4%
	Car	47.3%	39.5%	12.8%	0.4%	0.0%	80.0%	19.0%	1.0%	3.5%	4.0%	1.8%	90.8%	0.0%	0.0%	70.0%	30.0%
	Cycle	29.3%	17.4%	36.0%	17.3%	0.0%	83.6%	16.4%	0.0%	33.2%	0.0%	0.0%	66.8%	0.0%	0.0%	81.3%	18.7%
	Rail	0.0%	37.4%	46.7%	15.8%	0.0%	38.5%	56.6%	5.0%	0.0%	58.4%	17.0%	24.6%	0.0%	0.0%	55.7%	44.3%
	Walk	68.9%	24.4%	6.3%	0.4%	0.0%	92.7%	7.1%	0.2%	6.6%	2.6%	0.0%	90.8%	0.0%	0.0%	86.5%	13.5%
HBL	Bus	2.3%	68.7%	18.8%	10.2%	0.0%	36.2%	53.3%	10.6%	7.2%	12.5%	43.4%	36.8%	0.0%	0.0%	7.0%	93.0%
	Car	13.2%	65.8%	15.6%	5.4%	0.0%	59.1%	33.2%	7.7%	8.0%	1.2%	0.4%	90.4%	0.0%	0.0%	24.0%	76.0%
	Cycle	37.8%	62.2%	0.0%	0.0%	0.0%	71.4%	25.1%	3.6%	22.9%	0.0%	0.0%	77.1%	0.0%	0.0%	23.2%	76.8%
	Rail	0.0%	23.5%	50.1%	26.5%	0.0%	7.3%	43.0%	49.7%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	100.0%
	Walk	11.4%	83.6%	4.1%	0.9%	0.0%	57.1%	36.5%	6.4%	3.4%	0.0%	0.0%	96.6%	0.0%	0.0%	20.3%	79.7%

(green)	Sample size >1000
(yellow)	Sample Size <1000 and >300
(pink)	Sample Size <300
(grey)	No Samples

5. Data comparison - 2019 vs 2024

5.1 Traffic data

Traffic count data between 2019 and 2024 at consistent locations was analysed for average weekday to evaluate the impact of COVID-19 on travel behaviour, infrastructure usage, and modal shifts. The assessment is carried out for various time periods by count types and screenlines offering a comprehensive perspective on evolving transport trends.

5.1.1 12-hour / 24-hour traffic comparisons

Table 5-1 and Table 5-2 summarise traffic data from all 51 count locations, comprising both ATC and CTCs. While the 12-hour totals incorporate both ATC and CTC data, the 24-hour totals exclude CTC counts, as CTC data is only available for a 12-hour duration.

Table 5-1 - 12-hour traffic counts by count type: 2019 vs 2024

Count Type	2019	2024	Diff (2024-2019)	%Diff
ATC	669,932	633,819	-36,113	-5%
CTC	257,684	263,228	5,544	2%
Grand Total	927,616	897,047	-30,569	-3%

Table 5-2 - 24-hour traffic counts by count type: 2019 vs 2024

Count Type	2019	2024	Diff (2024-2019)	%Diff
ATC	854,312	815,316	-38,997	-5%
CTC	-	-	-	0%
Grand Total	854,312	815,316	-38,997	-5%

It is observed that overall change in traffic counts shows a 3% decline for 12-hour data and a 5% decline for 24-hour data between 2019 and 2024. However, within the 12-hour dataset CTC volumes have increased by 2%, largely due to the infrastructure developments in Aylesbury. These infrastructure changes have influenced turning movements, contributing to the observed growth in CTC counts as positive. A comparative analysis of 12-hour traffic volumes by screenline was carried for the years 2019 and 2024, and is presented in Table 5-3.

Table 5-3 - 12-hours traffic counts by screenline classification: 2019 vs 2024

Screenline	2019	2024	Diff	%Diff	No. of Links
1_1_Aylesbury_Inner_Cordon_In	68,282	70,646	2,364	3%	8
1_2_Aylesbury_Inner_Cordon_Out	64,761	69,410	4,649	7%	8
2_1_High_Wycombe_inner_Cordon_In	62,853	60,021	-2,833	-5%	9
2_2_High_Wycombe_inner_Cordon_Out	64,101	62,319	-1,782	-3%	9
3_1_Buckingham_North	13,437	13,425	-13	0%	2

Screenline	2019	2024	Diff	%Diff	No. of Links
3_2_Buckingham_South	13,566	13,463	-103	-1%	2
4_1_Aylesbury_Outer_Cordon_In	47,830	45,651	-2,179	-5%	6
4_2_Aylesbury_Outer_Cordon_Out	45,693	44,796	-897	-2%	6
5_1_Buckingham_North_West	7,900	9,387	1,487	19%	3
5_2_Buckingham_South_East	8,257	9,642	1,385	17%	3
6_1_Amersham_Cordon_In	49,587	43,989	-5,599	-11%	6
6_2_Amersham_Cordon_Out	51,604	45,141	-6,463	-13%	6
7_1_Marlow_Uxbridge_North	123,555	120,676	-2,879	-2%	5
7_2_Marlow_Uxbridge_South	121,666	116,665	-5,001	-4%	5
Ad hoc links	184,524	171,815	-12,708	-7%	24
Grand Total	927,616	897,047	-30,569	-3%	102

Between 2019 and 2024, overall traffic volumes across screenlines in Buckinghamshire declined modestly by 3%, indicating relative stability. However, Buckingham stands out with an 18% increase in traffic, followed by a 5% rise on the Aylesbury Inner Cordon. These increases are primarily attributed to infrastructure developments near the Land North of A421 Road (Buckingham) and Land East of Aylesbury.

5.1.2 Peak period traffic comparisons

Traffic data has been analysed and compared for BSMT2 modelled peak periods (i.e. AM peak period 07:00 to 10:00; Inter-peak period 10:00 to 16:00 and PM peak period 16:00 to 18:00) for an average weekday. Table 5-4 summarises peak period traffic data from all 51 (2 way) count locations, comprising both ATC and CTCs.

Table 5-4 - Peak period Traffic Counts by Count Type: 2019 vs 2024

Time period	Count Type	2019	2024	Diff (2024-2019)	%Diff
AM	ATC	181,487	170,858	-10,629	-6%
	CTC	70,382	71,349	967	1%
	Grand Total	251,869	242,207	-9,662	-4%
IP	ATC	300,416	287,134	-13,282	-4%
	CTC	113,255	120,769	7,514	7%
	Grand Total	413,671	407,903	-5,768	-1%
PM	ATC	188,029	175,827	-12,202	-6%
	CTC	74,047	71,110	-2,937	-4%
	Grand Total	262,076	246,937	-15,139	-6%

The decline in trips across all peak periods between 2019 and 2024 is primarily driven by reductions in goods vehicle movements, particularly LGVs, and car trips. However, as noted in section 5.1.1, car volumes have increased significantly in newly developed areas. A comparative analysis for peak period traffic volumes by screenline was carried for the years 2019 and 2024 and is presented in Table 5-5 to Table 5-7.

Table 5-5 - AM peak period traffic counts by screenline classification: 2019 vs 2024

Screenline	2019	2024	Diff	%Diff	No of Links
1_1_Aylesbury_Inner_Cordon_In	19,220	17,592	-761	-8%	8
1_2_Aylesbury_Inner_Cordon_Out	14,796	18,720	3,057	27%	8
2_1_High_Wycombe_inner_Cordon_In	16,593	15,749	-844	-5%	9
2_2_High_Wycombe_inner_Cordon_Out	18,439	17,586	-852	-5%	9
3_1_Buckingham_North	3,760	3,636	-124	-3%	2
3_2_Buckingham_South	3,895	3,955	60	2%	2
4_1_Aylesbury_Outer_Cordon_In	12,806	11,445	-1,361	-11%	6
4_2_Aylesbury_Outer_Cordon_Out	13,411	13,415	4	0%	6
5_1_Buckingham_North_West	2,245	2,991	746	33%	3
5_2_Buckingham_South_East	2,493	2,654	160	6%	3
6_1_Amersham_Cordon_In	14,490	12,744	-1,746	-12%	6
6_2_Amersham_Cordon_Out	13,817	12,670	-1,147	-8%	6
7_1_Marlow_Uxbridge_North	32,394	31,474	-920	-3%	5
7_2_Marlow_Uxbridge_South	33,235	30,850	-2,385	-7%	5
Adhoc	50,274	46,726	-3,548	-7%	24
Grand Total	251,869	242,207	-9,662	-4%	102

Table 5-6 - IP peak period traffic counts by screenline classification: 2019 vs 2024

Screenline	2019	2024	Diff	%Diff	No of Links
1_1_Aylesbury_Inner_Cordon_In	30,509	33,202	1,895	9%	8
1_2_Aylesbury_Inner_Cordon_Out	30,763	33,410	3,446	9%	8
2_1_High_Wycombe_inner_Cordon_In	27,467	27,294	-173	-1%	9
2_2_High_Wycombe_inner_Cordon_Out	27,495	28,001	506	2%	9
3_1_Buckingham_North	5,625	5,762	136	2%	2
3_2_Buckingham_South	5,746	5,826	79	1%	2
4_1_Aylesbury_Outer_Cordon_In	20,522	20,122	-400	-2%	6
4_2_Aylesbury_Outer_Cordon_Out	19,454	19,603	149	1%	6
5_1_Buckingham_North_West	3,304	3,877	573	17%	3
5_2_Buckingham_South_East	3,428	3,928	500	15%	3
6_1_Amersham_Cordon_In	21,249	19,003	-2,246	-11%	6
6_2_Amersham_Cordon_Out	22,021	19,560	-2,461	-11%	6
7_1_Marlow_Uxbridge_North	57,414	56,698	-716	-1%	5
7_2_Marlow_Uxbridge_South	56,785	55,202	-1,583	-3%	5
Adhoc	81,888	76,416	-5,472	-7%	24
Grand Total	413,671	407,903	-5,768	-1%	102

Table 5-7 - PM peak period traffic counts by screenline classification: 2019 vs 2024

Screenline	2019	2024	Diff	%Diff	No of Links
1_1_Aylesbury_Inner_Cordon_In	18,553	19,852	164	1%	8
1_2_Aylesbury_Inner_Cordon_Out	19,201	17,280	-787	-4%	8
2_1_High_Wycombe_inner_Cordon_In	18,794	16,978	-1,816	-10%	9
2_2_High_Wycombe_inner_Cordon_Out	18,168	16,732	-1,435	-8%	9
3_1_Buckingham_North	4,052	4,027	-25	-1%	2
3_2_Buckingham_South	3,925	3,683	-242	-6%	2
4_1_Aylesbury_Outer_Cordon_In	14,502	14,084	-418	-3%	6
4_2_Aylesbury_Outer_Cordon_Out	12,827	11,778	-1,050	-8%	6
5_1_Buckingham_North_West	2,351	2,520	168	7%	3
5_2_Buckingham_South_East	2,335	3,061	725	31%	3
6_1_Amersham_Cordon_In	13,848	12,242	-1,607	-12%	6
6_2_Amersham_Cordon_Out	15,766	12,911	-2,855	-18%	6
7_1_Marlow_Uxbridge_North	33,746	32,504	-1,242	-4%	5
7_2_Marlow_Uxbridge_South	31,646	30,613	-1,033	-3%	5
Adhoc	52,361	48,674	-3,688	-7%	24
Grand Total	262,076	246,937	-15,139	-6%	102

As highlighted in section 5.1.1, screenlines in Aylesbury and Buckingham show positive growth, aligning with the observed 12-hour traffic increases. In contrast, all other screenlines across Buckinghamshire exhibit either stable or declining traffic volumes.

5.1.3 Peak hour Traffic Comparisons

Traffic data has been analysed and compared for the BSTM2 modelled peak hours (i.e. AM peak hour 08:00 to 09:00; average of Inter-peak hour 10:00 to 16:00 and PM peak hour 17:00 to 18:00). Table 5-8 summarises peak hour traffic data from all 51 count locations, comprising both ATC and CTCs.

Table 5-8 - Peak hour traffic counts by count type: 2019 vs 2024

Time period	Count Type	2019	2024	Diff (2024-2019)	%Diff
AM	ATC	62,599	59,771	-2,828	-5%
	CTC	25,599	26,118	520	2%
	Grand Total	88,197	85,890	-2,308	-3%
IP	ATC	50,069	47,856	-2,213	-4%
	CTC	18,876	20,128	1,252	7%
	Grand Total	68,945	67,984	-961	-1%
PM	ATC	66,233	61,819	-4,414	-7%
	CTC	27,473	25,292	-2,181	-8%
	Grand Total	93,706	87,111	-6,595	-7%

Overall, reduction of trips between 2019 and 2024 in all peak hours is in line with the peak periods driven by good vehicles (predominantly LGVs) and reduction in car trips. A comparative analysis for peak hour traffic volumes by screenline for average weekday was carried for the years 2019 and 2024 and is presented in Table 5-9 to Table 5-11.

Table 5-9 - AM peak hour traffic counts by screenline classification: 2019 vs 2024

Screenline	2019	2024	Diff	%Diff	No of Links
1_1_Aylesbury_Inner_Cordon_In	6,679	6,141	-188	-8%	8
1_2_Aylesbury_Inner_Cordon_Out	5,022	6,387	1,015	27%	8
2_1_High_Wycombe_inner_Cordon_In	6,084	6,102	17	0%	9
2_2_High_Wycombe_inner_Cordon_Out	6,635	6,422	-213	-3%	9
3_1_Buckingham_North	1,391	1,360	-31	-2%	2
3_2_Buckingham_South	1,408	1,426	19	1%	2
4_1_Aylesbury_Outer_Cordon_In	4,610	4,252	-357	-8%	6
4_2_Aylesbury_Outer_Cordon_Out	4,717	4,377	-340	-7%	6
5_1_Buckingham_North_West	929	1,162	233	25%	3
5_2_Buckingham_South_East	1,001	1,126	124	12%	3
6_1_Amersham_Cordon_In	5,160	4,680	-480	-9%	6
6_2_Amersham_Cordon_Out	4,729	4,640	-90	-2%	6
7_1_Marlow_Uxbridge_North	11,029	10,675	-354	-3%	5
7_2_Marlow_Uxbridge_South	11,355	10,678	-678	-6%	5
Adhoc	17,447	16,463	-985	-6%	24
Grand Total	88,197	85,890	-2,308	-3%	102

Table 5-10 - Average IP peak hour traffic counts by screenline classification: 2019 vs 2024

Screenline	2019	2024	Diff	%Diff	No of Links
1_1_Aylesbury_Inner_Cordon_In	5,085	5,534	316	9%	8
1_2_Aylesbury_Inner_Cordon_Out	5,127	5,568	574	9%	8
2_1_High_Wycombe_inner_Cordon_In	4,578	4,549	-29	-1%	9
2_2_High_Wycombe_inner_Cordon_Out	4,582	4,667	84	2%	9
3_1_Buckingham_North	938	960	23	2%	2
3_2_Buckingham_South	958	971	13	1%	2
4_1_Aylesbury_Outer_Cordon_In	3,420	3,354	-67	-2%	6
4_2_Aylesbury_Outer_Cordon_Out	3,242	3,267	25	1%	6
5_1_Buckingham_North_West	551	646	96	17%	3
5_2_Buckingham_South_East	571	655	83	15%	3
6_1_Amersham_Cordon_In	3,542	3,167	-374	-11%	6

Screenline	2019	2024	Diff	%Diff	No of Links
6_2_Amersham_Cordon_Out	3,670	3,260	-410	-11%	6
7_1_Marlow_Uxbridge_North	9,569	9,450	-119	-1%	5
7_2_Marlow_Uxbridge_South	9,464	9,200	-264	-3%	5
Adhoc	13,648	12,736	-912	-7%	24
Grand Total	68,945	67,984	-961	-1%	102

Table 5-11 - PM peak hour traffic counts by screenline classification: 2019 vs 2024

Screenline	2019	2024	Diff	%Diff	No of Links
1_1_Aylesbury_Inner_Cordon_In	6,505	7,062	140	2%	8
1_2_Aylesbury_Inner_Cordon_Out	6,899	5,986	-496	-8%	8
2_1_High_Wycombe_inner_Cordon_In	6,914	5,869	-1,045	-15%	9
2_2_High_Wycombe_inner_Cordon_Out	7,029	6,068	-961	-14%	9
3_1_Buckingham_North	1,447	1,443	-4	0%	2
3_2_Buckingham_South	1,461	1,365	-96	-7%	2
4_1_Aylesbury_Outer_Cordon_In	5,287	5,023	-264	-5%	6
4_2_Aylesbury_Outer_Cordon_Out	4,665	4,278	-387	-8%	6
5_1_Buckingham_North_West	871	878	7	1%	3
5_2_Buckingham_South_East	891	1,113	222	25%	3
6_1_Amersham_Cordon_In	4,836	4,396	-439	-9%	6
6_2_Amersham_Cordon_Out	5,762	4,572	-1,190	-21%	6
7_1_Bourne End_North	11,504	11,071	-433	-4%	5
7_2_Bourne End_South	10,894	10,412	-482	-4%	5
Adhoc	18,740	17,575	-1,165	-6%	24
Grand Total	93,706	87,111	-6,595	-7%	102

Screenlines in the Aylesbury and Buckingham areas display similar growth trends, which appear to be influenced by traffic variations observed during peak periods.

5.1.4 Conversion factors

Peak hour to peak period conversion factors were compared for 2019 and 2024 presented in Table 5-12. It is observed that there is no major change in conversion factors from 2019 to 2024.

Table 5-12 - BSTM2 PYV conversion factors

Time Period	Conversion Factors	
	2019	2024
AM	2.85	2.82
IP	6.00	6.00
PM	2.79	2.84

5.1.5 Vehicle type distribution

Table 5-13 presents the distribution of vehicle types, cars, LGVs, and HGVs during peak hours for 2019 and 2024. The overall reduction in trips across all peak hours between these years is primarily driven by a decline in goods vehicles, particularly LGVs, as well as a decrease in car trips.

Table 5-13 - Peak hour Vehicle Distribution Change: 2019 vs 2024

Time period	Mode	2019	2024	Diff	%Diff
AM (0800:0900)	Car	75,010	72,806	-2,204	-3%
	LGV	9,046	8,246	-800	-9%
	HGV	4,141	4,837	696	17%
	Total	88,197	85,890	-2,308	-3%
IP (1000:1600)	Car	54,848	55,012	164	0%
	LGV	9,307	7,729	-1,578	-17%
	HGV	4,790	5,243	453	9%
	Total	68,945	67,984	-961	-1%
PM (1700:1800)	Car	83,934	78,037	-5,897	-7%
	LGV	7,737	6,442	-1,294	-17%
	HGV	2,035	2,631	596	29%
	Total	93,706	87,111	-6,595	-7%

5.2 Travel data

5.2.1 Trip rates

5.2.1.1 Home-based trip rates

Trip rates from the combined 2011–2019 NTS data (earlier dataset was used in the BSTM2 model) have been compared with those from NTS 2023. Table 5-14 presents the yearly trip rate by home-based purpose and changes in trip rates observed between the two periods. At Post-COVID-19, there is a reduction in commute and business trips. For all other trip purposes, the differences post-COVID-19 are minimal, indicating little to insignificant change.

Table 5-14 - Change in trip rates by purpose - 2023 vs (2011-2019)

NTS Survey Year	HBW	HBEB	HBEd	HBPS	HBL
2011	0.61	0.06	0.81	0.37	0.24
2012	0.60	0.07	0.85	0.35	0.24
2013	0.58	0.07	0.81	0.34	0.23
2014	0.59	0.08	0.88	0.33	0.23
2015	0.58	0.08	0.81	0.35	0.22
2016	0.57	0.08	0.87	0.34	0.23
2017	0.58	0.06	0.86	0.35	0.23
2018	0.56	0.07	0.90	0.35	0.24
2019	0.55	0.07	0.92	0.33	0.23
2011-19 Combined	0.58	0.07	0.85	0.35	0.23
2023	0.47	0.05	0.90	0.32	0.24
Ratio (2023/2011-19)	**0.81**	**0.74**	**1.05**	**0.94**	**1.01**

5.2.1.2 Non-home-based trip rates

Table 5-15 presents the change in NHB trip rates from national NTS data for 2011-2019 combined and 2023. The changes in gamma factors reveal a reduction in non-home-based business trips originating from home-based commute, shopping, and leisure trips. In contrast, other non-home-based trips have increased from the 2011–2019 period to 2023, with the most significant rise observed in NHBO/HBEB trips. While the changes related to the non-home-based trips from a home-based commute or shopping trips are reliable, the change in generation of non-home-based business or other trips from a home-based employer business trip are not reliable due to smaller home-based employer business samples.

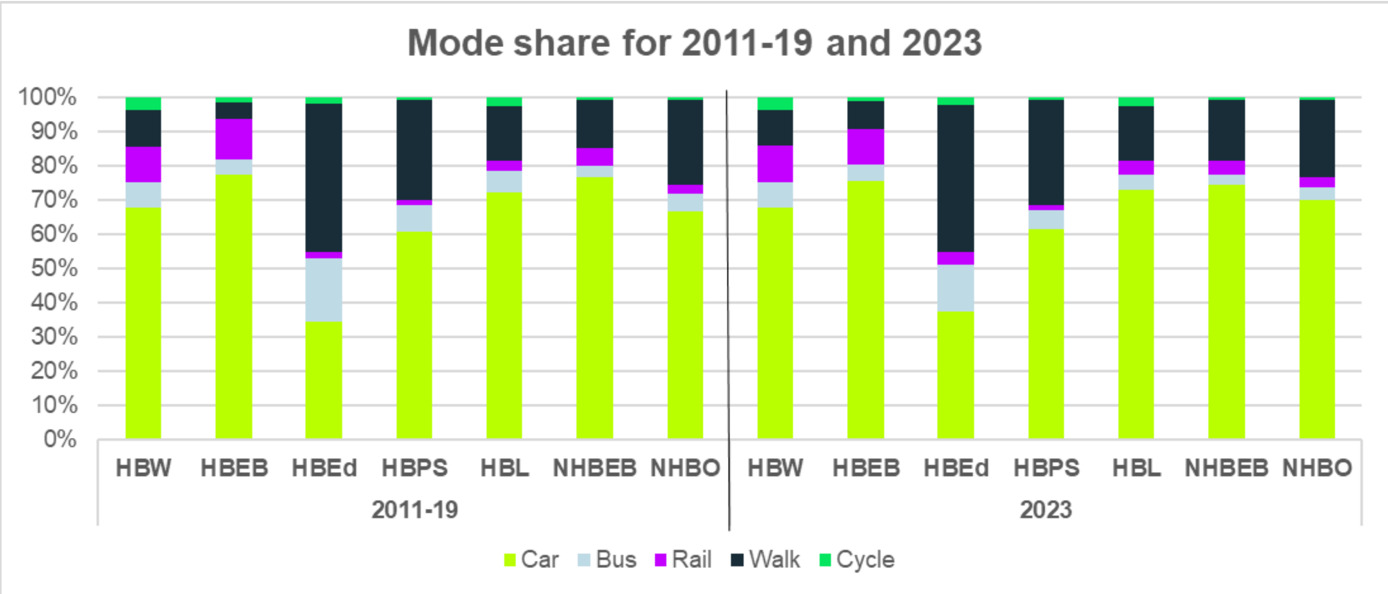
Table 5-15 - Change in trip rates by purpose - 2023 vs (2011-2019)

NHB trips per HB Attractions	Gamma Factors		
	2011-19	**2023**	**Ratio (2023/2011-19)**
NHBEB/HBW	0.0390	0.0374	**0.96**
NHBEB/HBEB	0.2181	0.3154	**1.45**
NHBEB/HBEd	0.0016	0.0021	**1.28**
NHBEB/HBPS	0.0092	0.0074	**0.80**
NHBEB/HBL	0.0075	0.0038	**0.50**
NHBO/HBW	0.1230	0.1705	**1.39**
NHBO/HBEB	0.0863	0.1431	**1.66**
NHBO/HBEd	0.0901	0.1185	**1.31**
NHBO/HBPS	0.1611	0.2261	**1.40**
NHBO/HBL	0.1553	0.2092	**1.35**

5.2.2 Mode share

This section showcases the change in mode shares, pre-COVID-19 and post-COVID-19. Figure 5-1, illustrates the mode shares from combined 2011–2019 data (in line with BSTM2 Update) and the 2023 data, revealing broadly similar patterns.

Figure 5-1 - Mode share for 2023 vs (2011-2019) - England level



The absolute difference in mode shares between pre-COVID-19 and post-COVID-19 is presented in Table 5-16. While there are minor shifts in individual purposes, the overall distribution remains consistent, suggesting that fundamental travel behaviours have not significantly changed over time. The table indicates a decline in bus mode share across all trip purposes except for commute and business travel, where usage has remained relatively stable. This reduction in bus usage appears to be offset primarily by the increased use of car. Due to the relatively low overall share of rail trips, it is difficult to draw any definitive conclusions regarding changes in rail usage due to the small sample size in NTS 2023. Notably, business travel shows a modest increase in walking trips, which may reflect evolving work habits and travel patterns, such as a shift towards more local or flexible work arrangements following COVID-19.

Table 5-16 - Change in mode share by trip purpose: 2023 vs 2011-2019

Mode Share	Car	Bus	Rail	Walk	Cycle
HBW	0.0%	-0.3%	0.6%	-0.2%	-0.1%
HBEB	-1.9%	0.6%	-1.5%	3.1%	-0.4%
HBEd	3.2%	-4.7%	1.6%	-0.2%	0.2%
HBPS	0.9%	-2.7%	0.3%	1.5%	-0.1%
HBL	0.7%	-1.7%	1.3%	-0.3%	0.1%
NHBEB	-2.2%	-0.3%	-1.5%	3.9%	0.0%
NHBO	3.3%	-1.4%	0.1%	-2.0%	0.0%
Total	0.7%	-1.8%	0.4%	0.8%	-0.1%

5.2.3 Trip length distribution

This section examines the shifts in travel patterns observed in the post-COVID-19 period, highlighting changes in trip length distribution compared to pre-COVID-19 period. The analysis of trip length distributions (TLDs) across different purposes reveals several post-COVID-19 shifts.

For HBW trips, bus and cycle journeys have become shorter, likely due to a reduction in longer trips now being made by car or rail. In HBEB trips, there has been an increase in shorter distance car, PT, and cycle trips, while walking trips have become longer, though the sample size is too small in post-COVID-19 NTS to draw firm conclusions. For HBEd trips, TLD patterns remain largely unchanged, except for cycling, where shorter trips have increased; however, the sample size for HBEd cycling is very limited in post-COVID-19 NTS. In HBPS trips, public transport trips have slightly shortened, while longer-distance cycling trips have increased. For HBL trips, rail usage has risen in the 25–50 and 100–200 mile bands but declined in the 5–25 mile range. Other modes show negligible changes in TLD patterns. It’s important to note that majority of these observations are influenced by smaller sample sizes and data noise in post-COVID-19 NTS and might not be a true change in travel behaviour.

Figure 5-2 and Figure 5-3 illustrate the TLD for car, bus and rail for HBW and HBPS, respectively.

Figure 5-2 - HBW trip length distribution by mode– 2023 vs 2011-2019

Figure 5-3 - HBPS trip length distribution by mode - 2023 vs 2011-2019

5.2.4 From-home (FH) and To-home (TH) factor by time period

As discussed in Section 4.3.4 and Section 4.3.5, the FH and TH proportions in NTS 2023 are based on limited sample sizes when broken down by time period, trip purpose, and mode. Given the unreliability of these disaggregated samples, it is recommended to retain the FH and TH factors from the BSTM2 Update model for use in the BSTM2 PYV model. As a result, comparing pre- and post-COVID-19 conditions in this context is not considered meaningful.

6. Conclusions

Traffic count data analysis

The observed traffic count data from various sources has been collated for the years 2019 and 2024 to enable screen line analysis within AoMIs i.e., Aylesbury, Buckingham, High Wycombe, Bourne End and Marlow. This data was processed to obtain average weekday peak hour traffic and conversion factors for the present year model. A comparison of 2019 and 2024 traffic data reveals that there is a reduction of 3-4% in traffic growth across the model area. This change will be reflected by adjusting trip rates used in the variable demand model resulting in the 2024 demand. The resultant demand will be assigned onto the model network to check the validation against traffic counts.

Journey times

The observed journey time data collected from TomTom has been processed for 20 two-way routes across the AoMIs i.e., Aylesbury, Buckingham, High Wycombe, Bourne End and Marlow. The observed and modelled trip lengths for these 20 two-way routes have been compared against each other and presented within this technical note to ensure that the variations are minimal. These routes will be used as part of the present year validation by comparing congested journey times from the highway model assignments against the observed times from the surveyed routes.

Travel demand behaviours from NTS data

The NTS data analysis for the year 2023 (post-COVID-19) and its comparisons against pre-COVID-19 (2011-2019 Combined in line with BSTM2) travel behaviours can be broadly summarised under the following key points:

Trip rate analysis reveals that the home-based commute trips have dropped significantly from pre- to post-COVID-19, while HBEd trip rates show an increase from 2019. There are only slight changes in trip rates for the other purposes. It is noted that the increase in HBEd trip rates between 2019 and 2024 is due to the methodology used for the calculation of trip rates representing 2019, by considering combined 2011-2019 NTS data.

There is a considerable reduction in non-home-based business trips from Home-based purposes, especially commute. However, there is an increase in non-home-based other trips from the Home-based trips;

Changes in commute mode shares are driven by trip rates changes. For education and business trips, the sample sizes in NTS 2023 data are too small to draw reliable conclusions on the changes. For other purposes, there’s a slight increase in car usage, likely due to a decline in bus travel, with some shifts to walking and rail;

Regarding trip length distributions, majority of the changes noted are not statistically reliable due to small sample sizes and will be used with caution. The apparent shortening of bus trips is likely due to fewer long-distance journeys, as people opt for car or rail instead; and

The proportions of From-home and To-home trips derived from the NTS 2023 data are found to be unreliable due to insufficient sample size in NTS 2023 data at a disaggregated level by time period, trip purpose, and mode.

Based on the National Travel Survey data analysis, it is thus suggested that the changes in trip rates by purpose are more reliable and will be implemented in BSTM2 PYV for 2024. The changes in trip rates will be applied as part of the synthetic trip end processing which will result in reduced number of trip productions dominated by the reduction in commute trip rates between 2019 and 2024. AtkinsRéalis does not intend to change the inputs related to From-home and To-Home factors as they are more driven by the sample sizes and are not a realistic change.

The mode share and trip length distributions will be primarily used for validation purposes. However, we expect that a penalty on bus mode across all purposes except commute and business might be required to validate the demand model for the year 2024.