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ANNEX C

Strategic Transport Modelling Report



In Partnership with:



**Belfast
City Council**



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INTRODUCTION

Executive Summary

Project Overview

The Department for Infrastructure (DfI) has identified the need to prepare a new Eastern Transport Plan (ETP).

A new ETP is required to support the preparation of Local Policy Plans for each Council area, supporting the delivery of their Local Development Plans (LDPs), as well as setting out DfI's proposals for the future transport network in the ETP area.

Following the development of DfI's proposals for the future transport network in the metropolitan area and Belfast city centre, these proposals have been tested using the Belfast Strategic Transport Model 2 (BSTM2) to assess their suitability and performance.

This report sets out an overview of the BSTM2, the forecast transport network without any interventions and how the ETP proposals perform in the forecast model runs for 2035 with the TEMPro-NI growth applied in the Belfast City Council (BCC) growth areas. There are two forecast growth scenarios used in this assessment:

- **BCC Core:** Trip ends were added to BSTM2 using BCC development information, but the total growth in population and employment in the BCC area was maintained to be consistent with TEMPro-NI Core forecasts; and
- **BCC Plan:** As per BCC Development Scenario but population and employment growth totals from BCC's adopted Plan Strategy were added.

Further details of these scenarios are set out in this report.

Model Results

Main Mode Choice

The main mode choice in the model sets out the total daily productions using car, public transport, walk or cycle. This is at a production level only i.e. the home end of a tour for home-based trips or the origin of a trip for non-home-based trips. The main mode choice in the Belfast area shows:

- In 2023 there are over:
 - 530,000 highway trips
 - 42,000 Public Transport (PT) trips
 - 165,000 walk trips; and
 - 6,000 cycle trips
- By 2035, the do minimum model forecast run indicates that highway trips are expected to increase by:
 - Over **30,000 (6%)** production trips a day in the BCC Core scenario
 - Almost **70,000 (13%)** trips in the BCC Plan scenario
- The introduction of the ETP measures shows:
 - There could be a decrease of up to **6,600 (-1.2%)** highway trips compared to the BCC Core scenario
 - There could be an increase of up to **2,600 (5.8%)** additional PT trips compared to the BCC Core scenario
 - The remaining (circa 4,000) trips switch to using active modes (walk and cycle)



Sub Mode Choice

The sub-mode choice in the model sets out the total daily trips by origins and destinations using car, bus and rail. The 24 hour sub mode choice with destinations in the Belfast area shows:

- In 2023 there are over:
 - 969,000 highway trips
 - 89,000 bus trips
 - 15,000 rail trips
- By 2035, the do minimum model forecast run indicates that highway trips are expected to increase by:
 - Over **38,000 (4%)** trips a day in the BCC Core scenario
 - Over **100,000 (11%)** additional trips in the BCC Plan scenario
- The introduction of the ETP measures shows:
 - There could be a decrease of up to **17,000 (-2%)** highway trips compared to the BCC Core scenario
 - There could be an increase of up to **5,400 (6%)** additional bus trips compared to the BCC Core scenario
 - There could be an increase of up to **200 (2%)** additional rail trips compared to the BCC Core scenario
 - The remaining (circa 11,400) trips switch to using active modes (walk and cycle)

Highway Delay

From 2023 to the 2035 Do Minimum scenarios:

- Across Belfast the highway delay could increase by 24-46% depending on the growth scenario and the peak.
- Within the city centre the delay could increase by 17-52% depending on the growth scenario and the peak.
- In all growth scenarios the AM peak experiences the highest level of delay increase in percentage and absolute terms.

Inner Cordon Flows

The introduction of the ETP measures mean there is likely to be a decrease in highway trips across the Inner Cordon, with a corresponding increase in bus trips.

In the peak hours, from 2035 Do Minimum compared to the 2035 ETP scenario, crossing the Inner Cordon inbound:

- The AM peak experiences a decrease of approx. **600 (-6%)** highway trips with a corresponding increase of approximately **1700** bus person trips and **100** rail person trips
- The interpeak experiences a decrease of approx. **700 (-11%)** highway trips with a corresponding increase of approximately **1500** bus person trips and **100** rail person trips
- The PM peak experiences a decrease of approx. **700 (-12%)** highway trips with a corresponding increase of approximately **700** bus person trips and **100** rail person trips

Cross City Centre Trips

In the Do Minimum scenario the rate of trips passing through the city centre cordon is:

- **2,100** trips equating to **18%** of trips entering the city centre in the AM peak
- **1,800** trips equating to **26%** of trips entering the city centre in the interpeak
- **2,400** trips equating to **36%** of trips entering the city centre in the PM peak



In the ETP scenario these trips are reduced by:

- **500 trips (-24%)** in the AM peak compared to the BCC Core scenario
- **600 trips (-35%)** in the interpeak compared to the BCC Core scenario
- **700 trips (-28%)** in the PM peak compared to the BCC Core scenario

Journey Times

Along the radial corridors where new bus priority will be introduced as part of the ETP proposals in the inbound direction:

- The highway journey times will increase by on average **5%** but could be up to **20%** and the bus journey times will decrease on average by **17%** but could be up to **41%** in the AM peak
- The highway journey times will increase by on average **12%** but could be up to **19%** and the bus journey times will decrease on average by **20%** but could be up to **37%** in the interpeak
- The highway journey times will increase by on average **13%** but could be up to **20%** and the bus journey times will decrease on average by **16%** but could be up to **41%** in the PM peak

Along the radial corridors where new bus priority will be introduced as part of the ETP proposals in the outbound direction:

- The highway journey times will increase by on average **10%** but could be up to **17%** and the bus journey times will decrease on average by **11%** but could be up to **34%** in the AM peak
- The highway journey times will increase by on average **13%** but could be up to **25%** and the bus journey times will decrease on average by **10%** but could be up to **32%** in the interpeak
- The highway journey times will increase by on average **12%** but could be up to **23%** and the bus journey times will decrease on average by **9%** but could be up to **37%** in the PM peak

1. Introduction

1.1 Background

The Department for Infrastructure (DfI) has identified a need to prepare a new Eastern Transport Plan (ETP) which encompasses the following ‘five councils’:

- Antrim and Newtownabbey Borough Council (ANBC);
- Ards and North Down Borough Council (ANDBC);
- Belfast City Council (BCC);
- Lisburn and Castlereagh City Council (LCCC); and
- Mid and East Antrim Borough Council (MEABC)

A new ETP is required to support the preparation of Local Policy Plans for each Council area, supporting the delivery of their Local Development Plans (LDPs), as well as setting out DfI’s proposals for the future transport network in the ETP area.

Following the development of DfI’s proposals for the future transport network in the metropolitan area and Belfast city centre, these proposals have been tested using the Belfast Strategic Transport Model 2 (BSTM2) to assess their suitability and performance.

1.2 Purpose of this Report

This report sets out an overview of the BSTM2, the forecast transport network without any interventions and how the ETP proposals perform in the forecast model runs.

1.3 Report Structure

This report is set out as follows:

- Chapter 2 sets out an overview of the BSTM2
- Chapter 3 gives an overview of the 2023 baseline conditions
- Chapter 4 shows an overview of the Forecast Do Minimum scenario
- Chapter 5 sets out an overview of the ETP proposals and the results of the model run

A summary and conclusion follows.

2. Belfast Strategic Transport Model 2

2.1 Introduction

The Department for Infrastructure (DfI) has a suite of demand forecasting tools, namely the TEMPro-NI dataset, the Northern Ireland Strategic Transport Model 2 (NISTM2) and the Belfast Strategic Transport Model 2 (BSTM2) transport models which provide an evidence base for policy and investment decisions. The Eastern Transport Plan city centre and metropolitan area proposals have been tested using the BSTM2.

This section sets out an overview of the BSTM2 to include its purpose, capabilities and any limitations along with a brief description of the model development.

2.2 Development

The first version of the NISTM model was commissioned in 2014 and built primarily using existing and freely available data sources. In parallel with the initial development work for Northern Ireland, mobile phone data was commissioned and obtained. The BSTM (version 1) model development was then commissioned.

Both models were implemented and validated for a 2013 base year. The BSTM included three time periods (AM, IP and PM) for highway and public transport and used junction (simulation) modelling for the highway supply in the greater Belfast area. Both models use the CUBE and SATURN software packages.

In 2022/23 the BSTM was updated to a 2019 base year to create BSTM2. The update included enhancements to the model implementation, including the parking sub model and modifications to the zoning system to separate residential and employment areas and development areas, with validation to 2019 datasets. Supply coding was updated to reflect changes on the ground, costs (fares, parking, vehicle operating costs etc.) were revised and updated demand data was taken from the 2019 TEMPro-NI present year dataset. Supplementary analysis tools were provided to improve visualisation and interpretation of model outputs. A 2023 present year (post-COVID) validation exercise was then completed, before the forecasting model was implemented for a range of 2035 scenarios using growth from TEMPro-NI or by utilising NI Council Local Development Plans.

2.3 Model Structure

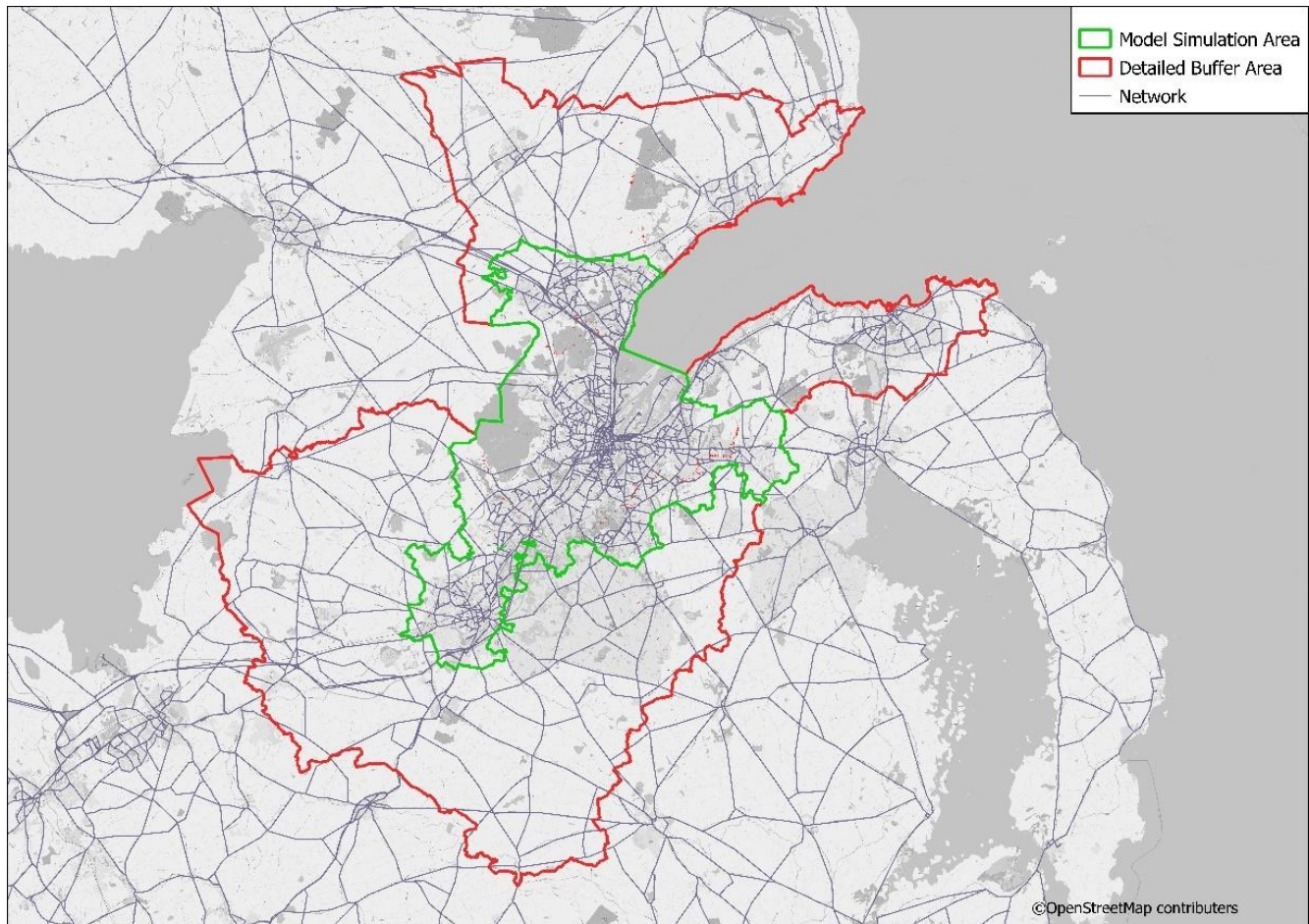
2.3.1 2019 Base Model

The 2019 base model for BSTM2 comprises:

- a set of modal base year matrices for three time periods (AM, IP and PM)
- highway network definition with greater detail (simulation network coding) in the Belfast area (including Lisburn and Newtownabbey)
- public transport services definition
- validated highway assignment model for three time periods (AM, IP and PM)
- validated public transport assignment model for three time periods (AM, IP and PM)
- a parking sub model for Belfast City Centre.

Figure 2-1 shows the highway modelled area comprising the detailed area of simulation modelling, the detailed buffer area which includes speed flow curves. The remainder of the network outside this area assumes fixed speeds.

Figure 2-1 - BSTM2 Modelled Area



The trip matrix building process comprises:

- Processing of input mobile phone and electronic ticket data to the correct zone system, scaling to 2019 to create the “observed” demand matrices by mode and purpose across Northern Ireland.
- Processing external demand, including cross-border trips, ports and airports and scaling to 2019.
- Processing of 2011 Census travel to work and schools data into synthetic matrices and scaling to 2019.
- Calculation of 2019 base model costs from assignment models.
- Synthetic trip distribution of 2019 TEMPro-NI trip ends by purpose and mode using a gravity model calibrated to trip length profiles.
- Blending of observed and synthetic demand matrices
- Application of the parking sub-model to the car mode matrices
- Conversion of demand matrices from production-attraction form to origin-destination form
- Merging of internal and external demand into final matrices to pass to initial assignment, and calculation of trip ends to pass to forecast model

Following the base year prior matrix development, the initial assignment process converts the final base matrices to the required assignment user classes and runs the highway assignment model and the public transport assignment

model in turn. Matrix calibration is carried out using matrix estimation in each assignment time-period for the highway matrices, bus and rail matrices.

2.3.2 Forecast Model

The forecast model process comprises the following:

- Demand Model:
 - The Reference Demand process combines the trip end growth with forecast trips for the ports, airports, and external Republic of Ireland, (RoI) zones and provides an initial update of the Base Matrices. This process involves a COVID-19 adjustment to account for the change in demand due to the pandemic.
 - The Composite Cost process calculates the change in generalised cost between the base and forecast year assignments and composites those changes ready for the different levels of the choice model
 - The Choice Model utilises the change in generalised cost between the base and forecast year assignments to determine the differences in demand response across multiple levels of choice:
 - Main Mode
 - Time Period
 - Destination
 - Sub-Mode
 - The outputs from this process are the modal OD matrices in person trips for each time period.
 - Forecast Year OD Matrices:
 - The PT OD Matrices do not get adjusted further and form the Forecast Year PT OD Matrices
 - The highway matrices are modified in the Parking Sub Model to account for parking supply in the destination zones. The outputs from this process form the Forecast Year Highway OD Matrices
- Forecast Year Assignment:
 - Public Transport Assignment: the forecast year PT OD matrices are assigned by time period in the PT assignment model
 - Highway: vehicle occupancies are applied to the Final Highway Base Matrices by purpose while the fixed forecast goods vehicle matrices are added at this stage. These are then reformatted for use in the SATURN highway assignment model

This process is then repeated multiple times, passing the output skims from the assignment models to calculate the change in costs for the demand model in the subsequent loop, until the model converges or the stated number of loops have been completed.

2.4 Model Capabilities and Limitations

The main capabilities and limitations of the BSTM2 are set out in Table 2-1.

Table 2-1: BSTM2 Main Capabilities and Limitations

Topic	Capabilities	Limitations
Appropriate for uses	BSTM2 is suitable for testing strategic highway and public transport schemes. BSTM2 is appropriate for more detailed scheme assessment (although it would be subject to refinement in local area of affected transport network). BSTM2 suitable for assessing general performance of junctions within the area of modelling providing delays, queues and volume/capacity ratios (albeit results would need supported by local modelling techniques). Includes Variable Demand Modelling VDM component to support wide range of forecasting applications including modal shift, time period switching and redistribution of trips. Some representation of all modes of personal travel, including active modes and Park & Ride BSTM2 includes parking supply model.	No functionality to easily introduce new development zones for key (major) future year developments. Limited functionality for assessing parking schemes (within Belfast). Inflexible implementation of P&R modelling makes introduction of new sites difficult. Limited active mode (walking and cycling) modelling. No trip distribution. No active mode network or assignment. Location specific pedestrian / cycle improvements / schemes cannot be tested. Simplified public transport modelling with no explicit representation of trips using both bus and rail.
Data used in model development	A wide range of survey data collected between 2013 and 2019, including mobile phone and electronic ticketing data, parking survey (Belfast), journey time data and traffic counts.	Data used in model development is now between 6-12 years old and is no longer considered representative of current conditions, especially due to changes in travel patterns post the COVID-19 pandemic (although the Present Year Validation takes account for reductions in travel demand).
Software	CUBE software provides appropriate functionality for strategic multi modal transport modelling. SATURN software suite recognised industry standard allowing for the creation of a detailed simulated highway network. The model converges in line with TAG criteria	
Validation	BSTM2 both calibrated and validated in line with TAG. Good calibration metrics for 2019 highway and public transport models. BSTM2 present year validation for 2023.	Insufficient data for independent flow validation of public transport for 2019. 2019 pre COVID base may not be representative of current conditions, however there is a good level of validation in the 2023 Present Year Validation run.
Model extent	Comprehensive coverage of key areas of interest	

Topic	Capabilities	Limitations
Model zoning	Model zones are based on administrative (Census) geography and adjusted for 2019 rebase to approximately align with districts.	Zoning based on 2011 Census SOA geography which is now superseded by 2021 Census geography (data zones). Current datasets not available on old (2011) administrative boundaries.
Network coding	Base year (2019) networks updated for BSTM2 implementing delivered schemes. BSTM2: Sample of signal times updated focusing on important junctions.	Some discrepancies exist between the base model network and the present-day road network due to coding and modified road layouts. BSTM2: signal timings for some junctions likely to be outdated. Variable speed limits not considered.
Car park modelling	BSTM2: Included in central Belfast	Limitations identified with BSTM2 parking supply assumptions and functionality. Based on data from 2013 parking survey.
Base matrices	Robust approach to base year matrix development – utilising mobile phone and electronic ticketing data fused with synthetic matrices. Matrices calibrated in line with TAG methodology.	Travel patterns may have changed significantly since 2011-2014 (source of matrix data), due to the impact of COVID-19.
Traffic growth forecast	Forecast matrices are typically constrained to TEMPro-NI growth in line with TAG. Forecast growth considers VDM response.	
Forecast highway and public transport schemes	Forecast models include highway schemes based on the Uncertainty Log.	
Consistency with Transport Infrastructure Ireland (TII)	Data for base year cross-border highway movements based on TII counts	Global growth factor for all forecast cross-border movements
Impact analysis capability	Atkins Data Visualisation tool implemented providing map based results	Limited analyses considering groups of travellers impacted by policies and schemes

3. Baseline 2023 Conditions

3.1 Introduction

Following the development of the 2019 base year model, a 2023 Present Year Validation was undertaken to ensure the impact of the pandemic was represented. This process included:

- Data collection undertaken at locations previously used for model calibration in the 2019 base year model. This means that the 2023 present-day forecast compared 2023 observed data at locations which were used in the calibration of the base model development to ensure a good fit between modelled and observed data. This included updating the highway, bus and rail flows in the locations where 2019 calibration and validation was undertaken.
- Covid adjustment factors were added to the reference demand and adjusted based on comparisons to the observed data
- TEMPro-NI was used to growth the trip productions and attractions in the model to 2023.
- Bus and rail services were updated with any changes in the interim
- Any highway schemes implemented in this time were added to the network.

3.2 Covid Adjustment Factors

The 2019 base demand is adjusted in the model to represent the reduction in travel associated with the Covid-19 pandemic. The factors for each purpose and mode are shown in Table 3-1.

Table 3-1 - COVID-19 Demand Adjustment Factors

Purpose	Car	Bus	Rail	Walk	Cycle
Home Based Work	0.857	0.713	0.640	1.000	0.828
Home Based Education	0.952	0.802	0.720	1.000	0.920
Home Based Employers Business	0.952	0.891	0.800	1.000	0.920
Home Based Other	0.952	0.891	0.800	1.000	0.920
Non Home Based Employers Business	0.952	0.891	0.800	1.000	0.920
Non Home Based Other	0.952	0.891	0.800	1.000	0.920

As set out in Table 3-1 Home Based Work and Education have slightly different factors to the other purposes due to the increase in working from home and the larger reduction in PT trips travelling to education.

3.3 Forecast Demand

Following the implementation of the Covid adjustment factors the base trip ends are growthed to 2023 using TEMPro-NI. TEMPro-NI is a trip end model for Northern Ireland developed for DfI, which provides trip ends for forecast years up to 2050 as required.

TEMPro-NI has been developed using NISRA population projections and Oxford Economics employment projections amongst other sources. TEMPro-NI provides trip end forecasts to a detailed level (Super Output Areas

(SOAs)) and is considered the best available tool for forecasting model trip ends across the whole of Northern Ireland.

These trip end forecasts are applied to the adjusted base trip ends across the model to create the reference demand. This change in trip productions and attractions is shown spatially in Figure 3-1.

Figure 3-1 - TEMPro-NI Change in Productions and Attractions from 2019 to 2023

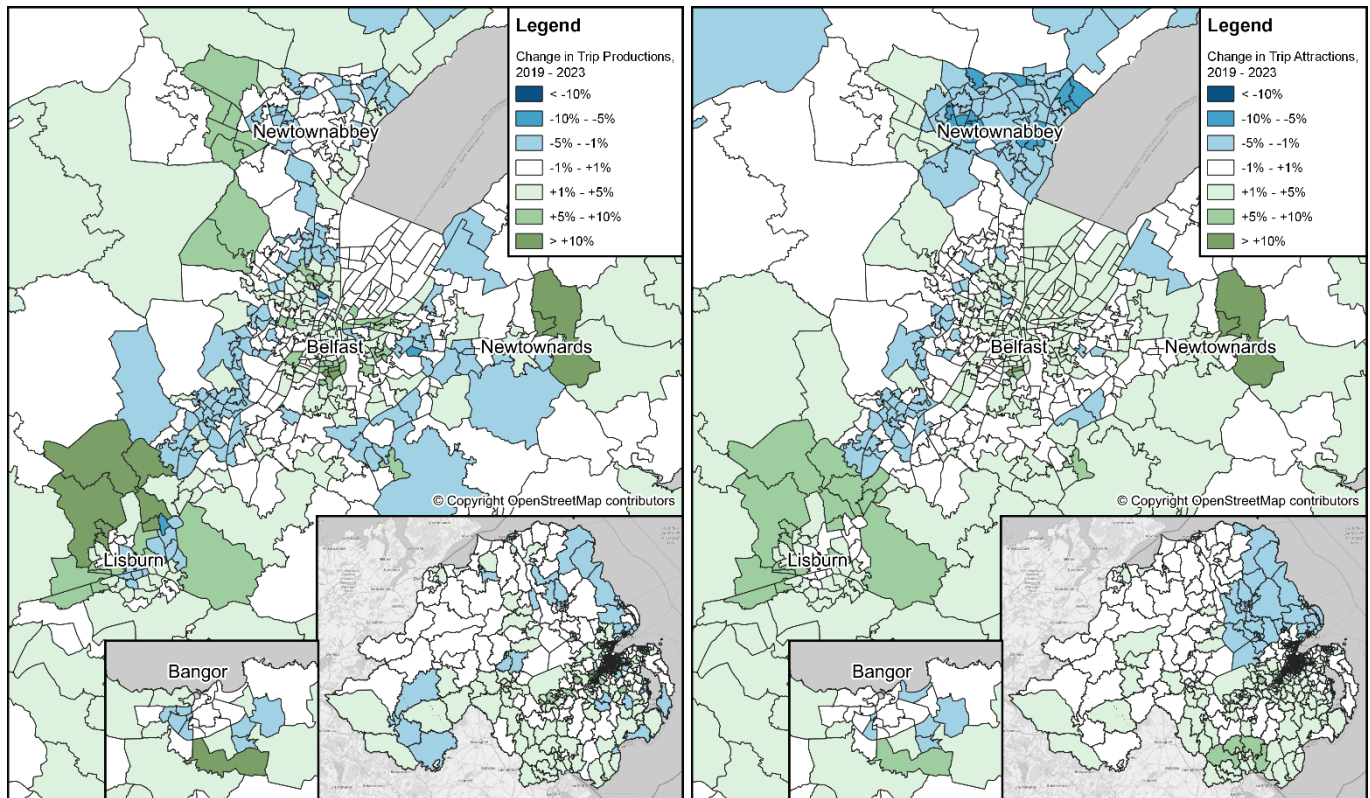


Figure 3-1 demonstrates the change in trip productions and attractions from 2019 to 2023. Some decreases are noted as:

- Based on historic spatial growth patterns for new dwellings and impact of household sizes decreasing means the number of people in existing houses are reducing
- Jobs can reduce due to different growth rates for different employment sectors i.e. some sectors are declining and these are in specific areas.

3.4 PT Supply Changes

The 2019 public transport lines files i.e. timetabled services were adjusted to better represent the 2023 services. This included:

- Updating all Metro and Glider services with 2023 TRACC¹ outputs prepared for the ETP project;
- Comparing Ulsterbus and Goldline 2023 timetables to 2019 and making relevant adjustments;
- Comparing NI Railways 2023 timetables to 2019 and making relevant adjustments.

¹ TRACC is travel time analysis software the department have made use of which encompasses public transport timetable data for NI

These changes were combined to create the 2023 bus and rail supply.

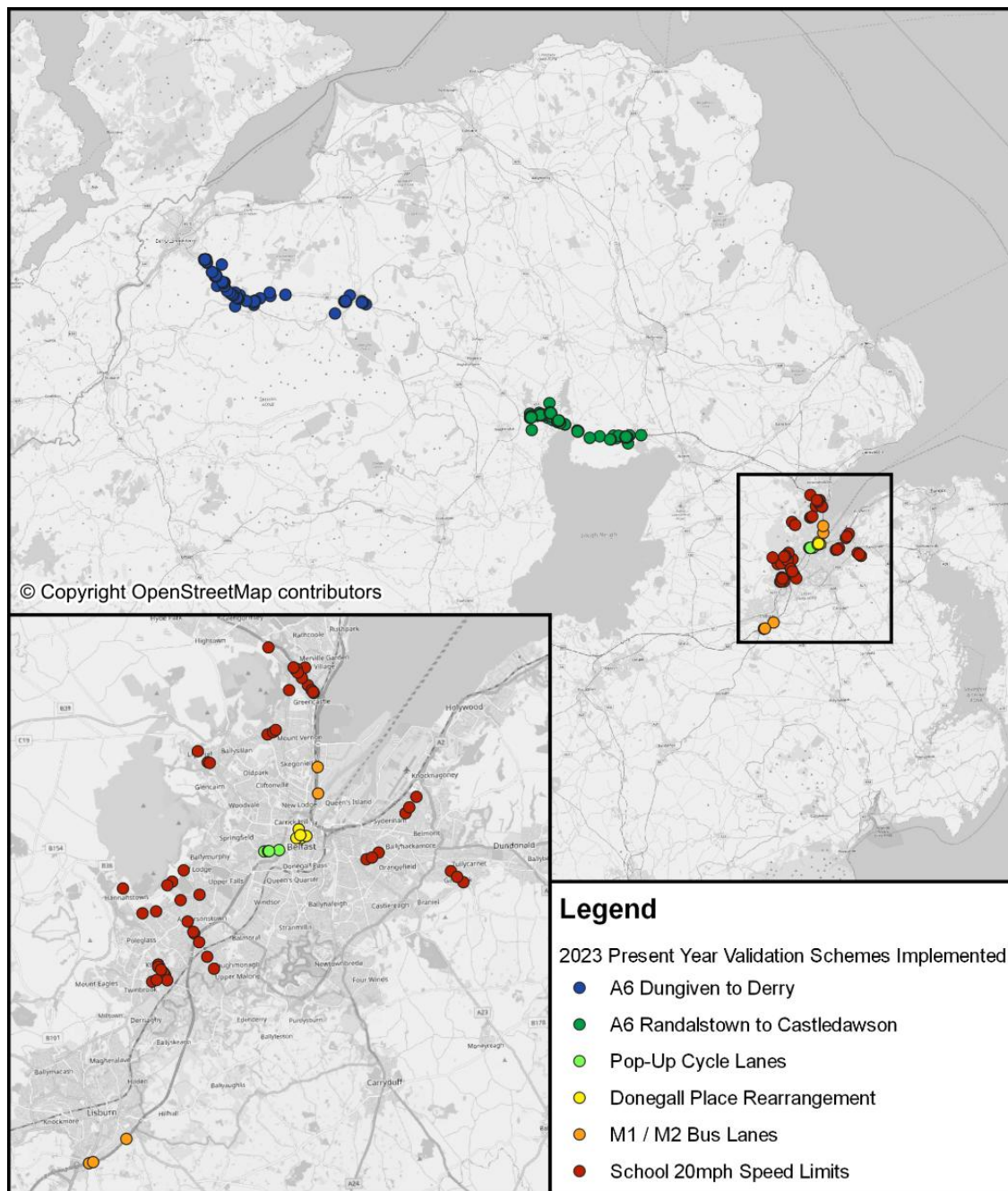
3.5 Highway Supply Changes

The highway supply changes included any highway schemes completed between the model build in 2019 and the surveys in 2023. This includes the following schemes:

- A6 Dungiven to Drumahoe - Buffer coding of A6 to dual carriageway, not including unbuilt Drumahoe - Derry
- A6 Randalstown – Castledawson - Buffer coding of A6 Toome - Castledawson to dual carriageway (Randalstown - Toome opened 2019)
- Pop-Up Cycle Lanes - Now permanent cycle lanes from COVID-19 on Grosvenor Rd (reminder not on modelled links)
- Donegall Place Rearrangement - Closure of Castle St, plus Royal Ave, Donegall PI and Castle PI to one-way
- M1 / M2 Bus Lanes - Conversion of hard shoulder to bus lane on M1 and M2
- School 20mph Speed Limits - 20mph speed limits outside schools, coded into AM peak only

The locations of these schemes are shown in Figure 3-2.

Figure 3-2 - 2023 Highway Network Changes



3.6 Baseline Flow and Delay

The AM flow across Belfast in 2023 is shown in Figure 3-3 and the delay is shown in Figure 3-4. The Interpeak and PM show a similar pattern of flow and delay.

Figure 3-3 - Actual Flow Across Belfast in the AM Peak



Figure 3-4 - Delay Across Belfast in the AM Peak

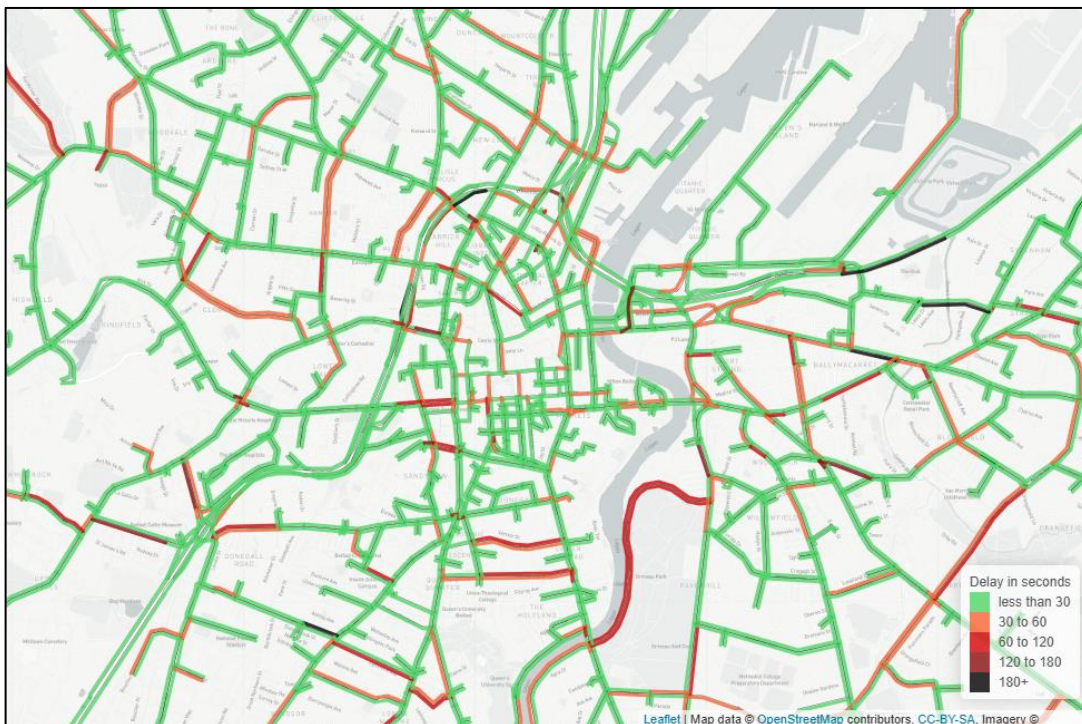


Figure 3-3 and Figure 3-4 show:

- The highest flows on the network are on the Strategic routes including the M1, M2, M3, A12 and A2;
- There are a number of links across Belfast showing a high level of delay (particularly in the city centre) which may become more significant in the forecast years as demand increases.

4. 2035 Forecast Demand Scenarios (Do Minimum)

4.1 Introduction

This section provides an overview of the 2035 Do Minimum forecast model runs, including the demand scenarios developed for the Eastern Transport Plan (ETP), as well as the highway and public transport schemes incorporated within the Do Minimum scenario.

4.2 Overview of Demand Scenarios

This section sets out an overview of the 2035 forecast demand scenarios used for the ETP testing.

TEMPro-NI does contain spatial detail on development areas, with growth allocated spatially within Council Areas based on past trends. Information provided by local authorities on expected developments will be more specific than the spatial inputs to TEMPro-NI. Therefore, it was desirable to add development information from Belfast City Council (BCC) to BSTM2 to produce a more realistic 2035 forecast year model. Given the level of growth predicted for the BCC area three forecast scenarios were developed for Belfast City Council:

1. **TEMPro-NI Core Scenario (TEMPro Core):** Trip ends were added to BSTM2 using TEMPro-NI forecasts at the SOA level;
2. **Belfast City Council Core Scenario (BCC Core):** Trip ends were added to BSTM2 using BCC development information, but the total growth in population and employment in the BCC area was maintained to be consistent with TEMPro-NI Core forecasts; and
3. **Belfast City Council Plan Scenario (BCC Plan):** As per Belfast City Council Core Scenario but full population and employment growth totals from BCC's Adopted Plan Strategy were added.

The development information utilised was obtained principally from BCC's Housing Land Monitor (HLM) and Employment Land Monitor (ELM) for 2023-24, the most recent iterations available at the time. Other data sources from BCC have also been used (for example Development Opportunity Areas for housing and Employment Densities for employment).

The plots in Figure 4-1 and Figure 4-2 show the locations of where the forecast productions and attractions change between 2023 to 2035 in the BCC Core scenario.

Figure 4-1 - 2035 Forecast Productions - BCC Core

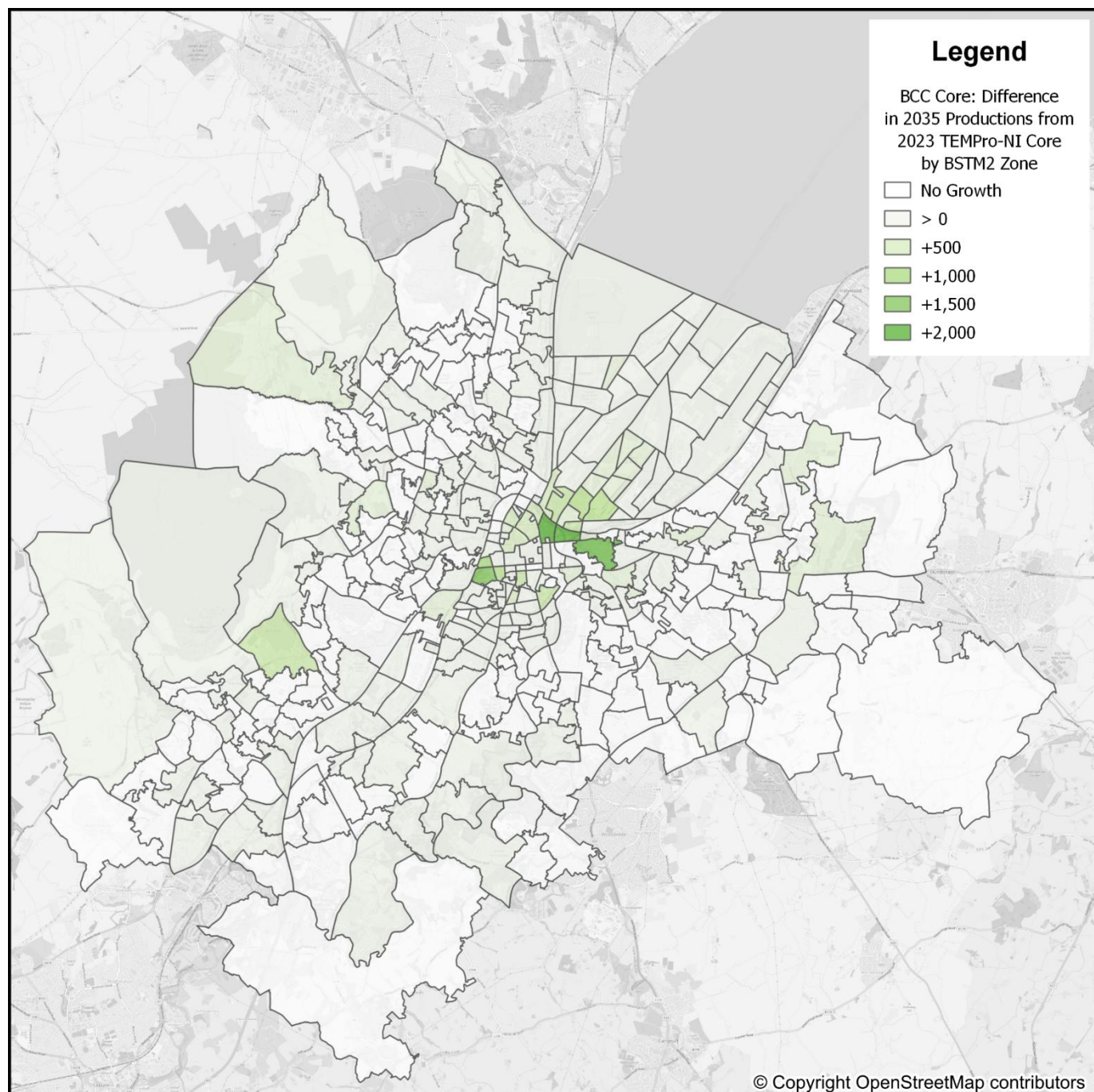


Figure 4-2 - 2035 Forecast Attractions - BCC Core

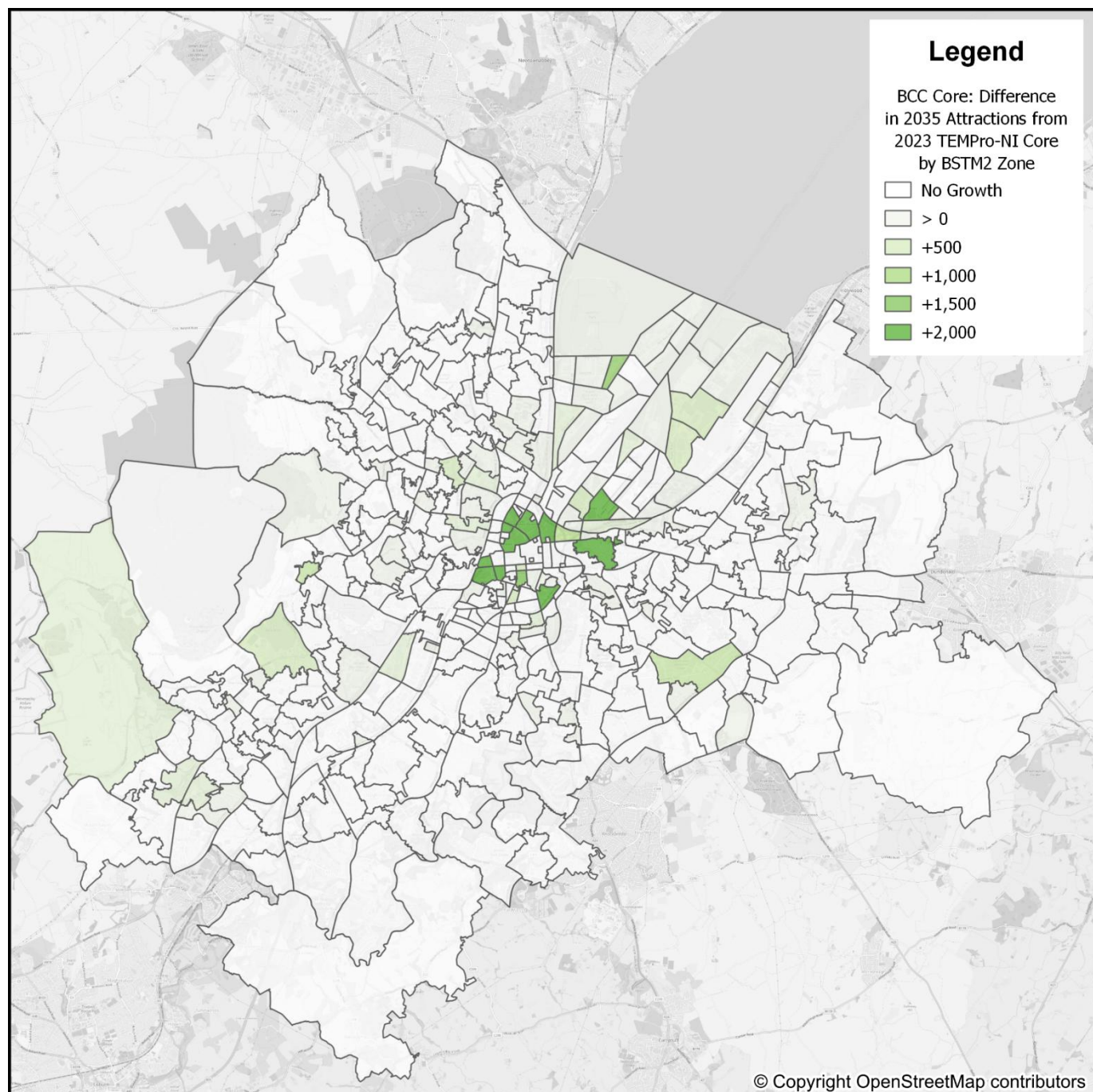


Figure 4-1 and Figure 4-2 show that the majority of the additional productions and attractions within Belfast City Council are close to the city centre.

4.3 Supply Changes

The Do Minimum network consists of several committed highway, bus and rail schemes. The highway schemes included are:

- A1 Junctions Phase 2 - Draft Statutory Orders
- A4 Enniskillen Southern Bypass
- Belfast Rapid Transit Phase 2 (Antrim Road and Ormeau Road options)
- Belfast Grand Central Station highway updates
- Short Term Belfast Cycle Network (BCN)
- Queens Island Updates (Titanic Eastern Access Road – Hamilton Road)
- McClure street closure

The bus and rail changes include:

- Belfast Rapid Transit Phase 2 (Antrim Road and Ormeau Road options)
- Belfast Grand Central Station
- Albert bridge bus lanes
- Hourly Enterprise services

4.4 Forecast Costs

The forecast costs utilised in the model are set out in Table 4-1.

Table 4-1 - 2035 Forecast Costs source

Cost Component	2035 Forecast Cost
Vehicle Operating Costs	TAG Databook (reduce by approx. 30% by 2035)
Value of Time	TAG Databook
Bus and Rail Fare Growth	RPI + 0% (based on past Translink trends) (i.e. 2023 costs in real terms)

Table 4-1 sets out the source of forecast costs in the model. The vehicle operating costs are forecast to reduce over time primarily due to the introduction of electric vehicles.

4.5 Do Minimum Forecasts

This section sets out an overview of the main outputs from the Do Minimum model runs. The results are presented for the BCC Core and BCC Plan growth scenarios as set out in Section 4.2. All the Do Minimum supply changes are included in both of these scenarios as set out in Section 4.3.

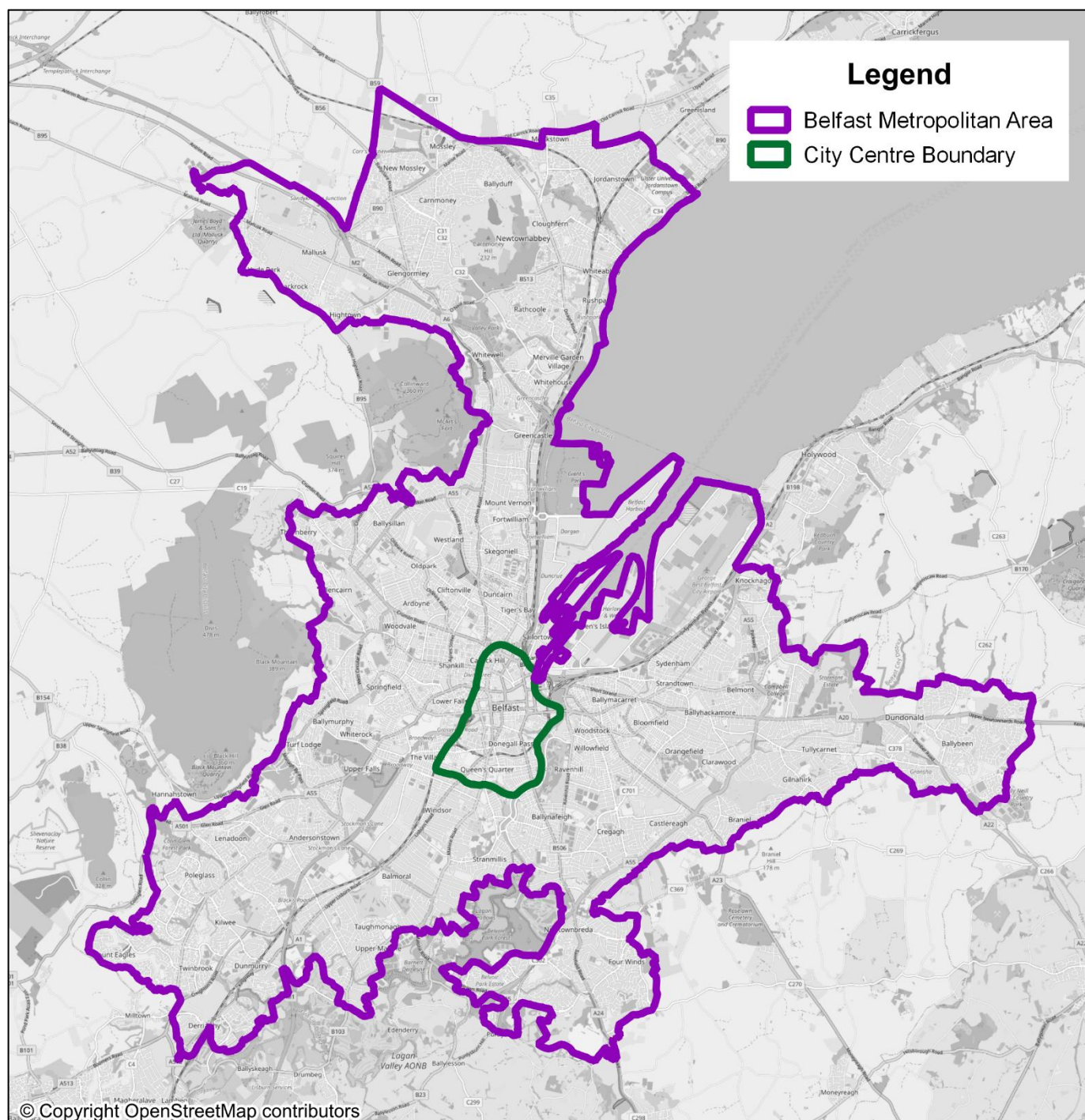
The model outputs include the following:

- Main Mode choice (total daily productions – further detail set out in the relevant section);
- Sub Mode choice (total daily trips - further detail set out in the relevant section);
- SATURN highway summary statistics (travel time, delay and speed);
- ADV plots showing changes in flow and delay



In some cases these outputs are shown for the Belfast area and Belfast City Centre. The locations of these areas are shown in Figure 4-3.

Figure 4-3 - Belfast and City Centre Locations



4.5.1 Main Mode Choice

The main mode choice in the model sets out the total daily productions using car, public transport, walk or cycle. This is at a production level only i.e. the home end of a tour for home-based trips or the origin of a trip for non-home-based trips.

4.5.1.1 Belfast

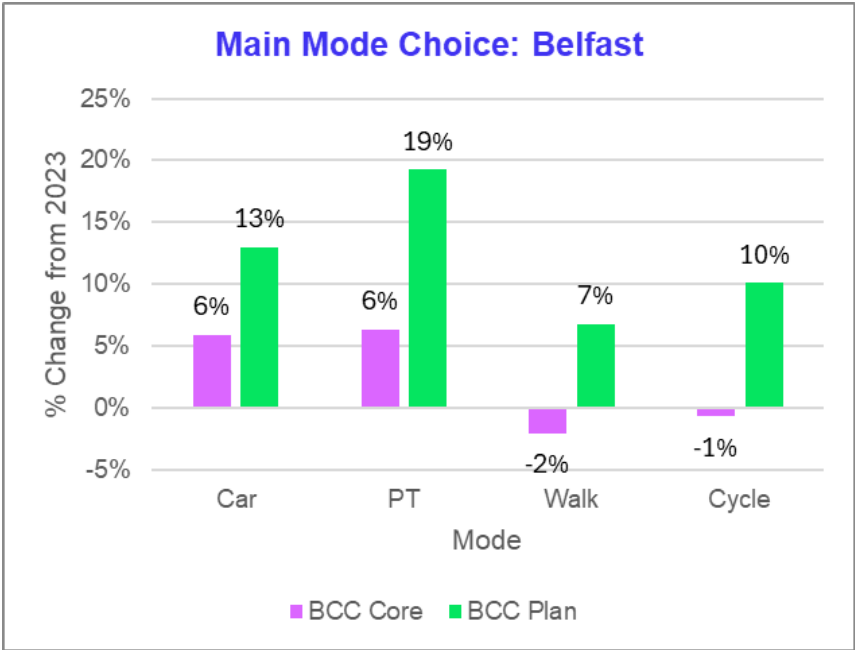
Table 4-2 - Total Main Mode Choice for Belfast

Scenario	Car	Public Transport	Walk	Cycle	Total
2023	532,300	42,200	165,300	5,900	745,700
2035 BCC Core DM	563,600	44,900	162,000	5,800	776,300
2035 BCC Plan DM	601,700	50,400	176,500	6,400	835,000

Table 4-3 - Change in Main Mode Choice from 2023 to 2035 for Belfast

Scenario	Car	Public Transport	Walk	Cycle	Total
2035 BCC Core DM	31,300	2,700	-3,300	-100	30,600
2035 BCC Plan DM	69,400	8,200	11,200	500	89,300

Figure 4-4 – Percentage Change in Main Mode Choice: 2023-2035 for Belfast



*Percentage Change calculated on values that are not subject to rounding

The main mode choice for Belfast shows that:

- By 2035 there will be between 30,600 and 89,300 additional trips generated in Belfast depending on the growth scenario
- Given the volume of current cycle trips, the percentage change appears high but the absolute change is relatively small compared to the other modes
- Car trips see the largest absolute increase in productions in both forecast scenarios
- Walk and cycle see a decrease in trips in the BCC Core scenario
- Public transport has a large percentage increase in trips in the BCC Plan scenario.

4.5.1.2 City Centre

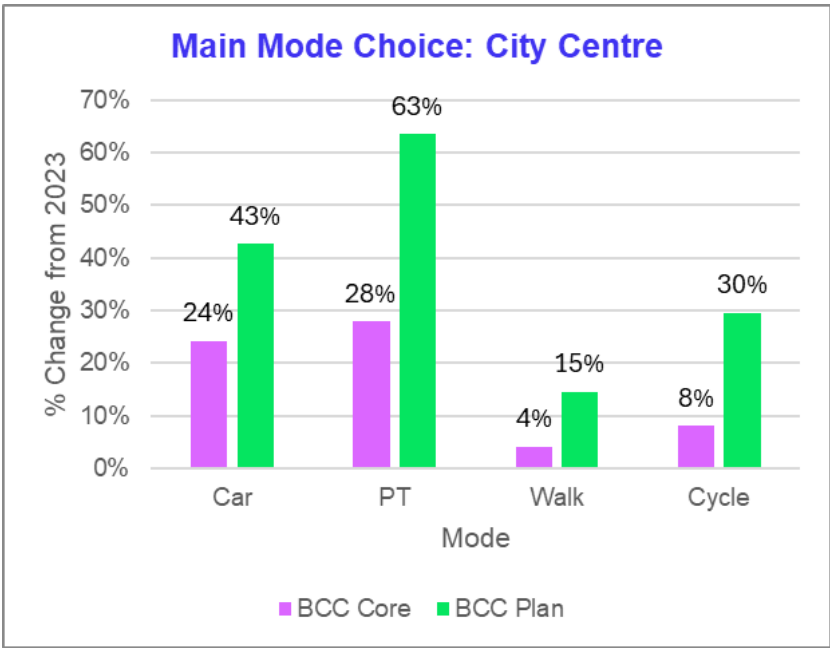
Table 4-4 - Total Main Mode Choice for Belfast City Centre

Scenario	Car	Public Transport	Walk	Cycle	Total
2023	44,900	3,700	21,800	500	71,000
2035 BCC Core DM	55,800	4,700	22,700	600	83,800
2035 BCC Plan DM	64,100	6,100	25,000	700	95,900

Table 4-5 - Change in Main Mode Choice from 2023 to 2035 for Belfast City Centre

Scenario	Car	Public Transport	Walk	Cycle	Total
2035 BCC Core DM	10,900	1,000	900	100	12,800
2035 BCC Plan DM	19,200	2,400	3,200	200	25,000

Figure 4-5 – Percentage Change in Main Mode Choice: 2023-2035 for Belfast City Centre



*Percentage Change calculated on values that are not subject to rounding

The main mode choice for Belfast City Centre shows that:

- By 2035 there will be between 12,800 and 25,000 additional trips generated in the City Centre depending on the growth scenario
- Car trips experience the largest increase in absolute change
- Public transport experiences a large percentage increase in productions in the city centre in the BCC Plan scenario.



4.5.2 Sub-Mode Choice

The sub-mode choice in the model sets out the total daily trips by origin and destination trips using car, bus and rail. The outputs for destinations are shown below.

4.5.2.1 Belfast

Table 4-6 - Total Sub Mode Choice for Belfast

Scenario	Car	Bus	Rail	Total
2023	969,000	89,000	15,100	1,073,000
2035 BCC Core DM	1,007,300	88,500	16,500	1,112,300
2035 BCC Plan DM	1,071,600	97,500	18,000	1,187,100

Table 4-7 - Change in Sub Mode Choice from 2023 to 2035 for Belfast

Scenario	Car	Bus	Rail	Total
2035 BCC Core DM	38,300	-500	1,400	39,300
2035 BCC Plan DM	102,600	8,500	2,900	114,100

4.5.2.2 City Centre

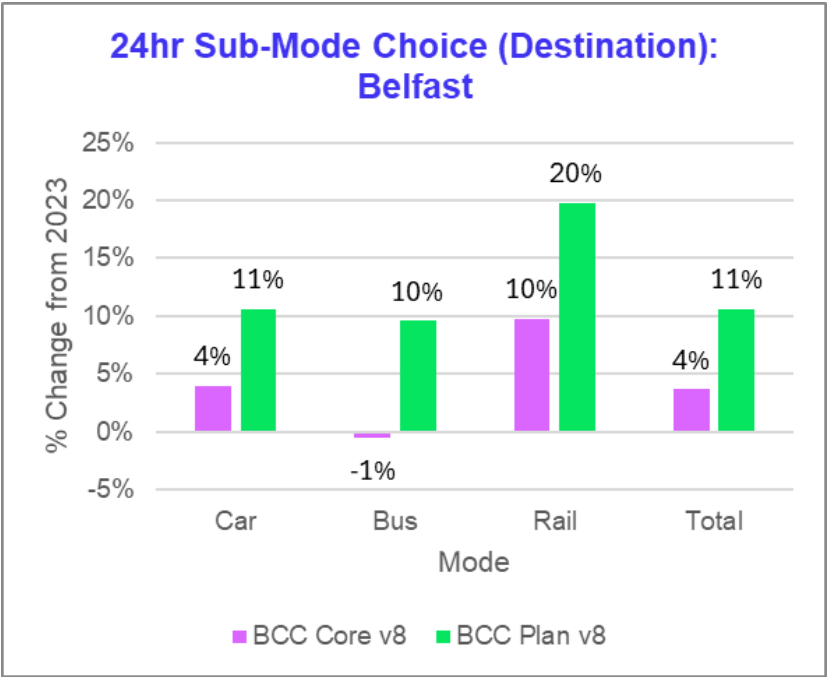
Table 4-8 - Total Sub Mode Choice for Belfast City Centre

Scenario	Car	Bus	Rail	Total
2023	91,800	28,800	9,000	129,700
2035 BCC Core DM	98,000	27,600	10,200	135,800
2035 BCC Plan DM	107,200	30,900	11,200	149,300

Table 4-9 - Change in Sub Mode Choice from 2023 to 2035 for Belfast City Centre

Scenario	Car	Bus	Rail	Total
2035 BCC Core DM	6,200	-1,200	1,200	6,100
2035 BCC Plan DM	15,400	2,100	2,200	19,600

Figure 4-6 – Percentage Change in Sub Mode Choice: 2023-2035 for Belfast

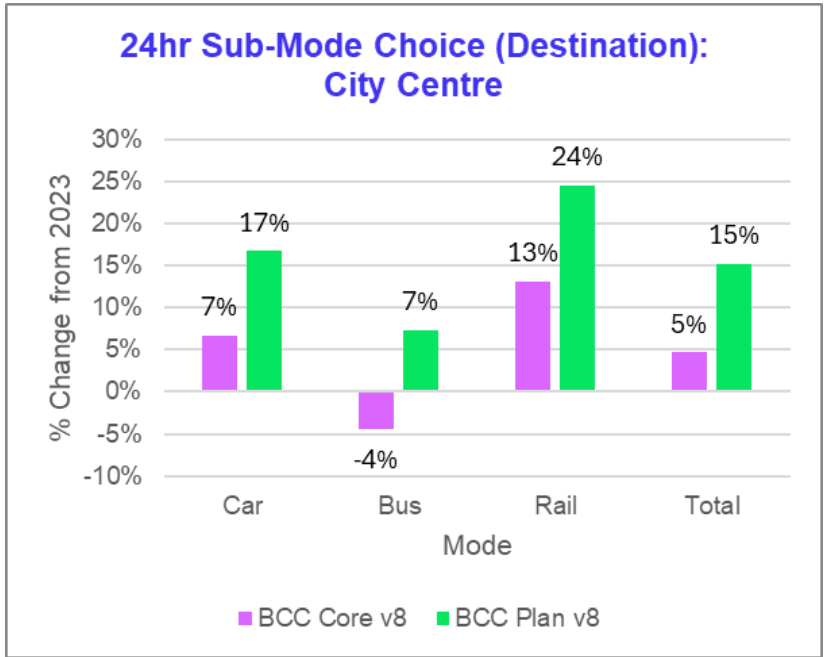


*Percentage Change calculated on values that are not subject to rounding

The sub mode choice for Belfast shows that:

- By 2035 there will be between 39,300 and 114,100 additional trips per day destinating in Belfast depending on the growth scenario
- Car trips see the largest absolute increase in trips in both forecast scenarios
- Rail experiences a large percentage increase in trips
- Bus experiences a slight decrease in trips (due to the Vehicle Operating Cost reduction set out in TAG) in the BCC Core scenario. With the BCC Plan growth, bus also experiences an increase in trips (10%).

Figure 4-7 – Percentage Change in Sub Mode Choice: 2023-2035 for Belfast City Centre



*Percentage Change calculated on values that are not subject to rounding

The sub mode choice for Belfast City Centre shows that:

- By 2035 there will be between 6,100 and 19,600 additional trips per day destinating in the City Centre depending on the growth scenario
- Car trips see the largest absolute increase in trips in both forecast scenarios
- Rail experiences a large percentage increase in trips
- Bus experiences a slight decrease in trips (again due to the Vehicle Operating Cost reduction set out in TAG) in the BCC Core scenario. With the BCC Plan growth, bus also experiences an increase in trips (7%)
- Bus experiences the smallest percentage growth across the modes

4.5.3 SATURN Highway Summary Statistics

The SATURN summary statistics include the following outputs from the SATURN highway assignments for the AM, IP and PM peak hours. These statistics have been summarised for the Belfast area and the city centre as set out in Figure 4-3. The summary statistics include:

- Total Time (hrs) - Sum of delays and free flow travel time in seconds
- Highway Delay (hrs) - Total Time minus the Cruise time in seconds where cruise time is the stopline to stopline time allowing (if appropriate) for speeds to decrease according to a link capacity-restraint in seconds
- Average Speed (kph) - Average congested link speed (including a weighted junction delay) in kilometres per hour (kph)

4.5.3.1 Total Time

Table 4-10 - Total Time in Belfast and Belfast City Centre– AM Peak

Scenario	Total Time		Change from 2023	
	Belfast	City Centre	Belfast	City Centre
2023	21,800	1,400		
2035 BCC Core DM	25,200	1,600	3,400	200
2035 BCC Plan DM	27,000	1,800	5,200	400

Table 4-11 - Total Time in Belfast and Belfast City Centre– Inter Peak

Scenario	Total Time		Change from 2023	
	Belfast	City Centre	Belfast	City Centre
2023	16,300	1,100		
2035 BCC Core DM	19,200	1,300	2,900	200
2035 BCC Plan DM	20,100	1,400	3,800	300

Table 4-12 - Total Time in Belfast and Belfast City Centre – PM Peak

Scenario	Total Time		Change from 2023	
	Belfast	City Centre	Belfast	City Centre
2023	18,800	1,300		
2035 BCC Core DM	21,700	1,500	2,900	200
2035 BCC Plan DM	23,100	1,700	4,300	400

Figure 4-8 – Percentage Change in Total Time: 2023-2035 for Belfast and Belfast City Centre – AM Peak

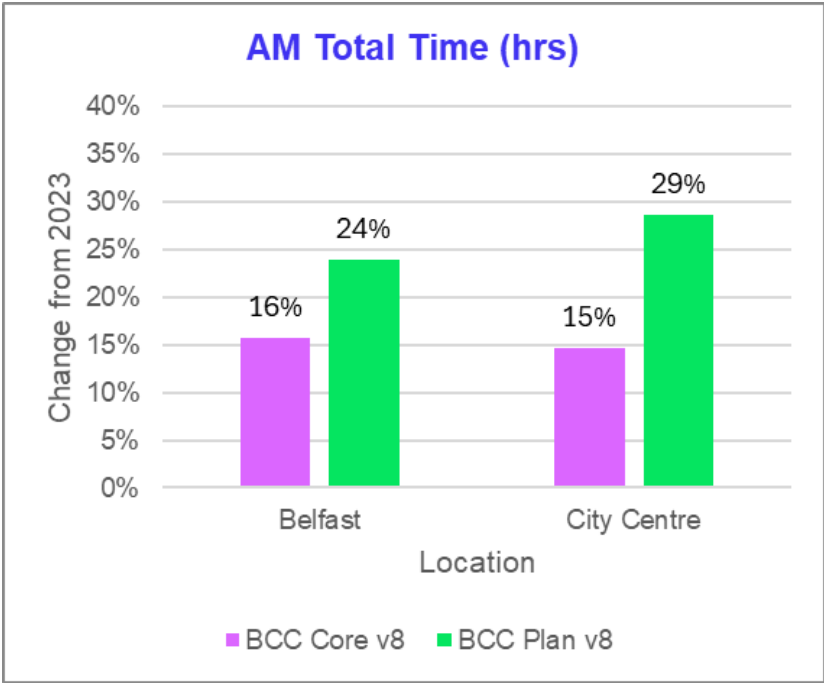


Figure 4-9 – Percentage Change in Total Time: 2023-2035 for Belfast and Belfast City Centre – Inter Peak

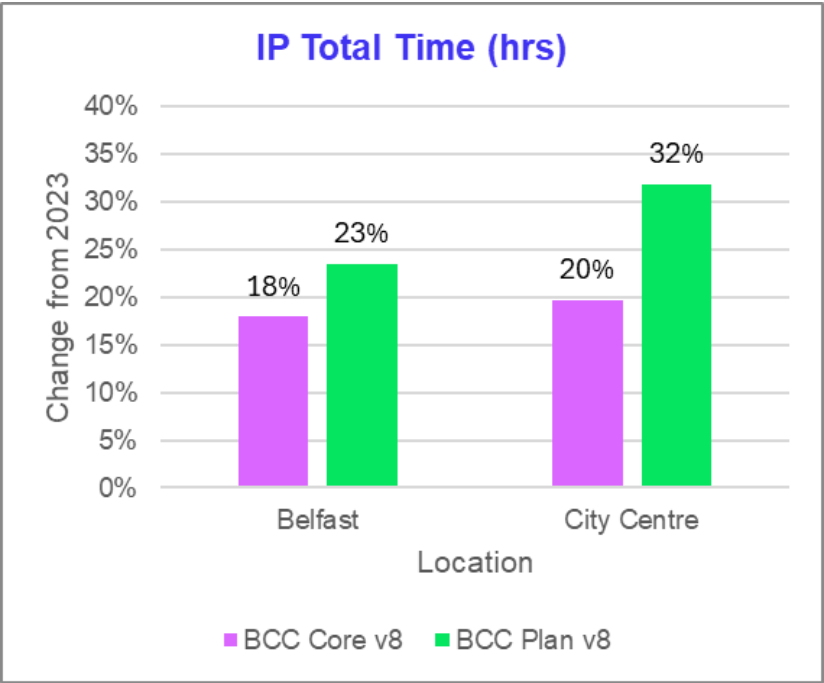
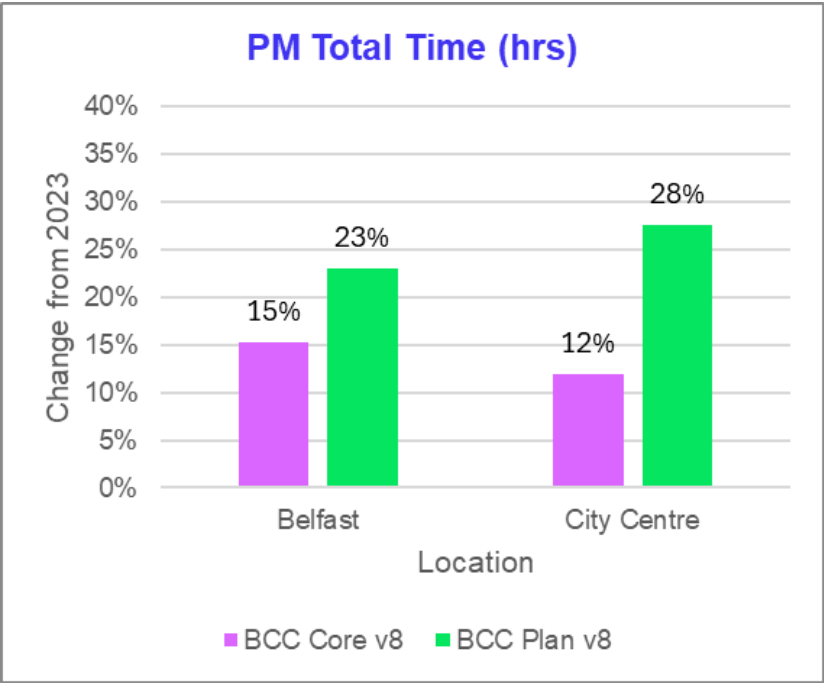


Figure 4-10 – Percentage Change in Total Time: 2023-2035 for Belfast and Belfast City Centre – PM Peak



- The total time across the city centre and Belfast increases as the level of demand increases in each forecast scenario
- In Belfast the total time increases by 15-18% in the BCC Core scenario and rises by 23-24% in the BCC Plan scenario
- In the city centre the total time increases by a similar percentage but the absolute change is much smaller given the scale of travel time

4.5.3.2 Highway Delay (hrs)

Table 4-13 - Total Delay in Belfast and Belfast City Centre– AM Peak

Scenario	Total Time		Change from 2023	
	Belfast	City Centre	Belfast	City Centre
2023	7,200	600		
2035 BCC Core DM	9,300	800	2,100	200
2035 BCC Plan DM	10,500	900	3,300	300

Figure 4-11 – Percentage Change in Total Delay: 2023-2035 for Belfast and Belfast City Centre – AM Peak

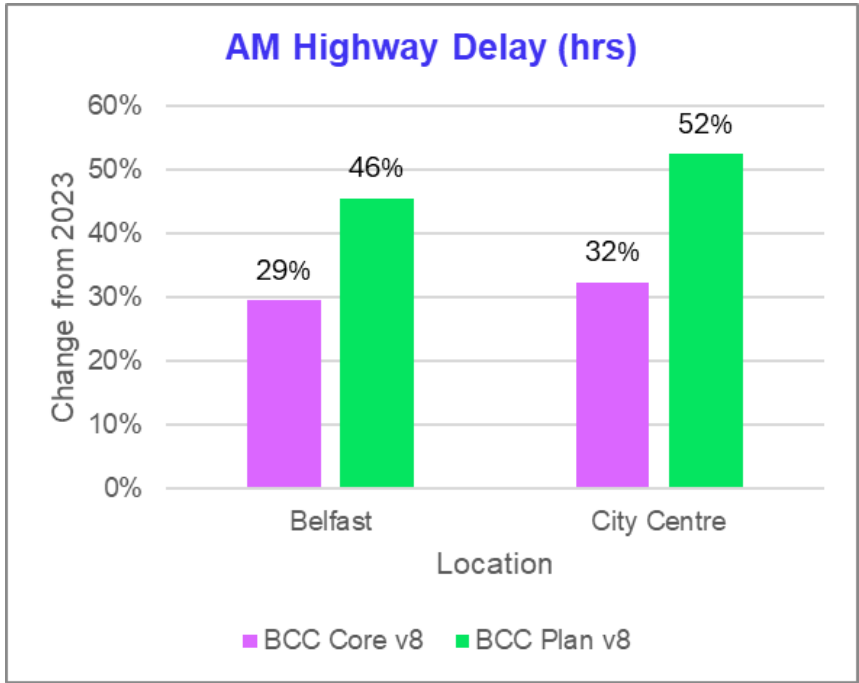


Table 4-14 - Total Delay in Belfast and Belfast City Centre– Inter Peak

Scenario	Total Time		Change from 2023	
	Belfast	City Centre	Belfast	City Centre
2023	4,600	400		
2035 BCC Core DM	6,000	600	1,400	200
2035 BCC Plan DM	6,400	600	1,800	200

Figure 4-12 – Percentage Change in Total Delay: 2023-2035 for Belfast and Belfast City Centre – Inter Peak

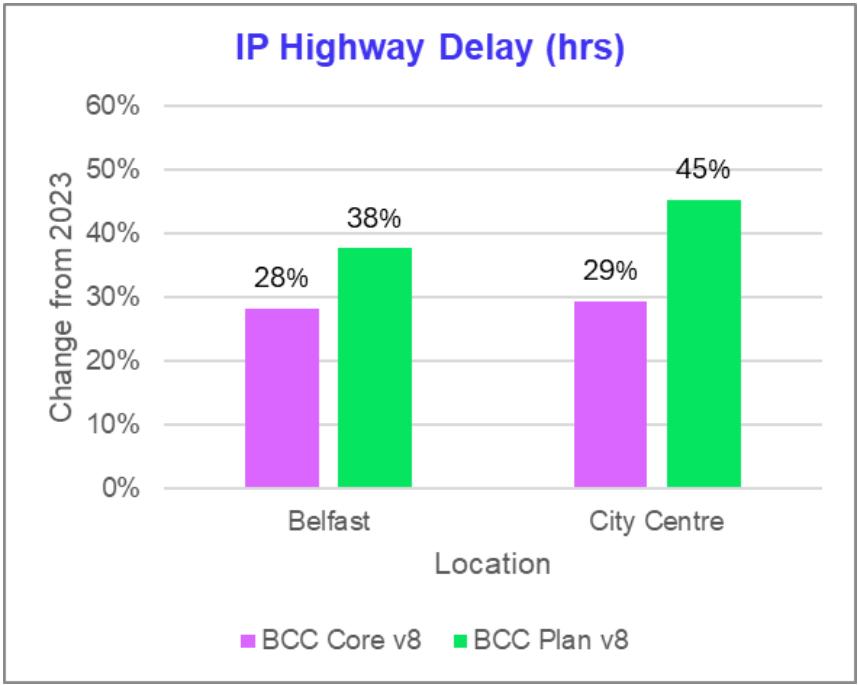
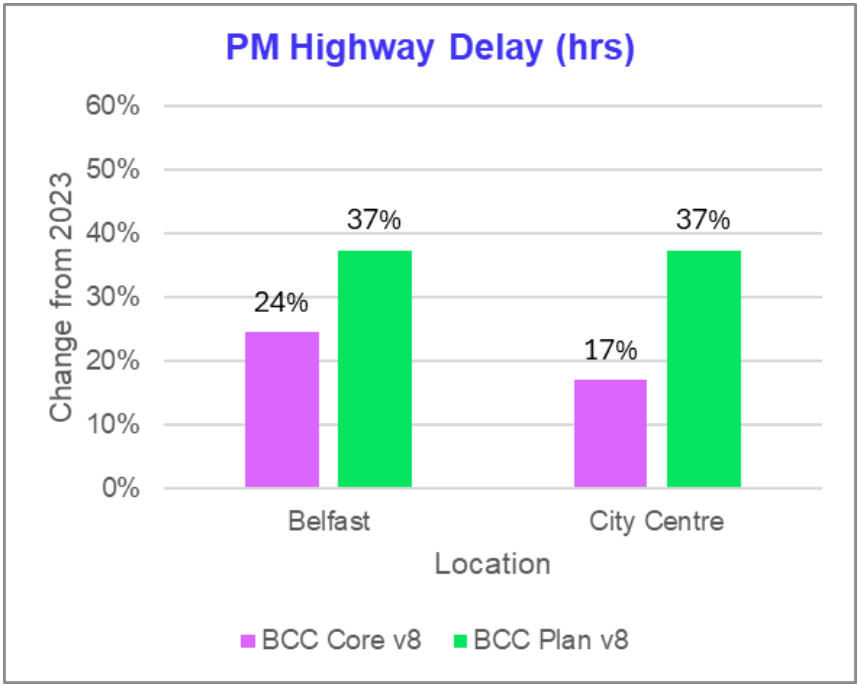


Table 4-15 - Total Delay in Belfast and Belfast City Centre – PM Peak

Scenario	Total Time		Change from 2023	
	Belfast	City Centre	Belfast	City Centre
2023	5,800	600		
2035 BCC Core DM	7,300	700	1,500	100
2035 BCC Plan DM	8,000	800	2,200	200

Figure 4-13 – Percentage Change in Total Delay: 2023-2035 for Belfast and Belfast City Centre – PM Peak



- Across Belfast the highway delay could be increased by 24-46% depending on the growth scenario and the peak.
- Within the city centre the delay could increase by 17-52% depending on the growth scenario and the peak.
- In all growth scenarios the AM peak experiences the highest level of delay increase in percentage and absolute terms.



4.5.3.3 Average Speed (kph)

Table 4-16 – Average Speed in Belfast and Belfast City Centre– AM Peak

Scenario	Total Time		Change from 2023	
	Belfast	City Centre	Belfast	City Centre
2023	33	14		
2035 BCC Core DM	30	12	-3	-2
2035 BCC Plan DM	29	12	-4	-2

Figure 4-14 – Percentage Change in Average Speed: 2023-2035 for Belfast and Belfast City Centre – AM Peak

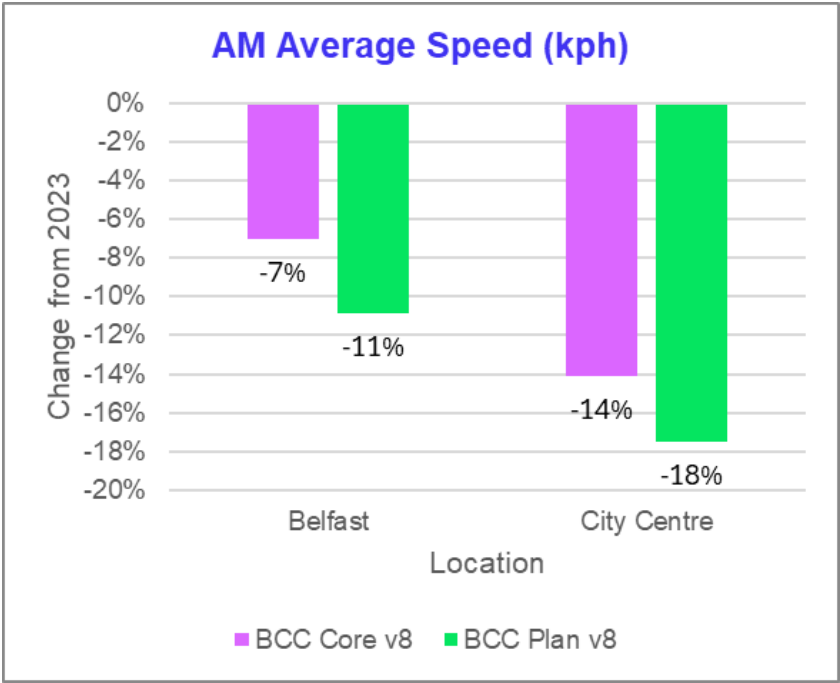


Table 4-17 - Average Speed in Belfast and Belfast City Centre– Inter Peak

Scenario	Total Time		Change from 2023	
	Belfast	City Centre	Belfast	City Centre
2023	37	15		
2035 BCC Core DM	35	14	-2	-1
2035 BCC Plan DM	34	13	-3	-2

Figure 4-15 – Percentage Change in Average Speed: 2023-2035 for Belfast and Belfast City Centre – Inter Peak

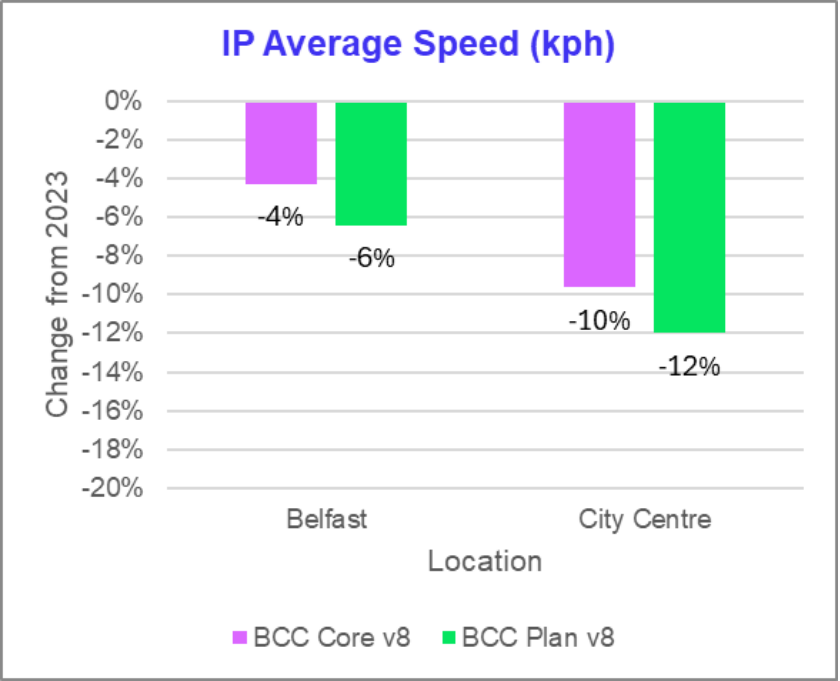
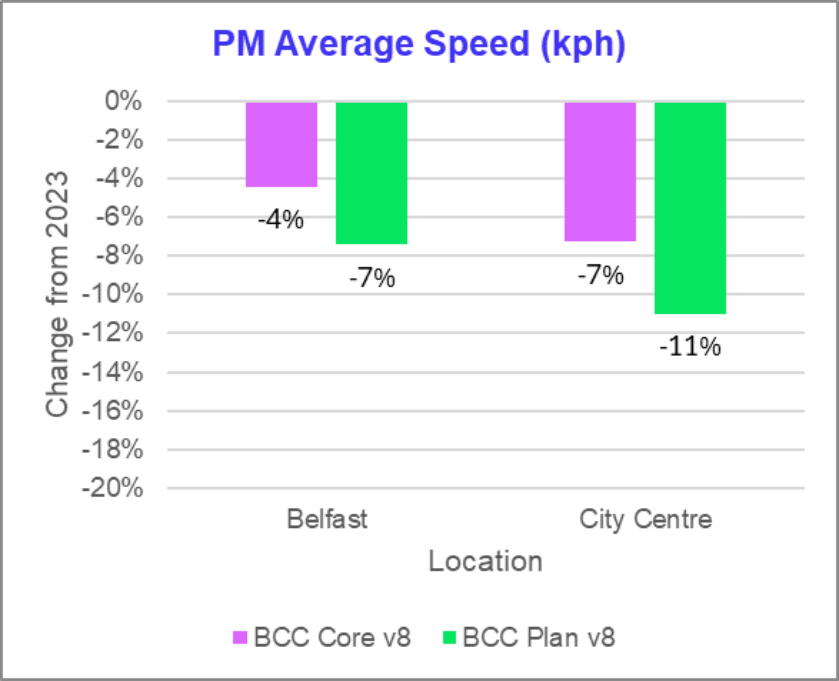


Table 4-18 - Average Speed in Belfast and Belfast City Centre – PM Peak

Scenario	Total Time		Change from 2023	
	Belfast	City Centre	Belfast	City Centre
2023	34	14		
2035 BCC Core DM	33	13	-1	-1
2035 BCC Plan DM	32	13	-2	-1

Figure 4-16 – Percentage Change in Average Speed: 2023-2035 for Belfast and Belfast City Centre – PM Peak



- The average speed decreases in all peaks and scenarios
- Given the low speeds in the city centre, a small change results in a large percentage change
- As would be expected, the city centre speeds are lower than across Belfast.

4.5.4 ADV Plots

BCC Core - Highway

The plots in Figure 4-17 to Figure 4-21 show the actual flow difference and delay difference between the 2035 BCC Core and 2023 Present Year Validation assignments for the AM, IP and PM Peaks.

Figure 4-17 - BCC Core: Actual Flow Difference - AM Peak (Forecast 2035 growth v 2023)

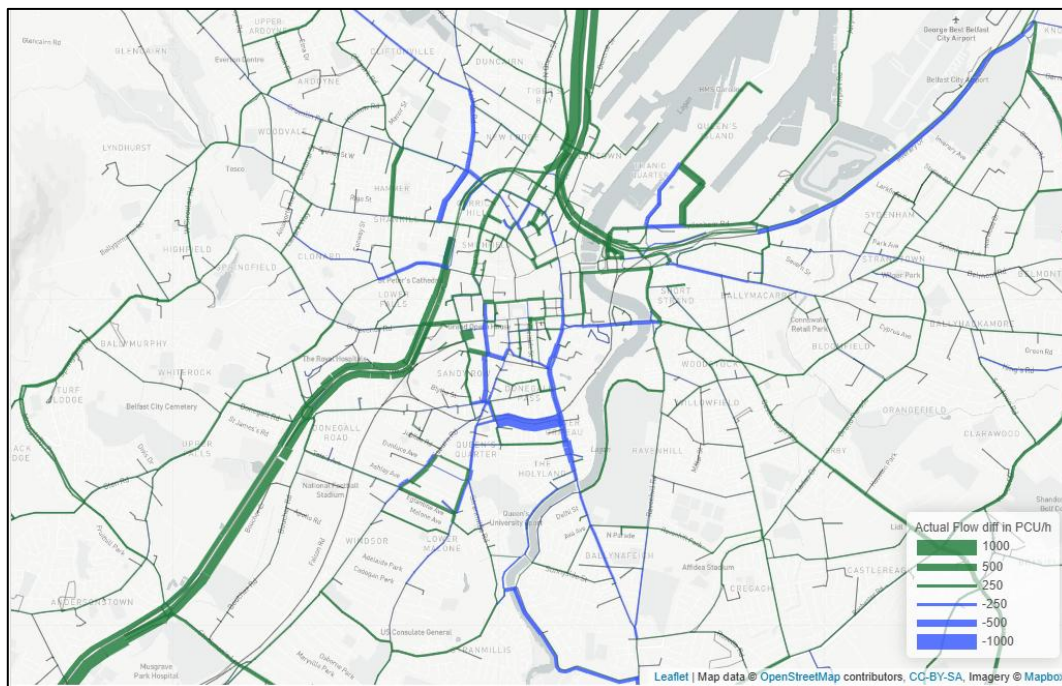


Figure 4-18 - BCC Core: Delay Difference - AM Peak (Forecast 2035 growth v 2023)

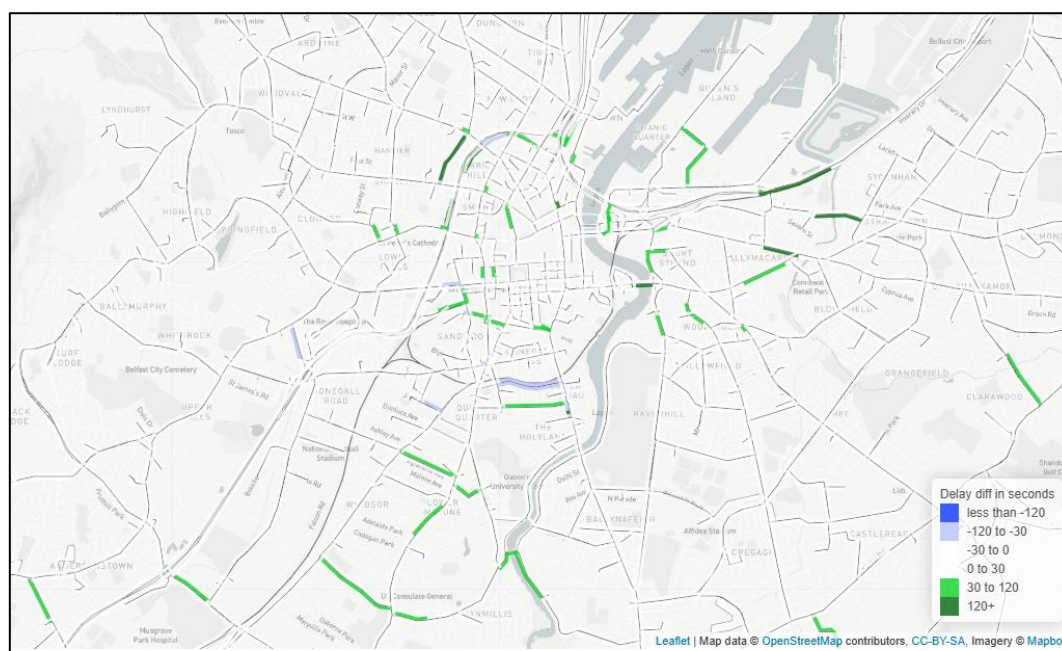


Figure 4-19 - BCC Core: Actual Flow Difference - Interpeak (Forecast 2035 growth v 2023)

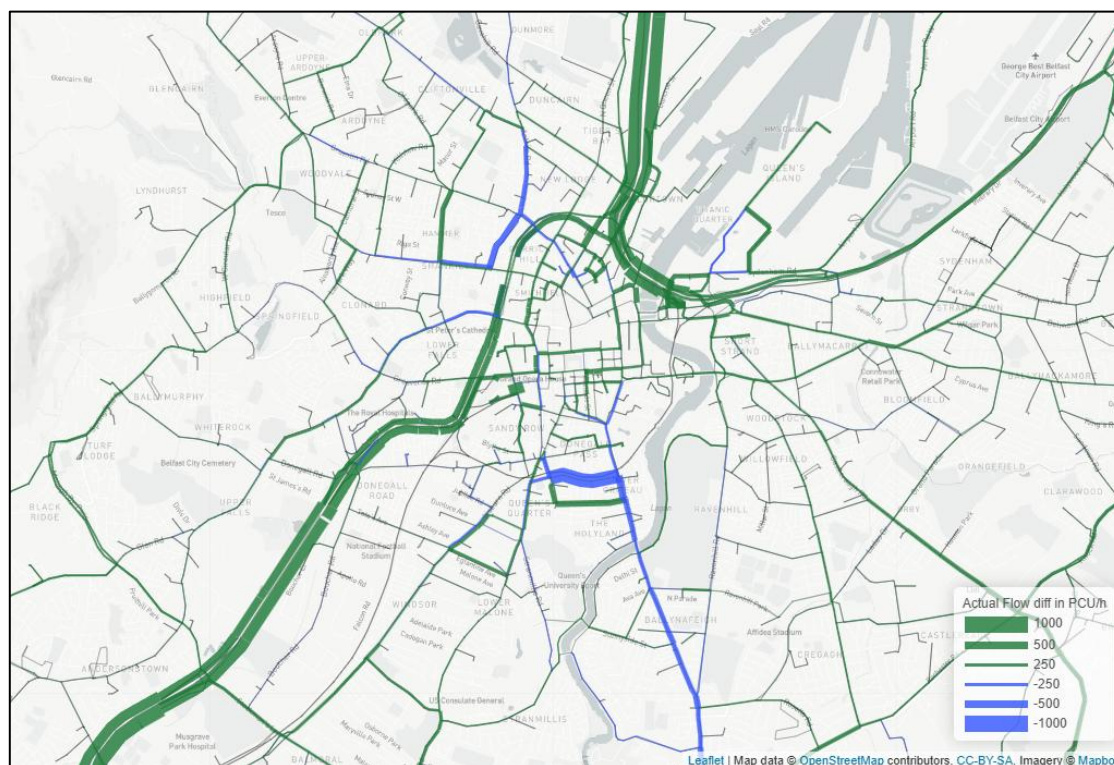


Figure 4-20 - BCC Core: Delay Difference - Interpeak (Forecast 2035 growth v 2023)

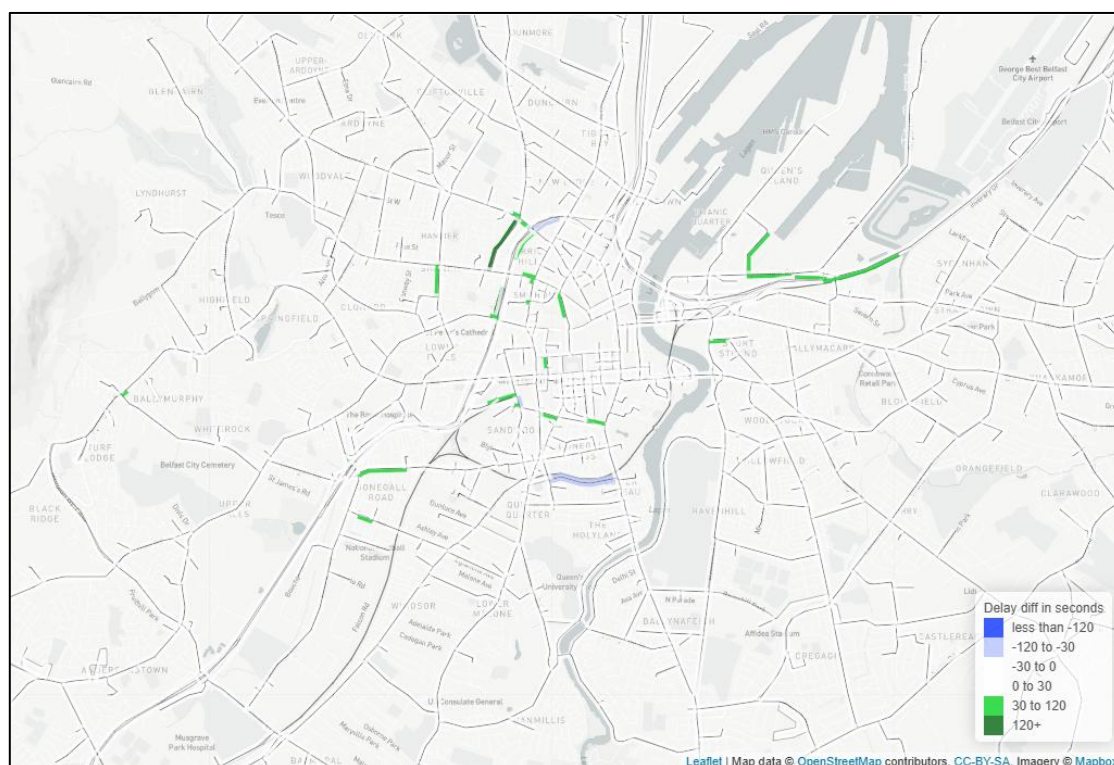


Figure 4-21 - BCC Core: Actual Flow Difference - PM Peak (Forecast 2035 growth v 2023)

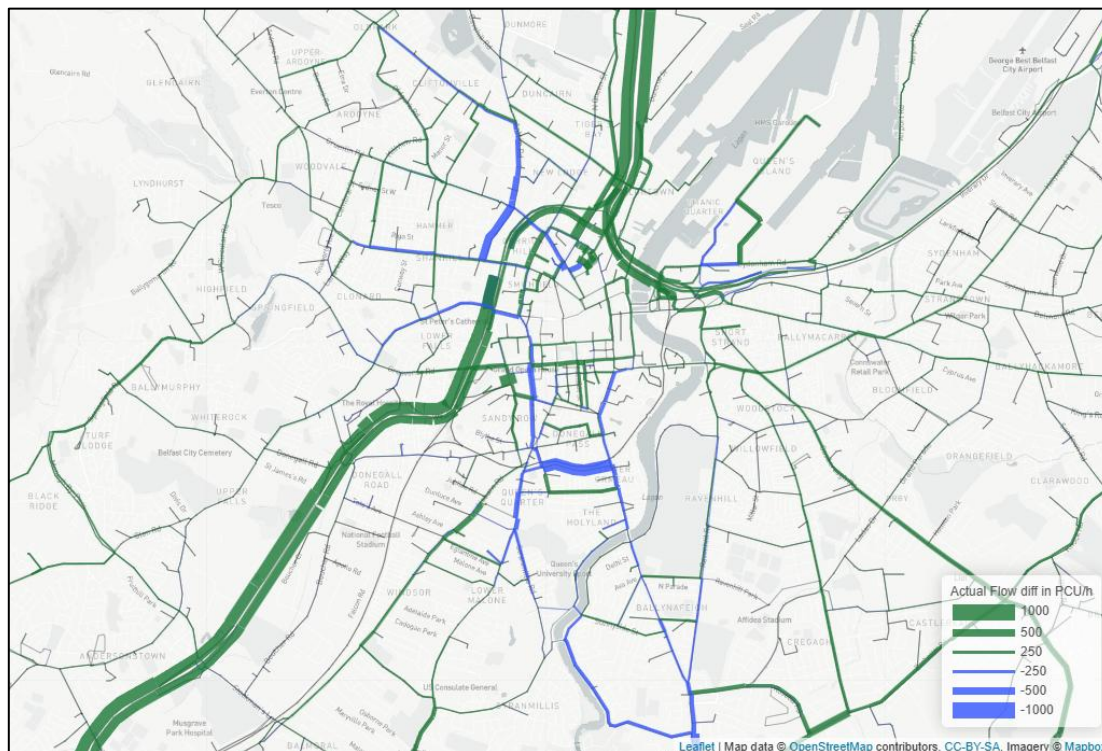


Figure 4-22 - BCC Core: Delay Difference - PM Peak (Forecast 2035 growth v 2023)

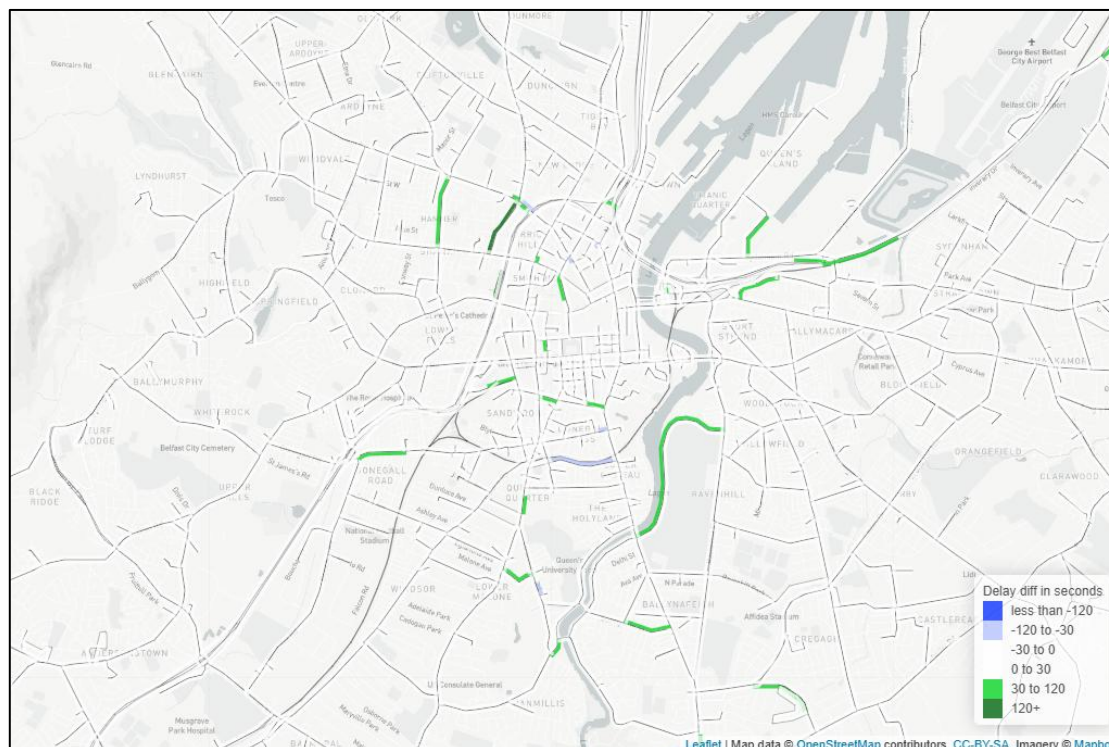


Figure 4-17 to Figure 4-21 show the change in flow and delay spread across the network with the additional demand. There are some localised reductions in flow on the Antrim Road and Ormeau Road with the introduction of BRT Phase 2. Other reductions are experienced in McClure Street with the removal of through traffic. The strategic routes along the M1, M2 and A12 experience the largest increase in flow.

BCC Core – Public Transport

The change in bus and rail person flow across a 12hr day are shown in Figure 4-23 and Figure 4-24.

Figure 4-23 - BCC Core: Bus Person Flow Difference – 12hr (Forecast 2035 growth v 2023)

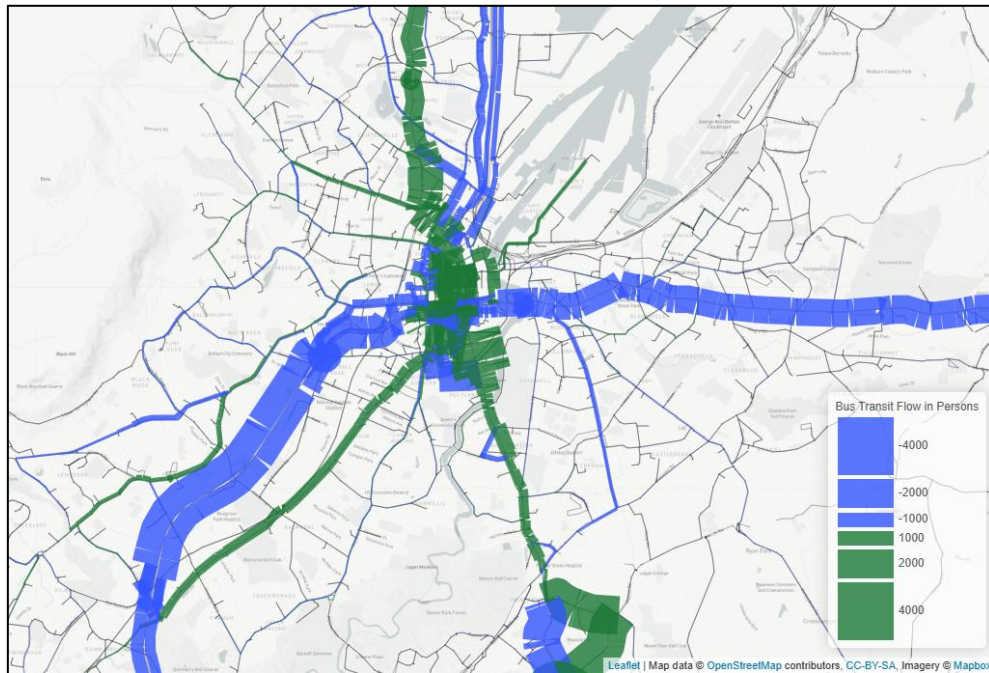


Figure 4-23 shows that along the existing eastern BRT corridor - Newtownards Road the flow reduces in the 2035 Do Minimum along with flow on the M1. This is likely due to the reducing costs of travelling by car.

Figure 4-24 - BCC Core: Rail Person Flow Difference – 12hr (Forecast 2035 growth v 2023)

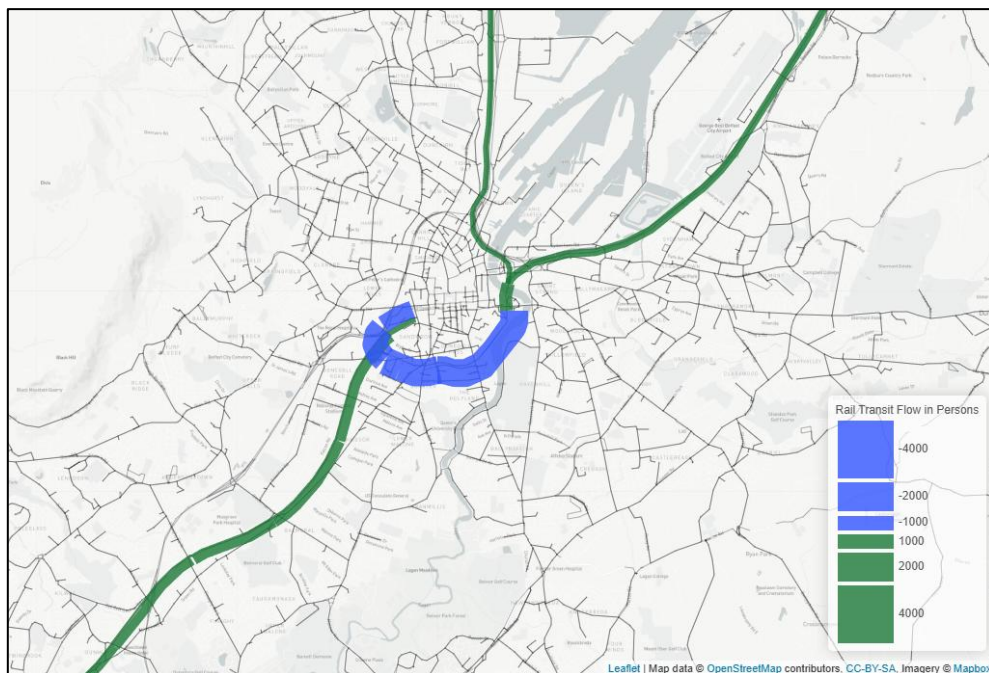


Figure 4-24 shows that rail person trips increase on all lines inbound and outbound from the city centre. There is however a decrease in rail trips travelling across the city centre.

BCC Plan - Highway

The plots in Figure 4-25 to Figure 4-30 show the actual flow difference and delay difference between the 2035 BCC Plan and 2023 Present Year Validation assignments for the AM, IP and PM Peaks.

Figure 4-25 - BCC Plan: Actual Flow Difference - AM Peak (Forecast Plan 2035 growth v 2023)

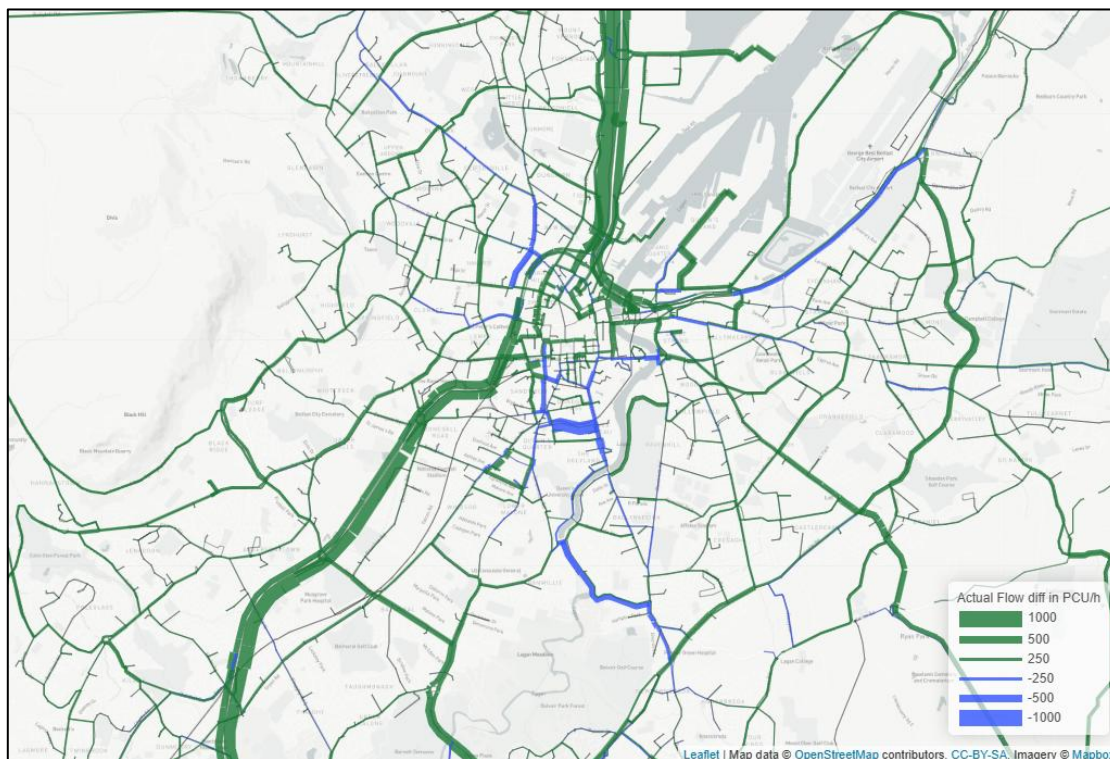


Figure 4-26 - BCC Plan: Delay Difference - AM Peak (Forecast Plan 2035 growth v 2023)

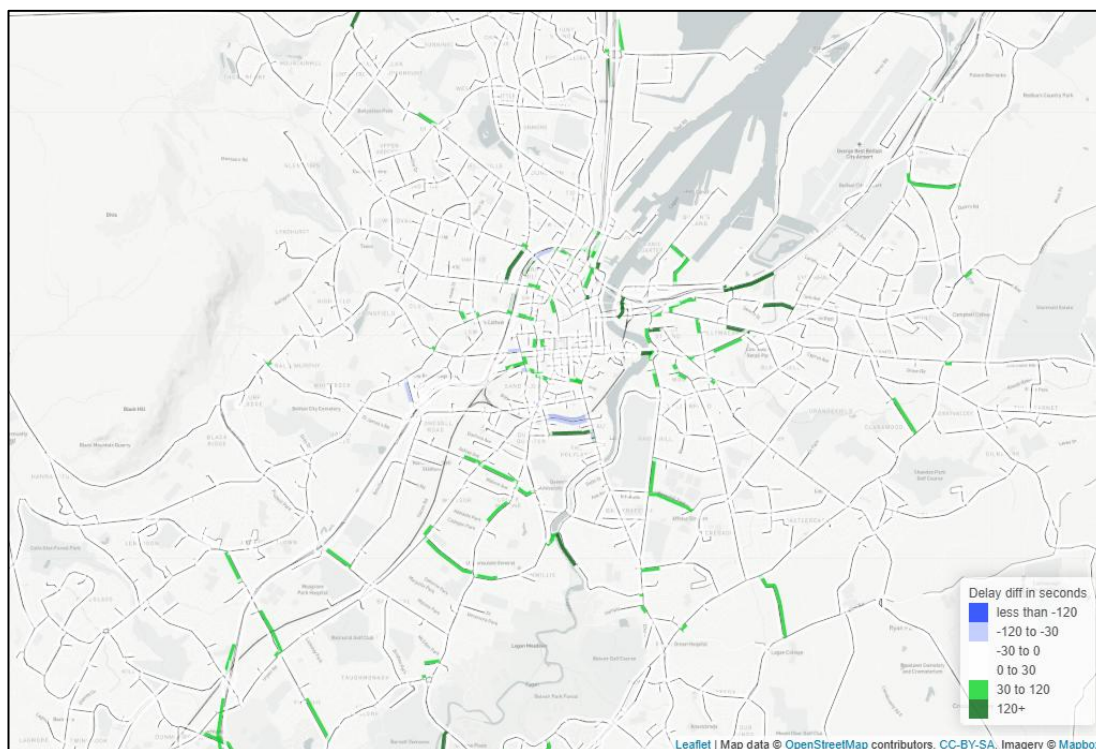


Figure 4-27 - BCC Plan: Actual Flow Difference – Interpeak (Forecast Plan 2035 growth v 2023)

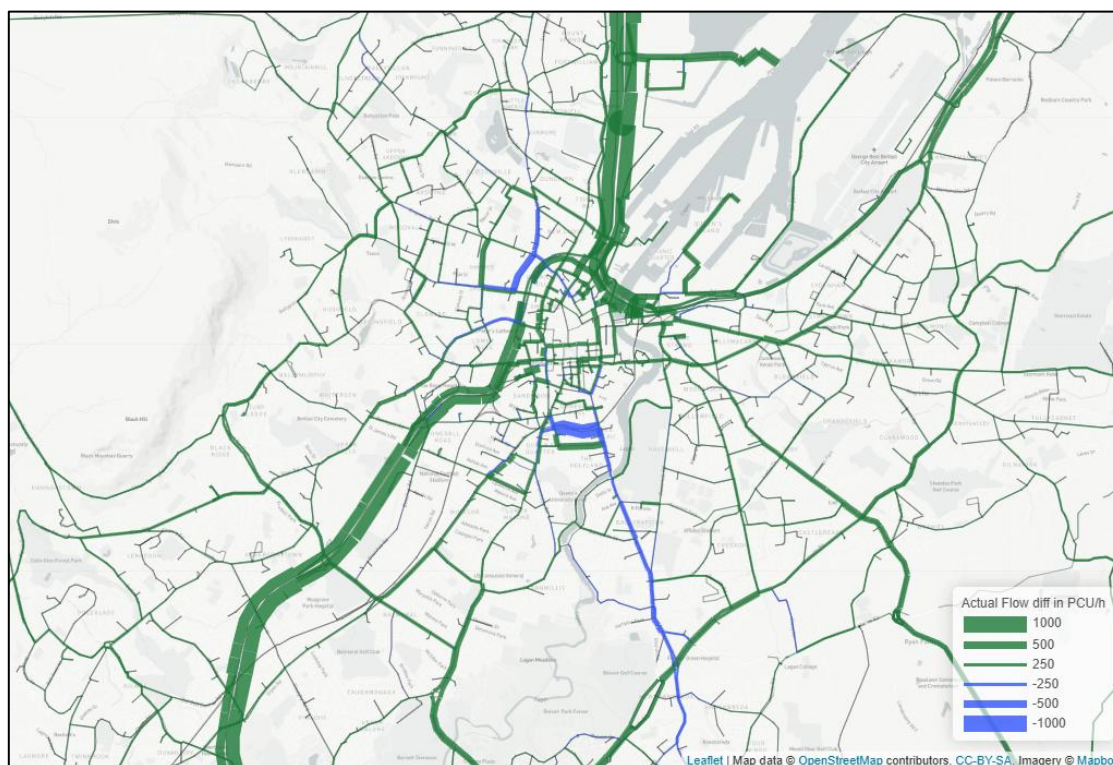


Figure 4-28 - BCC Plan: Delay Difference – Interpeak (Forecast Plan 2035 growth v 2023)

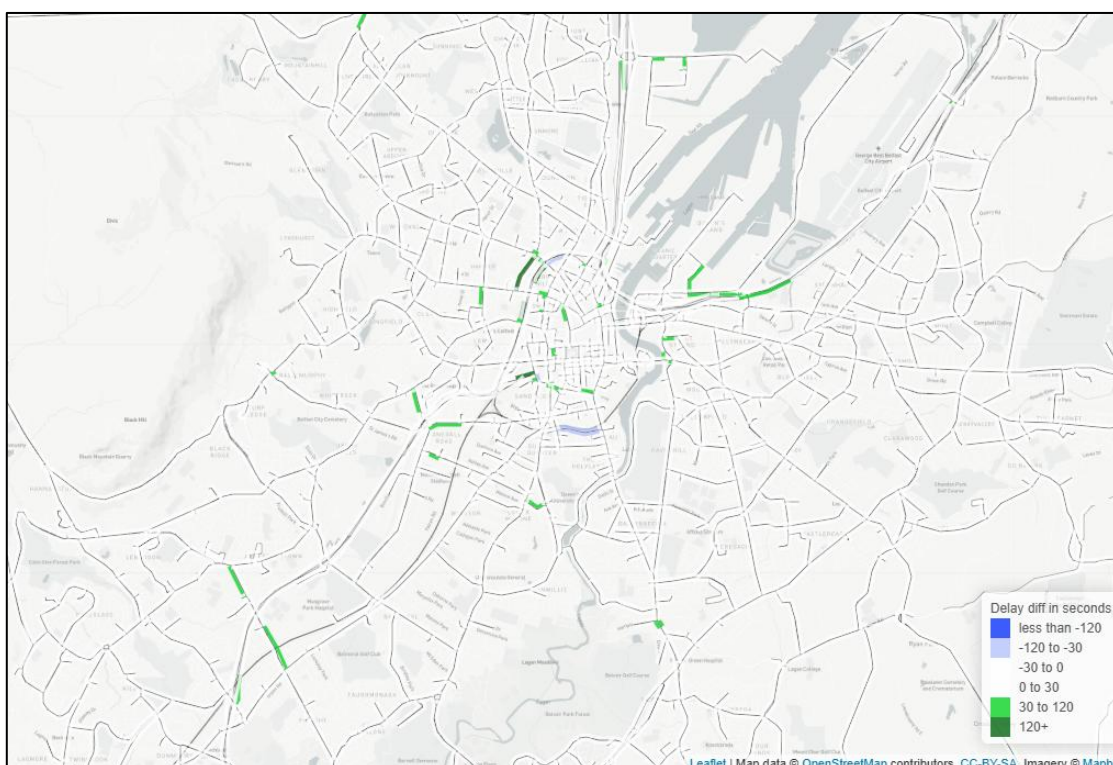


Figure 4-29 - BCC Plan: Actual Flow Difference - PM Peak (Forecast Plan 2035 growth v 2023)

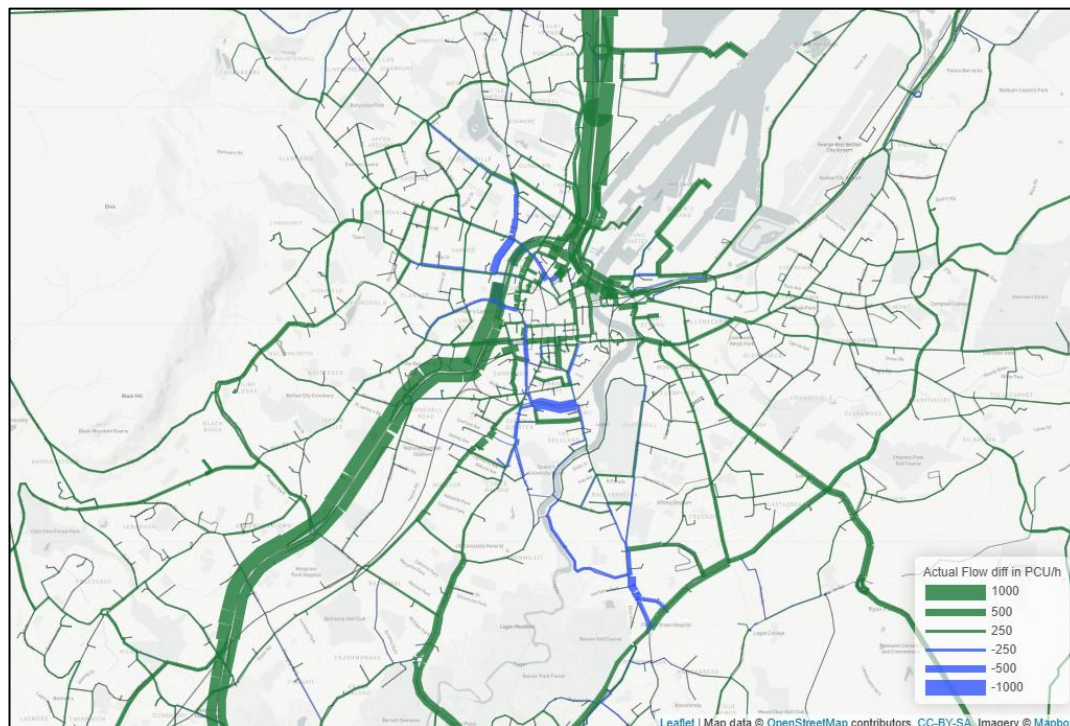


Figure 4-30 - BCC Plan: Delay Difference - PM Peak (Forecast Plan 2035 growth v 2023)

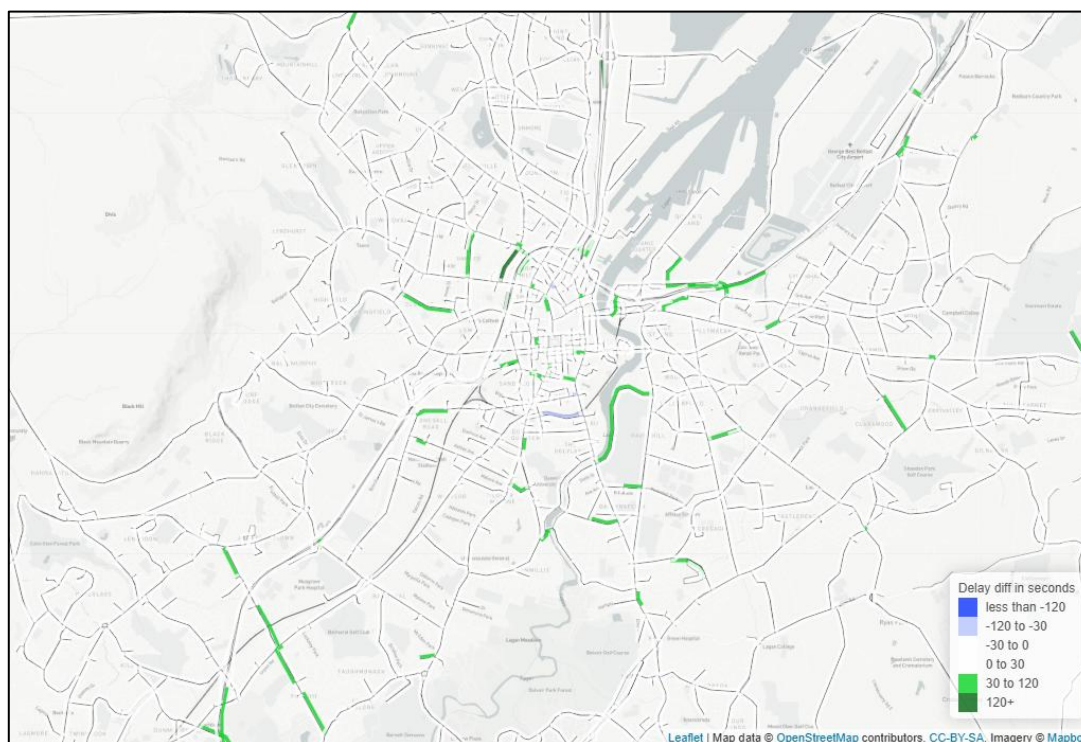


Figure 4-25 to Figure 4-30 show the change in flow and delay spread across the network with the additional demand. Similar to the BCC Core scenario, the impacts are localised reductions in flow on the Antrim Road and Ormeau Road with the introduction of BRT Phase 2. Other reductions are experienced in McClure street with the removal of through traffic. The strategic routes along the M1, M2 and A12 experience the largest increase in flow.

BCC Plan – Public Transport

The change in bus and rail person flow across a 12hr day are shown in Figure 4-31 and Figure 4-32.

Figure 4-31 - BCC Plan: Bus Person Flow Difference – 12hr (Forecast Plan 2035 growth v 2023)

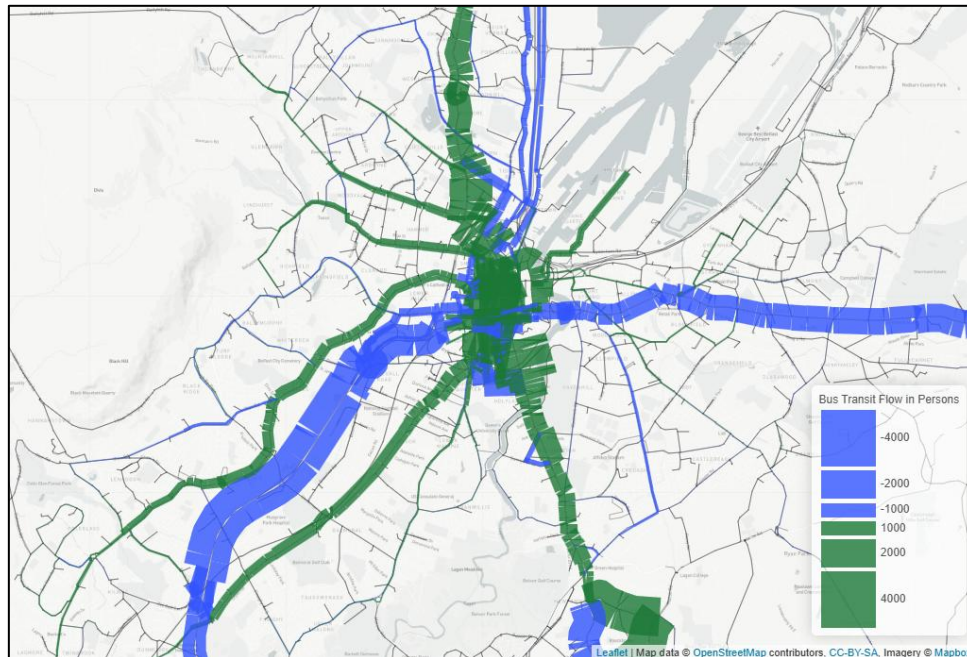


Figure 4-31 shows that there are flow decreases on the M1 and the Newtownards Road. There are increases noted on the Antrim Road and Ormeau Road (BRT Phase 2) along with the Lisburn Road, Falls Road, Shankill Road and Crumlin Road.

Figure 4-32 - BCC Plan: Rail Person Flow Difference – 12hr (Forecast Plan 2035 growth v 2023)

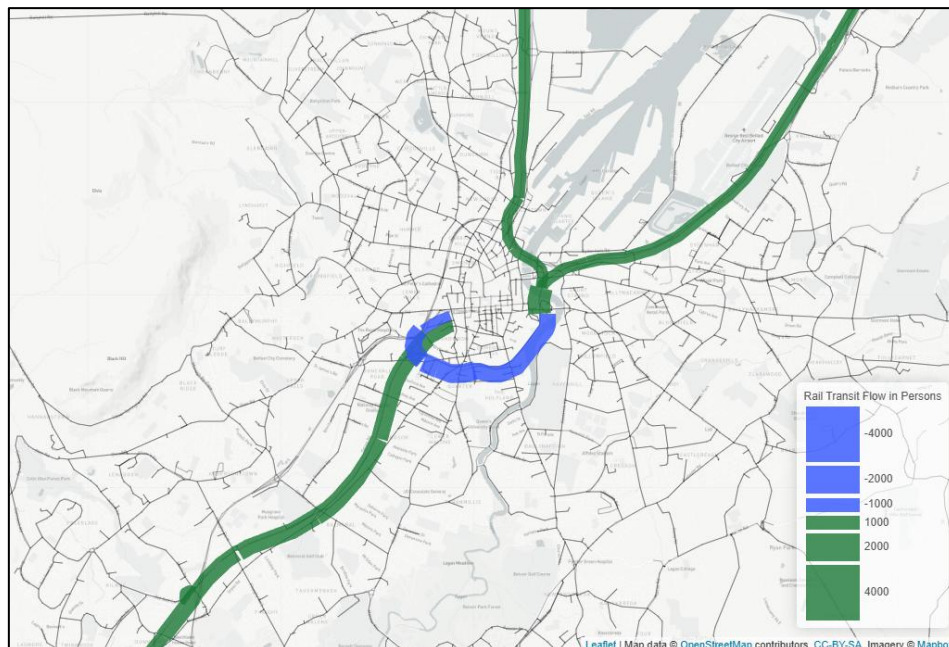


Figure 4-32 shows a similar pattern to the BCC Core scenario i.e. increase in rail trips to/from Belfast with a decrease in trips across the city centre.

Cycling

In order to represent the improvements to the cycle network as shown in Figure 5-1, the model applies a reduction to the cycle distance and time skims in the ETP scenario to reflect the improvements in safety and connectivity and impacts on perceived attractiveness of cycle (not actual shortening of trips). The reduction is applied as follows:

- The distance of trips within the city centre are reduced by 63%
- The distance of trips going to or from the city centre are reduced by 25%
- An absolute time reduction of 5 minutes when travelling to or from the city centre.

These reductions are derived from The Green Book.

Glider

A north-south glider service is proposed on the Shore Road and Lisburn Road. This service runs between Blacks Road Park and Ride and a proposed park and ride at Abbey Centre. These services are accompanied by additional inbound and outbound bus lanes along these routes. It is assumed that these bus lanes will operate Monday – Saturday from 7am to 7pm in line with existing glider services.

Buses

Additional bus priority has been added on the following routes:

- Hollywood Road
- Cregagh Road
- Malone Road
- Shankill Road
- Crumlin Road

Where the current road width allows, additional inbound and outbound bus lanes have been coded into the model. These new bus lanes are assumed to operate Monday – Saturday from 7am to 7pm. All existing bus lanes in the network have also been assumed to operate during these times.

Service changes have also been applied to the Metro area. These changes include:

- Generally increasing the frequency on the Metro corridors, particularly where Glider services are proposed
- Simplification of services, service numbers and routing
- New motorway express services on the M1 / Falls Road and M2 / Shore Road corridors

Coordination of Ulsterbus, Metro and Glider services where these operate on the same corridor

Within the City Centre, it is assumed that the bus services will travel across the City Centre (far-siding) and drop off/pick up passengers along the route.

Park and Rides

Additional Park and Rides have been coded into the model at the Abbey Centre and Hollywood Rd. These are coded into the model as pseudo park and rides. These pseudo park and rides consist of:

- Bus only trips (no car leg)
- Each internal zone connects to one pseudo-P&R using an NTLeg (a walk leg)
- The NTLeg cost is based on the highway network and car speed
- There is no capacity restraint on bus or Park and Ride capacity.



Speeds along corridors (20mph zones)

20mph speed limits have been applied to all:

- People and Movement Places; and
- People Places²

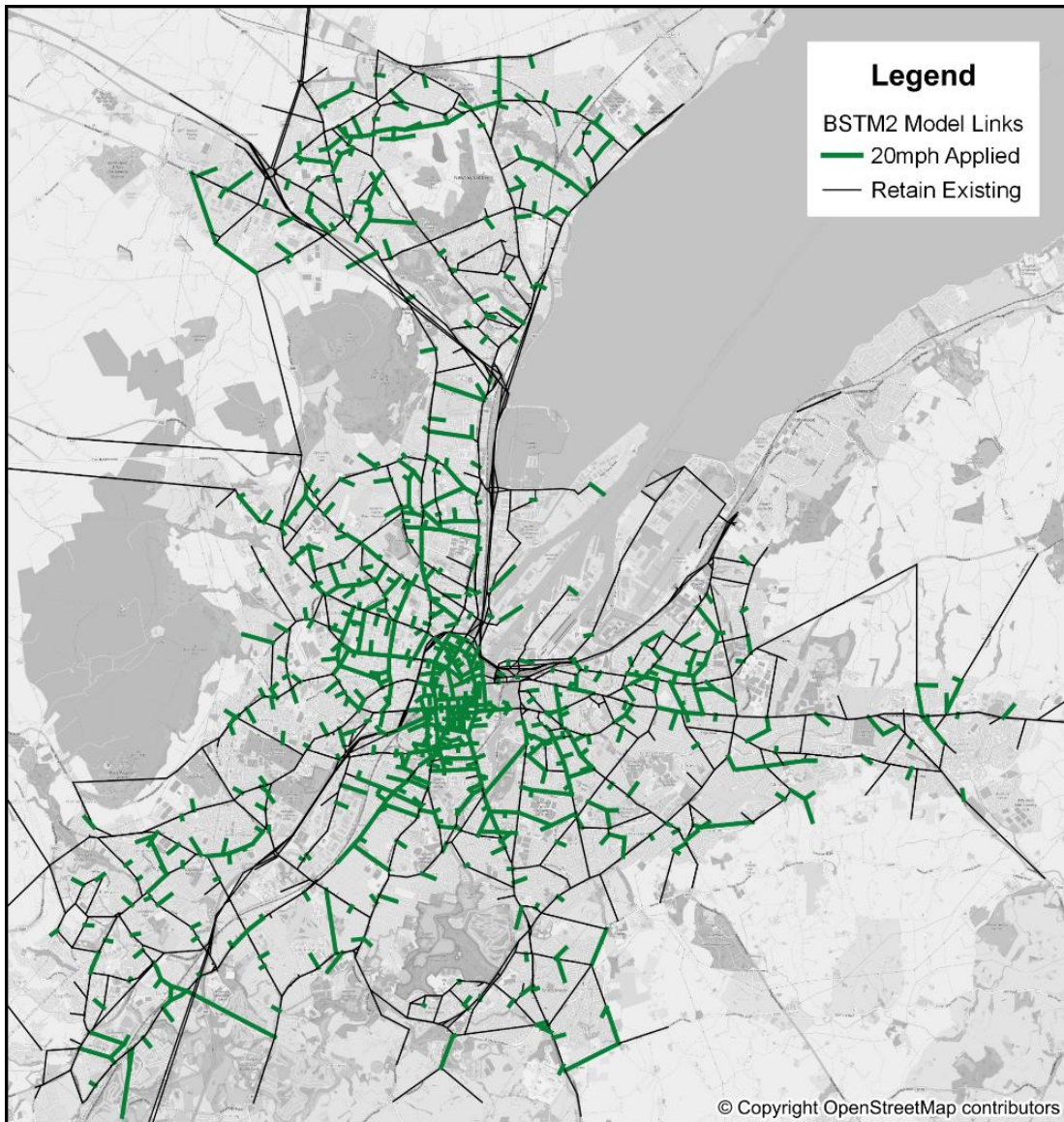
In addition, the 20mph city centre zone has been expanded.

The links where the 20mph has been applied are shown in Figure 5-2.

² **People and Movement Places** are defined as “*Mixed use places that serve the local community*”. Working with the Councils in the ETP area, People and Movement Places have been identified in locations where there are already a mixture of services and facilities on offer to the local community. ETP seeks to enhance access to the services already on offer in these locations, encouraging people to increase the number of trips they make by walking, wheeling or cycling rather than relying on car use to meet their everyday needs.

People Places are defined as “*neighbourhood areas including residential streets that prioritise active travel*”. On the whole, they cover the majority of the existing and planned residential areas across the ETP area.

Figure 5-2 - 20mph Speed Limits



City Centre

Within the city centre a number of changes are proposed to the network, these include:

- 20mph wide speed limit
- Removal of traffic on some roads (i.e. roads closed to car traffic / bus only routes)
- Reduction in parking supply: The number of on street parking spaces has been reduced in the city centre as part of the ETP proposals. These spaces have also been removed from the model. An overview of these changes is shown in Figure 5-3.
- New bus lanes
- Reduction in general traffic lanes
- Additional cycle routes

The above changes to the city centre are shown in Figure 5-4.

Figure 5-3 - ETP Parking Supply Changes

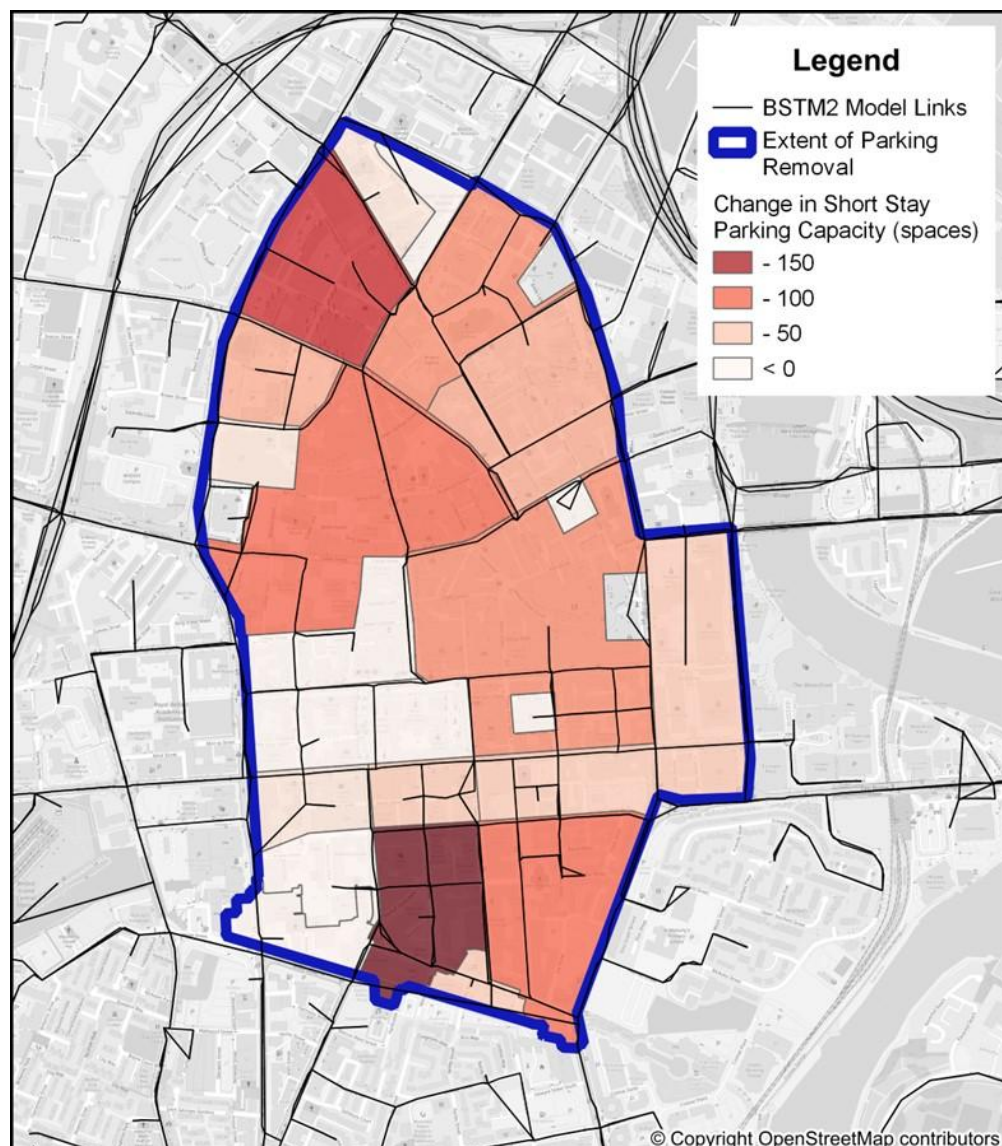
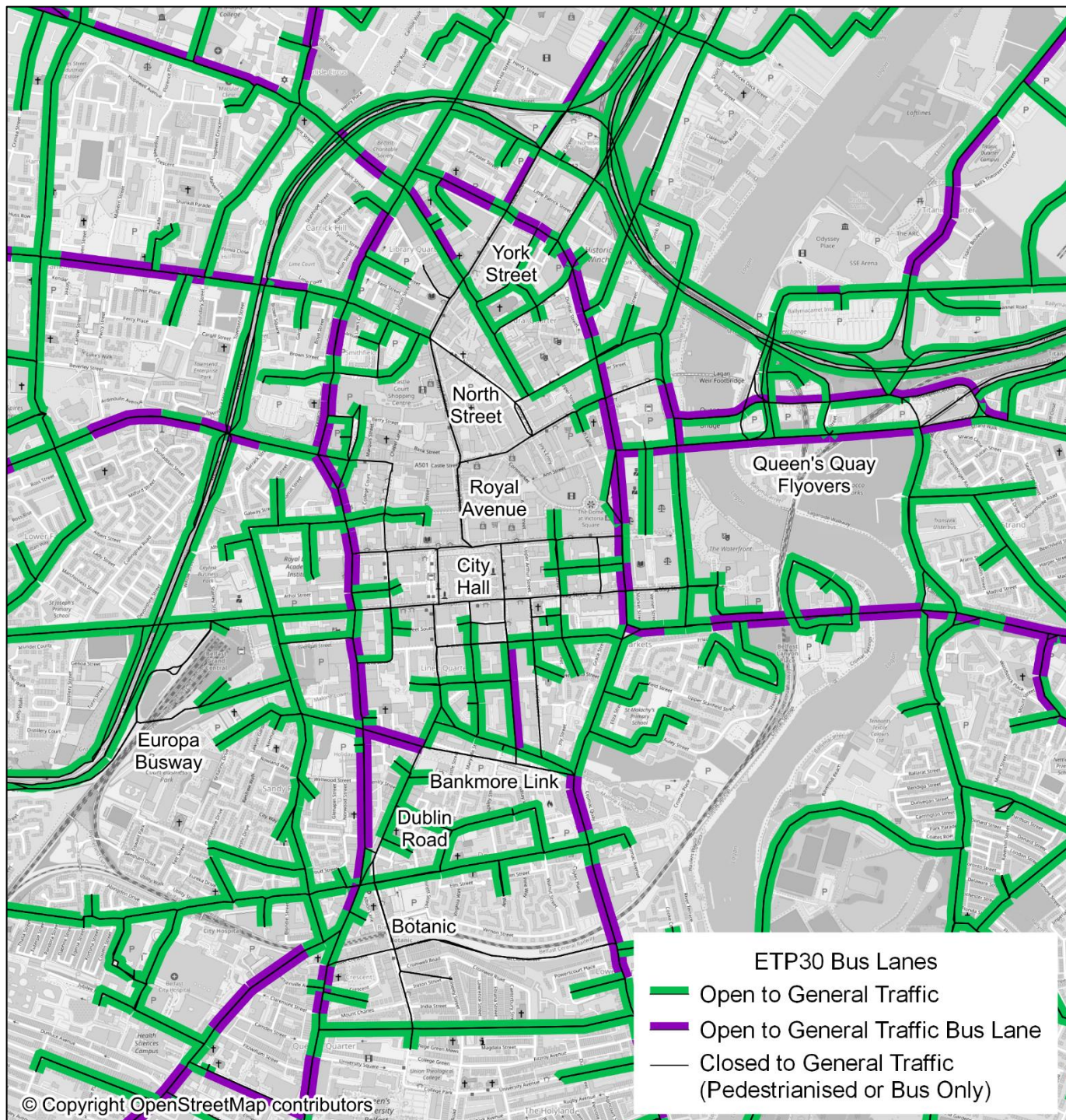


Figure 5-4 - ETP Supply Changes - City Centre



5.2 ETP Demand

The ETP Do Something testing utilises the BCC Core demand scenario. A sensitivity test has also been carried out using the BCC Plan demand scenario.

5.3 High Level Outputs (Mode Choice etc)

This section sets out an overview of the main outputs from the ETP model run as set out previously in this section.

Similar to the results of the Do Minimum run, the model outputs include the following:

- Main Mode choice;
- Sub Mode choice
- SATURN highway summary statistics (travel time, delay and speed);
- ADV plots showing changes in flow and delay
- Highway and bus journey times
- City centre flows
- Inner and middle cordon flows.

In some cases, these outputs are shown for the Belfast area and Belfast City Centre as set out in Figure 4-3.

5.3.1 Main Mode Choice

The main mode choice in the model sets out the total daily productions using car, public transport, walk or cycle. This is at a production level only i.e. the home end of a tour for home-based trips or the origin of a trip for non-home-based trips.

5.3.1.1 Belfast

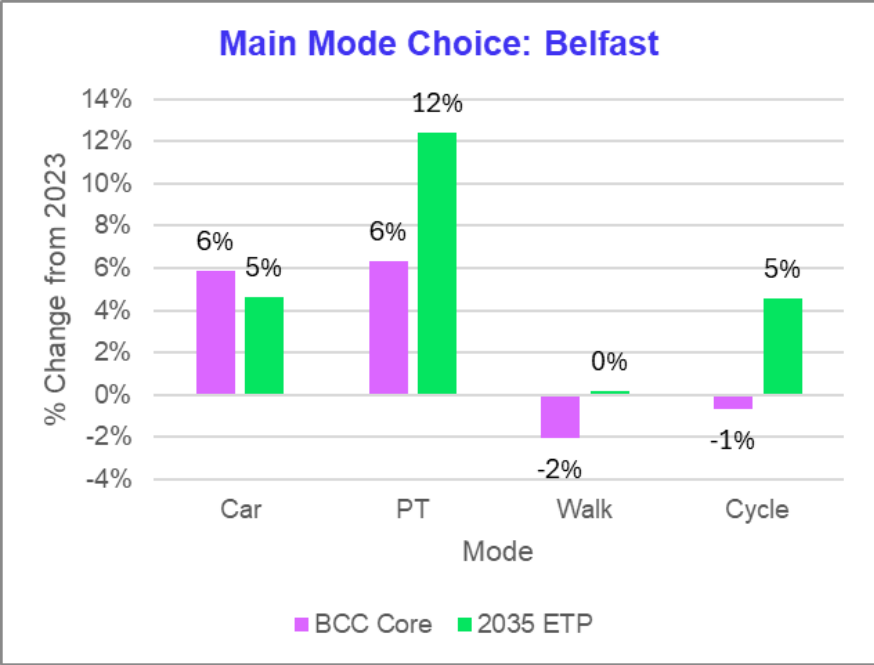
Table 5-1 - Total Main Mode Choice for Belfast

Scenario	Car	Public Transport	Walk	Cycle	Total
2023	532,300	42,200	165,300	5,900	745,700
2035 BCC Core DM	563,600	44,900	162,000	5,800	776,300
2035 ETP	557,000	47,500	165,600	6,100	776,300

Table 5-2 - Change in Main Mode Choice from DM for Belfast

Scenario	Car	Public Transport	Walk	Cycle	Total
2035 ETP	-6,600	2,600	3,600	300	0

Figure 5-5 – Percentage Change in Main Mode Choice: 2023-2035 for Belfast



*Percentage Change calculated on values that are not subject to rounding

The main mode choice for Belfast shows that:

- There is a 1% reduction in car trips (approx. 6,600) for trips produced in Belfast
- Public transport experiences an increase of 12% from 2023 and 6% from the 2035 BCC Core
- Walk and cycle trips also experience an increase over 2035 Do Minimum.

5.3.1.2 City Centre

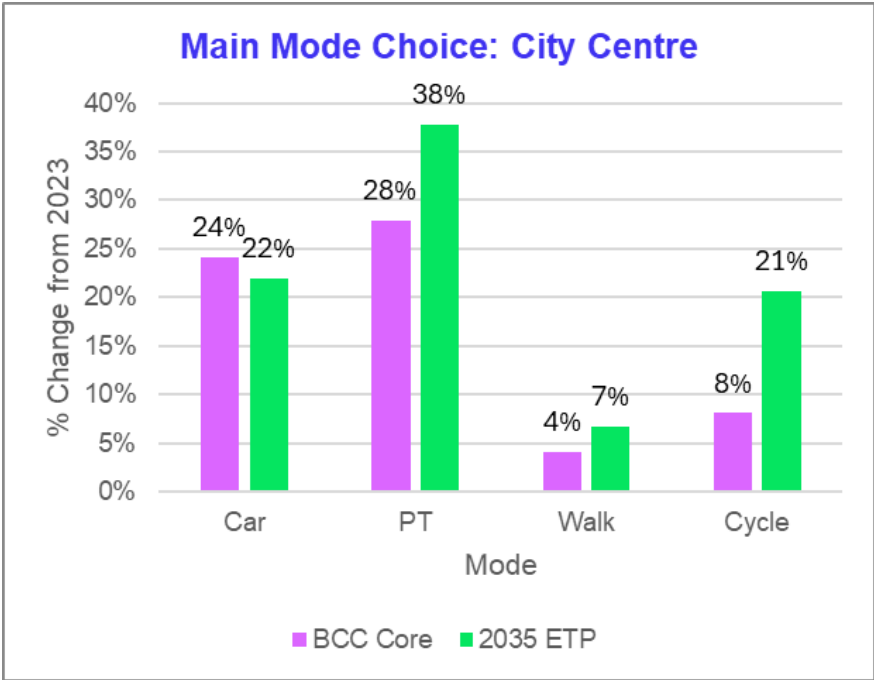
Table 5-3 - Total Main Mode Choice for Belfast City Centre

Scenario	Car	Public Transport	Walk	Cycle	Total
2023	44,900	3,700	21,800	500	71,000
2035 BCC Core DM	55,800	4,700	22,700	600	83,800
2035 ETP	54,800	5,100	23,300	700	83,800

Table 5-4 - Change in Main Mode Choice from DM for Belfast City Centre

Scenario	Car	Public Transport	Walk	Cycle	Total
2035 ETP	-1,000	400	600	100	0

Figure 5-6 – Percentage Change in Main Mode Choice: 2023-2035 for Belfast City Centre



*Percentage Change calculated on values that are not subject to rounding

The main mode choice for Belfast City Centre shows that:

- There is a 2% reduction in car productions from the city centre, this equates to approximately 1,000 cars per day;
- These car trips transfer to public transport, walk and cycle trips. This equates to an additional 10% increase in public transport productions in the city centre from BCC Core.

5.3.2 Sub-Mode Choice

The sub-mode choice in the model sets out the total daily trips by origin and destination trips using car, bus and rail. The outputs for destinations are shown below.

5.3.2.1 Belfast

Table 5-5 - Total Sub Mode Choice for Belfast

Scenario	Car	Bus	Rail	Total
2023	969,000	89,000	15,100	1,073,000
2035 BCC Core DM	1,007,300	88,500	16,500	1,112,300
2035 ETP	990,100	93,900	16,700	1,100,800

Table 5-6 - Change in Sub Mode Choice from DM for Belfast

Scenario	Car	Bus	Rail	Total
2035 ETP	-17,200	5,400	200	-11,500

5.3.2.2 City Centre

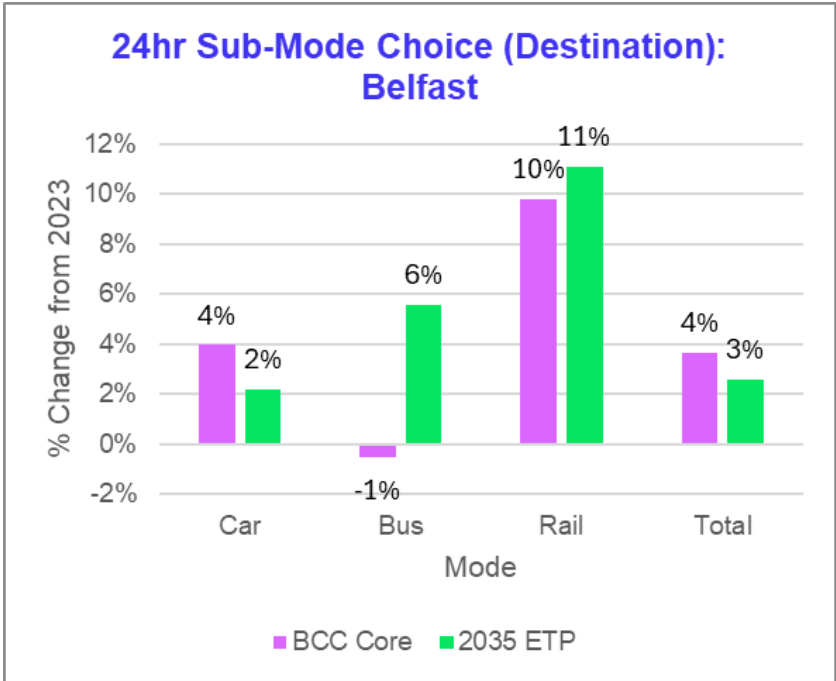
Table 5-7 - Total Sub Mode Choice for Belfast City Centre

Scenario	Car	Bus	Rail	Total
2023	91,800	28,800	9,000	129,700
2035 BCC Core DM	98,000	27,600	10,200	135,800
2035 ETP	97,300	30,300	10,300	137,900

Table 5-8 - Change in Sub Mode Choice from DM for Belfast City Centre

Scenario	Car	Bus	Rail	Total
2035 ETP	-700	2,700	100	2,100

Figure 5-7 – Percentage Change in Sub Mode Choice: 2023-2035 for Belfast

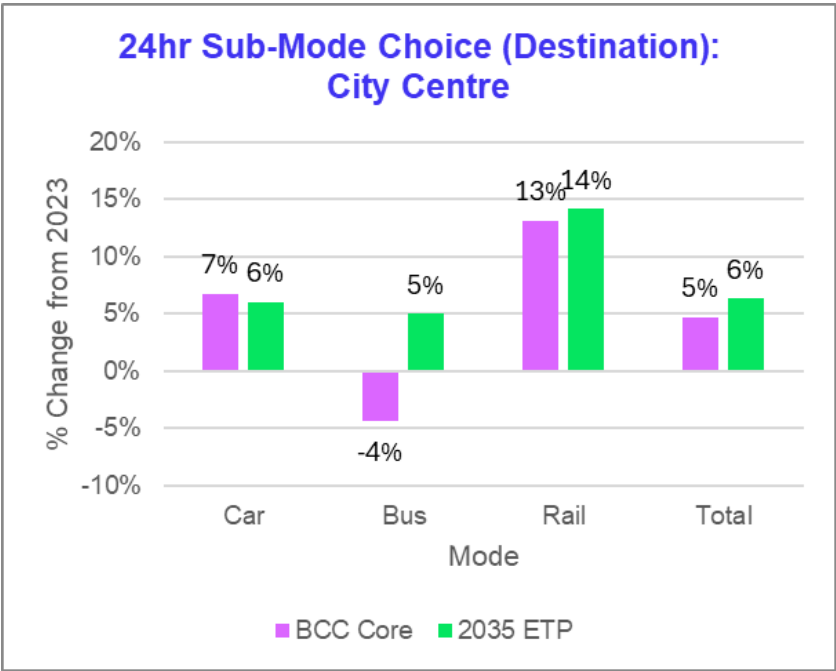


*Percentage Change calculated on values that are not subject to rounding

The sub mode choice for Belfast shows that:

- Across 24 hours there is a reduction in car trips with a destination in Belfast with ETP measures in place. While there is still an increase on trips from 2023, there is a 2% less of an increase in comparison to the Do Minimum. This equates to a reduction of approximately 17,200 in car trips.
- Bus and rail both experience an increase in person trips in comparison to the Do Minimum. This equates to an increase of approximately 5,400 bus trips destinating in Belfast.

Figure 5-8 – Percentage Change in Sub Mode Choice: 2023-2035 for Belfast City Centre



*Percentage Change calculated on values that are not subject to rounding

The sub mode choice for Belfast City Centre shows that:

- In the ETP scenario there is a reduction of approximately 700 car trips to the city centre across a 24 hour period.
- Bus trips increase by 2,700 in the city centre while rail experiences a minor increase of 100.

5.3.3 SATURN Highway Summary Statistics

The SATURN summary statistics include the following outputs from the SATURN highway assignments for the AM, IP and PM peak hours. These statistics have been summarised for the Belfast area and the city centre as set out in Figure 4-3. The summary statistics include:

- Total Time (hrs) - Sum of delays and free flow travel time in seconds
- Highway Delay (hrs) - Total Time minus the Cruise time in seconds where cruise time is the stopline to stopline time allowing (if appropriate) for speeds to decrease according to a link capacity-restraint in seconds
- Average Speed (kph) - Average congested link speed (including a weighted junction delay) in kilometres per hour (kph)

5.3.3.1 Total Time (hrs)

Table 5-9 - Total Time in Belfast and Belfast City Centre– AM Peak

Scenario	Total Time		Change from DM	
	Belfast	City Centre	Belfast	City Centre
2023	21,800	1,400		
2035 BCC Core DM	25,200	1,600		
2035 ETP	25,200	1,550	0	-50

Figure 5-9 – Percentage Change in Total Time: 2023-2035 for Belfast and Belfast City Centre – AM Peak

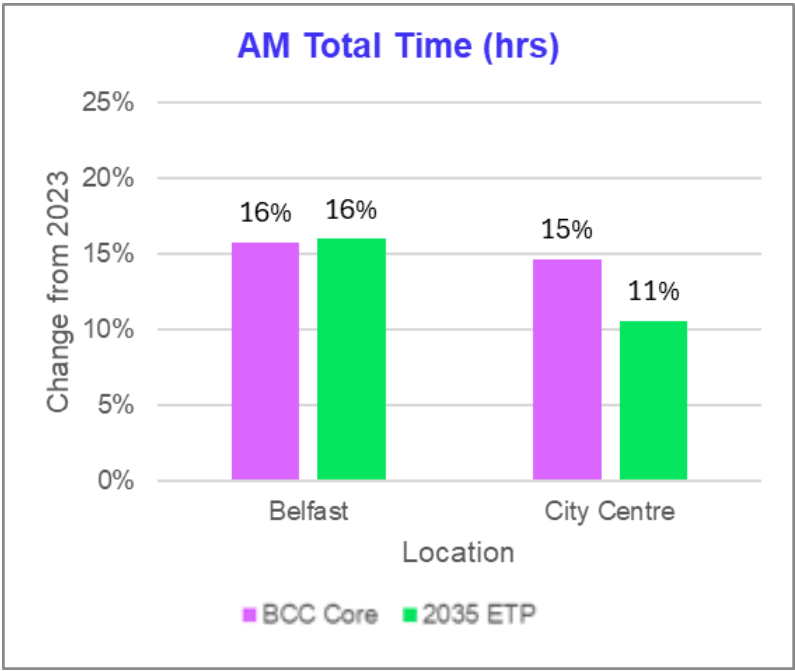


Table 5-10 - Total Time in Belfast and Belfast City Centre– Inter Peak

Scenario	Total Time		Change from DM	
	Belfast	City Centre	Belfast	City Centre
2023	16,300	1,100		
2035 BCC Core DM	19,200	1,300		
2035 ETP	20,000	1,250	800	-50

Figure 5-10 – Percentage Change in Total Time: 2023-2035 for Belfast and Belfast City Centre – Inter Peak

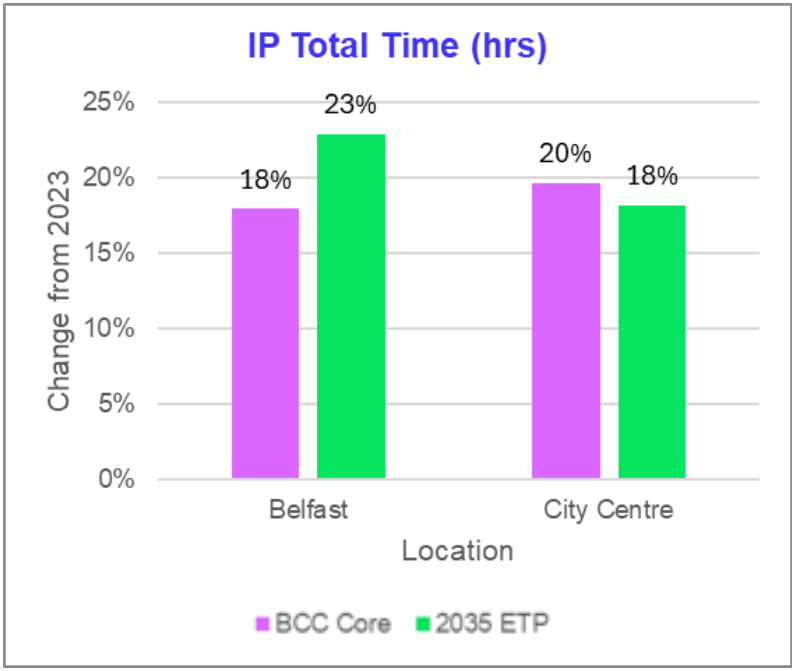
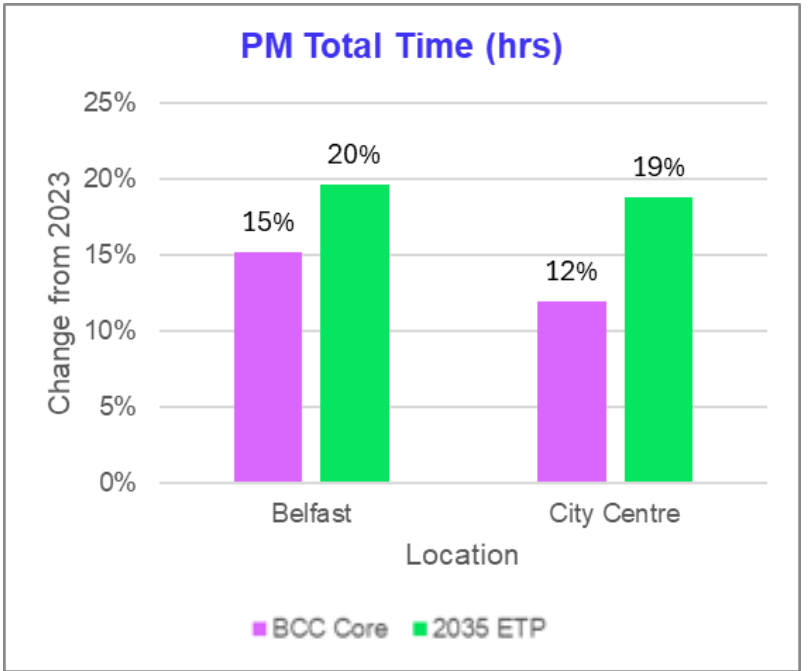


Table 5-11 - Total Time in Belfast and Belfast City Centre – PM Peak

Scenario	Total Time		Change from DM	
	Belfast	City Centre	Belfast	City Centre
2023	18,800	1,300		
2035 BCC Core DM	21,700	1,500		
2035 ETP	22,500	1,600	800	100

Figure 5-11 – Percentage Change in Total Time: 2023-2035 for Belfast and Belfast City Centre – PM Peak



- In the AM peak the total highway travel time in Belfast remains similar to the Do Minimum whereas in the City Centre it is reduced by approximately 50hrs.
- The IP experiences an increase in total highway travel time in Belfast (approx. 800hrs) likely due to the reallocation of road space to public transport, whereas the City Centre experiences a small decrease.
- The PM peak experiences an increase in both Belfast and the City Centre.

5.3.3.2 Highway Delay (hrs)

Table 5-12 - Total Delay in Belfast and Belfast City Centre– AM Peak

Scenario	Total Time		Change from DM	
	Belfast	City Centre	Belfast	City Centre
2023	7,200	600		
2035 BCC Core DM	9,300	800		
2035 ETP	8,900	800	-400	0

Figure 5-12 – Percentage Change in Total Delay: 2023-2035 for Belfast and Belfast City Centre – AM Peak

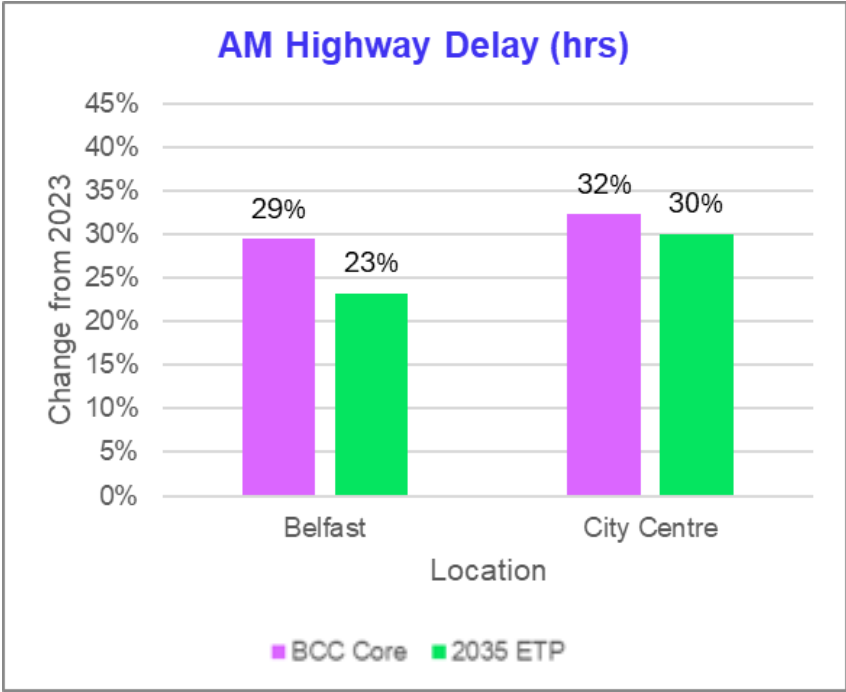


Table 5-13 - Total Delay in Belfast and Belfast City Centre– Inter Peak

Scenario	Total Time		Change from DM	
	Belfast	City Centre	Belfast	City Centre
2023	4,600	400		
2035 BCC Core DM	6,000	600		
2035 ETP	6,300	600	300	0

Figure 5-13 – Percentage Change in Total Delay: 2023-2035 for Belfast and Belfast City Centre – Inter Peak

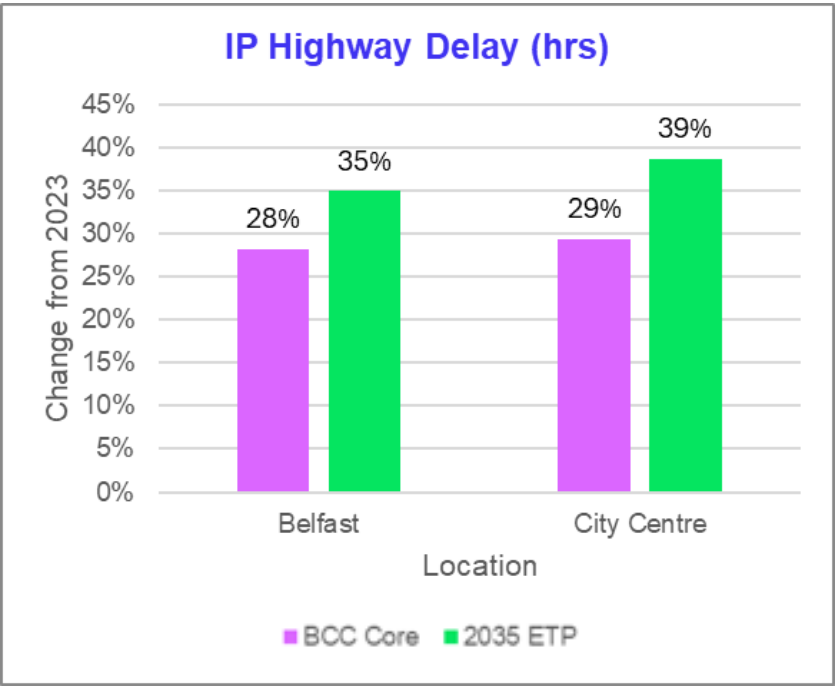
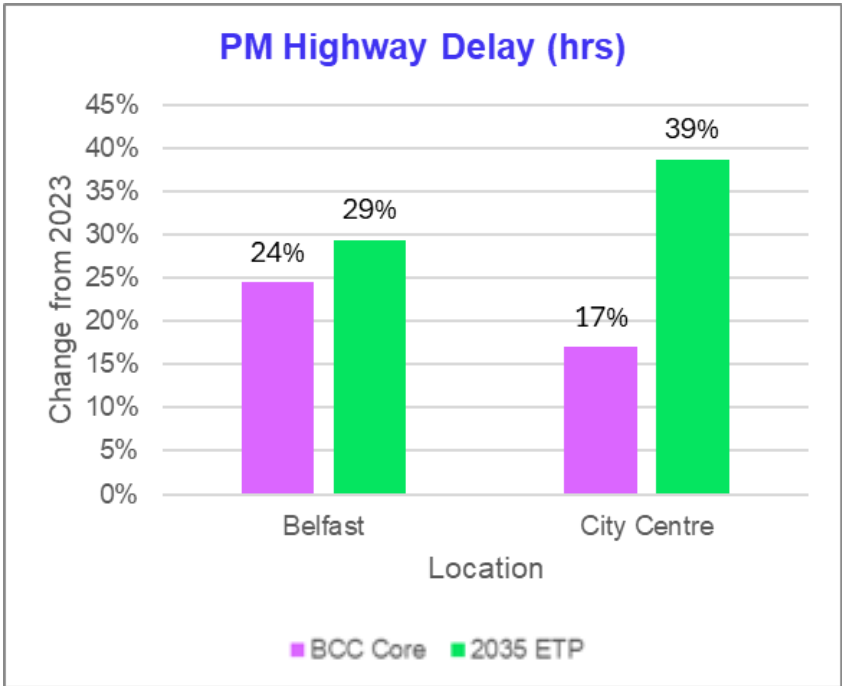


Table 5-14 - Total Delay in Belfast and Belfast City Centre – PM Peak

Scenario	Total Time		Change from DM	
	Belfast	City Centre	Belfast	City Centre
2023	5,800	600		
2035 BCC Core DM	7,300	700		
2035 ETP	7,600	800	300	100

Figure 5-14 – Percentage Change in Total Delay: 2023-2035 for Belfast and Belfast City Centre – PM Peak



- In the AM peak the highway delay is reduced in the Belfast area (approx. 400 hours) and slightly reduced in the City Centre, likely due to the reduction in vehicles travelling in Belfast
- In the IP and PM the highway delay is increased in both Belfast and the city centre.

5.3.3.3 Average Speed (kph)



Table 5-15 – Average Speed in Belfast and Belfast City Centre– AM Peak

Scenario	Total Time		Change from DM	
	Belfast	City Centre	Belfast	City Centre
2023	33	14		
2035 BCC Core DM	30	12		
2035 ETP	30	11	0	-1

Figure 5-15 – Percentage Change in Average Speed: 2023-2035 for Belfast and Belfast City Centre – AM Peak

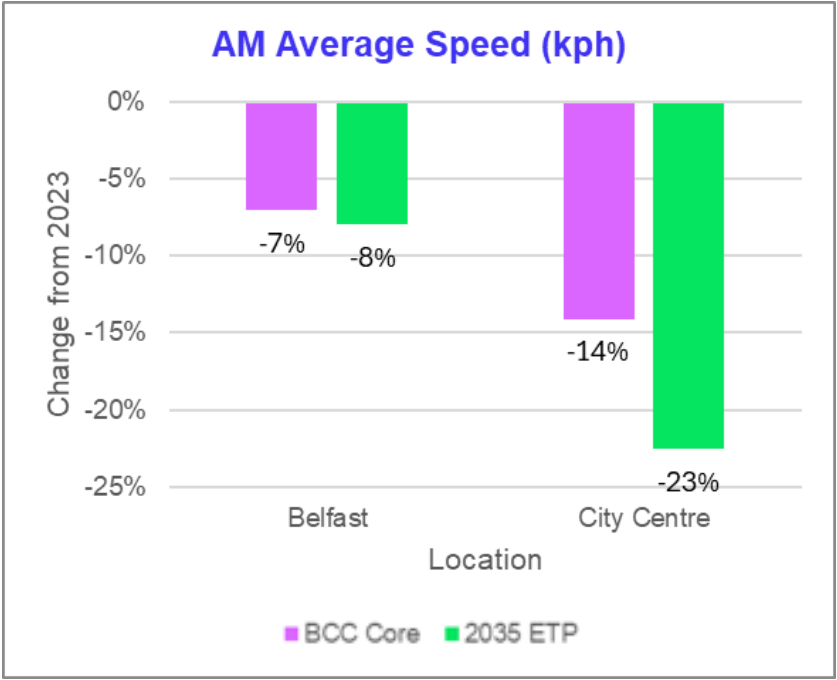


Table 5-16 - Average Speed in Belfast and Belfast City Centre– Inter Peak

Scenario	Total Time		Change from DM	
	Belfast	City Centre	Belfast	City Centre
2023	37	15		
2035 BCC Core DM	35	14		
2035 ETP	33	13	-2	-1

Figure 5-16 – Percentage Change in Average Speed: 2023-2035 for Belfast and Belfast City Centre – Inter Peak

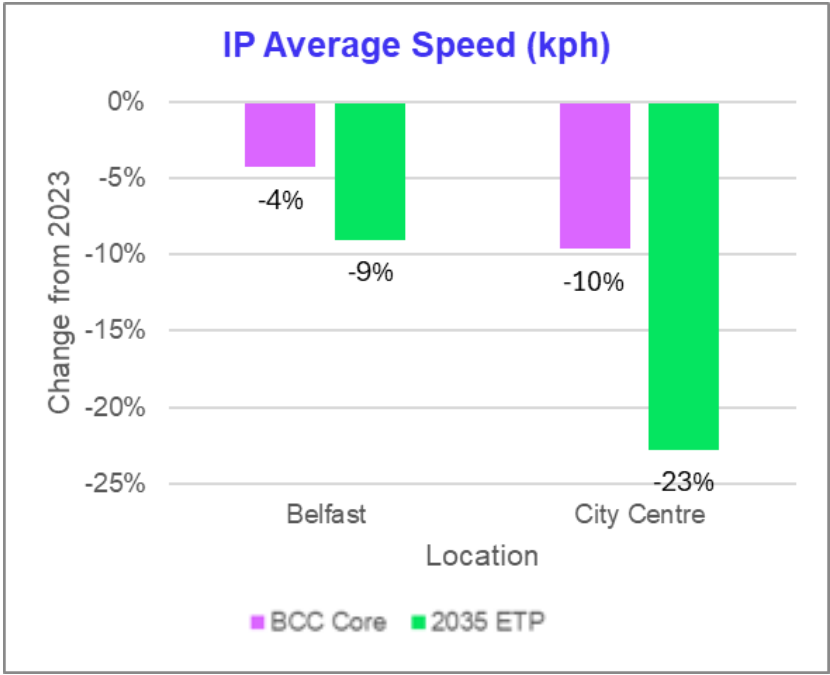
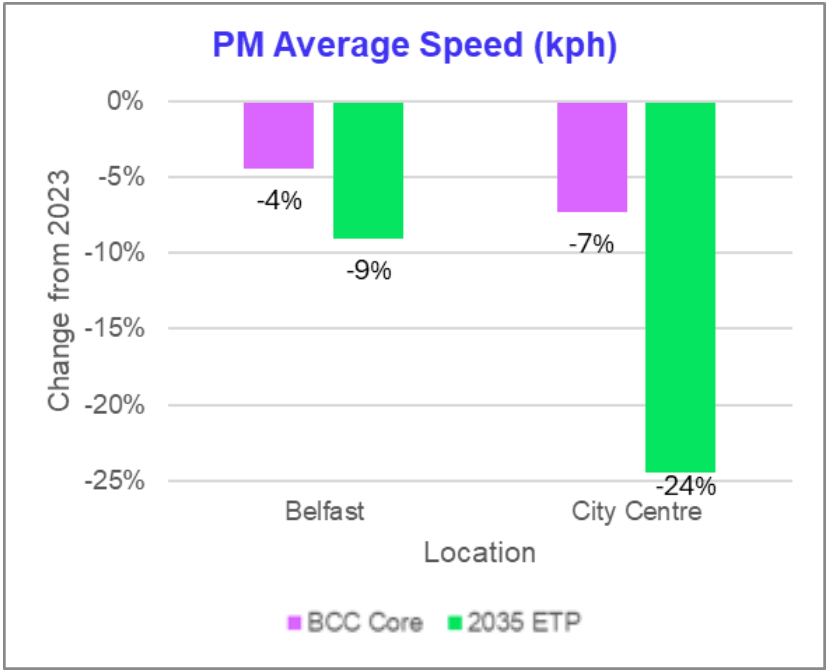


Table 5-17 - Average Speed in Belfast and Belfast City Centre – PM Peak

Scenario	Total Time		Change from DM	
	Belfast	City Centre	Belfast	City Centre
2023	34	14		
2035 BCC Core DM	33	13		
2035 ETP	31	11	-2	-2

Figure 5-17 – Percentage Change in Average Speed: 2023-2035 for Belfast and Belfast City Centre – PM Peak



- In the BCC Core scenario the highway speeds are forecast to reduce by 4-7% in the Belfast area compared to the 2023 Present Year Validation. These speeds are forecast to reduce further (8-9%) compared to 2023.
- In the city centre the highway speeds reduce by 1-2kph in the Do Minimum compared to 2023, this reduces further by 1-2kph in the ETP scenario.

5.4 ADV plots

The plots in Figure 5-18 to Figure 5-23 show the actual highway flow difference and delay difference between the 2035 ETP scenario and 2035 BCC Core assignments (Do Minimum) for the AM, IP and PM peaks. The delay difference is highlighted for differences greater than 30 seconds on each link.

Figure 5-18 - ETP: Highway Actual Flow Difference - AM Peak (with ETP v without ETP in 2035)

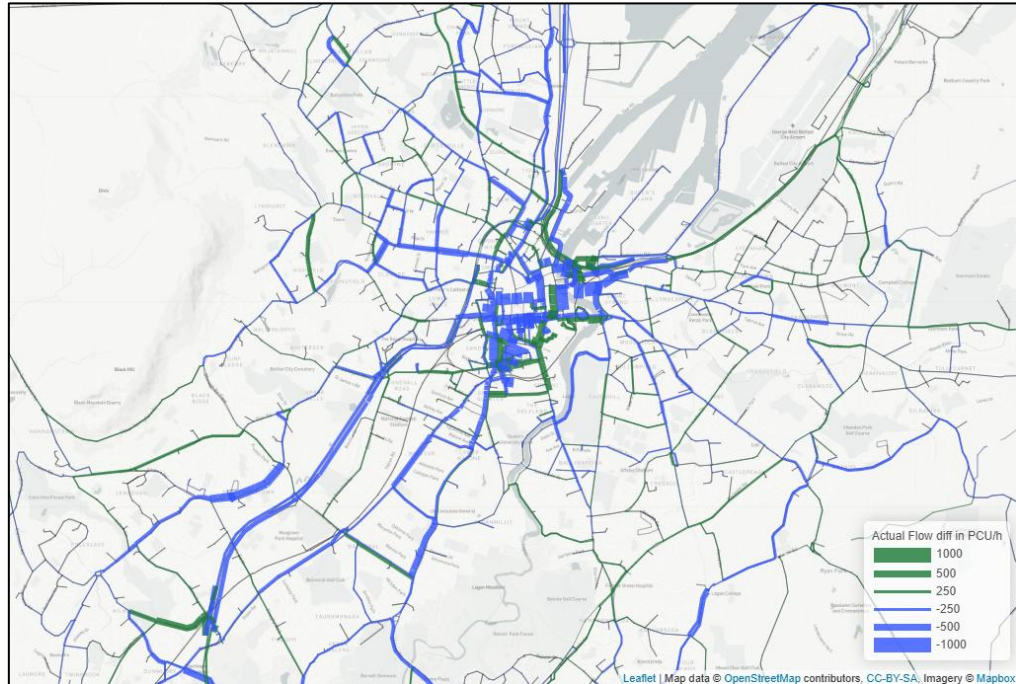


Figure 5-19 - ETP: Highway Delay Difference - AM Peak (with ETP v without ETP in 2035)

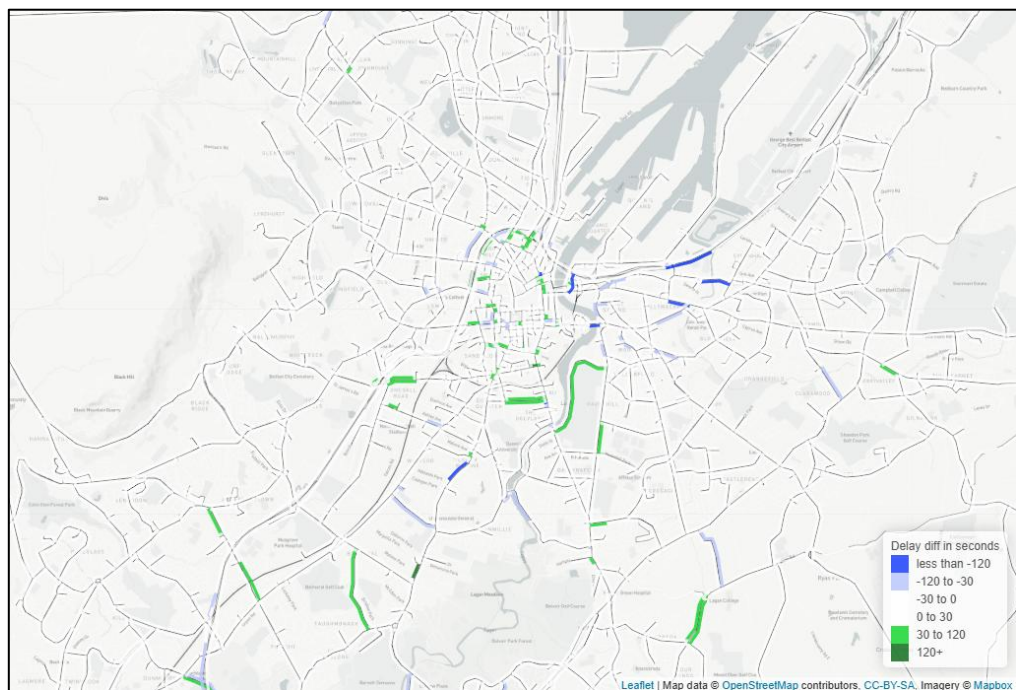


Figure 5-20 - ETP: Highway Actual Flow Difference - Interpeak (with ETP v without ETP in 2035)

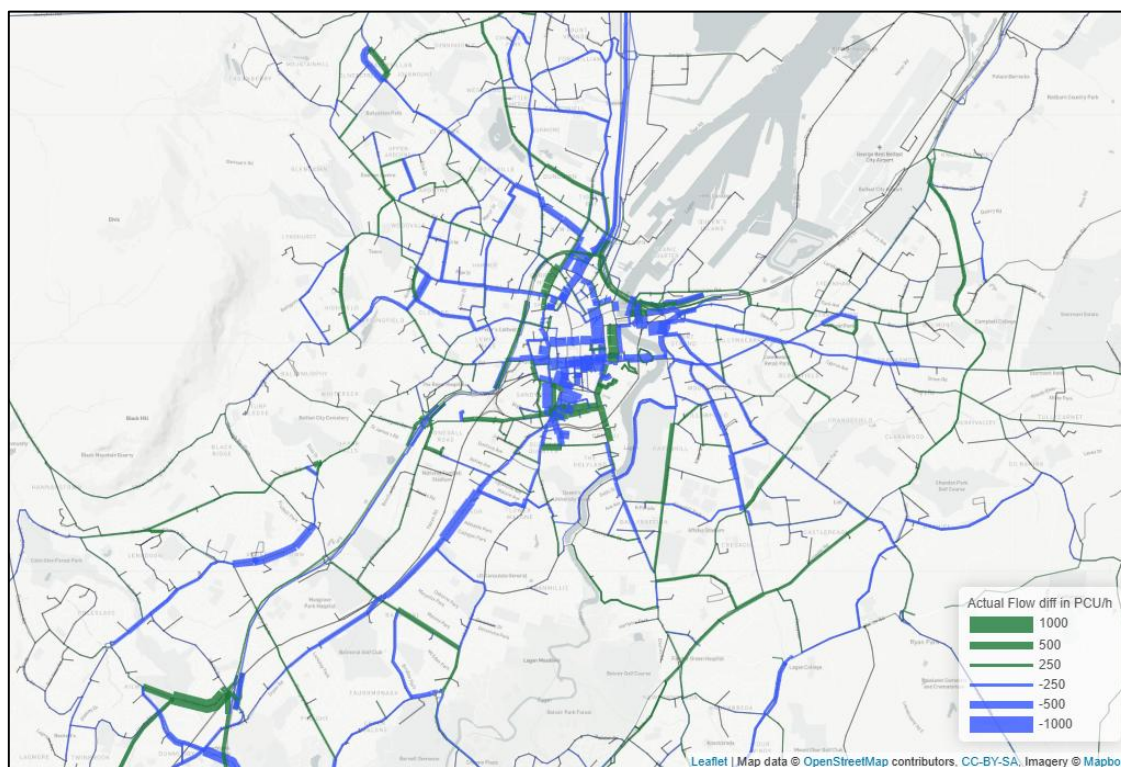


Figure 5-21 - ETP: Highway Delay Difference - Interpeak (with ETP v without ETP in 2035)

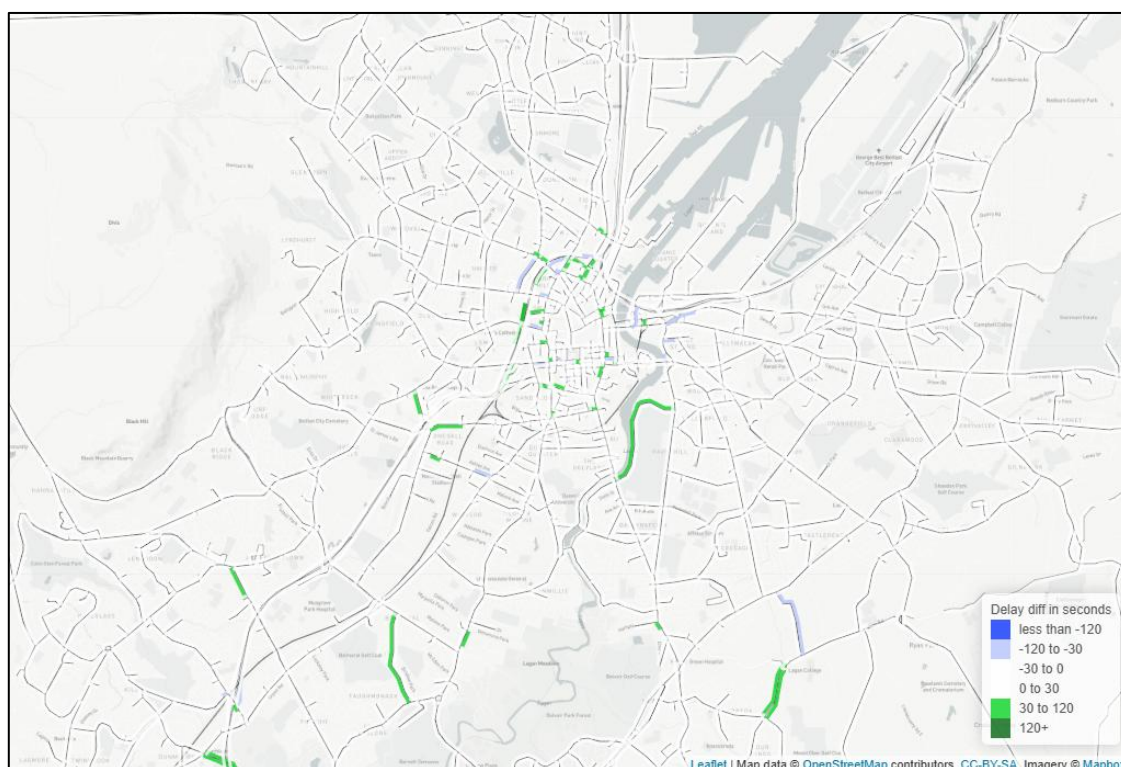


Figure 5-22 - ETP: Highway Actual Flow Difference - PM Peak (with ETP v without ETP in 2035)

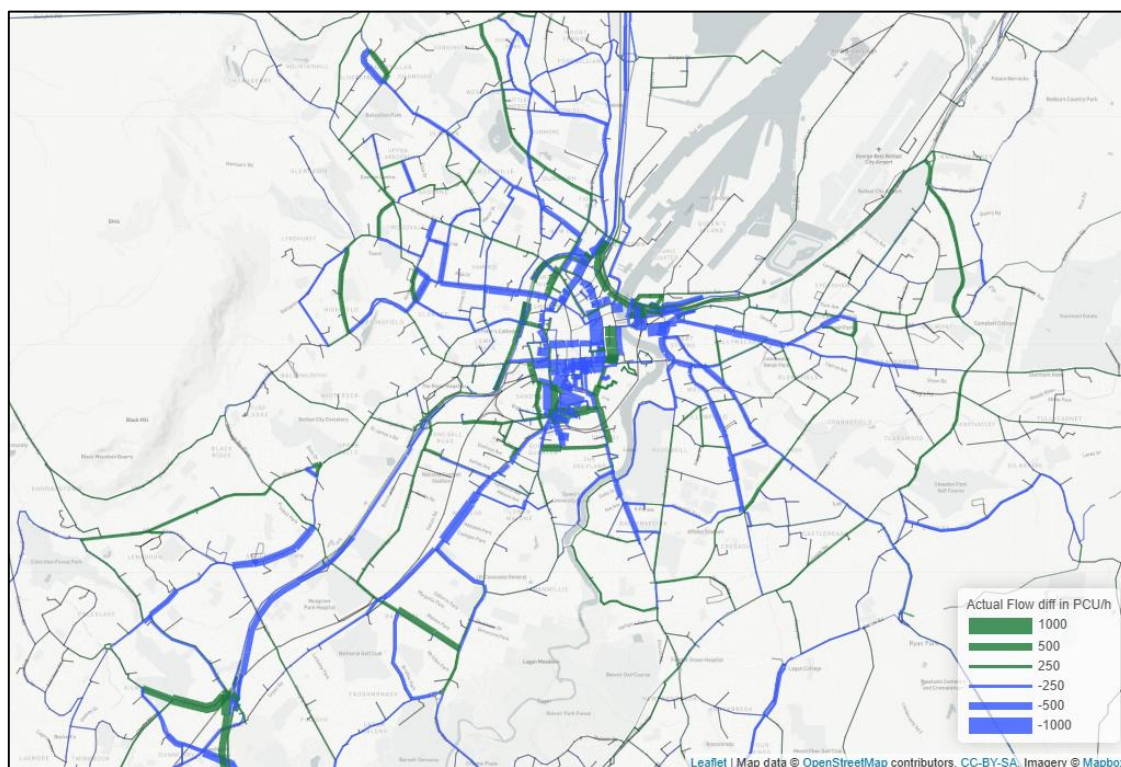


Figure 5-23 - ETP: Highway Delay Difference - PM Peak (with ETP v without ETP in 2035)

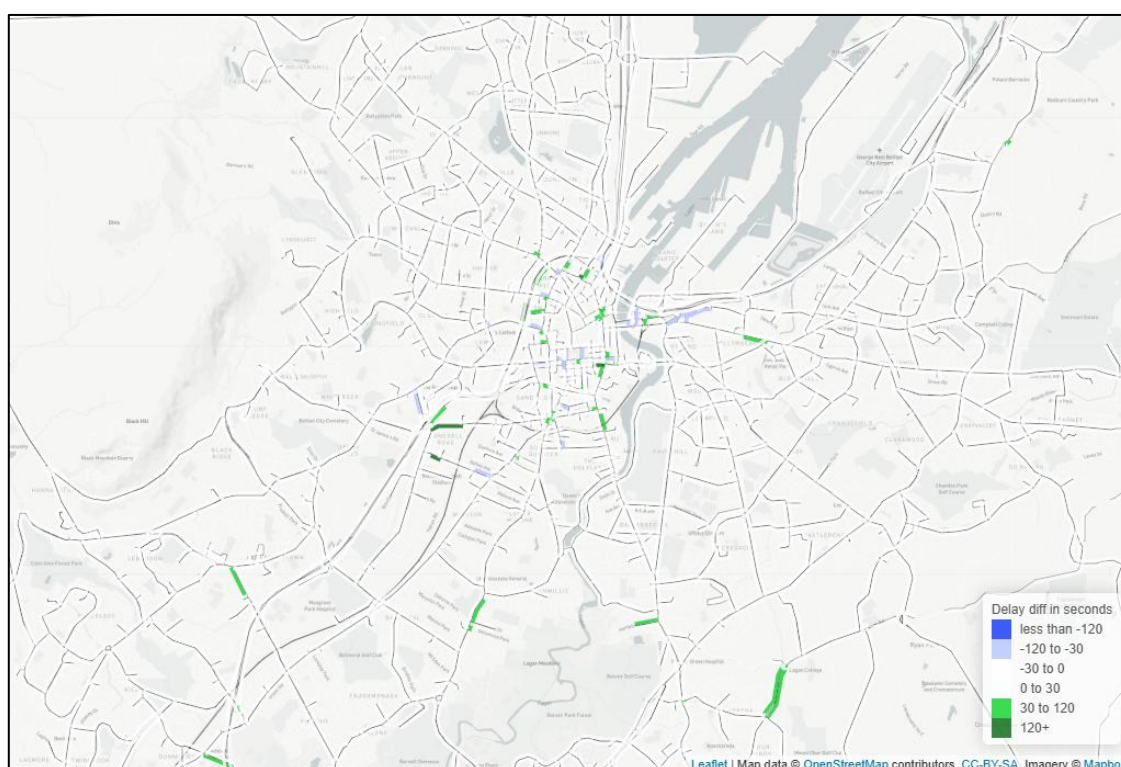


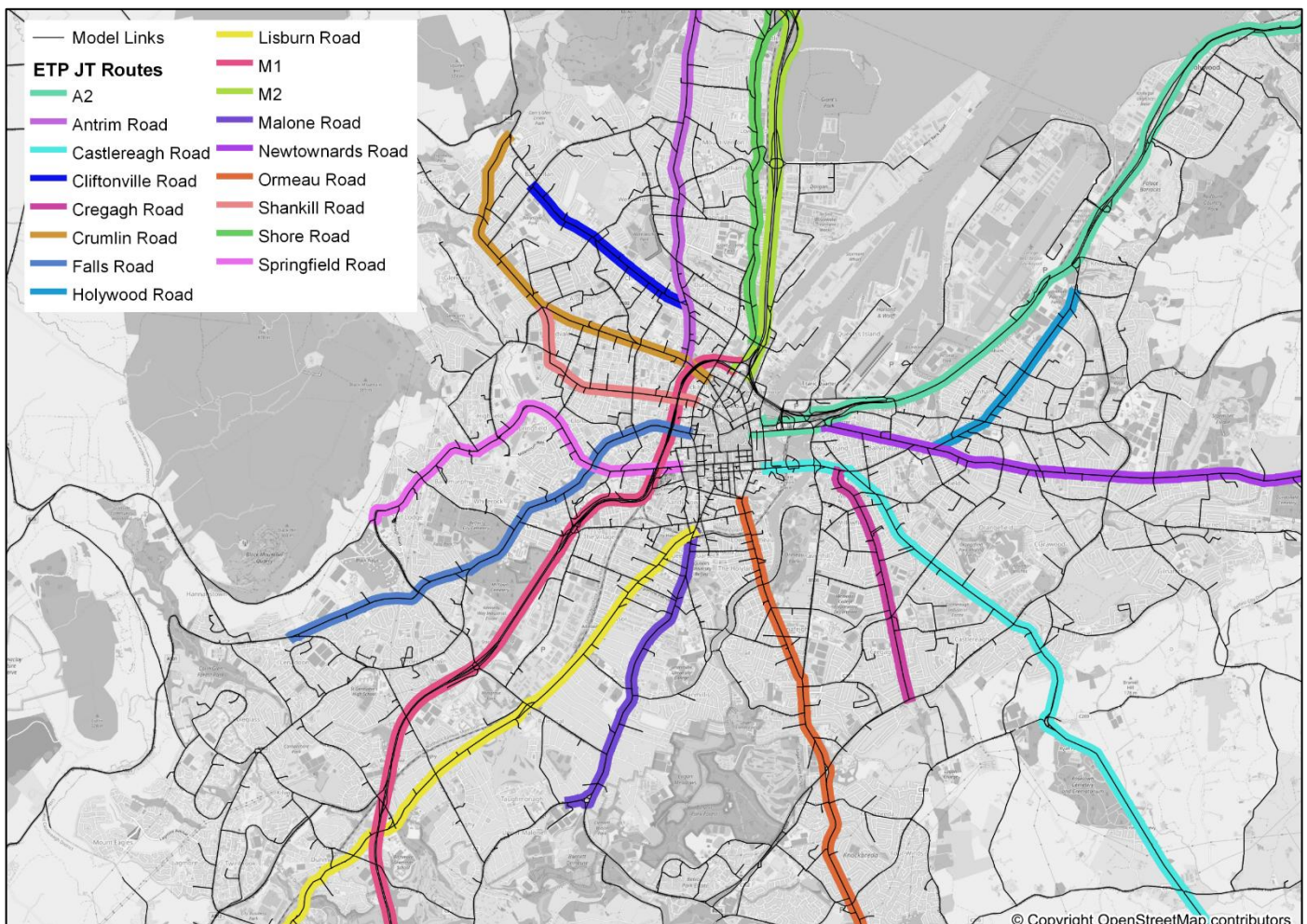
Figure 5-18 to Figure 5-23 show:

- While some links experience an increase in flow there is a general reduction in actual flow across the Belfast area, particularly in the city centre and along the main radial corridors into the city centre;
- There is also an increase in delay across the network due to the ETP interventions. These delays are largely experienced in the city centre.

5.5 Journey Times

The journey times across the main radial corridors have been assessed for both highway trips and bus trips. These routes are shown in Figure 5-24.

Figure 5-24 - ETP: Journey Time Routes



The percentage change in bus and highway journey times are shown in the following graphs.

5.5.1 AM Peak Inbound

Table 5-18 – Change in Highway Journey Times

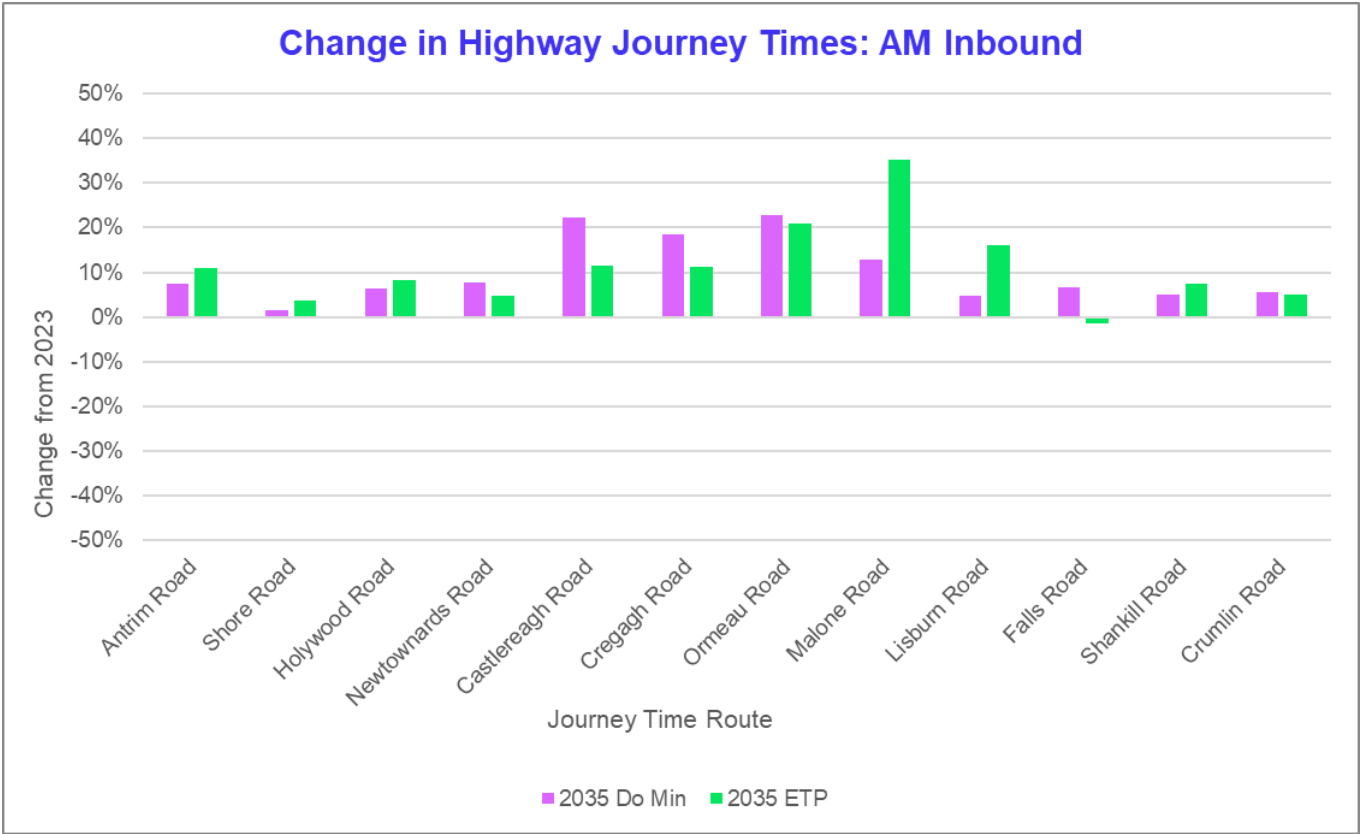
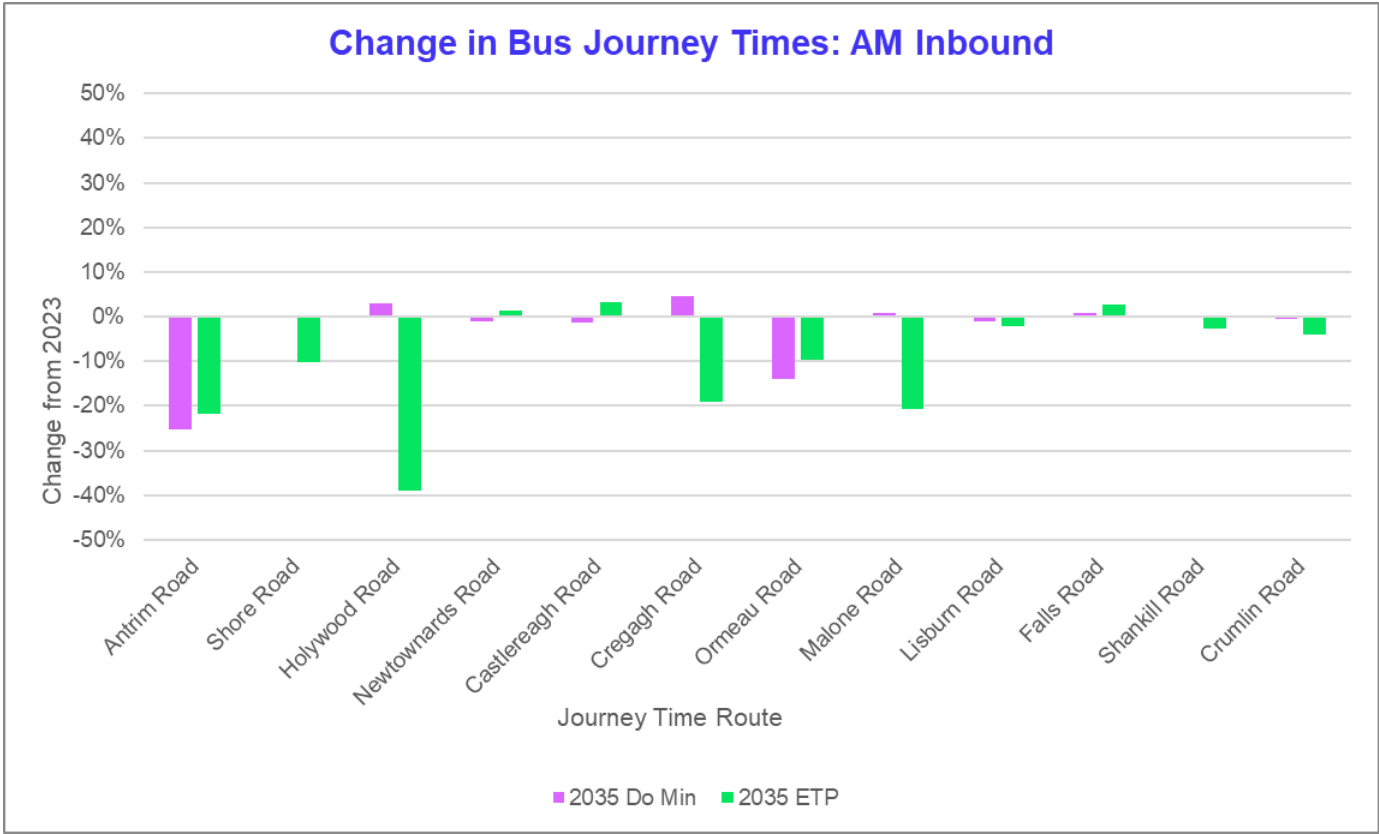


Table 5-19 – Change in Bus Journey Times



- In the Do Minimum scenario all highway journey times increase in the AM peak, inbound compared to 2023. The largest increases are experienced on the Castlereagh Road, Cregagh Road and Ormeau Road. This is likely due to the introduction of BRT Phase 2 on the Ormeau Road.
- The bus journey times on the Antrim Road and Ormeau Road decrease in the Do Min compared to 2023 with this introduction of BRT Phase 2.
- In the ETP scenario some of the highway journey times increase further, particularly on the Malone Road and Lisburn Road, however others are less than is predicted in the Do Minimum with the introduction of the ETP measures. This is noted on the Newtownards Road, Castlereagh Road, Cregagh Road and Ormeau Road.
- The largest reductions in bus journey times with the introduction of ETP are noted on the Shore Road, Hollywood Road, Cregagh Road and Malone Road, while smaller savings are noted on other routes

5.5.2 AM Peak Outbound

Table 5-20 – Change in Highway Journey Times

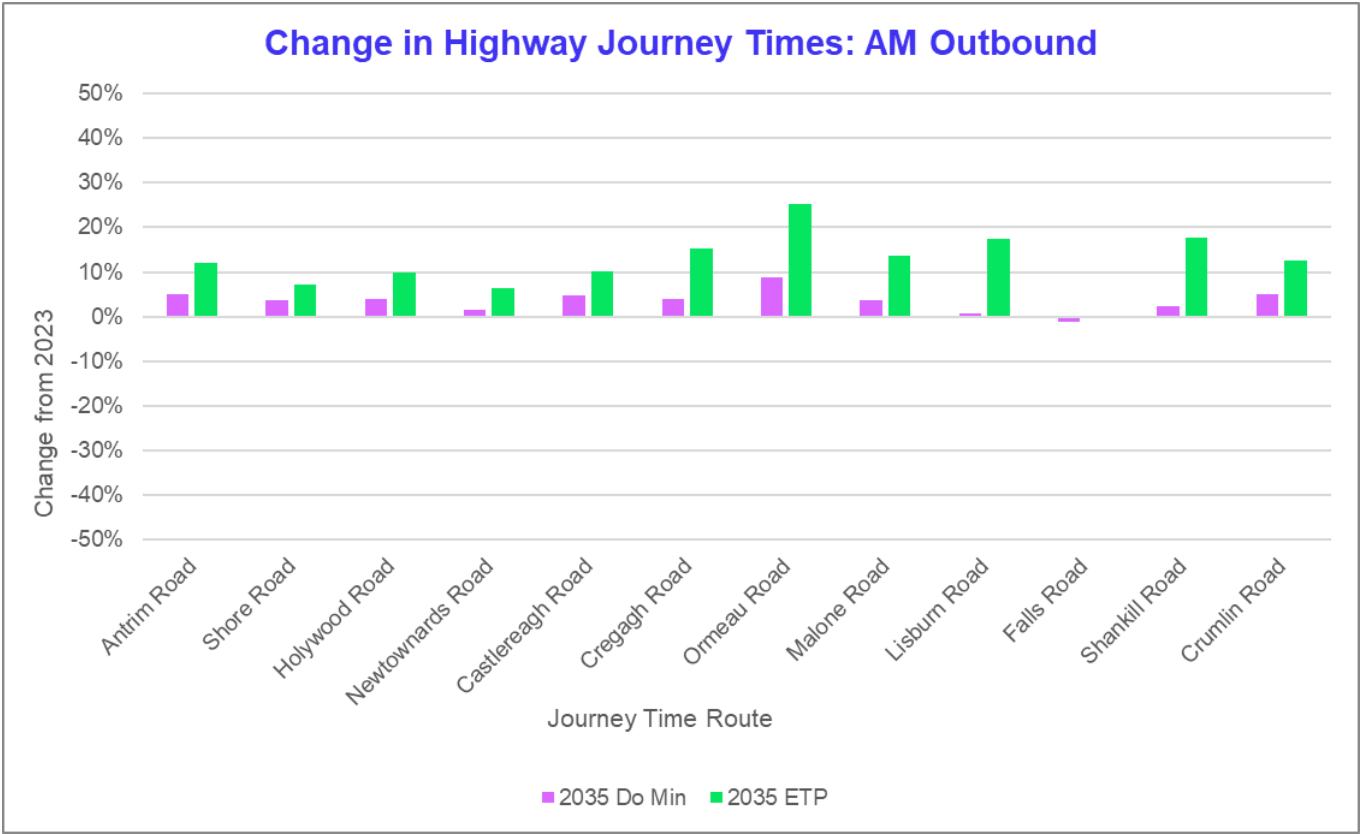
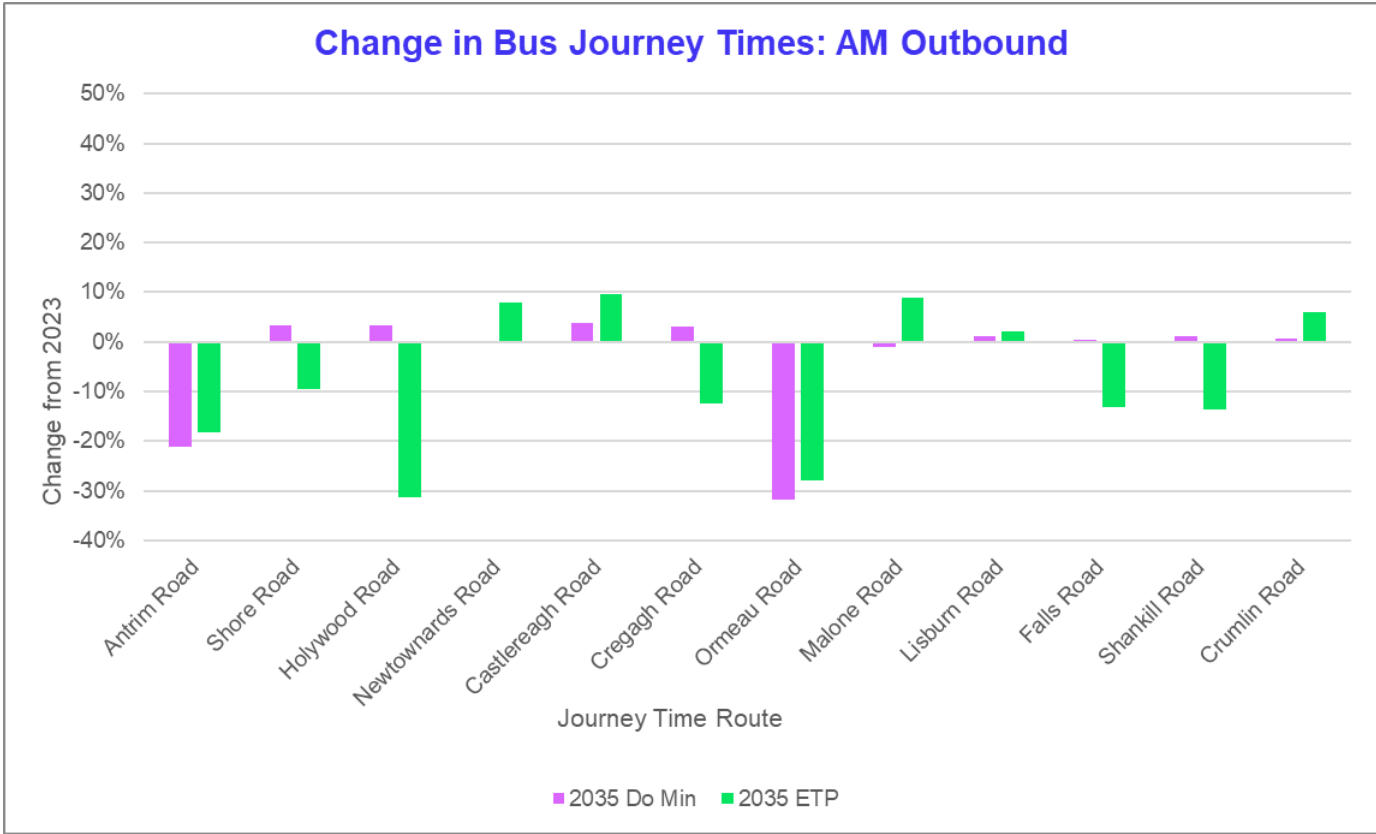


Table 5-21 – Change in Bus Journey Times



- On most corridors the highway journey times increase in the 2035 Do Minimum scenario. These journey times increase further with the introduction of the ETP measures in the AM peak, outbound.
- The bus journey times are reduced on the Antrim Road and Ormeau Road in the Do Minimum with the introduction of BRT Phase 2, while the savings are reduced slightly in the ETP scenario they are still significantly less than in 2023.
- With the introduction of the bus lanes the bus journey times are reduced along Shore Road, Hollywood Road, Cregagh Road and Shankill Road in the ETP scenario.
- There are some increases in bus journey time along Newtownards Road, Castlereagh Road, Malone Road and Crumlin Road where there are no new outbound bus lanes being introduced.

5.5.3 Interpeak Inbound

Table 5-22 – Change in Highway Journey Times

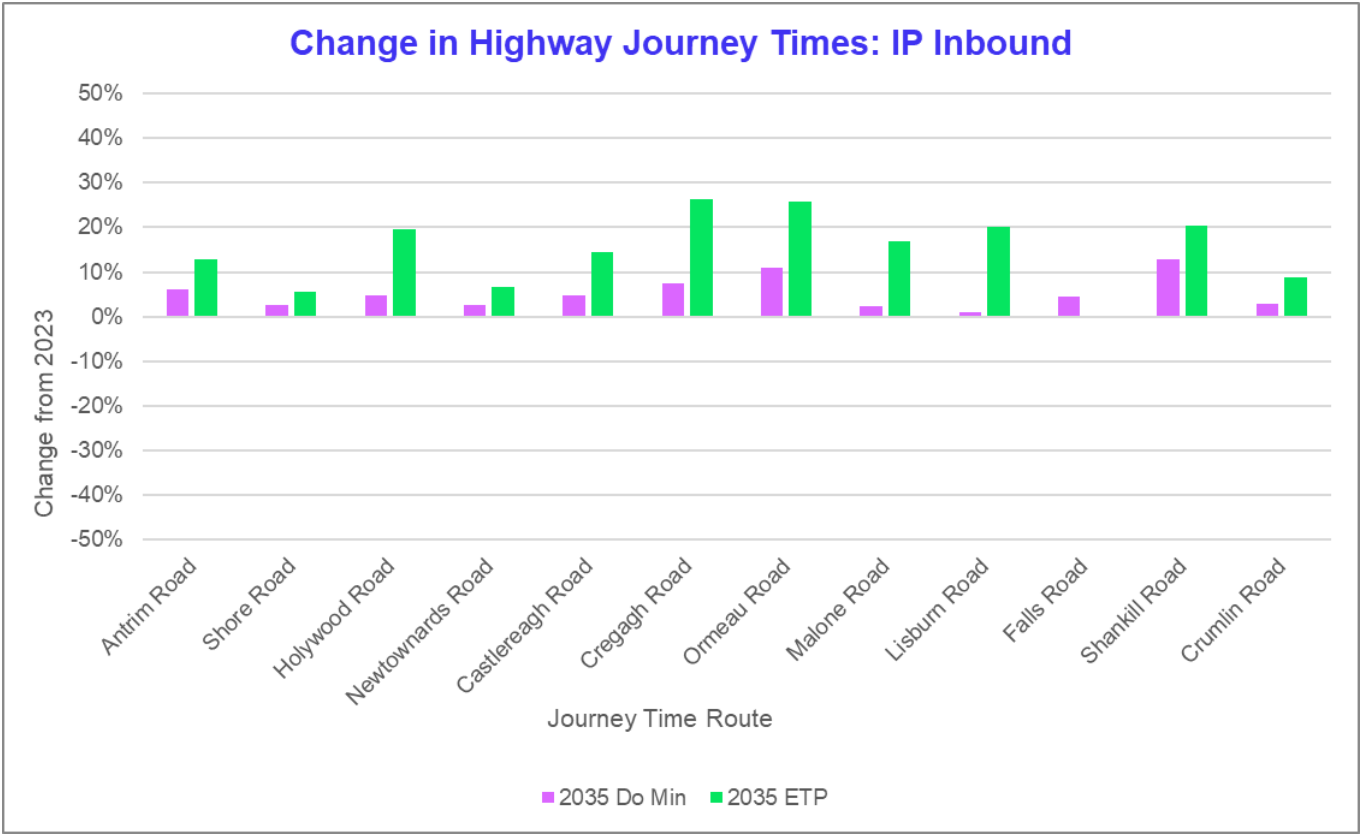
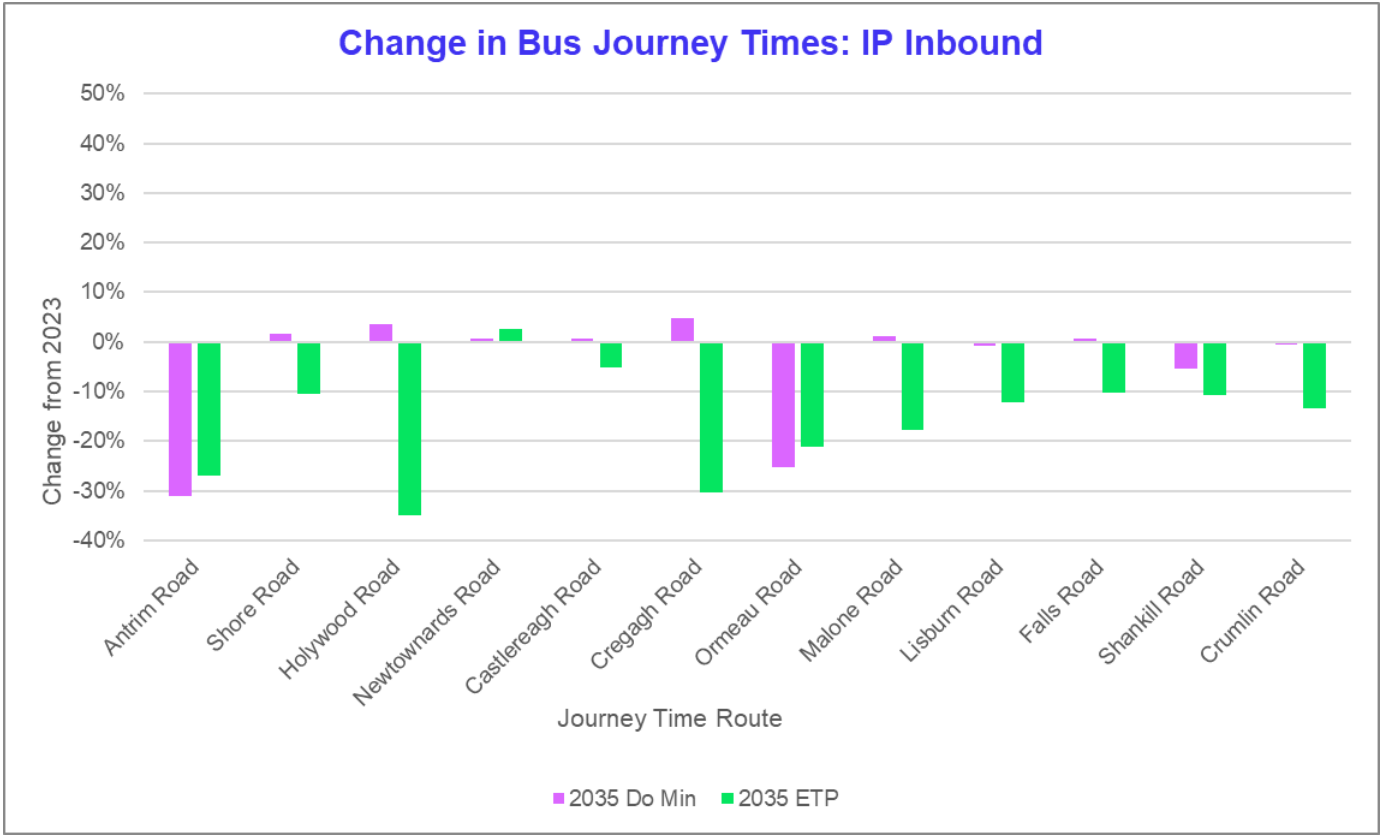


Table 5-23 – Change in Bus Journey Times



- In the Do Minimum scenario all highway journey times increase in the interpeak, inbound compared to 2023. The largest increases are experienced on the Cregagh Road and Ormeau Road. This is likely due to the introduction of BRT Phase 2 on the Ormeau Road.
- The bus journey times on the Antrim Road and Ormeau Road decrease in the Do Minimum compared to 2023 with this introduction of BRT Phase 2.
- In the ETP scenario most of the highway journey times increase further, particularly on the Cregagh Road and Ormeau Road.
- The largest reductions in bus journey times with the introduction of ETP are noted on the Hollywood Road and Cregagh Road, while savings are noted on other routes (Shore Road, Malone Road, Lisburn Road, Falls Road, Shankill Road and Crumlin Road)

5.5.4 Interpeak Outbound

Table 5-24 – Change in Highway Journey Times

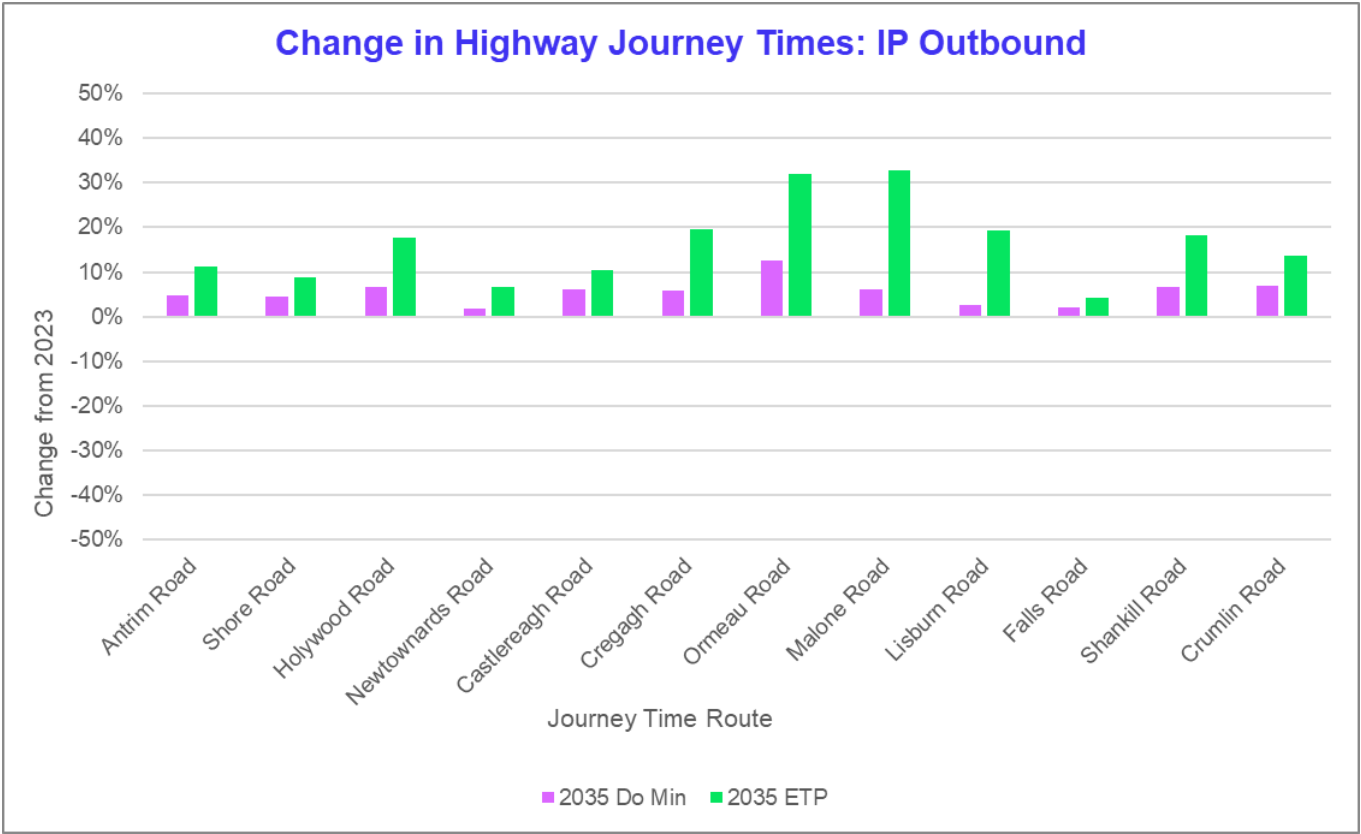
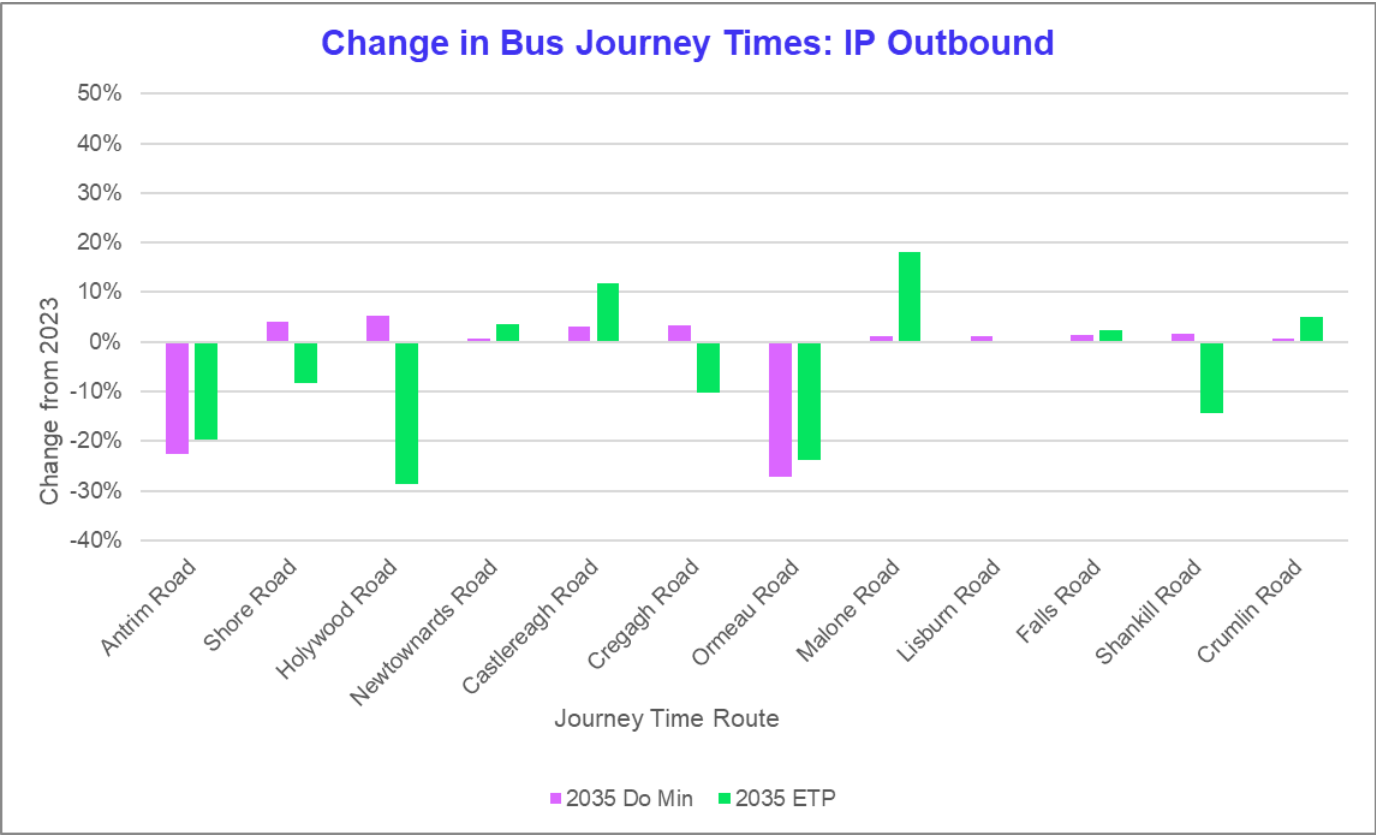


Table 5-25 – Change in Bus Journey Times



- On all corridors the highway journey times increase in the 2035 Do Minimum scenario. These journey times increase further with the introduction of the ETP measures in the interpeak, outbound.
- The bus journey times are reduced on the Antrim Road and Ormeau Road in the Do Minimum with the introduction of BRT Phase 2. While the savings are reduced slightly in the ETP scenario they are significantly less than in 2023.
- With the introduction of the bus lanes the bus journey times are reduced along Shore Road, Hollywood Road, Cregagh Road and Shankill Road.
- There are some increases in bus journey time along Newtownards Road, Castlereagh Road, Malone Road, Falls Road and Crumlin Road where there are no new outbound bus lanes being introduced.

5.5.5 PM Peak Inbound

Table 5-26 – Change in Highway Journey Times

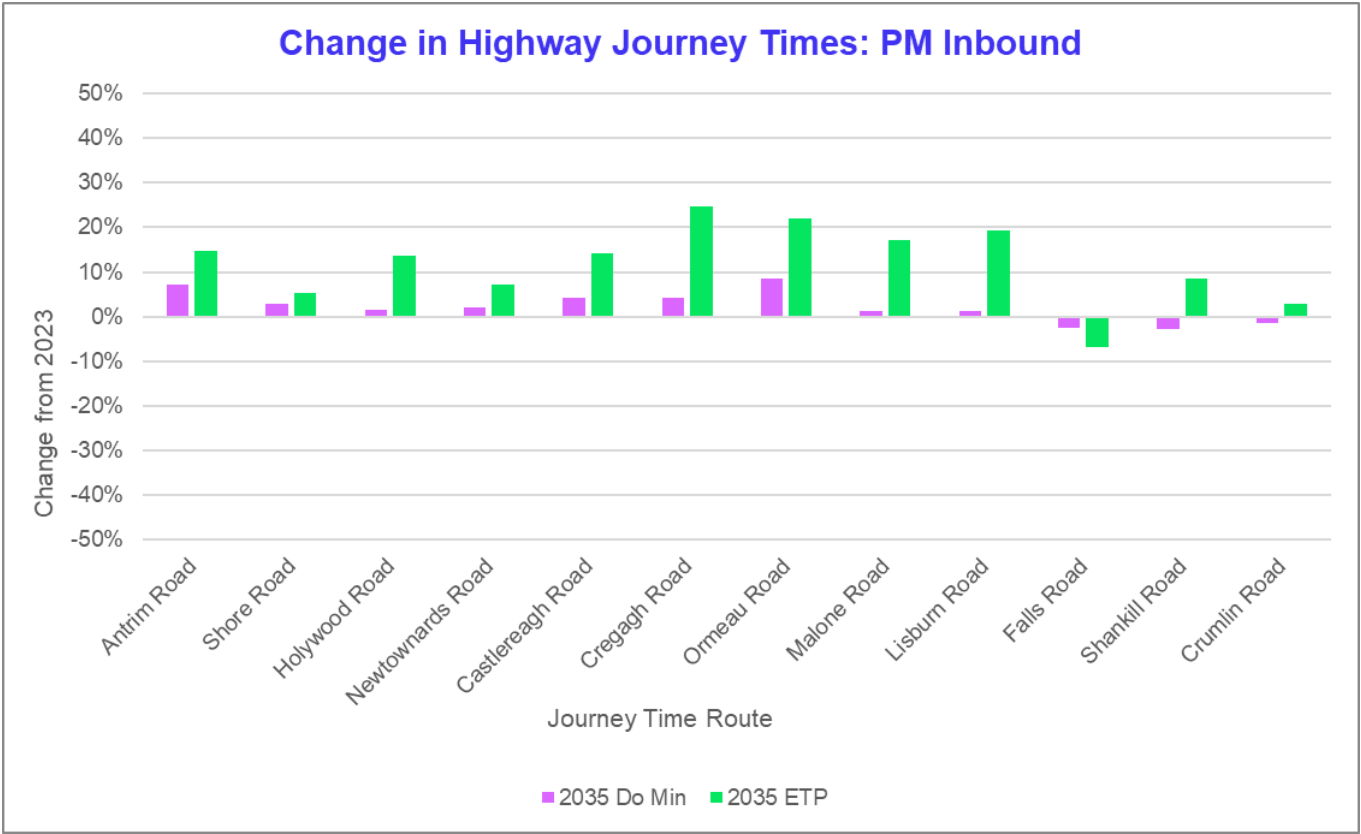
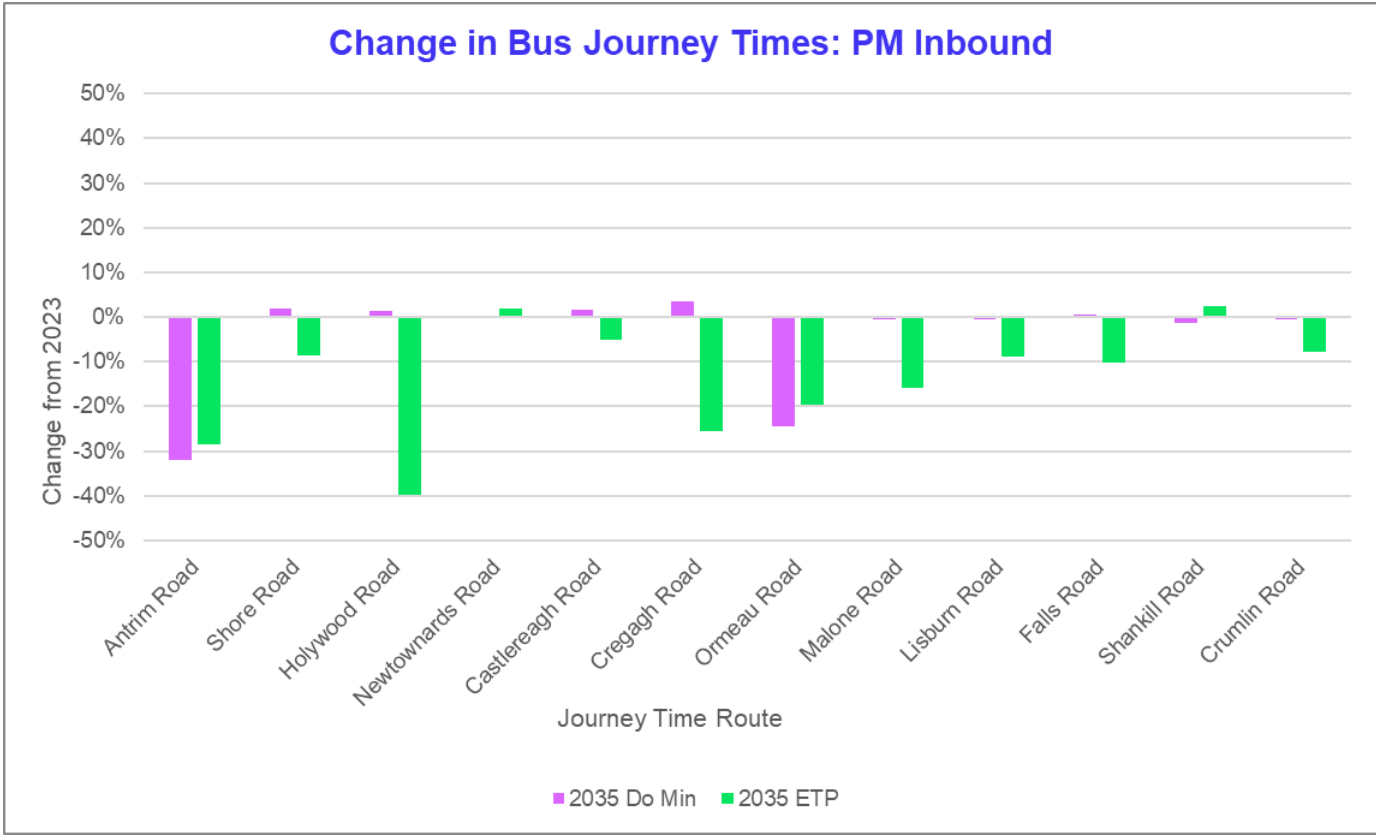


Table 5-27 – Change in Bus Journey Times



- In the Do Minimum scenario most highway journey times increase in the PM peak, inbound compared to 2023. The exceptions are the Falls Road, Shankill Road and Crumlin Road. The largest increases are experienced on the Antrim Road and Ormeau Road. This is likely due to the introduction of BRT Phase 2.
- The bus journey times on the Antrim Road and Ormeau Road decrease in the Do Minimum compared to 2023 with this introduction of BRT Phase 2.
- In the ETP scenario most of the highway journey times increase further, particularly on the Cregagh Road and Ormeau Road.
- The largest reductions in bus journey times with the introduction of ETP are noted on the Hollywood Road and Cregagh Road, while savings are noted on other routes (Shore Road, Malone Road, Lisburn Road, Falls Road, Castlereagh Road and Crumlin Road).

5.5.6 PM Peak Outbound

Table 5-28 – Change in Highway Journey Times

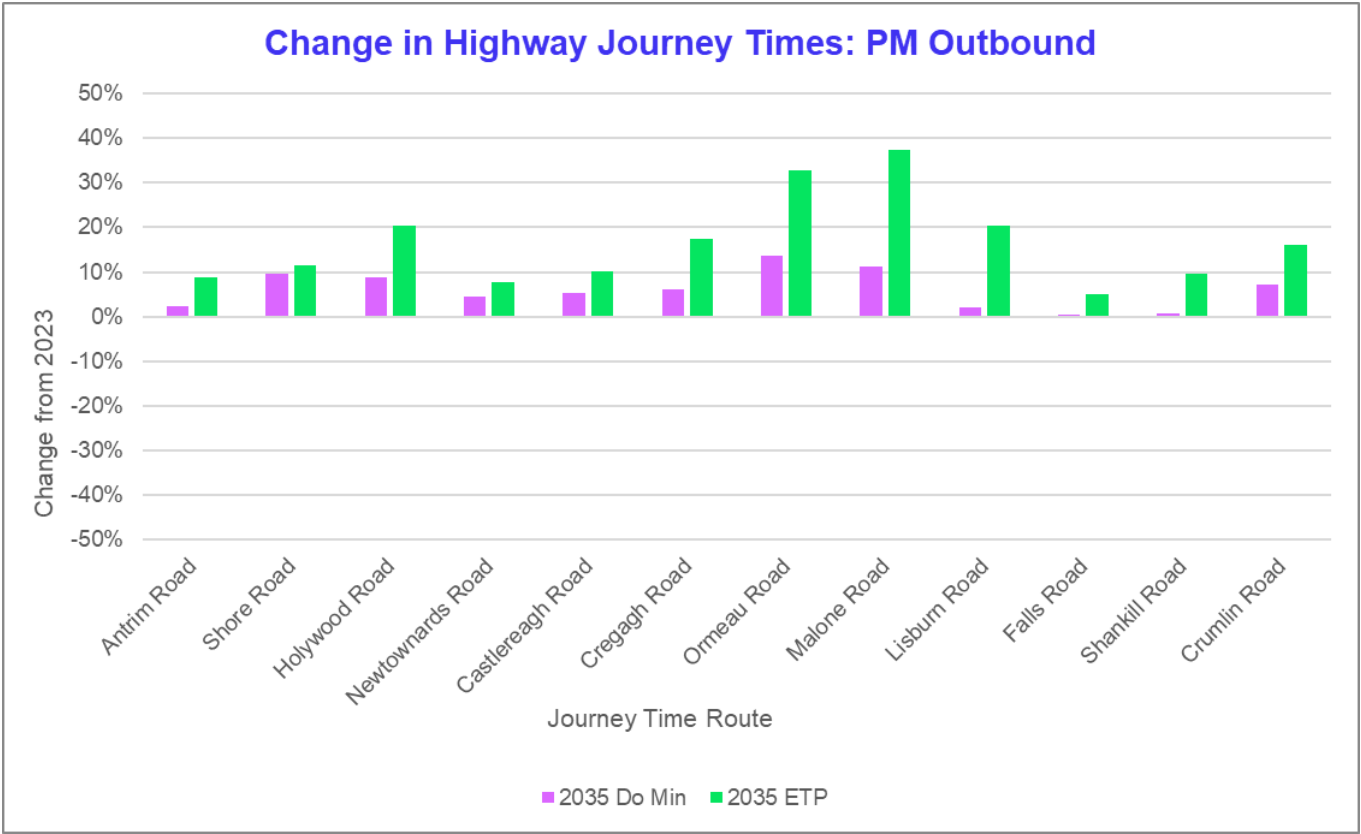
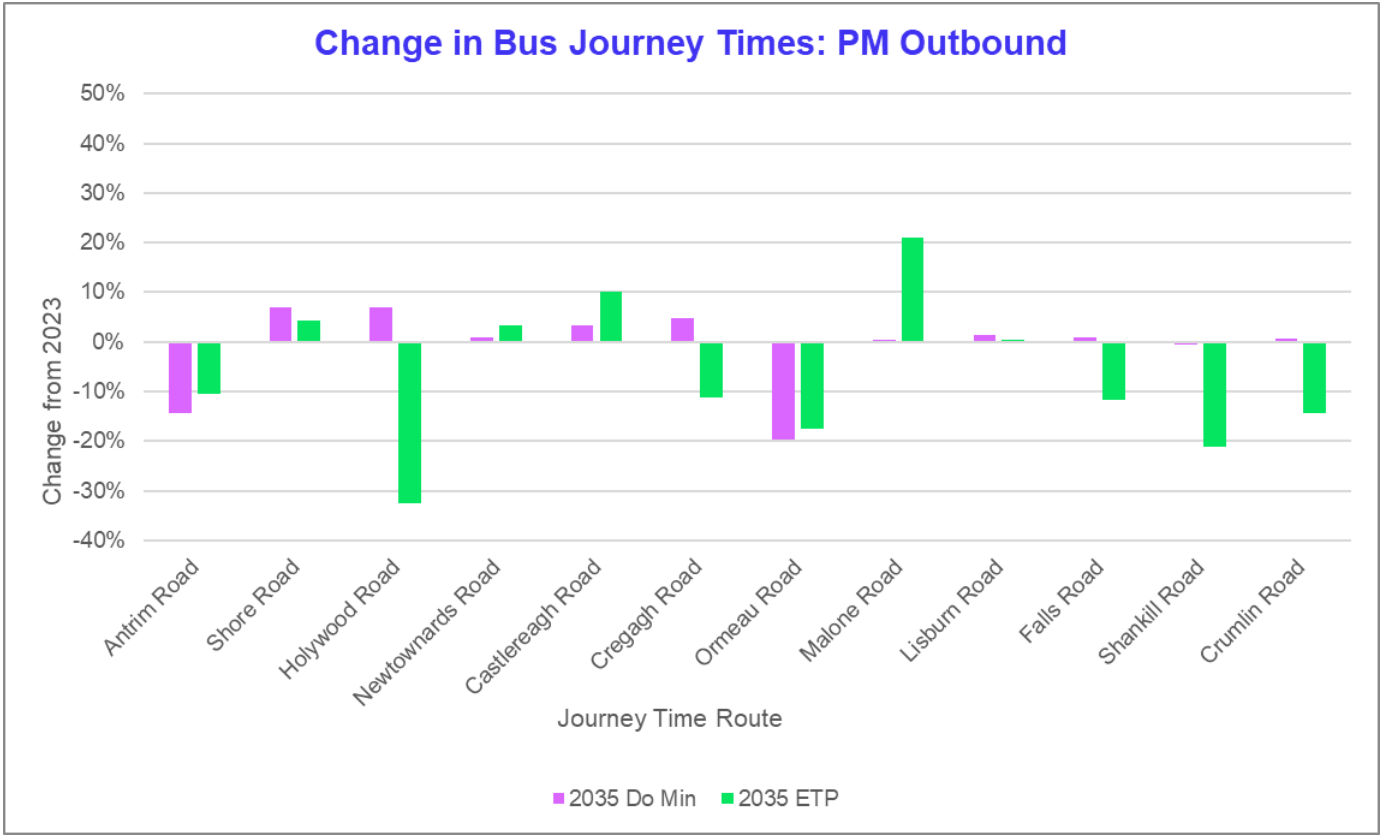


Table 5-29 – Change in Bus Journey Times



- On all corridors the highway journey times increase in the 2035 Do Minimum scenario. These journey times increase further with the introduction of the ETP measures in the PM peak, outbound.
- The bus journey times are reduced on the Antrim Road and Ormeau Road in the DoMinimum with the introduction of BRT Phase 2. While the savings are reduced slightly in the ETP scenario they are significantly less than in 2023.
- With the introduction of the bus lanes, the bus journey times are reduced along Hollywood Road, Cregagh Road, Falls Road, Shankill Road and Crumlin Road.
- There are some increases in bus journey time along Shore Road, Newtownards Road, Castlereagh Road and Malone Road where there are no new outbound bus lanes being introduced.

5.6 City Centre Highway Flow

The highway flow (in PCU³s) entering into the city centre consists of:

- Trips with their destination in the city centre; and
- Trips passing through the city centre.

The change in these types of trips is shown in Table 5-30.

Table 5-30 - City Centre Flows

Peak Hour	Trip Type	2035 DoMin	2035 ETP	Difference	Percentage Change
AM	Total In	11,900	11,200	-700	-6%
	Passing Through Trips	2,100	1,600	-500	-24%
	Passing Through Rate	18%	14%		
IP	Total In	6,900	6,200	-700	-11%
	Passing Through Trips	1,800	1,200	-600	-35%
	Passing Through Rate	26%	19%		
PM	Total In	6,500	5,800	-700	-11%
	Passing Through Trips	2,400	1,700	-700	-28%
	Passing Through Rate	36%	29%		

Table 5-30 shows:

- In the ETP 2035 scenario the number of highway trips into the city centre decreases
- The volume of through traffic reduces by 4-7% in each peak.
- The impact of ETP measures is greater on the highway through trips, which reduce more than those terminating within the city centre.
- The reduction in the number of highway trips per hour is similar in all time periods (500-700 PCU reduction).

5.7 Cordon Flows

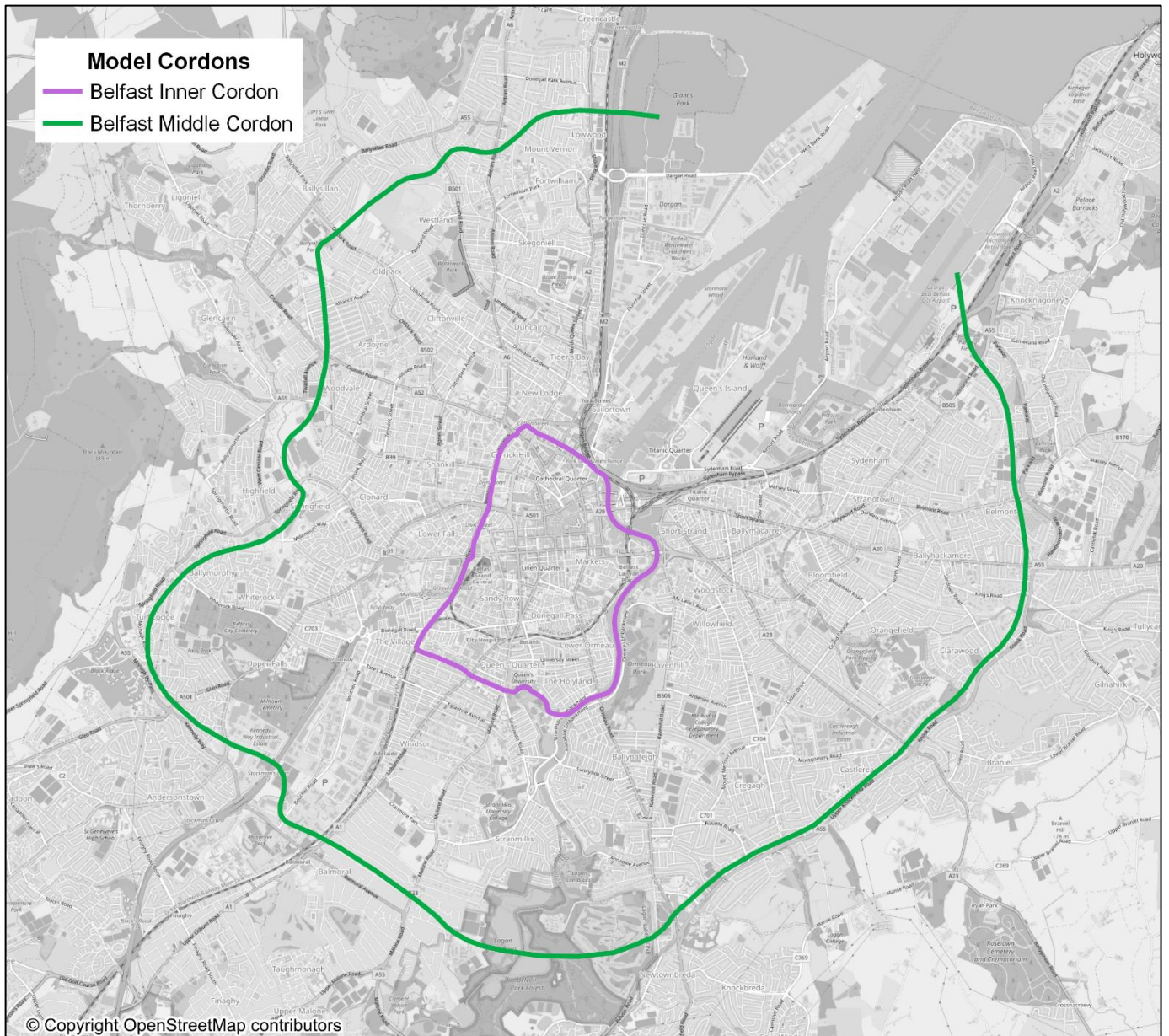
The flows crossing the inner and middle cordon are set out in this section. These are for:

- Highway
- Bus
- Rail

The locations of the cordons are shown in Figure 5-25.

³ Passenger Car Unit

Figure 5-25 - Inner and Middle Cordon



5.7.1 Inner Cordon

The change in inner cordon flows between the 2035 Do Minimum and ETP scenarios are shown in this section. The highway trips are shown in PCUs in the peak hour and the bus and rail trips are shown as person trips in the peak periods (3 hours in the AM and PM, 6 hours in the Interpeak).

5.7.1.1 Inner Cordon – Inbound

Figure 5-26 - Change in Flow Across the Inner Cordon

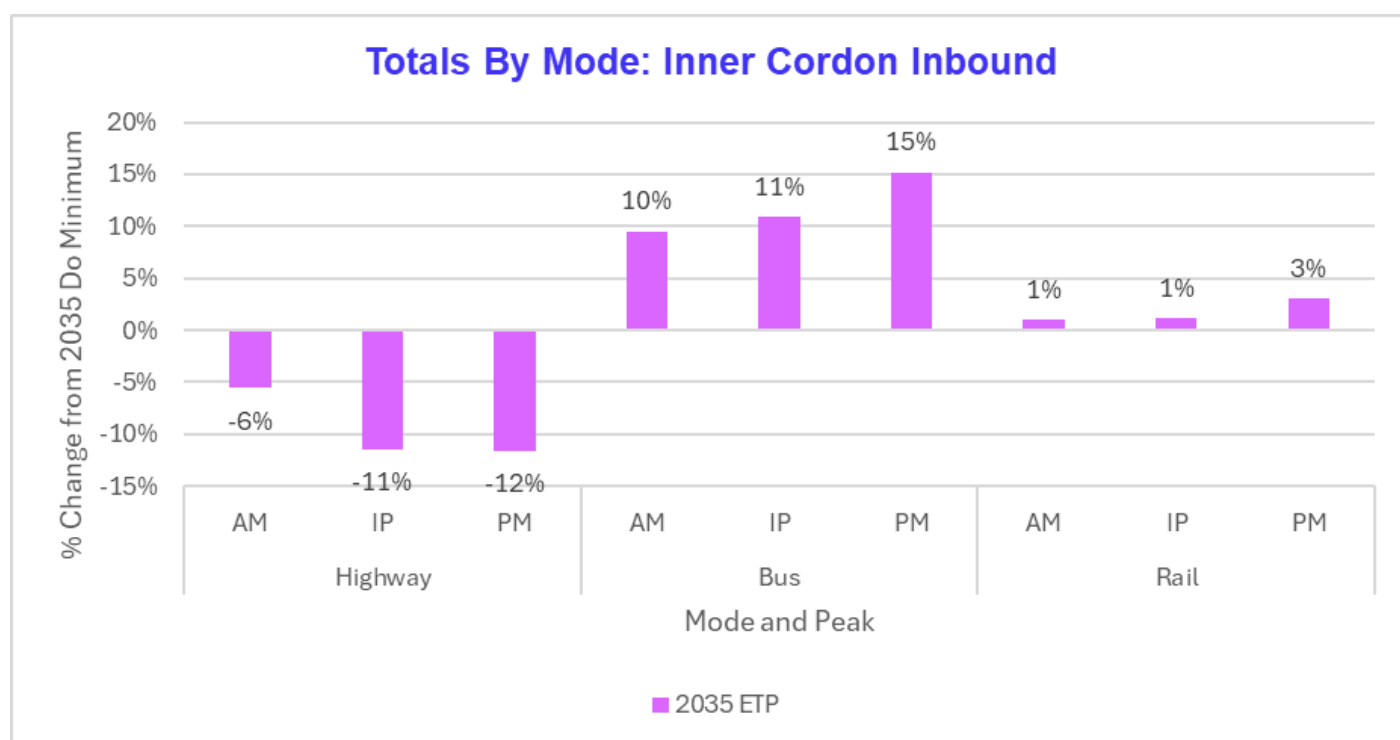


Table 5-31 - Flow Across the Inner Cordon - Inbound

	Highway			Bus			Rail		
	AM	IP	PM	AM	IP	PM	AM	IP	PM
2035 DoMin	10,700	6,300	6,200	17,300	13,300	4,500	8,100	4,700	2,300
2035 ETP	10,100	5,600	5,500	18,900	14,800	5,200	8,200	4,800	2,400

- The highway trips decrease across all peaks, between 6% and 12% reduction (equating to 600-700 trips per peak hour)
- Bus trips increase across each peak period by 10-15% (equating to approx. 700-1700 person trips)
- Rail trips increase by 1-3% across each peak period (approx. 100 trips per peak period)

5.7.1.2 Inner Cordon – Outbound

Figure 5-27 - Change in Flow Across the Inner Cordon

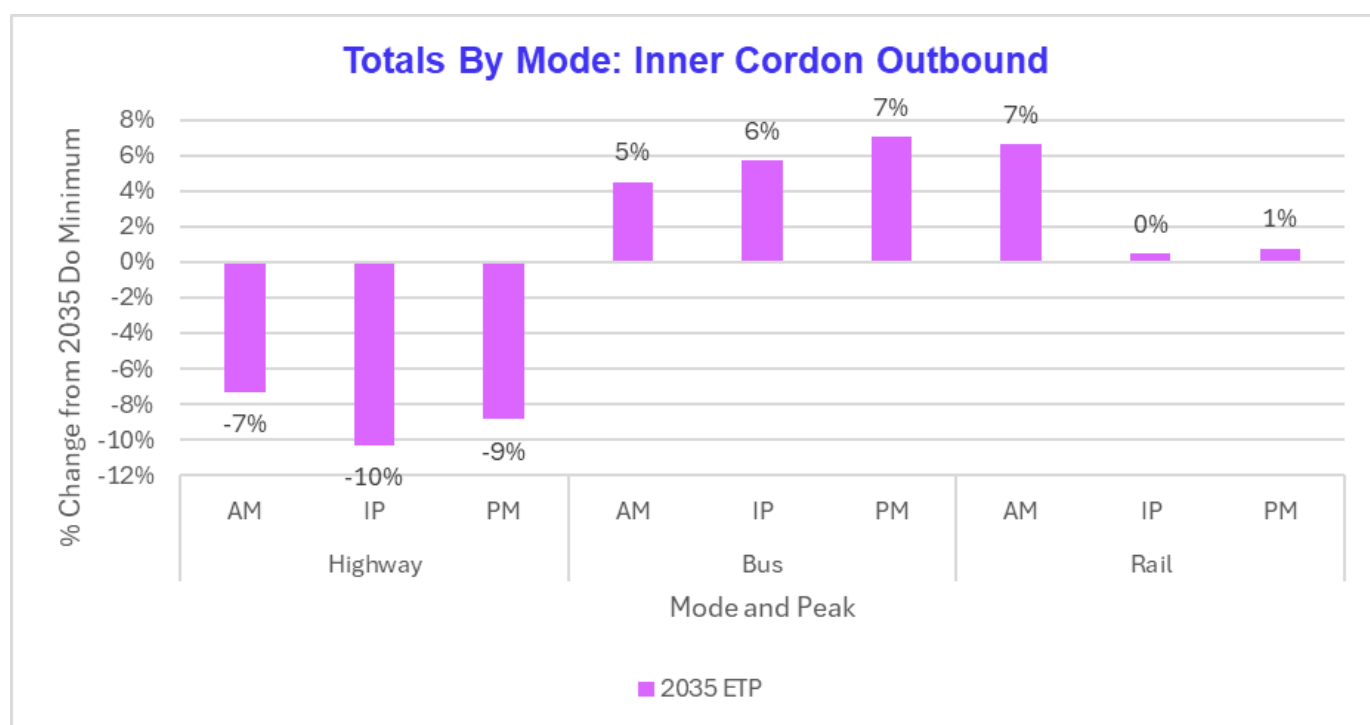


Table 5-32 - Flow Across the Inner Cordon - Outbound

	Highway			Bus			Rail		
	AM	IP	PM	AM	IP	PM	AM	IP	PM
2035 DoMin	5,900	7,700	10,200	5,700	16,000	14,900	2,000	5,100	7,700
2035 ETP	5,500	6,900	9,300	6,000	16,900	15,900	2,100	5,100	7,700

- The highway trips decrease across all peaks, between 7% and 10% reduction (equating to 400-900 trips per peak hour)
- Bus trips increase across each peak period by 5-7% (equating to approx. 300-1000 person trips)
- Rail trips increase by up to 7% across each peak period (up to. 100 trips per peak period).

5.7.2 Middle Cordon

The change in middle cordon flows between the 2035 Do Minimum and ETP scenarios are shown in this section. The highway trips are shown in PCUs in the peak hour and the bus and rail trips are shown as person trips in the peak periods (3 hours in the AM and PM, 6 hours in the Interpeak).

5.7.2.1 Middle Cordon – Inbound

Figure 5-28 - Change in Flow Across the Middle Cordon

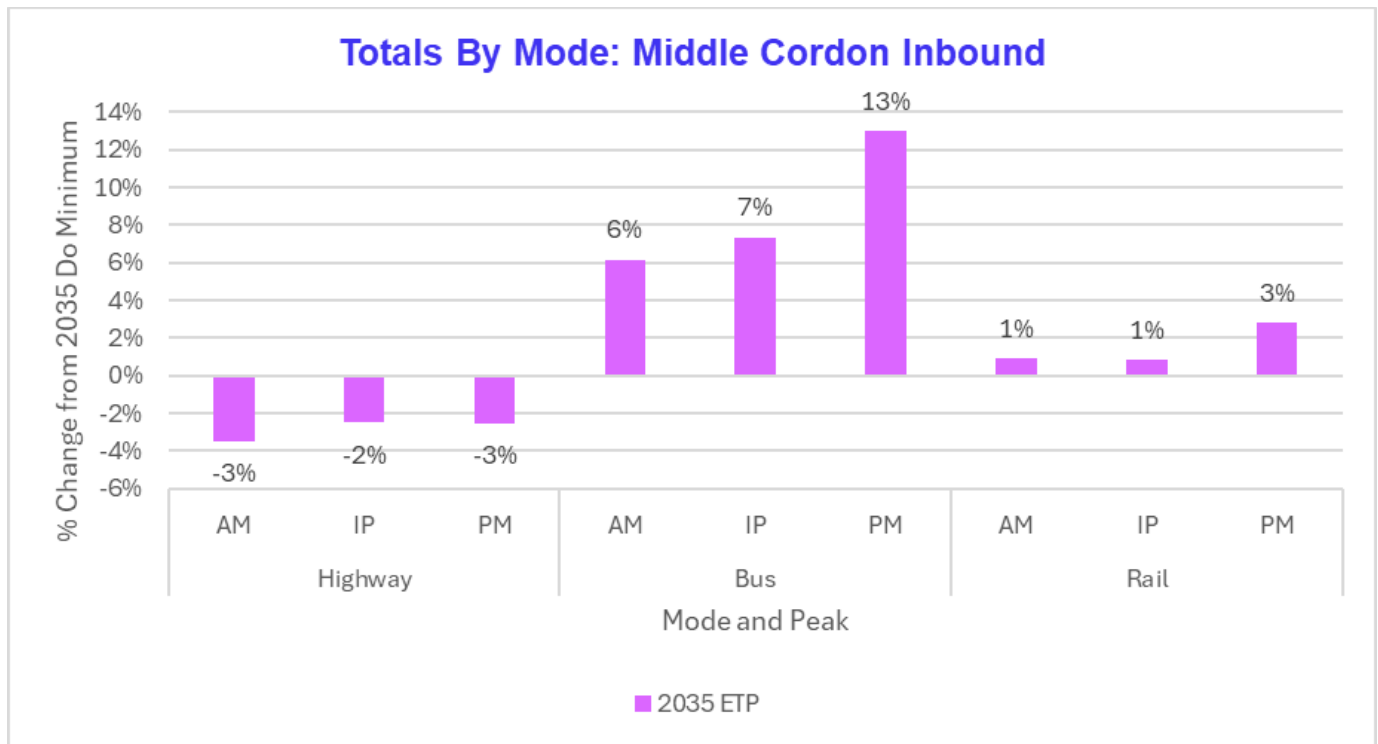


Table 5-33 - Flow Across the Middle Cordon - Inbound

	Highway			Bus			Rail		
	AM	IP	PM	AM	IP	PM	AM	IP	PM
2035 DoMin	29,900	21,500	20,000	17,000	11,800	3,300	9,300	5,700	2,700
2035 ETP	28,900	20,900	19,500	18,000	12,600	3,700	9,400	5,800	2,800

- The highway trips decrease across all peaks, between 2% and 3% reduction (equating to 500-1000 trips per peak hour)
- Bus trips increase across each peak period by 6-13% (equating to approx. 400-1000 person trips)
- Rail trips increase by 1-3% across each peak period (approx. 100 trips per peak period)

5.7.2.2 Middle Cordon – Outbound

Figure 5-29 - Change in Flow Across the Middle Cordon

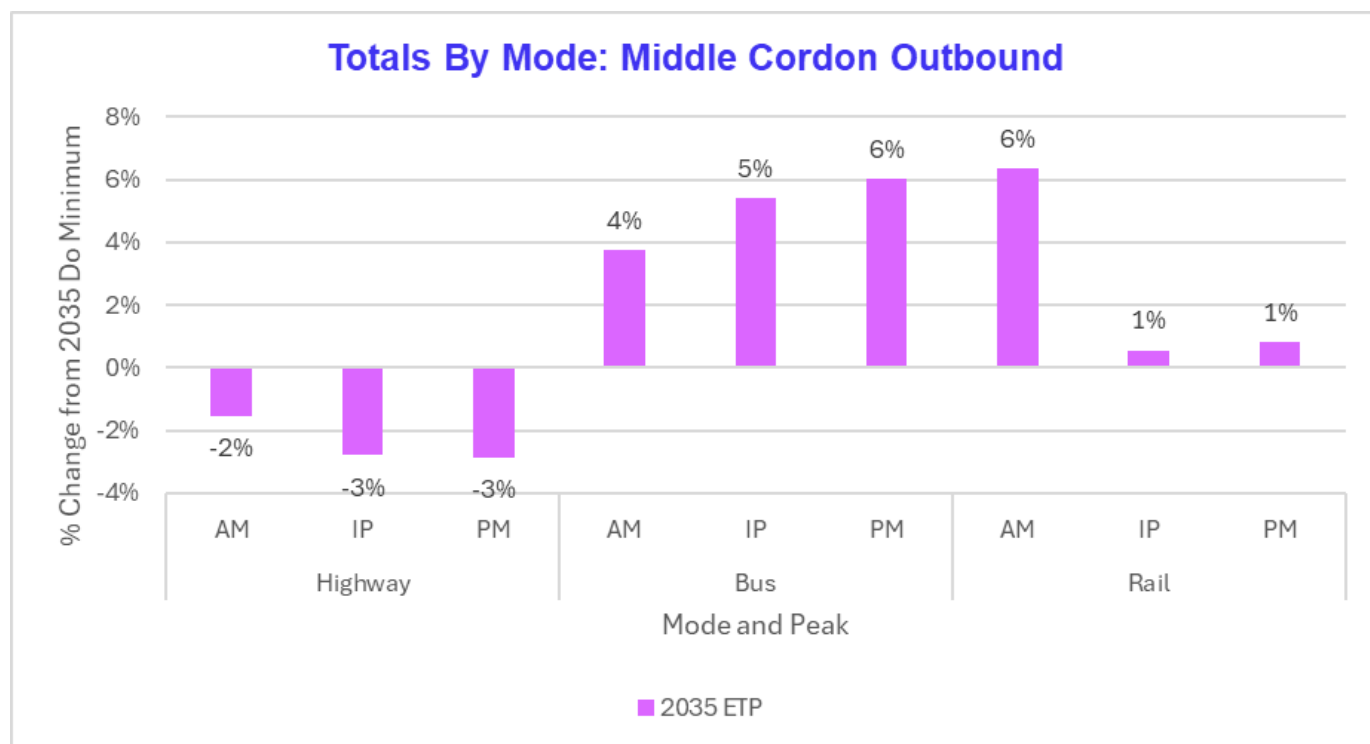


Table 5-34 - Flow Across the Middle Cordon - Outbound

	Highway			Bus			Rail		
	AM	IP	PM	AM	IP	PM	AM	IP	PM
2035 DoMin	21,900	25,900	29,000	5,700	15,500	13,400	2,300	6,200	8,900
2035 ETP	21,600	25,200	28,100	5,900	16,300	14,300	2,400	6,300	9,000

- The highway trips decrease across all peaks, between 2% and 3% reduction (equating to 300-900 trips per peak hour)
- Bus trips increase across each peak period by 4-6% (equating to approx. 200-900 person trips)
- Rail trips increase by up to 6% across each peak period (up to 100 trips per peak period)

5.8 Sensitivity Test: ETP Proposals with BCC Plan

A sensitivity test was undertaken using the BCC Plan demand and the ETP proposals. The supply changes for the ETP proposals remain the same as set out in section 5.1. This section sets out the model results.

The outputs include:

- Main Mode Choice
- ADV Plots

5.8.1 Main Mode Choice

The main mode choice in the model sets out the total daily productions using car, public transport, walk or cycle. This is at a production level only i.e. the home end of a tour for home-based trips or the origin of a trip for non-home-based trips.

5.8.1.1 Belfast

Figure 5-30 - Change in Main Mode Choice: BCC Core- Belfast

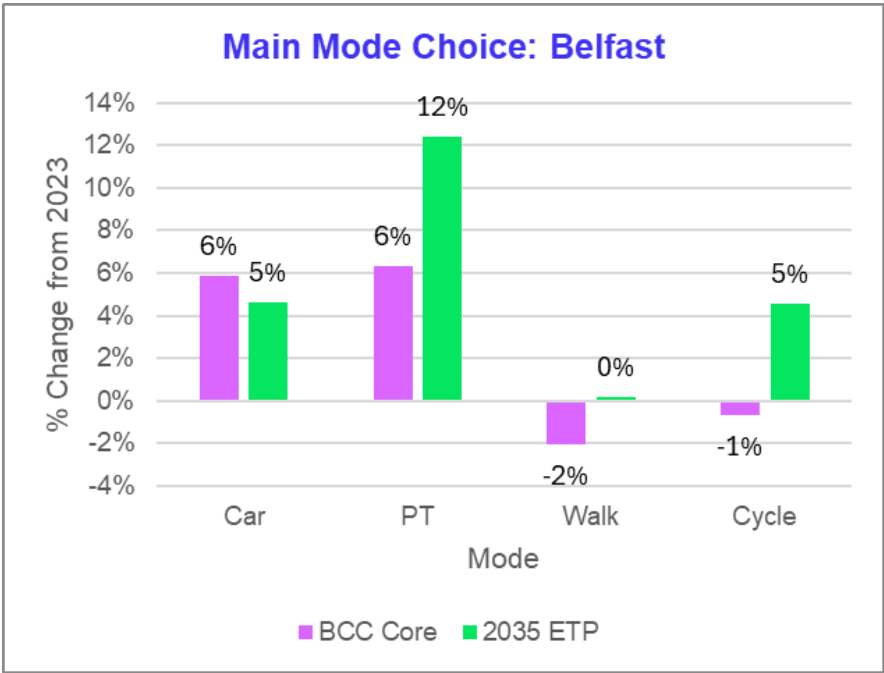
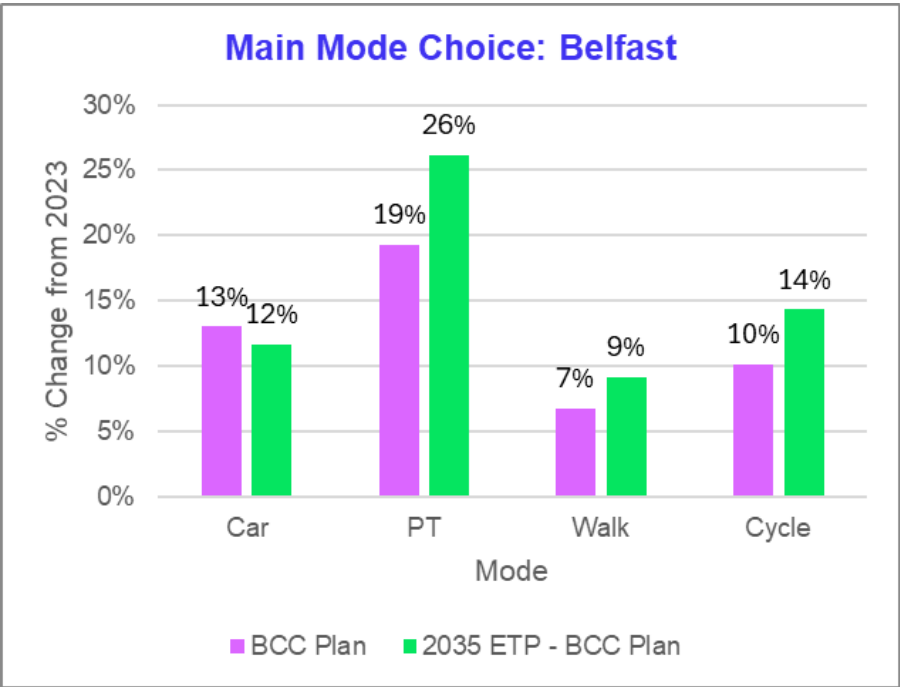


Figure 5-31 - Change in Main Mode Choice: BCC Plan - Belfast



*Percentage Change calculated on values that are not subject to rounding

Table 5-35 - Total Main Mode Choice for Belfast

Scenario	Car	Public Transport	Walk	Cycle
BCC Core	563,600	44,900	162,000	5,800
2035 ETP	557,000	47,500	165,600	6,100
BCC Plan	601,700	50,400	176,500	6,400
2035 ETP – BCC Plan	594,500	53,300	180,500	6,700

- The additional demand means the percentage increase from 2023 is higher with the BCC Plan growth
- The percentage change between BCC Plan and BCC Plan with ETP is similar to the change from BCC Core and 2035 ETP.
- While the overall values are higher with BCC Plan, the impact of ETP is similar.

5.8.1.2 City Centre

Figure 5-32 - Change in Main Mode Choice: BCC Core- Belfast City Centre

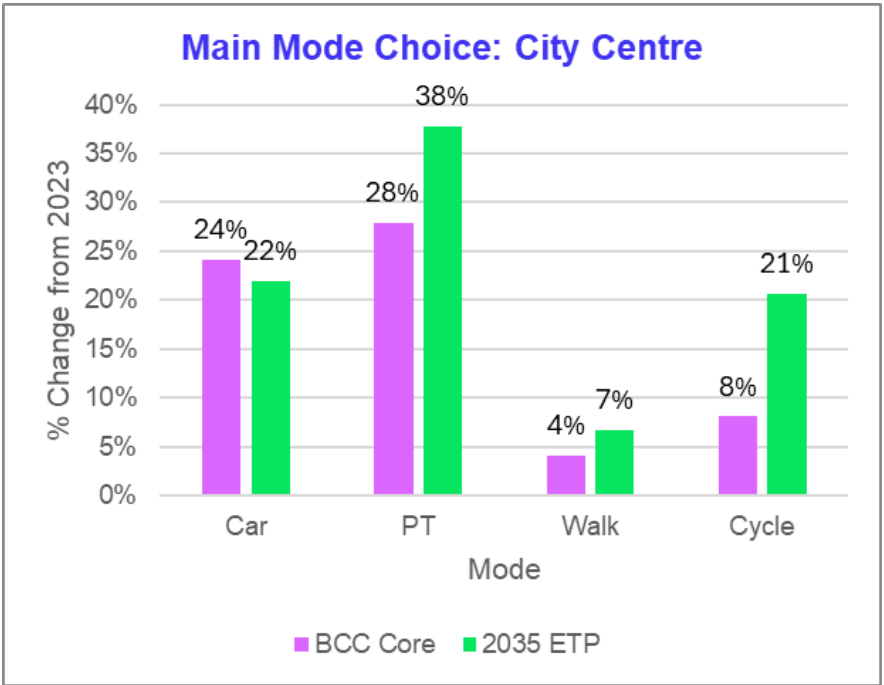
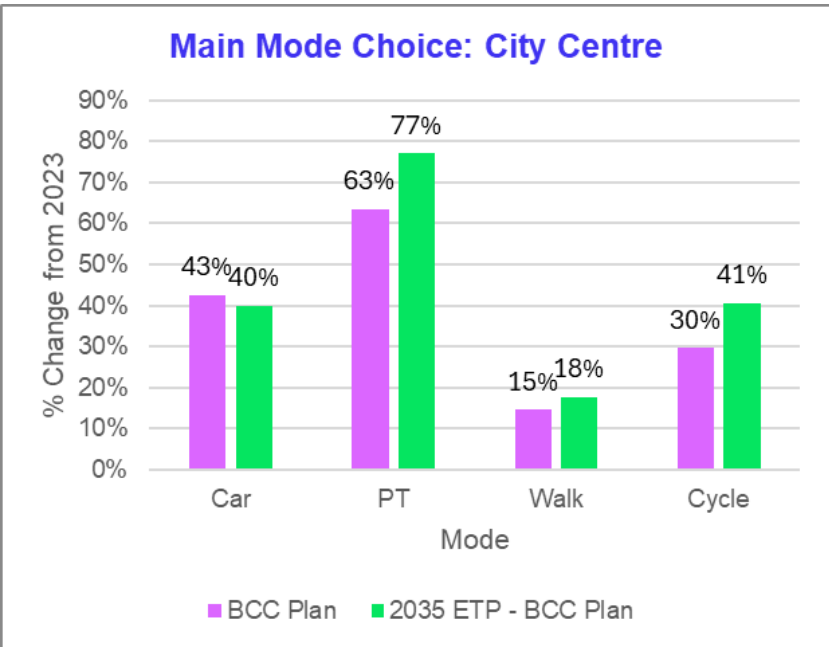


Figure 5-33 - Change in Main Mode Choice: BCC Plan - Belfast City Centre



*Percentage Change calculated on values that are not subject to rounding

Table 5-36 - Total Main Mode Choice for Belfast City Centre

Scenario	Car	Public Transport	Walk	Cycle
BCC Core	55,800	4,700	22,700	600
2035 ETP	54,800	5,100	23,300	700
BCC Plan	64,100	6,100	25,000	700
2035 ETP – BCC Plan	62,800	6,600	25,700	800

- Similar to the Belfast area, the BCC Plan scenarios have a higher level of demand and the impact of the ETP proposals is similar in each demand scenario.



5.8.2 ADV

The impact of the ETP proposals on the 2035 BCC Plan growth scenario is set out in Figure 5-34 and Figure 5-35 for the AM peak. There is a similar flow and delay change for interpeak and PM.

Figure 5-34 – BCC Plan ETP: Actual Flow Difference - AM Peak (with ETP v without ETP: BCC Plan Demand)

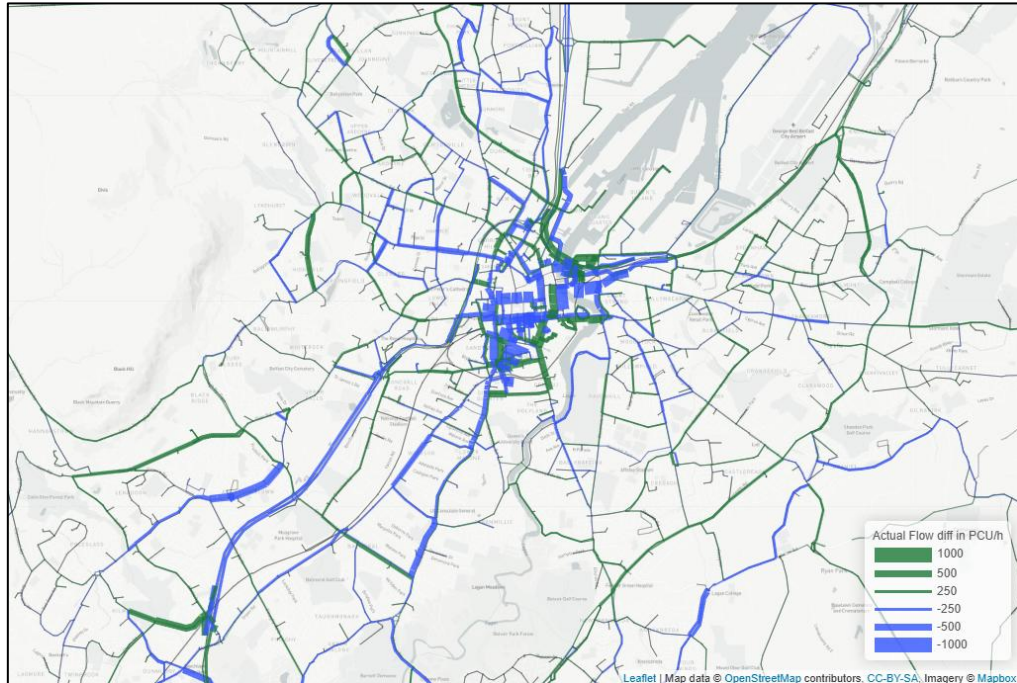
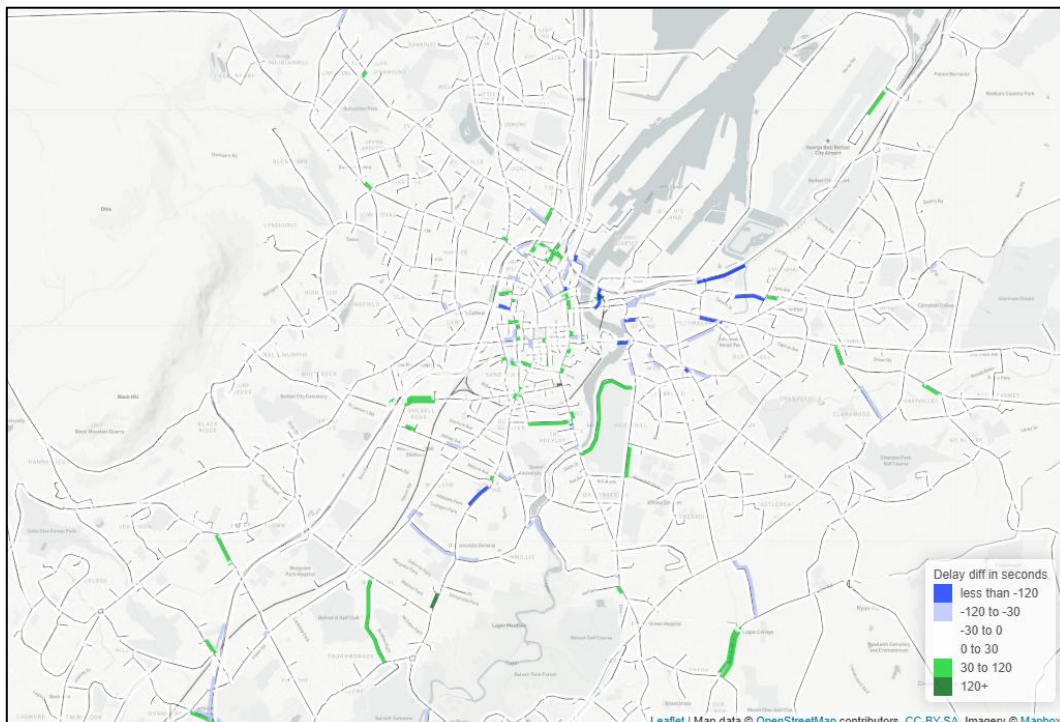


Figure 5-35 – BCC Plan ETP: Delay Difference - AM Peak (with ETP v without ETP: BCC Plan Demand)



The impact of the ETP proposals with BCC Plan growth is similar to the impact on the BCC Core growth scenario.

The actual flow difference and delay difference between the 2035 ETP scenario with the BCC Plan growth and with the BCC Core demand is set out in Figure 5-36 and Figure 5-37 for the AM peak. There is a similar pattern of flow changes and delay in the interpeak and the PM peak.

Figure 5-36 - ETP: Actual Flow Difference - AM Peak (with ETP v without ETP: BCC Plan Demand)

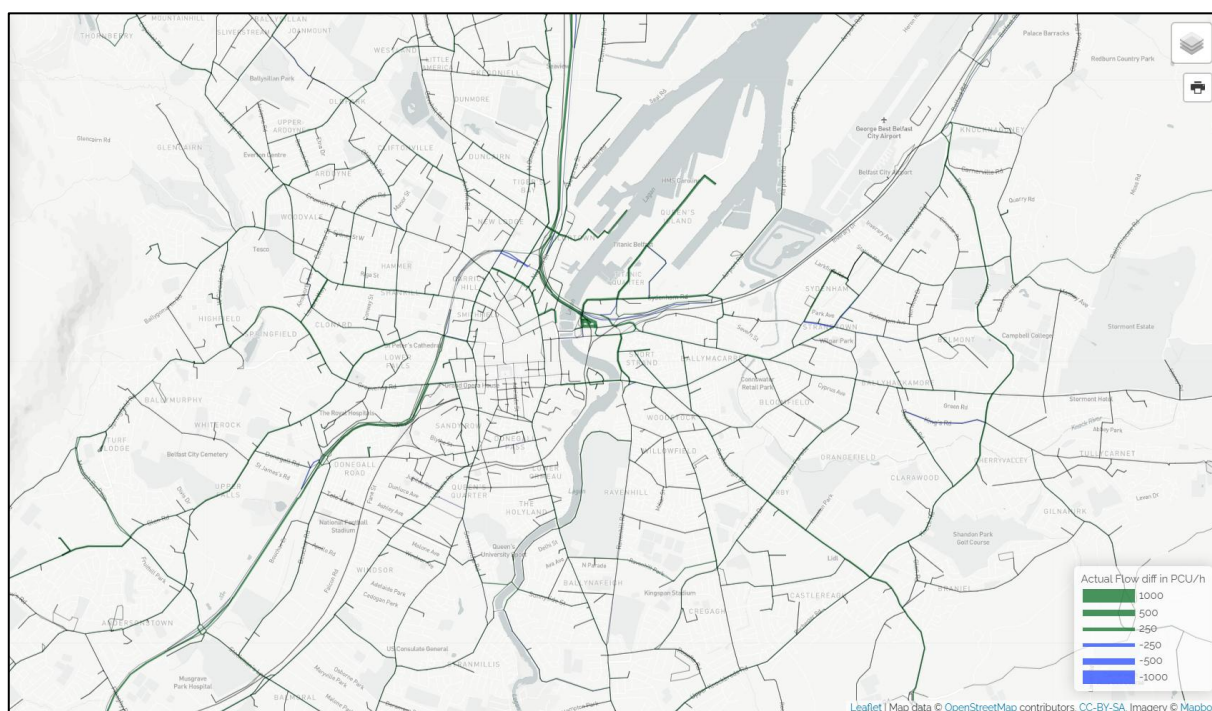


Figure 5-37 - ETP: Delay Difference - AM Peak (with ETP v without ETP: BCC Plan Demand)

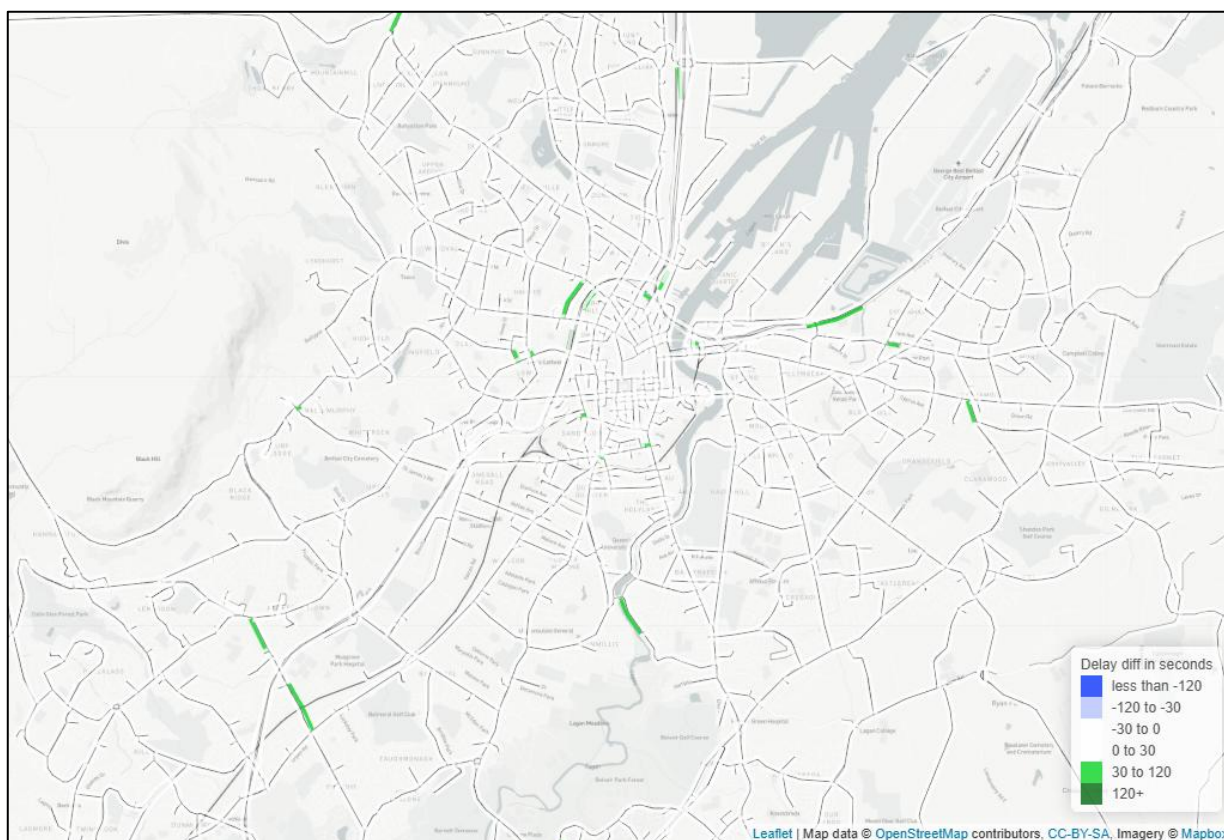


Figure 5-36 and Figure 5-37 show that the impact of the additional demand on the network leads to additional delays in some locations across Belfast. This includes the Sydenham Bypass, the Westlink slip roads, Donegall Pass and various other links accessing the main radial routes.

The highway flow increases are mainly observed on the strategic network (M1, M3 and M2) with some smaller increases across the network.

6. Summary

This section sets out a summary of the modelling reported in this document which has been undertaken for the Eastern Transport Plan. Following a brief overview of the BSTM2, this report has set out the following:

- A summary of the existing conditions of the transport network in the model. This has been set out for a 2023 base year, where a present year validation was undertaken on the model. The demand was factored to include the impact of Covid-19 on the different modes and the supply was adjusted to reflect the 2023 conditions.
- The 2035 Do Minimum forecasts set out the demand scenario used, i.e. Belfast City Council spatial growth, capped at a TEMPro-NI level and the supply updates for highway, bus and rail. The impact of the Do Minimum (2035 scenario which includes growth and planned schemes) demand and supply shows the main and sub mode choice change to highway and public transport demand. The impact of this change is then set out in network plots and the highway summary statistics. These showed:
 - An increase in total highway travel time and delay, accompanied by a decrease in highway network speeds
 - A general increase in flow across the highway network with some localised reductions in flow on the Antrim Road and Ormeau Road with the introduction of BRT Phase 2.
 - The strategic routes along the M1, M2 and A12 experience the largest increase in flow
- The Eastern Transport Plan proposals make up the Do Something scenario. This report has set out the modelled changes to the highway, public transport and active modes proposed as part of the ETP and the impact of these in the model. This modelling has shown:
 - A decrease in car trips and a corresponding increase in public transport, walk and cycle trips compared to the Do Minimum
 - The highway summary statistics show a reduction in delay in the AM peaks, but an increase in the IP and PM. This is likely due to a reduction in traffic volumes. A decrease in average speed across the highway network;
 - All highway journey times across the main radial corridors increase in all peaks, however the bus journey times reduce with the introduction of new bus lanes;
 - The number of vehicles entering the city centre has decreased, noting the majority of this reduction comes from trips passing through the city centre and not stopping;
 - The middle cordon also experiences a decrease in highway trips crossing which is accompanied by an increase in bus and rail trips.

The modelling undertaken for the Eastern Transport Plan demonstrates that, while 2035 Do Minimum forecasts indicate increased travel times, delays, and flows on strategic routes, the ETP proposals deliver a shift from car to public transport and active modes, reduce city centre traffic volumes, and improve bus journey times despite some increases in highway delay and reduced network speeds.

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