AtkinsRéalis

Stage 1 Modelling Outputs Report

South Gloucestershire Council

January 2024

SOUTH GLOUCESTERSHIRE COUNCIL – LOCAL PLAN LENS TESTING

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1. Introduction

AtkinsRéalis has been commissioned by South Gloucestershire Council (SGC) to support gathering the transport evidence base for the development of their New Local Plan[1]. The scope of work includes using the West of England Regional Transport Model (WERTM) suite consisting of Highway Assignment Model (HAM), Public Transport Assignment Model (PTAM) and Variable Demand Model (VDM) components to develop forecast year model scenarios for 2042 with SGC's local plan development changes. It is to be noted that AtkinsRéalis has undertaken an update to 2019 base year WERTM HAM to better support the local plan testing, and this updated HAM is used for forecasting. The current scope includes testing the impacts of the initial development lenses on the transport network and support SGC in identifying a preferred option, including high-level mitigation measures.

This report presents the inputs considered for the development lenses and the respective model outcomes. Three Do Something (DS) lenses have been tested at this stage and the impacts on the transport network, measured against the Do Minimum (DM) is detailed below.

1.1 Report Structure

The report is structured as follows:

- Chapter 2 – provides an overview of the approach to Local Plan Testing;
- Chapter 3 – describes the demand development process for Do Minimum;
- Chapter 4 – describes the network development for Do Minimum;
- Chapter 5 – provides the Do Minimum model outputs;
- Chapter 6 – outlines the three development lenses tested;
- Chapter 7 – provides a summary of Lens 1 testing;
- Chapter 8 – provides a summary of Lens 2 testing;
- Chapter 9 – provides a summary of Lens 3 testing; and
- Chapter 10 – provides a summary of the document.

[1] https://beta.southglos.gov.uk/new-local-plan/

2. Local Plan Testing Overview

This chapter provides a high-level overview of the forecast model development to support the local plan testing. It also provides an overview of the base model. Forecast demand development is detailed in Chapter 3 and the supply changes are presented in Chapter 4.

2.1 Base Model Overview

AtkinsRéalis has recently undertaken a partial update to the 2019 West of England Regional Transport Model (WERTM) HAM to improve its accuracy in key areas significant to the South Gloucestershire Council (SGC) Local Plan, including the A38, A4174, North Fringe and A432. Details of the model development can be found in the associated Local Model Validation Report (LMVR)[2] of WERTM-SGC highway model.

Base year PTAM and VDM models are taken from WERTM and highway skims from the updated HAM model are used in the VDM run. No changes are made to the PTAM. Details of PTAM and VDM are found in the WERTM Model Development and Validation Report (MDVR)[3].

Model features such as geographic coverage, zoning, modelled time periods for HAM, trip purposes, demand segments and assignment user classes are same as in WERTM.

2.2 Local Plan Modelling

As explained in Chapter 1, a “Do Minimum” (DM) scenario and three development lenses are modelled to test the impacts of new developments on the transport network. The DM scenario is developed using the WERTM Foundation Case (FC) serving as a starting point, and the Lenses are built on the DM scenario. Only a single forecast year of 2042 has been modelled for both DM and the three Lenses as agreed with SGC.

2.2.1 Forecasting Approach

- The structure of the model is identical to 2042 WERTM FC with updated input assumptions provided for the demand and supply components within South Gloucestershire. Developments or growth in the other three districts of West of England Combined Authority (WECA) i.e., Bath and North-East Somerset Council (B&NES), Bristol City Council (BCC) and North Somerset Council (NSC) remain same as in WERTM FC throughout the Local plan testing i.e., Do Minimum and Do Something Option testing scenarios;
- In line with WERTM FC, forecast year travel demand is derived in the form of ‘Person Trip Ends’, based on proposed land use supplied by SGC for the forecast year DM and DS Lenses. The inputs include population, employment and other attraction factors such as school places;
- Car external to external trips (i.e., those passing through the model area), LGV and HGV trips are prepared externally, using DfT road traffic forecasts;
- Network changes to Highway, PT and Active networks for the respective DM and DS Lenses are made; and
- Economic and behavioural assumptions (e.g., value of time, vehicle operating costs) also remain unchanged from WERTM FC, and are in line with the DfT TAG Databook v1.17.

[2] 5219624_WERTM_SGC_Update_LMVR_v5_issued.pdf
[3] WERTM MDVR v1_REV2_Issued.pdf

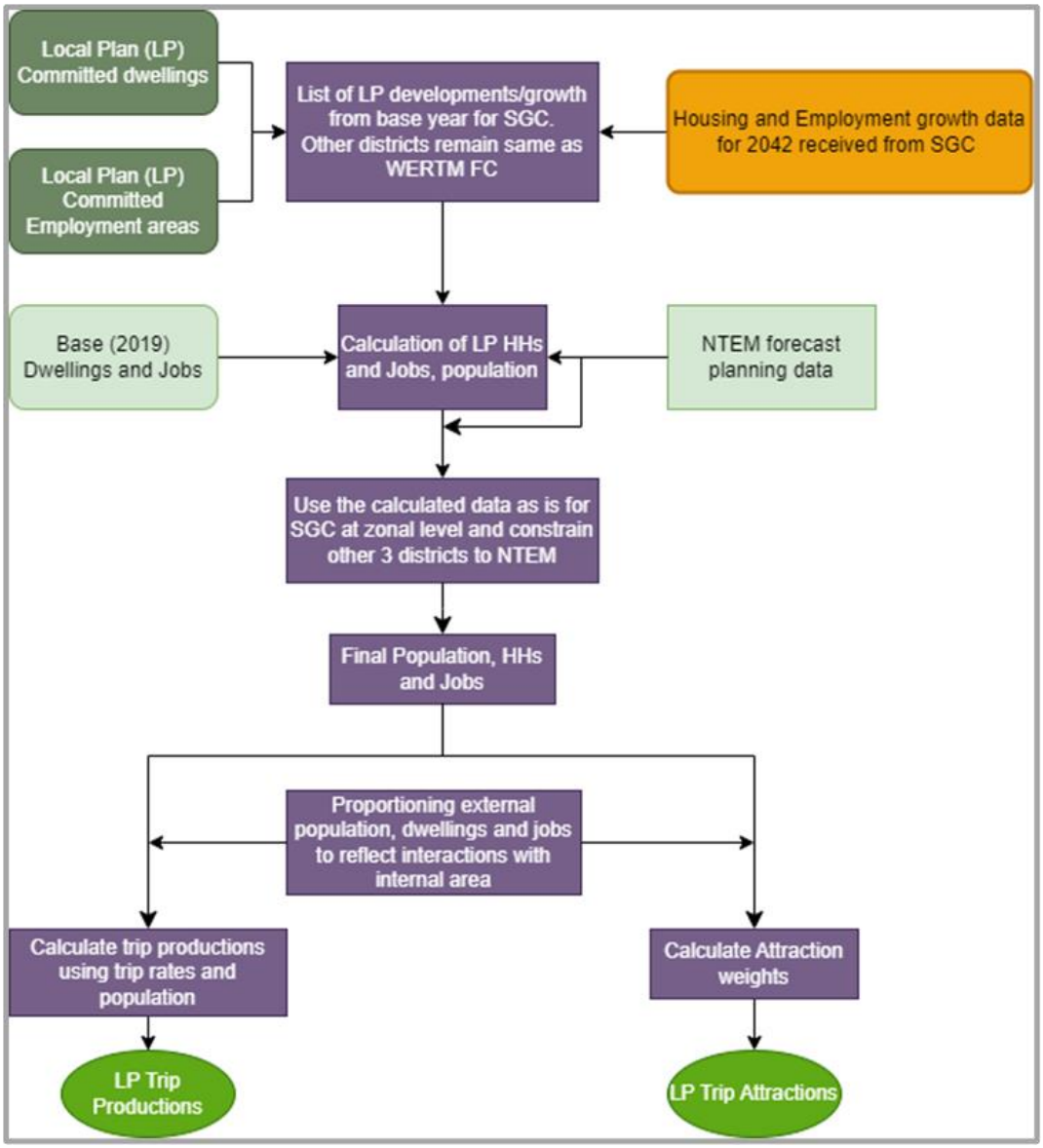
The details of the overall model structure are presented in Chapter 2 of the WERTM Model Development and Validation Report.

3. DM Travel Demand Development

3.1 Introduction

Forecast changes in travel demand are required to understand the transport impacts of any changes due to land use and transport interventions in future years. Travel demand is a direct consequence of the predicted demographics of people living, working, and pursuing other recreational and business activities across the study area. To estimate future demand for travel, the likely levels and patterns of land use activities, which in turn leads to person trips are required. These land uses are then translated into trip ends for Local Plan forecasts (forecast year 2042) using the assumptions and methodology presented in Figure 3-1. The methodology presented in Figure 3-1 is used to update only the forecast demand for the South Gloucestershire district. The demand for the rest of the local authority districts (LADs) in the region remains same as the WERTM FC except that National Trip End Model (NTEM) v8 is used in this study (whereas NTEM v7.2 was used during WERTM FC development).

Figure 3-1 – Local Plan Forecast Trip End Development



3.2 Development Assumptions

Developments and infrastructure from the uncertainty log shared by SGC are included in the demand forecasts within the South Gloucestershire district. The development log used for this study is presented in Appendix A. Housing and Employment development sites have been mapped to identify their geographic locations. Creation of existing zones was not considered necessary to represent the travel choices and transport impacts of the new development. Therefore the growth has been added to existing zones, which also avoids unnecessary increases in model size and run time.

3.2.1 Derivation of dwellings

For housing developments, the number of expected dwellings by site was provided by SGC. These were assumed to be equivalent to the number of households for the purpose of the Local Plan, though it should be noted that a proportion of dwellings normally remain vacant and therefore contain no household population. These dwellings are then assigned to one or more model zones based on the location and extent of development site. In case the development extends over multiple zones dwellings are divided based on the proportion of site area falling in each zone.

3.2.2 Derivation of jobs

For the employment developments, floor area in square metres and floor space distribution was provided by SGC. The floor space is then converted to number of jobs per each category using the job density assumptions from chapter 4 of Employment Density Guide 2015[4] presented in Appendix B.1. Equal splits between use classes are considered for sites where data is not available. For any missing employment categories like use class E job density is taken from Inclusive Local Economy and Employment Policy[5] presented in Appendix B.2. If there is a range in the job densities then average is considered for the estimation of jobs i.e., job density for use class B1b is 40-60 per m^2, this is considered as 50 jobs per m^2 for the estimation.

In addition to the jobs from employment floor space, service jobs are calculated as a proportion of number of dwellings. Service jobs refer to employment positions that primarily involve providing a service to individuals or businesses rather than producing tangible goods and it is expected that there will be growth in service jobs in proportion to growth in general population. The proportion is calculated based on the data of workforce jobs by industry from 2021 from Office for National Statistics (ONS) data[6]. Retail, Accommodation & food, Health and Education (categories G, I, Q and P respectively) are considered as service jobs, and the proportion is calculated at South Gloucestershire district level as a ratio of total service jobs to the total number of dwellings. This proportion is then used to calculate the service jobs for each zone and added to the actual jobs.

[4] https://www.kirklees.gov.uk/beta/planning-policy/pdf/examination/national-evidence/NE48_employment_density_guide_3rd_edition.pdf
[5] https://www.westminster.gov.uk/media/document/inclusive-local-economy-and-employment-updated-november-2021
[6] Nomis - Official Census and Labour Market Statistics - Nomis - Official Census and Labour Market Statistics (nomisweb.co.uk)

3.2.3 Derivation of school capacity

The housing developments in the forecast year generate various types of trips which include school trips by children below the age of 18. Additional school capacity to accommodate these trips has been created within the model, based on assumptions of pupils per dwelling.

School capacity for the forecast year is calculated based on the growth in housing developments i.e., dwellings. The assumptions to calculate the number of pupils per dwelling for each category of school are derived from experience in previous studies carried out by AtkinsRéalis Cambridgeshire Sub-regional model (CSRM2). Table 3-1 below presents the assumptions. The threshold is considered at zone level i.e., a zone will be allocated additional school capacity only if the forecast dwellings in that zone are greater than the threshold.

Table 3-1 - Forecast School Capacity assumptions

Category	Pupil per dwelling	Dwelling threshold
Primary School	0.20	100
Secondary School	0.13	200
Sixth Form (Tertiary)	0.04	200

3.2.4 Distribution of residential and employment development sites

Figure 3-2 and Figure 3-3 below show the location and sizes of the residential & employment developments in 2042. This shows that the largest new development sites are around Filton Airfield, Stoke Gifford and North-West of Yate while largest employment sites are around Stoke Gifford, North-West Yate and Severn Beach regions. It should be noted that the below figures present only the committed developments in the SGC area; developments in other three districts of B&NES, BCC and NSC remain the same as WERTM FC.

Figure 3-2 – Committed Housing development locations included as part of Local Plan in 2042

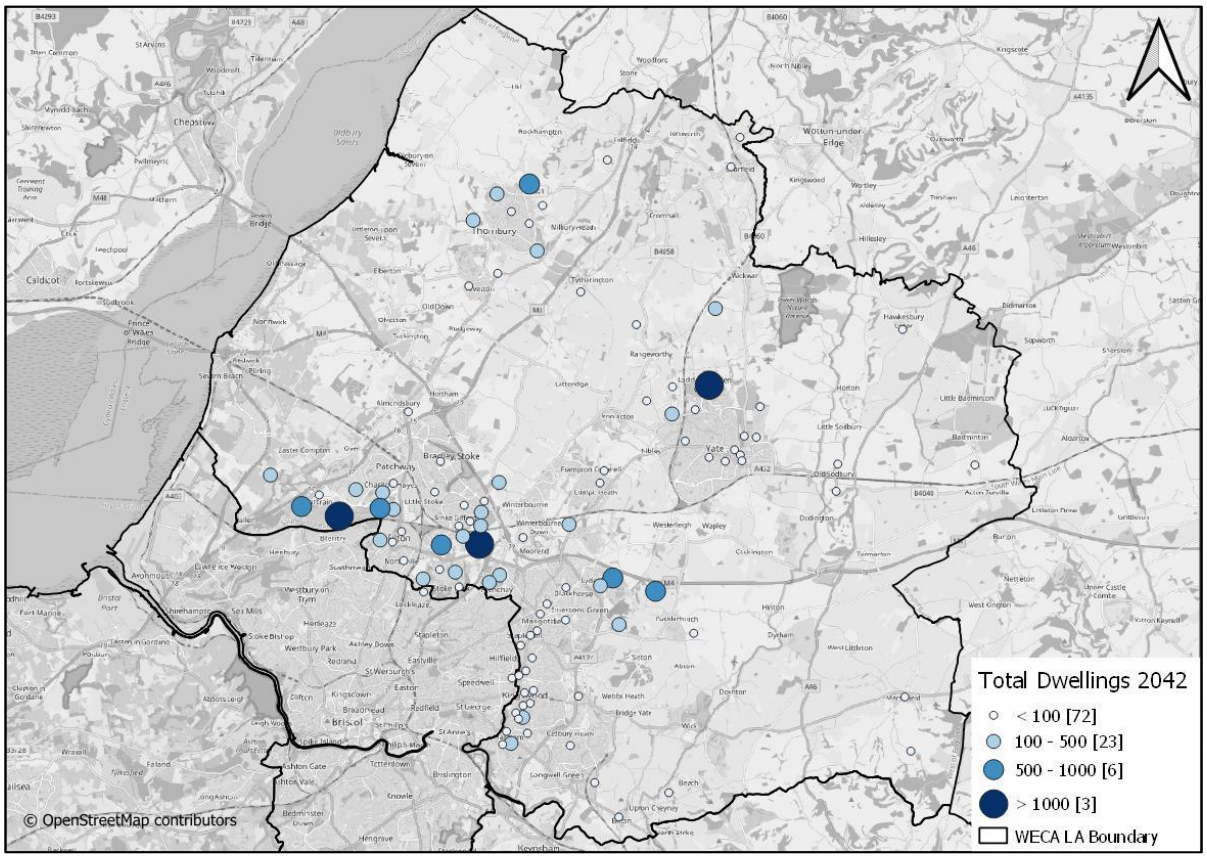
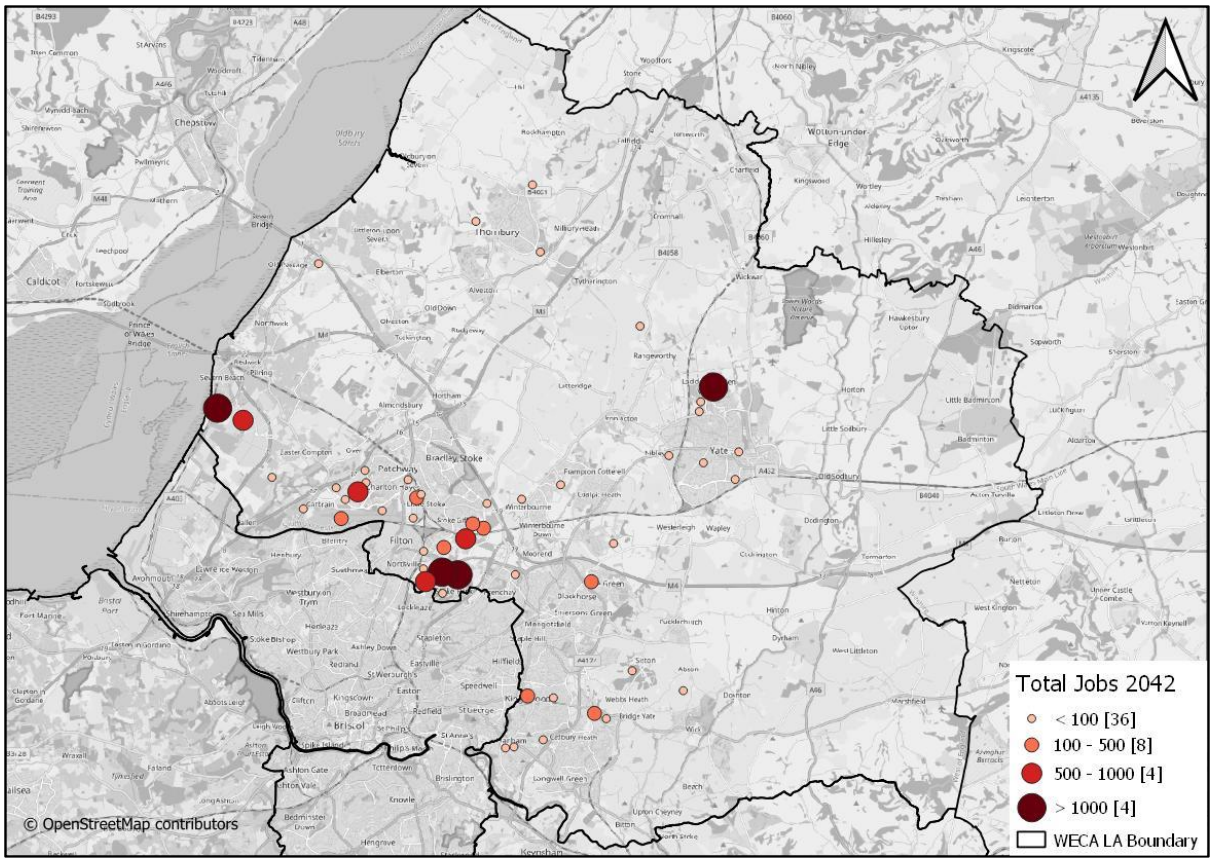


Figure 3-3 – Committed employment development sites included as part of Local Plan in 2042



3.3 Comparison of Developments with Planning Growth (NTEMv8)

After compiling dwelling and employment growth, the total development growth was summarised and compared with DfT NTEMv8 planning data growth. The forecast growth in dwellings and jobs is shown in Table 3-2. It has been assumed that all the development sites are built out by 2042. It is noted that Table 3-2 shows significant imbalances in households and jobs as well as show different levels of growth compared to NTEMv8.

The uncertainty log is generally identifying fewer households than NTEMv8, which is an imbalance which frequently occurs in 'bottom-up' planning data particularly for more distant forecast horizons. Hence, it was agreed that housing growth would be controlled to NTEMv8 levels at the district level with windfall allocations. In order to do so, the following procedure has been adopted:

- Households from the development log are added to the base year model households;
- The difference in NTEMv8 and development log households are calculated as windfalls; and
- The windfalls are allocated to the zones which have not been part of uncertainty log using base year household proportions.

Jobs growth from the local plan uncertainty log is higher than the NTEMv8 growth and has been agreed with SGC to use this growth as is without constraining to the NTEMv8 level.

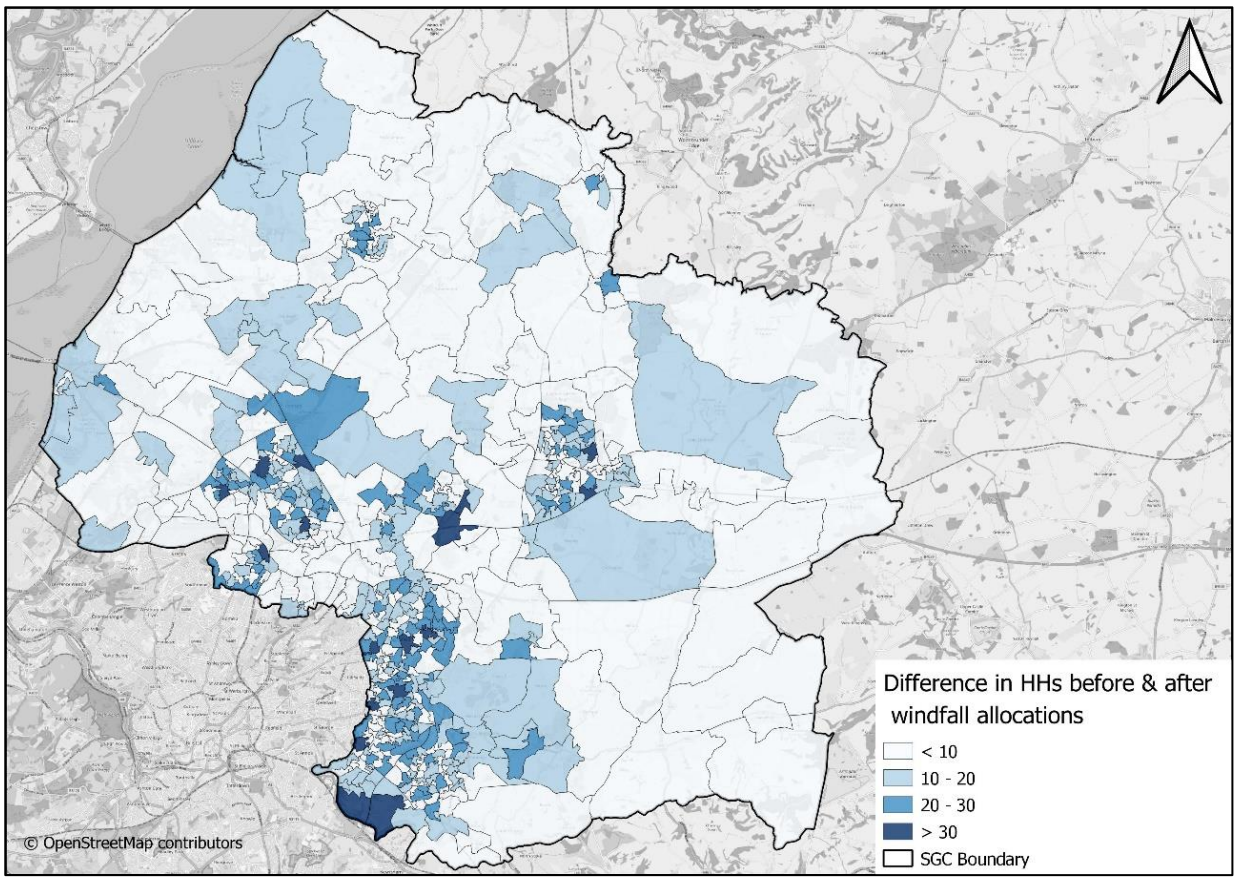
Table 3-2 - Growth in Housing and Employment between 2019 and 2042

Sector	Households			Jobs		
	WERTM Base	NTEMv8 Growth	Local Plan Growth	WERTM Base	NTEMv8 Growth	Local Plan Growth
Kingswood	7,660	1,796	719	7,014	620	354
Pilning, Severn Beach and Woodhouse Down	6,434	1,082	4,573	17,175	1,332	5,637
Patchway	20,642	4,837	1,687	28,277	2,078	967
Filton, Bristol Parkway & Frenchay	9,791	2,295	4,906	37,905	3,024	11,835
Thornbury	6,618	1,551	1,778	8,638	593	766
Iron Acton & Charfield	5,834	1,156	594	7,591	553	266
Yate	12,360	2,896	2,434	8,974	764	2,697
Pucklechurch & Chipping Sodbury	12,473	2,639	2,440	16,679	1,275	1,194
Mangotsfield	23,403	5,484	323	19,355	1,633	776
Longwell Green	12,953	3,035	53	10,140	815	161
South Gloucestershire	**118,169**	**26,770**	**19,508**	**161,747**	**12,689**	**24,652**

A map showing the household development differences between before and after windfall allocations is presented below in Figure 3-4. The developments (households) from the local plan at zone level are used as is and the windfall growth (i.e., the residual growth from NTEMv8) is allocated to the zones that do not have any local plan developments. This allocation is done based on the demand from base year and as such the windfall allocations are smaller in size for zones with less demand in the base.

In the figure below, zones with local plan development will have no difference in households before and after windfall allocations. No windfall allocation is considered for employment developments as the growth in jobs in local plan is higher than that in NTEMv8. For other districts of Bristol, Bath and North Somerset the developments considered for this study is the same as WERTM Foundation Case and are constrained to NTEMv8.

Figure 3-4 - Difference in Households before and after Windfall Allocations



3.4 Resulting Land Use and Demographic trends

The NTEMv8 dataset represents an estimate published by DfT of projected growth across Great Britain, based on a combination of Local Authority housing plans, ONS population and demographic projections, and DfT employment forecasts. The main advantages of this approach are that this provides a consistent and balanced projection of land use change across the country. Crucially for travel forecasting, this ensures a degree of balance between job and worker growth, so that a feasible number of commuting trips can be estimated. NTEM also automatically builds in established trends such as ageing population, falling household sizes and car ownership increasing. In addition, there are several key underlying statistics (from NTEMv8) that are projected to influence housing and worker growth. Table 3-3 presents the changes in land use between 2019 and 2042 and the key numbers are quoted below:

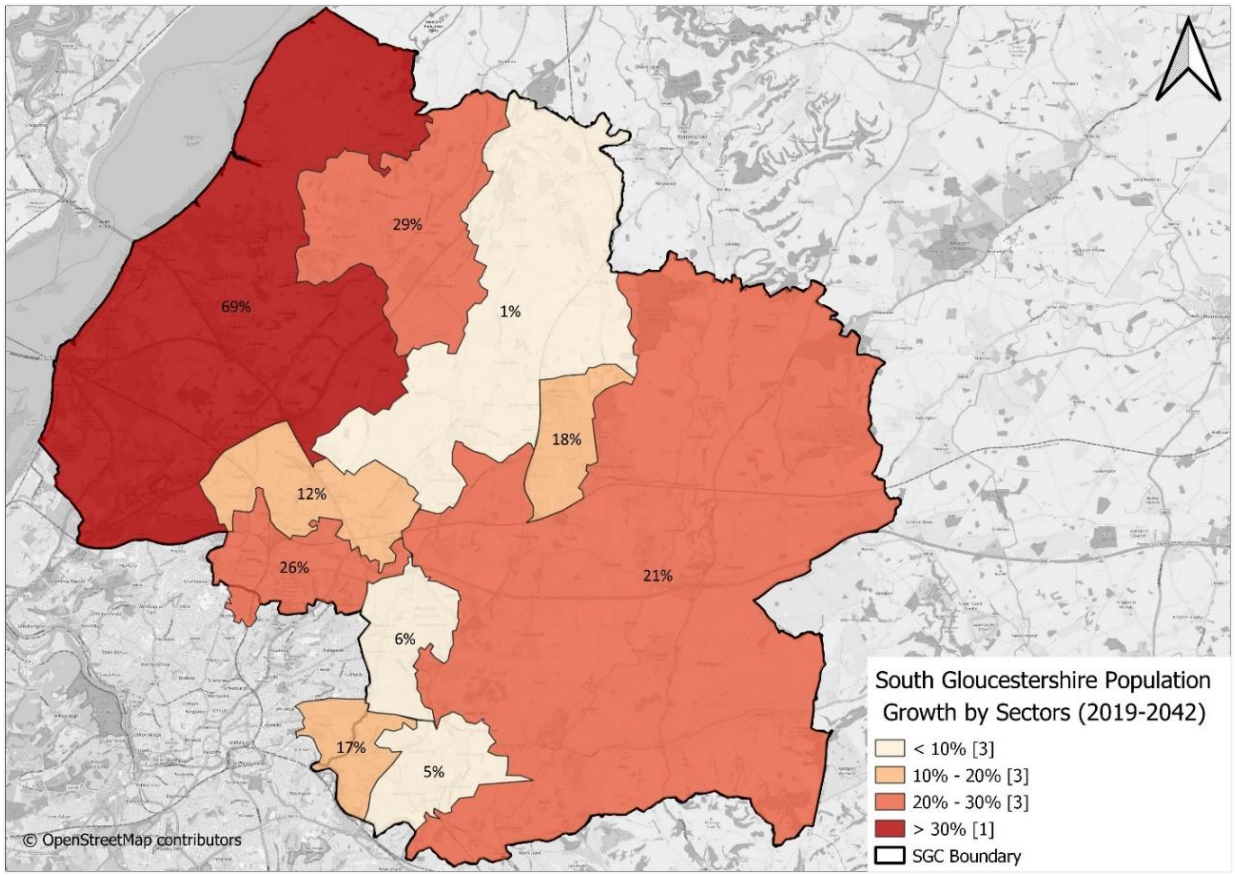
- Household growth (22%) is higher than the growth in population (17%), i.e., there is a trend in household sizes decreasing (2.92 to 2.80 persons per household);
- Population growth is +56,594, but only +18,161 workers growth, this reflects the ageing population; and
- Jobs growth is 19%, higher than the growth in workers (12%) for the South Gloucestershire area, which will lead to an undersupply of workers which would be balanced by either falling ‘out-commuting’ or rising ‘in-commuting’ (or a mixture of both).

Table 3-3 - SGC household, population, workers, and jobs change from Base Year

Sector	%age rise 2042 vs 2019			
	HHs	Pop	Workers	Jobs
Kingswood	15%	17%	10%	10%
Pilning, Severn Beach and Woodhouse Down	77%	69%	61%	35%
Patchway	15%	12%	3%	8%
Filton, Bristol Parkway & Frenchay	45%	26%	35%	31%
Thornbury	32%	29%	24%	12%
Iron Acton & Charfield	16%	1%	-4%	8%
Yate	26%	18%	11%	36%
Pucklechurch & Chipping Sodbury	25%	21%	16%	11%
Mangotsfield	8%	6%	4%	10%
Longwell Green	8%	5%	-4%	8%
South Gloucestershire	**23%**	**17%**	**12%**	**19%**

Figure 3-5 below shows the overall population growth from 2019 to 2042 within the study area.

Figure 3-5 - SGC Population Growth by Sector (2019-2042)



3.5 Daily Production and Attraction Trip Ends

3.5.1 Daily Productions

The dwelling information and assumptions detailed previously influence the growth of person trips at trip production level. Trip rates same as the base year (see Section 4.4 of WERTM MDVR) were applied to the forecast population to calculate the daily trip productions by purpose and demand strata (person type). Table 3-4 shows the difference between the base year trip productions and 2042 Do Minimum forecast scenario trip productions by purpose. Key observations from the table are:

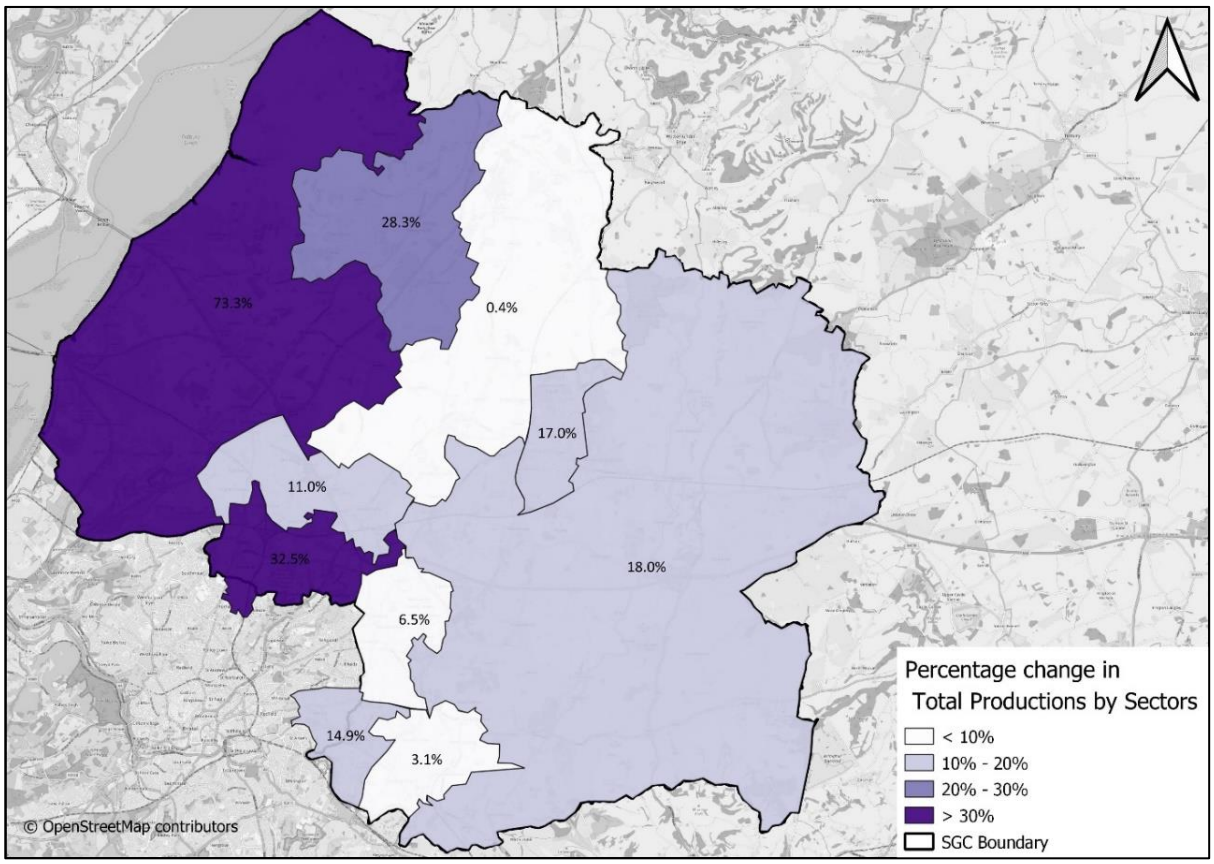
- Change in trips produced (13.5%) is lower than that of population change (17%) aligning with the reduction in economically active population;
- Education trips are expected to increase by 2042, due to an increase in young people and increase in escort trips included within Education;
- Commute (HBW) trips are expected to increase at a lower rate (10%) compared to population growth (17% - see Table 3-3). This is due to decline in the proportion of the population who are working; and
- Discretionary trips such as Shopping and Recreation are expected to increase considerably in line with the population trends, again due to aging population. This is in line with NTEM projections.

Table 3-4 - Base Year vs Do Minimum person trip productions by purpose

Purpose	Total Productions		Abs. Diff from Base	% Diff from Base
	Base (2019)	2042	2042	2042
Home Based Work (HBW)	376,858	415,219	38,361	10.2%
Home Based Employer Business (HBEB)	50,860	57,831	6,971	13.7%
Home Based Education (HBEd)	230,695	257,980	27,285	11.8%
Home Based Shopping/Personal Business (HBShopPB)	495,009	572,339	77,330	15.6%
Home Based Recreation/Visiting Friends & Relatives (HBRecVFR)	339,384	390,066	50,682	14.9%
Non-Home Based Employer Business (NHBEB)	54,513	60,762	6,249	11.5%
Non-Home Based Others (NHBO)	320,669	365,268	44,599	13.9%
Total	**1,867,988**	**2,119,466**	**251,478**	**13.5%**

Figure 3-6 shows the percentage change in total productions at a sector level between 2019 and 2042. The sectors generally show an increase in trips - these correspond to development areas in the development log.

Figure 3-6 - Percentage Change in Total Productions – 24 hours, All Modes and Purposes, 2042



3.5.2 Daily Attractions

The jobs information and assumptions influence the weightings of attractions in the forecast scenarios when compared with the base year. Trip attractions were derived from the number of jobs as follows for each purpose:

- HBW, HBEB, NHBEB – Jobs arising from the developments are calculated and added on to the base year zonal jobs;
- HBEd – Additional school capacity has been added to the base numbers on the basis of new housing developments as explained in Section 3.2.3;
- HBShopPB – These have been retained at base figures as the uncertainty log had no information on retail centres;
- HBRecVFR – Base year zonal attractions were scaled using the population growth between base and forecast years; and
- NHBO – Base year zonal attractions were scaled using the total growth of population and jobs between base and forecast years.

The tripend forecasts derived from the process are fed as zonal attributes into the model. While productions are defined by purpose, traveller type and age bands in the model, attractions are defined only by purpose as they act as attraction weights.

3.6 Goods vehicles and Car External-External trips

It is to be noted that the VDM does not predict changes in demand for external-to-external trips and goods trips, these must be input from external estimates. However, the model does determine routing for the vehicle trips and consider their influence on congestion. Growth assumptions for these matrices are adopted from WERTM which were taken from the DfT Road Traffic Forecasts.

The growth factors vary by region and are derived for South-West region of England, with appropriate growth rates being extracted for each movement based on the vehicle type and dominant road type. The growth rates are then applied to generate forecast in freight (LGV and HGV) and car external-external trips. These forecasts show a large increase in LGV trips, reflecting a growth in local deliveries and online shopping and a reduction in HGV trips on minor roads. No special adjustments to port traffic have been considered. Table 3-5 shows the growth rates derived by vehicle and road type from DfT road traffic forecasts. Detailed assumptions on how the growth factors are calculated and applied can be found in section 3.6 of the WERTM Forecasting Report.

Table 3-5 - DfT RTF Derived Growth Rates (2019 to 2042) by Road Type and Vehicle Type

Vehicle Type	2019 to 2042 Growth factor		
	Minor Roads	Trunk A	Motorway
Car	1.20	1.27	1.32
LGV	1.33	1.28	1.28
HGV	0.97	1.03	1.04

4. Do Minimum Supply Development

4.1 Coding approach and assumptions

The committed schemes from the supply log of SGC are included in the Do Minimum (DM). Along with these, the schemes from WERTM FC are also included in the DM. All the schemes are assumed to have been completed by 2042. The details of the schemes such as design layouts were provided by SGC and coding for schemes from WERTM was directly taken from the FC HAM model.

The following approach was adopted for coding the highway network for the DM scenario:

- The coding assumptions (Speed Flow Curves, link capacities etc.) were adopted from the network coding manual used to develop the base model network;
- Numbering for new nodes is consistent with the base model, i.e., based on the local authority in which the node is located; and
- Wider signal timings are consistent with the base model, i.e., they have not been optimized to accommodate forecast changes. It was not considered proportionate for the development of the strategic DM for junction-by-junction re-optimization and localized checking of every signal junction.

The following approach was adopted for coding the Public Transport (PT) and active network for the DM scenario:

- The coding assumptions (link type, stop type, naming conventions for new stops and services, etc.) are consistent with the coding in the base model; and
- The user perception factors used for active network are consistent with the factors in the base model. For all public realm enhancement schemes, the existing walk and/or cycle link perception factor has been updated based on the scheme description, example – segregated cycle path, off-road cycle track.

4.1.1 Approach to update Public Transport services

It is unlikely that the public transport level of service (either route coverage or service frequency) will remain consistent between the model base year and forecast year. The impacts of travel restrictions during the Covid pandemic and the adoption of new travel behaviours has brought about significant changes to local buses services in the region. Bus and rail routes have been adjusted in the DM to reflect the 2023 timetables and services in SGC, with the assumption these are continued into the future. The changes in model were carried out only for the services that are completely internal to SGC or have any interaction with SGC i.e., originating/terminating in SGC.

4.1.1.1 Bus Routes

2023 bus timetable data was sourced from Bus Open Data Service (BODS)[7] in GTFS format and was imported into the model. Checks were carried against the BODS data by comparing the routes from Travelwest journey planner[8]. Bus routes that are interacting with SGC were removed from the model and the routes from 2023 GTFS data were added. A new service along route Y2 serving North Yate is added, North and South Yate will have a 30-minute frequency but combined will provide a 15-minute frequency along the main A432 corridor.

[7] https://data.bus-data.dft.gov.uk/downloads/
[8] Routes & Timetables | Travelwest

4.1.1.2 Rail routes

Rail data for 2023 was downloaded from DataCutter[9]. Similar to bus routes, rail routes interacting with SGC were removed from the model and 2023 data was imported. In addition to this, updates to timetables were also made based on the calling pattern information for Charfield station received from SGC.

4.2 Highway Schemes

The DM scenario includes schemes from the WERTM FC and schemes received from SGC to be modelled for Local plan. Table 4-1 below presents all the schemes from SGC and any modifications to WERTM schemes. Appendix C presents the scheme drawings.

Table 4-1 – Do Minimum Highway Schemes

S No.	Scheme Name	Scheme location (Local Authority)	Source
1	M49 junction and new links	South Gloucestershire	WERTM FC Added western link road at M49 Junction and connected Palmer and Govier Way, zone connection was updated
2	M32 P&R	South Gloucestershire	WERTM Variant test
3	A38	South Gloucestershire	Scheme drawings
4	A432	South Gloucestershire	Scheme drawings
5	Hambrook Junction	South Gloucestershire	Scheme drawings, Google maps street view
6	Filton Airfield	South Gloucestershire	Drawings from planning application

4.3 Active Travel Schemes

The DM scenario includes schemes from the WERTM FC, and schemes received from SGC to be modelled for Local plan. Table 4-2 below presents the active travel schemes included in the DM. Apart from these, improvements to active travel from A38, A432 and Bradley Stoke Way are also included in the DM.

Table 4-2 - Active mode schemes development log

S No.	Scheme Name	Description
1	Hayes Way and Merlin Road	Shared use path route alongside the carriageway. East of Ford Garage built in Cycle Ambition Fund 2, West of Ford Garage built in CPNN Cycle links.
2	Southmead Road Stepped Cycle Track	New stepped cycle track constructed as part of CPNN Cycle links project. Connects to on road cycle lane that starts near Braemar Avenue, installed as part of EATF.

[9] https://datacutter.basemap.co.uk/DataCutter

S No.	Scheme Name	Description
3	A4018 cycle track	New shared use path from the BCC boundary to NCN4, including new Toucan crossing to facilitate access to Henbury rail station.
4	Catbrain lane	Surface upgrade to facilitate new quiet road link into airfield site.
5	Patchway Station to A38 link	New shared use path providing safe access to A38 corridor and CPNN from Patchway station and neighbouring residential areas.
6	Station road contra flow	New bi-directional cycle track enabling contra flow cycling on an otherwise one-way road.
7	Grovesend Road/ Gillingstool	New segregated cycle track planned to link Thornbury town centre with the A38 Strategic Corridor.
8	Alveston Hill	New off road cycle track, and segregated cycle track linking Alveston with Thornbury town centre and connecting to the A38 corridor.
9	Yate Spur (phase 5&6)	Completion of the Yate Spur off road cycle route, connecting the Ring Road cycle path and Bristol and Bath Railway Path with Yate.
10	Filton to MoD	Improvement to existing Ring Road cycle path, to remove critical junctions and pinch points.
11	Keynsham Road	New off-road cycle route, and improvements to existing shared path to provide a safe, direct link from Keynsham to the Bristol and Bath Railway Path.

4.4 PT Schemes

No further PT schemes are modelled in the DM in addition to the schemes from WERTM FC. However, there are changes in the services and PT timetables reflecting the 2023 scenario as explained in Section 4.1.1.

Details of highway, PT and active travel schemes from WERTM can be found in the WERTM Forecasting Report and the scheme drawings are presented in Appendix E

5. Do Minimum Forecasts

The assumptions and processes detailed in Chapter 3 result in trip ends for use in the VDM providing insights on how the changes in planning data reflects in changes in trip ends. When these are applied to the VDM, with the supply changes as described in Chapter 4, the output results in trip matrices split by purpose and mode. This chapter gives insights about convergence and stability and analyses the demand responses along with the highway (HAM) and public transport (PTAM) assignments in the DM model.

5.1 Demand Model Outputs

The VDM treats all four WECA districts of SGC, B&NES, BCC and NSC (for the purpose of WERTM, NSC is treated as a part of WECA) as internal, and the model provides demand responses accordingly. For the purpose of this study and reporting, these responses are evaluated at the South Gloucestershire level, treating South Gloucestershire as internal and all others as external. In other words, the VDM analysis covers internal-to-internal, internal-to-external, and external-to-internal trips for South Gloucestershire, and the same are presented in the following sections.

5.1.1 Model Convergence

The VDM iterates to account for changes in highway costs (congestion) feeding back and influencing travellers' choices. Travel costs supplied from the highway assignment in each loop will alter the demand generated in the VDM until demand-supply equilibrium or convergence is reached. Having a converged model is crucial because it signifies stability in the model and reduces the model noise. The convergence criterion in WERTM is based on the nested demand gap values calculated for each choice model. The equation used to calculate the gap value as set out in TAG unit M2.1 Section 6.3.4 is presented below.

$$Percentage\ Gap = \frac{\sum_a -U_a|\ D_a^{new} - D_a^{old}|}{\sum_a -U_a D_a^{old}} \times 100$$

Where,

U_a is the costs specified in referenced nested demand procedures (i.e., negative utility)

D_a^{old} is the saved demand from last iteration

D_a^{new} is the saved demand from current iteration

a runs through all matrix entries, demand strata, modes and times of the day

The Do Minimum has converged with an overall gap value of 0.198 in 14 iterations, which is within the convergence GAP target of 0.2% as per TAG Unit M2.1.

Table 5-1 presents gap statistics for each of the choice models by purpose. The outputs from the converged loops are used for reporting the results in the subsequent sections.

Table 5-1 - % Gap values for Do Minimum

Purpose	Mode & Destination choice	Car Sub-Mode	PT Sub-Mode
Home Based Work (HBW)	0.30%	0.52%	0.30%
Home Based Employer Business (HBEB)	0.29%	0.51%	0.74%
Home Based Education (HBEd)	0.16%	0.28%	0.12%
Home Based Shopping/Personal Business (HBShopPB)	0.12%	0.17%	0.03%
Home Based Recreation/Visiting Friends & Relatives (HBRecVFR)	0.11%	0.13%	0.16%
Non-Home Based Employer Business (NHBEB)	0.15%	0.16%	0.20%
Non-Home Based Others (NHBO)	0.13%	0.17%	0.05%

5.1.2 Demand Matrices

5.1.2.1 Change in trips by purpose

Table 5-2 below presents the final forecast demand at the 24-hour production / attraction level by mode and purpose across all the movements within, to and from South Gloucestershire. The table shows that there is a rise of approximately 25% in total number of trips from base year to the 2042 DM. A significant portion of this increase is in shopping, leisure and other 'discretionary' trips rather than commuting and work, which reflects the changes in production presented in Table 3-4. This is expected given the relatively low growth in workers compared with the general population, largely due to the ageing population. In terms of travel modes, the increase is mainly attributed to Car mode followed by PT.

Table 5-2 – DM 24 hr P/A Trips by Purpose by Mode and comparison to base year

Purpose	DM: 24hr P/A Trips					Abs Diff to Base					Percentage Diff to Base				
	Car	PT	Walk	Cycle	Total	Car	PT	Walk	Cycle	Total	Car	PT	Walk	Cycle	Total
HBW	119,417	12,457	8,900	4,988	145,762	13,667	2,779	1,040	594	18,079	12.9%	28.7%	13.2%	13.5%	14.2%
HBEB	19,781	2,077	597	282	22,737	2,642	323	97	42	3,104	15.4%	18.4%	19.4%	17.4%	15.8%
HBEd	45,256	11,755	25,279	2,874	85,163	11,019	808	2,624	348	14,799	32.2%	7.4%	11.6%	13.8%	21.0%
HBShopPB	155,531	19,421	24,180	3,590	202,722	30,596	4,323	1,655	229	36,803	24.5%	28.6%	7.3%	6.8%	22.2%
HBRecVFR	129,996	12,372	12,957	1,264	156,589	37,063	3,501	1,647	174	42,384	39.9%	39.5%	14.6%	15.9%	37.1%
NHBEB	23,763	585	1,024	68	25,440	4,210	23	125	3	4,362	21.5%	4.2%	13.9%	4.9%	20.7%
NHBO	128,509	5,085	19,044	72	152,710	31,991	361	3,536	9	35,896	33.1%	7.6%	22.8%	13.6%	30.7%
Total	**622,253**	**63,752**	**91,981**	**13,138**	**791,124**	**131,187**	**12,118**	**10,724**	**1,398**	**155,428**	**26.7%**	**23.5%**	**13.2%**	**11.9%**	**24.4%**

5.1.3 Mode Shares

5.1.3.1 Mode Shares by Purpose

Table 5-3 below presents the mode shares by purpose for DM. There is an increase in car shares in DM when compared to the base year for all purposes except commute and business. The car share increase is attributed to the rise in PT fares and the relative decrease in car operating costs due to fuel efficiency and increase in share of

electric vehicles. In 2042, according to TAG v1.17 (consistent with the version used for model parameters), electric vehicles will account for 36% of vehicle kilometres travelled by cars, contributing to a reduction in car operating costs.

Table 5-3 – DM Mode Shares by Purpose and comparison to base year

Purpose	DM 24hr P/A Trips				Mode Share				Change in Mode Share			
	Car	PT	Walk	Cycle	Car	PT	Walk	Cycle	Car	PT	Walk	Cycle
HBW	119,417	12,457	8,900	4,988	81.9%	8.5%	6.1%	3.4%	0.9%	1.0%	-0.1%	0.0%
HBEB	19,781	2,077	597	282	87.0%	9.1%	2.6%	1.2%	0.3%	0.2%	-0.1%	0.0%
HBEd	45,256	11,755	25,279	2,874	53.1%	13.8%	29.7%	3.4%	4.5%	1.8%	-2.5%	-0.2%
HBShopPB	155,531	19,421	24,180	3,590	76.7%	9.6%	11.9%	1.8%	1.4%	0.5%	-1.6%	-0.3%
HBRecVFR	129,996	12,372	12,957	1,264	83.0%	7.9%	8.3%	0.8%	1.6%	0.1%	-1.6%	-0.1%
NHBEB	23,763	585	1,024	68	93.4%	2.3%	4.0%	0.3%	0.6%	-0.4%	-0.2%	0.0%
NHBO	128,509	5,085	19,044	72	84.2%	3.3%	12.5%	0.0%	1.5%	-0.7%	-0.8%	0.0%
Total	**622,253**	**63,752**	**91,981**	**13,138**	**78.7%**	**8.1%**	**11.6%**	**1.7%**	**1.4%**	**-0.1%**	**-1.2%**	**-0.2%**

5.1.3.2 Mode Shares by Sector

The change in car mode shares by production and attraction sectors for all purposes between DM and base is shown in Figure 5-1 and Figure 5-2. Car mode shares generally increase in DM. The sectors with large dwelling sites like Pilning and Severn Beach show a drop in car share as local demand has shifted to other modes specifically Walk resulting from the active travel schemes. Similarly, Filton with high job growth shows a decrease in attraction car share. The decrease in car shares in SGC occurred in Pilning and Severn Beach, Iron Action and Charfield, Filton sectors is attributed to the availability of PT services in these sectors with Charfield being a new rail station.

Figure 5-1 – Difference between DM and Base Year for Car Mode Shares - Productions, All Purposes

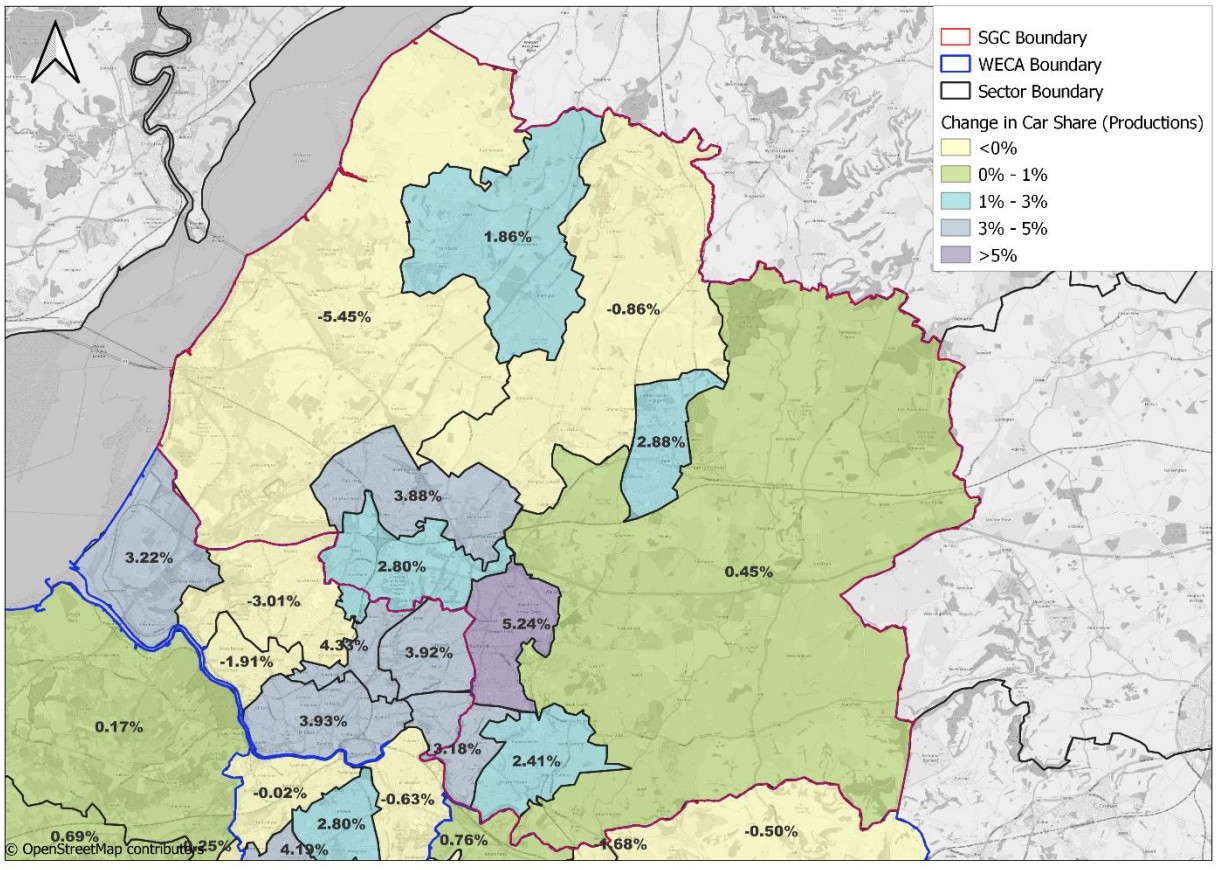
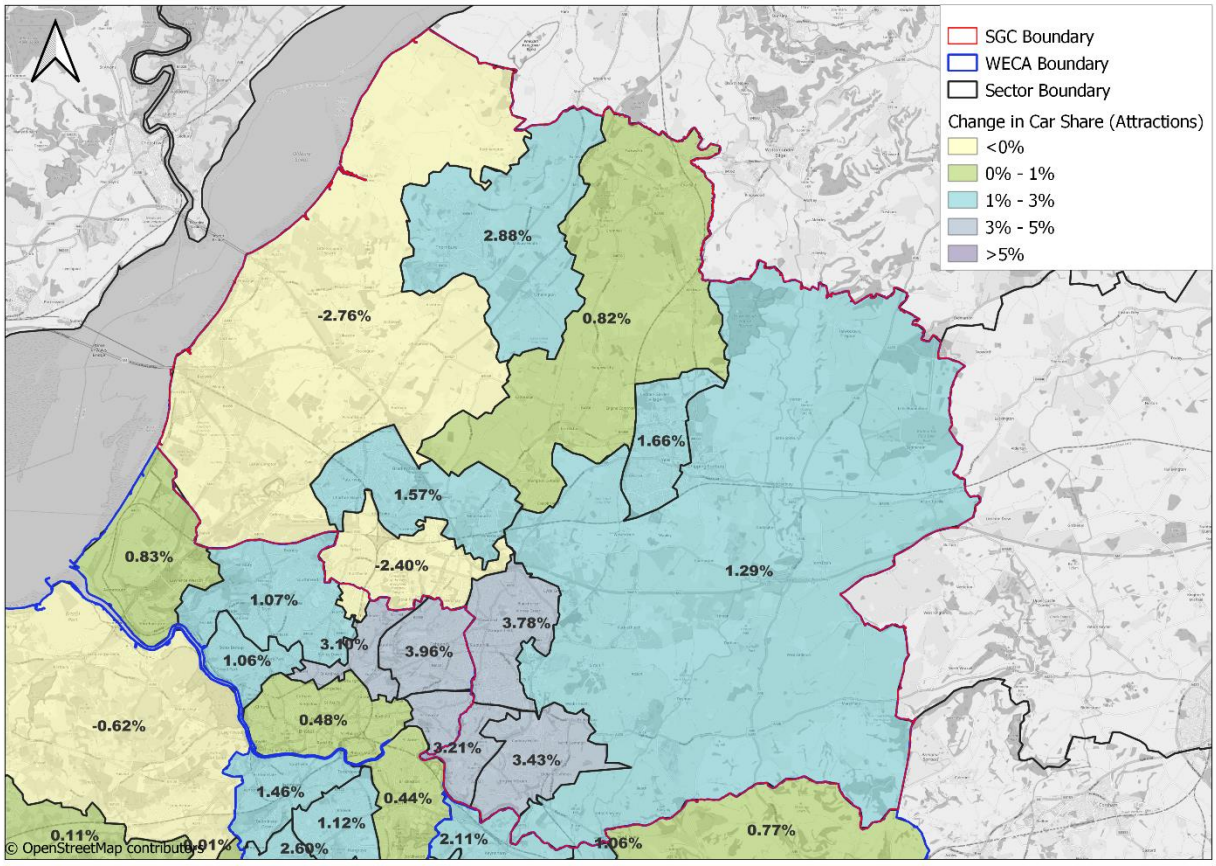


Figure 5-2 - Difference between DM and Base Year for Car Mode Shares - Attractions, All Purposes



5.1.4 Trip Lengths

Trip lengths at 24-hour production / attraction level are analysed for each purpose and mode to identify whether trips are becoming longer or shorter between the base and forecast year. Comparison of average trip length between DM and Base Year is presented in Table 5-4. Average trip lengths by Car have increased for all purposes. This is primarily due to reduced vehicles operating costs. The only exception is for discretionary trips where there is a shift to rail for long-distance trips. Long-distance rail trips in the model are driven by trips from the external area (the East and North sectors) to the WECA/SGC region. Bus journey lengths has shortened over time due to the increase in fares. Trip lengths for active modes are stable in the DM.

Table 5-4 – DM Average Trip Length by Purpose by Mode, Comparison to Base Year

Purpose	DM Average Trip Lengths					Absolute Diff from Base				
	Car	Bus	Rail	Cycle	Walk	Car	Bus	Rail	Cycle	Walk
HBW	21.9	9.5	168.9	8.1	1.8	▲ 0.5	▼ -0.7	▲ 30.0	▼ -0.1	▬ 0.0
HBEB	22.4	6.8	86.9	5.0	0.9	▲ 0.3	▼ -0.4	▲ 3.6	▬ 0.0	▬ 0.0
HBEd	6.8	10.5	15.8	4.2	1.7	▲ 0.6	▼ -1.4	▼ -0.9	▲ 0.1	▬ 0.0
HBShopPB	19.6	9.8	185.8	5.7	1.5	▼ -2.5	▼ -2.3	▲ 121.7	▬ 0.0	▬ 0.0
HBRecVFR	19.0	9.1	193.2	7.2	2.1	▼ -1.4	▼ -2.5	▲ 125.3	▼ -0.1	▲ 0.1
NHBEB	17.9	8.9	126.6	5.8	0.8	▲ 0.7	▼ -1.2	▲ 8.7	▼ -0.1	▬ 0.0
NHBO	16.8	10.9	130.3	5.2	1.5	▲ 0.1	▼ -1.6	▲ 105.7	▼ -0.3	▬ 0.0
Grand Total	**18.5**	**10.0**	**178.1**	**6.4**	**1.6**	▼ **-0.8**	▼ **-1.8**	▲ **76.6**	▬ **0.0**	▬ **0.0**

5.2 Highway Assignment outputs

The advice on model convergence is set out in TAG Unit M3.1 and is discussed in Section 20.4.6 in MDVR. The HAM model convergence for DM is summarized in Table 5-5 presenting the gap statistics and percentage of links passing the flow criteria for the last four iterations.

Table 5-5 – DM SATURN Highway Assignment Convergence Summary

Scenario	Time Period	Number of iterations	%Flow	%Delay	%GAP
DM	AM Peak	66	99.2	99.5	0.0220
		67	99.2	99.4	0.0270
		68	99.1	99.4	0.0190
		69	99.4	99.4	0.0330
	Inter Peak	41	98.8	99.7	0.0085
		42	99.5	99.7	0.0100
		43	99.1	99.8	0.0091
		44	99.2	99.8	0.0069
	PM Peak	82	98.4	99.2	0.0290
		83	99.2	99.3	0.0320
		84	99.0	99.3	0.0240
		85	99.3	99.3	0.0290

5.2.1 Overall network statistics

Table 5-6 below presents the network statistics for the DM and base year for all time periods. Average speeds have reduced in the DM and average trip lengths did not have any significant change. Overall trip totals, travel time and distance, delay/vehicle has increased in the DM.

Table 5-6 – DM Overall highway network statistics (whole UK model)

Time Period	Scenario	Base Year	DM	% Diff with Base
AM Peak	Matrix Totals (pcu/hr)	183,134	220,067	20.2%
	Total Travel Times (pcu-hrs)	109,473	141,630	29.4%
	Travel Distance (pcu-kms)	6,595,465	7,894,026	19.7%
	Average Speed (km/h)	60.20	55.70	-7.5%
	Total Delay / Vehicle (mins/pcu)	6.08	8.55	40.5%
	Average Trip Length (pcu.km)	36.01	35.87	-0.4%
Inter Peak	Matrix Totals (pcu/hr)	151,695	182,604	20.4%
	Total Travel Times (pcu-hrs)	81,878	100,984	23.3%
	Travel Distance (pcu-kms)	5,561,242	6,716,937	20.8%
	Average Speed (km/h)	67.90	66.50	-2.1%

Time Period	Scenario	Base Year	DM	% Diff with Base
	Total Delay / Vehicle (mins/pcu)	3.31	3.83	15.7%
	Average Trip Length (pcu.km)	36.66	36.78	0.3%
PM Peak	Matrix Totals (pcu/hr)	184,099	219,676	19.3%
	Total Travel Times (pcu-hrs)	108,247	139,850	29.2%
	Travel Distance (pcu-kms)	6,498,046	7,829,401	20.5%
	Average Speed (km/h)	60.00	56.00	-6.7%
	Total Delay / Vehicle (mins/pcu)	6.18	8.50	37.7%
	Average Trip Length (pcu.km)	35.30	35.64	1.0%

5.2.2 Impact on Network

Model flows from the DM have been compared with the base year to demonstrate how traffic flows are expected to change in future year due to the network and land use changes. Figure 5-3 and Figure 5-4 below presents the flow difference and delay difference respectively between the DM and base in AM Peak, Figure 5-5 and Figure 5-6 presents the same for PM peak. Green indicates an increase and blue indicates a decrease in the plots presented.

There is generally an increase in traffic on the network due to the increased land use i.e., population and employment. A network wide traffic flow increase is observed attributed to traffic generated by new developments as well as wider population (NTEM) and employment growth. There is a rerouting due to the inclusion of committed schemes (such as Cribs Patchway New Neighbourhood, M49/Avonmouth junction and Link Road, updates at Hambrook junction and Filton airfield) with traffic moving to newly coded schemes from existing road network.

Overall delays have increased across the network by 40% and 38% in the AM and PM peaks respectively. In the study area of SGC a notable increase in delay is estimated on the M32 NB (185secs) and M4J20 Eastbound (EB) (108secs) in AM peak. Decrease in delays observed at the Hambrook junction due to the bans put in place at the junction. Similar trends are observed in the PM peak. The link delay increases at specific locations like zone connectors on A432 and Rosedown Avenue, signals at North Road/B4059 and A46/B4465 junctions suggest that the network coding may need refinement in those areas, e.g., signal optimization and other minor amendments to representation of junctions.

Figure 5-3 – DM vs Base Highway Flow difference AM peak

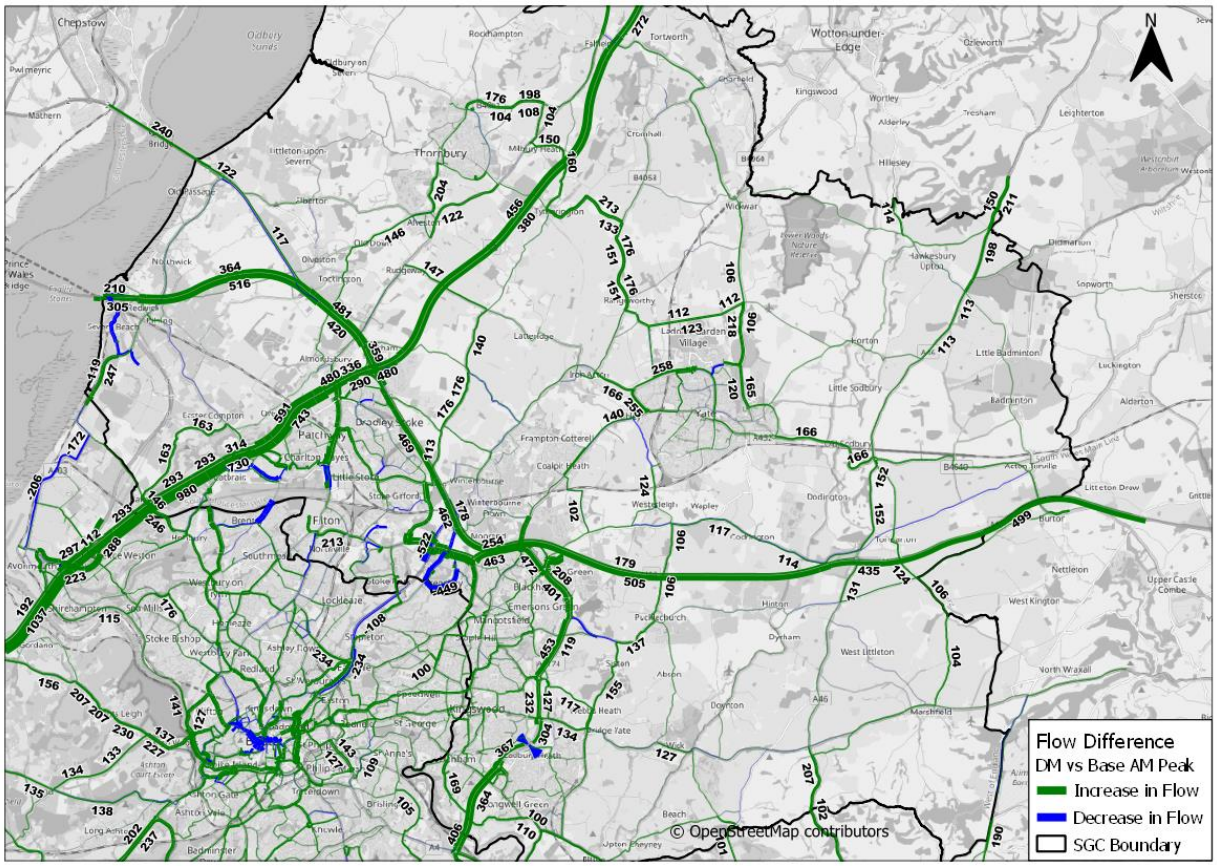


Figure 5-4 – DM vs Base Highway Delay difference AM peak

Figure 5-5 – DM vs Base Highway Flow difference PM peak

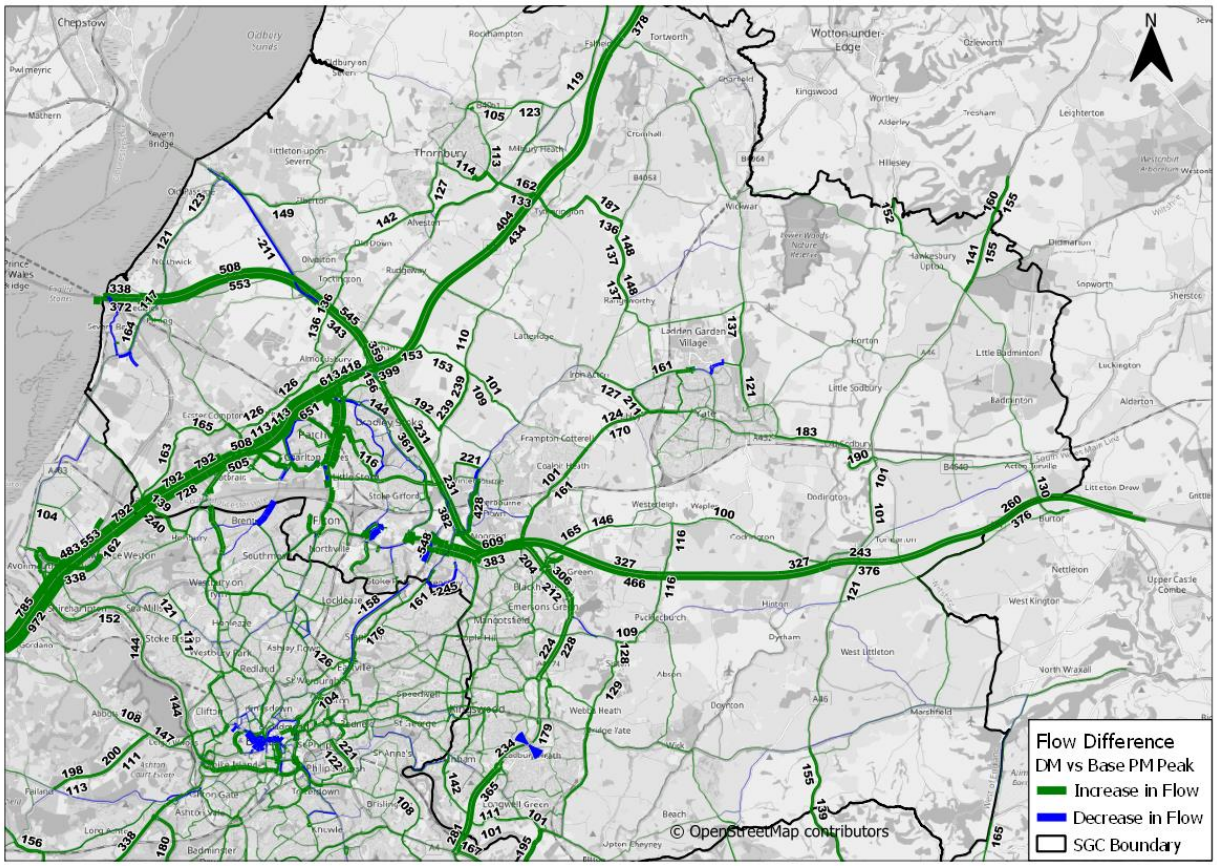
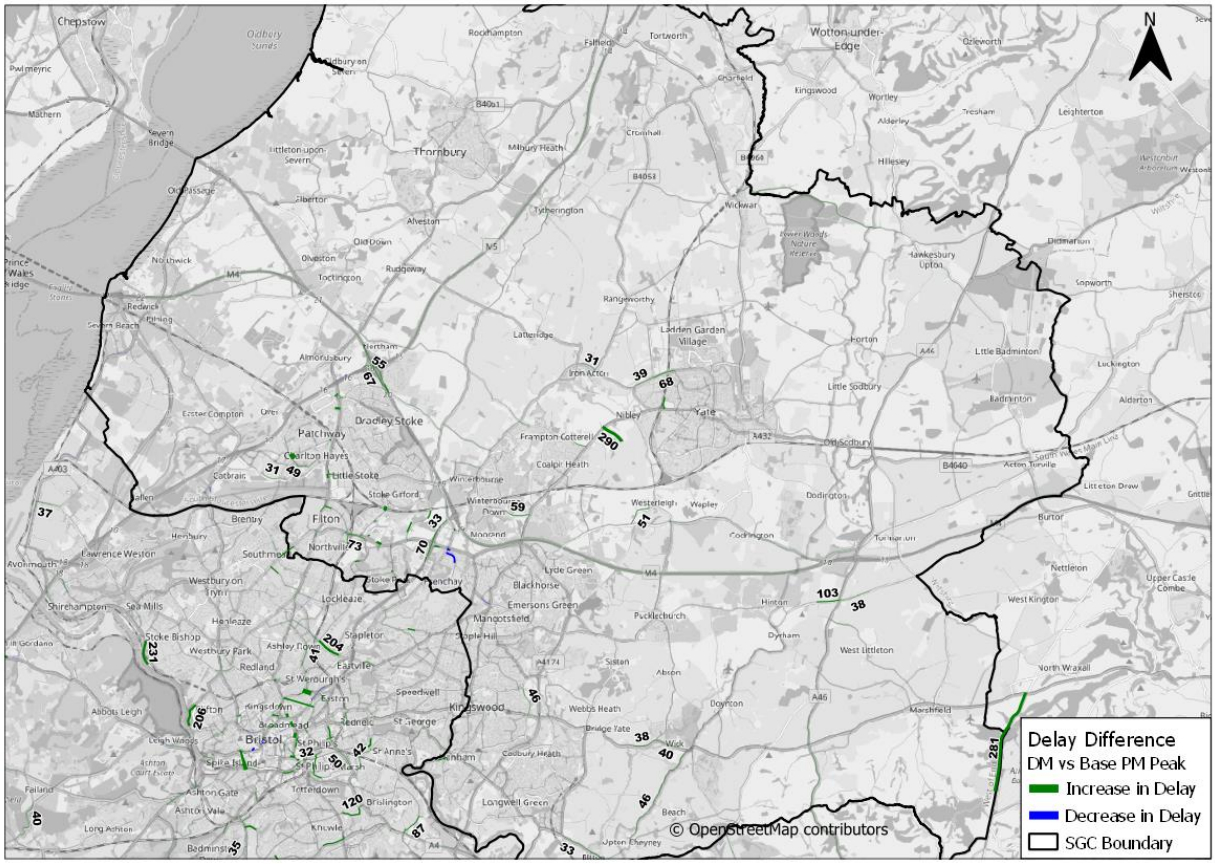


Figure 5-6 – DM vs Base Highway Delay difference PM peak



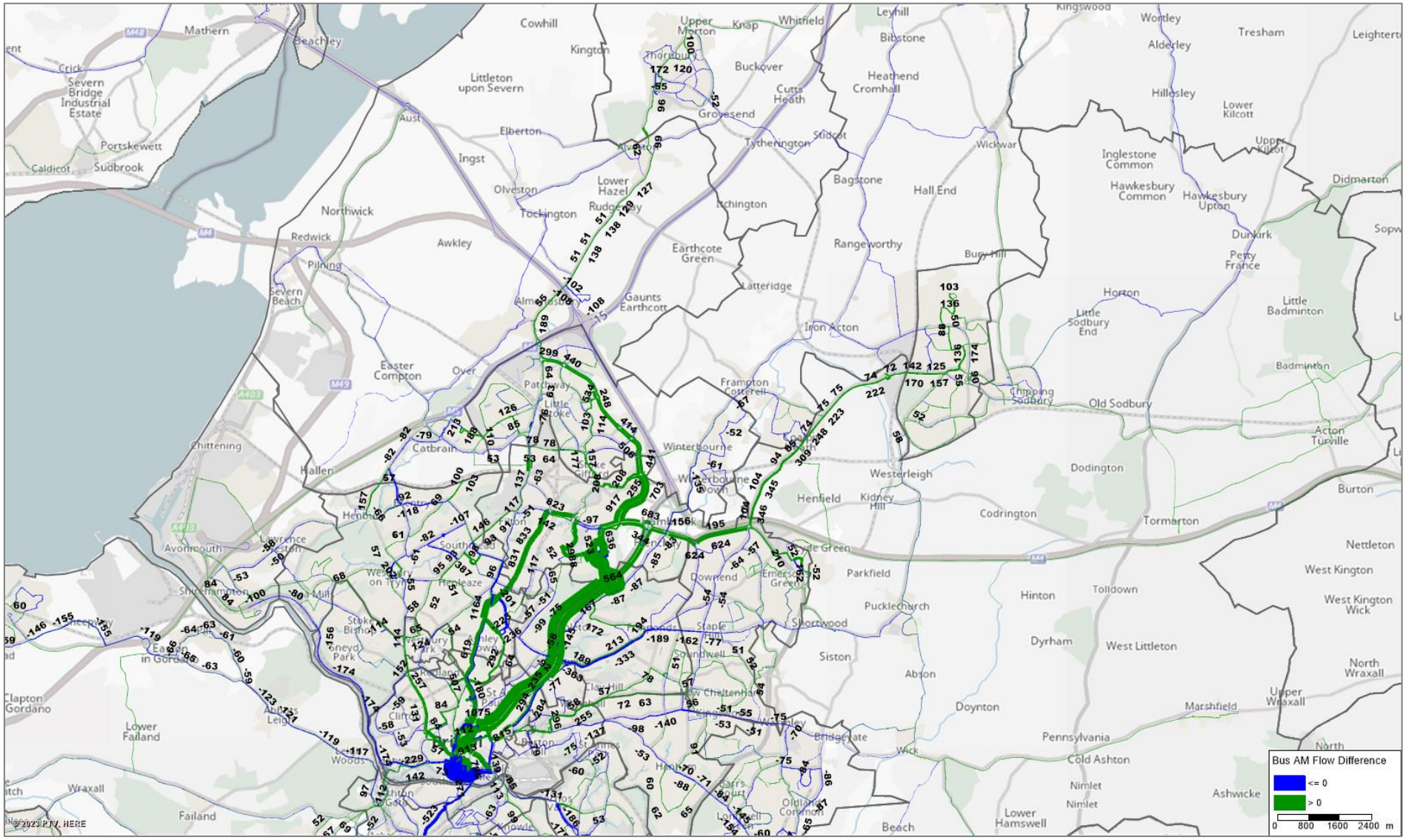
5.3 PT Assignment outputs

5.3.1 Bus patronage changes

An increase in flow is observed along the M32 corridor through to Filton and extending onto A38 and A432 corridors. The majority of the increase on the M32 and Filton Avenue is a result of the increase in bus demand between Bristol and Patchway, Filton sectors. There is an increase in bus patronage on the A432 due to a new bus route serving North Yate providing a 15 min frequency on the A432 corridor with increased patronage from commuters towards Filton and Bristol dominating in the AM peak. There is also a similar increase in patronage on the A38/Bradley Stoke Way corridor, and Lyde Green to Bristol. Bus flows are observed on the new link built through former Filton Airfield. Similar trend is observed in the PM peak but with an increase in patronage in the Northbound direction.

Figure 5-7 presents the bus flow difference between the 2042 DM and base year for AM peak and the same for PM peak is presented in Appendix F.1.1. An increase in flow is observed along the M32 corridor through to Filton and extending onto A38 and A432 corridors. The majority of the increase on the M32 and Filton Avenue is a result of the increase in bus demand between Bristol and Patchway, Filton sectors. There is an increase in bus patronage on the A432 due to a new bus route serving North Yate providing a 15 min frequency on the A432 corridor with increased patronage from commuters towards Filton and Bristol dominating in the AM peak. There is also a similar increase in patronage on the A38/Bradley Stoke Way corridor, and Lyde Green to Bristol. Bus flows are observed on the new link built through former Filton Airfield. Similar trend is observed in the PM peak but with an increase in patronage in the Northbound direction.

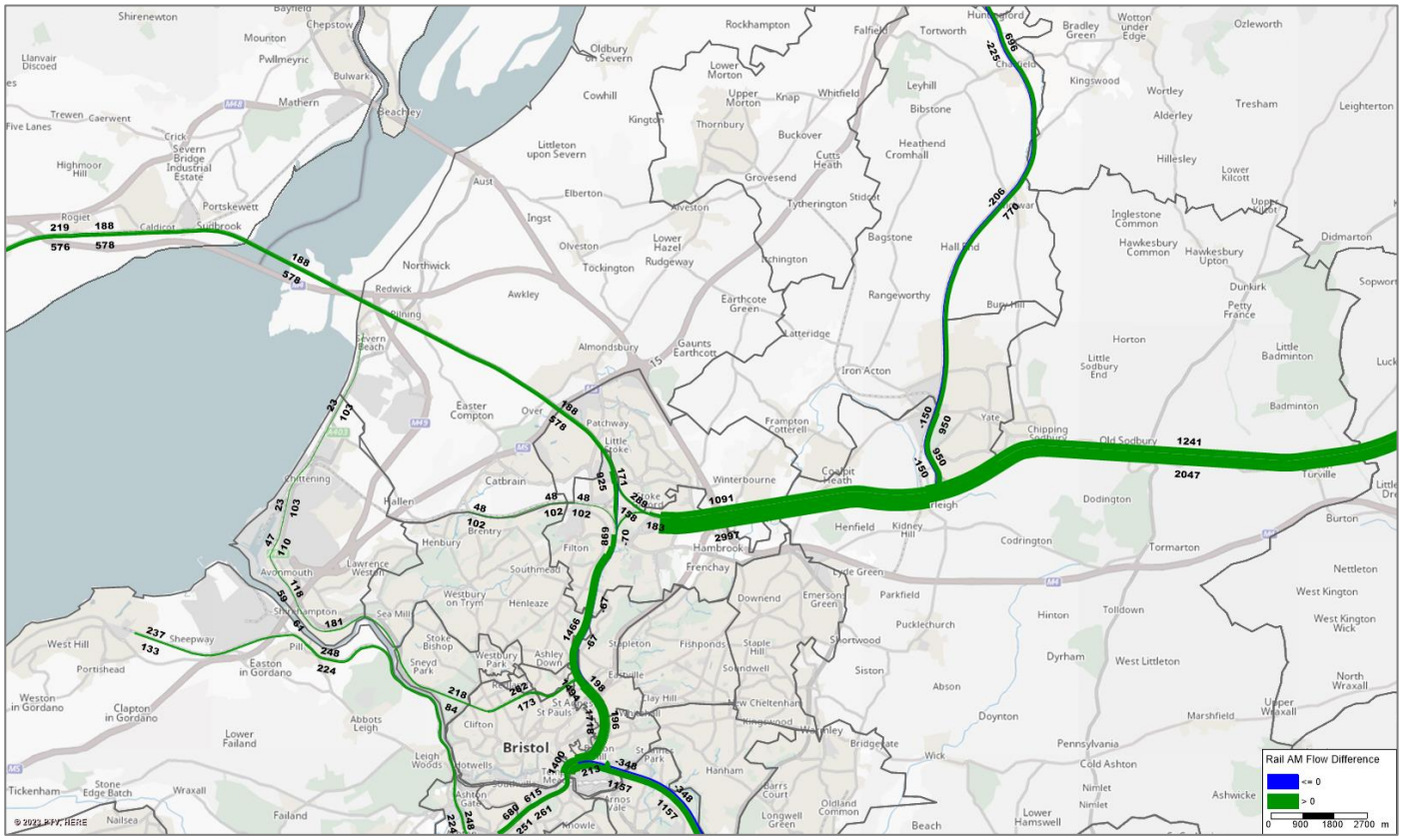
Figure 5-7 - Bus AM Flow Difference (persons) - DM minus Base



5.3.2 Rail Patronage changes

Figure 5-8 presents the rail flow differences between the 2042 DM and base year for the AM peak (the same for the PM peak is presented in Appendix F.1.2). Rail patronage has generally increased from base to forecast years. Within SGC flows are observed on the new Henbury line, and a patronage of approximately 100 person trips are observed at Charfield (Boarding of 77 and 24, Alighting of 22 and 76 in AM and PM peaks respectively). There is an increase in trips from the sectors of North External and East External to Filton and Severn Beach sectors resulting from the new developments in the DM. As a result, a shift in trips is observed between the Bristol Parkway - East External sector (towards London) corridor and Bristol-Bath- East External sector suggesting there is a rerouting happening and also a change in destination choice with Filton having a higher number of developments in DM from the committed developments.

Figure 5-8 - Rail AM Flow Difference (persons) - DM minus Base



6. Development Lenses

Three development (or Do Something (DS)) Lenses for the year 2042 have been tested as part of the local plan as mentioned in Chapter 1. The lenses differ in the location of new developments and also the quantum of housing and employment developments. The three development lenses are:

- Lens 1 – No Green Belt Loss;
- Lens 2 – Urban Edge; and
- Lens 3 – Transport Corridors.

Each lens in terms of the developments and their impact on the model outputs are presented in the subsequent chapters.

6.1 Demand Development

Assumptions laid out in Chapter 3 are followed for demand development for DS lense testing as well. Dwellings and jobs for each lens are calculated separately similar to DM. The developments from each lens are assigned to a model zone based on the geographical location, and the resulting dwellings and jobs from these developments are modelled in addition to the developments from DM. In addition to the dwellings and jobs, school capacity is also calculated based on the assumptions mentioned in Chapter 3.2.3. Table 6-1 below presents the summary of the total number of dwellings and jobs considered in each scenario. The column 'Scenario' presents the dwellings/jobs as part of that particular scenario and column 'Total' presents the growth from base (2019) to forecast year for each scenario.

Table 6-1 -Summary of Land Use Developments, growth above 2019 Base Year

Model Scenario	Dwellings			Jobs		
	Scenario	Total	% Additional Growth above DM	Scenario	Total	% Additional Growth above DM
DM	25,763	25,763	-	24,658	24,658	-
Lens 1	+8,351	34,114	+32.4%	+11,324	35,982	+45.9%
Lens 2*	+13,166	38,929	+51.1%	+13,326	37,984	+54.0%
Lens 3	+12,068	37,831	+46.8%	+7,790	32,448	+31.6%

*Number of jobs in Option 2 is constrained

There was an imbalance between the housing and employment growth in Lens 2 with the number of dwellings being 13,166 and number of jobs at 32,685 including service jobs. This imbalance between housing and jobs will impact the In-commuting and Out-commuting proportions, and it was agreed with SGC to constrain the actual number of jobs (jobs from employment developments) in Lens 2 to that in Lens 1 and service jobs are calculated based on the number of dwellings. The constraint is applied as a blanket reduction across all the developments.

6.2 Supply development

The purpose of Stage 1 is to identify the impact of new developments on the transport network in the absence of specific mitigation measures or schemes. Consequently, there are no new schemes incorporated within the development lens during this stage. However, additional connectors are added in the HAM and PTAM for zones where more than 300 dwellings were proposed. Additional connectors were coded for zones where new dwellings had existing alternate access on ground or proposed access arrangements. For zones where no alternate access was available, the capacity of the connectors was increased to infinite to ensure the trips could load onto the network.

7. Lens 1 - No Green Belt Loss

7.1 Introduction

Figure 7-1 below presents the location of developments under No Green Belt Loss also referred to as Lens 1. Appendix D.1 presents the list of developments at site level. Developments are mostly located in rural/suburban areas towards northern part of SGC.

Figure 7-1 – Lens 1 Development locations

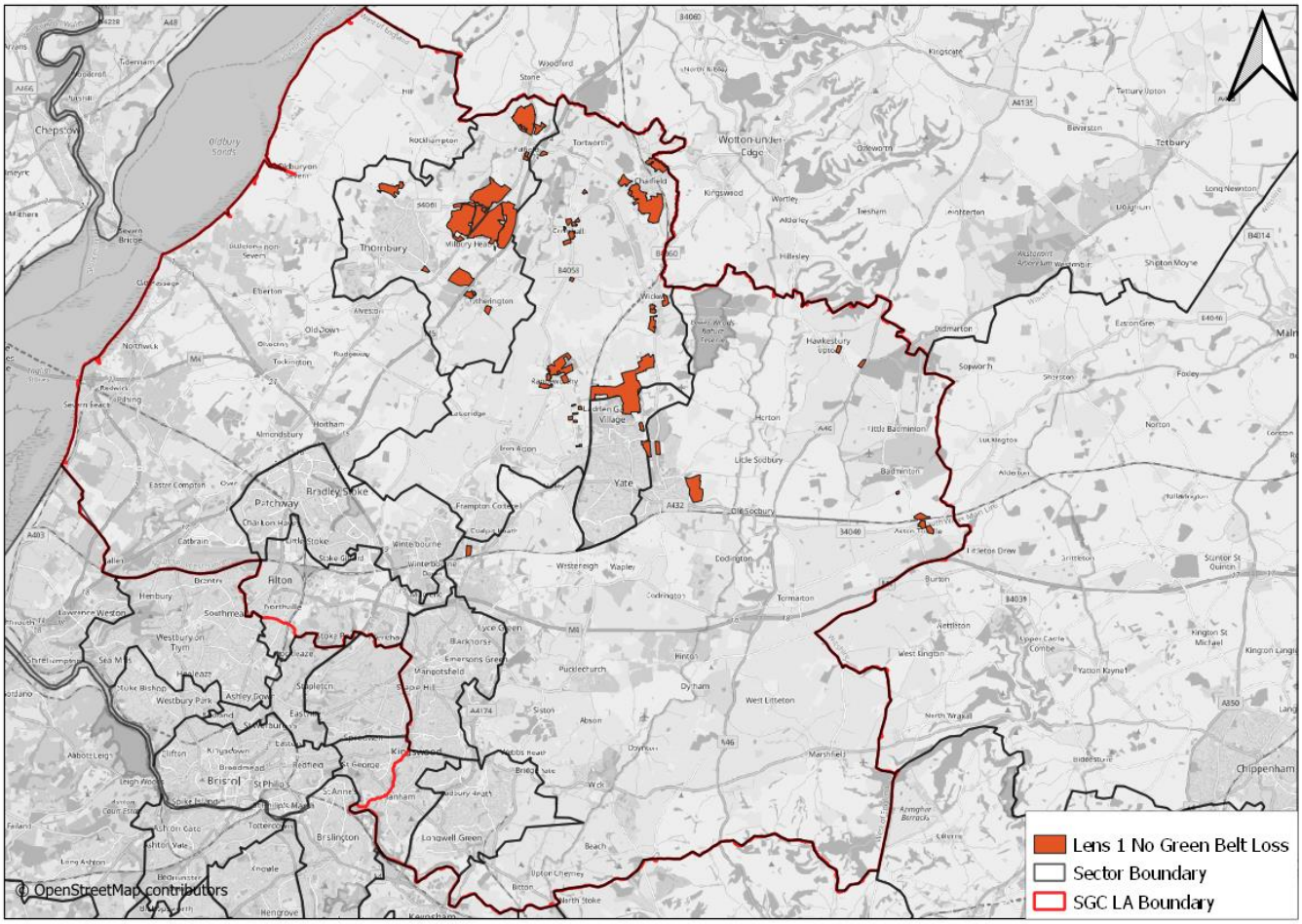


Table 7-1 presents the number of dwellings and jobs resulting from the above developments along with the sector wise percentages contributing to the total. Growth in number of jobs is higher than housing which will result in lesser out-commuting i.e., fewer people travelling outside study area for work.

Table 7-1 – Housing and Jobs in Lens 1

Sector	Dwellings	Jobs	% of Total Dwellings	% of Total Jobs
Thornbury	3,524	5,297	42.2%	46.8%
Iron Acton & Charfield	3,146	2,369	37.7%	20.9%
Yate	430	189	5.2%	1.7%
Pucklechurch & Chipping Sodbury	1,251	3,470	15.0%	30.6%
SGC Total	**8,351**	**11,324**	**100%**	**100%**

7.2 Demand Model outputs

7.2.1 Model Convergence

The Lens 1 model converged with an overall gap value of value of 0.165 in thirteen iterations, which is within the convergence GAP target of 0.2% as per TAG Unit M2.1. The outputs from the converged loops are used for reporting the results in the subsequent sections.

7.2.2 Demand Matrices

7.2.2.1 Change in trips by purpose

Table 7-2 below presents the final forecast demand for Lens 1 at the 24-hour production / attraction level by mode and purpose across all the movements that involves SGC. There is an increase of approximately 4% in total trips across modes and purposes from DM to Lens 1 resulting from the new developments. The majority of new trips are occurring by car, primarily due to the location of new developments. There has been an overall increase in trips for all purposes, with a majority attributed to home-based work and education trips in terms of percentage increase. This is expected with the increase in population and jobs.

Table 7-2 – Lens 1 24 hr P/A Trips by Purpose by Mode and comparison to DM

Purpose	Lens 1: 24hr P/A Trips					Abs Diff to DM					Percentage Diff to DM				
	Car	PT	Walk	Cycle	Total	Car	PT	Walk	Cycle	Total	Car	PT	Walk	Cycle	Total
HBW	125,193	12,797	9,214	5,077	152,281	5,776	340	313	89	6,519	4.8%	2.7%	3.5%	1.8%	4.5%
HBEB	20,721	2,151	622	290	23,785	940	73	26	8	1,048	4.8%	3.5%	4.3%	2.7%	4.6%
HBEd	47,748	12,036	26,097	2,953	88,834	2,492	281	819	79	3,671	5.5%	2.4%	3.2%	2.7%	4.3%
HBShopPB	161,358	19,705	24,635	3,639	209,337	5,827	284	455	50	6,615	3.7%	1.5%	1.9%	1.4%	3.3%
HBRecVFR	135,231	12,543	13,263	1,281	162,319	5,235	172	307	17	5,731	4.0%	1.4%	2.4%	1.3%	3.7%
NHBEB	24,771	593	1,031	69	26,464	1,008	8	7	1	1,024	4.2%	1.4%	0.7%	0.8%	4.0%
NHBO	132,909	5,163	19,394	72	157,539	4,400	78	350	1	4,829	3.4%	1.5%	1.8%	1.3%	3.2%
Total	**647,932**	**64,988**	**94,257**	**13,382**	**820,559**	**25,678**	**1,237**	**2,277**	**244**	**29,435**	**4.1%**	**1.9%**	**2.5%**	**1.9%**	**3.7%**

7.2.3 Mode Shares

7.2.3.1 Mode Shares by Purpose

Table 7-3 below presents the mode shares by purpose for Lens 1 and comparison with DM. Though the changes are minor there is an increase in car mode share with reduction in PT and Walk. These shifts align with the

increase in car trips as shown in Table 7-2. The most significant change is observed in education-related trips, where escort trips associated with this purpose play a prominent role.

Table 7-3 – Lens 1 Mode Shares by Purpose and comparison to DM

Purpose	Lens 1: 24hr P/A Trips				Mode Share				Change in Mode Share			
	Car	PT	Walk	Cycle	Car	PT	Walk	Cycle	Car	PT	Walk	Cycle
HBW	125,193	12,797	9,214	5,077	82.2%	8.4%	6.1%	3.3%	0.3%	-0.1%	-0.1%	-0.1%
HBEB	20,721	2,151	622	290	87.1%	9.0%	2.6%	1.2%	0.1%	-0.1%	0.0%	0.0%
HBEd	47,748	12,036	26,097	2,953	53.7%	13.5%	29.4%	3.3%	0.6%	-0.3%	-0.3%	-0.1%
HBShopPB	161,358	19,705	24,635	3,639	77.1%	9.4%	11.8%	1.7%	0.4%	-0.2%	-0.2%	0.0%
HBRecVFR	135,231	12,543	13,263	1,281	83.3%	7.7%	8.2%	0.8%	0.3%	-0.2%	-0.1%	0.0%
NHBEB	24,771	593	1,031	69	93.6%	2.2%	3.9%	0.3%	0.2%	-0.1%	-0.1%	0.0%
NHBO	132,909	5,163	19,394	72	84.4%	3.3%	12.3%	0.0%	0.2%	-0.1%	-0.2%	0.0%
Total	**647,932**	**64,988**	**94,257**	**13,382**	**79.0%**	**7.9%**	**11.5%**	**1.6%**	**0.3%**	**-0.1%**	**-0.1%**	**0.0%**

7.2.3.2 Mode Shares by Sector

presents the change in car mode shares by production and attraction sectors for all purposes between Lens 1 and DM. Car mode shares have increased as seen in the above table. Notably, Thornbury sector contributing 42% and 47% of dwellings and jobs in Lens 1 shows the highest growth in production shares, particularly in Education trips. The mode shares suggest a shift from walk to car, possibly due to an imbalance between the rise in dwellings and jobs in the sector, pushing individuals to opt for cars for longer trips. While Iron Acton and Charfield experience significant growth, it is distributed across multiple modes. Yate, on the other hand, exhibits a minor decrease in car mode shares, accompanied by an increase in public transport and walking. Similar trends are observed in attraction shares, with Thornbury showing the most substantial change.

Figure 7-2 and Figure 7-3 presents the change in car mode shares by production and attraction sectors for all purposes between Lens 1 and DM. Car mode shares have increased as seen in the above table. Notably, Thornbury sector contributing 42% and 47% of dwellings and jobs in Lens 1 shows the highest growth in production shares, particularly in Education trips. The mode shares suggest a shift from walk to car, possibly due to an imbalance between the rise in dwellings and jobs in the sector, pushing individuals to opt for cars for longer trips. While Iron Acton and Charfield experience significant growth, it is distributed across multiple modes. Yate, on the other hand, exhibits a minor decrease in car mode shares, accompanied by an increase in public transport and walking. Similar trends are observed in attraction shares, with Thornbury showing the most substantial change.

Figure 7-2 – Difference between Lens 1 and DM for Car Mode Shares - Productions, All Purposes

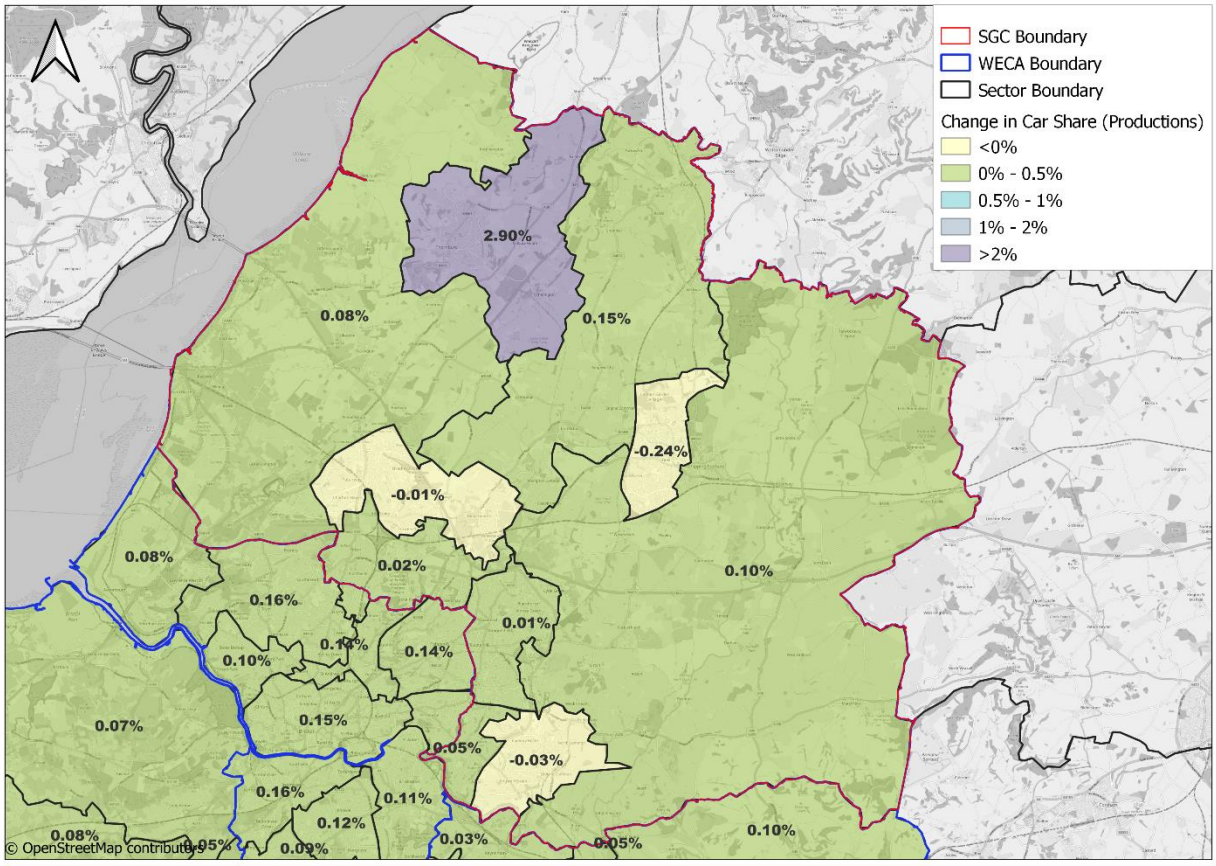
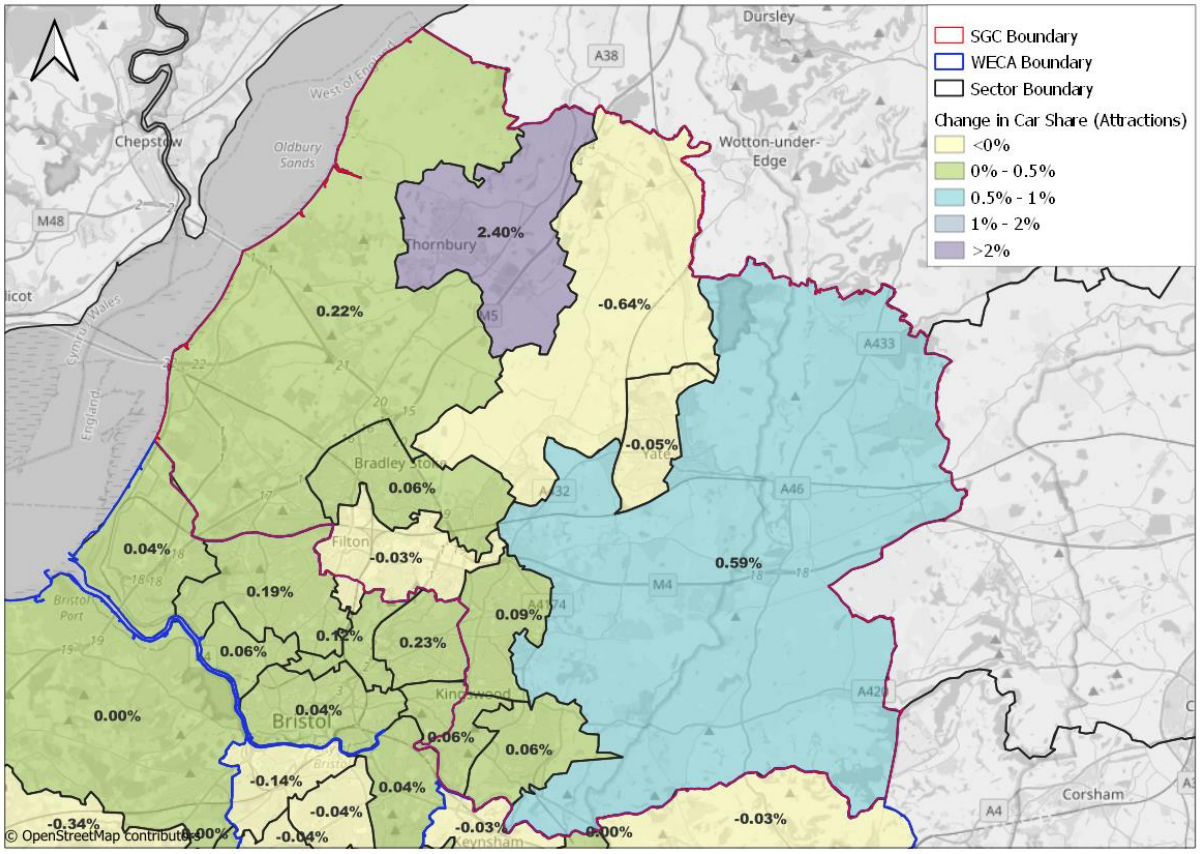


Figure 7-3 - Difference between Lens 1 and DM for Car Mode Shares - Attractions, All Purposes



7.2.4 Trip Lengths

Average trip lengths (measured in Kilometers) in Lens 1 and comparison with DM is presented in Table 7-4. Average trip lengths by Car have minor increase for all purposes except for Education and Shopping. Bus and Rail journeys have shortened as car is chosen for longer trips. Walk and Cycle trip lengths have remained stable. Though the changes are minor there is an increase in short distance trips with decrease in medium distance trips via Bus; and a decrease in long distance trips via Rail with an increase in medium distance trips suggesting that the additional trips in Lens 1 are preferring Car for longer trips. This again is attributed to reduced Vehicle operating Costs (VoCs) for car and the location of new developments.

Table 7-4 – Lens 1 Average Trip Length by Purpose by Mode, Comparison to DM

Purpose	Lens 1 Average Trip Lengths					Absolute Diff to DM				
	Car	Bus	Rail	Cycle	Walk	Car	Bus	Rail	Cycle	Walk
HBW	22.1	9.5	167.3	8.0	1.8	▲ 0.2	▬ 0.0	▼ -1.6	▼ -0.1	▬ 0.0
HBEB	22.6	6.8	84.1	4.9	0.9	▲ 0.2	▬ 0.0	▼ -2.9	▼ -0.1	▬ 0.0
HBEd	6.7	10.4	15.8	4.1	1.7	▼ -0.1	▼ -0.1	▬ 0.0	▬ 0.0	▬ 0.0
HBShopPB	19.5	9.9	184.1	5.7	1.5	▼ -0.1	▲ 0.1	▼ -1.7	▬ 0.0	▬ 0.0
HBRecVFR	19.0	9.1	192.8	7.2	2.1	▬ 0.0	▬ 0.0	▼ -0.5	▬ 0.0	▬ 0.0
NHBEB	18.2	8.9	124.9	5.8	0.8	▲ 0.3	▬ 0.0	▼ -1.7	▬ 0.0	▬ 0.0
NHBO	17.0	10.9	129.2	5.2	1.5	▲ 0.2	▬ 0.0	▼ -1.1	▬ 0.0	▬ 0.0
Grand Total	**18.5**	**10.0**	**176.6**	**6.3**	**1.6**	▬ **0.0**	▬ **0.0**	▼ **-1.5**	▬ **0.0**	▬ **0.0**

7.3 Highway Assignment Outputs

The HAM model convergence for Lens 1 is summarized in Table 7-5 presenting the gap statistics and percentage of links passing the flow criteria for the last four loops. The highway assignment model has converged except for the PM peak. The flow criteria in PM peak is 98.9% just below the required criteria of 99% and the demand model has converged with in the set criteria. Hence the PM peak assignments are considered acceptable.

Moreover, the demand model has converged in 10 iterations as mentioned in section 7.2.1 which provides confidence that any instability in the PM peak highway assignments hasn't affected the model choices.

Table 7-5 – Lens 1 SATURN Highway Assignment Convergence Summary

Scenario	Time Period	Number of iterations	%Flow	%Delay	%GAP
Option 1	AM Peak	86	98.6	99.2	0.0240
		87	99.2	99.3	0.0280
		88	99.1	99.4	0.0220
		89	99.4	99.4	0.0310
	Inter Peak	37	99.4	99.7	0.0120
		38	99.0	99.7	0.0130
		39	99.1	99.7	0.0120
		40	99.3	99.8	0.0083
	PM Peak	97	99.2	99.3	0.0370
		98	98.9	99.3	0.0260
		99	99.1	99.3	0.0380
		100	98.9	99.3	0.0260

7.3.1 Overall Network Statistics

Table 7-6 below presents the network statistics for Lens 1 and DM for all time periods. There is no significant change between Lens 1 and DM across the peaks.

Table 7-6 – Lens 1 Overall highway network statistics (whole UK model)

Time Period	Scenario	DM	Lens 1	% Diff with DM
AM Peak	Matrix Totals (pcu/hr)	220,067	222,103	0.9%
	Total Travel Times (pcu-hrs)	141,630	142,809	0.8%
	Travel Distance (pcu-kms)	7,894,026	7,929,065	0.4%
	Average Speed (km/h)	55.70	55.50	-0.4%
	Total Delay / Vehicle (mins/pcu)	8.55	8.61	0.7%
	Average Trip Length (pcu.km)	35.87	35.70	-0.5%
Inter Peak	Matrix Totals (pcu/hr)	182,604	184,251	0.9%
	Total Travel Times (pcu-hrs)	100,984	101,508	0.5%

Time Period	Scenario	DM	Lens 1	% Diff with DM
	Travel Distance (pcu-kms)	6,716,937	6,738,183	0.3%
	Average Speed (km/h)	66.50	66.40	-0.2%
	Total Delay / Vehicle (mins/pcu)	3.83	3.84	0.2%
	Average Trip Length (pcu.km)	36.78	36.57	-0.6%
PM Peak	Matrix Totals (pcu/hr)	219,676	221,576	0.9%
	Total Travel Times (pcu-hrs)	139,850	140,832	0.7%
	Travel Distance (pcu-kms)	7,829,401	7,851,768	0.3%
	Average Speed (km/h)	56.00	55.80	-0.4%
	Total Delay / Vehicle (mins/pcu)	8.50	8.57	0.8%
	Average Trip Length (pcu.km)	35.64	35.44	-0.6%

7.3.2 Impact on Network

Figure 7-4 and

Figure 7-5 below presents the flow and delay difference respectively between Lens 1 and DM in AM Peak, Figure 7-6 and Figure 7-7 presents the same for PM peak. These differences are primarily a result of increased land utilization in the area. During the AM Peak, there is a noticeable increase in traffic flow along B4061 and A38 near Thornbury, as well as on the M5 between Almondsbury junction and M5 J14. These increases are attributed mainly to the developments in the Thornbury and Charfield sectors. The rise in traffic at M5 J14 is of the magnitude of 111 pcu/hr and 139 pcu/hr on B4059 Eastbound and Westbound respectively, and 54 pcu/hr on the NB off slip in AM peak. There is increase in traffic getting on to M5 from B4509 west producing a blocking back on B4509 bridge causing delays. The growth of developments around Yate has led to increased traffic on B4509 and B4060. It is important to note that the decreases in traffic flow seen are due to rerouting caused by the introduction of new zone connectors. Furthermore, we observe significant delays on several local roads, including Earthcott Road, the B4058/Yate Road junction, and the zone connector on Peg Hill.

The PM Peak shows a decline in traffic flow on M5 Northbound, primarily due to increased delays on the Northbound Offslip at M5 J14. This has resulted from a minor increase in flow on the B4509 causing blocking back and thereby increasing delays for the exiting vehicles on the slip road. Significant increase in delays is observed on a few local roads including Itchington Road, B4058/Yate Road junction, connector onto A432 north of Coalpit Heath.

The operational challenges at M5 J14 and M4 J20 were anticipated, and potential solutions for these and other locations will be examined during the upcoming phase of mitigation measures and preferred option testing.

Flow and delay difference plots for Lens 1 focussed on key SRN junctions M5J14, M4/M5 and M4/M32 are presented from Appendix G.1 to Appendix G.12.

Figure 7-4 – Lens 1 vs DM Highway Flow difference AM peak

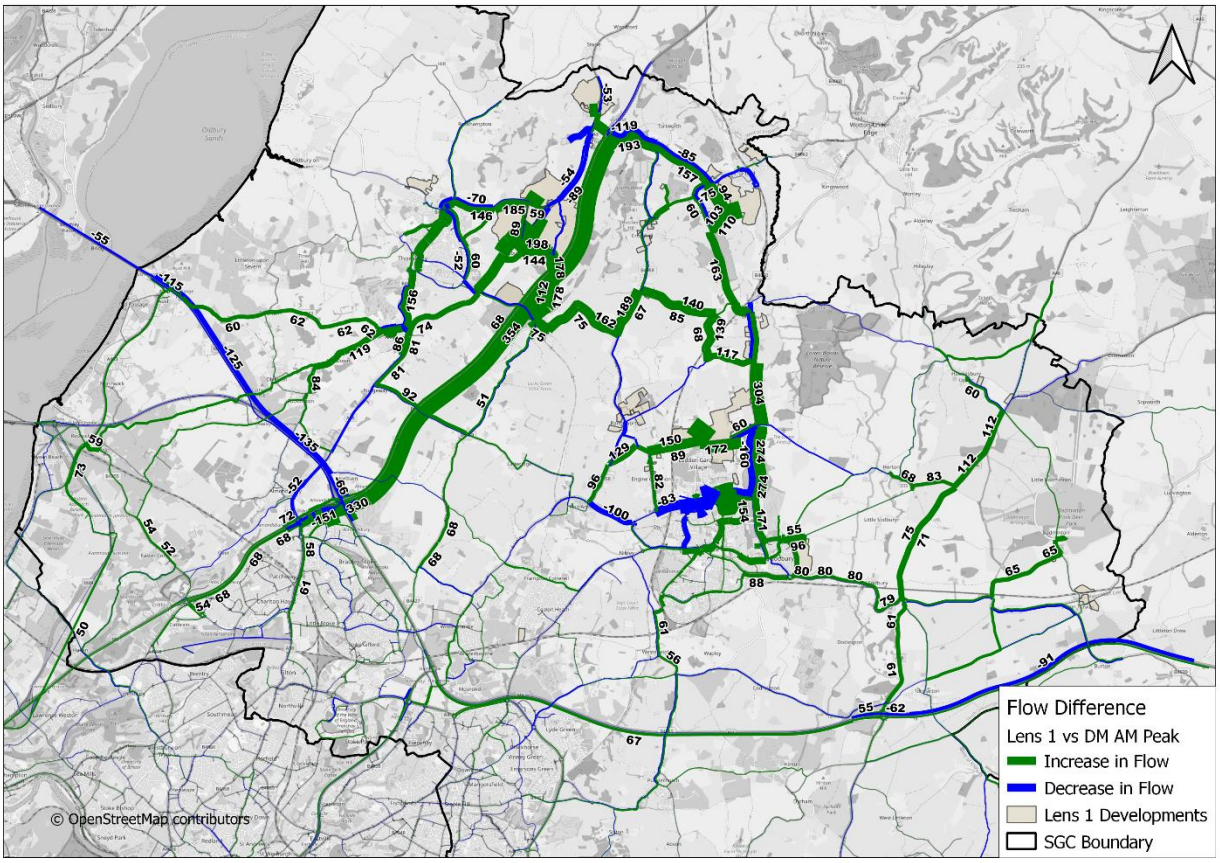


Figure 7-5 - Lens 1 vs DM Highway Delay difference AM peak

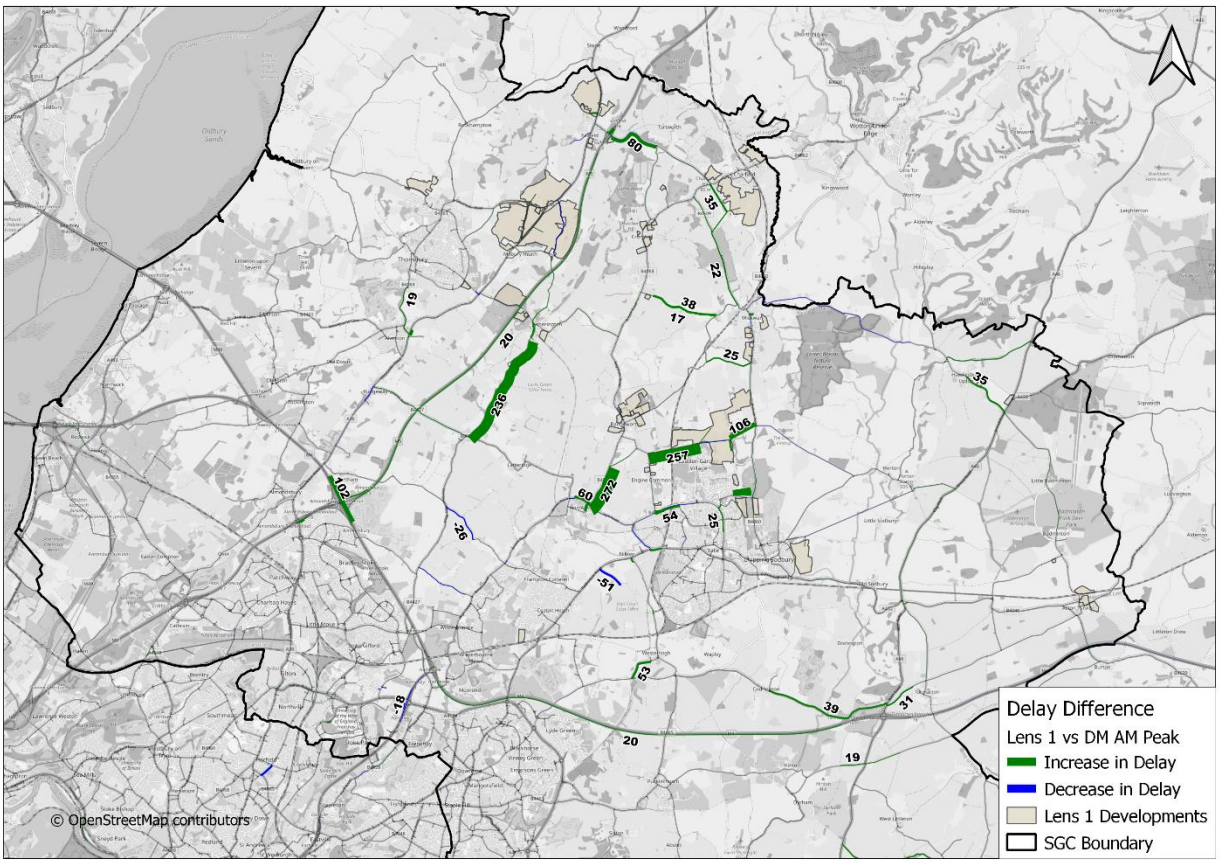


Figure 7-6 – Lens 1 vs DM Highway Flow difference PM peak

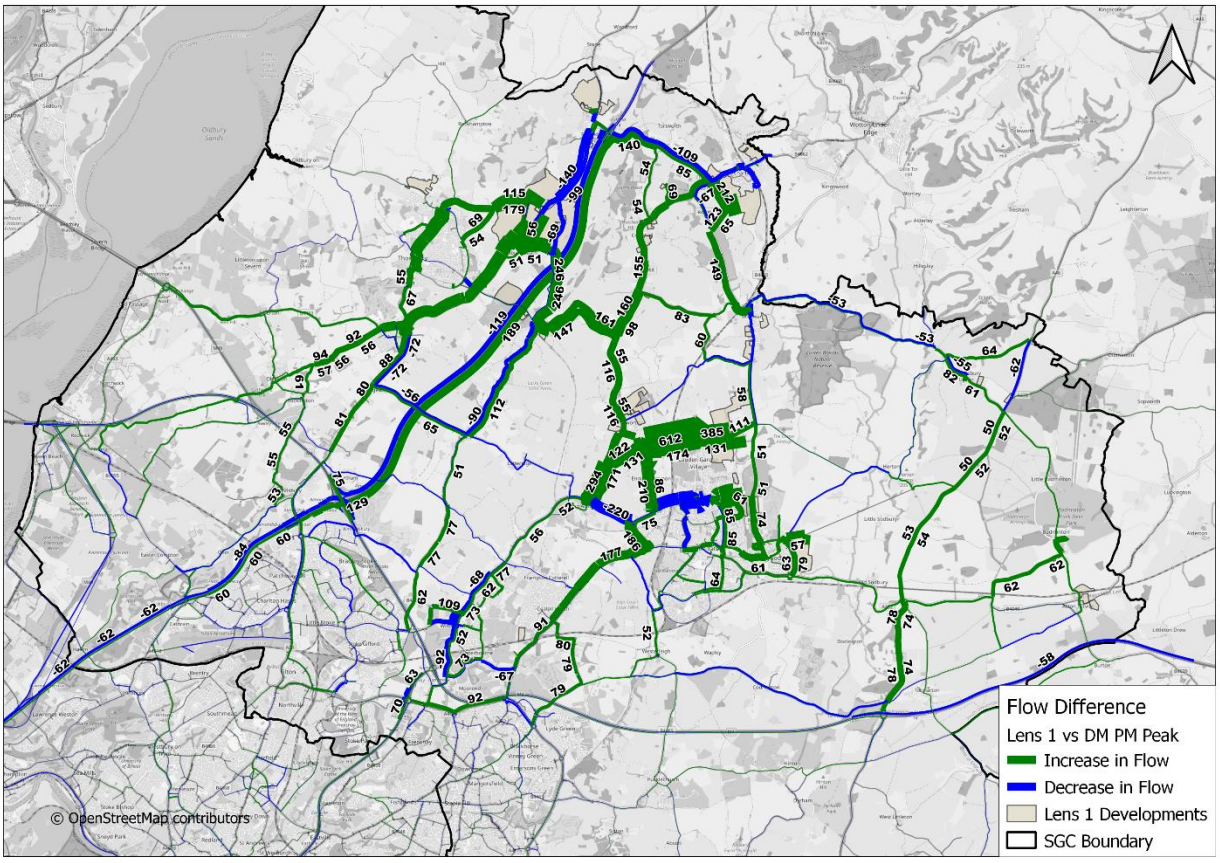
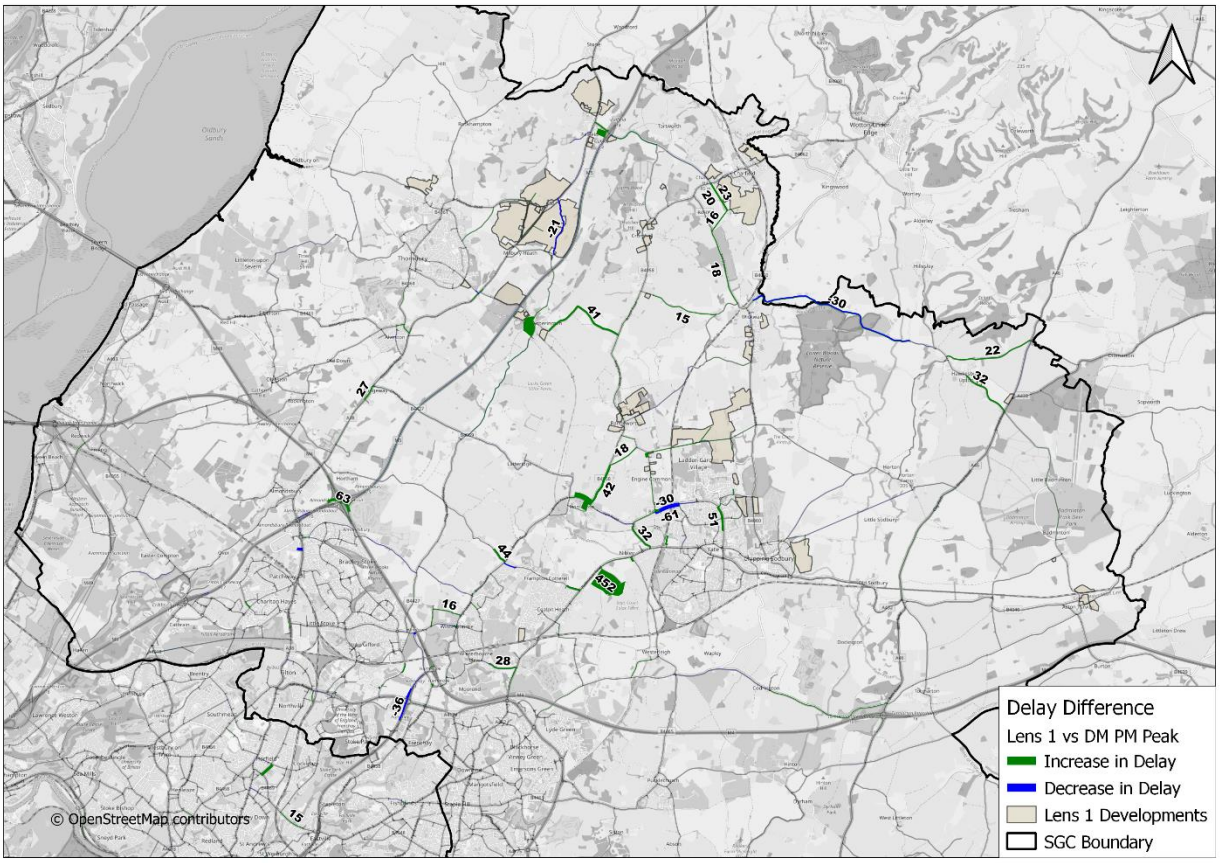


Figure 7-7 - Lens 1 vs DM Highway Delay difference PM peak

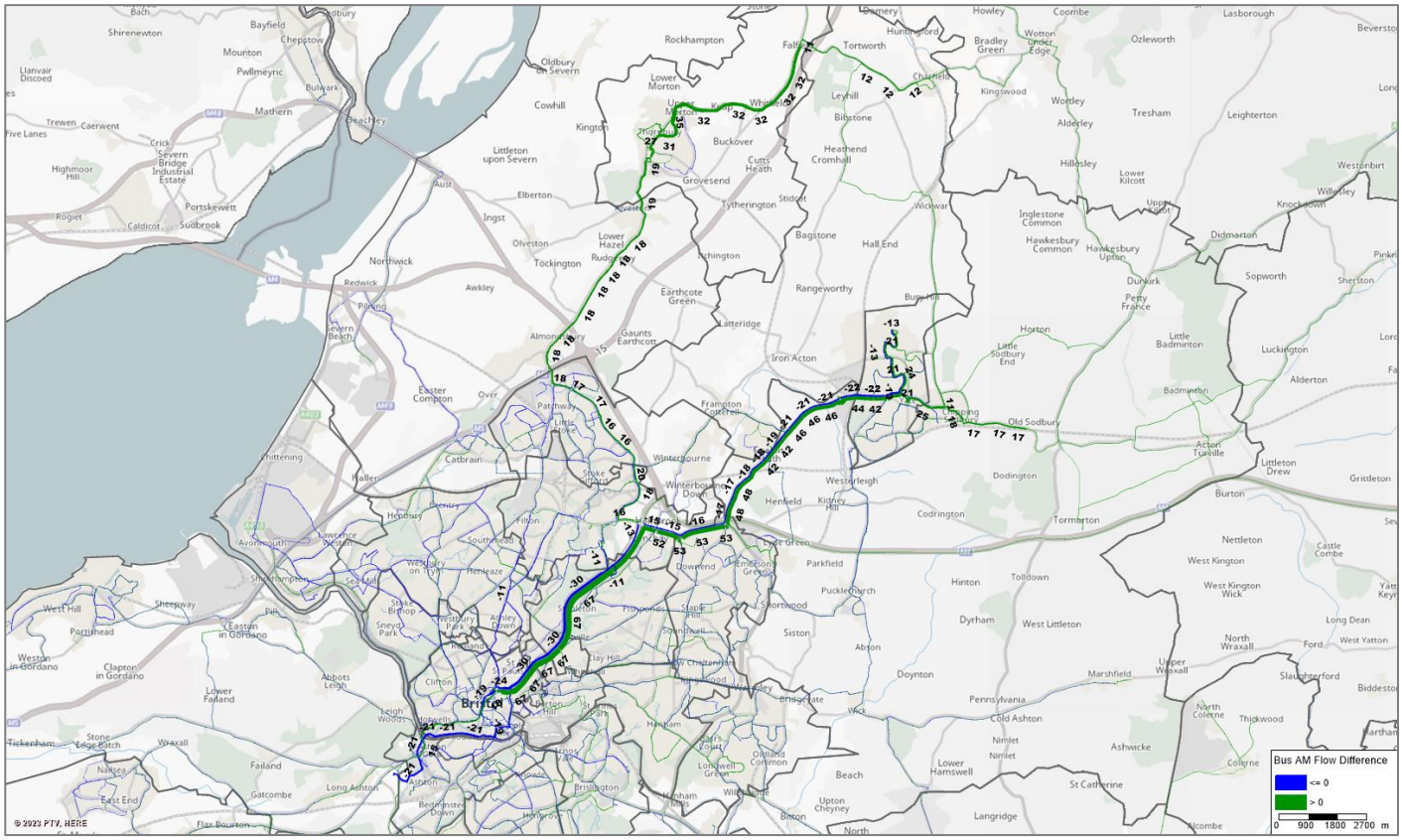


7.4 PT Assignment Outputs

7.4.1 Bus patronage changes

Figure 7-8 presents the bus flow differences between Lens1 and DM for AM peak and Appendix F.2.1 presents the same for PM peak. There are minor increases in bus flow along the A38/Bradley Stoke Way and A432 towards Bristol serving the new developments in Thornbury and Yate, on B4509 from Charfield in AM peak. The trend has reversed in PM peak with increases towards Thornbury and Yate.

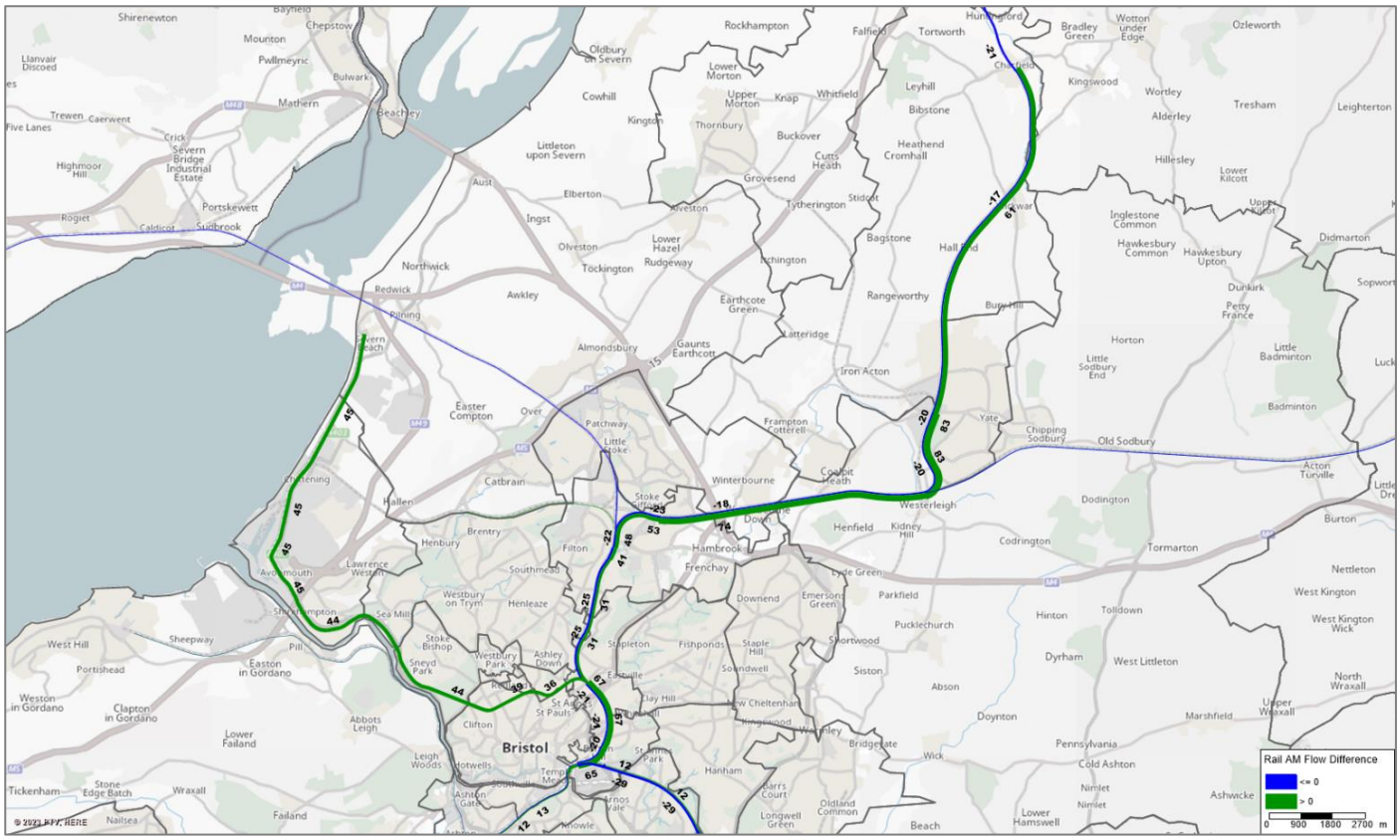
Figure 7-8 - Bus AM Flow Difference (persons) – Lens 1 vs DM



7.4.2 Rail Patronage changes

Figure 7-9 presents the rail flow differences between Lens 1 and DM for AM peak and F.2.2 presents the rail flow differences for PM peak. An increase in flow from Charfield and Yate is observed towards Filton and Bristol in the AM peak resulting from the new developments in Lens 1. There is also an increase observed from Severn Beach to Bristol. The directionality is reversed in the PM peak with increase in flow from Bristol to Charfield and Bristol to Severn Beach.

Figure 7-9 - Rail AM Flow Difference (persons) – Lens 1 vs DM


Rail AM Flow Difference
<= 0
> 0
0 900 1800 2700 m
Bristol
© 2023 TomTom, HERE

8. Lens 2 - Urban Edge

8.1 Introduction

Figure 8-1 presents the location of developments under Urban Edge also referred to as Lens 2. Appendix D.2 presents the list of developments at site level.

Figure 8-1 – Lens 2 Development Locations

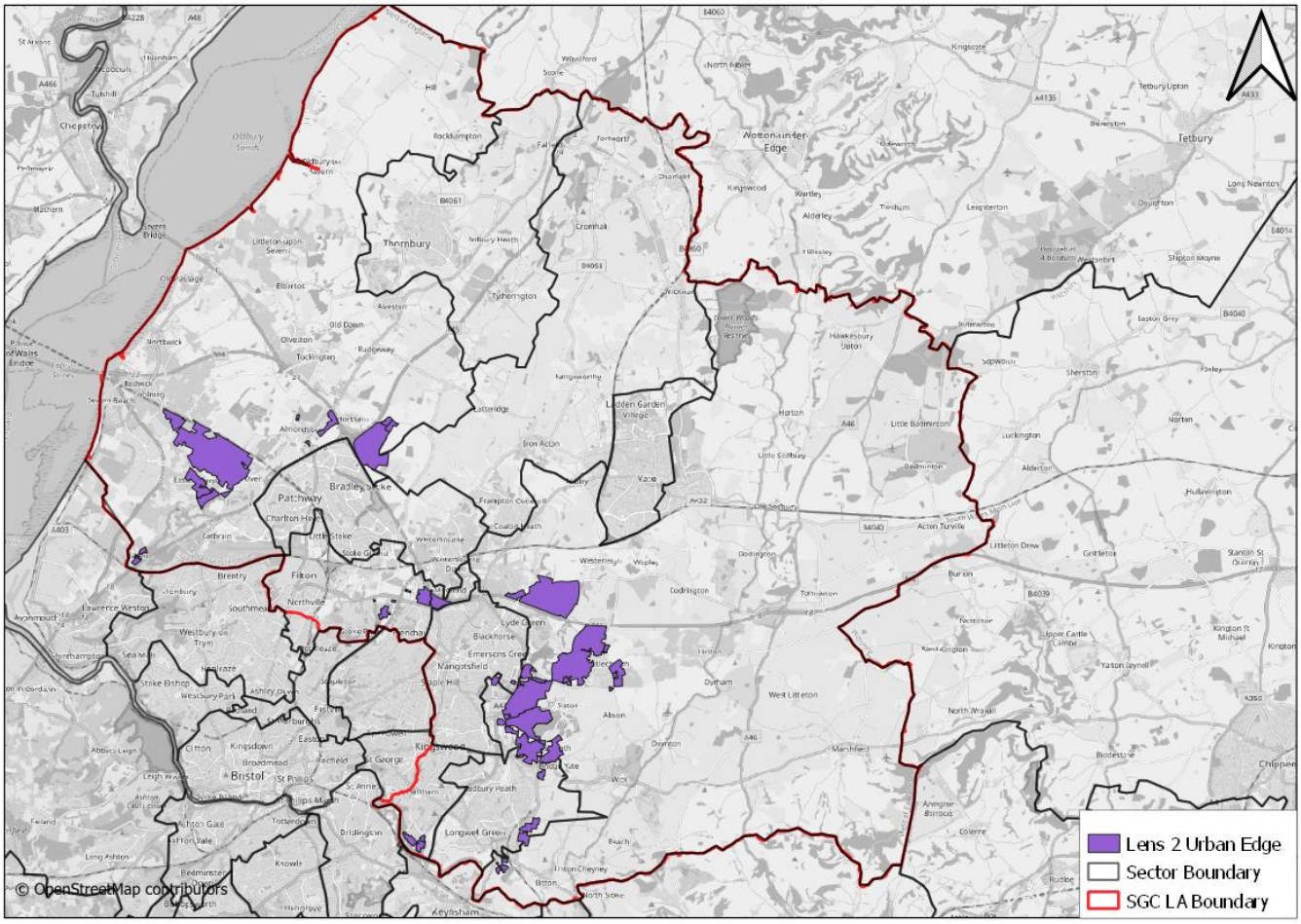


Table 8-1 presents the number of dwellings and jobs resulting from the above developments along with the sector wise percentages contributing to the total. Growth in housing and jobs is almost equal in this growth scenario.

Table 8-1 - Housing and Jobs in Lens 2

Sector	Dwellings	Jobs	% of Dwellings	% of Jobs
Kingswood	333	138	2.5%	1.0%
Pilning, Severn Beach and Woodhouse Down	3,747	2,956	28.5%	22.2%
Filton, Bristol Parkway & Frenchay	794	999	6.0%	7.5%
Iron Acton & Charfield	114	48	0.9%	0.4%
Pucklechurch & Chipping Sodbury	7,096	7,586	53.9%	56.9%
Mangotsfield	64	27	0.5%	0.2%
Longwell Green	1,018	1,572	7.7%	11.8%
SGC Total	**13,166**	**13,326**	**100%**	**100%**

8.2 Demand Model outputs

8.2.1 Model Convergence

The Lens 2 model converged with an overall gap value of 0.187 in eight iterations, which is within the convergence GAP target of 0.2% as per TAG Unit M2.1. The outputs from the converged loops are used for reporting the results in the subsequent sections.

8.2.2 Demand Matrices

8.2.2.1 Change in trips by purpose

Table 8-2 below presents the final forecast demand for Lens 2 at the 24-hour production / attraction level by mode and purpose across all the movements that involves SGC. There is an overall increase of 6% in total trips across modes and purposes in Lens 2. All purposes have shown a substantial increase, with education and work-related trips showing particularly higher growth. The majority of the new trips are taking place by Car followed by Walk and PT. A significant increase in Cycle trips is also observed in terms of percentage increase. The 6.1% rise in Walk trips and the 9.2% rise in Cycle trips indicate a shift towards more sustainable modes of travel, influenced by the strategic placement of developments on the urban edge.

Table 8-2 – Option 2 24 hr P/A Trips by Purpose by Mode and comparison to DM

Purpose	Lens 2: 24hr P/A Trips					Abs Diff to DM					Percentage Diff to DM				
	Car	PT	Walk	Cycle	Total	Car	PT	Walk	Cycle	Total	Car	PT	Walk	Cycle	Total
HBW	127,159	12,908	9,648	5,504	155,219	7,742	451	748	516	9,457	6.5%	3.6%	8.4%	10.3%	6.5%
HBEB	21,277	2,182	659	312	24,430	1,496	104	63	30	1,693	7.6%	5.0%	10.5%	10.7%	7.4%
HBEd	48,962	12,468	27,347	3,128	91,904	3,706	714	2,068	254	6,741	8.2%	6.1%	8.2%	8.8%	7.9%
HBShopPB	163,851	19,957	25,366	3,883	213,057	8,319	536	1,186	294	10,335	5.3%	2.8%	4.9%	8.2%	5.1%
HBRecVFR	138,280	12,681	13,704	1,365	166,029	8,284	309	748	101	9,440	6.4%	2.5%	5.8%	8.0%	6.0%
NHBEB	25,303	598	1,069	74	27,045	1,541	14	44	6	1,604	6.5%	2.3%	4.3%	8.5%	6.3%
NHBO	135,737	5,242	19,760	76	160,814	7,228	157	716	4	8,104	5.6%	3.1%	3.8%	5.6%	5.3%
Total	**660,568**	**66,037**	**97,553**	**14,342**	**838,499**	**38,315**	**2,285**	**5,572**	**1,204**	**47,375**	**6.2%**	**3.6%**	**6.1%**	**9.2%**	**6.0%**

8.2.3 Mode Shares

8.2.3.1 Mode Shares by Purpose

Table 8-3 below presents the mode shares by purpose for Lens 2 and comparison with DM. Despite the changes being relatively minor, there is an increase in overall car mode share, accompanied by reduction in PT across all purposes.

Table 8-3 – Lens 2 Mode Shares by Purpose and comparison to DM

Purpose	Lens 2: 24hr P/A Trips				Mode Share				Change in Mode Share			
	Car	PT	Walk	Cycle	Car	PT	Walk	Cycle	Car	PT	Walk	Cycle
HBW	127,159	12,908	9,648	5,504	81.9%	8.3%	6.2%	3.5%	0.0%	-0.2%	0.1%	0.1%
HBEB	21,277	2,182	659	312	87.1%	8.9%	2.7%	1.3%	0.1%	-0.2%	0.1%	0.0%
HBEd	48,962	12,468	27,347	3,128	53.3%	13.6%	29.8%	3.4%	0.1%	-0.2%	0.1%	0.0%
HBShopPB	163,851	19,957	25,366	3,883	76.9%	9.4%	11.9%	1.8%	0.2%	-0.2%	0.0%	0.1%
HBRecVFR	138,280	12,681	13,704	1,365	83.3%	7.6%	8.3%	0.8%	0.3%	-0.3%	0.0%	0.0%
NHBEB	25,303	598	1,069	74	93.6%	2.2%	4.0%	0.3%	0.2%	-0.1%	-0.1%	0.0%
NHBO	135,737	5,242	19,760	76	84.4%	3.3%	12.3%	0.0%	0.3%	-0.1%	-0.2%	0.0%
Total	**660,568**	**66,037**	**97,553**	**14,342**	**78.8%**	**7.9%**	**11.6%**	**1.7%**	**0.1%**	**-0.2%**	**0.0%**	**0.0%**

8.2.3.2 Mode Shares by Sector

Figure **8-2** and Figure 8-3 presents the change in car mode shares by production and attraction sectors for all purposes between Lens 2 and DM. Pilning and Severn Beach, Pucklechurch and Chipping Sodbury are the sectors with major developments and thereby the sectors with relatively higher changes in mode shares. Pilning and Severn Beach has an increase in production car shares across all purposes with Pucklechurch and Chipping Sodbury having a reduction in car and PT shares with shift to walk and cycle except for shopping, suggesting that the latter sector has an equilibrium in housing and employment growth and the need to travel farther is reduced. Similar trends are seen for the attraction shares as well.

Figure 8-2 – Difference between Lens 2 and DM for Car Mode Shares - Productions, All Purposes

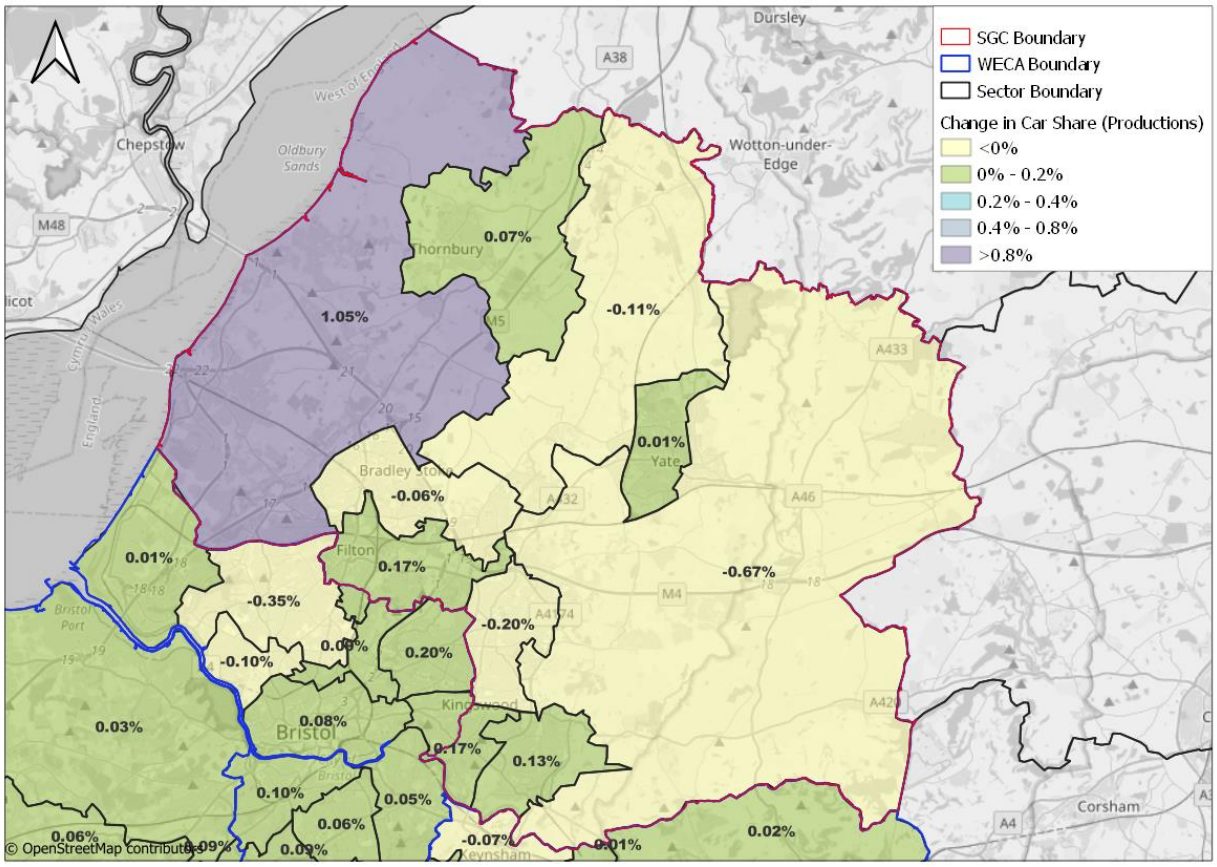
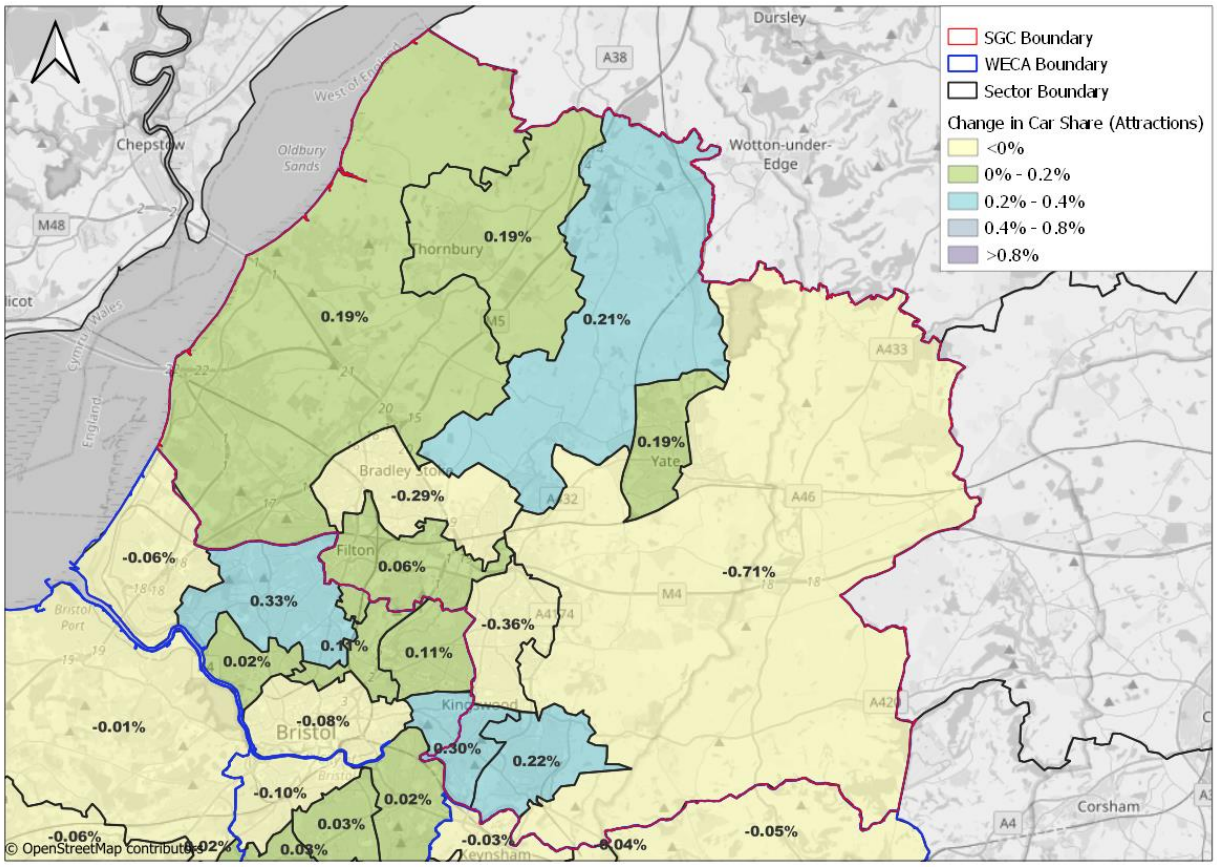


Figure 8-3 - Difference between Lens 2 and DM for Car Mode Shares - Attractions, All Purposes



8.2.4 Trip Lengths

Average trip lengths in Lens 2 and comparison with DM is presented in Table 8-4. Average trip lengths by Car and Rail have decreased whereas Bus trip lengths have remained stable. Walk trip lengths have also remained stable whereas Cycle trip lengths have seen an increase owing to the proximity of the development locations to the active travel schemes included. Drop in car shares as shown in the above figures suggest a growth in short distance trips.

Table 8-4 – Lens 2 Average Trip Length by Purpose by Mode, Comparison to DM

Purpose	Lens 2 Average Trip Lengths					Absolute Diff to DM				
	Car	Bus	Rail	Cycle	Walk	Car	Bus	Rail	Cycle	Walk
HBW	21.4	9.5	168.5	8.2	1.8	-0.5	0.0	-0.5	0.1	0.1
HBEB	21.9	6.8	86.4	5.1	0.9	-0.5	0.0	-0.6	0.1	0.0
HBEd	6.7	10.4	15.7	4.2	1.7	-0.1	-0.1	-0.1	0.1	0.1
HBShopPB	19.1	9.8	185.2	5.8	1.5	-0.5	0.0	-0.6	0.2	0.0
HBRecVFR	18.6	9.1	192.8	7.4	2.1	-0.4	0.0	-0.4	0.1	0.1
NHBEB	17.7	8.9	126.5	6.0	0.8	-0.3	0.0	-0.1	0.2	0.0
NHBO	16.7	10.9	130.8	5.3	1.5	-0.2	0.0	0.5	0.1	0.0
Grand Total	**18.0**	**9.9**	**177.5**	**6.5**	**1.7**	**-0.4**	**0.0**	**-0.6**	**0.1**	**0.0**

8.3 Highway Assignment Outputs

The HAM model convergence for Lens 2 is summarized in Table 8-5 presenting the gap statistics and percentage of links passing the flow criteria for the last four loops. The highway assignment model has converged for all peaks except for the AM peak. The flow criteria in AM peak is 98.9% just below the required criteria of 99% and the demand model has converged with in the set criteria. Hence the AM peak assignments are considered acceptable.

Table 8-5 – Lens 2 SATURN Highway Assignment Convergence Summary

Scenario	Time Period	Number of iterations	%Flow	%Delay	%GAP
Lens 2	AM Peak	97	99.0	99.2	0.0250
		98	98.9	99.2	0.0280
		99	99.1	99.3	0.0270
		100	98.9	99.2	0.0220
	Inter Peak	33	99.4	99.8	0.0130
		34	99.2	99.7	0.0100
		35	99.4	99.8	0.0110
		36	99.3	99.8	0.0097
	PM Peak	88	99.2	99.3	0.0320
		89	99.0	99.3	0.0290
		90	99.2	99.2	0.0320
		91	99.2	99.4	0.0270

8.3.1 Overall Network Statistics

Table 8-6 below presents the network statistics for Lens 2 and DM for all time periods. There is no significant change between Lens 2 and DM across the peaks with changes of only ±1%.

Table 8-6 – Lens 2 Overall highway network statistics (whole UK model)

Time Period	Scenario	DM	Lens 2	% Diff with DM
AM Peak	Matrix Totals (pcu/hr)	220,067	222,824	1.3%
	Total Travel Times (pcu-hrs)	141,630	142,885	0.9%
	Travel Distance (pcu - kms)	7,894,026	7,917,036	0.3%
	Average Speed (km/h)	55.70	55.40	-0.5%
	Total Delay / Vehicle (mins/pcu)	8.55	8.64	1.0%
	Average Trip Length (pcu.km)	35.87	35.53	-0.9%
Inter Peak	Matrix Totals (pcu/hr)	182,604	184,818	1.2%
	Total Travel Times (pcu-hrs)	100,984	101,562	0.6%
	Travel Distance (pcu-kms)	6,716,937	6,732,260	0.2%
	Average Speed (km/h)	66.50	66.30	-0.3%
	Total Delay / Vehicle (mins/pcu)	3.83	3.86	0.8%
	Average Trip Length (pcu.km)	36.78	36.43	-1.0%
PM Peak	Matrix Totals (pcu/hr)	219,676	222,465	1.3%
	Total Travel Times (pcu-hrs)	139,850	141,154	0.9%
	Travel Distance (pcu-kms)	7,829,401	7,849,137	0.3%
	Average Speed (km/h)	56.00	55.60	-0.7%
	Total Delay / Vehicle (mins/pcu)	8.50	8.62	1.3%
	Average Trip Length (pcu.km)	35.64	35.28	-1.0%

8.3.2 Impact on Network

Figure 8-4 and Figure 8-5 presents the flow and delay difference respectively between Lens 2 and DM in AM Peak, Figure 8-6 and Figure 8-7 presents the same for PM peak. These differences are primarily a result of increased land utilization in the area. An increase in flow is observed along the corridors and roads adjacent to developments in the Pucklechurch & Chipping Sodbury sector, specifically along A4174, Westerleigh Road, High Street, and Shortwood Hill. In the Pilning and Severn Beach sector, an increase in flow is also observed along Blackhorse Hill from the developments at Swanmoor and Easter Compton and dissipating into neighbouring areas. Furthermore, the developments on either side of the Almondsbury junction contribute to increases in flow in the Patchway and Bradley Stoke area. No significant increase in delays from DM is observed on the network due to the additional developments with the exception of two minute increase in delay on a zone connector onto A4174 station road at Filton Abbey Wood station in PM peak.

Flow and delay difference plots for Lens 2 focussed on key SRN junctions M4/M5 and M4/M32 are presented from Appendix G.13 to Appendix G.20.

Figure 8-4 – Lens 2 vs DM Highway Flow difference AM peak

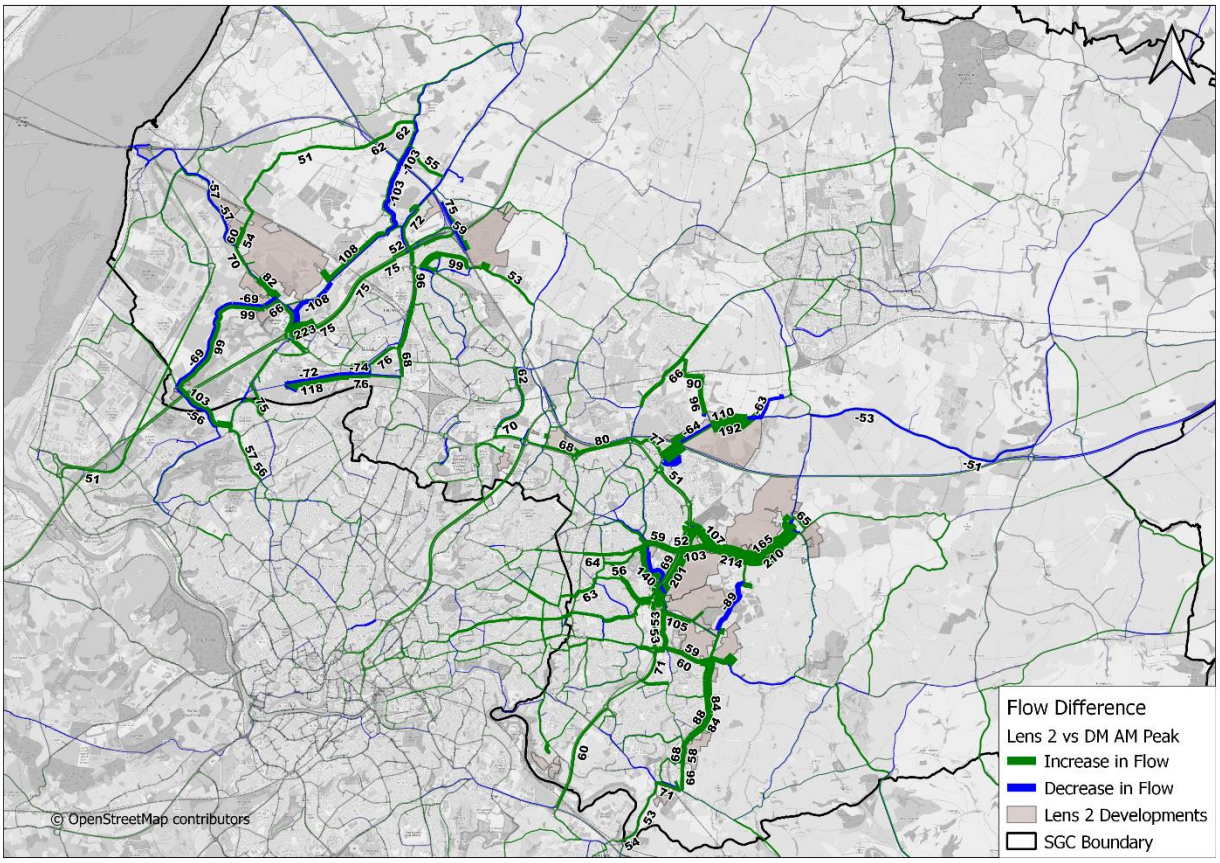


Figure 8-5 – Lens 2 vs DM Highway Delay difference AM peak

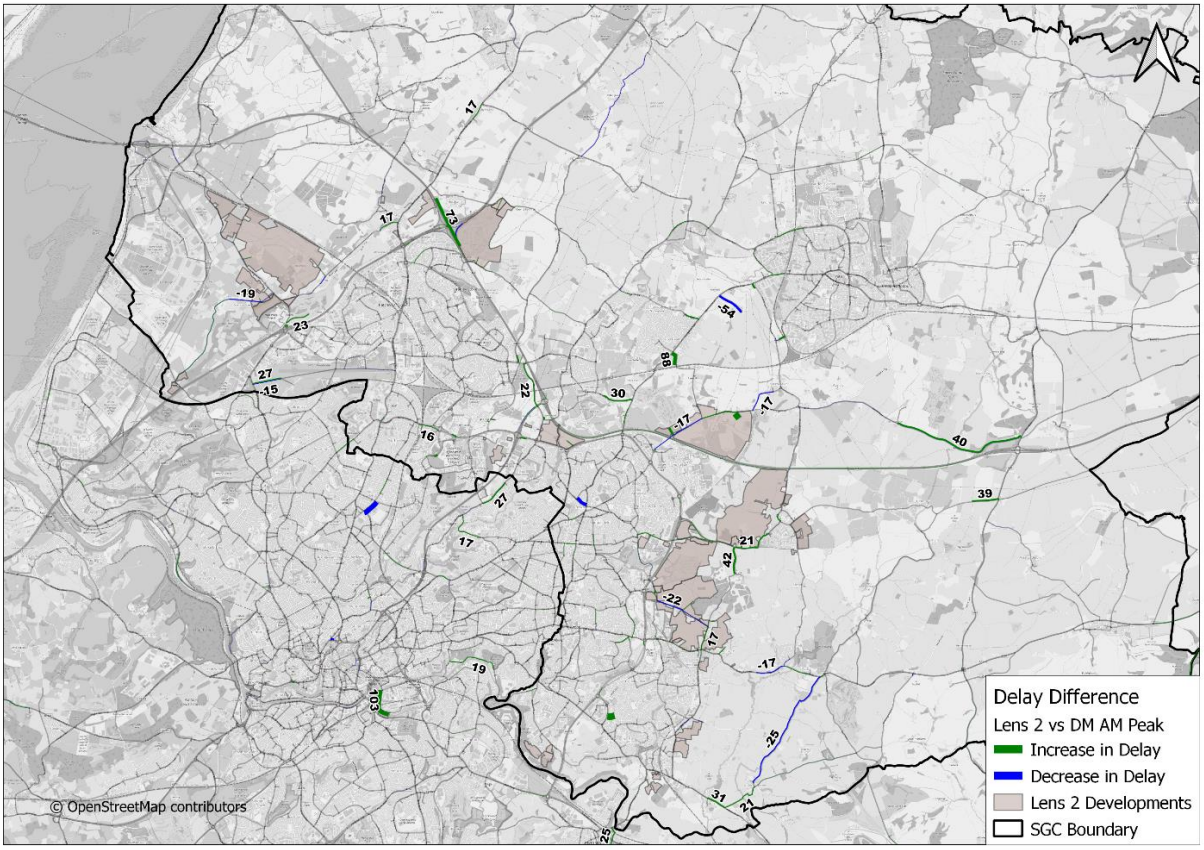


Figure 8-6 – Lens 2 vs DM Highway Flow difference PM peak

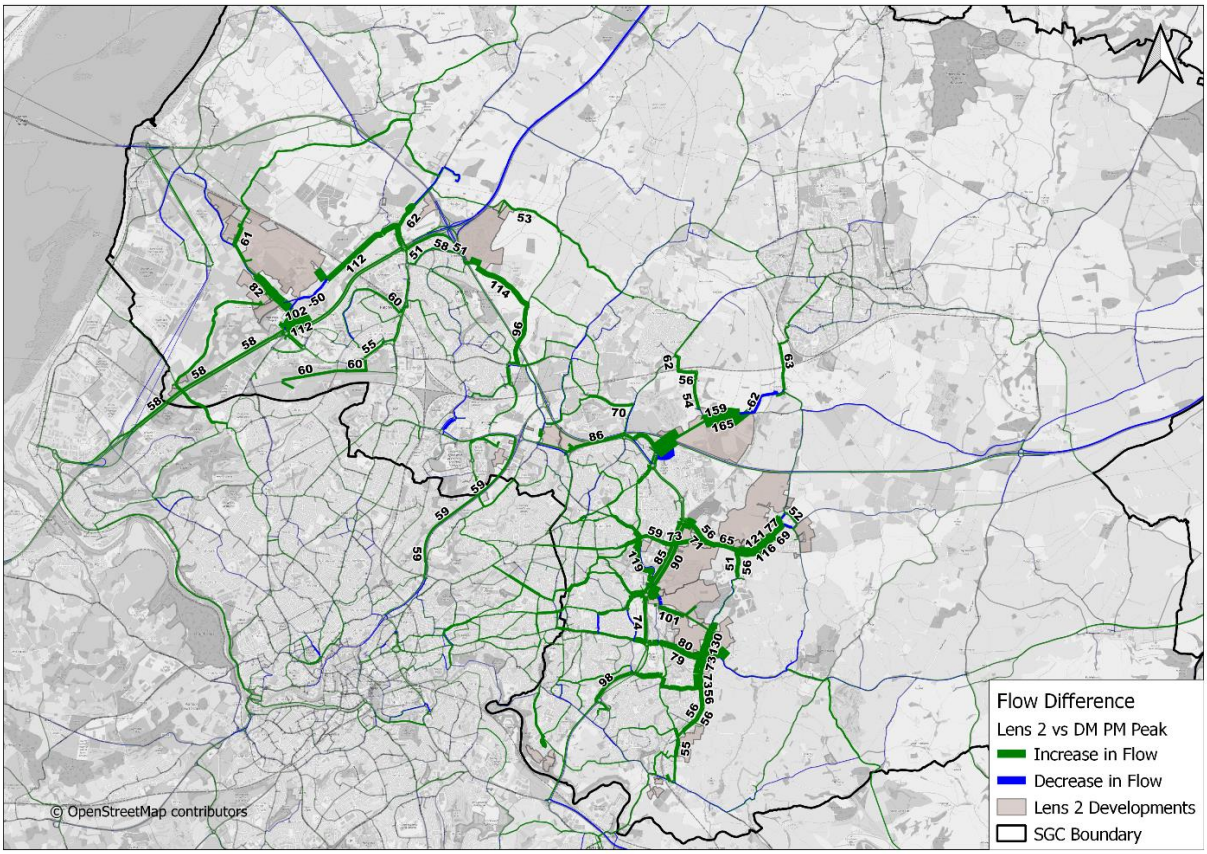
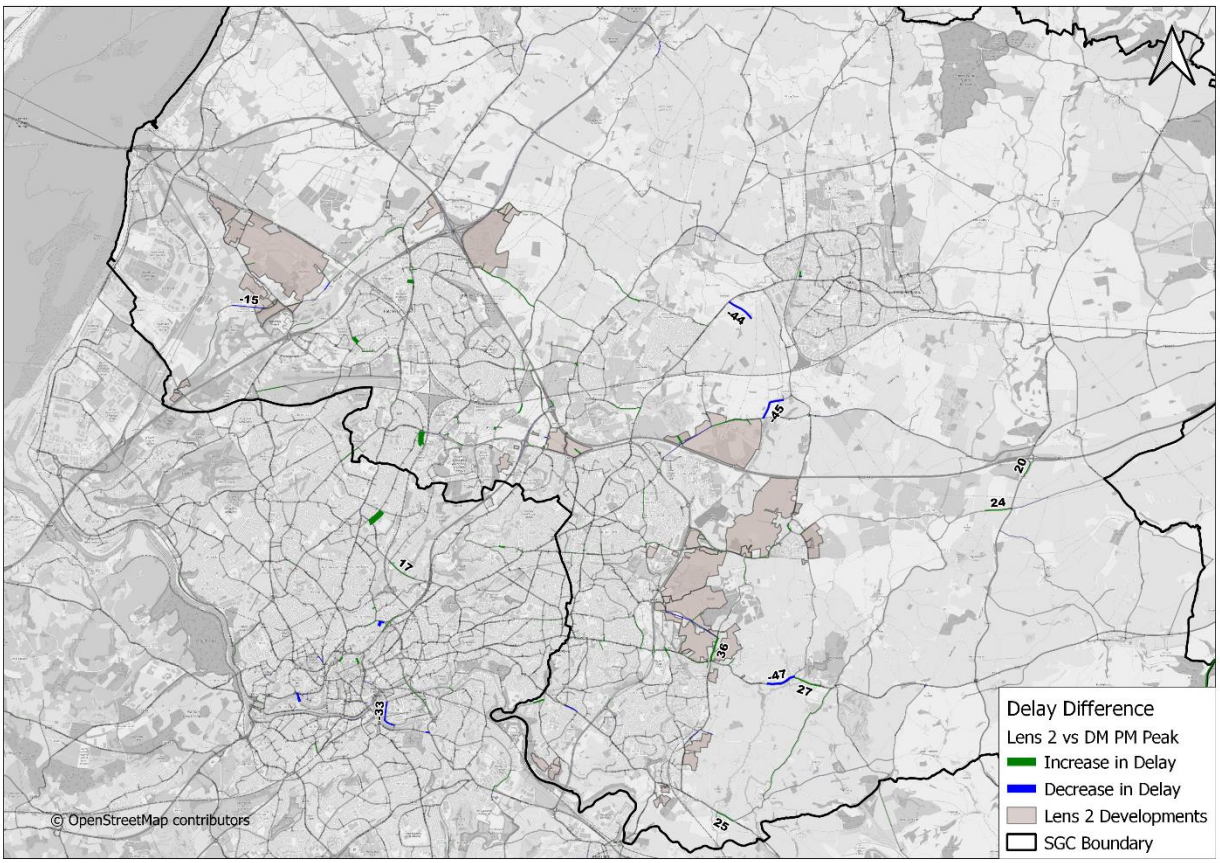


Figure 8-7 – Lens 2 vs DM Highway Delay difference PM peak

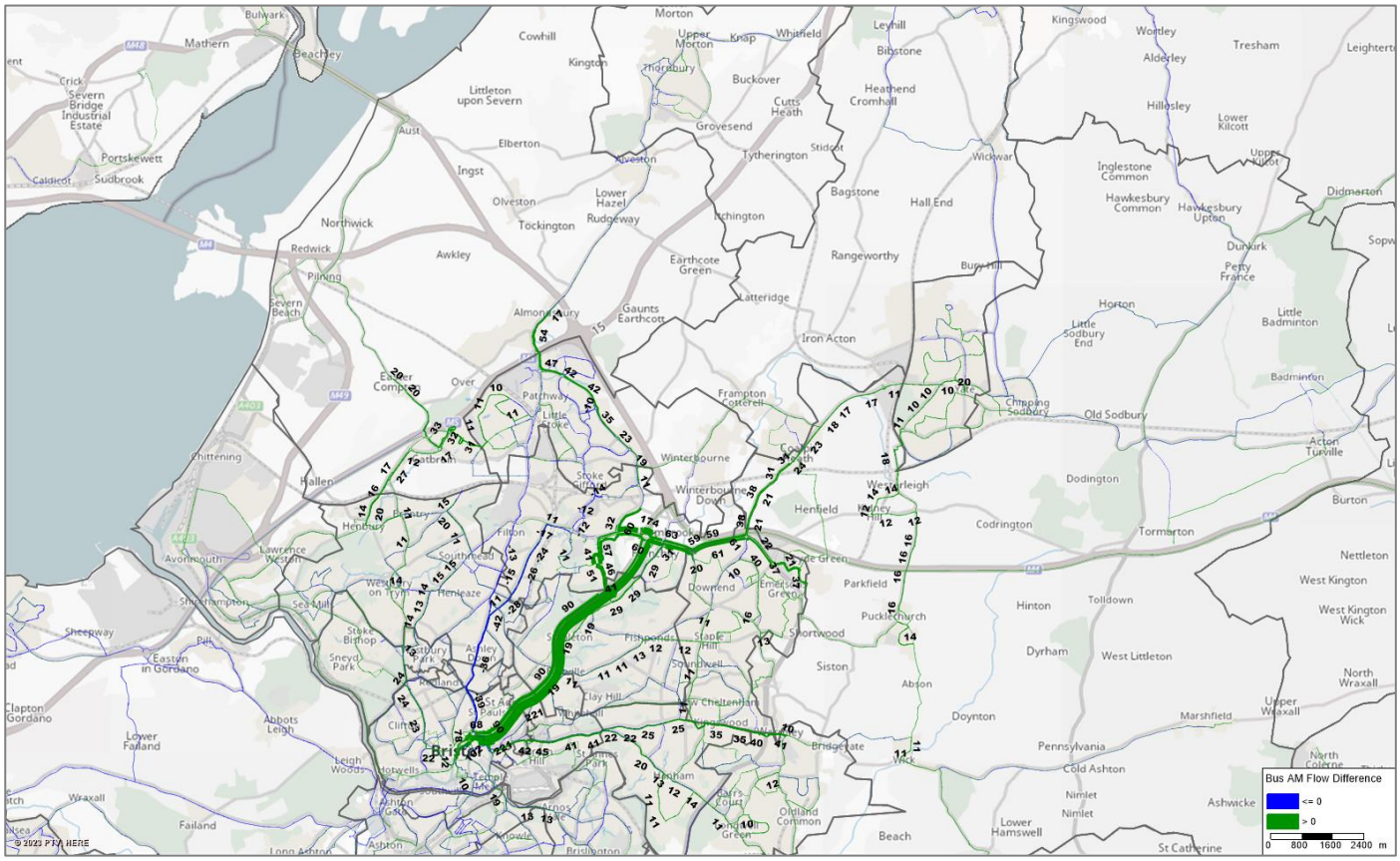


8.4 PT Assignment Outputs

8.4.1 Bus patronage changes

Bus patronage difference between the Lens 2 and DM for AM peak is presented in Figure 8-8. There is an increase on the A4174 between the University of West of England and Emersons Green, A432 from Yate and A38 from Almondsbury. These increases are attributed to the new developments near Shortwood, Easter Compton and Almondsbury, and Westerleigh. There is an increase in flows on the A420 and A431 towards Bristol from Warmley and Longwell Green, and on the B4465 from Pucklechurch to Yate resulting from the new developments in Lens 2. Similar trends are seen in the PM peak as shown in Appendix 10.2F.3.1F.3.1 with the directionality reversed as the trips return in the PM peak.

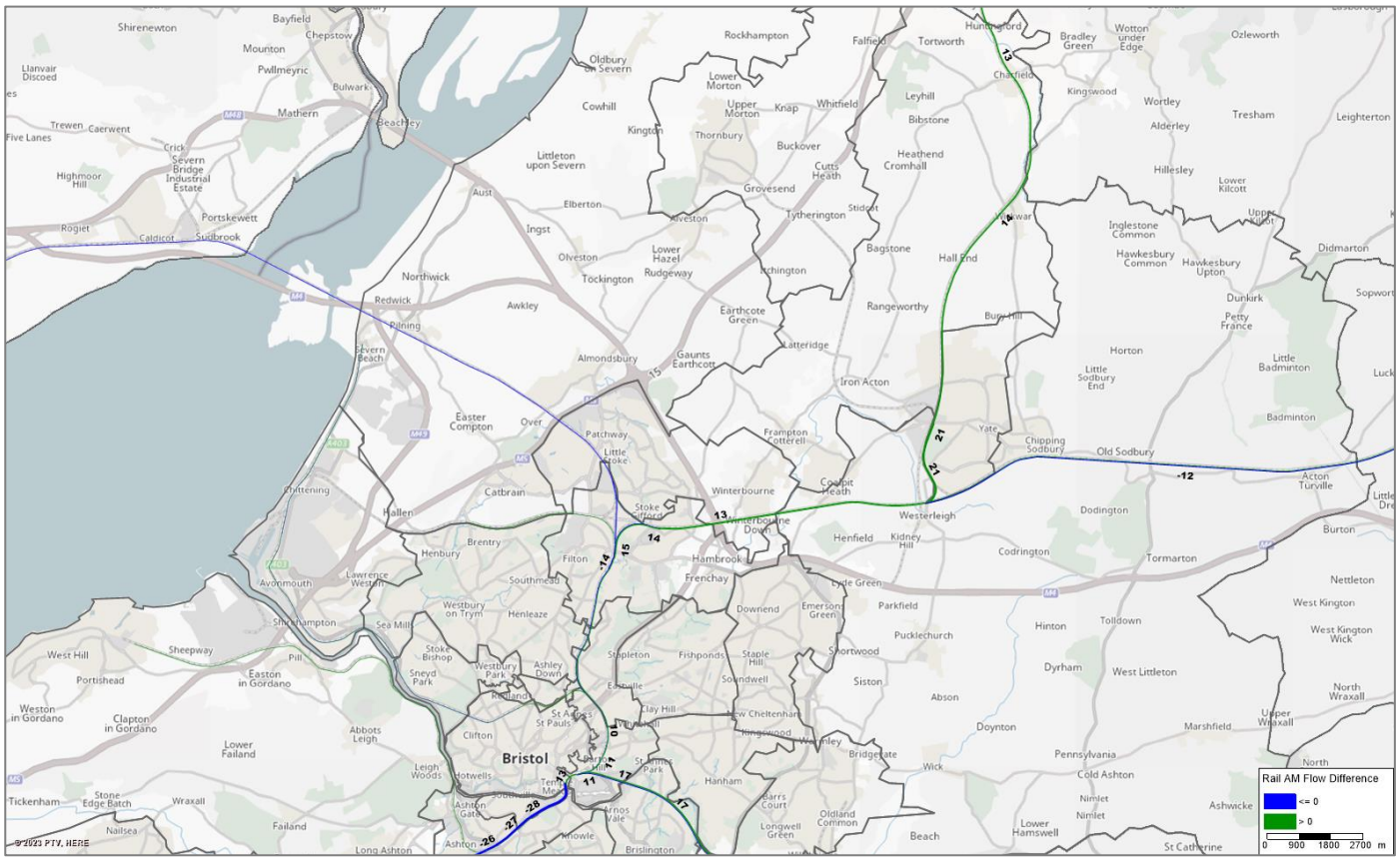
Figure 8-8 - Bus AM Flow Difference (persons) – Lens 2 vs DM



8.4.2 Rail Patronage changes

Rail patronage difference between the Lens 2 and DM for AM peak is presented in Figure 8-9 and Appendix F.3.2 presents the same for PM peak. Rail flow differences are very minimal owing to the location of new developments on the urban edge, and the increase in trips are via Car, Bus or Active travel modes with only 0.4% of increase in Rail trips.

Figure 8-9 - Rail AM Flow Difference (persons) – Lens 2 vs DM



9. Lens 3 - Transport Corridors

9.1 Introduction

Figure 9-1 below presents the location of developments under Transport Corridors also referred to as Lens 3. Appendix D.3 presents the list of developments at site level.

Figure 9-1 – Lens 3 Development Locations

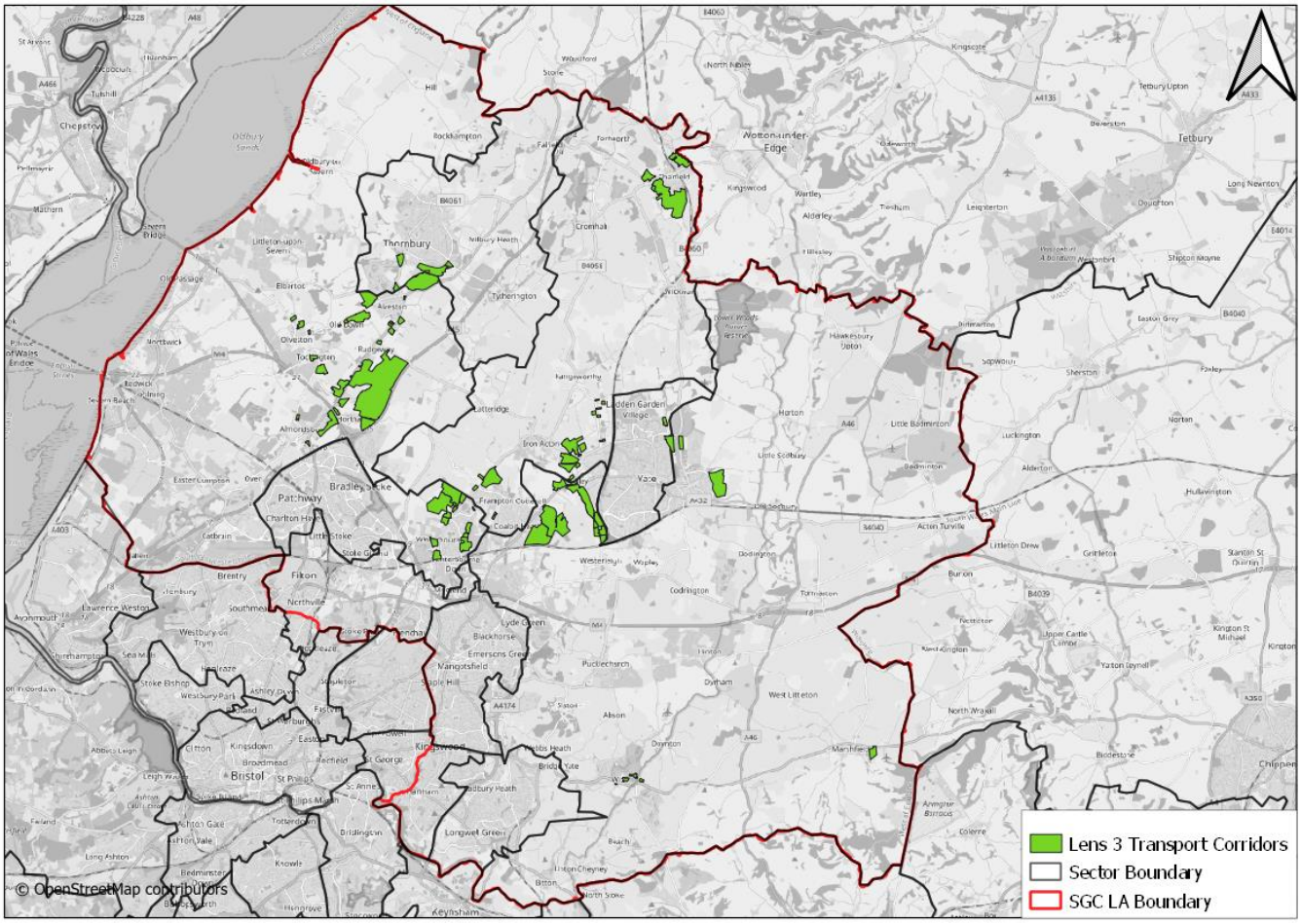


Table 9-1 presents the number of dwellings and jobs resulting from the above developments along with the sector wise percentages contributing to the total. Growth in housing is higher than the number of jobs which will result in higher out-commuting i.e., more people travelling outside study area for work.

Table 9-1 - Housing and Jobs in Lens 3

Sector	Dwellings	Jobs	% of Dwellings	% of Jobs
Pilning, Severn Beach and Woodhouse Down	3,353	1,939	27.8%	24.9%
Patchway	1,642	1,747	13.6%	22.4%
Thornbury	335	139	2.8%	1.8%
Iron Acton & Charfield	2,972	1,538	24.6%	19.7%
Yate	175	73	1.5%	0.9%
Pucklechurch & Chipping Sodbury	3,591	2,353	29.8%	30.2%
SGC Total	**12,068**	**7,790**	**100%**	**100%**

9.2 Demand Model outputs

9.2.1 Model Convergence

The Lens 3 model have converged with an overall gap value of value of 0.194 in eleven iterations, which is within the convergence GAP target of 0.2% as per TAG Unit M2.1. The outputs from the converged loops are used for reporting the results in the subsequent sections.

9.2.2 Demand Matrices

9.2.2.1 Change in trips by purpose

trips are happening via Car followed by Walk and PT. All purposes have seen a rise in trips. Walk and Cycle has an increase of 4.8% and 4.3% respectively attributed to the active travel schemes along the A38 corridor, Alveston Hill, Grovesend Road and Yate Spur with access to new developments.

Table 9-2 below presents the final forecast demand for Lens 3 at the 24-hour production / attraction level by mode and purpose across all the movements impacted by growth in SGC. There is an increase of approximately 5% in total trips across modes and purposes from DM to Lens 3 resulting from the new developments. The majority of the new trips are happening via Car followed by Walk and PT. All purposes have seen a rise in trips. Walk and Cycle has an increase of 4.8% and 4.3% respectively attributed to the active travel schemes along the A38 corridor, Alveston Hill, Grovesend Road and Yate Spur with access to new developments.

Table 9-2 – Lens 3 24 hr P/A Trips by Purpose by Mode and comparison to DM

Purpose	Lens 3: 24hr P/A Trips					Abs Diff to DM					Percentage Diff to DM				
	Car	PT	Walk	Cycle	Total	Car	PT	Walk	Cycle	Total	Car	PT	Walk	Cycle	Total
HBW	125,320	13,069	9,428	5,201	153,018	5,903	612	528	214	7,256	4.9%	4.9%	5.9%	4.3%	5.0%
HBEB	20,979	2,187	650	298	24,113	1,198	109	53	15	1,376	6.1%	5.3%	8.9%	5.5%	6.1%
HBEd	48,478	12,113	26,826	3,037	90,455	3,222	358	1,548	163	5,291	7.1%	3.0%	6.1%	5.7%	6.2%
HBShopPB	163,525	20,027	25,135	3,711	212,398	7,993	606	955	121	9,675	5.1%	3.1%	3.9%	3.4%	4.8%
HBRecVFR	139,111	12,701	13,545	1,306	166,663	9,115	329	588	42	10,074	7.0%	2.7%	4.5%	3.3%	6.4%
NHBEB	24,818	599	1,054	70	26,541	1,055	14	30	2	1,101	4.4%	2.4%	2.9%	2.4%	4.3%
NHBO	134,793	5,234	19,738	73	159,839	6,284	149	694	2	7,129	4.9%	2.9%	3.6%	2.7%	4.7%
Total	**657,024**	**65,929**	**96,376**	**13,697**	**833,026**	**34,770**	**2,177**	**4,395**	**559**	**41,902**	**5.6%**	**3.4%**	**4.8%**	**4.3%**	**5.3%**

9.2.3 Mode Shares

9.2.3.1 Mode Shares by Purpose

Table 9-3 below presents the mode shares by purpose for Lens 3 and comparison with DM. Despite the changes being relatively minor, there is an increase in overall car mode share, accompanied by reduction in PT and Walk.

Table 9-3 – Lens 3 Mode Shares by Purpose and comparison to DM

Purpose	Lens 3: 24hr P/A Trips				Mode Share				Change in Mode Share			
	Car	PT	Walk	Cycle	Car	PT	Walk	Cycle	Car	PT	Walk	Cycle
HBW	125,320	13,069	9,428	5,201	81.9%	8.5%	6.2%	3.4%	0.0%	0.0%	0.1%	0.0%
HBEB	20,979	2,187	650	298	87.0%	9.1%	2.7%	1.2%	0.0%	-0.1%	0.1%	0.0%
HBEd	48,478	12,113	26,826	3,037	53.6%	13.4%	29.7%	3.4%	0.5%	-0.4%	0.0%	0.0%
HBShopPB	163,525	20,027	25,135	3,711	77.0%	9.4%	11.8%	1.7%	0.3%	-0.2%	-0.1%	0.0%
HBRecVFR	139,111	12,701	13,545	1,306	83.5%	7.6%	8.1%	0.8%	0.5%	-0.3%	-0.1%	0.0%
NHBEB	24,818	599	1,054	70	93.5%	2.3%	4.0%	0.3%	0.1%	0.0%	-0.1%	0.0%
NHBO	134,793	5,234	19,738	73	84.3%	3.3%	12.3%	0.0%	0.2%	-0.1%	-0.1%	0.0%
Total	**657,024**	**65,929**	**96,376**	**13,697**	**78.9%**	**7.9%**	**11.6%**	**1.6%**	**0.2%**	**-0.1%**	**-0.1%**	**0.0%**

9.2.3.2 Mode Shares by Sector

Figure 9-2 and Figure 9-3 presents the change in Car mode shares by production and attraction sectors for all purposes between Lens 3 and DM. Thornbury, Charfield and Yate sectors have a decrease in Car shares with shift to Walk. Pilning and Severn Beach sector has seen an increase in car shares for all purposes. A decrease in car trips is observed between Yate and Filton resulting in the decrease of car mode shares of the respective sectors.

Figure 9-2 – Difference between Lens 3 and DM for Car Mode Shares - Productions, All Purposes

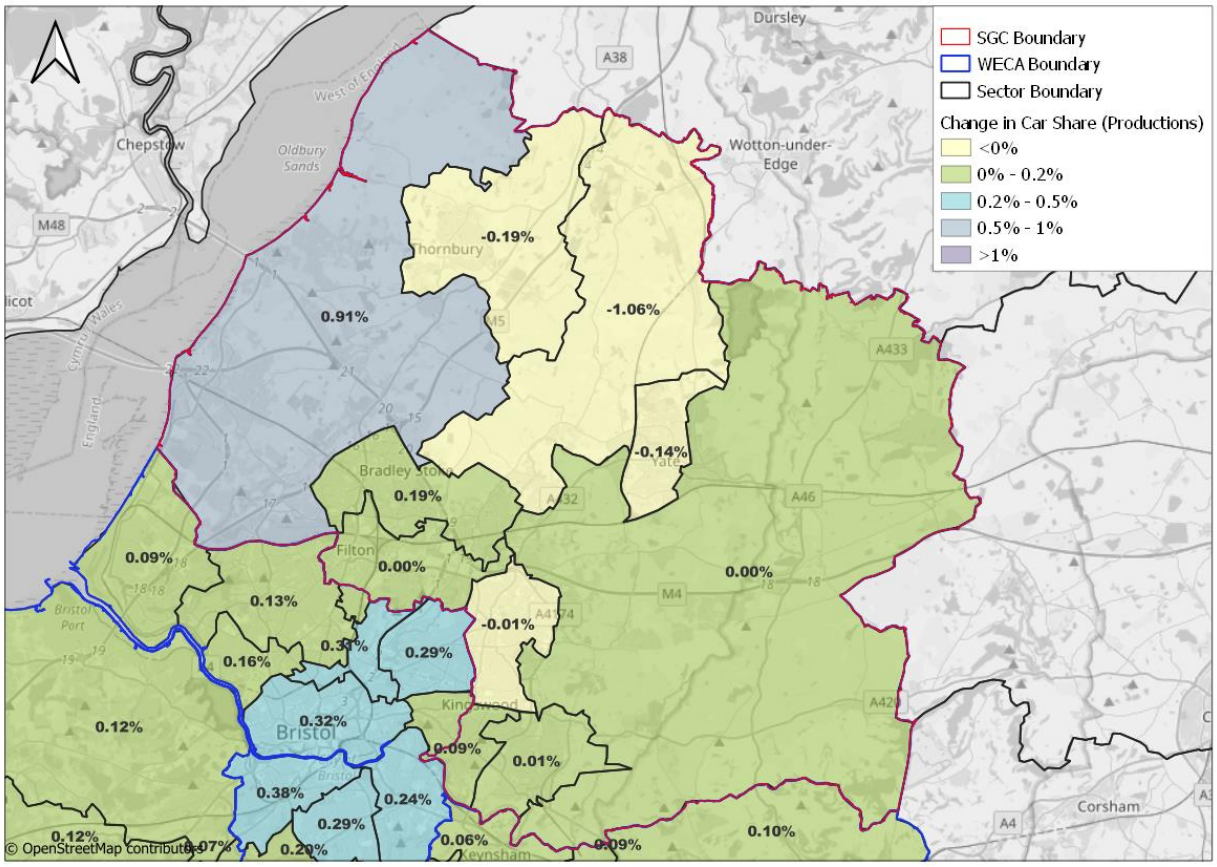
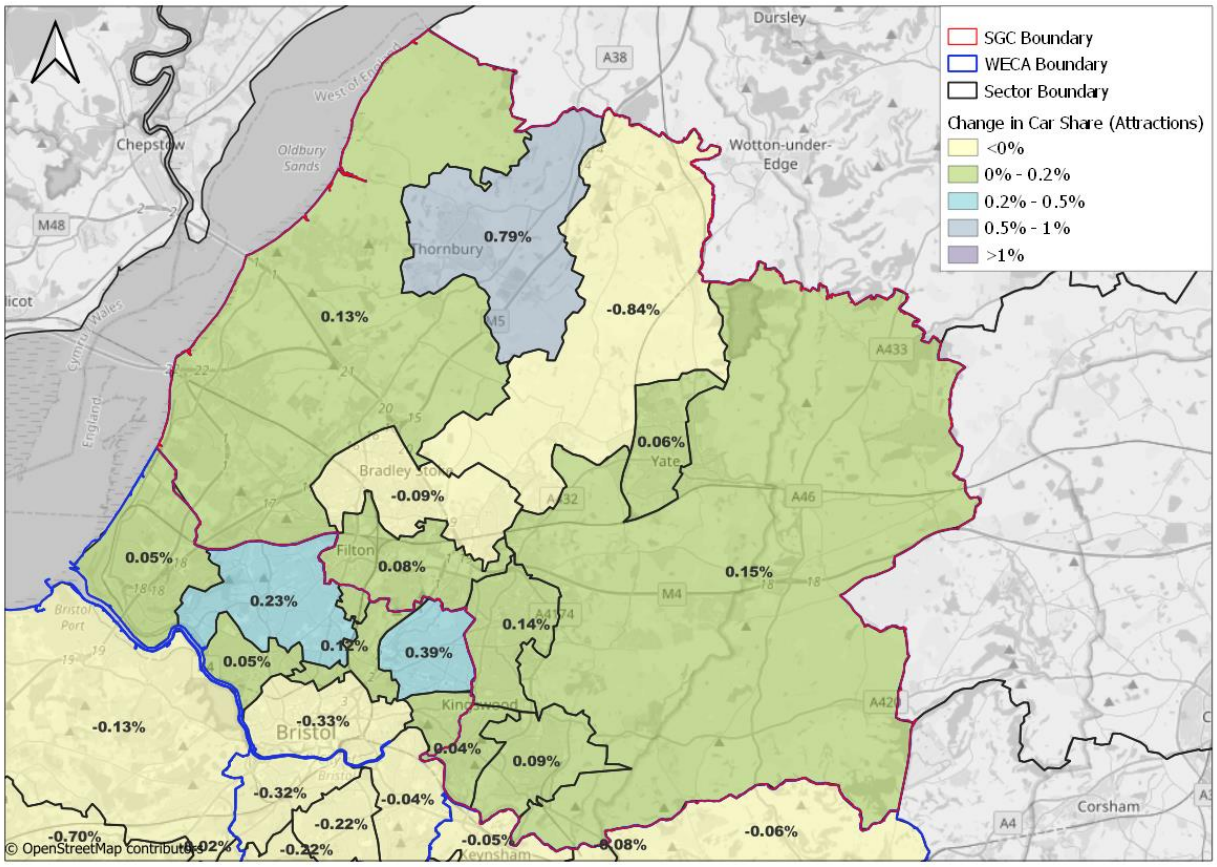


Figure 9-3 - Difference between Lens 3 and DM for Car Mode Shares - Attractions, All Purposes



9.2.4 Trip Lengths

Average trip lengths in Lens 3 and comparison with DM is presented in Table 9-4. Average trip lengths by Car and Rail have decreased for all purposes suggesting an increase in short distance trips, Walk and Cycle trip lengths have remained stable.

Table 9-4 – Lens 3 Average Trip Length by Purpose by Mode, Comparison to DM

Purpose	Lens 3 Average Trip Lengths					Absolute Diff to DM				
	Car	Bus	Rail	Cycle	Walk	Car	Bus	Rail	Cycle	Walk
HBW	21.7	9.7	168.0	8.0	1.8	-0.2	0.2	-0.9	0.0	0.0
HBEB	22.1	6.9	85.2	4.9	0.9	-0.3	0.1	-1.8	-0.1	0.0
HBEd	6.7	10.4	15.8	4.1	1.7	-0.1	-0.1	0.0	0.0	0.0
HBShopPB	19.3	10.0	183.6	5.7	1.5	-0.4	0.1	-2.2	0.0	0.0
HBRecVFR	18.9	9.2	190.2	7.2	2.1	-0.1	0.0	-3.1	-0.1	0.0
NHBEB	17.8	8.9	125.5	5.8	0.8	-0.1	0.0	-1.0	0.0	0.0
NHBO	16.8	11.0	128.4	5.1	1.5	0.0	0.1	-1.8	0.0	0.0
Grand Total	18.3	10.0	175.9	6.4	1.6	**-0.2**	**0.0**	**-2.1**	**0.0**	**0.0**

9.3 Highway Assignment Outputs

The HAM model convergence for Lens 3 is summarized in Table 9-5 presenting the gap statistics and percentage of links passing the flow criteria for the last four loops. The highway assignment model has converged for all peaks except for the PM peak similar to Lens 1. The flow criteria in PM peak is 98.9% just below the required criteria of 99% and the demand model has converged with in the set criteria. Hence the PM peak assignments are considered acceptable.

Table 9-5 – Lens 3 SATURN Highway Assignment Convergence Summary

Scenario	Time Period	Number of iterations	%Flow	%Delay	%GAP
Lens 3	AM Peak	71	98.7	99.1	0.0240
		72	99.1	99.3	0.0230
		73	99.3	99.3	0.0240
		74	99.4	99.5	0.0300
	Inter Peak	34	99.2	99.7	0.0130
		35	99.1	99.7	0.0098
		36	99.3	99.7	0.0130
		37	99.2	99.7	0.0093
	PM Peak	97	98.9	99.2	0.0300
		98	99.1	99.2	0.0350
		99	99.1	99.3	0.0330
		100	98.9	99.3	0.0300

9.3.1 Overall Network Statistics

Table 9-6 below presents the network statistics for Lens 3 and DM for all time periods. There is no significant change between Lens 3 and DM across the peaks.

Table 9-6 – Lens 3 Overall highway network statistics (whole UK model)

Time Period	Scenario	DM	Lens 3	% Diff with DM
AM Peak	Matrix Totals (pcu/hr)	220,067	222,658	1.2%
	Total Travel Times (pcu-hrs)	141,630	142,740	0.8%
	Travel Distance (pcu-kms)	7,894,026	7,924,697	0.4%
	Average Speed (km/h)	55.70	55.50	-0.4%
	Total Delay / Vehicle (mins/pcu)	8.55	8.57	0.2%
	Average Trip Length (pcu.km)	35.87	35.59	-0.8%
Inter Peak	Matrix Totals (pcu/hr)	182,604	184,616	1.1%
	Total Travel Times (pcu-hrs)	100,984	101,552	0.6%
	Travel Distance (pcu-kms)	6,716,937	6,735,055	0.3%
	Average Speed (km/h)	66.50	66.30	-0.3%
	Total Delay / Vehicle (mins/pcu)	3.83	3.85	0.5%
	Average Trip Length (pcu.km)	36.78	36.48	-0.8%
PM Peak	Matrix Totals (pcu/hr)	219,676	222,131	1.1%
	Total Travel Times (pcu-hrs)	139,850	141,318	1.0%
	Travel Distance (pcu-kms)	7,829,401	7,854,281	0.3%
	Average Speed (km/h)	56.00	55.60	-0.7%
	Total Delay / Vehicle (mins/pcu)	8.50	8.65	1.8%
	Average Trip Length (pcu.km)	35.64	35.36	-0.8%

9.3.2 Impact on Network

Figure 9-4 and Figure 9-5 presents the flow and delay difference respectively between Lens 3 and DM in AM Peak, Figure 9-6 and Figure 9-7 presents the same for PM peak. These differences are primarily a result of increased land utilization in the area. Increase in flow is seen along the local roads like Alveston Road, A38, Tytherington Road/Sidcot lane, B4509, A432. This is observed in all the peaks.

There are increases in delays, although not significant observed across the network on local roads in SGC. Down Road at Winterbourne Down, Church Road, connector on Rose Oak Lane joining onto A432 are exhibiting noticeable delays in AM and PM peaks due to the additional traffic generated from developments at Coalpit Heath and Frampton Cotterell. In PM peak zone connector onto A432 near Yate station have a significant increase in delay due to increased traffic on A432.

Flow and delay difference plots for Lens 3 focussed on key SRN junctions M5J14, M4/M5 and M4/M32 are presented from Appendix G.21 to Appendix G.32.

Figure 9-4 – Lens 3 vs DM Highway Flow difference AM peak

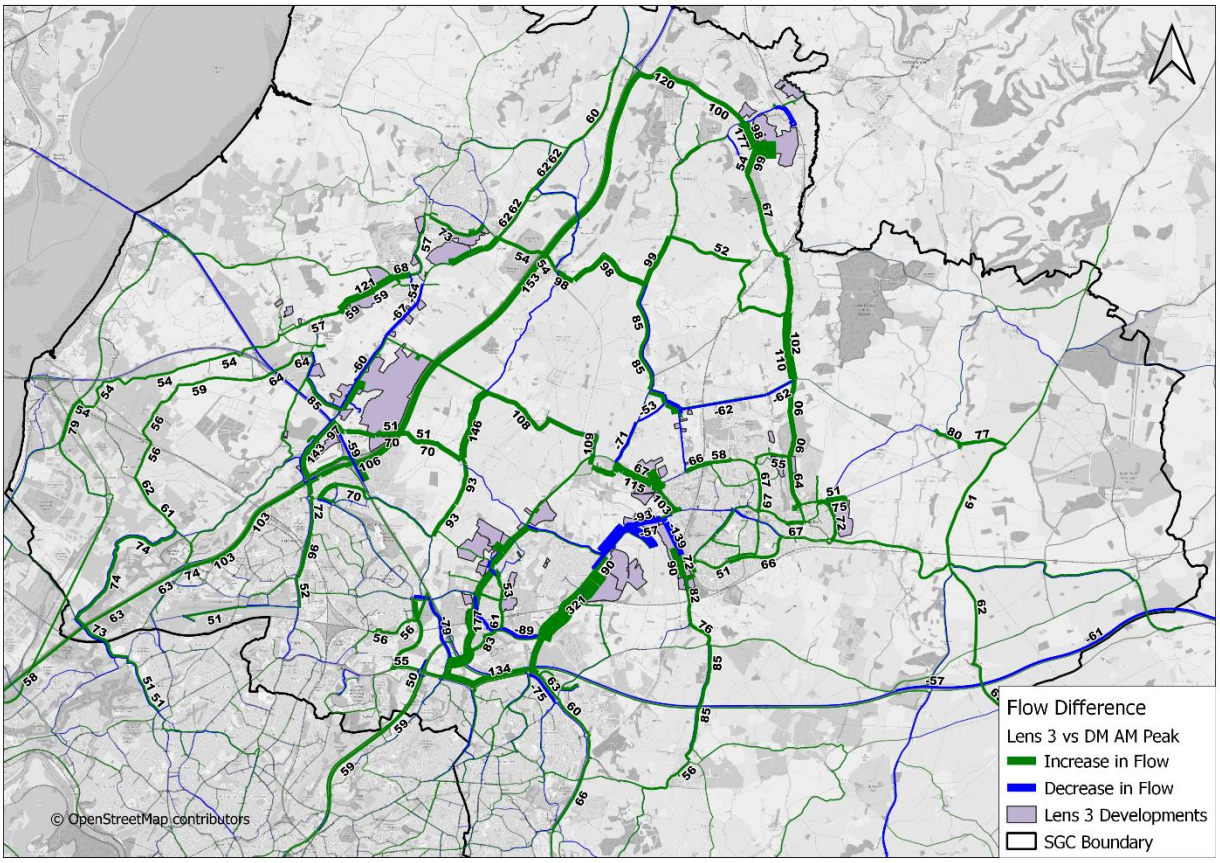


Figure 9-5 – Lens 3 vs DM Highway Delay difference AM peak

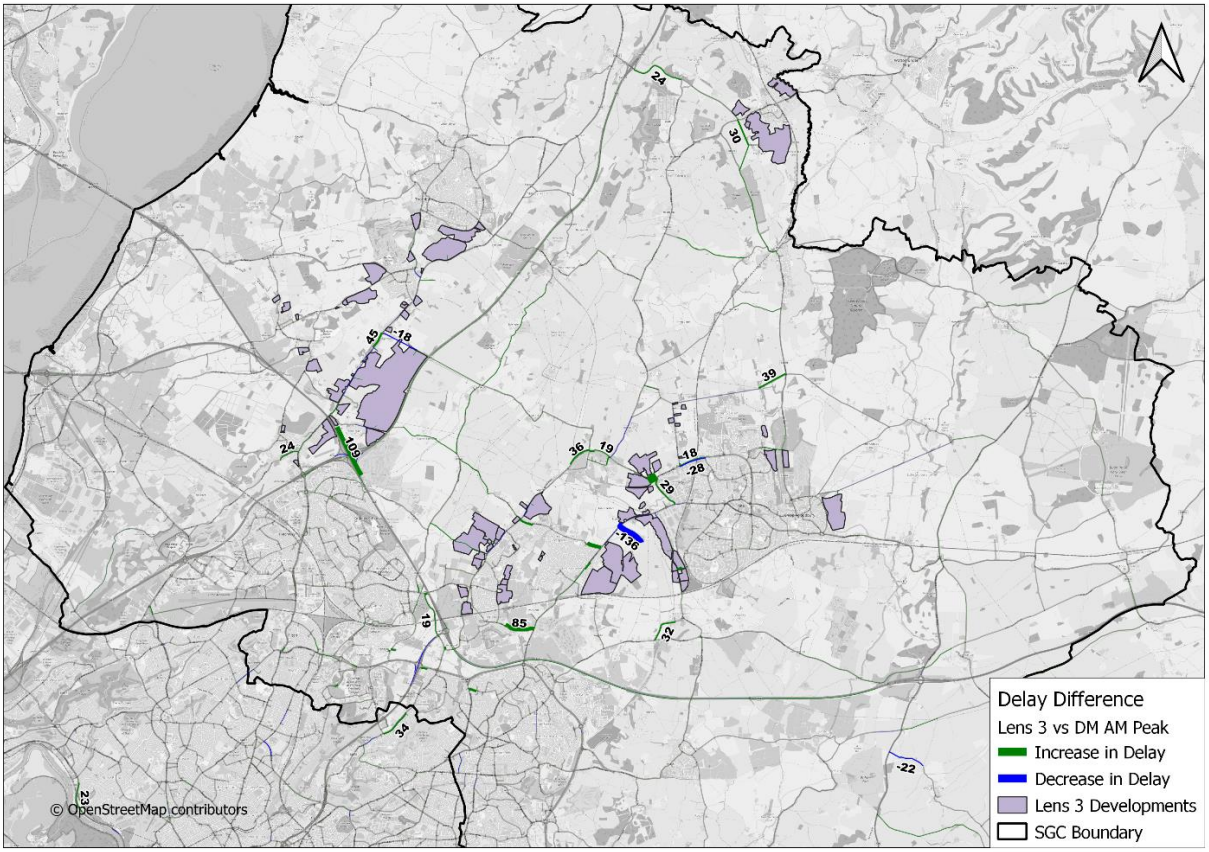


Figure 9-6 – Lens 3 vs DM Highway Flow difference PM peak

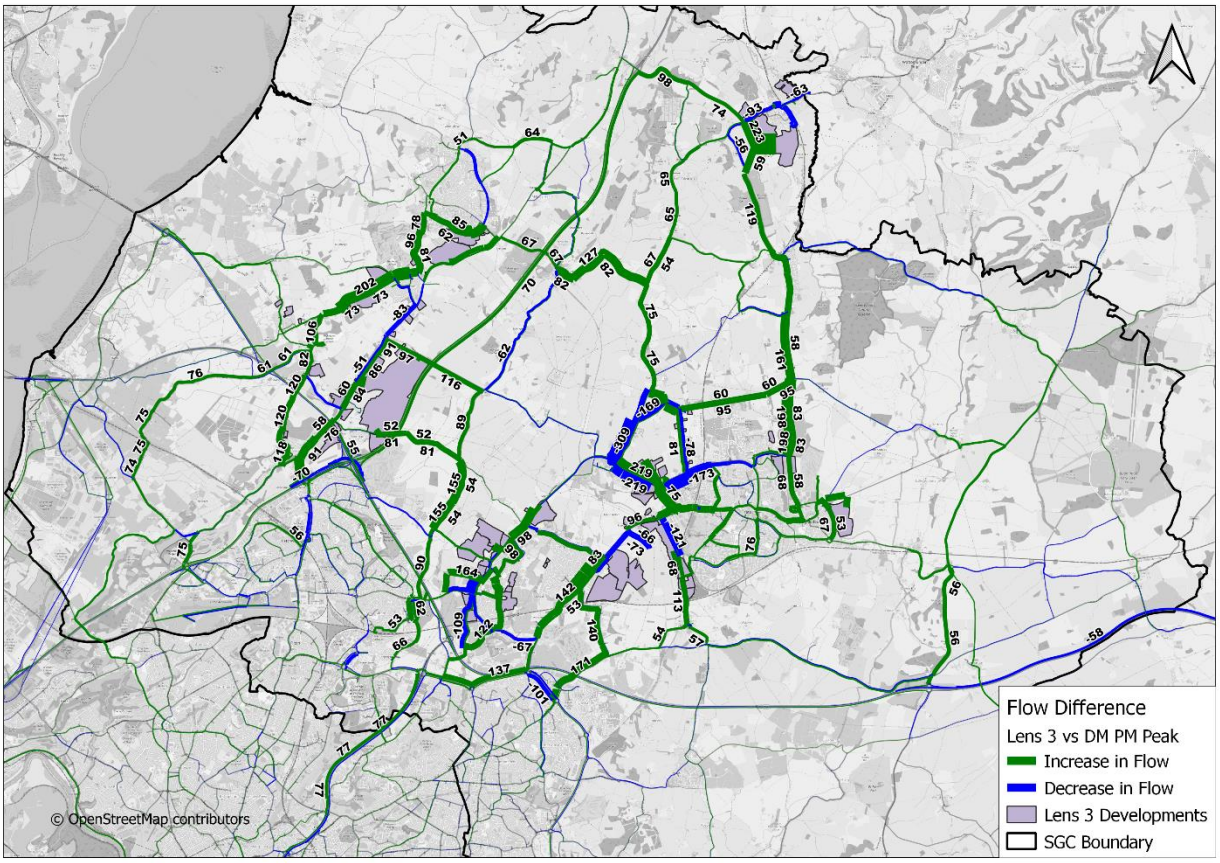
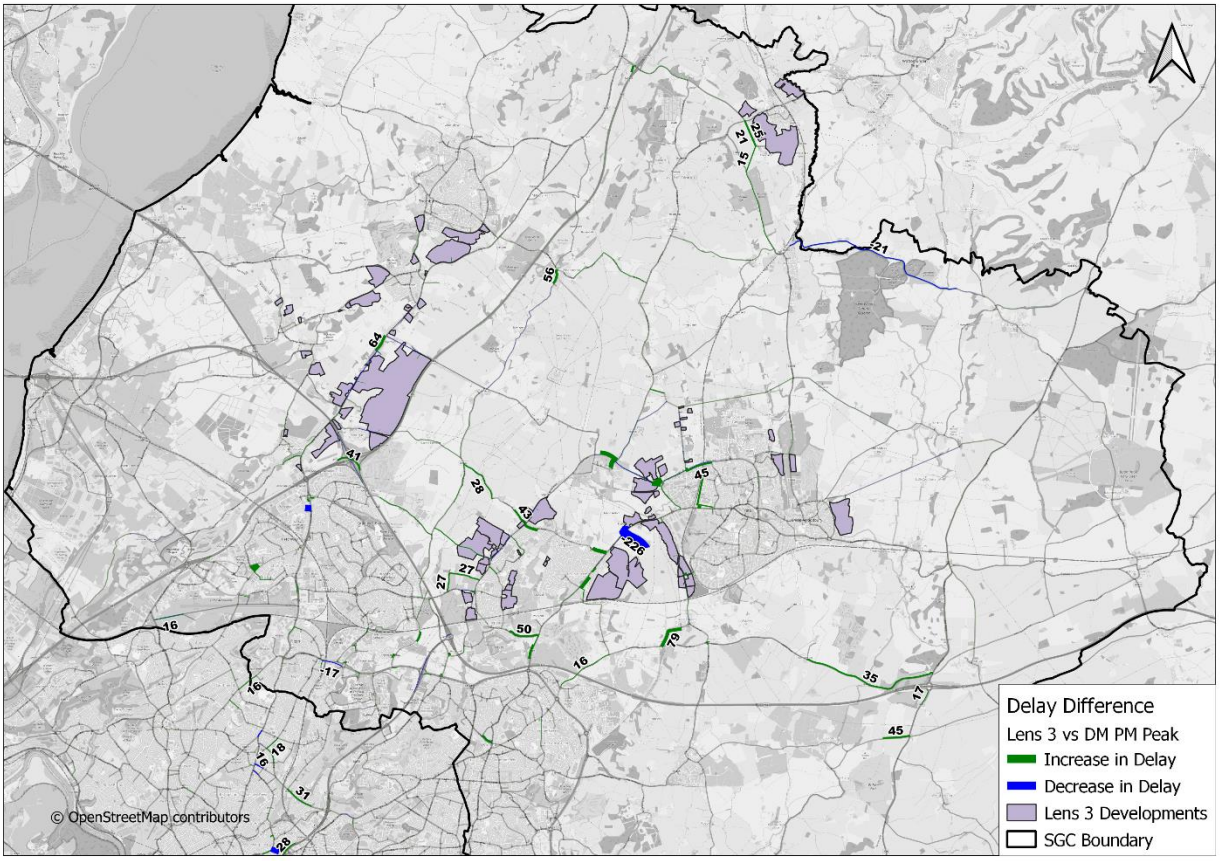


Figure 9-7 – Lens 3 vs DM Highway Delay difference PM peak

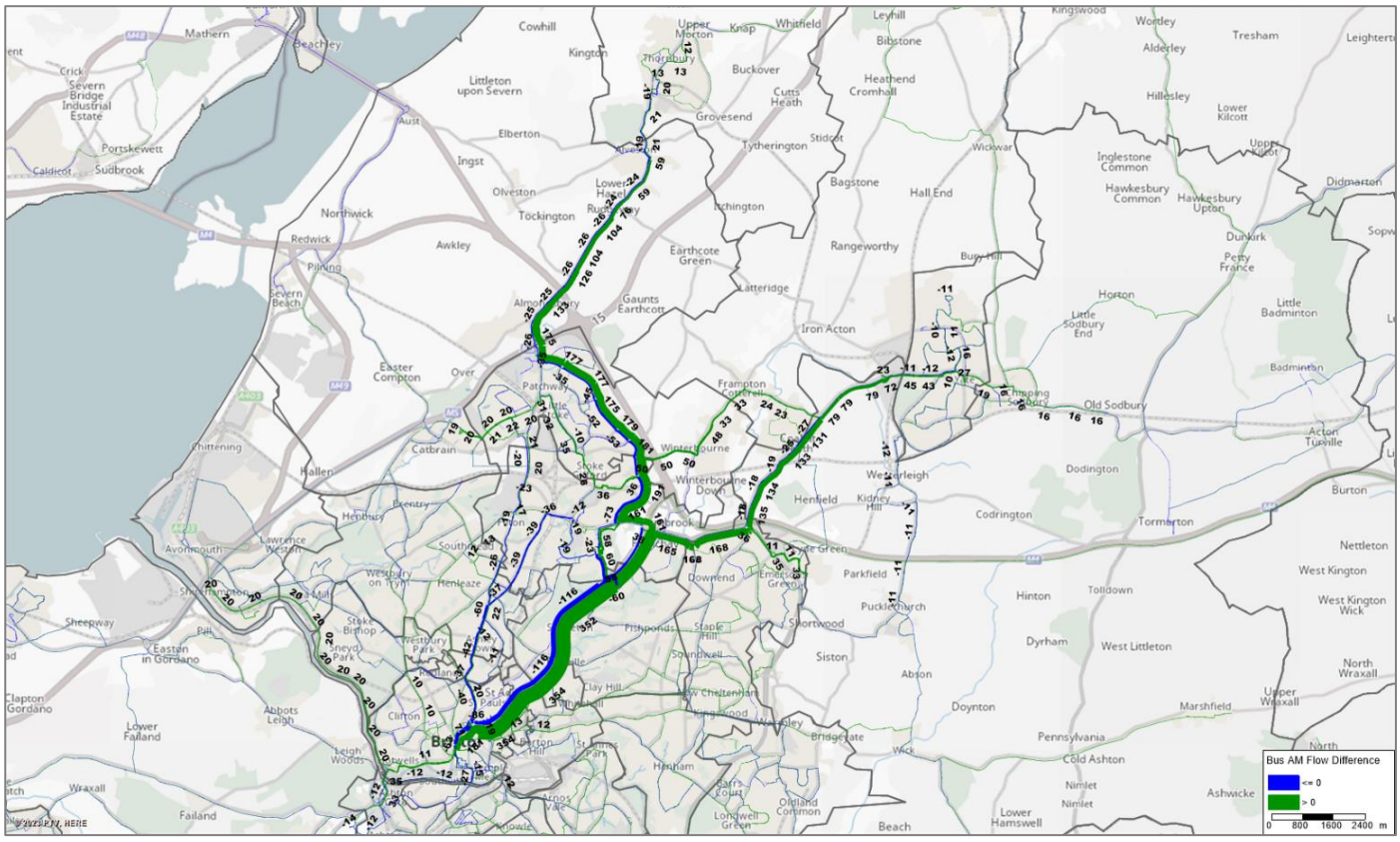


9.4 PT Assignment Outputs

9.4.1 Bus patronage changes

The bus patronage difference between the Lens 3 and DM for the AM peak is presented in Figure 9-8 and F.4.1 presents the flow difference for the PM peak. Flow increase is observed on A38 and A432 Southbound towards Filton and Bristol suggesting an increase in PT patronage due to trips generated from the new developments at Hortham/Almondsbury, Winterbourne and Westerleigh. Home based work and shopping trips are the major contributor for this increase in bus patronage towards Bristol. In the PM peak, the increase is seen in the Northbound direction with trips returning towards Almondsbury/Thornbury and Yate.

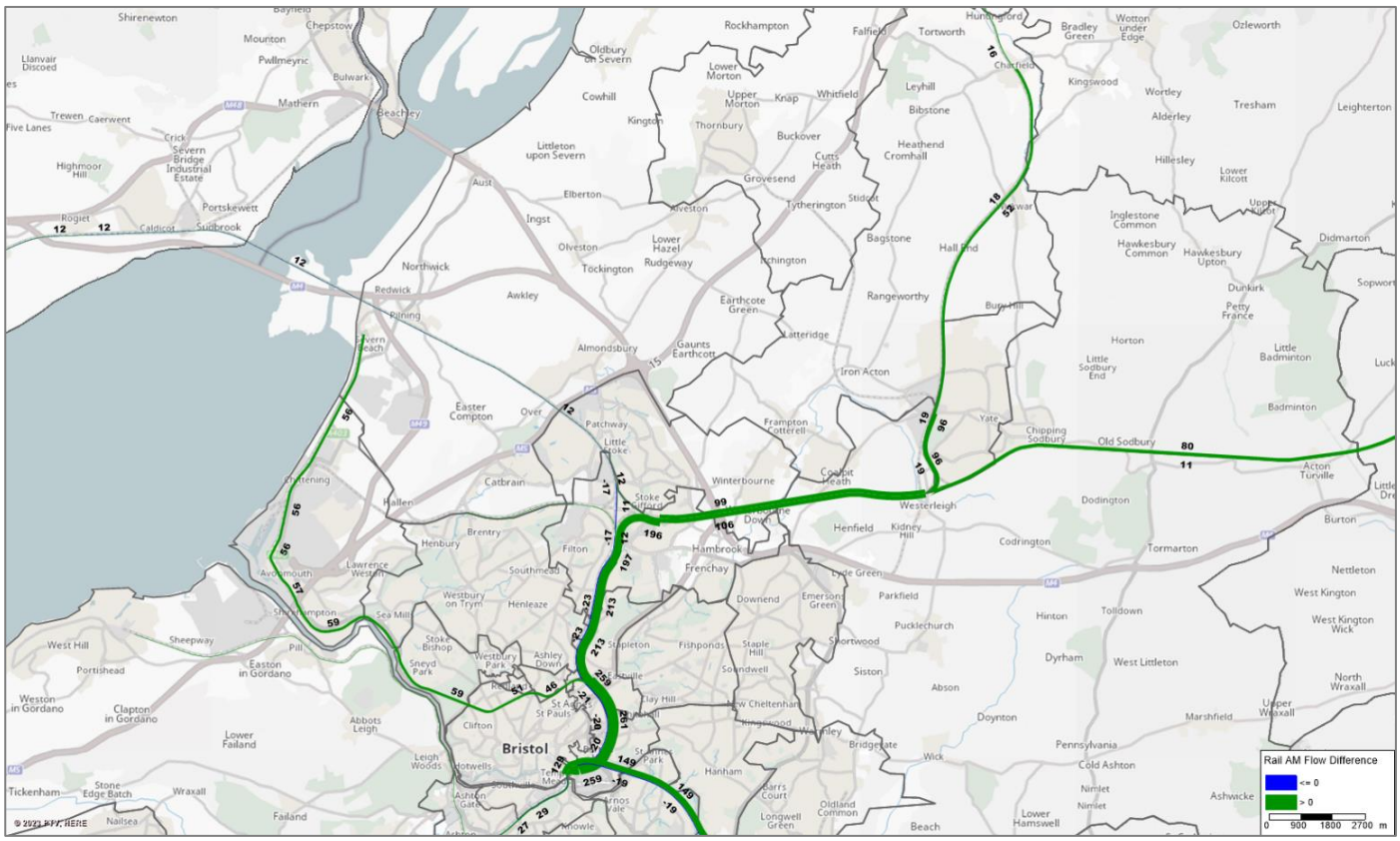
Figure 9-8 - Bus AM Flow Difference (persons) – Lens 3 vs DM



9.4.2 Rail Patronage changes

Rail patronage difference between the Lens 3 and DM is presented in Figure 9-9 and F.4.2 presents the rail flow differences for PM peak. There is a decrease in long distance trips reflecting the trip length reduction shown in Table 9-4 and increase in trips from SGC to Bristol for the home based work category. An increase in flow from Charfield and Yate is observed towards Filton and Bristol in the AM peak resulting from the new developments at Charfield and surrounding Yate in Lens 3. The directionality is reversed in the PM peak with increased flow from Bristol to Yate and Charfield. An increase is also observed in trips between Severn Beach and Bristol.

Figure 9-9 - Rail AM Flow Difference (persons) – Lens 3 vs DM



10. Summary

10.1 Summary of Approach and Assumptions

This report has described the process followed in preparing the Do Minimum and the three lens tests for the SGC Local Plan and has outlined the results of those tests. The WERTM model (with a Base Year update to the HAM for SGC) was used for this study and demand and supply changes (derived from a development log) applied as inputs to arrive at a forecast demand. A summary of assumptions during the Do Minimum model development is below:

- WERTM Foundation Case has been used as a building block to develop the local plan forecasts. The growth in South Gloucestershire is derived based on the uncertainty logs supplied by SGC. It is assumed that the developments outside South Gloucestershire remain unchanged from the WERTM FC. Similarly, highway, PT and active travel infrastructure schemes from WERTM are also considered valid for the Local plan testing and schemes from SGC are added additionally. PT routes both bus and rail have been updated to reflect 2023 timetables for services in SGC.

- Growth in housing (dwellings) and jobs (including service jobs) are calculated based on the developments. The HCA Employment Density Guide (2015) was used to calculate the number of jobs. Additional school capacity is added in the forecast year based on the growth in housing development i.e., growth in school age children. These growth numbers are then converted to 24-hour Production/Attraction trip ends with the changes in demographics, car ownership and expected travel behaviour controlled to NTEMv8 trip end projections. Freight traffic has been forecast based on National Road Traffic Forecasts.

Along with the demand and supply assumptions, limitations on the inputs mentioned in section 7.1.3 of WERTM Forecasting Report related to economic, political, social/environmental, technological and availability of information are also still valid and should be monitored regularly for any policy changes during the future application of the model. TAG Databook v1.17 is used for the local plan testing to be consistent with the parent model of WERTM, however latest TAG Databook will be used for modelling the preferred option and during the mitigation phase.

10.2 Summary of Model Outputs

A 2042 Do Minimum model has been developed with demand and supply inputs from the committed developments and schemes, and the model reached an acceptable level of demand-supply convergence, meeting the convergence requirement laid out by TAG. There is an increase in trips from base year due to increased land use and the model predicts an increase in the use of cars in forecast year, which becomes relatively cheaper, more widely available and provide shorter journey times for the majority of trips. Local and strategic network sees an increase in traffic and delay increases are in line with the flow changes.

Three lenses: No Green Belt Loss, Urban Edge and Transport Corridors have been developed with new developments in each option in addition to DM amounting to 4%, 6% and 5% increase in overall trips respectively in comparison to DM. All the three modelled lenses reached an acceptable level of demand-supply convergence, meeting the convergence requirement laid out by TAG. Models show an increase in overall trips catering the new developments with preference in usage of car. The absolute and percentage demand growth by various modes and the mode share for all the three lenses are presented in Table 10-1

Table 10-1 – Overall Summary of Change in Demand by Mode.

Additional Trips by Lens	Car	PT	Walk	Cycle	Total
Lens 1 - No Greenbelt Loss	25,678	1,237	2,277	244	29,435
Lens 2 - Urban Edge	38,315	2,285	5,572	1,204	47,375
Lens 3 - Transport Corridors	34,770	2,177	4,395	559	41,902
Percentage Growth by Lens					
Lens 1 - No Greenbelt Loss	4.1%	1.9%	2.5%	1.9%	3.7%
Lens 2 - Urban Edge	6.2%	3.6%	6.1%	9.2%	6.0%
Lens 3 - Transport Corridors	5.6%	3.4%	4.8%	4.3%	5.3%
Percentage Growth by Mode					
Lens 1 - No Greenbelt Loss	87.2%	4.2%	7.7%	0.8%	100.0%
Lens 2 - Urban Edge	80.9%	4.8%	11.8%	2.5%	100.0%
Lens 3 - Transport Corridors	83.0%	5.2%	10.5%	1.3%	100.0%
Percentage Mode Share Change					
Lens 1 - No Greenbelt Loss	0.3%	-0.1%	-0.1%	0.0%	
Lens 2 - Urban Edge	0.1%	-0.2%	0.0%	0.0%	
Lens 3 - Transport Corridors	0.2%	-0.1%	-0.1%	0.0%	

The model outputs in terms of mode shift align with expectations given the nature and scale of development in each Lens. As can be seen from the Table 10-1 above, Lens 2 produces the greatest rise in trips overall and for each mode. The change in mode share by mode is not large, though Lens 2 exhibits the smallest rise in car mode share, and also signs of a small increase in walk and cycle mode share. However, because these shares are calculated across WECA as a whole the changes are very small.

By calculating the proportion of additional trips by each model as presented in Table 10-1, the pattern is clearer. In Lens 2 the proportion of new trips by car is 81%, compared to 87% and 83% in Lens 1 and Lens 3. This can clearly be related to the greater density and ability to reach destinations with shorter trips, which increases the propensity to walk and cycle. Lens 3 by contrast has a higher proportion of new trips by PT, which can be attributed to the proximity to transport links of the development.

Lens 1 and Lens 3 exhibit an increase in traffic on the M5 along with local roads catering to additional developments (at Thornbury and Charfield in Lens 1 test and at Charfield and Hortham in Lens 3 test). Lens 2 appears to have a less significant impact on the key SRN junctions, although adds pressure to the key local road network including the A4174. Delays on the network are reviewed in each lens and a few important locations are identified, notably M5 J14 and M4 J20 on the strategic network. Other locations include, the B4058/Yate Road junction, local roads and connectors joining onto A432. Local checks, minor amendments, and signal optimization are needed to resolve these issues and will be carried out in the next stage of modelling, alongside any other mitigation measures proposed.

APPENDICES

Appendix A. Development Log

Appendix A - SGC - Development Log.xlsx

Appendix A - WECA - Development Log.xlsm

Appendix B. Employment Assumptions

B.1 Employment Density Guide

4. Employment density matrix

Use Class	Sub-Category	Sub-Sector	Density (sqm)	Notes
B1a Offices	General Office	Corporate	13	NIA
		Professional Services	12	NIA
		Public Sector	12	NIA
		TMT	11	NIA
		Finance & Insurance	10	NIA
	Call Centres		8	NIA
B1b	R&D Space		40-60	NIA lower densities will be achieved in units with higher provision of shared or communal spaces
B1c	Light Industrial		47	NIA
B2	Industrial & Manufacturing		36	GIA
B8	Storage & Distribution	National Distribution Centre	95	GEA
		Regional Distribution Centre	77	GEA
		'Final Mile' Distribution Centre	70	GEA
Mixed B Class	Small Business Workspace	Incubator	30-60	B1a, B1b – the density will relate to balance between spaces, as the share of B1a increases so too will employment densities.
		Maker Spaces	15-40	B1c, B2, B8 - Difference between 'planned space' density and utilisation due to membership model
		Studio	20-40	B1c, B8
		Co-Working	10-15	B1a - Difference between 'planned space' density and utilisation due to membership model
		Managed Workspace	12-47	B1a, b, c
B8 / Sui Generis	Data Centres	Wholesale	200-950	
		Wholesale Dark Site	440-1,400	
		Co-location Facility	180-540	
A1	Retail	High Street	15-20	NIA
		Foodstore	15-20	NIA
		Retail Warehouse	90	NIA
A2	Finance & Professional Services		16	NIA
A3	Restaurants & Cafes		15-20	NIA
C1	Hotels	Limited Service / Budget	1 per 5 beds	FTE per bed
		Mid-scale	1 per 3 beds	FTE per bed
		Upscale	1 per 2 beds	FTE per bed
		Luxury	1 per 1 bed	FTE per bed
D2	Fitness Centres	Budget	100	GIA
		Mid Market	65	GIA – both types tend to generate between 40-50 jobs per gym
		Family		
	Cinema		200	GIA
	Visitor & Cultural Attractions		30-300	The diversity of the cultural attraction sector means a very wide range exists
	Amusement & Entertainment Centres		70	Potential range of 20-100sqm

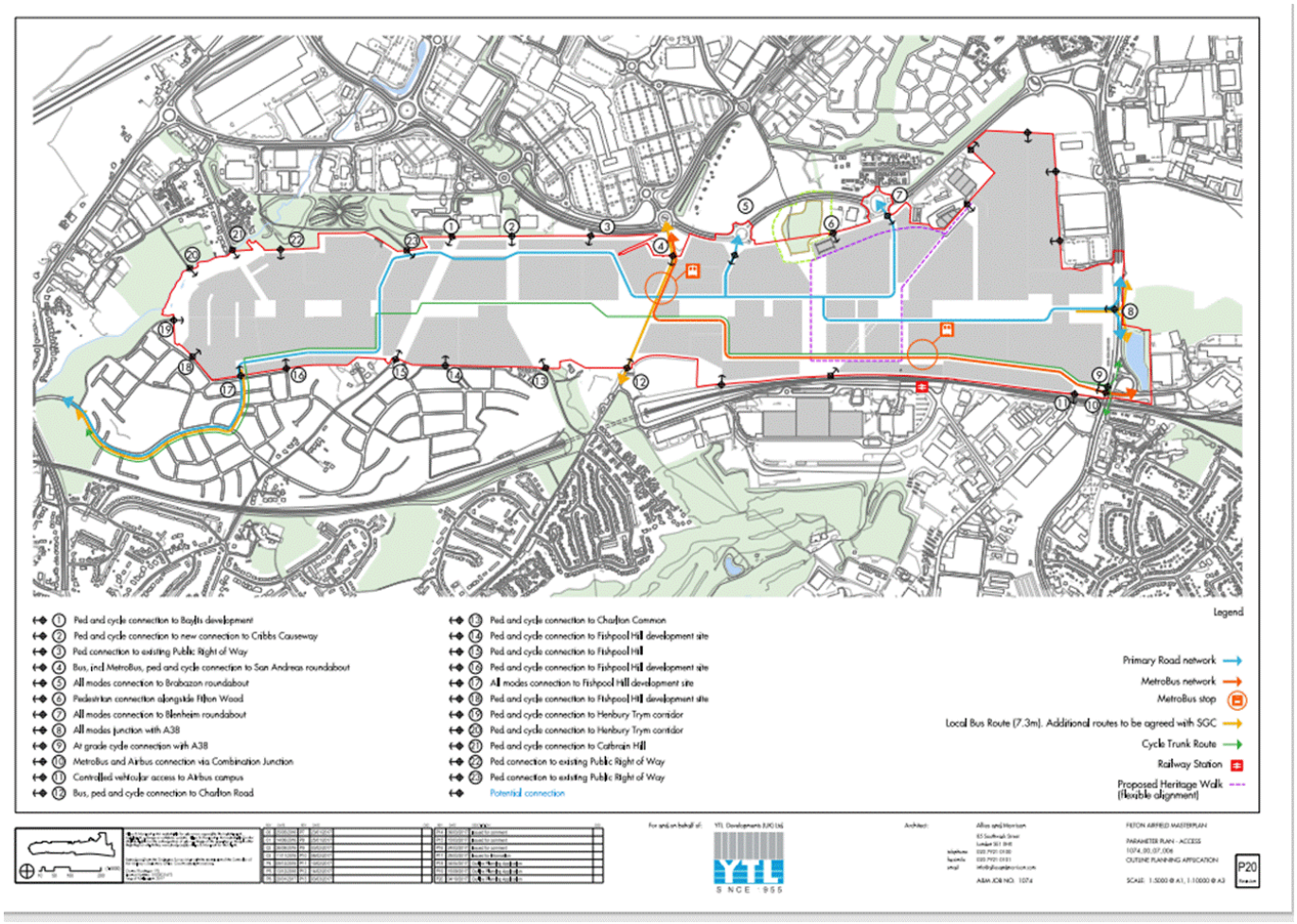
B.2 Class E Job density

Occupancy levels will vary depending on what type of E Class floorspace is proposed. The following average jobs densities will therefore be used to calculate the occupancy level of different types of E Class floorspace. These are based on the ranges contained with HCA Employment density guide, 3rd edition, 2015 and the London Office Policy Review, 2017.

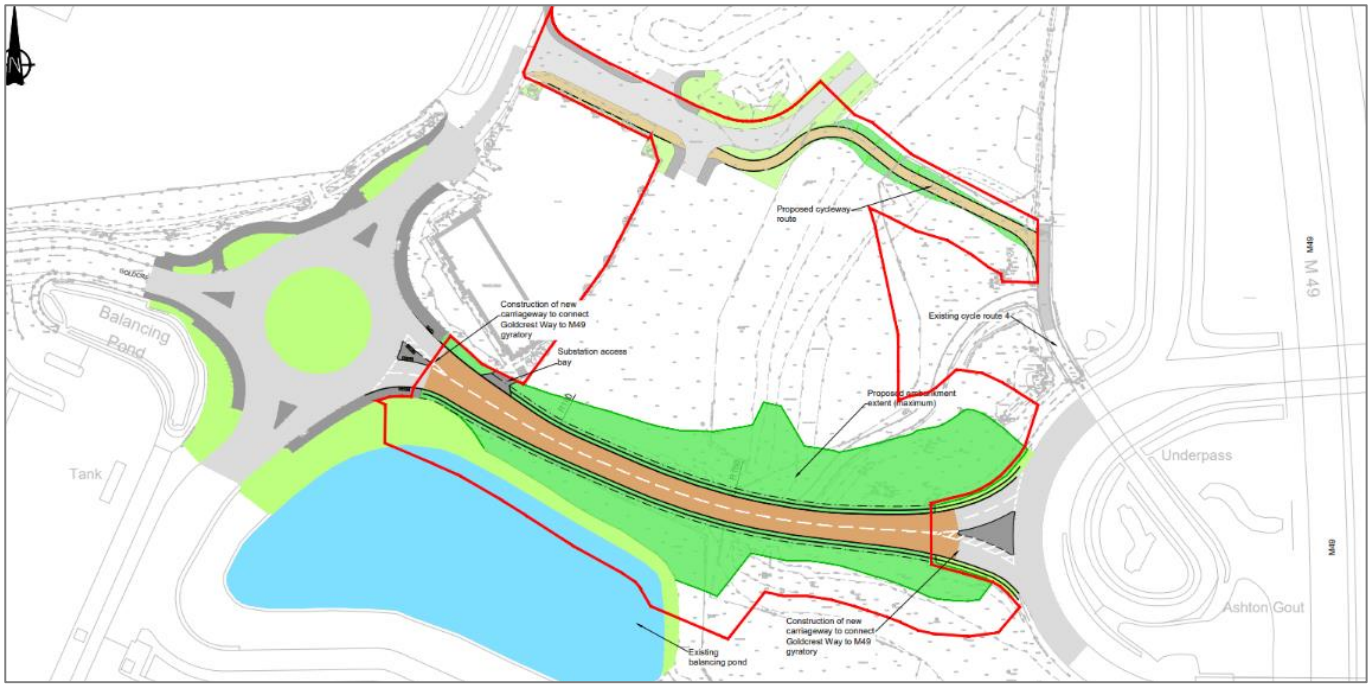
Proposed use	Job density
Class E (a/ b) – shop / café/ restaurant	1 job per 17.5sqm
Class E (c) – financial and professional	1 job per 16sqm
Class E (d) – gymnasiums/ fitness centres	1 job per 65sqm
Class E (g) - offices	1 job per 11.3sqm

Appendix C. DM Scheme Drawings

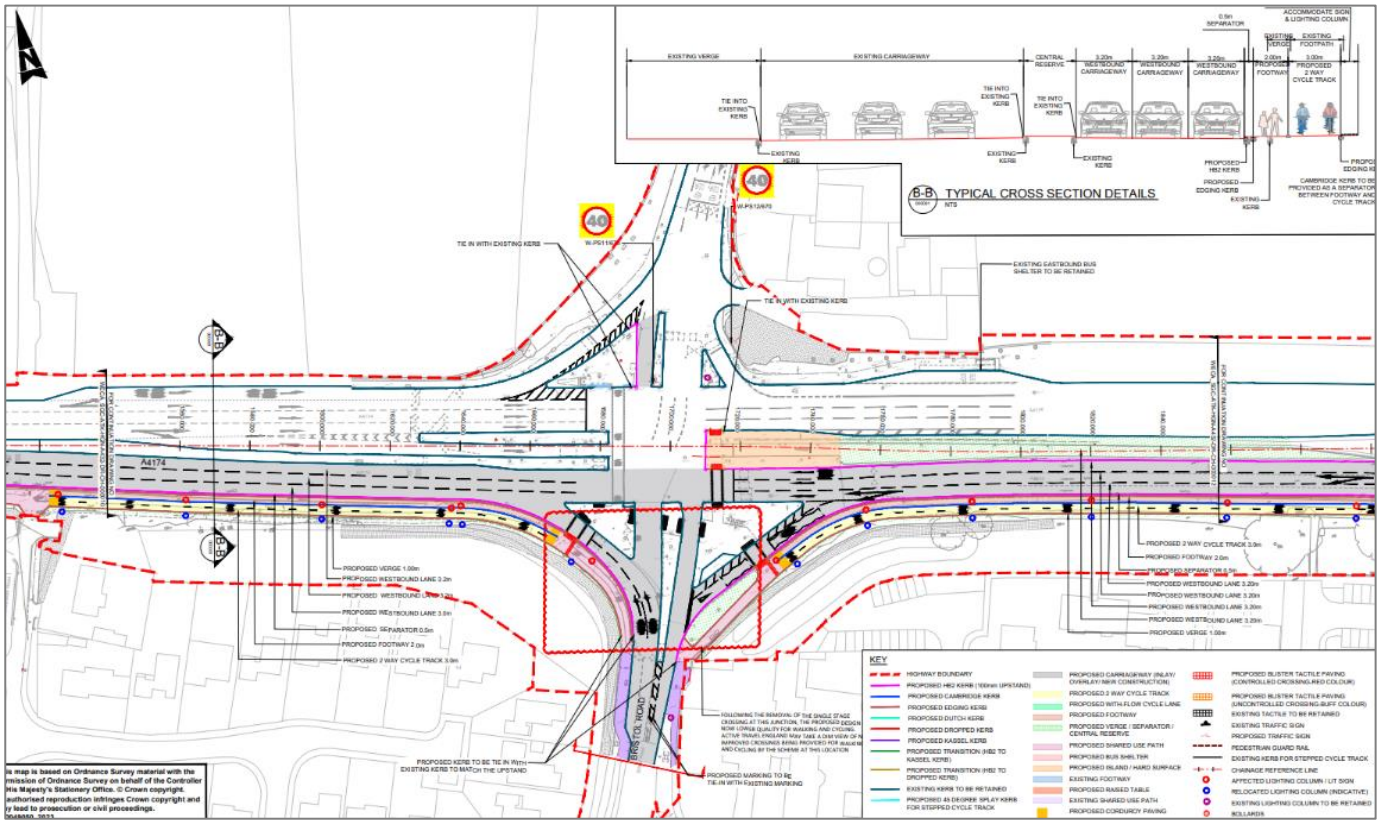
C.1 Filton Airfield Development Proposed Infrastrucuture



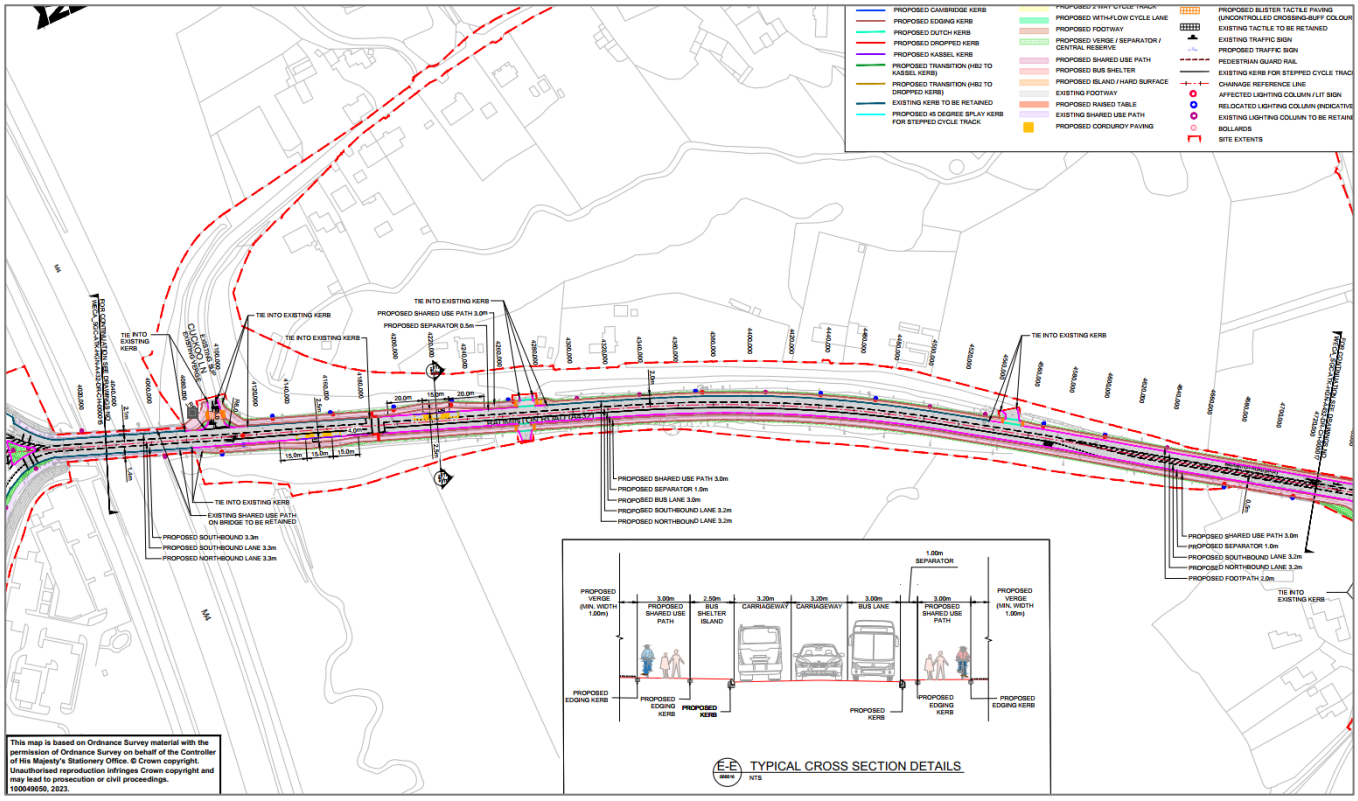
C.2 M49 Junction and new links



C.3 Hambrook Junction



C.4 A432


PROPOSED CAMBRIDGE KERB
PROPOSED EDGING KERB
PROPOSED DUTCH KERB
PROPOSED DROPPED KERB
PROPOSED KASSEL KERB
PROPOSED TRANSITION (HB2 TO KASSEL KERB)
PROPOSED TRANSITION (HB2 TO DROPPED KERB)
EXISTING KERB TO BE RETAINED
PROPOSED 45 DEGREE SPLAY KERB FOR STEPPED CYCLE TRACK
PROPOSED WITH-FLOW CYCLE LANE
PROPOSED FOOTWAY
PROPOSED VERGE / SEPARATOR / CENTRAL RESERVE
PROPOSED SHARED USE PATH
PROPOSED BUS SHELTER
PROPOSED ISLAND / HARD SURFACE
EXISTING FOOTWAY
PROPOSED RAISED TABLE
EXISTING SHARED USE PATH
PROPOSED CORDUROY PAVING
PROPOSED BLISTER TACTILE PAVING (UNCONTROLLED CROSSING-BUFF COLOUR)
EXISTING TACTILE TO BE RETAINED
EXISTING TRAFFIC SIGN
PROPOSED TRAFFIC SIGN
PEDESTRIAN GUARD RAIL
EXISTING KERB FOR STEPPED CYCLE TRACK
CHAINAGE REFERENCE LINE
AFFECTED LIGHTING COLUMN / LIT SIGN
RELOCATED LIGHTING COLUMN (INDICATIVE)
EXISTING LIGHTING COLUMN TO BE RETAINED
BOLLARDS
SITE EXTENTS
TIE INTO EXISTING KERB
PROPOSED SHARED USE PATH 3.0m
PROPOSED SEPARATOR 0.5m
PROPOSED SEPARATOR 1.0m
PROPOSED BUS LANE 3.0m
PROPOSED SOUTHBOUND LANE 3.2m
PROPOSED NORTHBOUND LANE 3.2m
EXISTING SHARED USE PATH ON BRIDGE TO BE RETAINED
PROPOSED SOUTHBOUND 3.3m
PROPOSED SOUTHBOUND LANE 3.3m
PROPOSED NORTHBOUND LANE 3.3m
PROPOSED FOOTPATH 2.0m
PROPOSED SHARED USE PATH
PROPOSED BUS SHELTER ISLAND
PROPOSED CARRIAGEWAY
PROPOSED BUS LANE
PROPOSED VERGE (MIN. WIDTH 1.00m)
PROPOSED EDGING KERB
PROPOSED KERB
1.00m SEPARATOR
TYPICAL CROSS SECTION DETAILS
NTS
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Appendix D. Lenses Development Log

D.1 Lens 1 Developments

Appendix D1 - Option1 No GB Loss - Development Log.xlsx

D.2 Lens 2 Developments

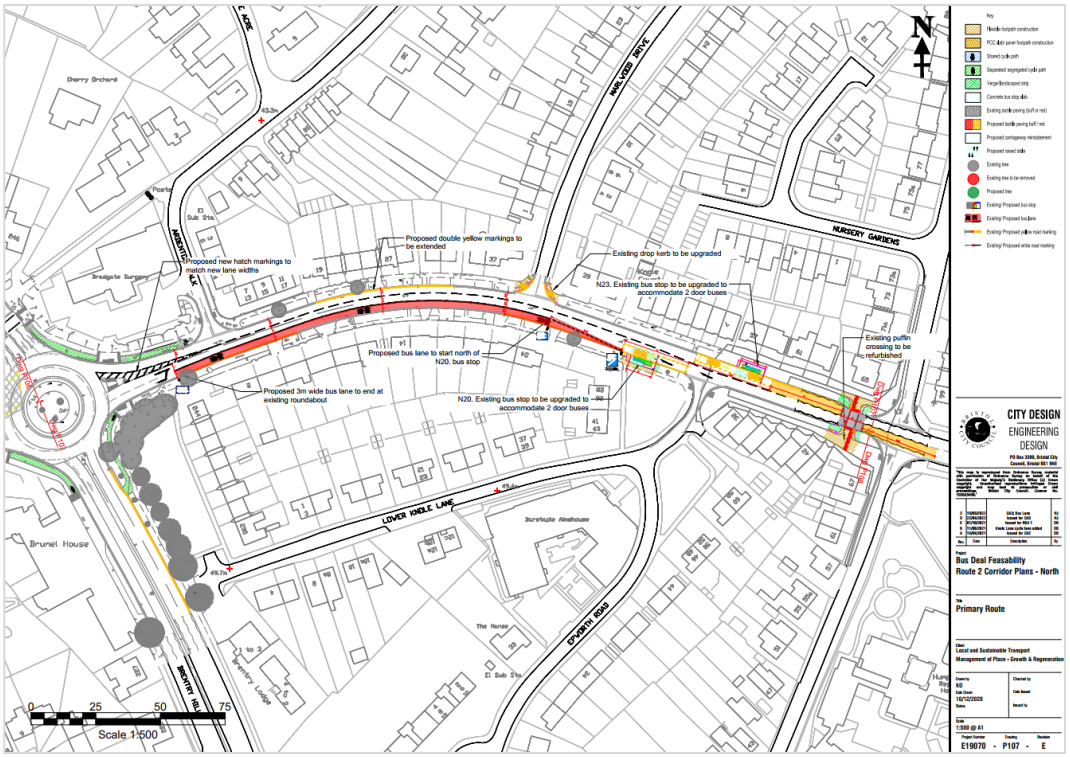
Appendix D2 - Option2 Urban Edge - Development Log.xlsx

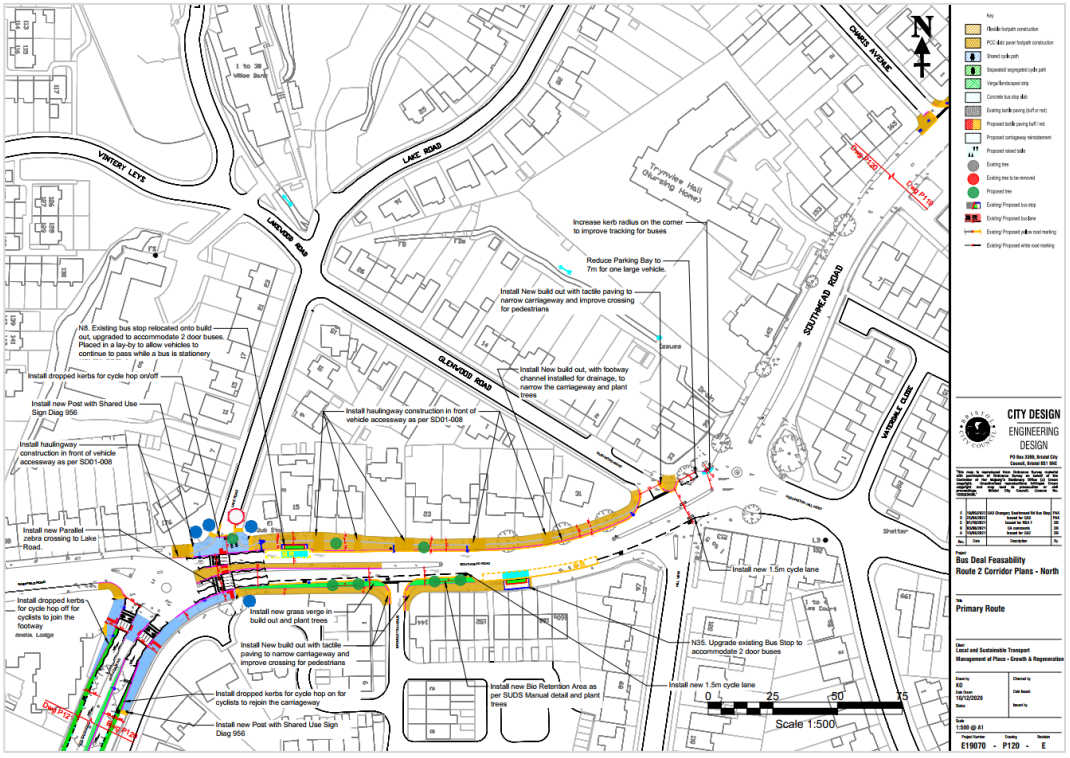
D.3 Lens 3 Developments

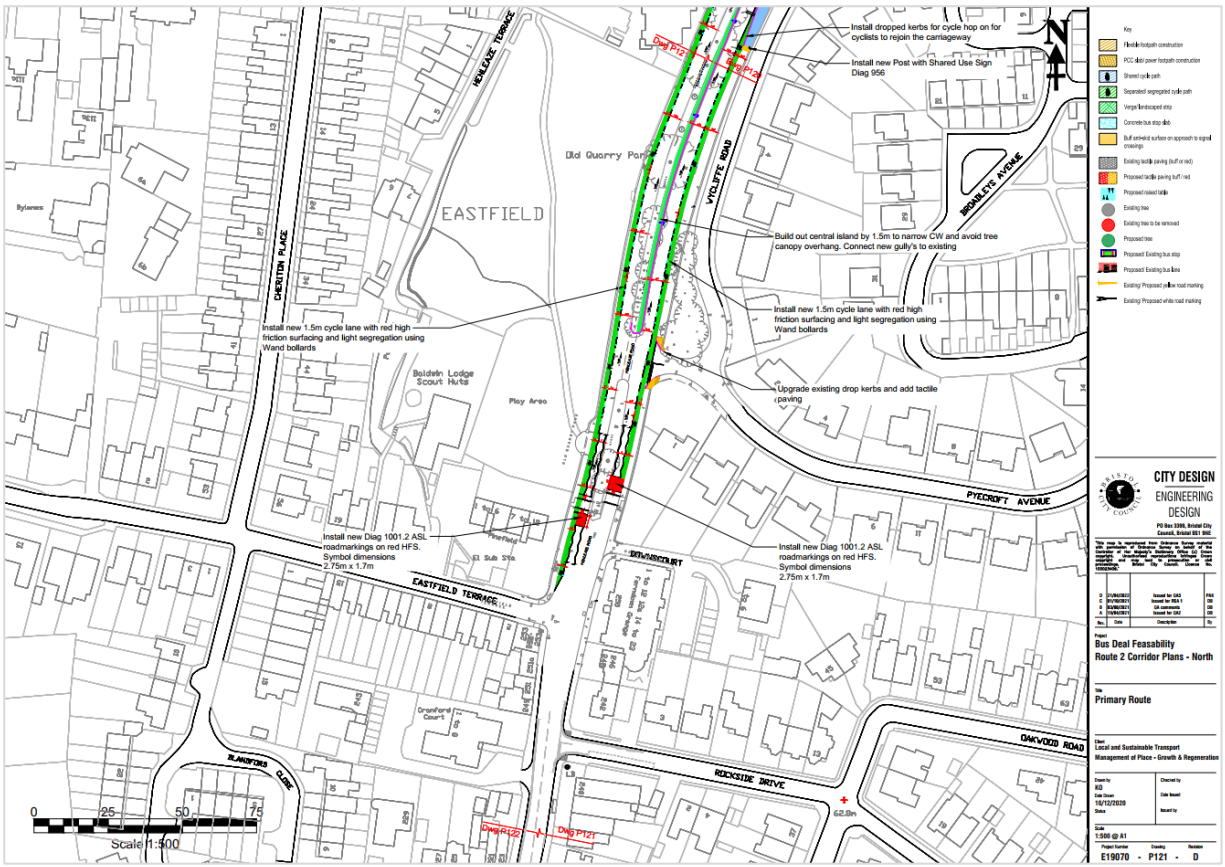
Appendix D3 - Option3 Transport Corridors - Development Log.xlsx

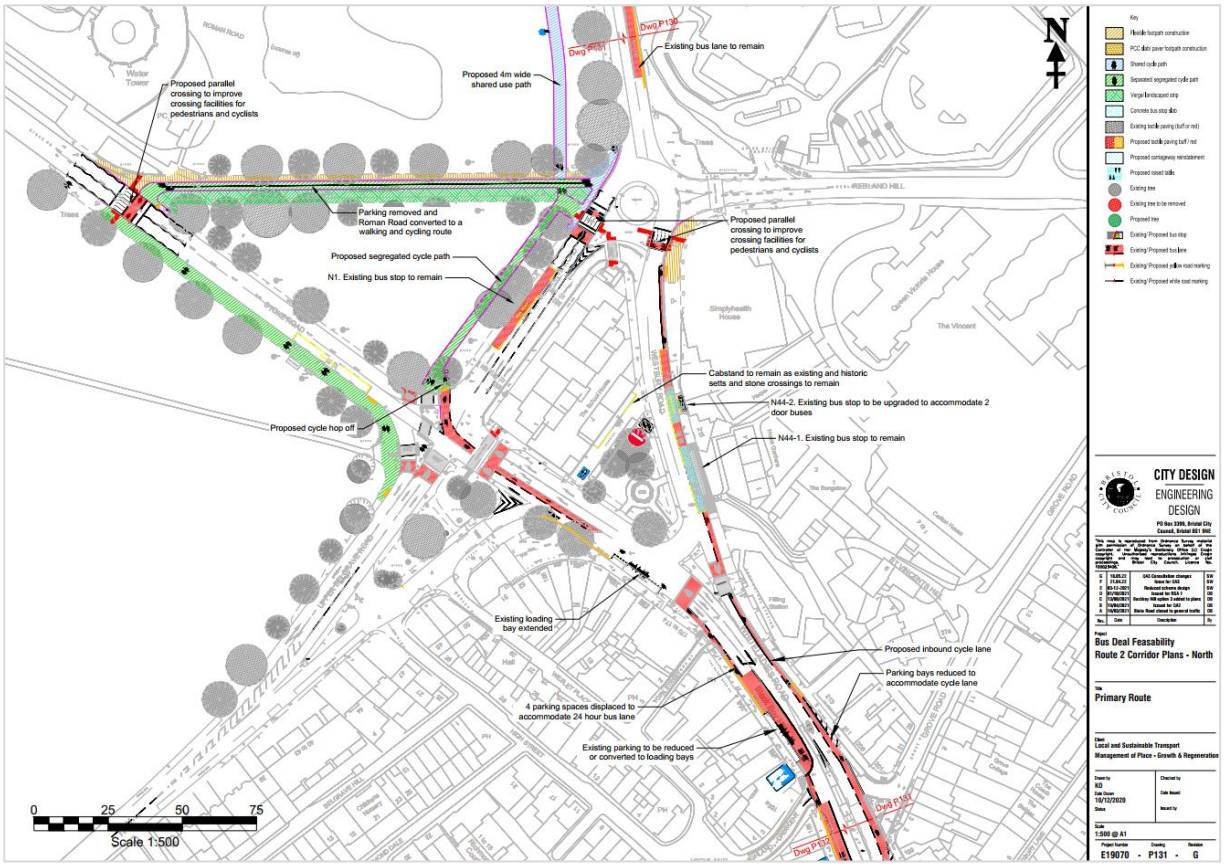
Appendix E. Scheme Plans from WERTM

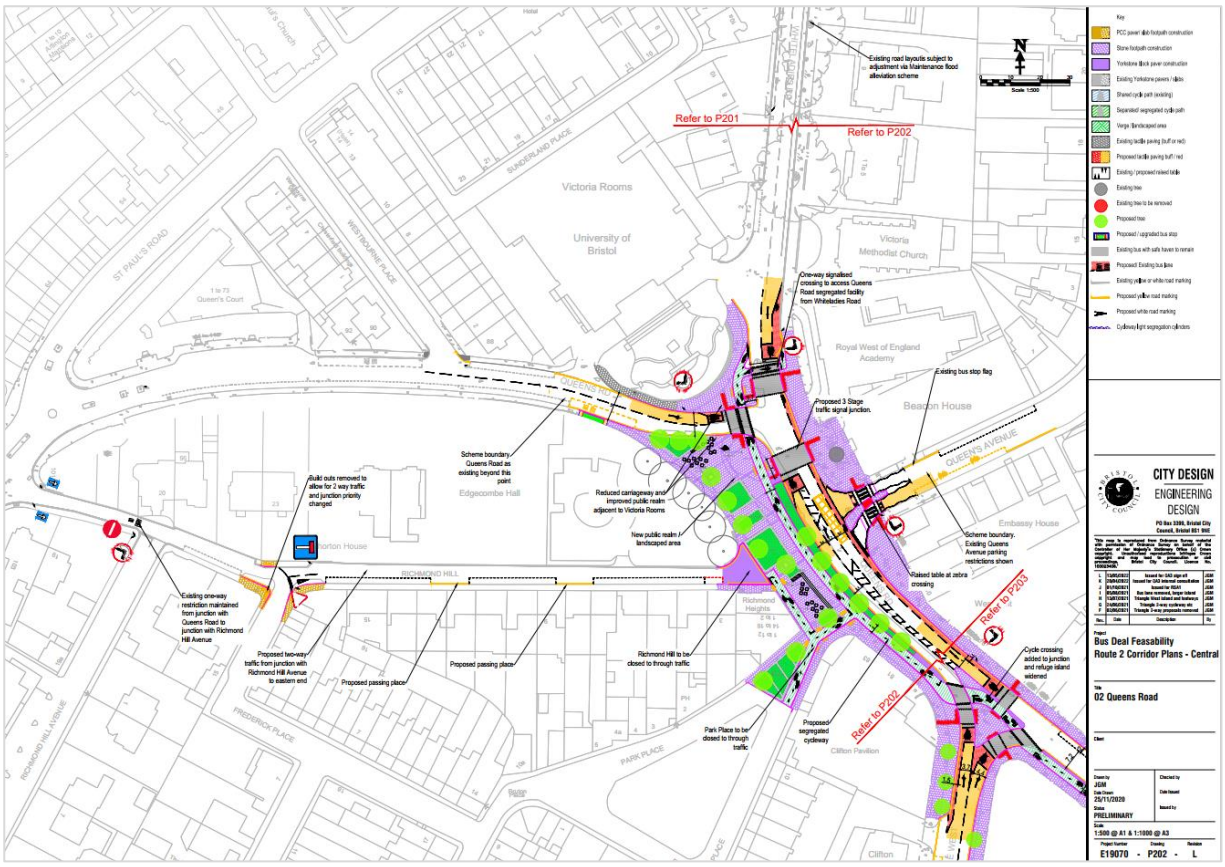
E.1 A4018/A37 Bus Corridor Improvements

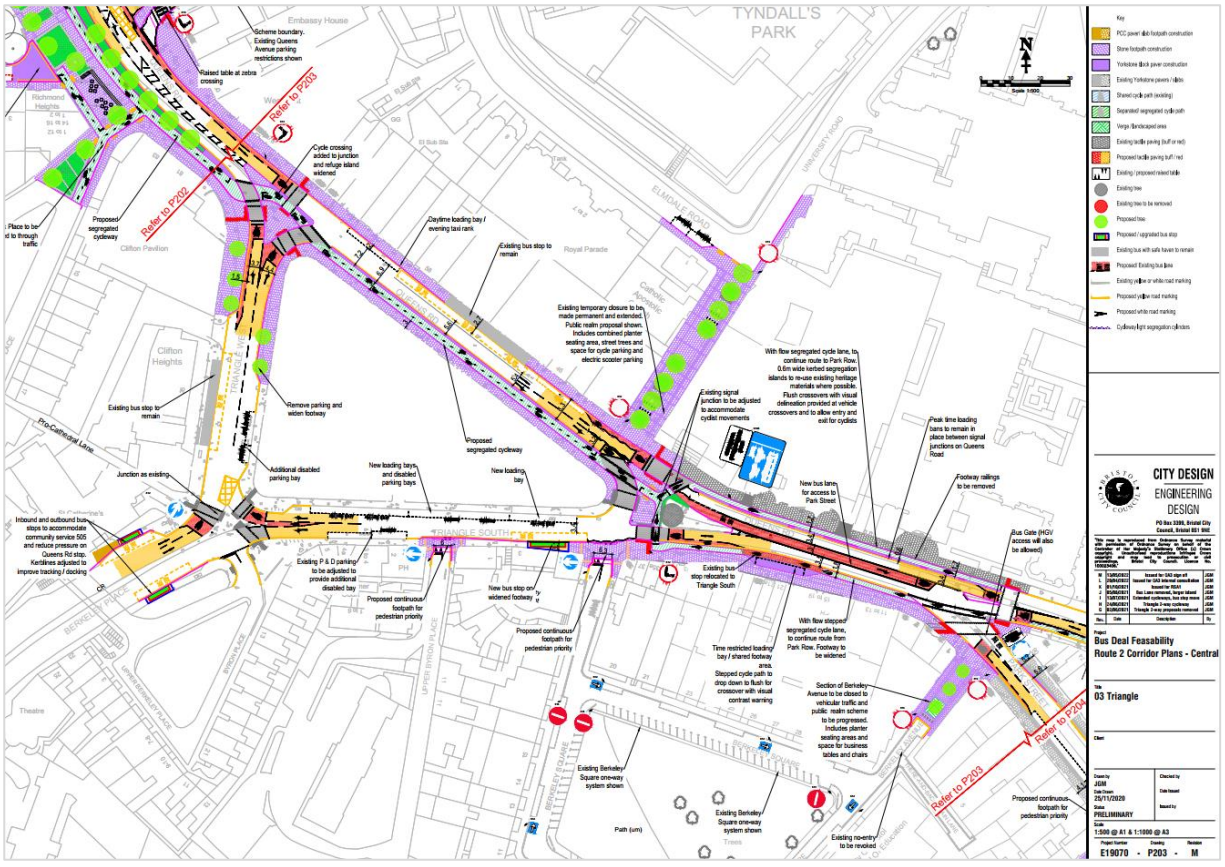


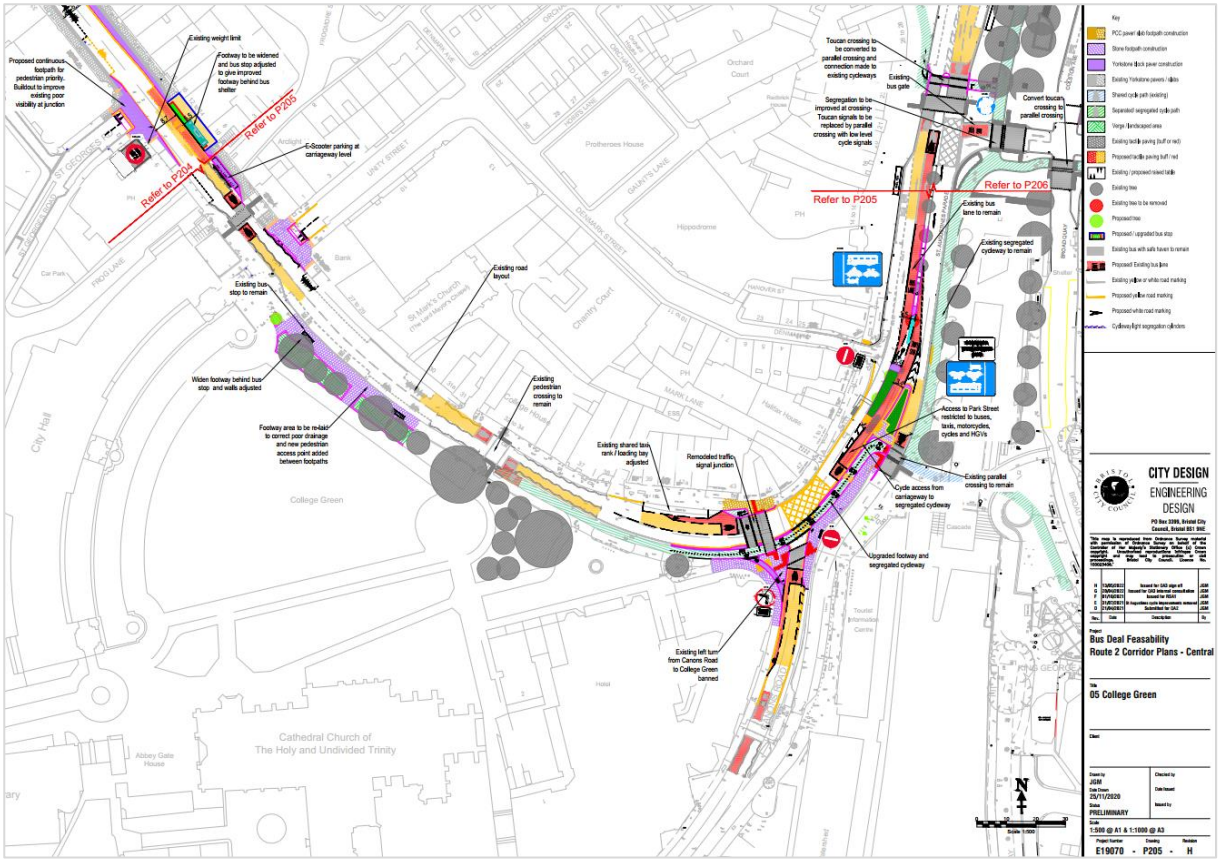


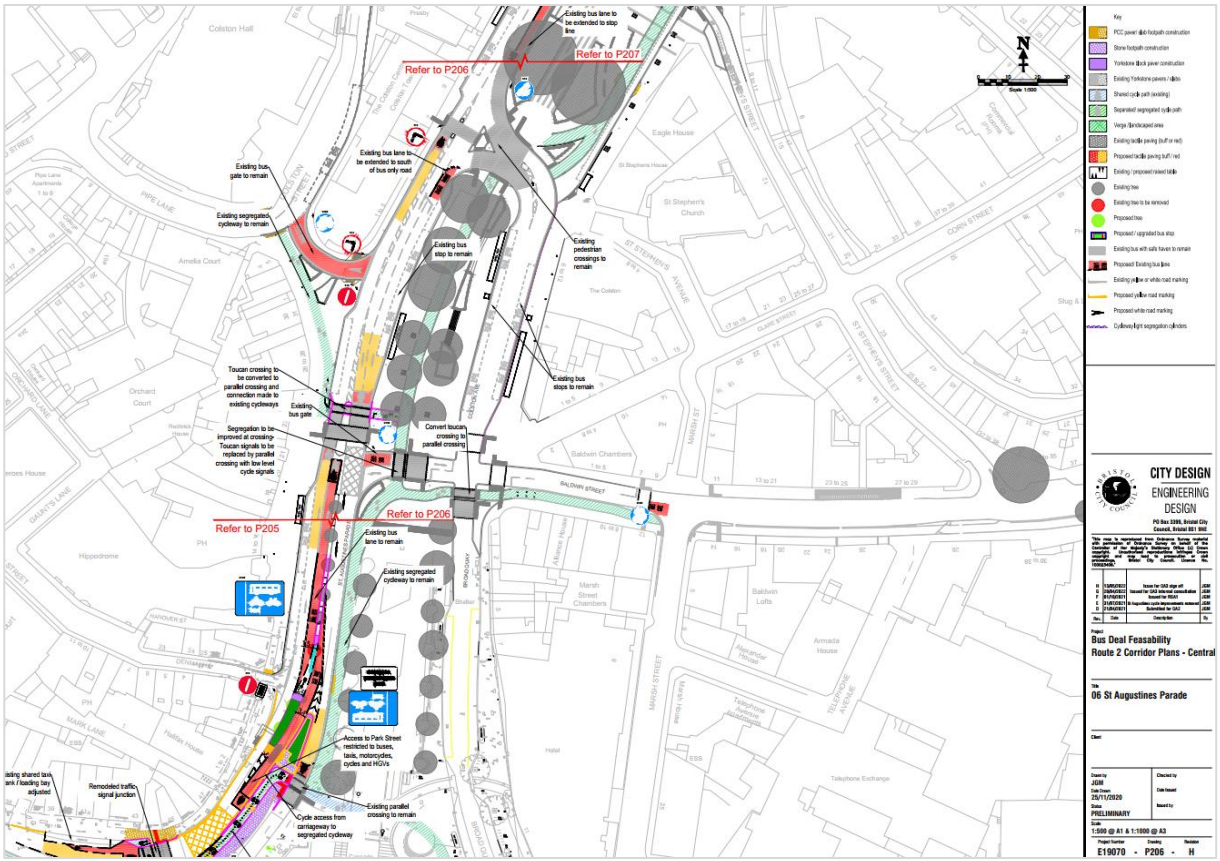

Install dropped kerbs for cycle hop on for cyclists to rejoin the carriageway
Install new Post with Shared Use Sign Diag 956
Build out central island by 1.5m to narrow CW and avoid tree canopy overhang. Connect new gully's to existing
Install new 1.5m cycle lane with red high friction surfacing and light segregation using Wand bollards
Upgrade existing drop kerbs and add tactile paving
Install new Diag 1001.2 ASL roadmarkings on red HFS. Symbol dimensions 2.75m x 1.7m
Install new 1.5m cycle lane with red high friction surfacing and light segregation using Wand bollards
Install new Diag 1001.2 ASL roadmarkings on red HFS. Symbol dimensions 2.75m x 1.7m
EASTFIELD
Old Quarry Park
Baldwin Lodge Scout Hut
Play Area
CHERITON PLACE
HOLLAND TERRACE
CYCLOPS ROAD
BROMLEYS AVENUE
PYECROFT AVENUE
EASTFIELD TERRACE
WENTWORTH
OAKWOOD ROAD
ROCKSIDE DRIVE
SLIMFORDS CLOSE
Dwg P122
Dwg P121
Scale 1:500
CITY DESIGN
ENGINEERING DESIGN
Bus Deal Feasability
Route 2 Corridor Plans - North
Primary Route
Local and Sustainable Transport
Management of Place - Growth & Regeneration
E19070 - P121 - D

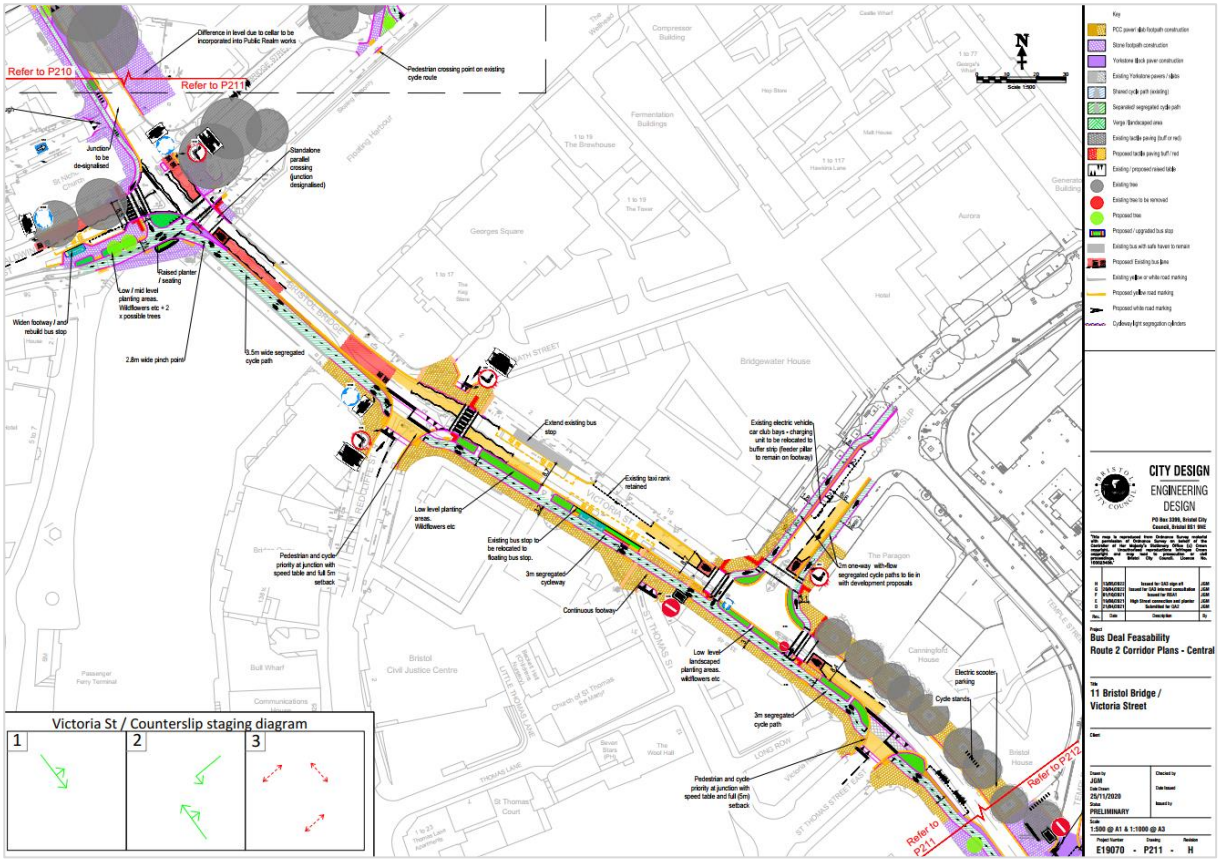

Proposed parallel crossing to improve crossing facilities for pedestrians and cyclists
Proposed 4m wide shared use path
Existing bus lane to remain
Parking removed and Roman Road converted to a walking and cycling route
Proposed segregated cycle path
N1. Existing bus stop to remain
Proposed parallel crossing to improve crossing facilities for pedestrians and cyclists
Cabstand to remain as existing and historic setts and stone crossings to remain
N44-2. Existing bus stop to be upgraded to accommodate 2 door buses
N44-1. Existing bus stop to remain
Proposed cycle hop off
Existing loading bay extended
Proposed inbound cycle lane
Parking bays reduced to accommodate cycle lane
4 parking spaces displaced to accommodate 24 hour bus lane
Existing parking to be reduced or converted to loading bays
Dwg P130
Dwg P131
Dwg P132
Dwg P133
Scale 1:500
CITY DESIGN
ENGINEERING DESIGN
Bus Deal Feasability
Route 2 Corridor Plans - North
Primary Route
Local and Sustainable Transport
Management of Place - Growth & Regeneration
E19070 - P131 - G

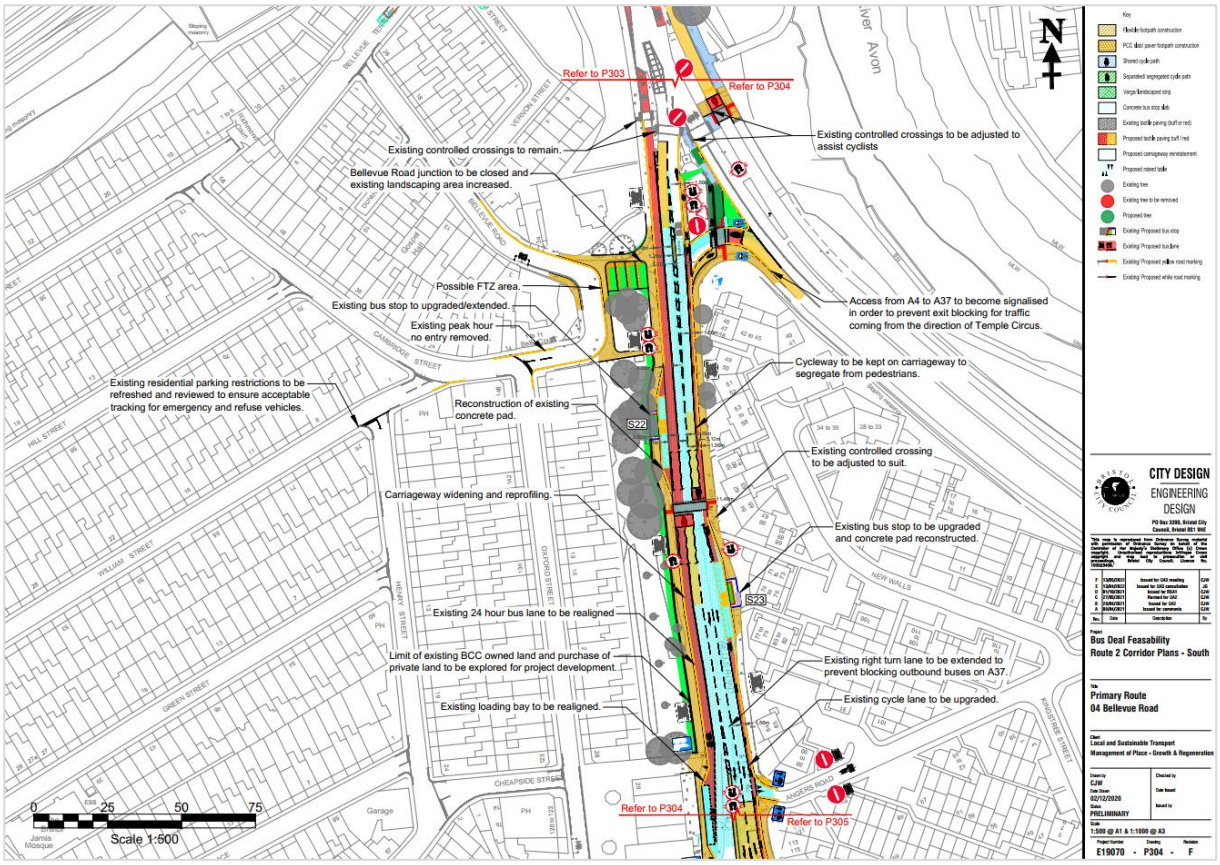

Refer to P201
Refer to P202
Victoria Rooms
University of Bristol
Victoria Methodist Church
Royal West of England Academy
Beacon House
Edgecombe Hall
Clifton Pavilion
Existing road layouts subject to adjustment via Maintenance flood alleviation scheme
One-way signalised crossing to access Queens Road segregated facility from Whiteladies Road
Existing bus stop flag
Proposed 3 Stage traffic signal junction.
Scheme boundary. Queens Road as existing beyond this point
Build outs removed to allow for 2 way traffic and junction priority changed
Reduced carriageway and improved public realm adjacent to Victoria Rooms
New public realm / landscaped area
Existing one-way restriction maintained from junction with Queens Road to junction with Richmond Hill Avenue
Proposed two-way traffic from junction with Richmond Hill Avenue to eastern end
Proposed passing place
Proposed passing place
Richmond Hill to be closed to through traffic
Park Place to be closed to through traffic
Proposed segregated cycleway
Scheme boundary. Existing Queens Avenue parking restrictions shown
Raised table at zebra crossing
Refer to P203
Refer to P202
Cycle crossing added to junction and refuge island widened
CITY DESIGN
ENGINEERING
DESIGN
Bus Deal Feasability
Route 2 Corridor Plans - Central
02 Queens Road
PRELIMINARY
1:500 @ A1 & 1:1000 @ A3
E19070 - P202 - L

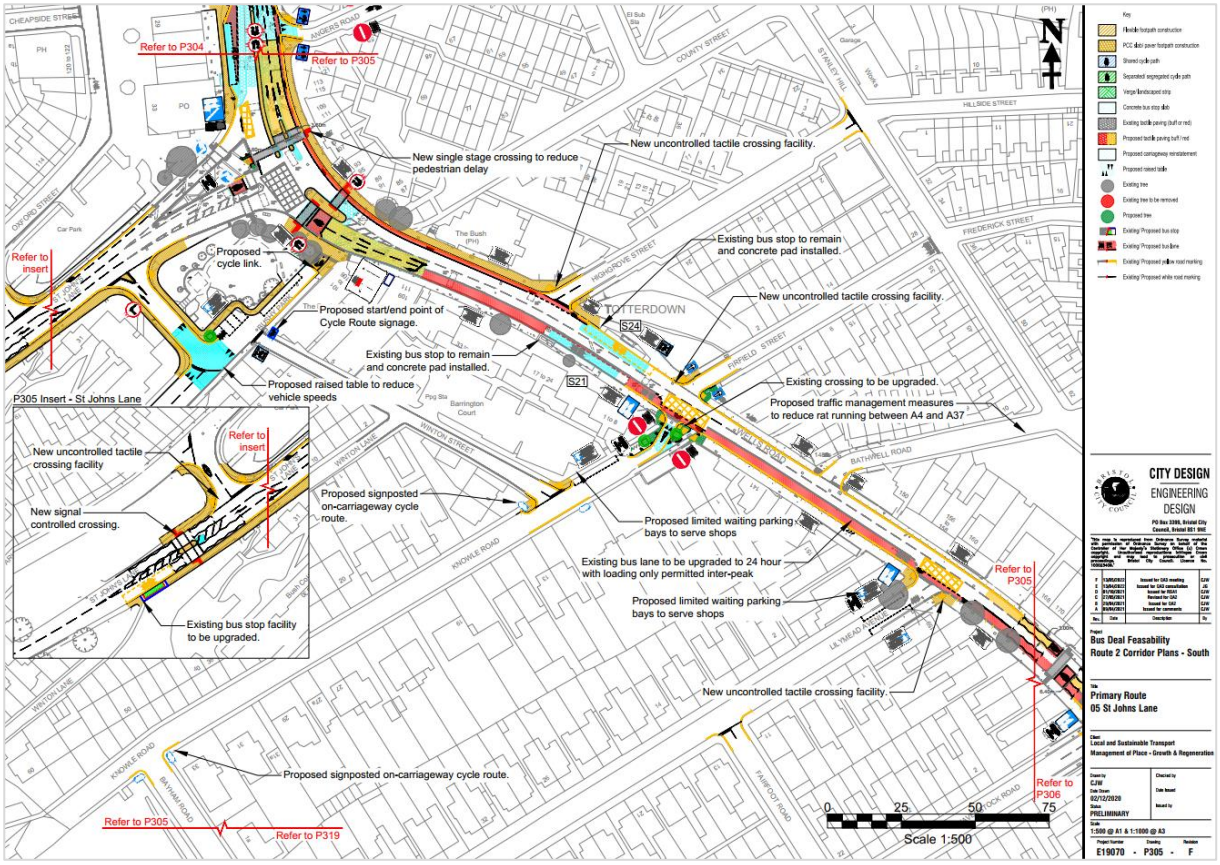

TYNDALL'S PARK
Scheme boundary. Existing Queens Avenue parking restrictions shown
Raised table at zebra crossing
Refer to P203
Refer to P202
Cycle crossing added to junction and refuge island widened
Proposed segregated cycleway
Clifton Pavilion
Daytime loading bay / evening taxi rank
Existing bus stop to remain
Royal Parade
Existing temporary closure to be made permanent and extended. Public realm proposal shown. Includes combined planter seating area, street trees and space for cycle parking and electric scooter parking
With flow segregated cycle lane, to continue route to Park Row. 0.6m wide kerbed segregation islands to re-use existing heritage materials where possible. Flush crossovers with visual delineation provided at vehicle crossovers and to allow entry and exit for cyclists
Existing signal junction to be adjusted to accommodate cyclist movements
Peak time loading bans to remain in place between signal junctions on Queens Road
Footway railings to be removed
Remove parking and widen footway
Existing bus stop to remain
Pro-Cathedral Lane
Junction as existing
Additional disabled parking bay
New loading bays and disabled parking bays
New loading bay
Proposed segregated cycleway
New bus lane for access to Park Street
Bus Gate (HGV access will also be allowed)
Inbound and outbound bus stops to accommodate community service 505 and reduce pressure on Queens Rd stop. Kerblines adjusted to improve tracking / docking
Existing P & D parking to be adjusted to provide additional disabled bay
Proposed continuous footpath for pedestrian priority
New bus stop on widened footway
Existing bus stop relocated to Triangle South
Proposed continuous footpath for pedestrian priority
With flow stepped segregated cycle lane, to continue route from Park Row. Footway to be widened
Time restricted loading bay / shared footway area.
Stepped cycle path to drop down to flush for crossover with visual contrast warning
Section of Berkeley Avenue to be closed to vehicular traffic and public realm scheme to be progressed. Includes planter seating areas and space for business tables and chairs
Existing Berkeley Square one-way system shown
Existing Berkeley Square one-way system shown
Existing no-entry to be revoked
Refer to P204
Refer to P203
Proposed continuous footpath for pedestrian priority
CITY DESIGN
ENGINEERING
DESIGN
Bus Deal Feasability
Route 2 Corridor Plans - Central
03 Triangle
PRELIMINARY
1:500 @ A1 & 1:1000 @ A3
E19070 - P203 - M

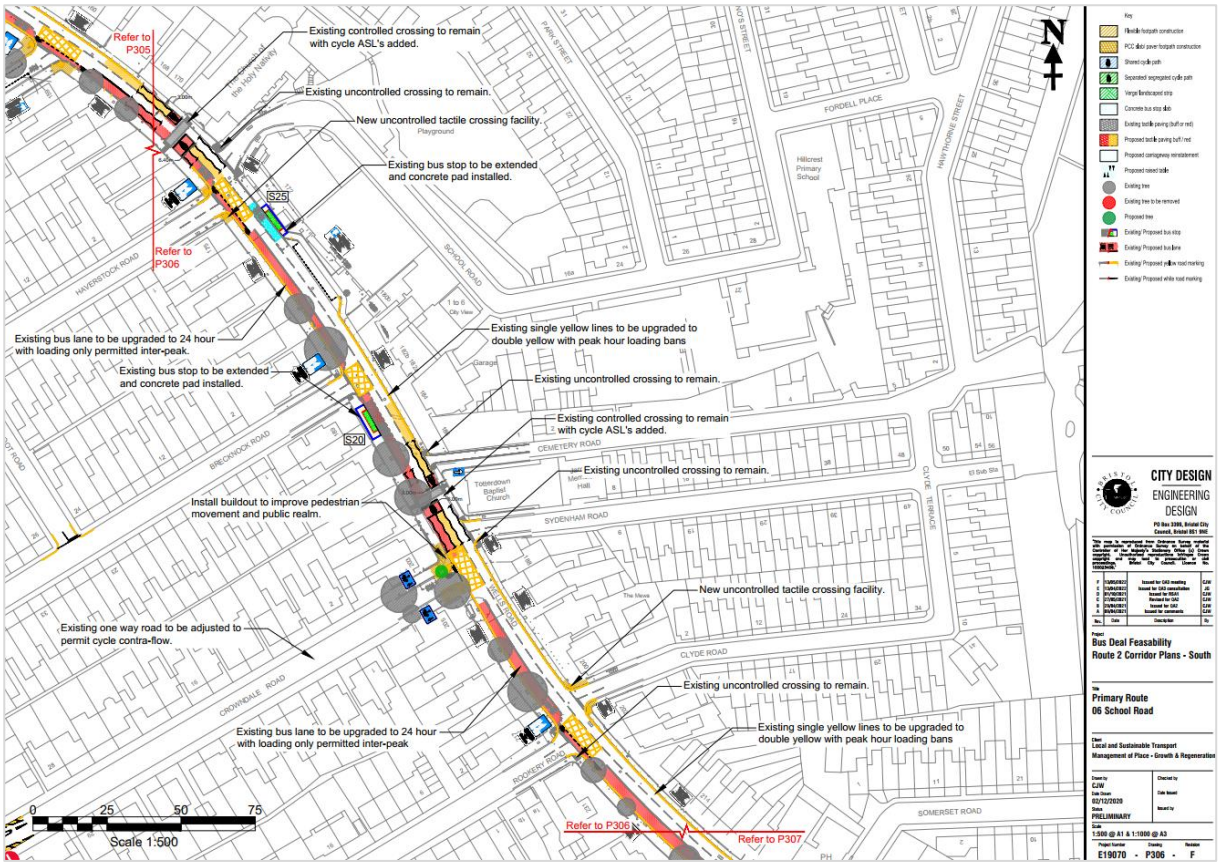

Refer to P204
Refer to P205
Refer to P206
Existing weight limit
Footway to be widened and bus stop adjusted to give improved footway behind bus shelter
Proposed continuous footpath for pedestrian priority. Build out to improve existing poor visibility at junction
E-Scooter parking at carriageway level
Existing bus stop to remain
Widen footway behind bus stop and walls adjusted
Footway area to be re-laid to correct poor drainage and new pedestrian access point added between footpaths
Existing road layout
Existing pedestrian crossing to remain
Existing shared taxi rank / loading bay adjusted
Remodelled traffic signal junction
Toucan crossing to be converted to parallel crossing and connection made to existing cycleways
Existing bus gate
Segregation to be improved at crossing - Toucan signals to be replaced by parallel crossing with low level cycle signals
Convert toucan crossing to parallel crossing
Existing bus lane to remain
Existing segregated cycleway to remain
Access to Park Street restricted to buses, taxis, motorcycles, cycles and HGVs
Existing parallel crossing to remain
Cycle access from carriageway to segregated cycleway
Upgraded footway and segregated cycleway
Existing left turn from Canons Road to College Green banned
College Green
Cathedral Church of The Holy and Undivided Trinity
CITY DESIGN ENGINEERING DESIGN
Bus Deal Feasability
Route 2 Corridor Plans - Central
05 College Green
E19070 - P205 - H

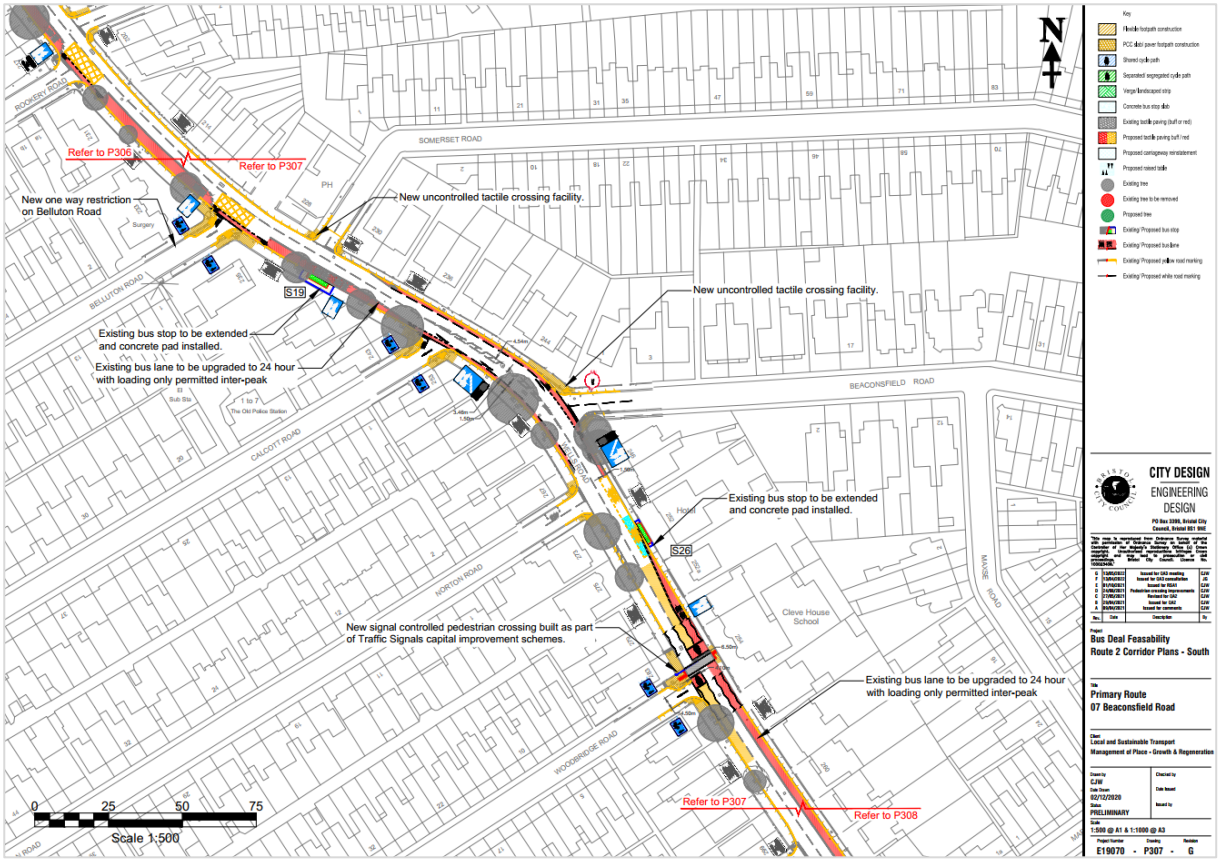

Refer to P206
Refer to P207
Refer to P205
Existing bus lane to be extended to stop line
Existing bus lane to be extended to south of bus only road
Existing bus gate to remain
Existing segregated cycleway to remain
Existing bus stop to remain
Existing pedestrian crossings to remain
Existing bus stops to remain
Toucan crossing to be converted to parallel crossing and connection made to existing cycleways
Existing bus gate
Segregation to be improved at crossing - Toucan signals to be replaced by parallel crossing with low level cycle signals
Convert toucan crossing to parallel crossing
Existing bus lane to remain
Existing segregated cycleway to remain
Access to Park Street restricted to buses, taxis, motorcycles, cycles and HGVs
Existing parallel crossing to remain
Cycle access from carriageway to segregated cycleway
Remodelled traffic signal junction
CITY DESIGN ENGINEERING DESIGN
Bus Deal Feasability
Route 2 Corridor Plans - Central
06 St Augustines Parade
E19070 - P206 - H

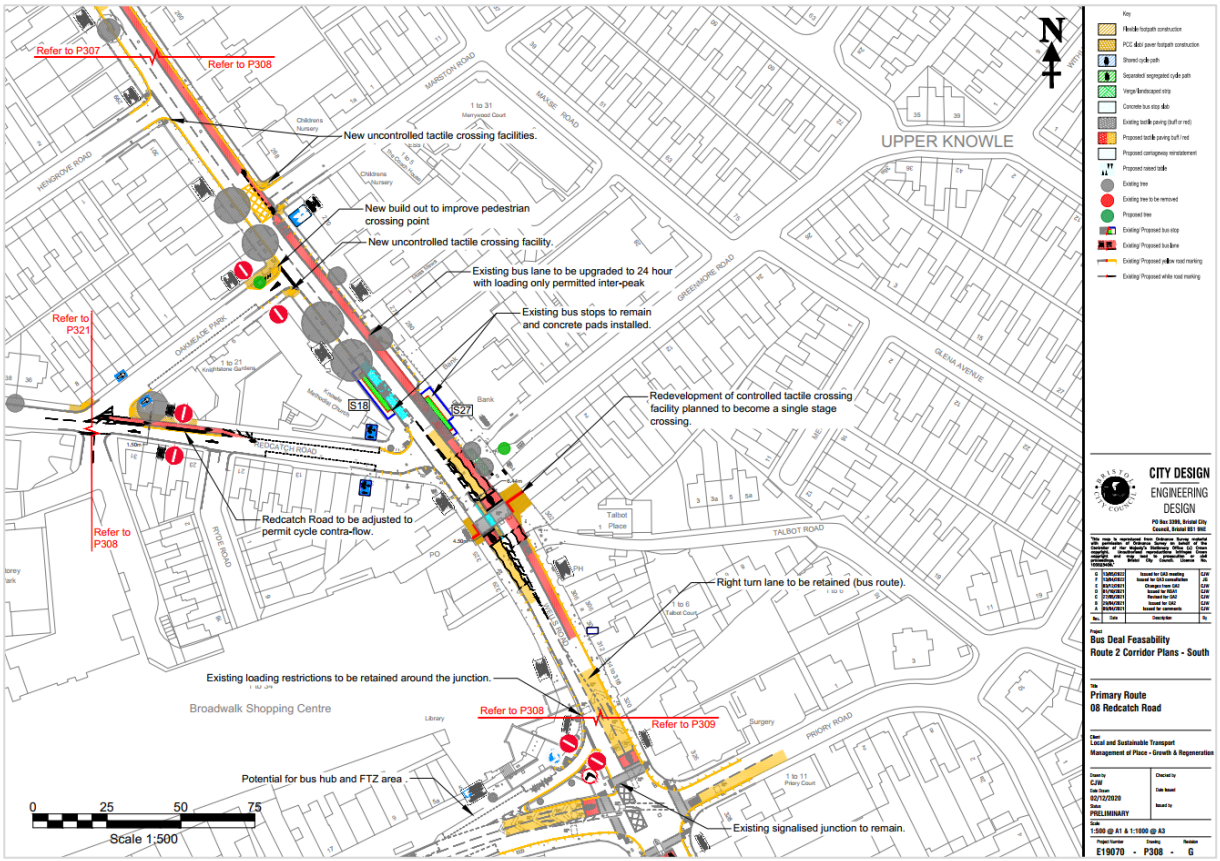

Refer to P210
Refer to P211
Refer to P212
Difference in level due to collar to be incorporated into Public Realm works
Pedestrian crossing point on existing cycle route
Junction to be de-signalised
Standalone parallel crossing (junction designalised)
Raised planter / seating
Low / mid level planting areas. Wildflowers etc + 2 x possible trees
Widen footway / and rebuild bus stop
2.8m wide pinch point
3.5m wide segregated cycle path
Extend existing bus stop
Existing taxi rank retained
Low level planting areas. Wildflowers etc
Existing bus stop to be relocated to floating bus stop.
3m segregated cycleway
Continuous footway
Pedestrian and cycle priority at junction with speed table and full 5m setback
Existing electric vehicle car club bays + charging unit to be relocated to buffer strip (feeder pillar to remain on footway)
0m one-way with-flow segregated cycle paths to tie in with development proposals
Low level landscaped planting areas. wildflowers etc
3m segregated cycle path
Pedestrian and cycle priority at junction with speed table and full (5m) setback
Electric scooter parking
Cycle stands
Victoria St / Counterslip staging diagram
1
2
3
CITY DESIGN
ENGINEERING
DESIGN
Bus Deal Feasability
Route 2 Corridor Plans - Central
11 Bristol Bridge / Victoria Street
PRELIMINARY
1:500 @ A1 & 1:1000 @ A3
E19070 - P211 - H

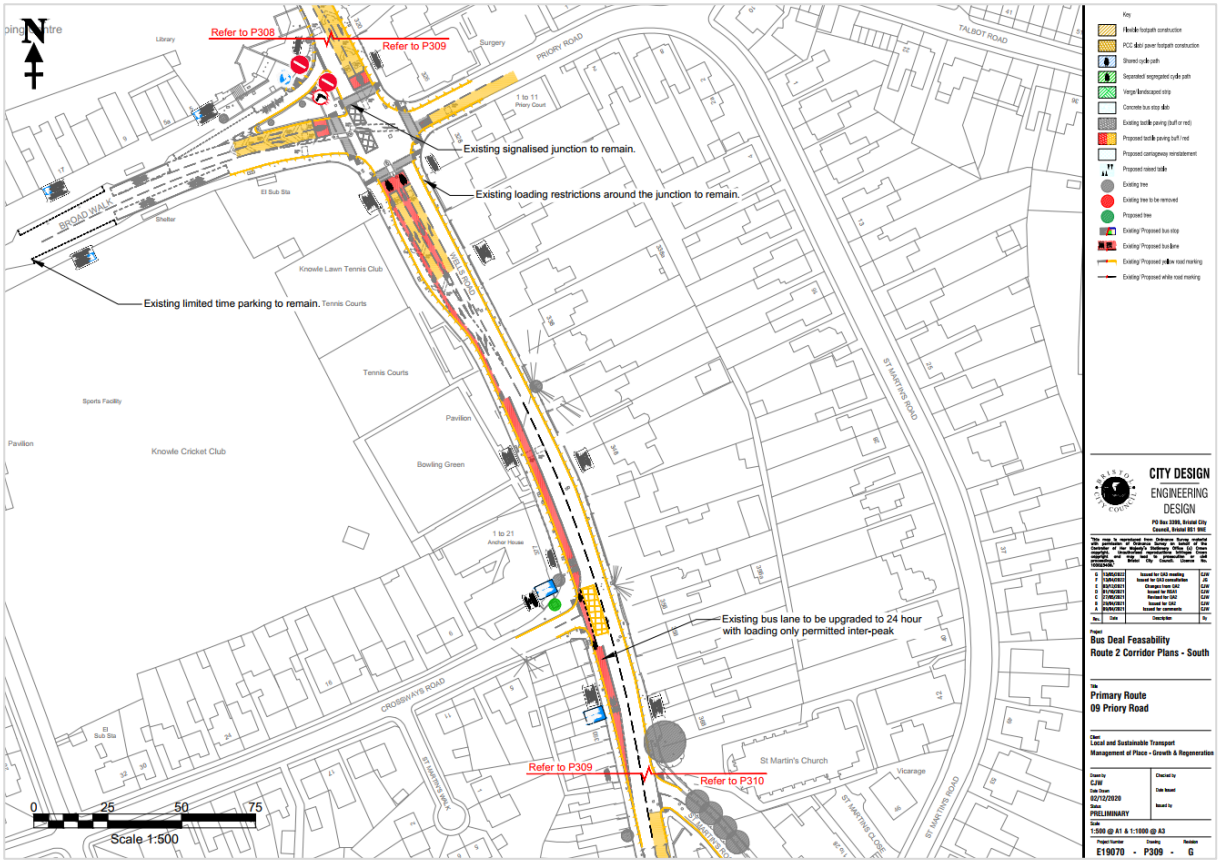

Refer to P303
Refer to P304
Refer to P305
Existing controlled crossings to remain.
Bellevue Road junction to be closed and existing landscaping area increased.
Existing controlled crossings to be adjusted to assist cyclists
Possible FTZ area.
Existing bus stop to upgraded/extended.
Existing peak hour no entry removed.
Access from A4 to A37 to become signalised in order to prevent exit blocking for traffic coming from the direction of Temple Circus.
Cycleway to be kept on carriageway to segregate from pedestrians.
Existing residential parking restrictions to be refreshed and reviewed to ensure acceptable tracking for emergency and refuse vehicles.
Reconstruction of existing concrete pad.
Existing controlled crossing to be adjusted to suit.
Carriageway widening and reprofiling.
Existing bus stop to be upgraded and concrete pad reconstructed.
Existing 24 hour bus lane to be realigned
Limit of existing BCC owned land and purchase of private land to be explored for project development.
Existing right turn lane to be extended to prevent blocking outbound buses on A37.
Existing loading bay to be realigned.
Existing cycle lane to be upgraded.
0 25 50 75
Scale 1:500
CITY DESIGN
ENGINEERING
DESIGN
Bus Deal Feasability
Route 2 Corridor Plans - South
Primary Route
04 Bellevue Road
PRELIMINARY
1:500 @ A1 & 1:1000 @ A3
E19070 - P304 - F

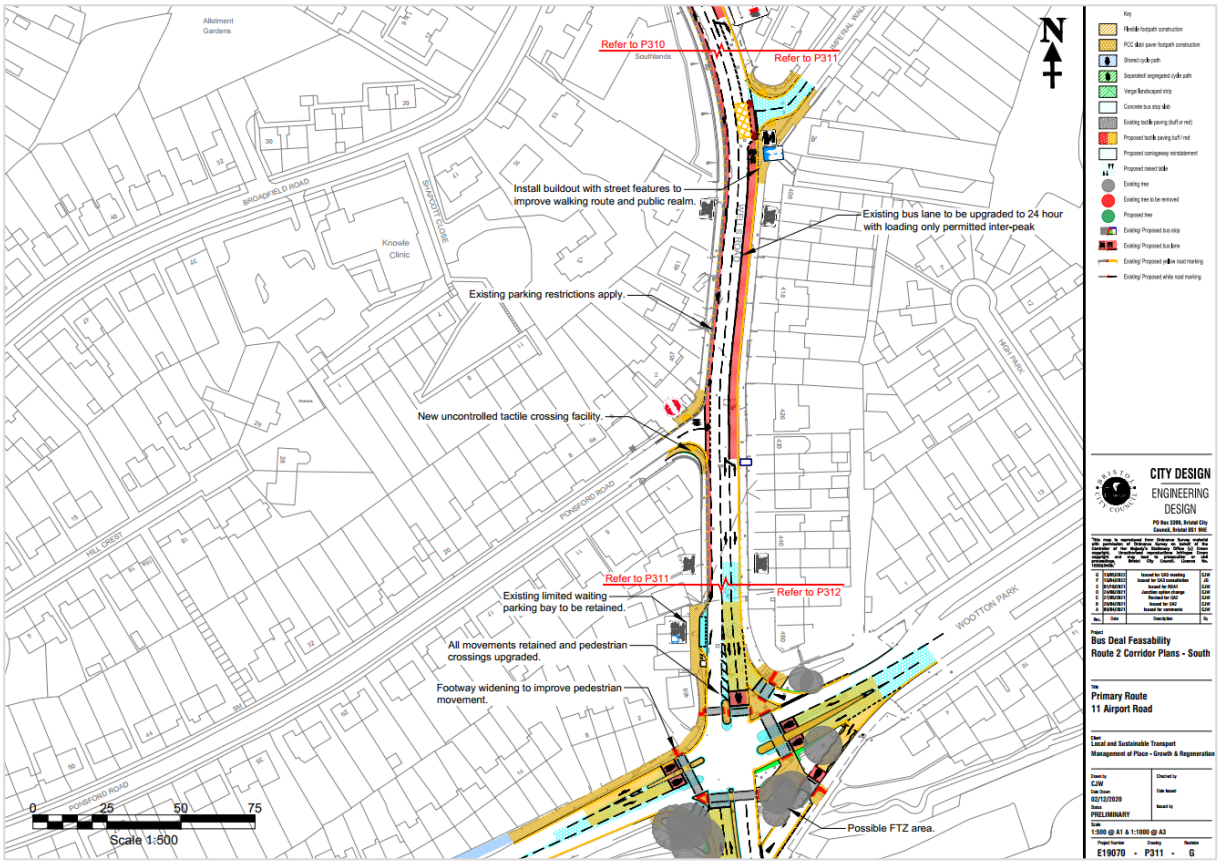

Refer to P304
Refer to P305
New single stage crossing to reduce pedestrian delay
New uncontrolled tactile crossing facility.
Existing bus stop to remain and concrete pad installed.
Proposed cycle link.
Refer to insert
Proposed start/end point of Cycle Route signage.
New uncontrolled tactile crossing facility.
Existing bus stop to remain and concrete pad installed.
Proposed raised table to reduce vehicle speeds
Existing crossing to be upgraded.
Proposed traffic management measures to reduce rat running between A4 and A37
P305 Insert - St Johns Lane
New uncontrolled tactile crossing facility
New signal controlled crossing.
Proposed signposted on-carriageway cycle route.
Proposed limited waiting parking bays to serve shops
Existing bus lane to be upgraded to 24 hour with loading only permitted inter-peak
Proposed limited waiting parking bays to serve shops
Existing bus stop facility to be upgraded.
New uncontrolled tactile crossing facility.
Proposed signposted on-carriageway cycle route.
Refer to P319
Refer to P306
0 25 50 75
Scale 1:500
CITY DESIGN
ENGINEERING DESIGN
Bus Deal Feasability
Route 2 Corridor Plans - South
Primary Route
05 St Johns Lane
Local and Sustainable Transport
Management of Place - Growth & Regeneration
PRELIMINARY
1:500 @ A1 & 1:1000 @ A3
E19070 - P305 - F


Refer to P305
Existing controlled crossing to remain with cycle ASL's added.
Existing uncontrolled crossing to remain.
New uncontrolled tactile crossing facility.
Existing bus stop to be extended and concrete pad installed.
Refer to P306
Existing bus lane to be upgraded to 24 hour with loading only permitted inter-peak.
Existing single yellow lines to be upgraded to double yellow with peak hour loading bans
Existing bus stop to be extended and concrete pad installed.
Existing uncontrolled crossing to remain.
Existing controlled crossing to remain with cycle ASL's added.
Existing uncontrolled crossing to remain.
Install buildout to improve pedestrian movement and public realm.
New uncontrolled tactile crossing facility.
Existing one way road to be adjusted to permit cycle contra-flow.
Existing uncontrolled crossing to remain.
Existing bus lane to be upgraded to 24 hour with loading only permitted inter-peak
Existing single yellow lines to be upgraded to double yellow with peak hour loading bans
Refer to P306
Refer to P307
0 25 50 75
Scale 1:500
CITY DESIGN
ENGINEERING DESIGN
Bus Deal Feasability
Route 2 Corridor Plans - South
Primary Route
06 School Road
Local and Sustainable Transport
Management of Place - Growth & Regeneration
PRELIMINARY
1:500 @ A1 & 1:1000 @ A3
E19070 - P306 - F

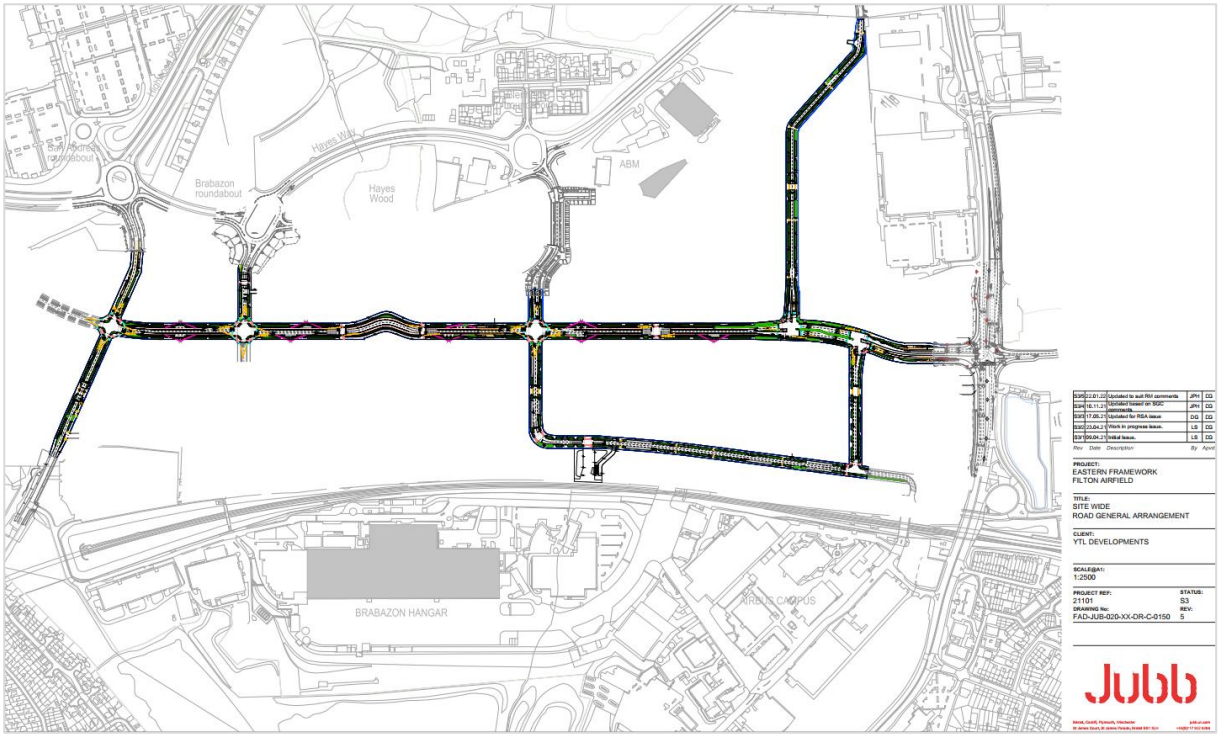

Refer to P306
Refer to P307
New one way restriction on Belluton Road
New uncontrolled tactile crossing facility.
New uncontrolled tactile crossing facility.
Existing bus stop to be extended and concrete pad installed.
Existing bus lane to be upgraded to 24 hour with loading only permitted inter-peak
Existing bus stop to be extended and concrete pad installed.
New signal controlled pedestrian crossing built as part of Traffic Signals capital improvement schemes.
Existing bus lane to be upgraded to 24 hour with loading only permitted inter-peak
Refer to P307
Refer to P308
Scale 1:500
CITY DESIGN
ENGINEERING
DESIGN
Bus Deal Feasability
Route 2 Corridor Plans - South
Primary Route
07 Beaconsfield Road
PRELIMINARY
E19070 - P307 - G

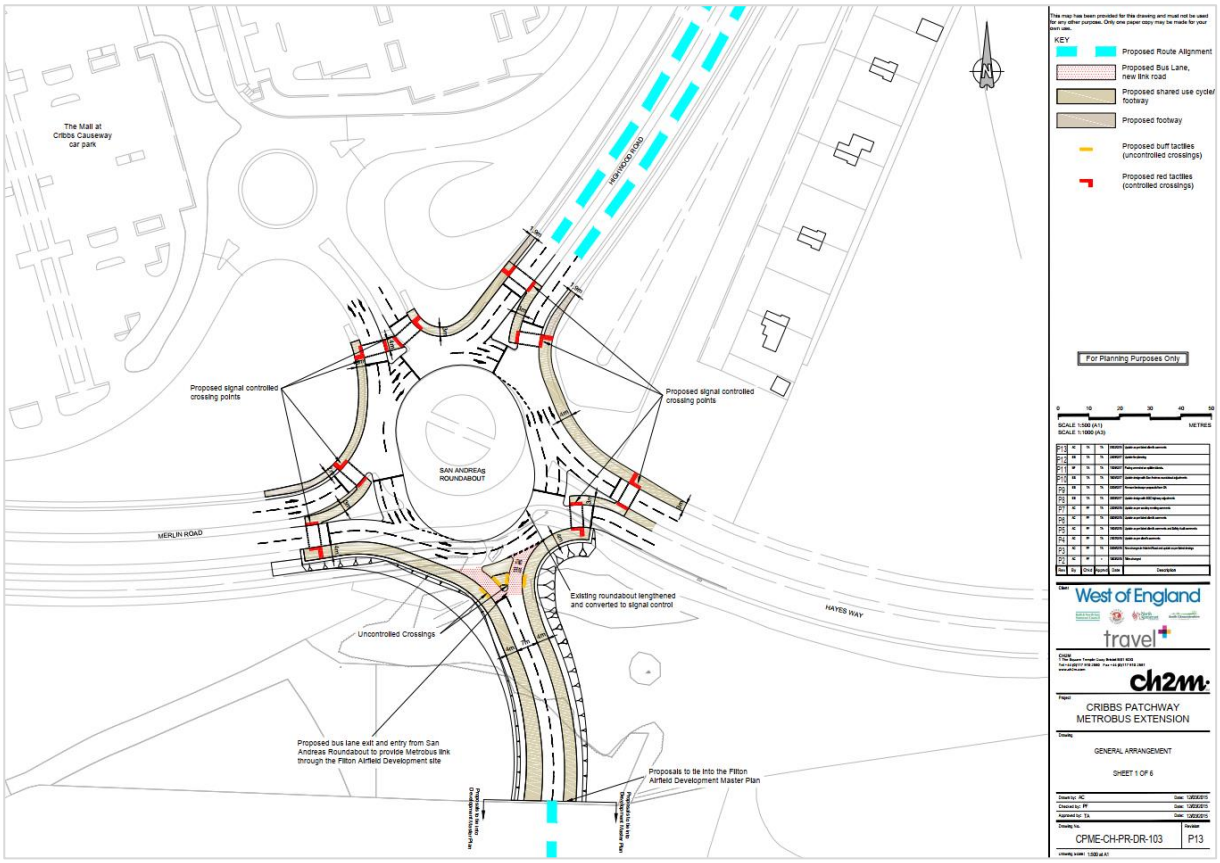

Refer to P307
Refer to P308
New uncontrolled tactile crossing facilities.
New build out to improve pedestrian crossing point
New uncontrolled tactile crossing facility.
Existing bus lane to be upgraded to 24 hour with loading only permitted inter-peak
Existing bus stops to remain and concrete pads installed.
Refer to P321
Redevelopment of controlled tactile crossing facility planned to become a single stage crossing.
Redcatch Road to be adjusted to permit cycle contra-flow.
Refer to P308
Right turn lane to be retained (bus route).
Existing loading restrictions to be retained around the junction.
Broadwalk Shopping Centre
Refer to P308
Refer to P309
Potential for bus hub and FTZ area
Existing signalised junction to remain.
Scale 1:500
CITY DESIGN
ENGINEERING
DESIGN
Bus Deal Feasability
Route 2 Corridor Plans - South
Primary Route
08 Redcatch Road
PRELIMINARY
E19070 - P308 - G

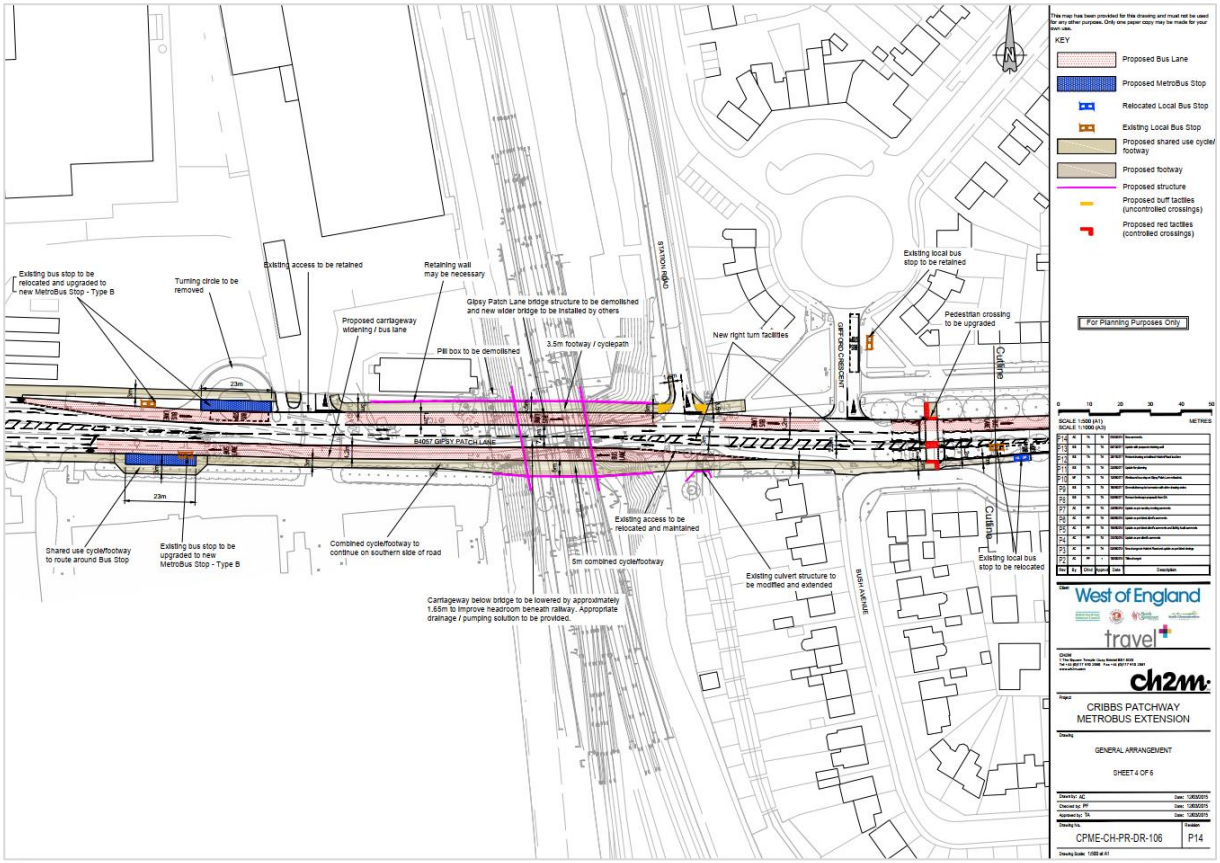

Refer to P308
Refer to P309
Existing signalised junction to remain.
Existing loading restrictions around the junction to remain.
Existing limited time parking to remain.
Existing bus lane to be upgraded to 24 hour with loading only permitted inter-peak
Refer to P309
Refer to P310
0 25 50 75
Scale 1:500
CITY DESIGN
ENGINEERING DESIGN
Bus Deal Feasability
Route 2 Corridor Plans - South
Primary Route
09 Priory Road
Local and Sustainable Transport
Management of Place - Growth & Regeneration
PRELIMINARY
1:500 @ A1 & 1:1000 @ A3
E19070 - P309 - G

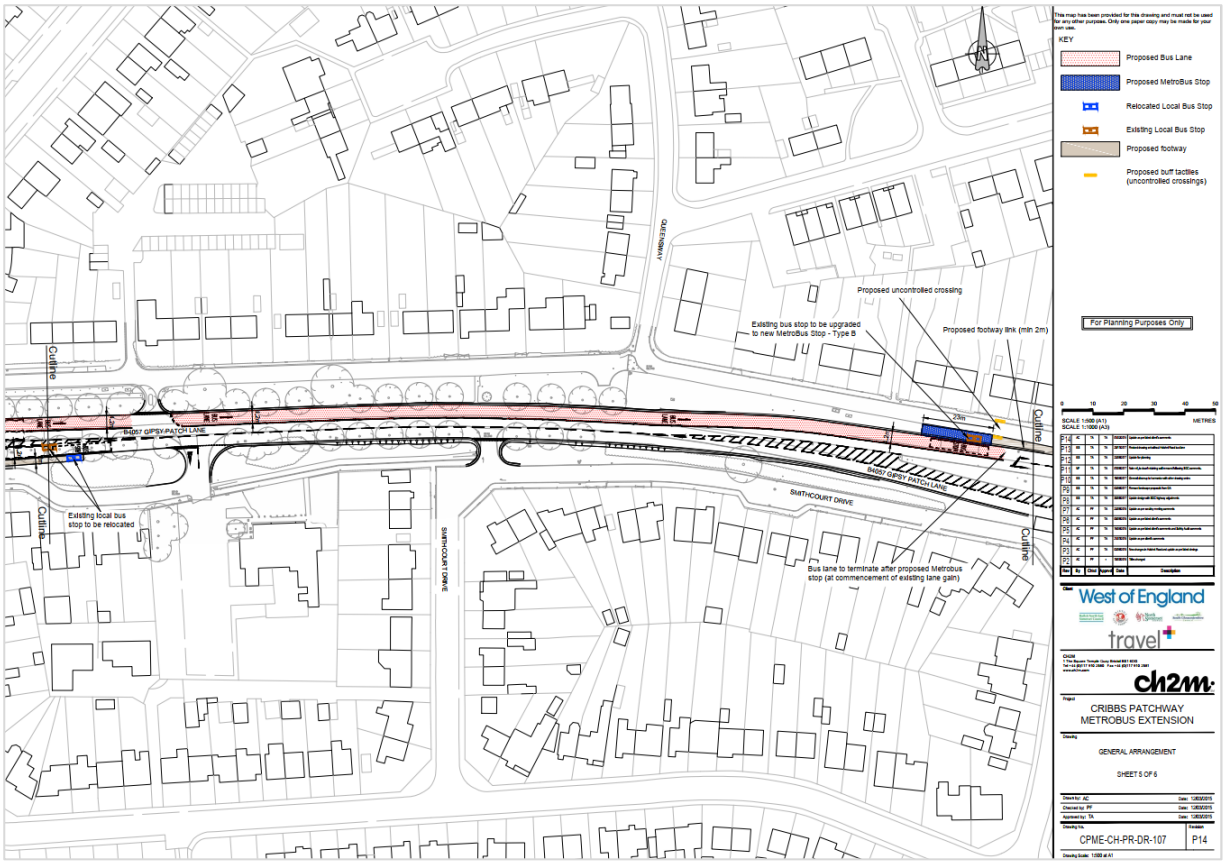

Refer to P310
Refer to P311
Install buildout with street features to improve walking route and public realm.
Existing bus lane to be upgraded to 24 hour with loading only permitted inter-peak
Existing parking restrictions apply.
New uncontrolled tactile crossing facility.
Refer to P311
Refer to P312
Existing limited waiting parking bay to be retained.
All movements retained and pedestrian crossings upgraded.
Footway widening to improve pedestrian movement.
Possible FTZ area.
0 25 50 75
Scale 1:500
CITY DESIGN
ENGINEERING DESIGN
Bus Deal Feasability
Route 2 Corridor Plans - South
Primary Route
11 Airport Road
Local and Sustainable Transport
Management of Place - Growth & Regeneration
PRELIMINARY
1:500 @ A1 & 1:1000 @ A3
E19070 - P311 - G

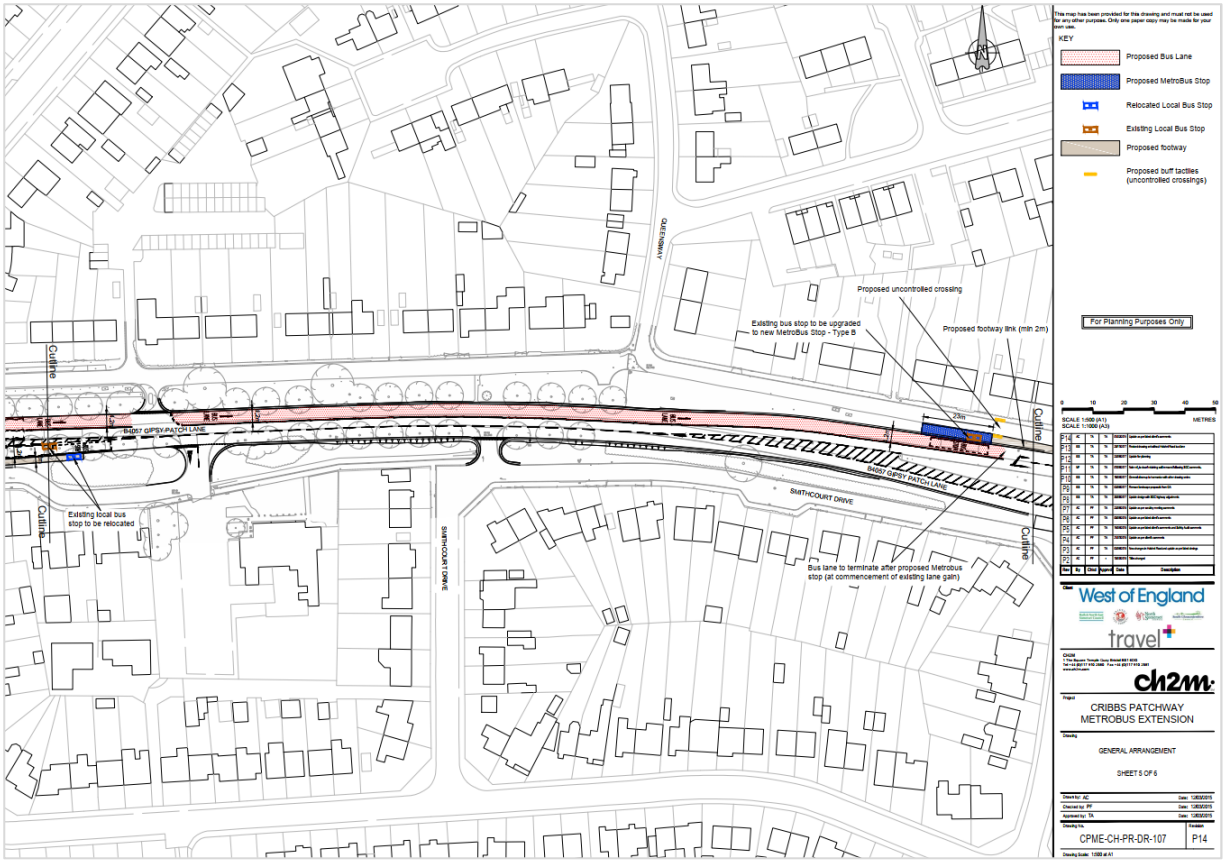
E.2 Cribbs Patchway Metrobus Extension






KEY
Proposed Bus Lane
Proposed MetroBus Stop
Relocated Local Bus Stop
Existing Local Bus Stop
Proposed shared use cycle/footway
Proposed footway
Proposed structure
Proposed buff tactiles (uncontrolled crossings)
Proposed red tactiles (controlled crossings)
For Planning Purposes Only
Existing bus stop to be relocated and upgraded to new MetroBus Stop - Type B
Turning circle to be removed
Existing access to be retained
Retaining wall may be necessary
Gipsy Patch Lane bridge structure to be demolished and new wider bridge to be installed by others
Proposed carriageway widening / bus lane
Pill box to be demolished
3.5m footway / cyclepath
New right turn facilities
Existing local bus stop to be retained
Pedestrian crossing to be upgraded
Cutting
B4057 GIPSY PATCH LANE
Existing access to be relocated and maintained
Shared use cycle/footway to route around Bus Stop
Existing bus stop to be upgraded to new MetroBus Stop - Type B
Combined cycle/footway to continue on southern side of road
5m combined cycle/footway
Existing culvert structure to be modified and extended
Existing local bus stop to be relocated
Carriageway below bridge to be lowered by approximately 1.65m to improve headroom beneath railway. Appropriate drainage / pumping solution to be provided.
BISHOPSWORTH ROAD
CLIFFORD CRESCENT
BISHOPSWORTH AVENUE
West of England
travel
ch2m
CRIBBS PATCHWAY METROBUS EXTENSION
GENERAL ARRANGEMENT
SHEET 4 OF 6
CPME-CH-PR-DR-106
P14


KEY
Proposed Bus Lane
Proposed MetroBus Stop
Relocated Local Bus Stop
Existing Local Bus Stop
Proposed footway
Proposed buff tactiles (uncontrolled crossings)
For Planning Purposes Only
Proposed uncontrolled crossing
Existing bus stop to be upgraded to new MetroBus Stop - Type B
Proposed footway link (min 2m)
Cutting
B4057 GIPSY PATCH LANE
SMITHCOURT DRIVE
Existing local bus stop to be relocated
Bus lane to terminate after proposed Metrobus stop (at commencement of existing lane gain)
QUEENSWAY
West of England
travel
ch2m
CRIBBS PATCHWAY METROBUS EXTENSION
GENERAL ARRANGEMENT
SHEET 5 OF 6
CPME-CH-PR-DR-107
P14

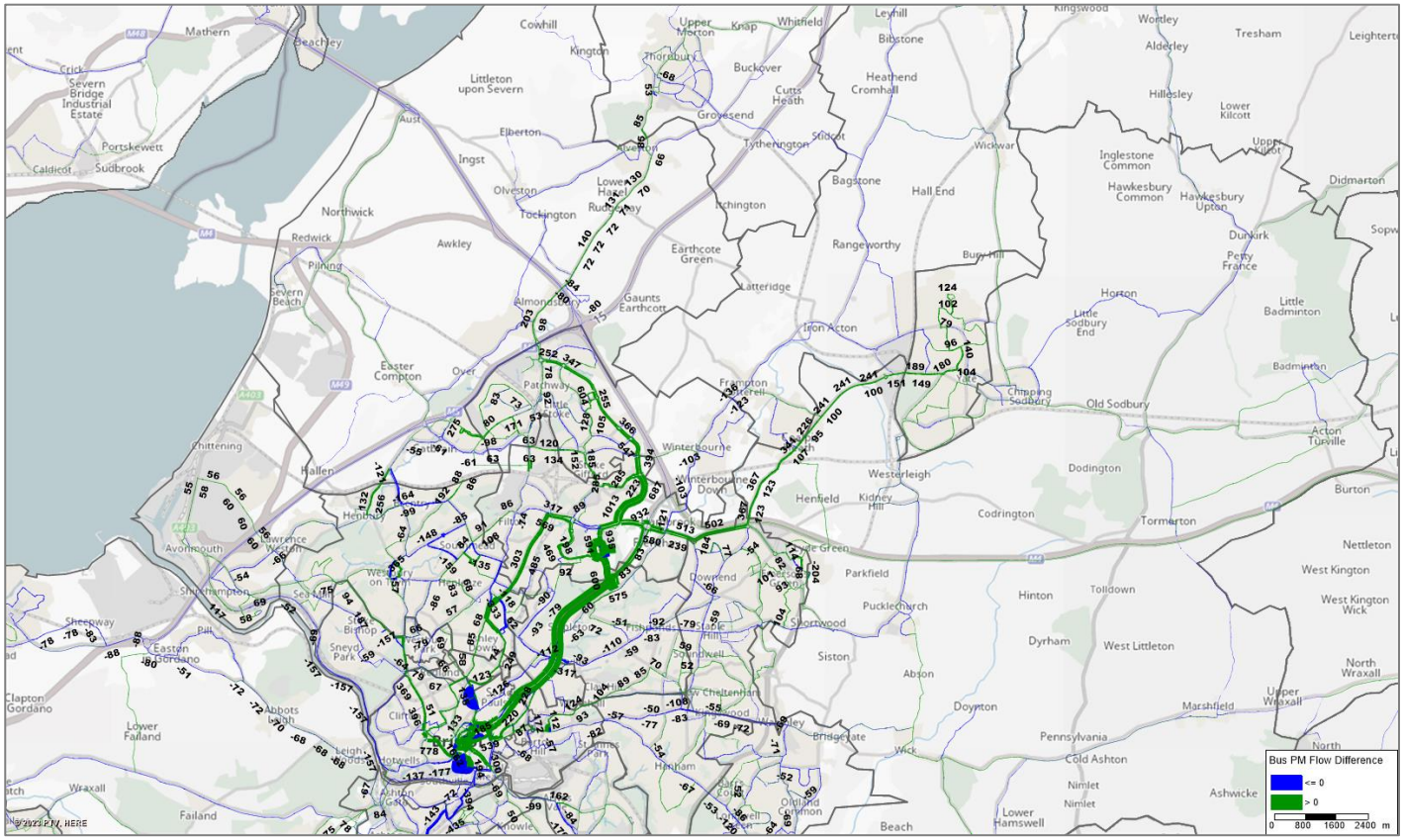

KEY
Proposed Bus Lane
Proposed MetroBus Stop
Relocated Local Bus Stop
Existing Local Bus Stop
Proposed footway
Proposed buff tactiles (uncontrolled crossings)
For Planning Purposes Only
Proposed uncontrolled crossing
Existing bus stop to be upgraded to new MetroBus Stop - Type B
Proposed footway link (min 2m)
Existing local bus stop to be relocated
Bus lane to terminate after proposed Metrobus stop (at commencement of existing lane gain)
B4057 GIPSY PATCH LANE
SMITHCOURT DRIVE
QUEENSWAY
Cutfirre
SCALE 1:500 (A1)
SCALE 1:1000 (A3)
METRES
West of England
travel
Ch2m
CRIBBS PATCHWAY
METROBUS EXTENSION
GENERAL ARRANGEMENT
SHEET 5 OF 6
CPME-CH-PR-DR-107
P14

E.3 MetroWest

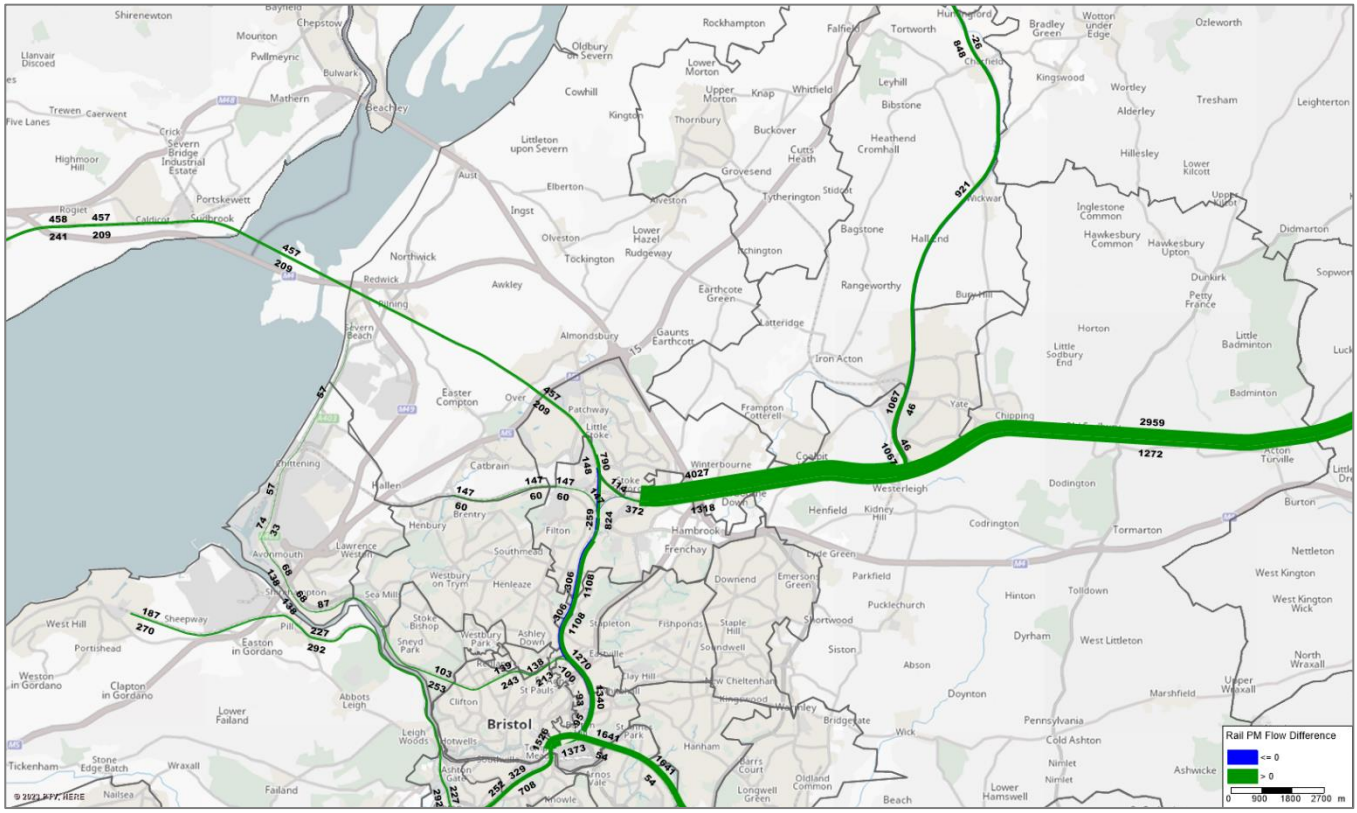
Appendix F. PT Difference Plots

F.1 Do Minimum vs Base

F.1.1 Bus PM Flow Difference (persons) - DM minus Base

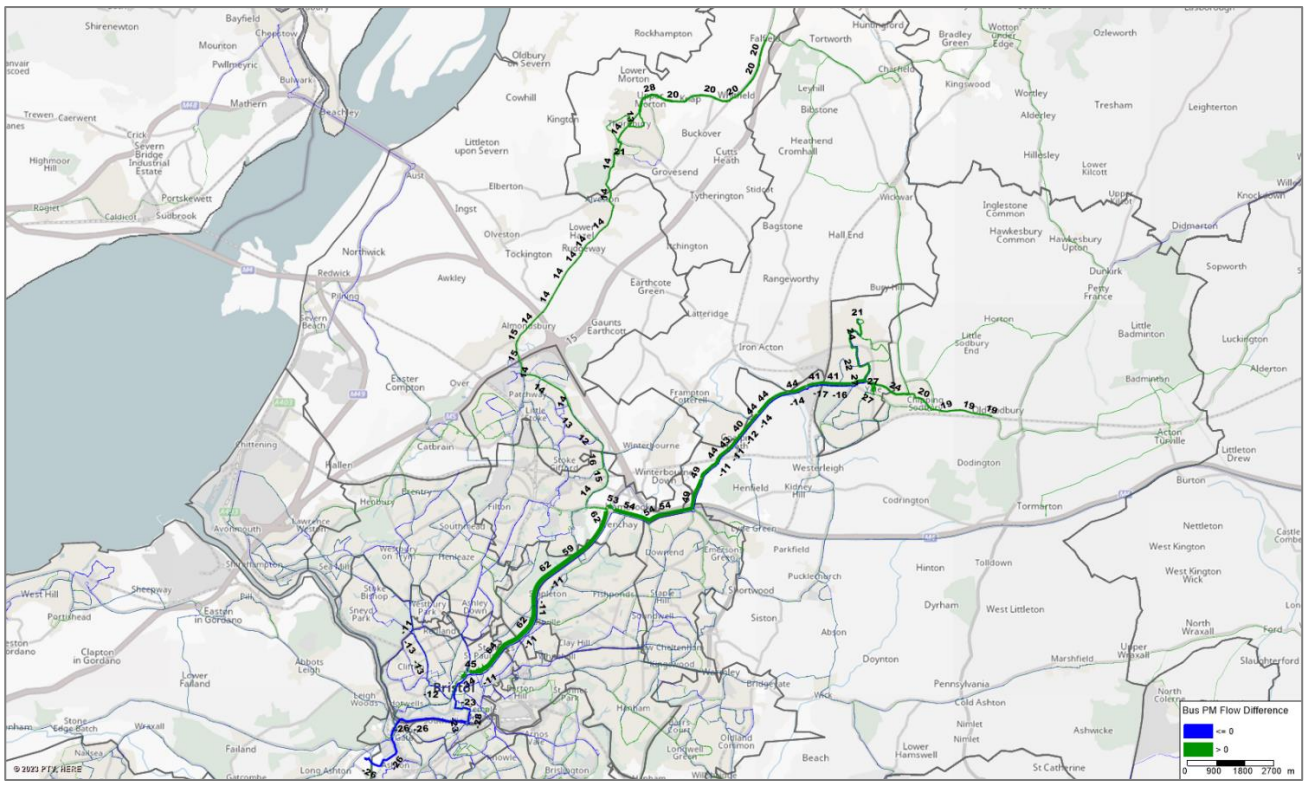


F.1.2 Rail PM Flow Difference (persons) - DM minus Base

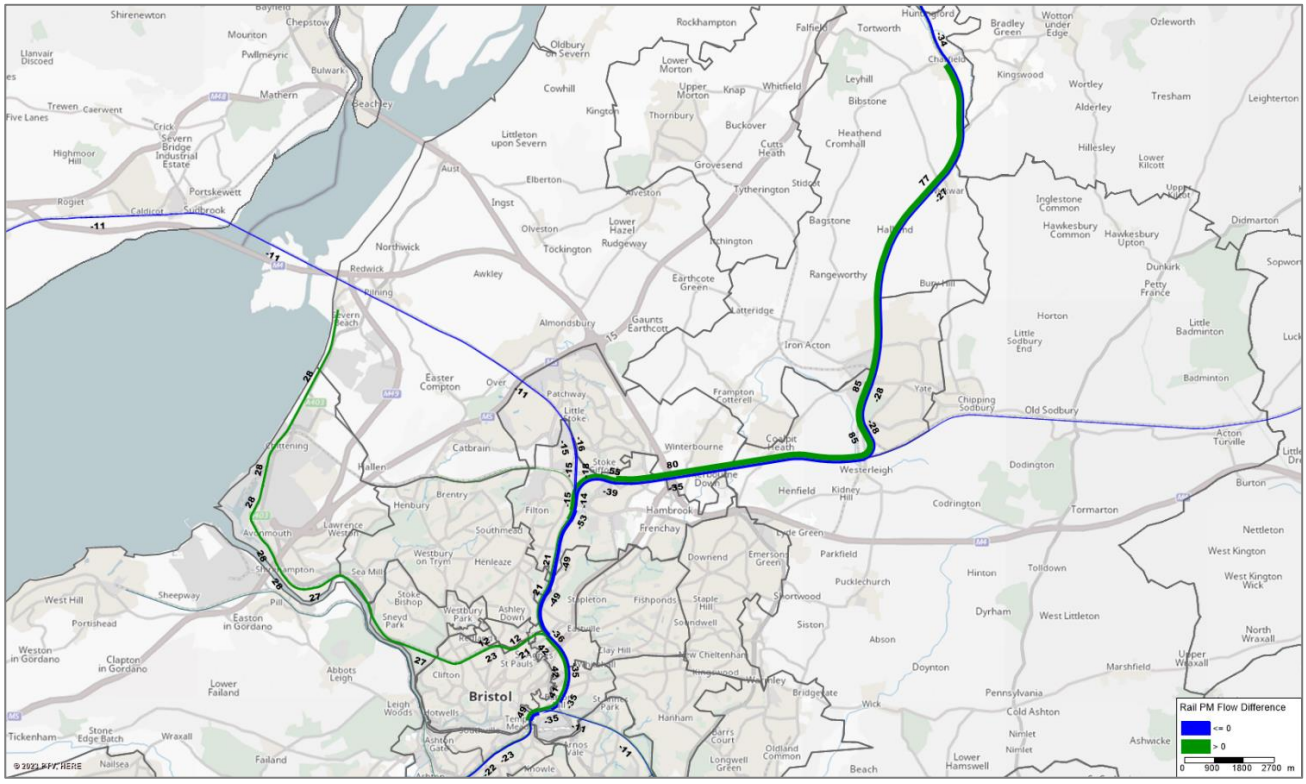


F.2 Lens 1 vs Do Minimum

F.2.1 Bus PM Flow Difference (persons) – Lens 1 minus DM

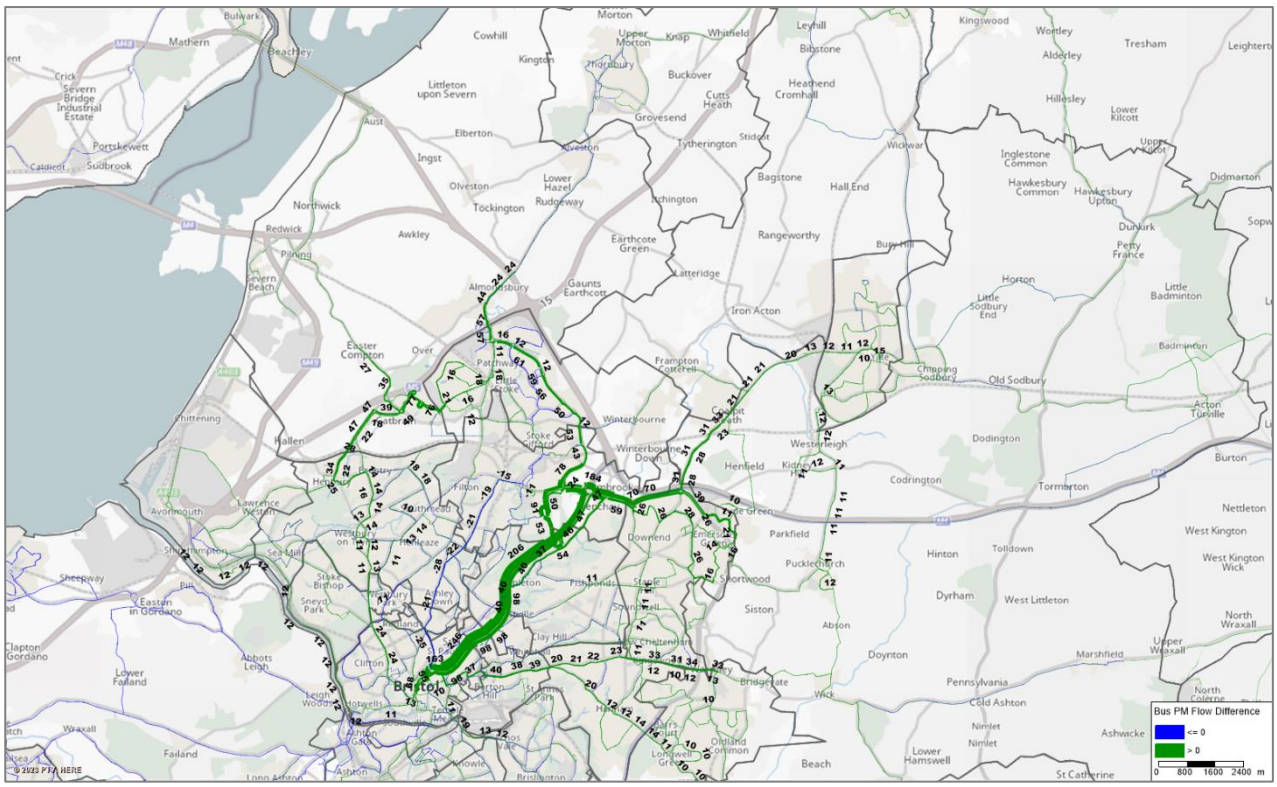


F.2.2 Rail PM Flow Difference (persons) - Lens 1 minus DM

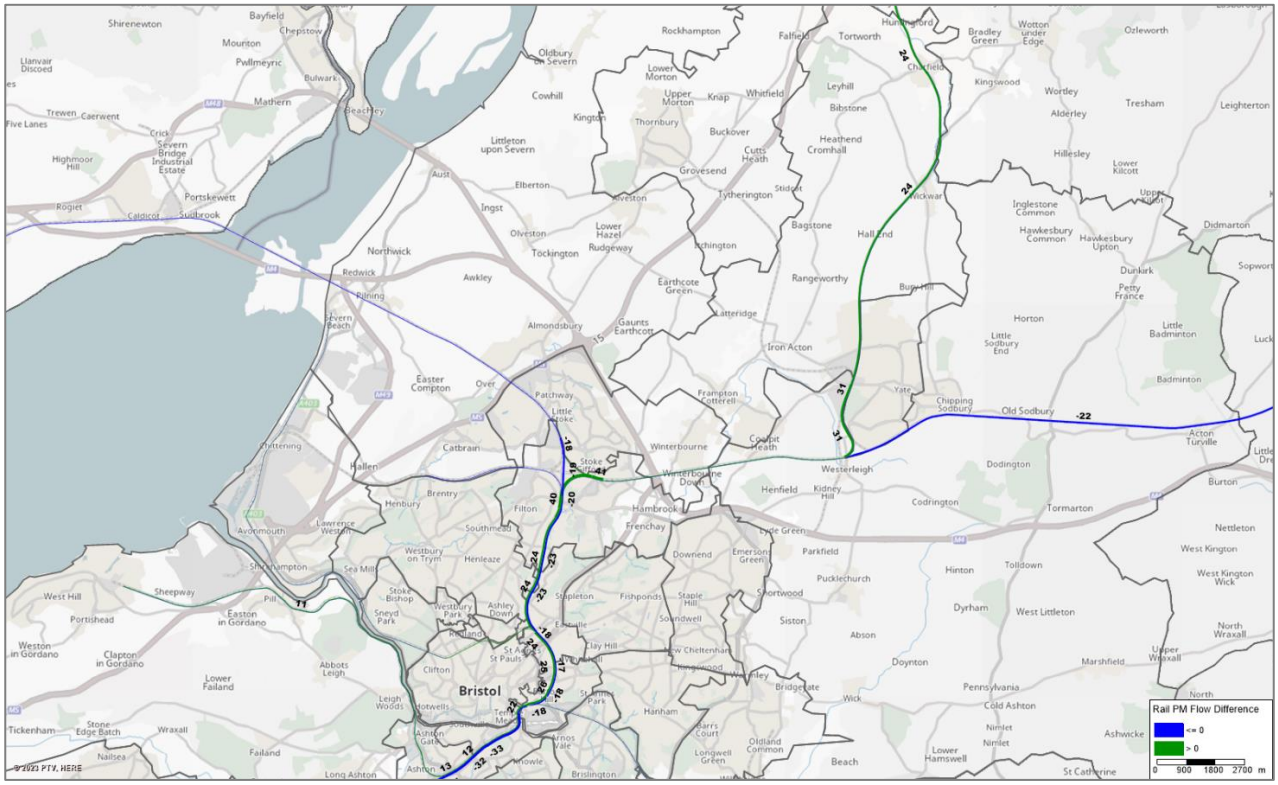


F.3 Lens 2 vs Do Minimum

F.3.1 Bus PM Flow Difference (persons) – Lens 2 minus DM

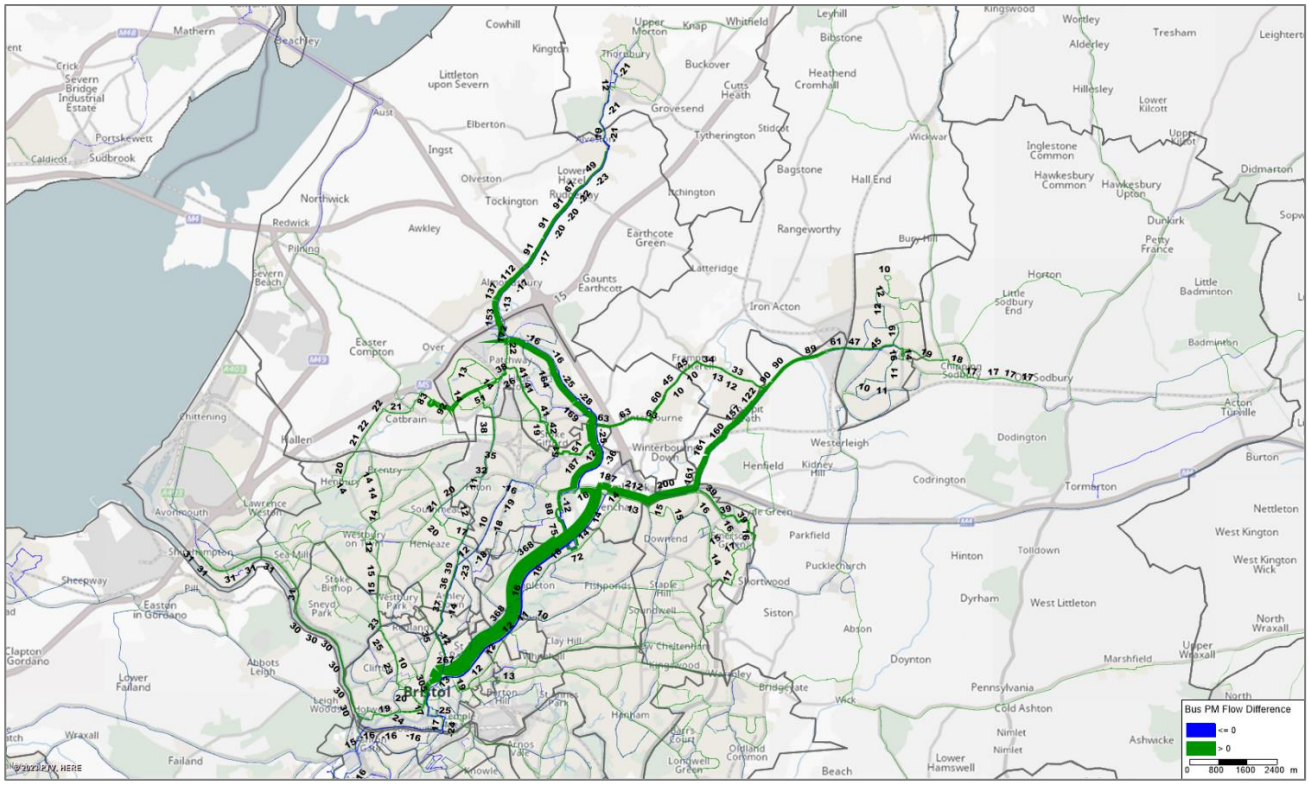


F.3.2 Rail PM Flow Difference (persons) – Lens 2 minus DM

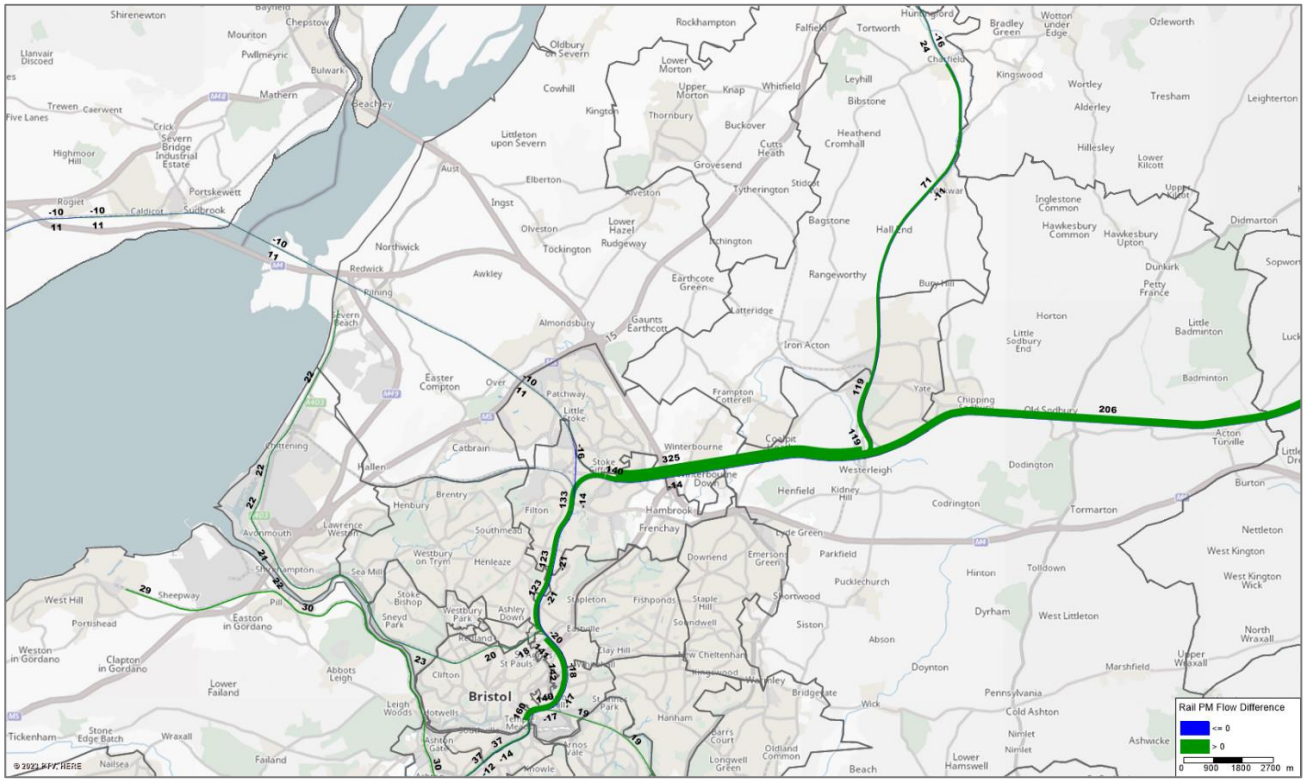


F.4 Lens 3 vs Do Minimum

F.4.1 Bus PM Flow Difference (persons) – Lens 3 minus DM

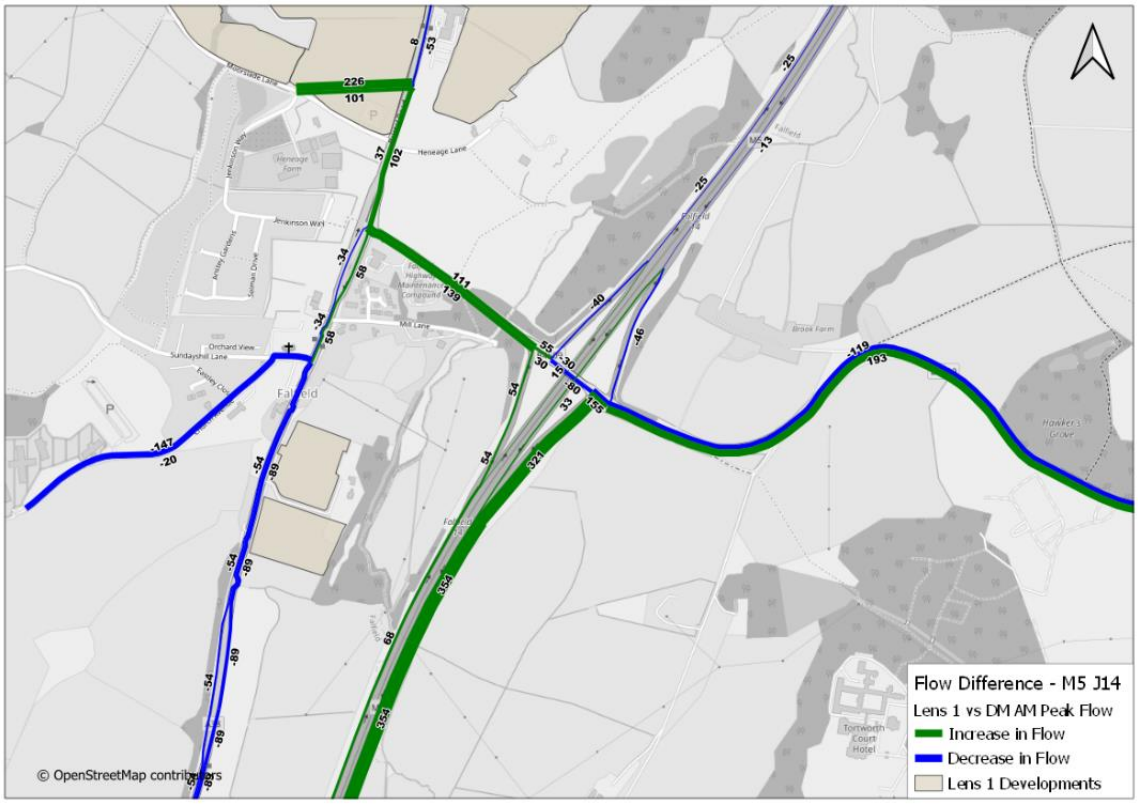


F.4.2 Rail PM Flow Difference (persons) – Lens 3 minus DM

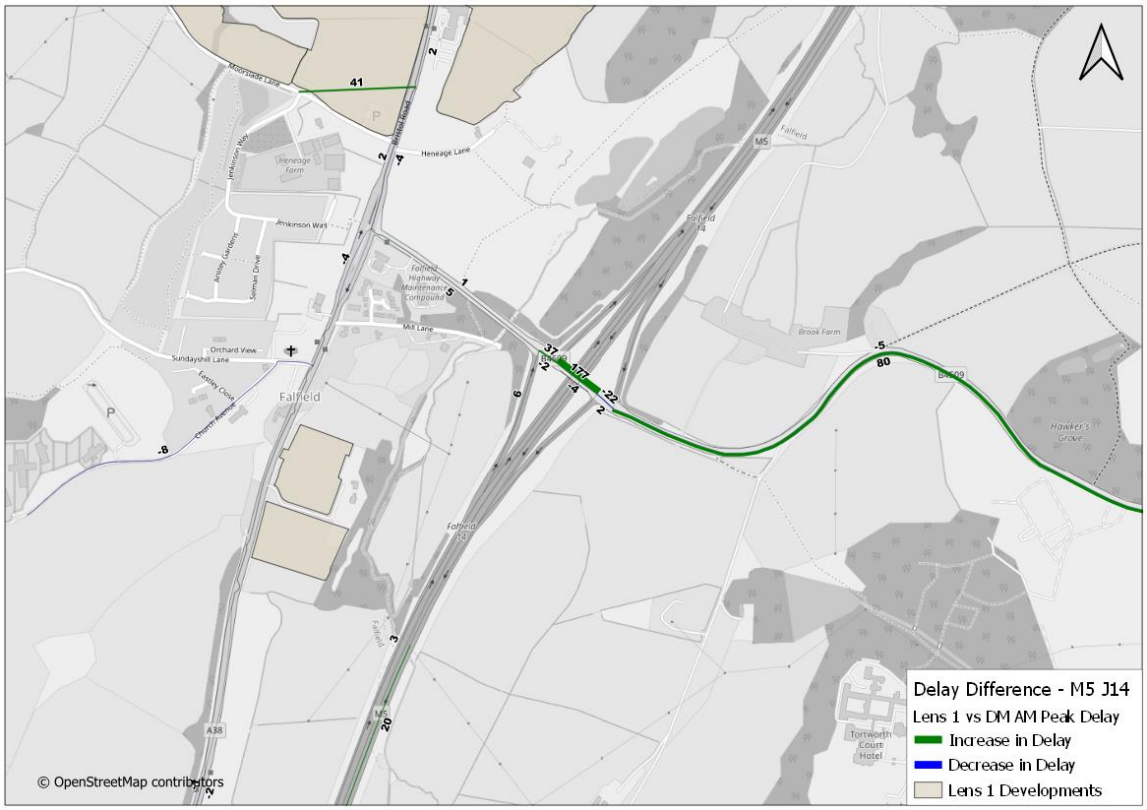


Appendix G. HAM Flow and Delay Difference plots at SRN Junctions

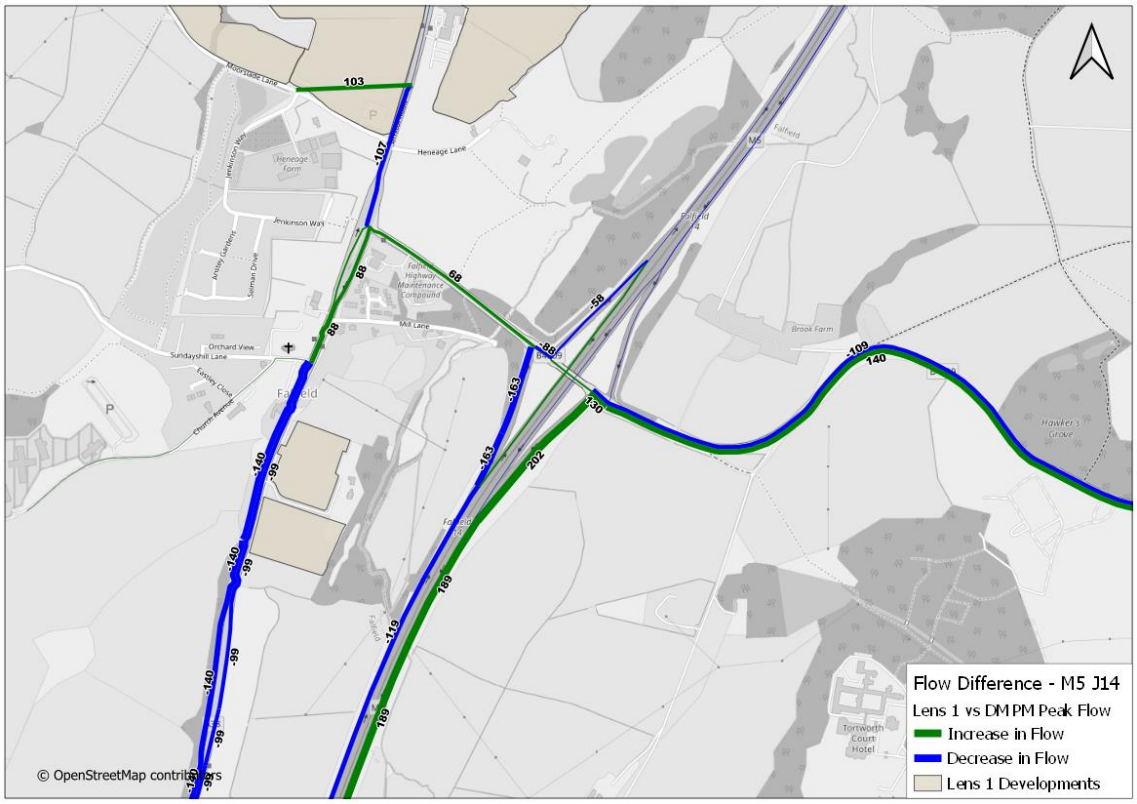
G.1 Lens 1 vs DM M5J14 AM Flow



G.2 Lens 1 vs DM M5J14 AM Delay

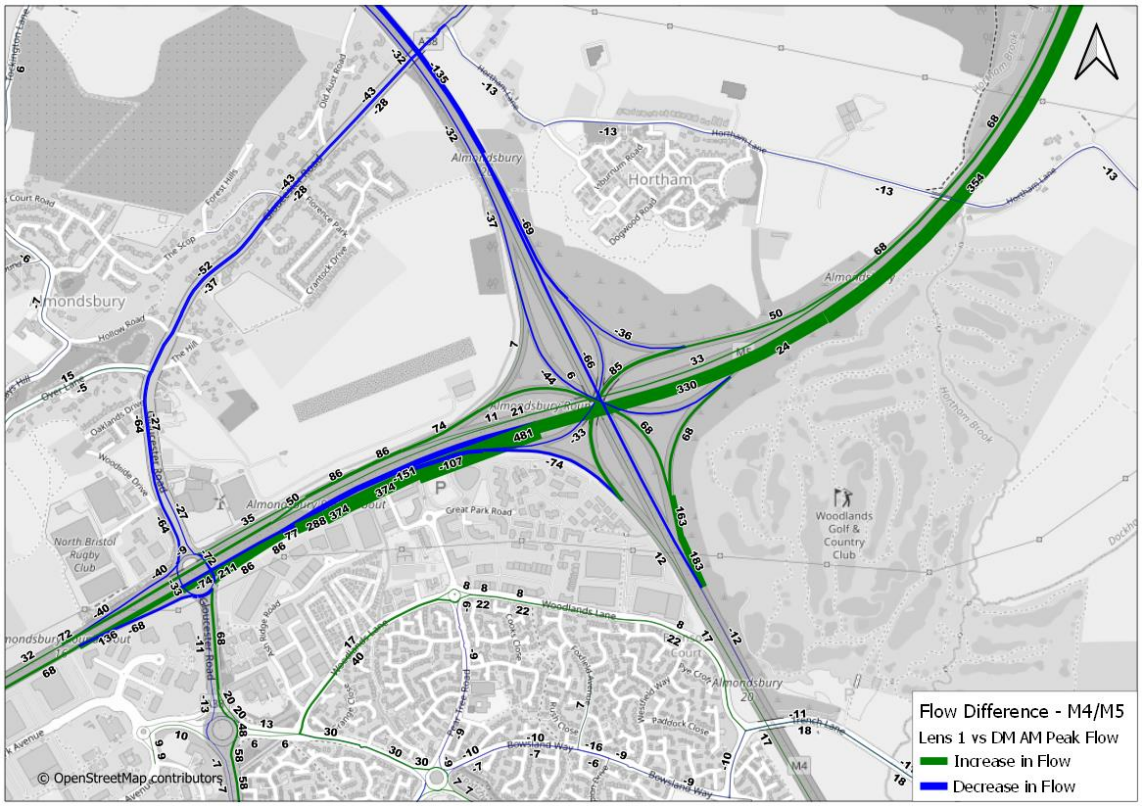


G.3 Lens 1 vs DM M5J14 PM Flow

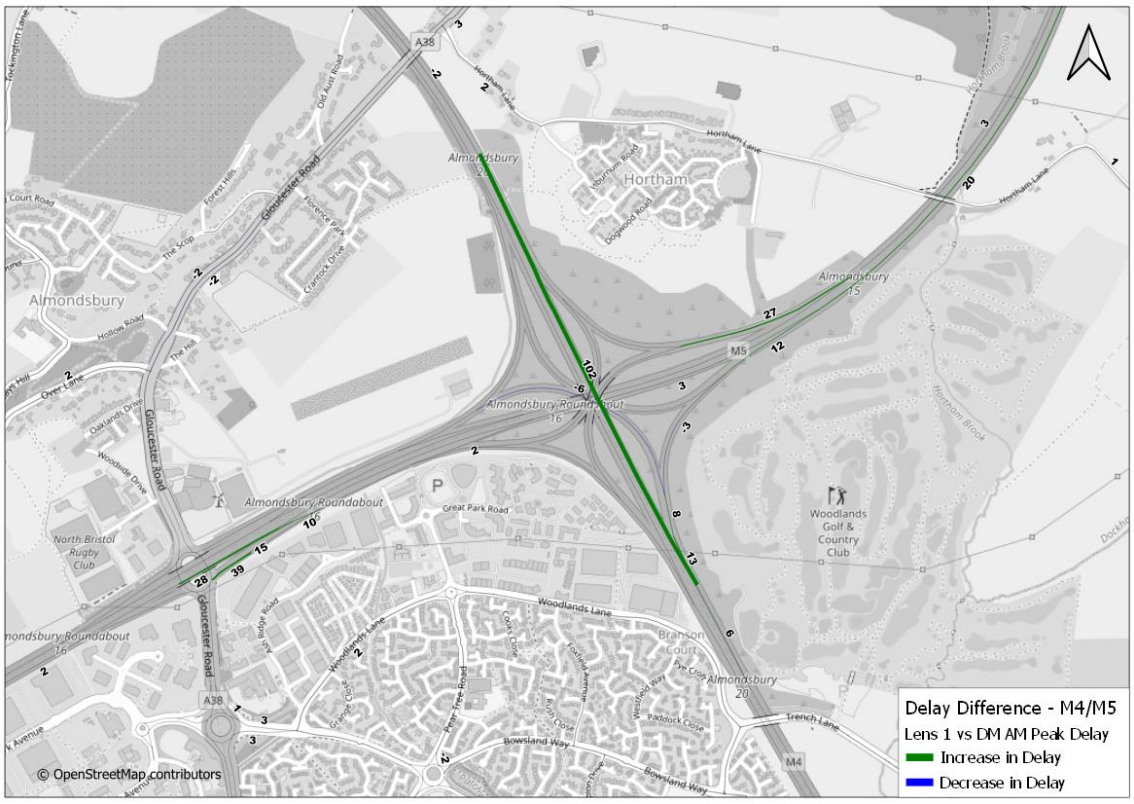


G.4 Lens 1 vs DM M5J14 PM Delay

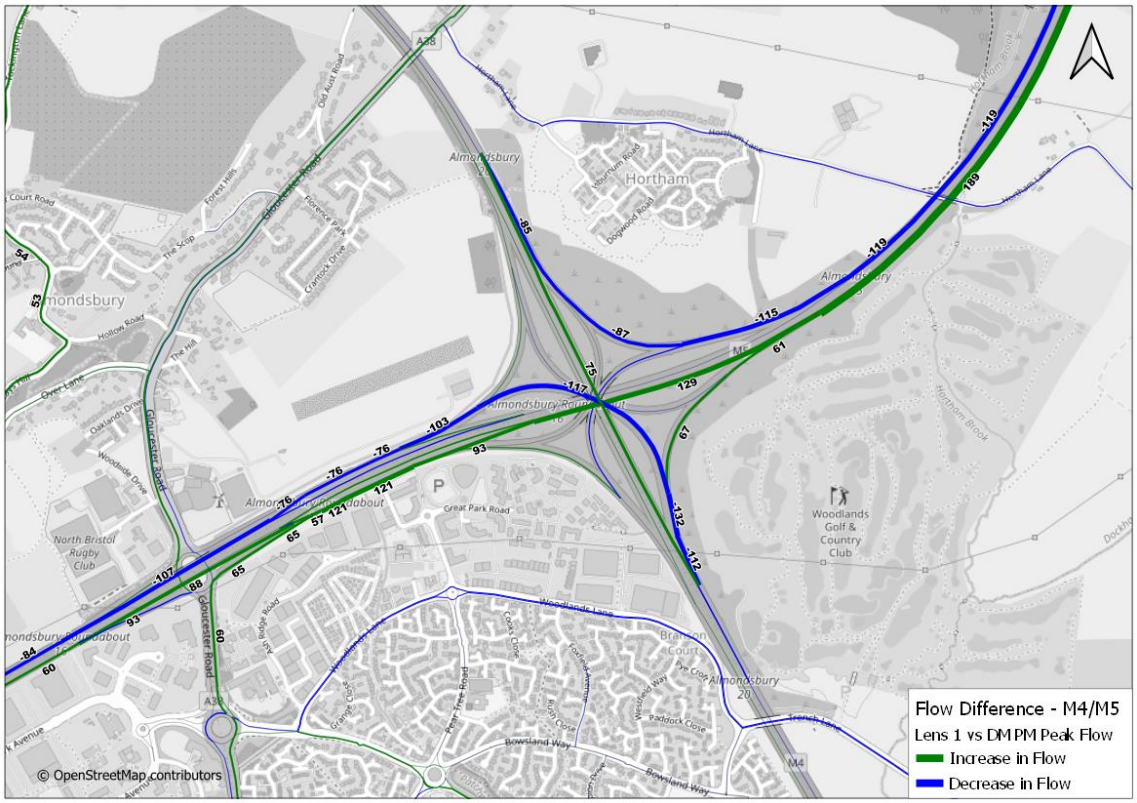
G.5 Lens 1 vs DM M4/M5 AM Flow



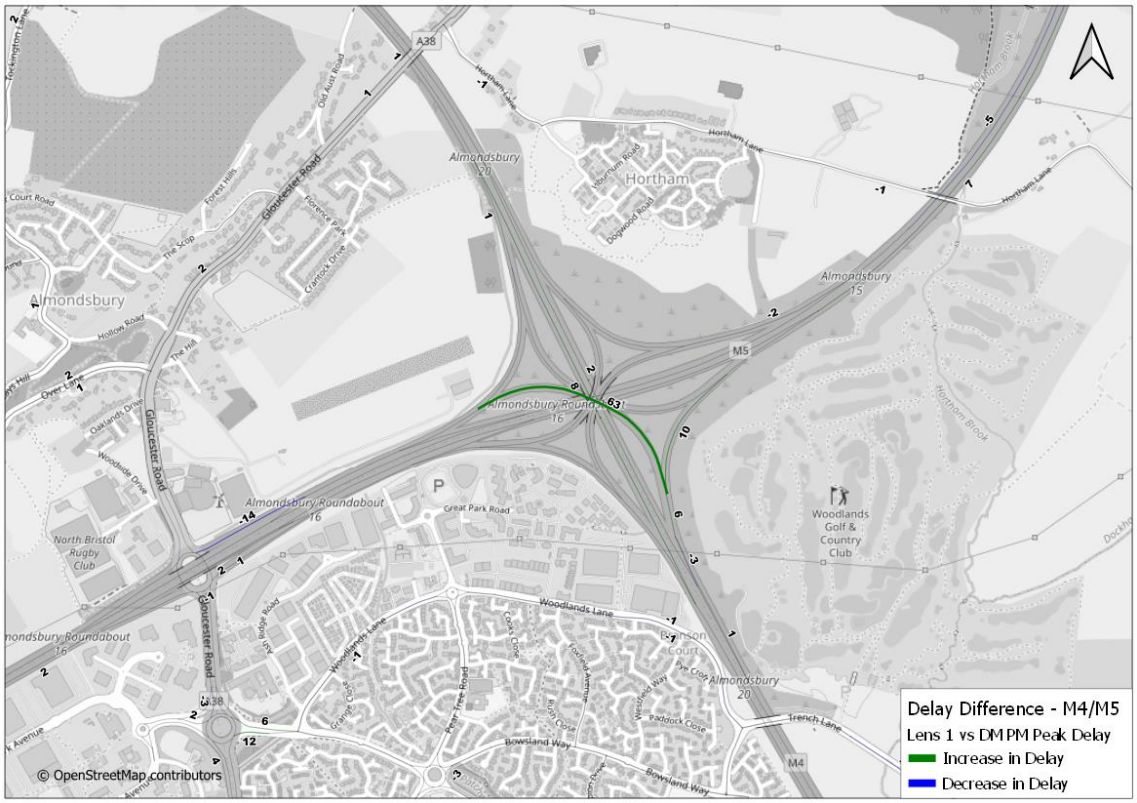
G.6 Lens 1 vs DM M4/M5 AM Delay



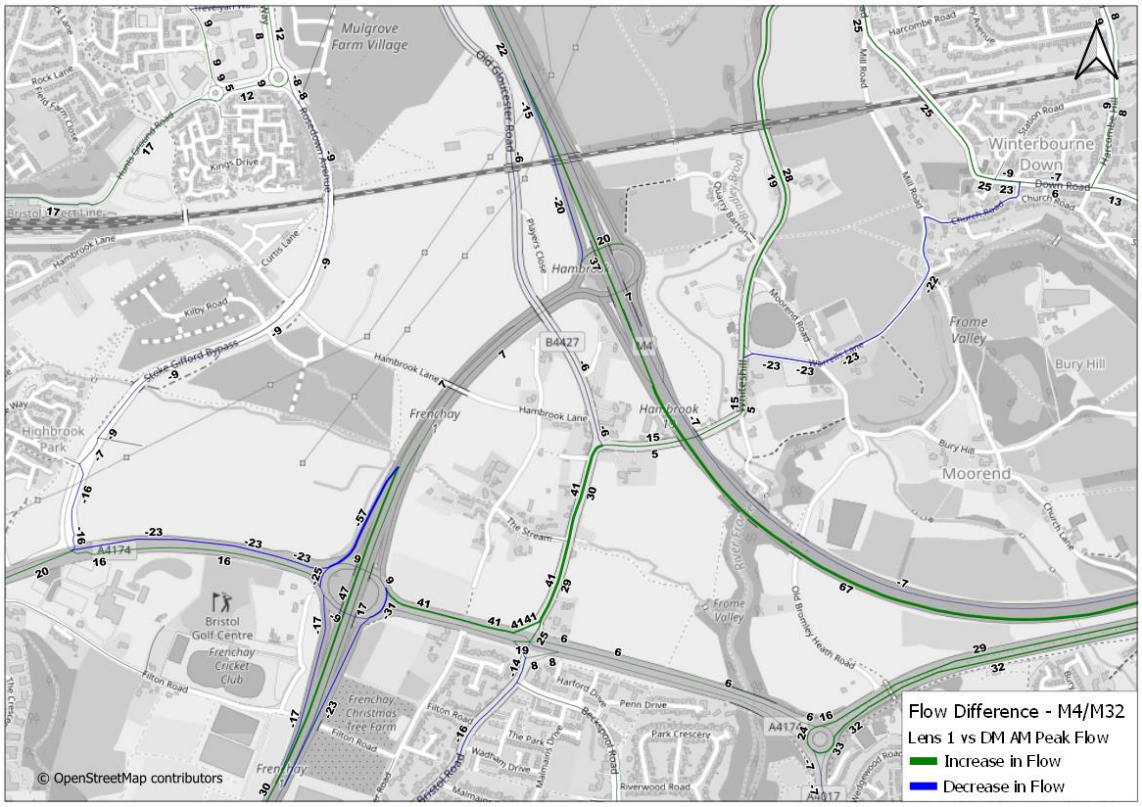
G.7 Lens 1 vs DM M4/M5 PM Flow



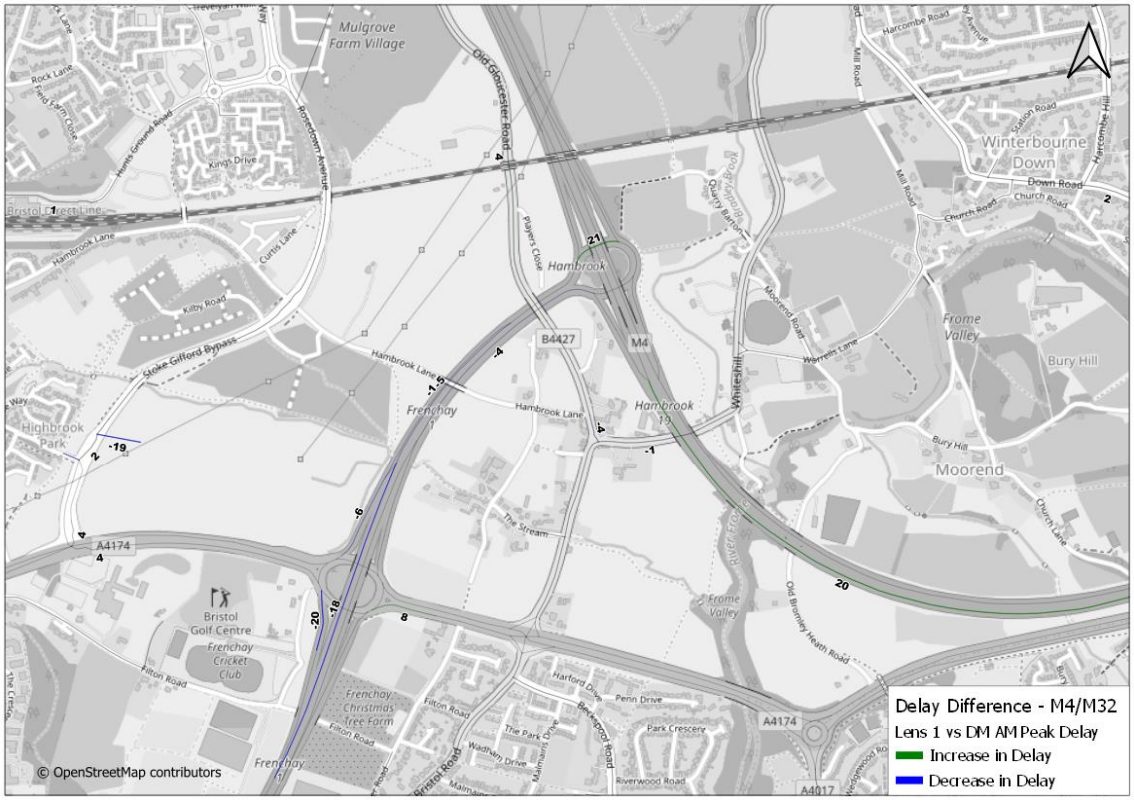
G.8 Lens 1 vs DM M4/M5 PM Delay



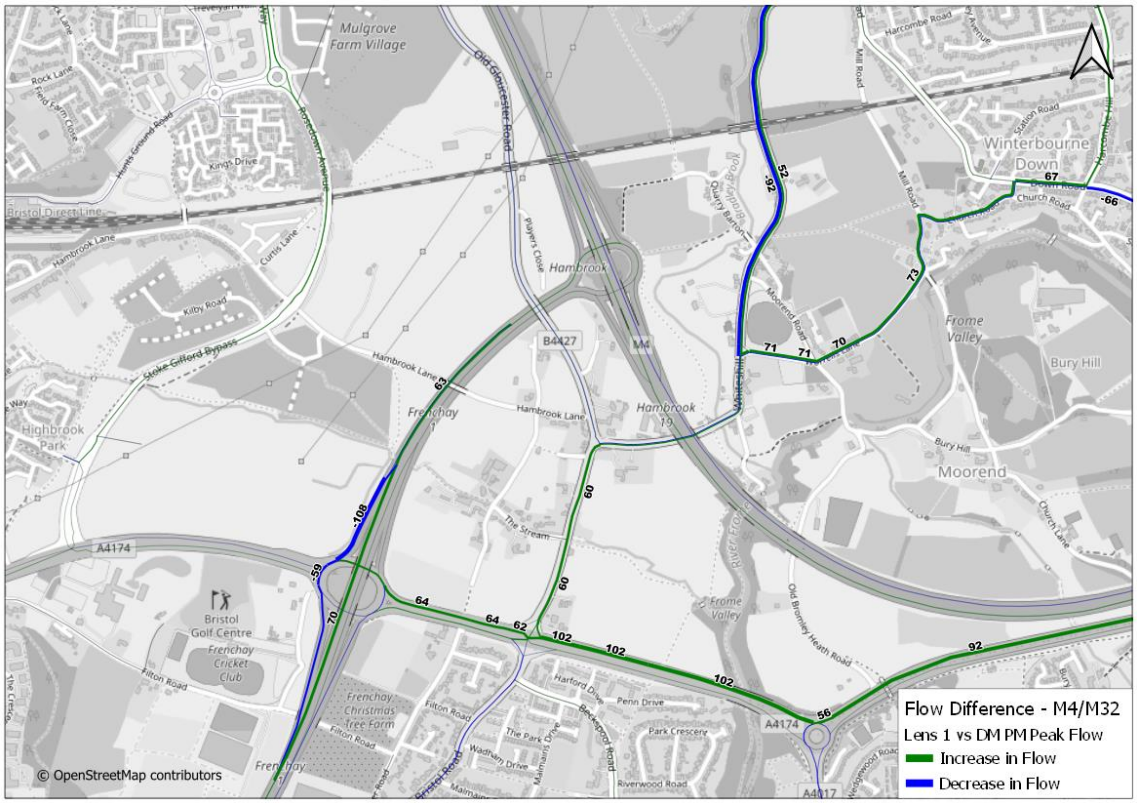
G.9 Lens 1 vs DM M4/M32 AM Flow



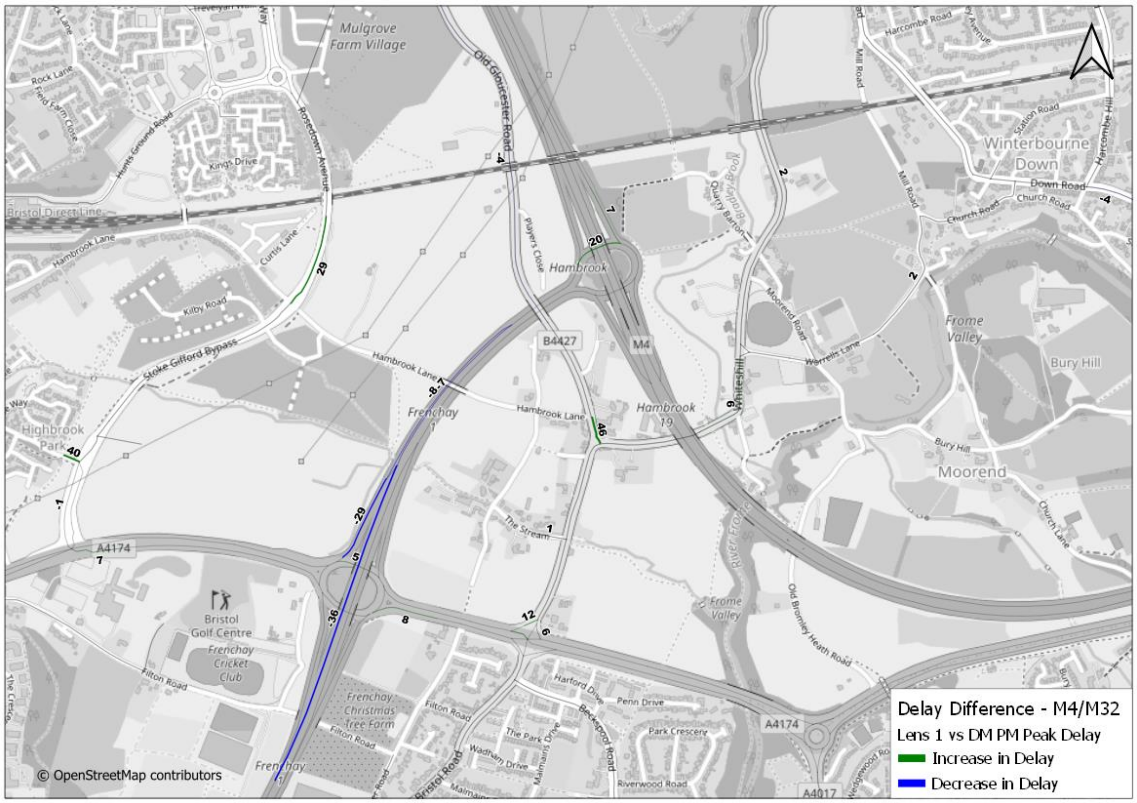
G.10 Lens 1 vs DM M4/M32 AM Delay



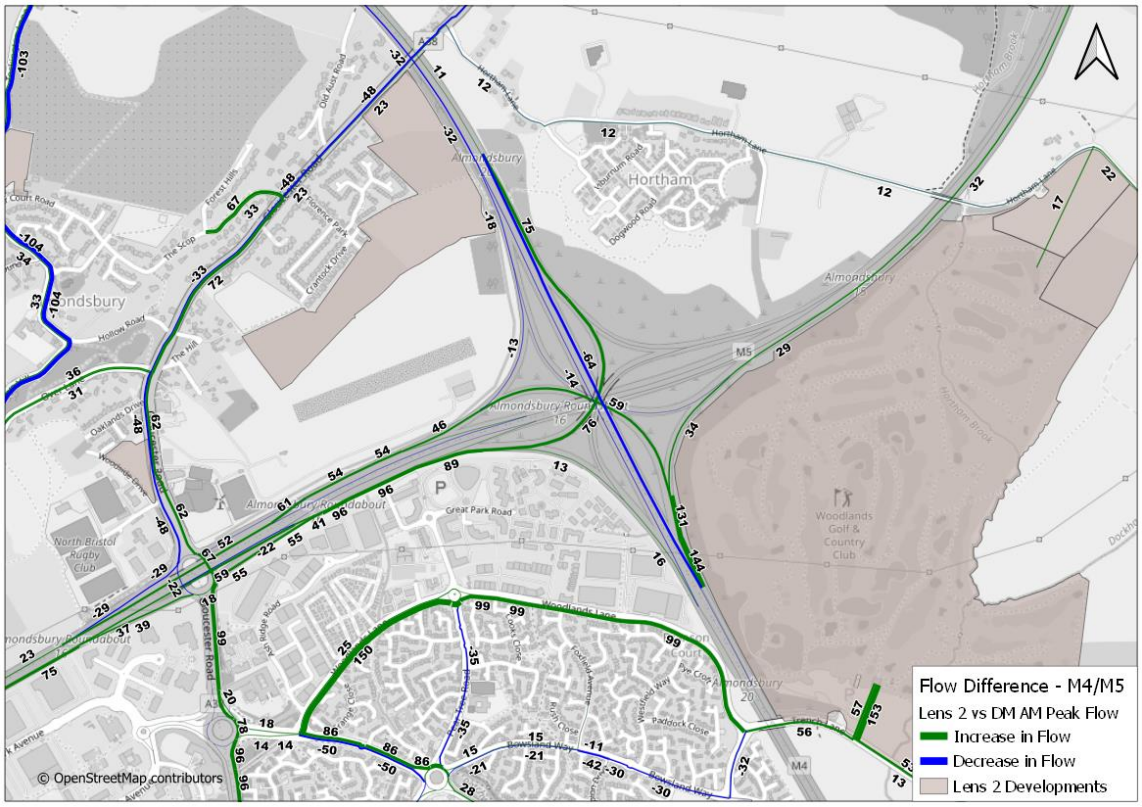
G.11 Lens 1 vs DM M4/M32 PM Flow



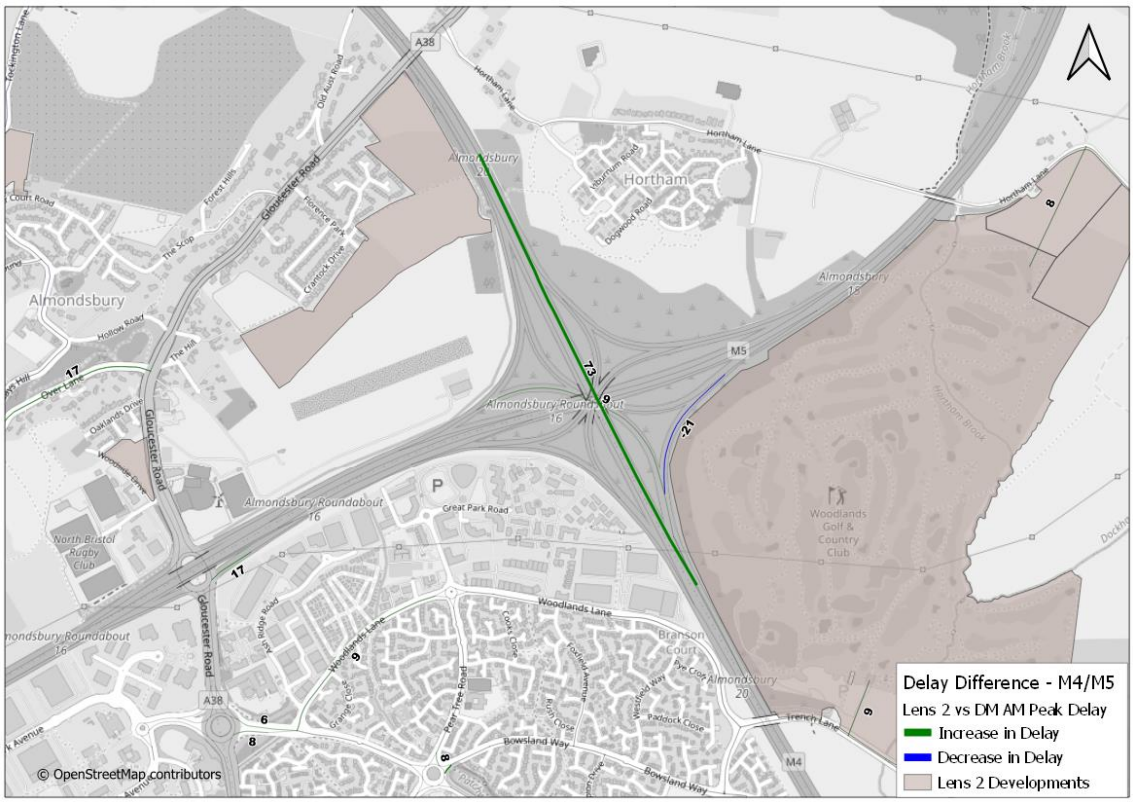
G.12 Lens 1 vs DM M4/M32 PM Delay



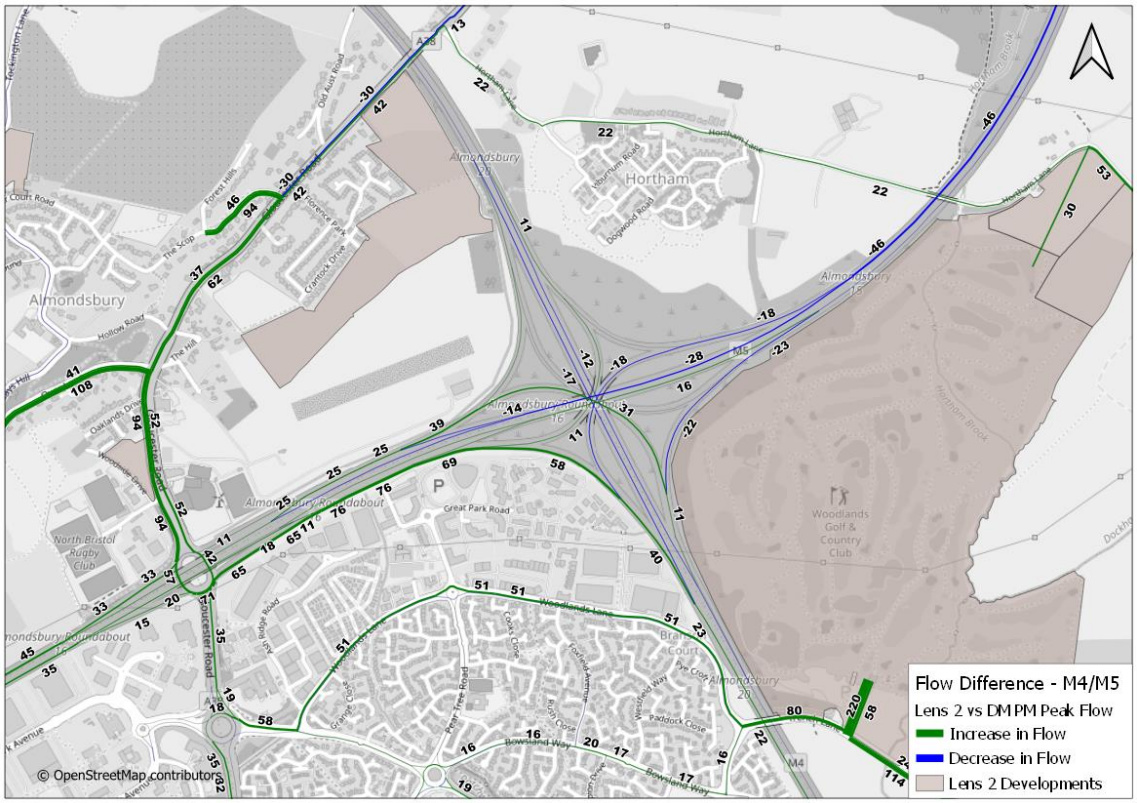
G.13 Lens 2 vs DM M4/M5 AM Flow



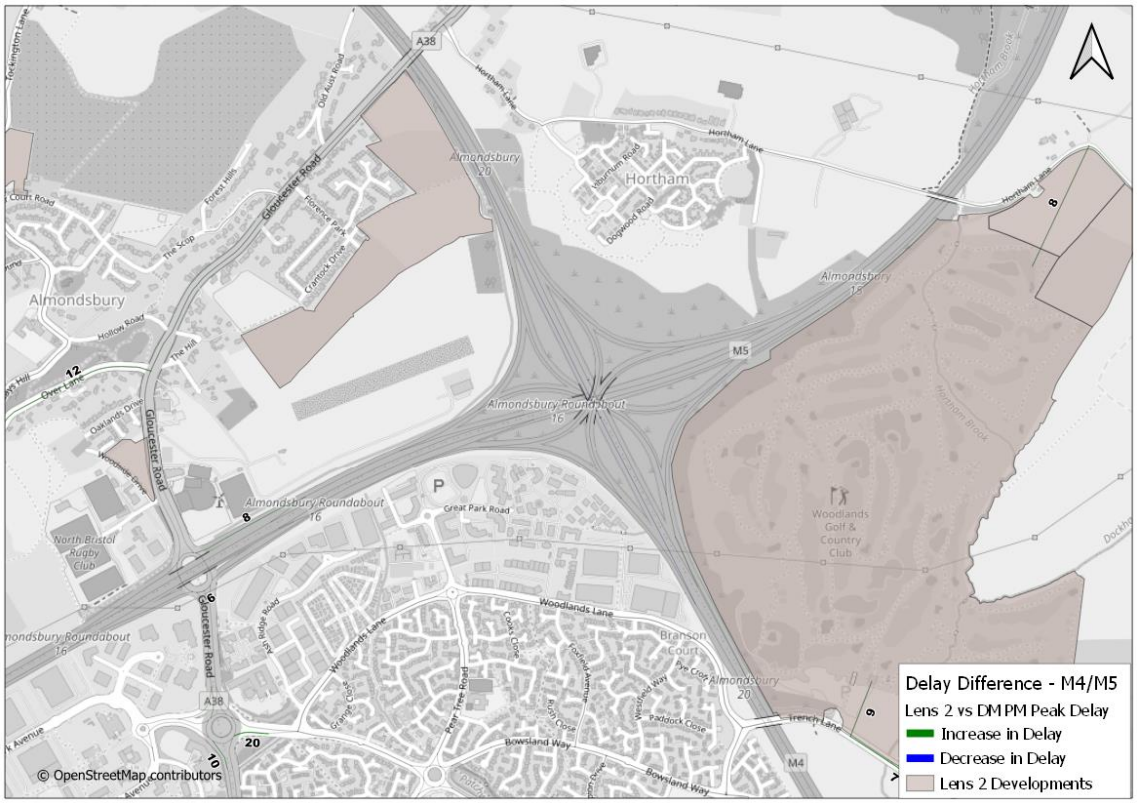
G.14 Lens 2 vs DM M4/M5 AM Delay



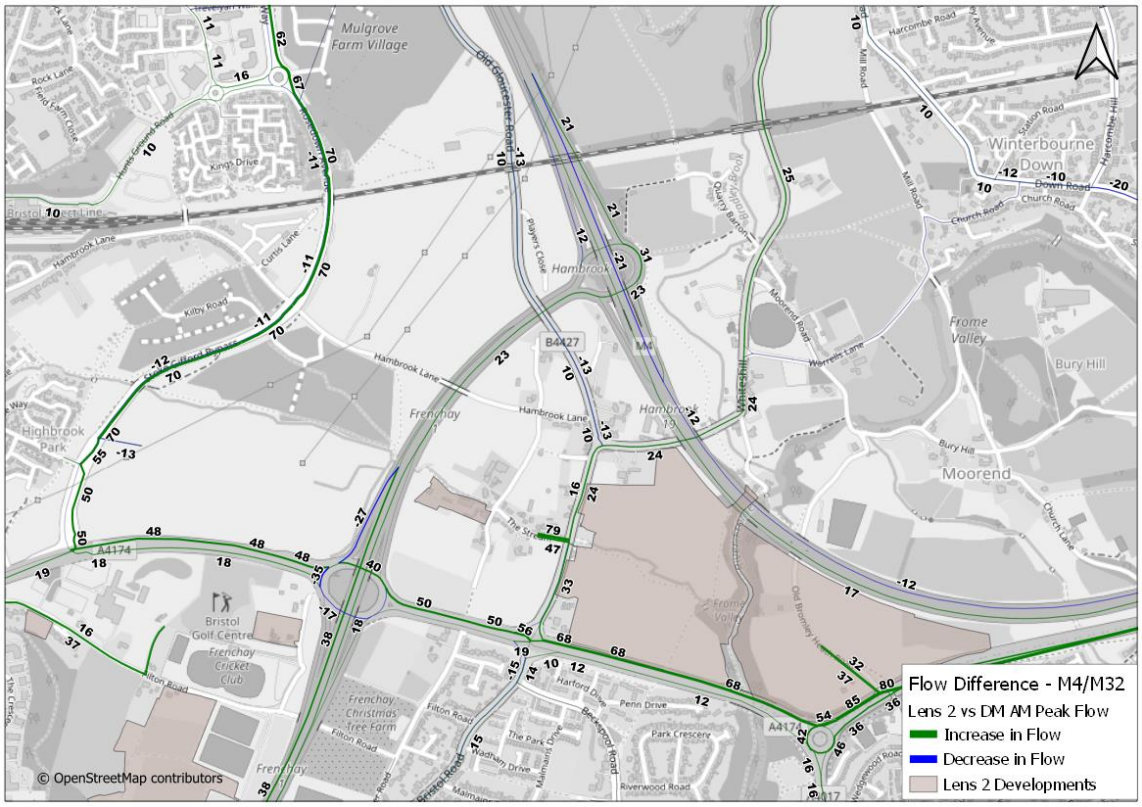
G.15 Lens 2 vs DM M4/M5 PM Flow



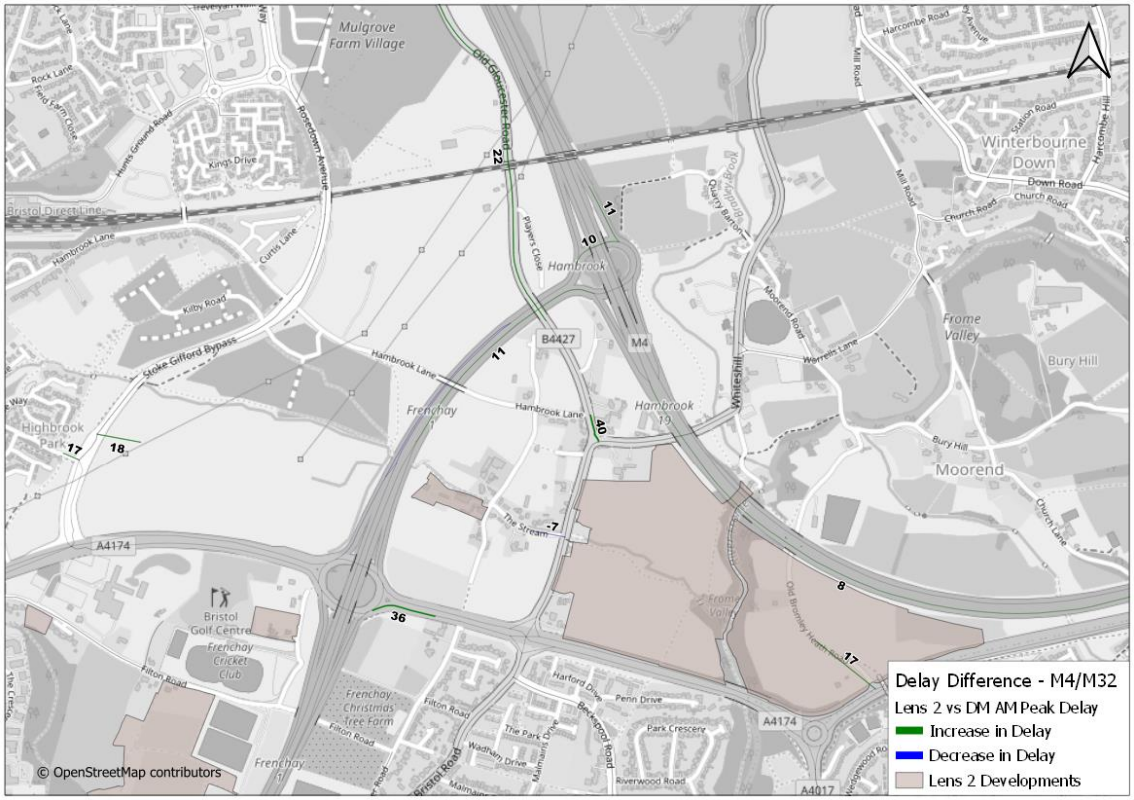
G.16 Lens 2 vs DM M4/M5 PM Delay



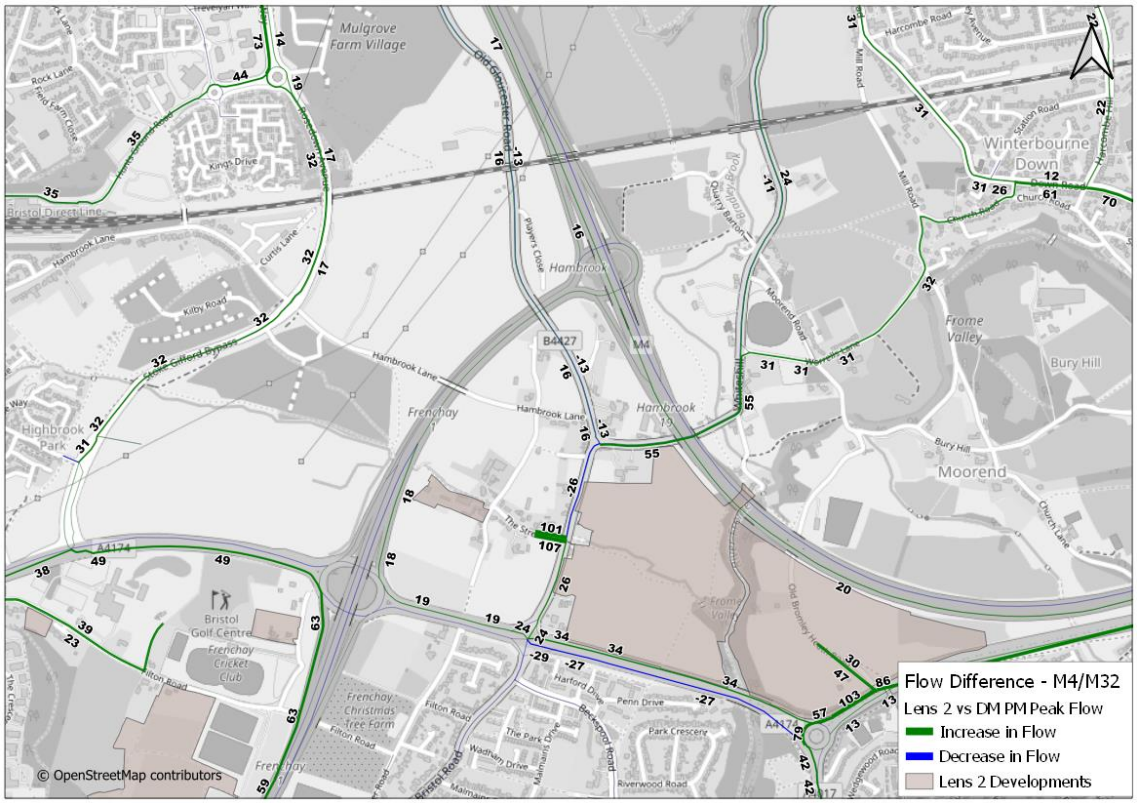
G.17 Lens 2 vs DM M4/M32 AM Flow



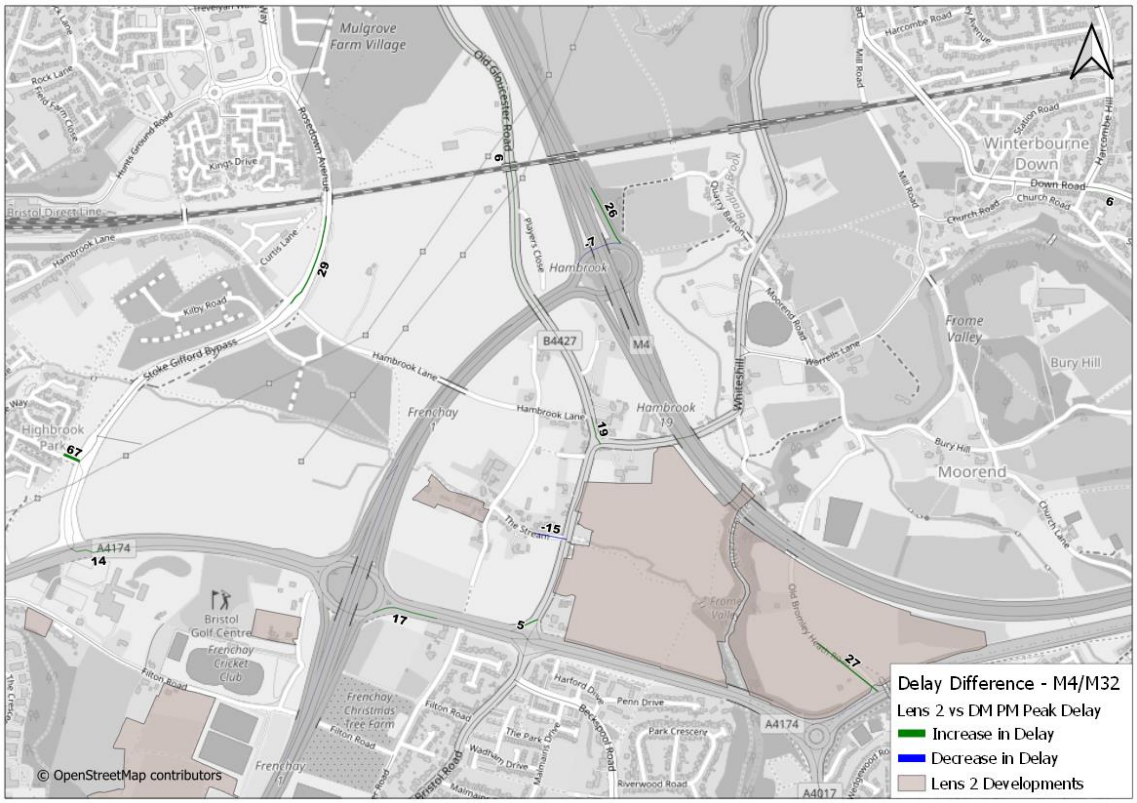
G.18 Lens 2 vs DM M4/M32 AM Delay



G.19 Lens 2 vs DM M4/M32 PM Flow

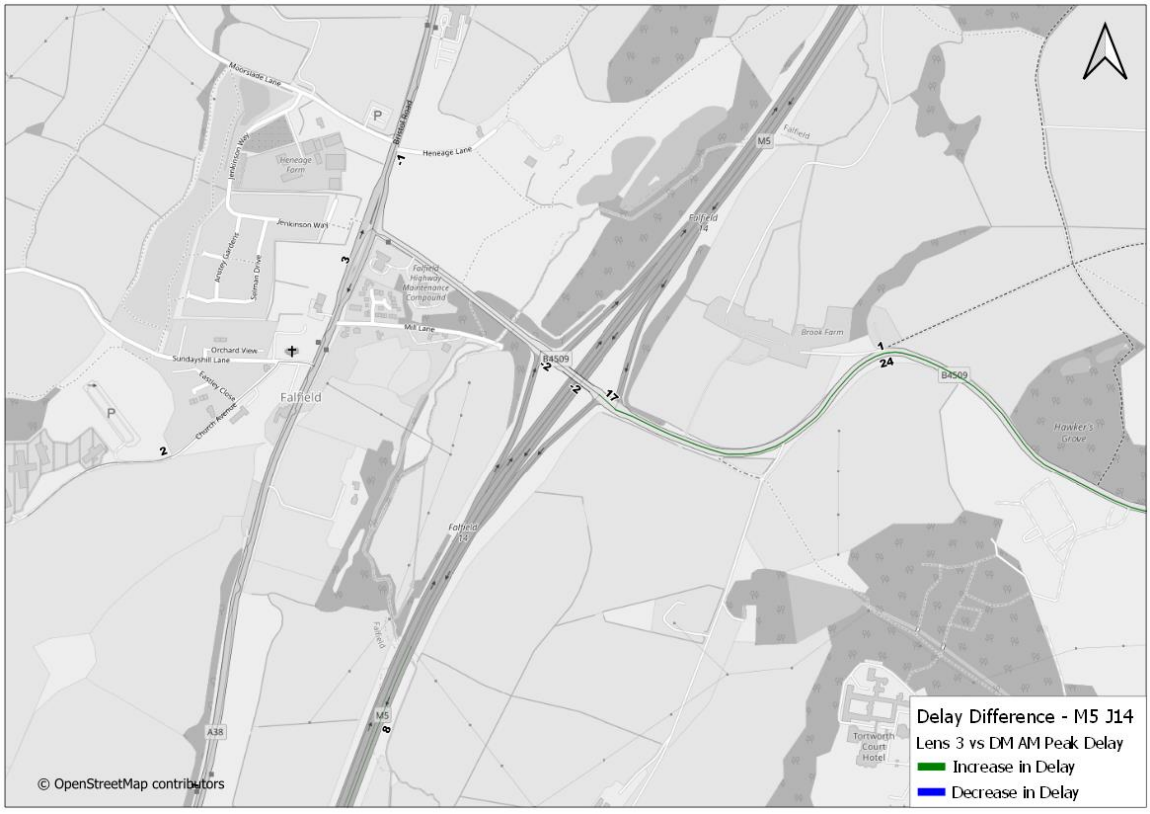


G.20 Lens 2 vs DM M4/M32 PM Delay



G.21 Lens 3 vs DM M5J14 AM Flow

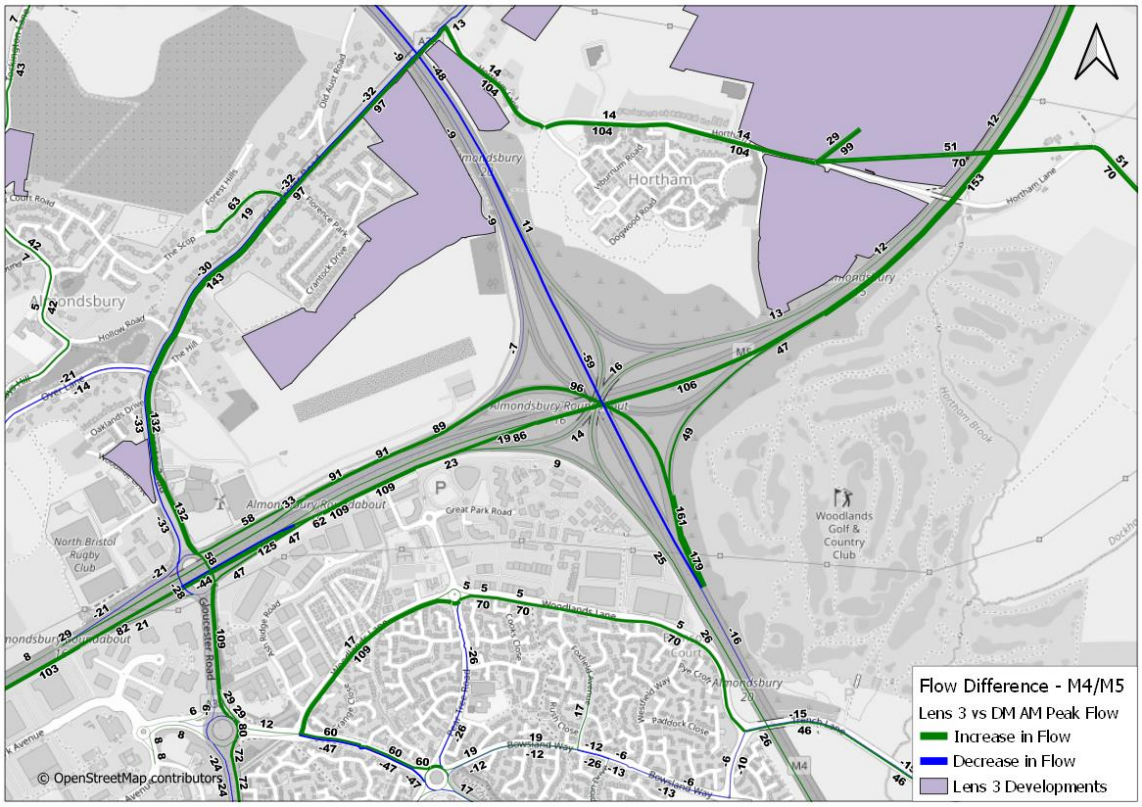
G.22 Lens 3 vs DM M5J14 AM Delay



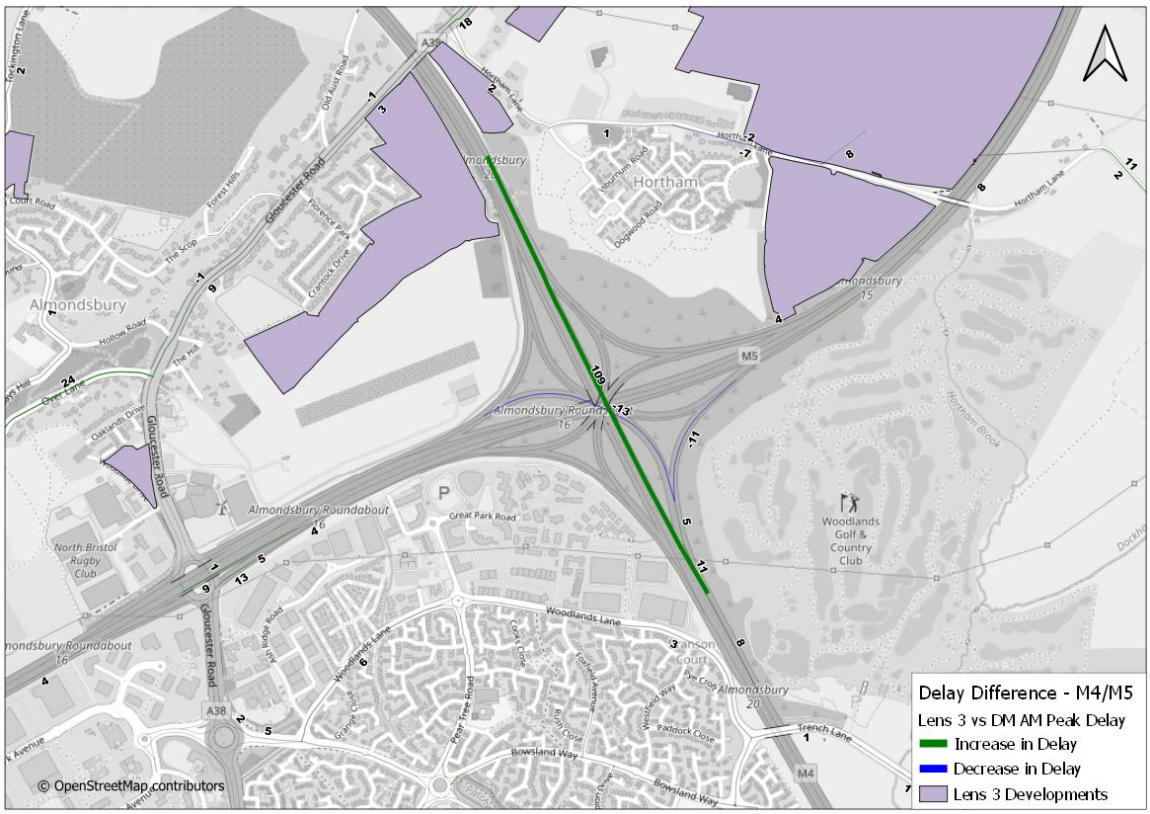
G.23 Lens 3 vs DM M5J14 PM Flow

G.24 Lens 3 vs DM M5J14 PM Delay

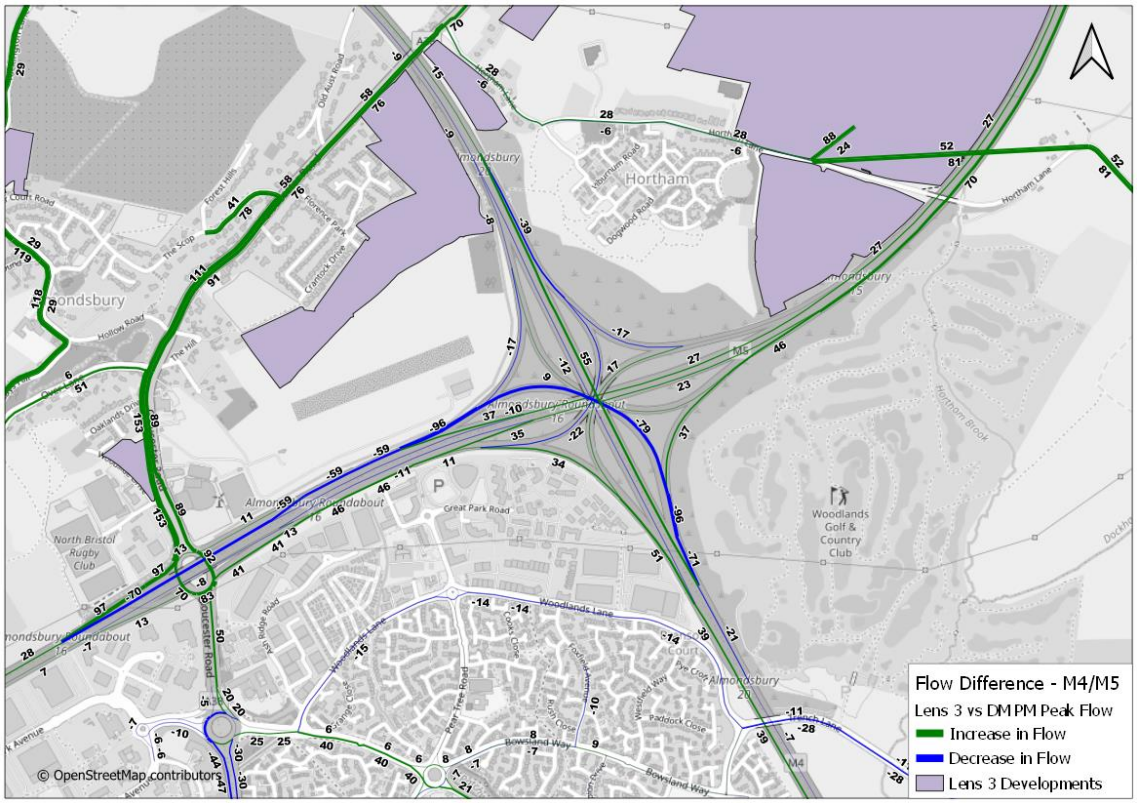
G.25 Lens 3 vs DM M4/M5 AM Flow



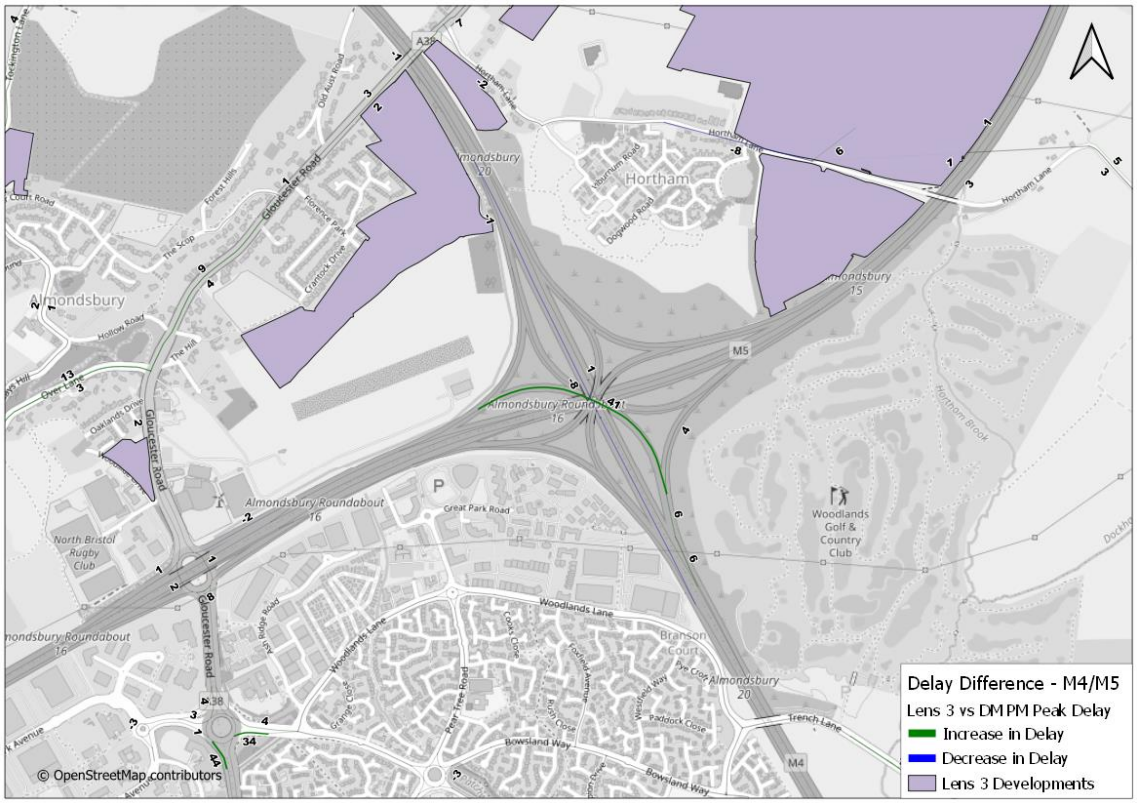
G.26 Lens 3 vs DM M4/M5 AM Delay



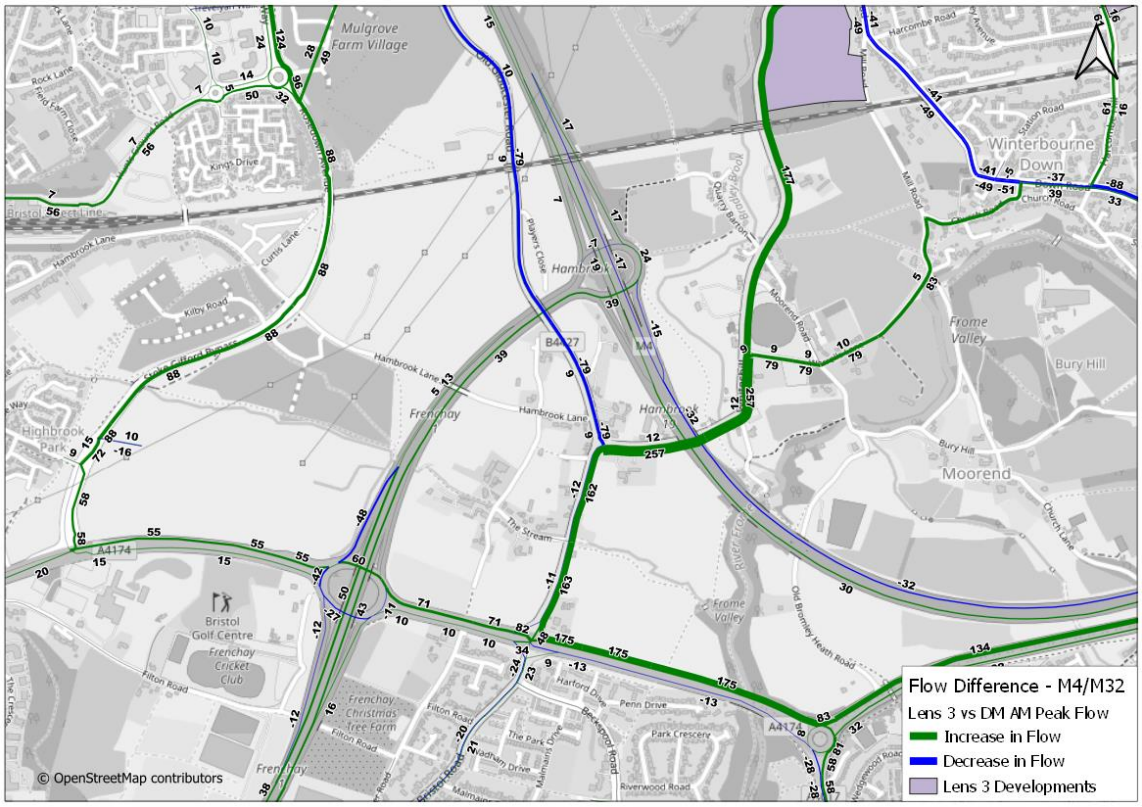
G.27 Lens 3 vs DM M4/M5 PM Flow



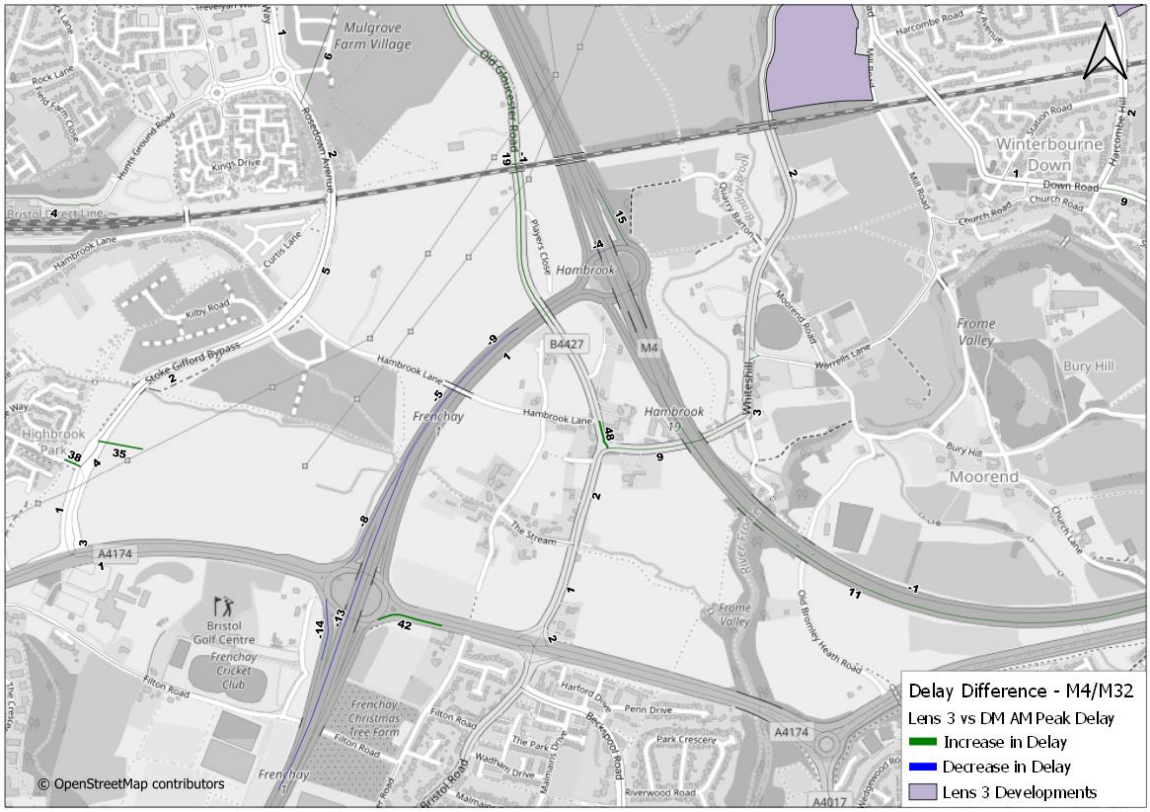
G.28 Lens 3 vs DM M4/M5 PM Delay



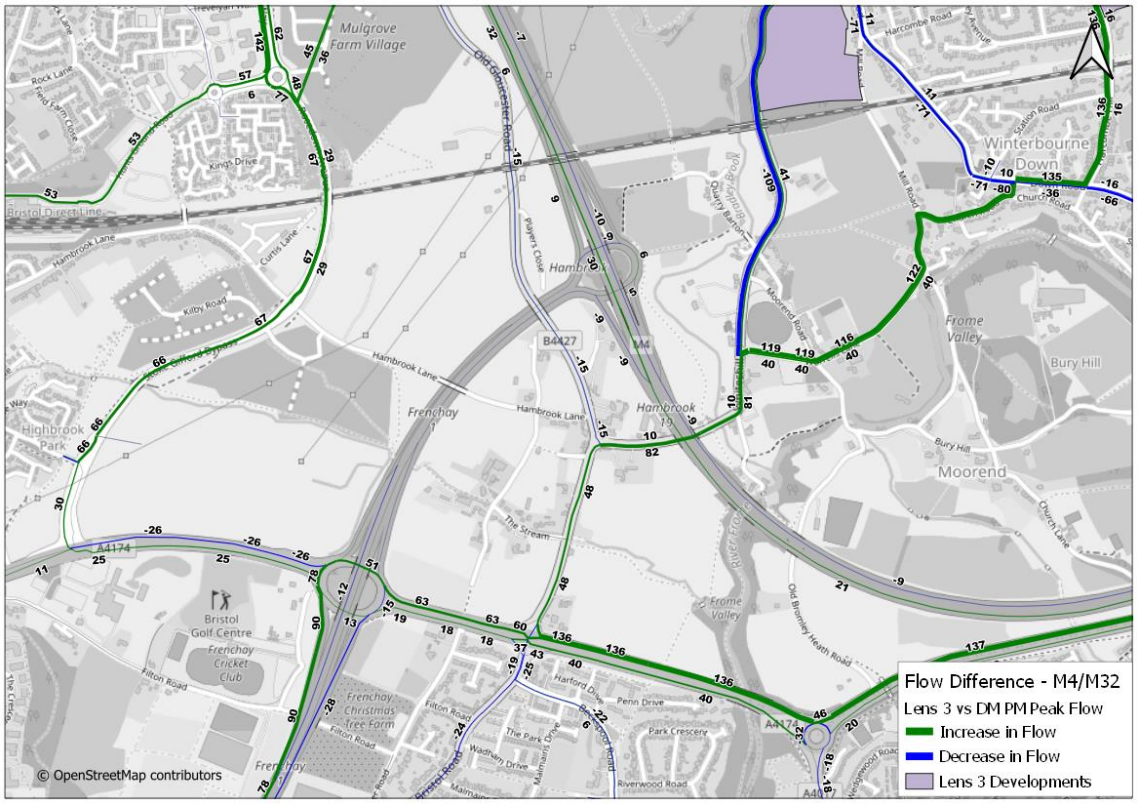
G.29 Lens 3 vs DM M4/M32 AM Flow



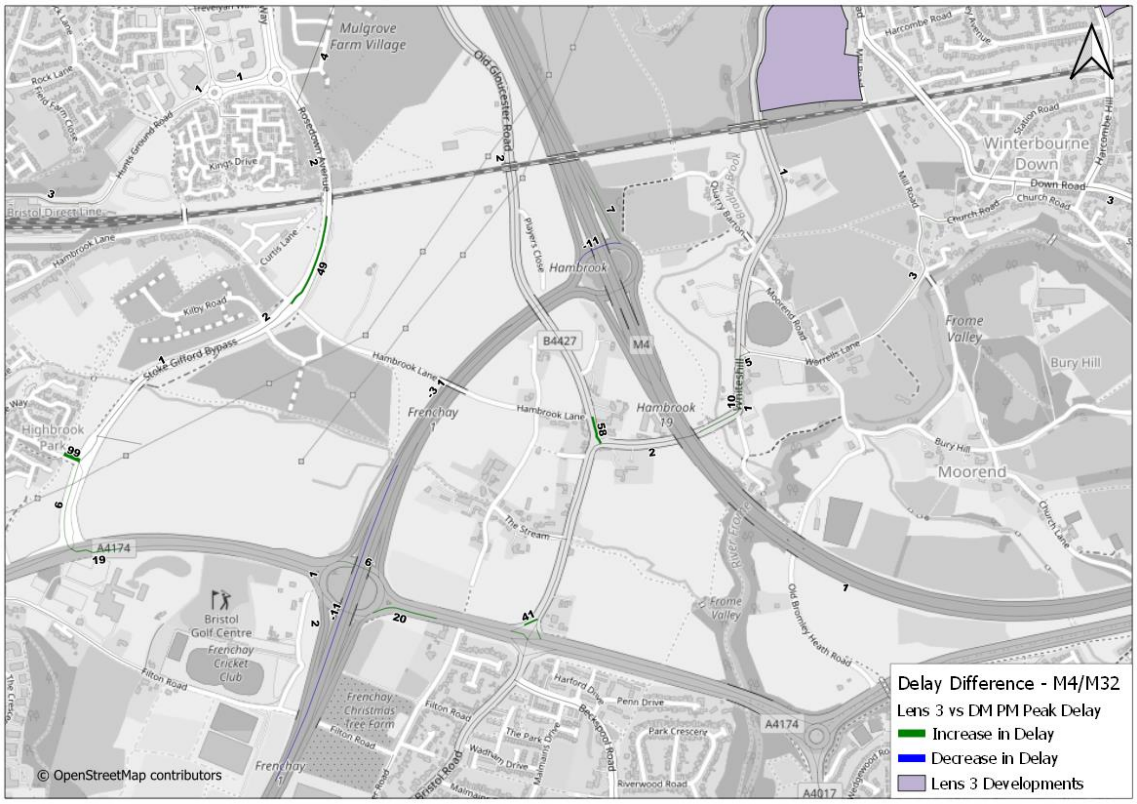
G.30 Lens 3 vs DM M4/M32 AM Delay



G.31 Lens 3 vs DM M4/M32 PM Flow



G.32 Lens 3 vs DM M4/M32 PM Delay



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