Preliminary Transport Modelling Report

BusConnects Cork Sustainable Transport Corridors

November 2023

Rialtas na hÉireann
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Project Ireland 2040

BUS CONNECTS CORK
SUSTAINABLE TRANSPORT FOR A BETTER CITY.

BusConnects Cork Sustainable Transport Corridors

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Contents

List of Acronyms

Acronym	Definition
AADT	Annual Average Daily Traffic
ATC	Automatic Traffic Counts
CPO	Compulsory Purchase Order
CSA	Census Small Area
DfT	Department for Transport (UK)
DoT	Department of Transport (Ireland)
DM	Do Minimum
DS	Do Something
ED	Engineering Design
EIA	Environmental Impact Assessment
EIARs	Environmental Impacts Assessment Reports
SWRM	South West Regional Model
FDM	Full Demand Model
GEH	Geoffrey E. Havers statistic
JTC	Junction Turning Counts
LAM	Local Area Model
LGV	Light Goods Vehicles
NDFM	National Demand Forecasting Model
NDP	National Development Plan
NHTS	National Household Travel Survey
NPF	National Planning Framework
NTA	National Transport Authority
OGV	Other Goods Vehicles
PAG	Project Appraisal Guidelines
pcu	passenger car units
PDR	Preliminary Design Report
PRO	Preferred Route Option
RMS	Regional Modelling System
SAPS	Small Area Population Statistics
STCs	Sustainable Transport Corridors
TAG	Transport Analysis Guidance
TIA	Transport Impact Assessment
TII	Transport Infrastructure Ireland
TRL	Transport Research Laboratory

1. Introduction

1.1 Introduction

The purpose of this document is to provide an overview of the suite of forecast transport modelling tools that have been and continue to be developed to support the design development and assessment of the BusConnects Cork Sustainable Transport Corridors (STCs) (hereafter referred to as the proposed STCs). It also presents the results of preliminary transport modelling which has been undertaken at this early stage of the design and planning process. Eleven proposed STCs make up BusConnects Cork Sustainable Transport Corridors (hereafter referred to as BCC STC). Work regarding examination of environmental impacts is underway that may culminate in Environmental Impact Assessment Reports (EIARs) to be prepared and submitted as part of a number of planning applications to An Bord Pleanála.

1.2 Background

BusConnects Cork (BCC) is a €600 million investment in Cork's sustainable transport system, to be implemented by 2030 under the Government's National Development Plan. Its objective is to transform the bus system to make it more useful to more people and, in parallel, deliver safe cycling facilities on key corridors. BusConnects Cork is a central part of the Cork Metropolitan Area Transport Strategy (CMATS), which sets out an ambitious vision to deliver an integrated and sustainable transport system for the region. BCC STC is one of nine measures included in the delivery of the overall BusConnects Cork (BCC) Programme as presented in Diagram 1-1 below.

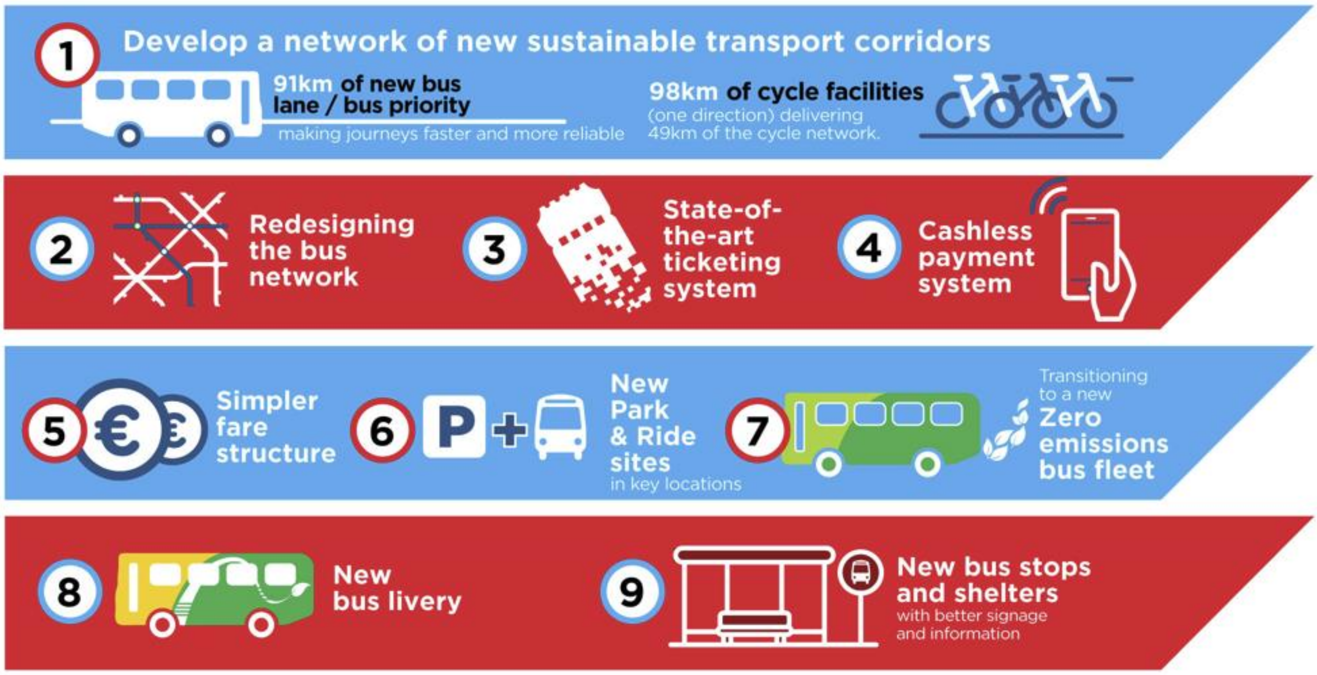


Diagram 1-1 BusConnects Cork Measures

1.3 Proposed Sustainable Transport Corridors

The proposed STCs are being planned as part of BCC STC to provide enhanced walking, cycling, and bus infrastructure on key access corridors in the Cork region, which will enable and deliver efficient, safe, and integrated sustainable transport movement along these corridors. The development of the proposed STCs will enable efficient bus movement along these routes, together with the provision of safe, segregated cycling facilities, and walking improvements where feasible, in addition to accommodating general traffic movement. The eleven proposed STCs are as follows:

- STC A: Dunkettle to City;
- STC B: Mayfield to City;
- STC C: Blackpool to City;
- STC D: Hollyhill to City;
- STC E: Ballincollig to City;
- STC F: Bishopstown to City;
- STC G: Togher to City;
- STC H: Airport Road to City;
- STC I: Maryborough Hill to City;
- STC J: Mahon to City;
- STC K: Kinsale Road to Douglas

An image of the proposed routes of the STCs is presented in Diagram 1-2.

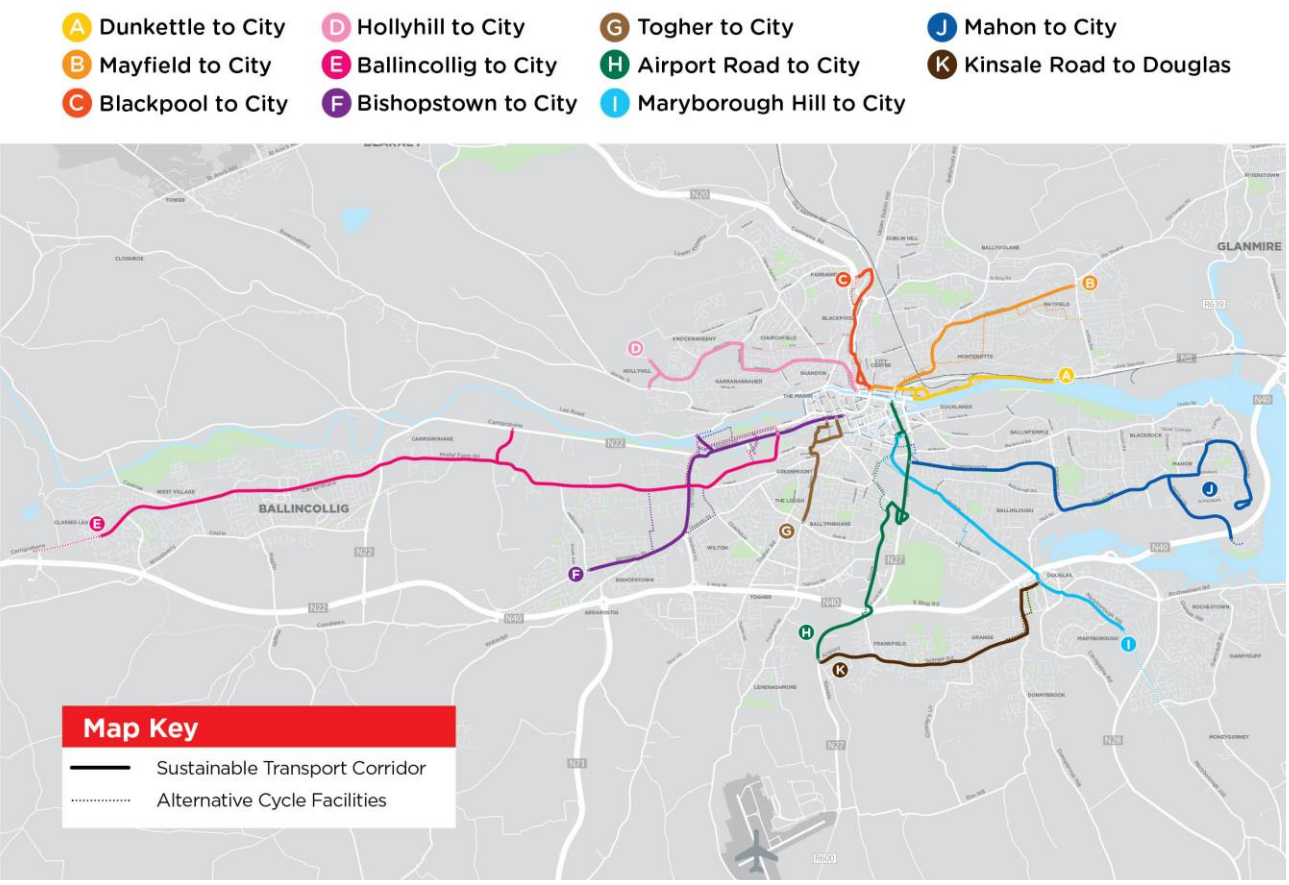


Diagram 1-2 Overview of BusConnects Cork – Sustainable Transport Corridors Works

To achieve the overall aim of the STCs, the NTA has identified the following objectives:

- Enhance the capacity and potential of the public transport system by improving bus speeds, reliability and punctuality through the provision of bus lanes and other measures to provide priority to bus movement over general traffic movements;
- Enhance the potential for cycling by providing safe infrastructure for cycling, segregated from general traffic wherever practicable;
- Support the delivery of an efficient, low carbon and climate resilient public transport service, which supports the achievement of Ireland's emission reduction targets;
- Enable compact growth, regeneration opportunities and more effective use of land in Cork, for present and future generations, through the provision of safe and efficient sustainable transport networks;
- Improve accessibility to jobs, education, and other social and economic opportunities through the provision of improved sustainable connectivity and integration with other public transport services; and
- Ensure that the public realm is carefully considered in the design and development of the transport infrastructure and seek to enhance key urban focal points where appropriate and feasible.

In line with the above objectives, the transport assessment of the proposed STCs and the transport modelling outputs will be focused on the concept of the "movement of people" rather than, solely, the "movement of vehicles". The emphasis of the design philosophy is on maximising the capacity of the proposed STCs to move people on sustainable modes whilst still providing for the necessary movement of private vehicles along each STC.

The timeline for the delivery of the proposed STCs is:

- **2023 to 2025** – Preparation of Statutory Application including selection of the Preferred Route Option, optimised Engineering Design, EIAR, and identification of property requirements and drafting of Compulsory Purchase Order (CPO);
- **2024-2026** – Statutory Process including submission of application to An Bord Pleanála, statutory consultation and Oral Hearing; and
- **2026 to 2030** – In the event of approval by An Bord Pleanála under section 51 of the Roads Act 1993 (as amended) and confirmation of the CPO, carry out property acquisition and construction.

The Emerging Preferred Route Options were published for non-statutory public consultation between June 30th 2022 and October 3rd 2022. A second public consultation was held in March 2023 and continued until May 25th 2023 outlining the Preferred Route Option (PRO) taking into account the submissions received from the first public consultation exercise. A third round of consultation is being undertaken during Quarter 4 of 2023.

Following this and the consideration of submissions received, the PRO will be finalised and the Preferred Route Options Report will be completed and published. The Environmental Impact Assessment (EIA) work including a Transport Impact Assessment (TIA) will be completed. The finalisation of the Preferred Route Options Report, and subsequent detail design development, will support the statutory submission to An Bord Pleanála for approval under section 51 of the Roads Act 1993 (as amended).

1.4 Report Purpose

The purpose of this document is to provide an overview of the suite of forecast transport modelling tools that will be developed to support the design development and assessment of the proposed STCs. It also presents the results of preliminary transport modelling which has been undertaken at this early stage of the design and planning process.

The modelling and designs for the BCC STCs are preliminary and will be refined further as part of the EIA and TIA and design development process. This will include the development and use of more detailed modelling such as a local area model (LAM) and microsimulation modelling of the proposed STCs. Accordingly, the output reported in this report should be regarded as preliminary information only.

At this stage in the project (Preferred Route Options at Public Consultation 3 - November 2023), there is a need to balance the complex interactions between neighbouring proposed STCs and their cumulative impacts. It has been considered most efficient and informative to group proposed STCs when presenting the modelling results in order to provide a balanced view of their impacts in combination. As such the following combinations have been modelled and presented separately in this report:

- Northern Sector proposed STCs (A, B, C, and D).
- South West Sector proposed STCs (E, F, and G); and
- South East Sector proposed STCs (H, I, J, and K).

The proposed STCs and their sector definition is illustrated in Diagram 1-3.

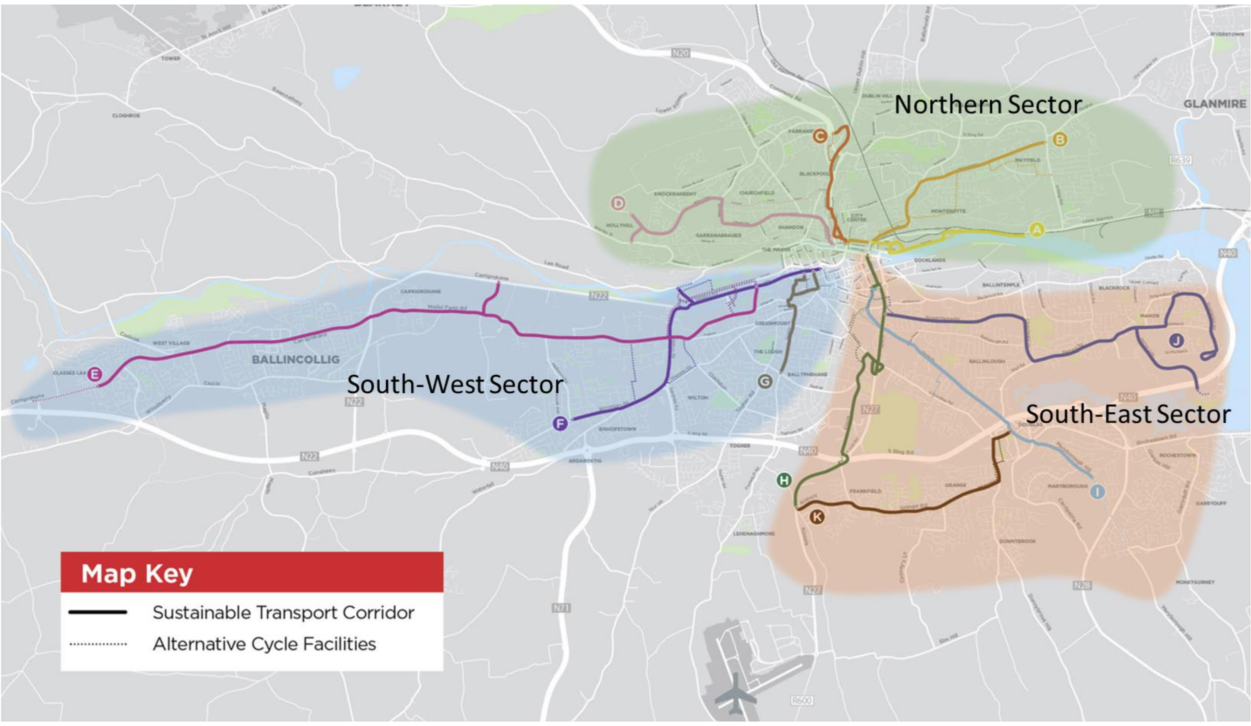


Diagram 1-3 Proposed Sustainable Transport Corridors and Sector Definition

1.5 Report Structure

The remainder of this report is laid out as follows:

- **Section 2 – Transport Modelling Methodology**, provides an overview of the transport modelling methodology including the use of the NTA's South West Regional Model (SWRM), the development of local area and micro-simulation modelling to support the assessment of the proposed STCs;
- **Section 3 – SWRM Calibration and Validation,** provides evidence on the base year performance of the SWRM to illustrate its suitability for the modelling exercise;
- **Section 4 – Forecast Model Development**, documents the approach and assumptions used to develop a forecast model scenario which was used to test the STCs at PC3 stage;

- **Section 5 – Proposed STC Evaluation**, documents the initial modelling outputs with regards to traffic redistribution as a results of the Preferred Route Option Designs for the STCs;
- **Section 6 – Conclusion**, provides a short summary of the key messages and conclusions presented in the report.

2. Transport Modelling Methodology

2.1 Introduction

The following section describes the overall methodology used for developing the various transport modelling tools which, in turn, will be used to support the assessment of the proposed STCs. This assessment in relation to the receiving transport environment requires a qualitative assessment of changes to the transport environment, as well as quantitative analysis that will be undertaken using a suite of multi-modal transport modelling tools which will be developed for the proposed STCs.

The assessment of traffic and transport benefits and impacts of the proposed STCs requires a transport modelling approach which can provide information on, for example, the mode share changes along the route, people movement by different modes of transport travelling along the corridor as well as traffic re-routing impacts on the surrounding road network. The modelling approach will require an assessment of bus, pedestrian and cycle operations and bus reliability with a focus on the movement of people along the route.

To enable this, a multi-tiered transport modelling approach has been adopted. The NTA's SWRM is the primary modelling tool and provides the overarching information on forecast travel demand for each mode of transport. The SWRM will be supported by other modelling tools which provide more granular level traffic information in later stages of the EIA process to allow for detailed and refined modelling at a local network and junction level. For this purpose, a cordoned[1] corridor-wide, road (motorised vehicle only) based Local Area Model (LAM) is currently in development to be used in combination with a multi-modal corridor micro-simulation model and local junction models which work in tandem with the NTA's SWRM.

The traffic and transport assessments will be carried out in relation to the following scenarios:

- **'Do Minimum'** – The 'Do Minimum' scenario (Opening Year 2030, Design Year 2045) represents the likely traffic and transport conditions of the direct and indirect study areas including for any transportation schemes which have taken place, been approved, or are planned for implementation, **without** the proposed STCs in place. This scenario forms the reference case by which to compare the proposed STCs ('Do Something') for the quantitative assessments.
- **'Do Something'** – The 'Do Something' scenario represents the likely traffic and transport conditions of the direct and indirect study areas including for any transportation schemes which have taken place, been approved, or are planned for implementation, **with** the proposed STCs in place (i.e., the Do Minimum scenario with the addition of the proposed STCs).

Further detail on the design years and the transport schemes that are included in the future 'Do Minimum' models can be found in section 4.

2.2 Proposed STC Transport Models

This section sets out the various transport modelling tools that have been or are being developed and used to inform the preparation of the TIA and Traffic and Transport Chapter of the EIAR and to support design decisions. The purpose of each tool is detailed and the use of the tool for each element of the proposed STC development is defined.

The modelling tools that are being developed do not work in isolation but will instead work as a combined modelling system driven by the SWRM as the primary source for multi-model demand and trip growth etc. which will be passed to the cordoned local area model, microsimulation models and junction models for the proposed STCs, which will be refined and calibrated to represent local conditions to a greater level of detail then that contained within the SWRM.

[1] Cordoning is the process of creating a smaller area model (network and demand) from a larger model

Importantly, no one tool can provide the full set of modelling data required to inform both the EIA and TIA requirements and to support design iterations and decisions e.g., the SWRM via the LAM will provide road traffic flow information (for example Annual Average Daily Traffic (AADT) and link speed data which will be used to inform Air Quality and Noise models).

The micro-simulation models are the most appropriate tool to provide the end-to-end bus journey times for the proposed STCs based on the detailed interaction of vehicle movements along the corridor. In addition, the LAM will be used directly for supporting design development decisions and to assist with an understanding of the implications of banned turns and potential trip redistribution away from the proposed STC during both the Construction and Operational Phases.

2.2.1 Proposed STC Transport Modelling Hierarchy

There are four tiers of transport modelling which will be used to assess the proposed STCs and these are detailed below and shown graphically in Diagram 2.1.

- **Tier 1 (Strategic Level):** The NTA's SWRM is the primary tool which has been used to date to undertake the strategic modelling of the proposed STC and has provided the strategic multi-modal demand outputs for the proposed forecast years;
- **Tier 2 (Local Level):** A LAM is being developed to provide a more detailed understanding of traffic movement at a local level. The LAM will be a subset model created from the SWRM but will contain a more refined road network model used to provide consistent road-based outputs to inform the TIA, EIA, and junction design models. This information will include road network speed data and traffic redistribution impacts for the Operational Phase. The LAM will also provide traffic flow information for the micro-simulation model and junction design models and be used to support junction design and traffic management plan testing;
- **Tier 3 (Corridor Level):** A micro-simulation model of the full 'end to end' corridors will be developed for each of the three sectors covering the proposed STCs. The primary role of the micro-simulation models will be to support the ongoing development of junction designs and traffic signal control strategies and to provide bus journey time information for the determination of benefits of the proposed STCs; and
- **Tier 4 (Junction Level)**: Local junction models will be developed, for each junction along the proposed STCs to support local junction design development. These models will be informed by the outputs from the above modelling tiers, as well as the junction designs which are, as discussed above, based on people movement prioritisation.

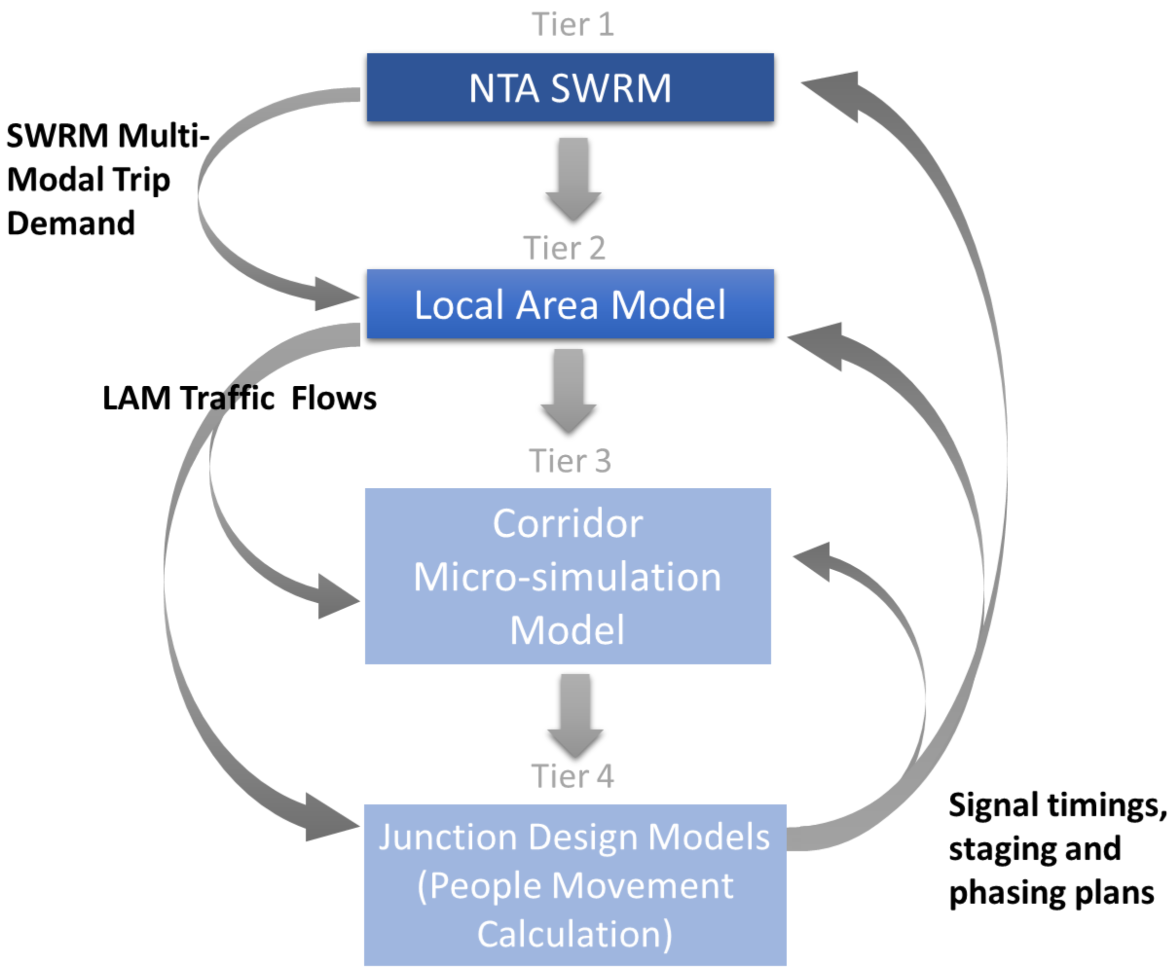


Diagram 2.1 Proposed STC Modelling Hierarchy

The purpose of each of the modelling tools is summarised in Table 2.1 and discussed further in subsequent sections.

Table 2.1 Modelling tool and purpose

Tool	Purpose	Inputs
NTA SWRM	Forecast Multi-Modal demand impacts proposed STC including both area wide and corridor level Mode share Policy assessment (e.g., demand management) Donor Network for LAM	NTA Forecast Planning Data (2023,2030,2045) Proposed STC designs Proposed STC Traffic signal plans and timings
Local Area Model (LAM)	General Traffic Redistribution impacts Link Flows (AADTs) Link Speeds Junction turning flows Construction Strategy and Traffic Management measure testing Donor network for proposed STC Micro-sim model	Traffic surveys Journey time data SWRM forecast matrices Proposed STC designs Proposed STC Traffic signal plans and timings
Micro-simulation Model	Operational features Design validation Person delay measurement Bus journey times	LAM demand matrices Proposed STC designs Proposed STC Traffic signal plans and timings

Tool	Purpose	Inputs
	Queue formation Scheme visualisation	
Junction Design Models / People Movement Calculation	Junction design tool Proposed STC signal plan and timing development. People Movement Calculation	Junction Turning flows from LAM

The following sections describe in further detail each of the modelling tools and their role within the assessment of the proposed STCs.

2.2.2 NTA Regional Modelling System (RMS) and South West Regional Model (SWRM)

The SWRM is part of the National Transport Authority's (NTA) Regional Modelling System (RMS) for Ireland that allows for the appraisal of a wide range of potential future transport and land use alternatives. The RMS comprises the National Demand Forecasting Model (NDFM); five large-scale, detailed, multi-modal regional transport models; and a suite of Appraisal Modules. The five regional models comprising the RMS are focussed on the travel to-work areas for Dublin (represented by the East Regional Model (ERM)), for Cork (represented by the aforementioned SWRM), for Limerick (represented by the Mid-West Regional Model (MWRM)), for Galway (represented by the West Regional Model (WRM)) and for Waterford (represented by the South East Regional Model (SERM)).

The key attributes of the five regional models include full geographic coverage of each region, detailed representations of all major surface transport modes including active modes, road and public transport networks and services, and of travel demand for five time periods (AM, two Inter-Peaks, PM and Off-Peak). The RMS encompasses behavioural models calibrated to 2017 National Household Travel Survey[2] data that predict changes in trip destination and mode choice in response to changing traffic conditions, transport provision and/or policies which influence the cost of travel.

2.2.2.1 Purpose of the RMS

The NTA uses the RMS to help inform decisions required during strategy development and to assess schemes and policy interventions that are undertaken as part of its remit. The RMS has been developed to provide the NTA with the means to undertake comparative appraisals of a wide range of potential future transport and land use options, and to provide evidence to assist in the decision-making process. Examples of how the RMS can assist the NTA include testing new public transport schemes by representing the scheme in the assignment networks, testing demand management measures by, for example, changing the cost of parking or number of parking spaces within the regional model or testing the impacts of new land use by changing the planning data assumptions within the NDFM.

The RMS includes the 2016 Census/POWSCAR and 2017 National Household Travel Survey (NHTS) data sets and the NTA has included a range of improvements to the main model components from previous versions developed to represent a 2012 base year. These improvements include improving and making changes to such elements as the NDFM, development of the Long-Distance Model, updated zoning, networks, and parking modules; best-practice discrete choice modelling using the NHTS and POWSCAR datasets to estimate the parameters of the behavioural models, improved model runtimes, and general model functionality improvements.

2.2.2.2 RMS Components

The NTA RMS is comprised of the following three main components, namely:

- The National Demand Forecasting Model (NDFM);

[2] https://www.nationaltransport.ie/wp-content/uploads/2019/01/National_Household_Travel_Survey_2017_Report_-_December_2018.pdf

- Five Regional Models (including the SWRM); and
- A suite of Appraisal Modules.

The NDFM takes input attributes such as land-use data, population etc., and estimates the total quantity of daily travel demand produced by, and attracted to, each of the 18,641 Census Small Areas in Ireland.

The SWRM is a strategic multi-modal transport model representing travel by all the primary surface modes – including, walking and cycling (active modes), and travel by car, bus, rail, tram, light goods and heavy goods vehicles, and broadly covers the south west area and the counties of Cork and Kerry.

The SWRM is comprised of the following key elements:

- **Trip End Integration:** The Trip End Integration module converts the 24-hour trip ends output by the NDFM into the appropriate zone system and time period disaggregation for use in the Full Demand Model (FDM);
- **The Full Demand Model (FDM):** The FDM processes travel demand, carries out mode and destination choice, and outputs origin-destination travel matrices to the assignment models. The FDM and assignment models run iteratively until an equilibrium between travel demand and the cost of travel is achieved; and
- **Assignment Models:** The Road, Public Transport, and Active Modes assignment models receive the trip matrices produced by the FDM and assign them in their respective transport networks to determine route choice and the generalised cost for each origin and destination pair.

Destination and mode choice parameters within the SWRM have been calibrated using two main sources: Census 2016 Place of Work, School or College - Census of Anonymised Records (2016 POWSCAR), and the Irish National Household Travel Survey (2017 NHTS).

2.2.2.3 The use of the SWRM for the proposed STCs

The SWRM covers the counties of Cork and Kerry, with a detailed representation of Cork City as illustrated in Diagram 2-1. The NTA's SWRM is the most sophisticated modelling tool available for assessing complex multi modal movements within an urban context. This provides a consistent framework for transport assessments. The SWRM is the ideal tool to use as a basis for the assessment of the proposed STCs and to estimate its multi-modal impact. In addition, it provides the platform to forecast future trip demand and distribution.

The NTA SWRM is, therefore, the primary high-level modelling tool for the strategic transport assessment of the proposed STCs, providing the sole source of multi-modal forecast trip / person demand for each of the scenarios to be assessed. The SWRM provides the strategic impacts and benefits of the proposed STCs and the outputs from the SWRM will provide key inputs to the TIA's and EIAR.

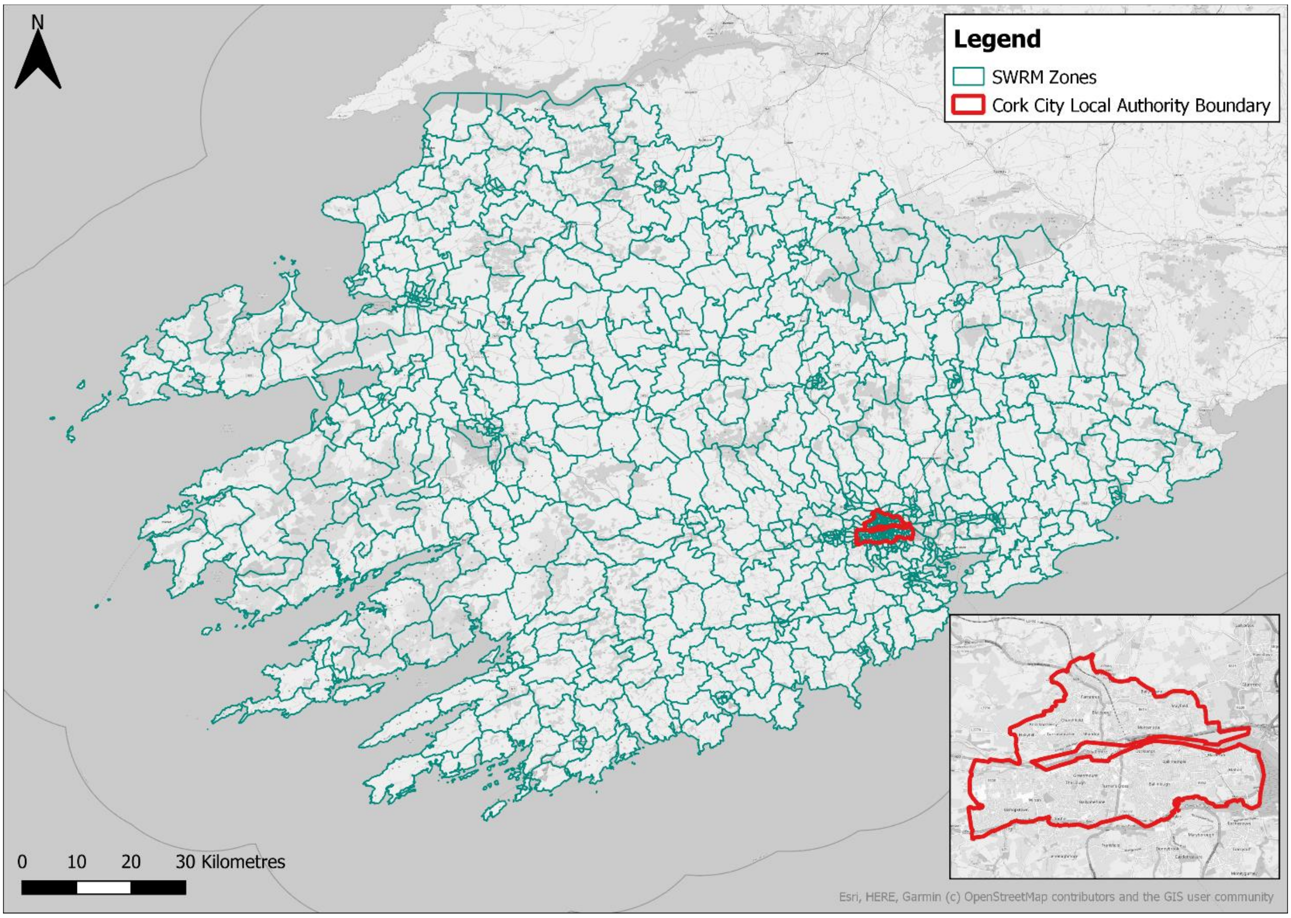


Diagram 2-1 SWRM Coverage

2.2.3 Local Area Model (LAM)

To support the detailed assessment of the proposed STCs a more disaggregate urban area traffic model will be developed, as a cordoned model from the SWRM, that can incorporate the most up to date 2023 traffic survey data. Diagram 2-2 shows the preliminary LAM model extent. The LAM will provide the appropriate level of detail required to inform the various disciplines and levels of decision making for the proposed STCs e.g., capturing the impact of redistribution of traffic on streets and roads not included within the strategic detail of the SWRM. As such, a LAM will be developed to support the assessment of the proposed STCs.

The LAM will be compatible with the SWRM road network, being a direct extraction from the SWRM road model, but with the addition of extra road network and zoning detail. The LAM will be calibrated and validated with the most recent 2023 traffic survey data and journey time information, which ensures that the model reflects ‘on-the-ground’ conditions for the proposed STC in February/March 2023 (e.g., following COVID-19 restrictions).

The LAM which is a more refined version of the road network model component of the SWRM will be used to provide all road-based outputs to inform the TIA, EIA and junction design models. i.e., AADTs, road network speed data, traffic re-distribution impacts during construction and operation of the proposed STCs. The LAM will also provide traffic flow information for the corridor micro-simulation models and junction design models.

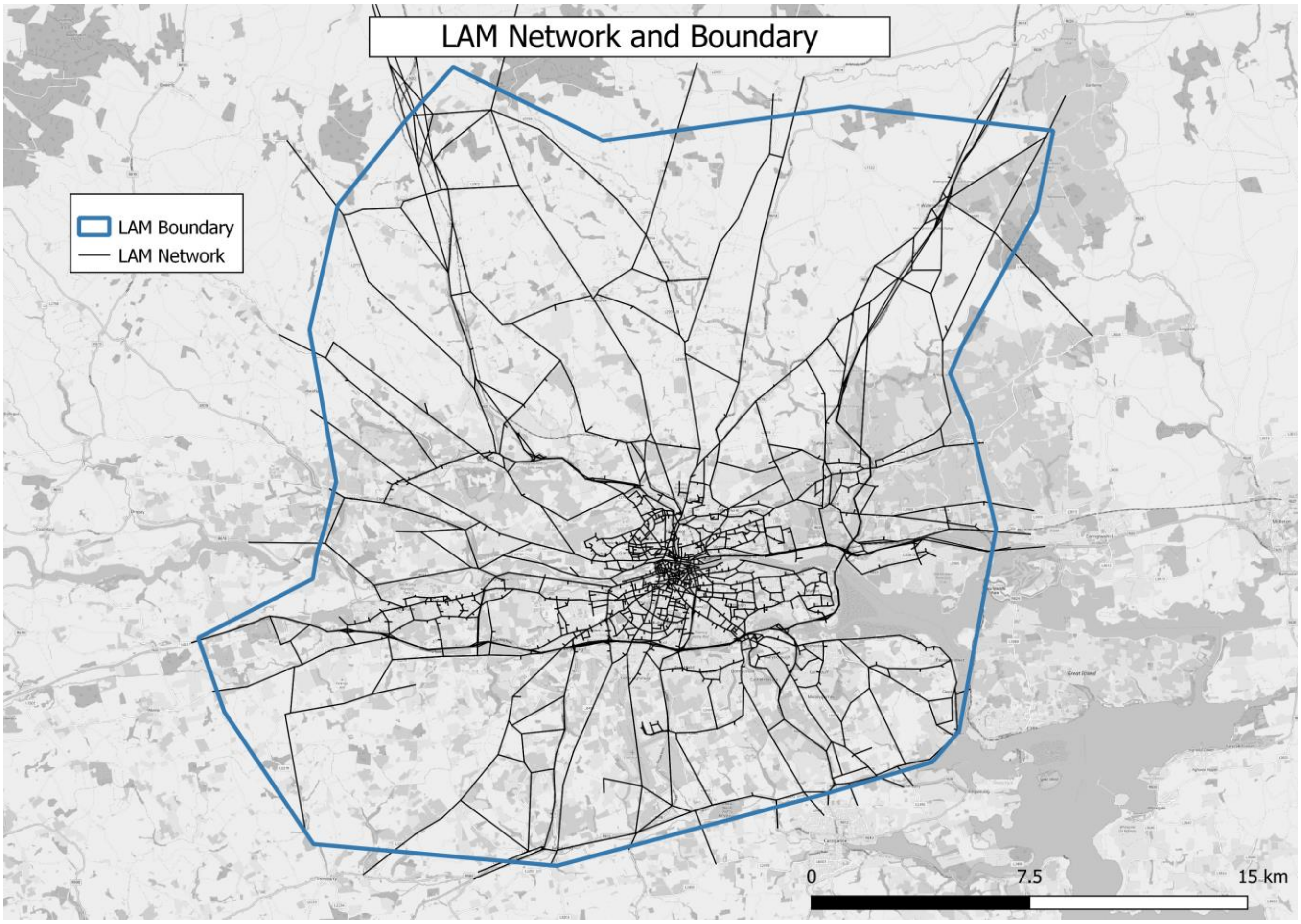


Diagram 2-2 Proposed STC Local Area Model Network

2.2.4 Proposed STC Micro-Simulation Models

A set of three micro-simulation models will be developed for the full continuous 'end-to-end' routes of the proposed STCs and offline network. These will group proposed STCs and represent the following sectors:

- Northern sector (STCs A, B, C, and D);
- South west sector (STCs E, F, and G); and
- South east sector (STCs H, I, J, and K).

The network extent of each sector model is shown in Diagram 2-3 to Diagram 2-4 below. The Micro-simulation models will be developed to assist in the operational validation of the scheme designs and to provide visualisation of scheme operability along with its impacts and benefits.

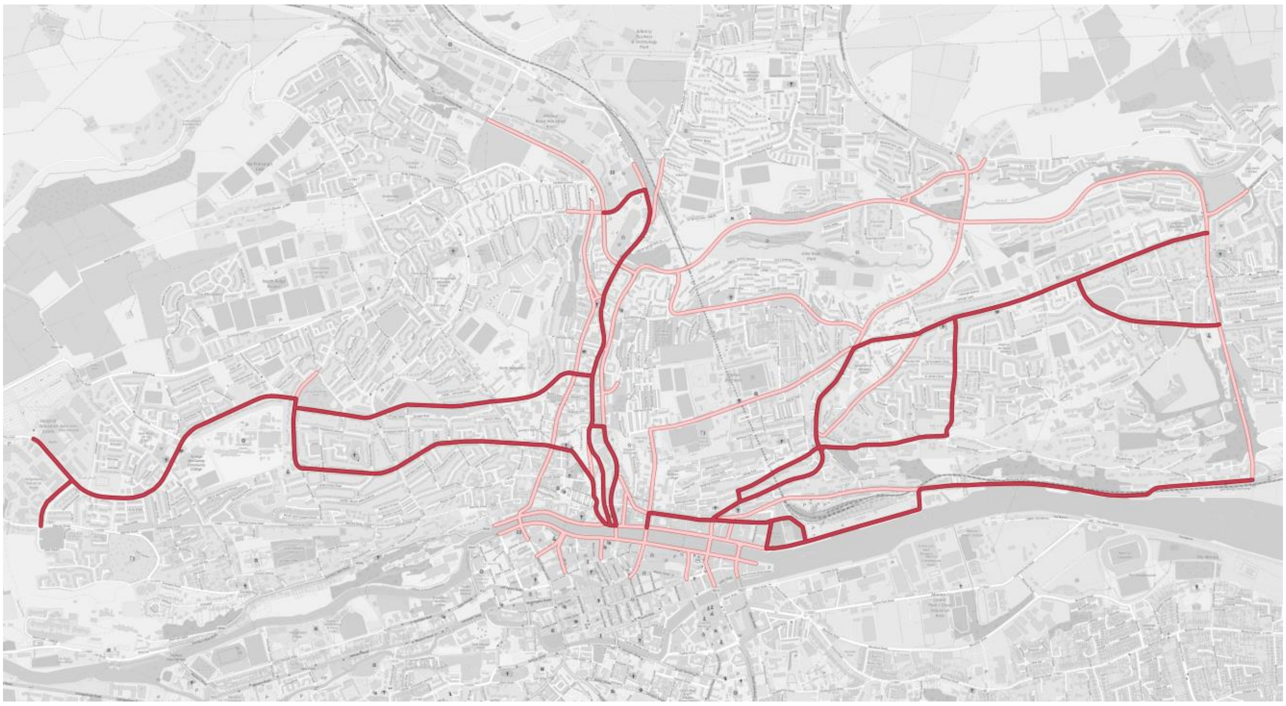


Diagram 2-3 Proposed STC Microsimulation Model Network – Northern STCs

Diagram 2-4 Proposed STC Microsimulation Model Network – South west STCs

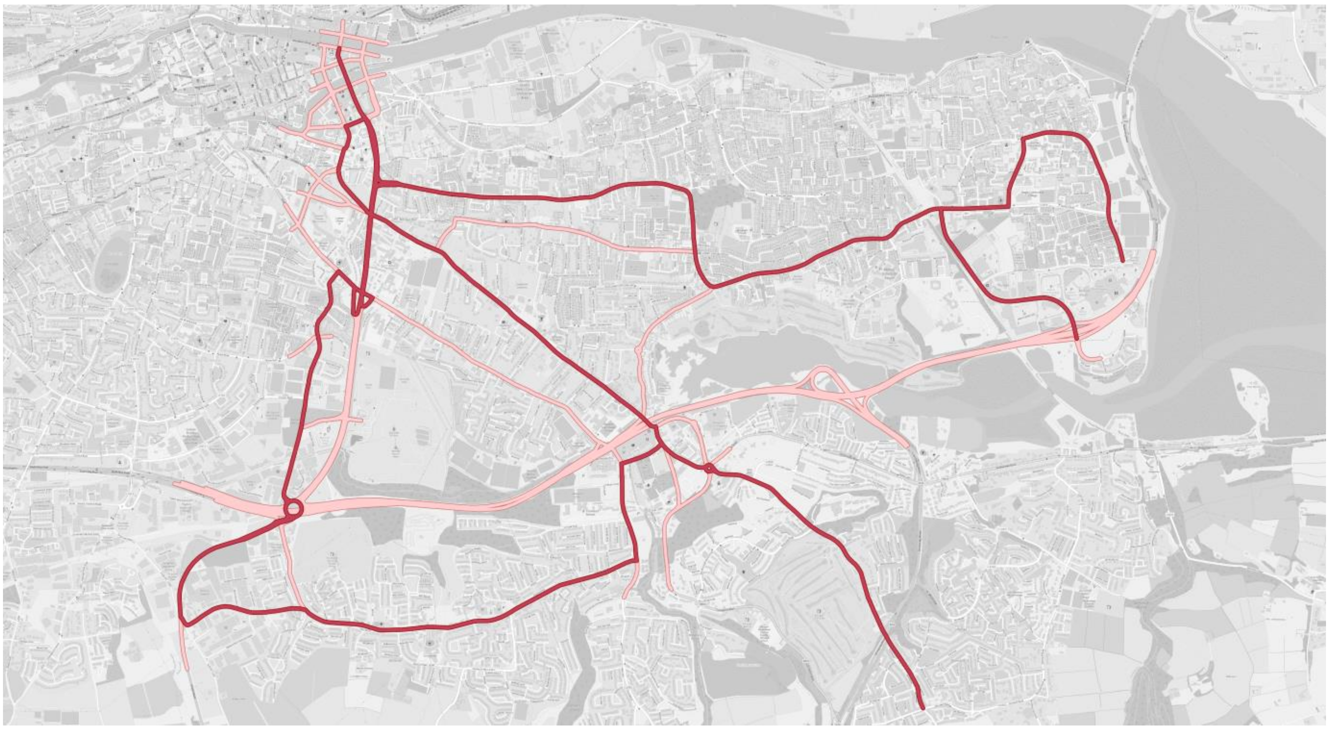


Diagram 2-5 Proposed STC Microsimulation Model Network – South east STCs

2.2.5 Role of the Corridor Micro-Simulation Models

The micro-simulation models will provide key information on end-to-end bus and car journey times along the proposed STCs as well as impacts of traffic routing and delays on offline strategic routes adjacent to the proposed STCs. Traffic flow information for the micro-simulation models will be provided from the LAM and will use consistent information from the junction design models, in terms of signal plans, green times, staging, phasing and offsets. 3D visualisations of sections of the proposed STCs will be developed based on the 2D models to help visualise and demonstrate the benefits and impacts of the scheme to stakeholders.

Overall, the micro-simulation models will provide key transport metric inputs to the TIA in terms of operational features, vehicle interaction, person level delay and bus journey time and reliability performance.

2.2.6 Proposed STC Junction Design Models

The fourth tier of modelling in the modelling hierarchy to support the assessment of the proposed STC will be the individual junction design models that will be developed for junctions along the proposed STC. These junction design models will be supplied with traffic flow information from the LAM and from the relevant micro-simulation model for each proposed STC. The LAM, Micro-simulation and local junction models will contain consistent design, transport demand, signal phasing and staging information.

2.2.7 Role of the Proposed STC Junction Design Models

The junction design models will be used to inform junction design considerations as part of the formulation of the Preliminary Design for the proposed STCs. The junction models will be developed for standalone junction assessments and for combinations of secondary (off-line to proposed STC) junctions. The junction models will be used in combination with the proposed STC micro-simulation models at each junction along the corridors for operational testing and 'proof of concept' development of the preferred design.

The junction design models will be important supporting design tools for analysis of the design proposals and will inform the development of signal plans and phasing at junctions along the proposed STCs. The junction models will be used to inform the LAM and proposed STC micro-simulation models, with information such as design amendments, signal plans and timings being fed back in the iterative process where appropriate.

As part an iterative process, the resultant scheme designs will be re-modelled in the SWRM, LAM and micro-simulation models to understand the strategic and corridor specific issues and inform the preparation of the TIAs and EIAs and the planning submission for the proposed STCs.

2.2.8 Iterative Design Process

One of the reasons for developing a multi-tiered modelling framework (described further below), is to ensure the environmental and transport impacts are mitigated to the greatest extent possible during design development and to enable information on potential impacts to be provided from the various EIA and TIA disciplines back into the design process for consideration and inclusion in the proposals. This process will result in embedding mitigation into the design process by the consideration of potential environmental impacts throughout the Preliminary Design development process.

Diagram 2-6 below illustrates this process whereby the emerging design for the proposed STCs will be tested using the transport models described above as part of an iterative process. The transport models will provide an understanding of the benefits and impacts of the proposals (mode share changes, traffic redistribution, bus performance etc.) with traffic flow information also informing other environmental disciplines (Air Quality, Noise and Vibration, Climate etc.) which in turn will allow feedback of potential impacts into the design process and allow for changes and in turn mitigation to be embedded in the designs. The process may include physical changes, adjustments to traffic signal staging, phasing and green times to limit traffic displacement as well as traffic management arrangements and/or turn bans where appropriate. This will ensure that any displaced traffic will be maintained on higher capacity roads, whilst continuing to meet scheme objectives along the proposed STCs.

The iterative process will conclude when the design team are satisfied that the proposed STC meets its required objectives (maximising the people movement capacity of the proposed STC) and that the environmental impacts and level of residual impacts are reduced to a minimum.

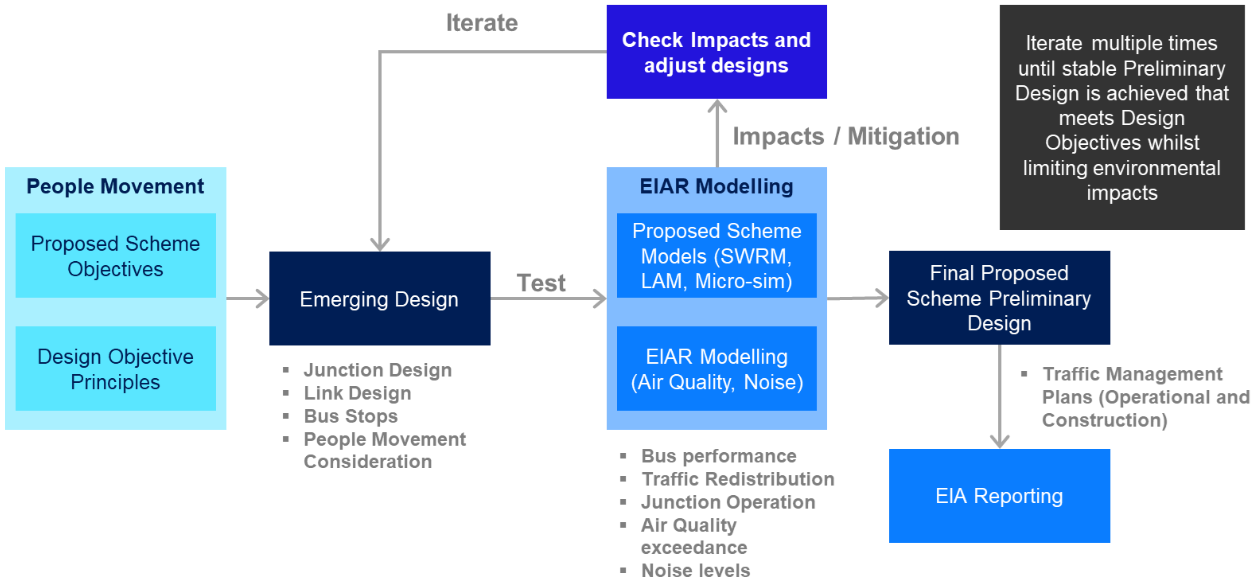


Diagram 2-6 Iterative Design Process

3. SWRM Calibration and Validation

The calibration and validation of the SWRM has been reviewed with respect to the base model, and this is presented in Section 3.1. A present year validation exercise was undertaken to review the validity of the model when forecast to 2019 from the 2016 base year. The results of the 2019 validation exercise are presented in section 3.2.

3.1 Base Model Calibration and Validation

The SWRM base model was calibrated using guidance from the United Kingdom Department for Transport's Transport Analysis Guidance (UK TAG). UK TAG guidance sets out acceptability criteria for various elements of the model development process. For the purposes of this study, the model assignment calibration has been reviewed with respect to:

- Road model individual link flow calibration;
- Road model screenline flow calibration; and
- Public transport flow calibration.

Model calibration is the adjustment of constants and other model parameters in estimated or asserted models in an effort to make the models replicate observed data for a base year or otherwise produce more reasonable results.

Model validation is the application of the calibrated models and comparison of the results against observed data which is ideally independent to that data used in calibration.

A detailed summary of the model calibration and validation is available in the South West Regional Model Development Report[3].

3.1.1 Base Road Model Calibration

The calibration criteria and acceptability guidelines for the road assignment model are specified in UK TAG Unit M3.1. The high-level calibration statistics for the road assignment model are summarised in Table 3.1.

Table 3.1 Road Model Calibration Performance Summary

MEASURE	AM	LT	SR	PM	OP
% Links within UK TAG Flow Criteria (Calibration)	84%	91%	91%	84%	94%
% Links GEH[4] < 5	80%	87%	87%	82%	85%
Screenlines Passing UK TAG Flow Criteria	57%	64%	57%	60%	n/a

The model performance in relation to link flow indicates that the model performs very well, given the strategic multi-modal nature of the model, and is very close to meeting the UK TAG link flow criteria for all modelled time periods.

Screenline performance shows that while the model does not meet strict UK TAG criteria across all screenlines, aggregating key screenlines into strategic cordons indicates a very good representation of traffic travelling to and from Cork and Cork city centre.

These results indicate the model provides a robust basis for assessing the high-level impacts of the STC proposals.

[3] https://www.nationaltransport.ie/wp-content/uploads/2022/09/SWRM-Model-Development-Report.pdf

[4] The GEH Statistic is a formula used in traffic engineering, traffic forecasting, and traffic modelling to compare two sets of traffic volumes, named after is inventor Geoffrey E. Havers. Further information can be found at https://en.wikipedia.org/wiki/GEH_statistic

3.1.2 Base Public Transport Model Calibration

The calibration of the public transport assignment model uses observed data from a peak hour (such as 0800 to 0900). The public transport service representation is based on an average hour (average hour between 0700 and 1000) so that all public transport services available within that time period can be used.

The calibration criteria and acceptability guidelines for the public transport assignment model are specified in UK TAG Unit M3.2. The high-level calibration statistics for the public transport assignment model are summarised in Table 3.2.

Table 3.2 PT Model Calibration Performance Summary

MEASURE	AM	LT	SR	PM	OP
Bus Link Flows GEH < 5	64%	-	-	67%	-
Bus Screenlines GEH < 5	50%	-	-	100%	-
Rail Screenlines GEH < 5	75%	75%	100%	100%	75%
Bus Journey Times Within 10%	99%	98%	99%	100%	100%

The modelled bus flows are a good match to the observed data, with the majority of individual links having a GEH of less than 5. When grouped into screenlines, 50% of the AM screenlines and all of the PM screenlines meet the criteria set out in UK TAG.

Modelled rail flows are an excellent match to the observed data with all screenlines in the SR and PM periods meeting the criteria set out in UK TAG. Only a single screenline in the AM, LT and OP periods fail to meet the criteria set out in UK TAG.

While the public transport model flows do not fully meet the criteria set out in UK TAG for bus screenline flow this may be due to the discrepancy between modelled average hour and observed peak hour as noted above.

Bus journey times calibrate extremely well against the observed AVL data, with all peaks having 98% of routes or greater within 10% of observed journey times.

3.1.3 Base Assignment Model Validation

The base year SWRM was validated using guidance from the United Kingdom Department for Transport's Transport Analysis Guidance (UK TAG). UK TAG guidance sets out acceptability criteria for various elements of the model development process. For the purposes of this study, the model assignment validation has been reviewed with respect to:

- Road model individual link flow validation;
- Road model screenline flow validation; and
- Road model journey time validation.

3.1.4 Base Road Model Validation

The validation criteria and acceptability guidelines for the road assignment model are specified in UK TAG Unit M3.1. The high-level validation statistics for the road assignment model are summarised in Table 3.3.

Table 3.3 Road Model Validation Performance Summary

MEASURE	AM	LT	SR	PM	OP
% Links within UK TAG Flow Criteria (Validation)	86%	93%	92%	84%	n/a
Journey Times Passing UK TAG Validation	77%	87%	77%	67%	90%

The model meets the recommended criteria for link flow validation all peaks, with the exception of the PM Peak which is just 1% below the recommended criteria set out in UK TAG. The model exceeds the recommended criteria for journey time validation in the LT and OP peaks, and is very close to passing in all other time periods.

Further investigation of the routes that fail to meet the recommended criteria indicates that model journey times are generally too fast in the buffer network outside of Cork in all time periods in both directions, however within the city centre there is a good match between the modelled and observed journey times.

3.2 2019 Assignment Model Validation

A further modelling validation exercise was carried out to demonstrate that the SWRM was suitably calibrated and validated and capable of forecasting transport patterns in Cork City. This exercise created a 2019 "forecast" SWRM scenario using up-to-date network and service inputs, and compared the model outputs against observed data from 2018 – 2019.

The SWRM was run in forecast mode using 2019 networks and 2019 demand, generated by the NDFM using reference case 2019 planning sheets. The resulting 2019 forecast model was then used to carry out the following assessments:

- Analysis of modelled and observed traffic flows throughout the Cork City network;
- A journey time analysis for road traffic;
- Analysis of Public Transport Boarding and Alighting data / total PT Demand; and
- Analysis of Public Transport Journey Times.

3.2.1 2019 Traffic Flows

In order to assess how well the SWRM forecasts traffic flows in the area of interest of the study, the 2019 SWRM peak hour traffic flows were compared to the results of traffic counts carried out at 85 sites throughout the city between September 2018 and October 2019. The count locations, and AM peak hour GEH results, are illustrated in Diagram 3-1. Table 3.4 presents detailed statistics for all time periods.

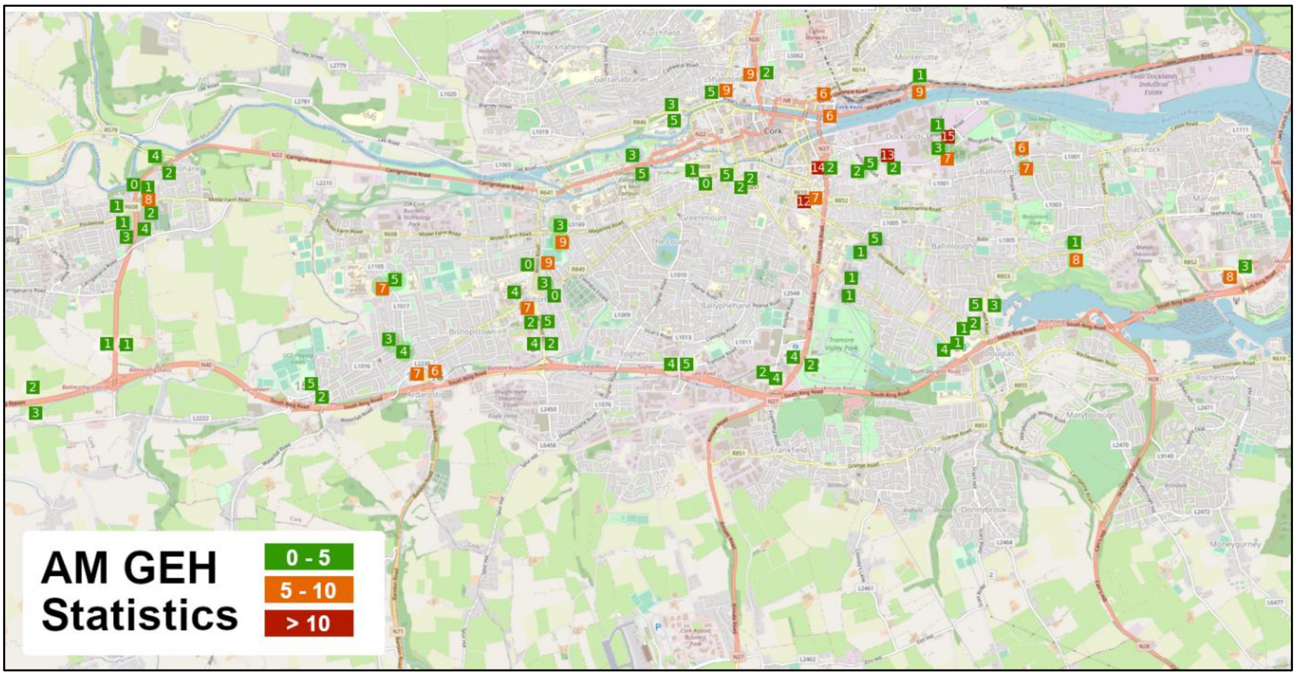


Diagram 3-1 Junction Count Locations and AM GEH Statistics

Table 3.4 SWRM 2019 Flow Validation

MEASURE	AM	LT	SR	PM
% Flows within UK TAG Flow Criteria (Validation)	72%	78%	81%	64%
% Flows GEH < 5	75%	75%	82%	71%
Turning proportion within 10% of observed	67%	80%	79%	66%

The analysis above indicates that modelled traffic flows compare extremely well to observed traffic levels with 71% to 82% of all turning flows assessed having a GEH of less than 5, and therefore indicating a good match between observed and modelled traffic flows.

It is highlighted that these UK TAG criteria are only strictly applicable during development of the base year model, and it would be expected that model forecasts would not perform as favourably due to increased uncertainty around additional assumptions. However, the results still present a useful comparison and the high number of flows which pass the criteria indicates the model is performing well, especially considering the wide number of interactions present in a strategic multi-modal model of this kind.

3.2.2 2019 Journey Times

In addition to the examination of traffic flows, journey time validation was conducted using data from each direction of 15 routes in the SWRM area (shown in Diagram 3-2). Table 3.5 gives the final journey time validation statistics both in terms of AM and PM journey times when comparing forecast 2019 data to observed Journey Time data from the 2019 TomTom database.

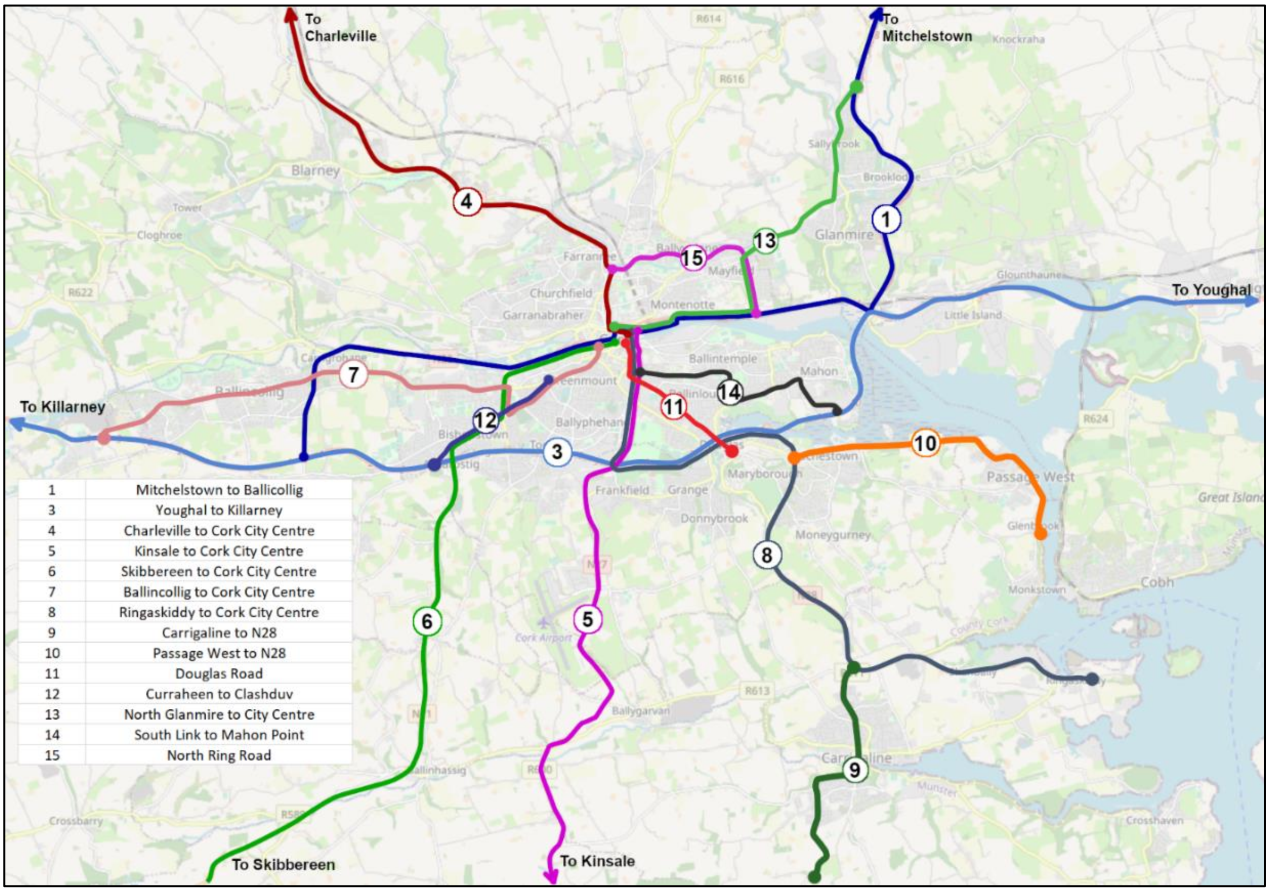


Diagram 3-2 Journey Time Routes

On average, the journey time analysis found that modelled journey time were faster than observed data. TAG guidance suggests that modelled journey times should be within 15% of observed data, and in total 23 (77%) of the 30 routes analysed meet this criterion in the AM peak hour and 21 (70%) of the routes meet this criterion in the PM peak hour. On average, across all routes and time periods, modelled journey times were 8.95% faster than observed journey times, indicating a reasonably good match between modelled and observed data.

Table 3.5 SWRM 2019 Road Journey Time Analysis (in minutes)

ROUTE	PERIOD	OBSERVED JOURNEY TIME	MODELLED JOURNEY TIME	DIFF	% DIFF
Mitchelstown to Ballincollig	AM	80	65	-15	-18.9%
Ballincollig to Mitchelstown	AM	63	61	-3	-4.1%
Cappaquin to Killarney	AM	110	94	-16	-14.4%
Killarney to Cappaquin	AM	110	97	-12	-11.2%
Youghal to Killarney	AM	114	113	-1	-1.0%
Killarney to Youghal	AM	117	103	-14	-11.6%
Charleville to Cork City	AM	61	56	-5	-8.8%
Cork City to Charleville	AM	53	56	3	5.2%
Kinsale to Cork City	AM	39	37	-3	-6.5%
Cork City to Kinsale	AM	32	33	1	2.5%
Skibbereen to Cork City	AM	107	96	-12	-10.7%
Cork City to Skibereen	AM	111	104	-7	-6.4%
Ballincollig to Cork City	AM	52	60	8	15.1%
Cork City to Ballincollig	AM	44	46	3	6.1%
Ringaskiddy to Cork City	AM	29	27	-2	-5.9%
Cork City to Ringaskiddy	AM	22	26	4	15.8%
Carrigaline to N28	AM	11	10	-1	-11.1%
N28 to Carrigaline	AM	11	9	-1	-12.8%
N28 to Passage West	AM	11	11	0	-0.2%
Passage West to N28	AM	17	19	3	16.1%
Douglas Road Inbound	AM	13	10	-3	-24.9%
Douglas Road Outbound	AM	11	7	-3	-32.2%
Curraheen to Clashduv	AM	11	11	0	0.1%
Clashduv to Curraheen	AM	9	10	0	4.7%
Nth Glanmire to Cork City	AM	21	20	0	-2.0%
Cork City to North Glanmire	AM	29	27	-2	-5.5%
Sth Link to Mahon Point	AM	15	16	1	4.3%
Mahon Point to South Link	AM	15	12	-2	-15.8%
N20 to N8	AM	12	15	3	25.2%
N8 to N20	AM	11	10	0	-3.3%
Mitchelstown to Ballincollig	PM	67	59	-8	-11.4%
Ballincollig to Mitchelstown	PM	66	65	-1	-0.9%
Cappaquin to Killarney	PM	116	98	-18	-15.7%
Killarney to Cappaquin	PM	113	95	-18	-16.2%
Youghal to Killarney	PM	118	107	-10	-8.7%
Killarney to Youghal	PM	122	110	-12	-9.8%
Charleville to Cork City	PM	60	55	-5	-8.5%
Cork City to Charleville	PM	61	56	-5	-8.3%
Kinsale to Cork City	PM	40	32	-7	-18.7%
Cork City to Kinsale	PM	34	35	1	3.7%
Skibbereen to Cork City	PM	116	100	-16	-13.8%
Cork City to Skibereen	PM	114	98	-16	-14.1%
Ballincollig to Cork City	PM	49	43	-6	-11.4%

ROUTE	PERIOD	OBSERVED JOURNEY TIME	MODELLED JOURNEY TIME	DIFF	% DIFF
Cork City to Ballincollig	PM	44	39	-5	-11.6%
Ringaskiddy to Cork City	PM	27	29	1	4.5%
Cork City to Ringaskiddy	PM	22	22	0	-2.1%
Carrigaline to N28	PM	9	10	1	9.4%
N28 to Carrigaline	PM	13	11	-2	-17.4%
N28 to Passage West	PM	10	12	1	13.1%
Passage West to N28	PM	10	11	0	4.3%
Douglas Road Inbound	PM	11	9	-2	-19.1%
Douglas Road Outbound	PM	13	9	-4	-32.2%
Curraheen to Clashduv	PM	9	8	-1	-10.3%
Clashduv to Curraheen	PM	10	10	0	-0.5%
Nth Glanmire to Cork City	PM	22	23	1	4.3%
Cork City to North Glanmire	PM	21	22	1	3.9%
Sth Link to Mahon Point	PM	21	16	-5	-23.4%
Mahon Point to South Link	PM	16	13	-3	-20.1%
N20 to N8	PM	10	10	0	1.8%
N8 to N20	PM	10	12	2	17.9%

3.2.3 2019 Public Transport Demand

The 2019 modelled public transport passenger flows were compared to the results of the 2017 NTA bus passenger survey and 2016 Rail Census (latest PT data available). For rail, total passengers boarding and alighting at Kent Station were compared to observed data. For bus, modelled data was compared to observed flows crossing an inner and outer screenline.

The results are summarised in Table 3.6. These tables show a reasonable validation of the modelled flows at the screenline level (with all modelled demand flows within +/- 25% observed flows). Viewed overall, the results indicate that the SWRM tends to slightly underestimate the PT demand. However, inbound demand, which tends to be the focus in the AM peak, shows an excellent match at the screenline level (within 0.5% of observed), as do outbound rail flows; outbound bus demand, on the other hand, is underestimated by 25%.

Table 3.6 SWRM 2019 Passenger Flow Validation

MODE	DIRECTION	TIME PERIOD	OBSERVED DEMAND	MODELLED DEMAND	DIFF	%DIFF	M/O
Bus	IN	AM	8,933	8,980	47	0.53%	1.01
Bus	OUT	AM	11,318	8,514	-2,804	-24.77%	0.75
Bus	IN	LT	8,028	6,604	-1,424	-17.74%	0.82
Bus	OUT	LT	10,254	7,456	-2,798	-27.29%	0.73
Bus	IN	PM	8,409	6,809	-1,600	-19.03%	0.81
Bus	OUT	PM	12,867	10,018	-2,849	-22.14%	0.78
Rail	IN	AM	1,428	1,417	-11	-0.77%	0.99
Rail	OUT	AM	594	649	55	9.26%	1.09
Rail	IN	LT	520	498	-22	-4.23%	0.96
Rail	OUT	LT	460	471	11	2.39%	1.02
Rail	IN	PM	850	821	-29	-3.41%	0.97
Rail	OUT	PM	1,412	1,418	6	0.42%	1.00

*Diff = Modelled-Observed, % Diff = (Modelled - Observed)/Observed, m/o = Modelled/Observed

3.2.4 2019 Public Transport Journey Times

End-to-end modelled bus journey times were compared against observed bus journey times, recorded via the Automatic Vehicle Location (AVL) system. Table 3.7 summarises the comparison between modelled and observed values. Between 74% and 79% (depending on the time period) of the bus routes are modelled within +/-25% of the observed values indicating a good fit between observed and modelled journey times. Routes not meeting that criterion are mostly faster than the observed data, which is consistent with the road journey time validation.

Table 3.7 SWRM 2019 Bus Journey Time Validation

TIME PERIOD	AM		LT		SR		PM	
	COUNT	%	COUNT	%	COUNT	%	COUNT	%
Model faster (>50%)	1	2%	3	7%	2	4%	1	2%
Model faster (25-50%)	13	22%	6	14%	7	15%	8	15%
Model within +/-25%	43	74%	34	79%	37	77%	41	77%
Model slower (25-50%)	0	0%	0	0%	0	0%	0	0%
Model slower (>50%)	1	2%	0	0%	2	4%	3	6%
Total	58	100%	43	100%	48	100%	53	100%

3.3 Summary and Conclusions

This section presents the summary of the base year model calibration and validation, and the summary of an extensive forecast year validation exercise, comparing the output of a 2019 forecast year SWRM run with observed survey data across both highway and public transport, and assessing the model performance both in terms of counts/flows and travel time. The results of this analysis are summarised below.

3.3.1 Traffic Flows

The base model traffic flow calibration and validation presented in Sections 3.1.1, 3.1.3, and 3.2.1 demonstrate that the model calibrates and validates to a high standard and provides a robust basis for assessing the high level impacts of the STC proposals.

The comparison of the modelled and observed traffic flows for the 2019 validation exercise, presented in Table 3.4, indicates an excellent match between observed and modelled traffic flows across 80 sites. This indicates that the SWRM forecasts traffic demand favourably within Cork City.

3.3.2 Road Journey Times

The base model road journey time validation, as set out in Section 3.1.3, is a good match between modelled and observed within the study area of Cork City. This is further evidence that the SWRM provides a robust basis for the assessment of the BusConnects proposals.

The comparison across 15 two-way routes for the AM and PM peak hours undertaken as part of the 2019 validation exercise indicates that the model performs well, with 77% of the routes meeting the criteria set out in UK TAG for both the AM and PM peak hours. This demonstrates that the model can forecast traffic flows and subsequently their journey times in a forecast scenario to a robust level.

3.3.3 Public Transport Demand

The base model bus flows are a good match to the observed data, with the majority of individual links having a GEH of less than 5, and when grouped into screenlines 50% of the AM screenlines and all of the PM screenlines meet the criteria set out in UK TAG.

Analysis of bus demand from the 2019 SWRM shows that the model performs well with an average difference of 18% between modelled and observed demand across all directions and time periods.

The rail demand is well matched to the observed data in all time periods and directions in both the base model and the 2019 model. The base model matches the observed screenline flows well, with only a single screenline in the AM, LT and OP periods failing to meet the criteria set out in UK TAG.

Analysis of public transport demand from the 2019 SWRM model showed that overall rail demand was well matched to observed data in all directions (inbound and outbound) and all time periods with an average difference of 0.61% between observed and modelled demand.

3.3.4 Public Transport Journey Times

The base model bus journey times calibrate very well against the observed journey time data with all peaks having 98% of routes or greater within 10% of observed journey times.

Analysis of modelled bus journey times in the 2019 validation exercise shows that between 74% and 79% (depending on the time period) of the bus routes are modelled within +/-25% of the observed values indicating a good fit between observed and modelled journey times.

3.3.5 Conclusion

The calibration and validation of the base SWRM, and the validation exercise undertaken on the forecast 2019 SWRM demonstrate that the SWRM provides a robust basis for the assessment of the BCC STC proposals in terms of traffic flow impact.

4. Forecast Model Development

4.1 Introduction

The following section describes the process to develop the future year forecast models for the assessment of the proposed STCs. The section presents detail on the forecast years for the opening and design years as well as the assumptions on background schemes that are anticipated to be in place in these forecast years. The section also presents the assumptions on the future year growth which uses forecast year runs of the SWRM.

4.2 Forecast Travel Demand

Transport demand is a key input to the modelling process, which is directly related to the land-use data fed into the NDFM at the outset of the modelling process. Population, employment, and education attractions must be prepared and defined at the Census Small Area (CSA) level to be input to the RMS.

The NTA has defined a 2040 National Planning Framework (NPF) planning sheet, based on 2016 Census data, regional growth projections and their knowledge of Local Authority development plans. Population, employment and education attraction growth are located in areas that are likely to be developed between now and 2040.

The NTA has provided the necessary planning sheets for the forecast assessment year (2030), which has been derived by linear interpolation between the 2016 Census data and the NTA's 2040 NPF reference case planning sheet. It has been assumed that there is no change in land use distribution between the Do Minimum and Do Something scenarios.

4.3 Do Minimum Assumptions

The assessment year for the scheme is 2030. The preliminary STC traffic modelling assessments have been carried out in relation to the following scenarios:

- Future **'Do Minimum'** ('likely receiving environment') Scenario – The future year model has been developed to represent the opening design years, without the proposed STCs in place.
    - Typically, a 'Do Minimum' model includes any known permanent improvements or changes to the road or public transport network that have taken place, been approved, or are planned for implementation. These models are important to form the reference case by which to compare the proposal ('Do Something') models. In this case, the 'Do Minimum' will include the revised service provision proposed by BusConnects Cork.
- Future **'Do Something'** ('likely receiving environment') Scenario – This scenario includes the proposed STC infrastructure, implementing all elements of the design for the proposed STCs i.e., the 'Do Minimum' conditions with the addition of all proposed STCs.

The Do Minimum scenario was used to compare the impacts of the STC with and without the road infrastructure in place.

4.3.1 Do Minimum Infrastructure

Forecast year infrastructure was informed by the NTA's Reference Case scenario for the year 2030 which includes assumptions relating to the inclusion of transport proposals in the particular forecast year based on in line with the investment proposals contained within the Project Ireland 2040 National Development Plan[5] (NDP) 2021-2030. Through engagement with the NTA, TII and Cork City Council this scenario was refined, and an agreed Do Minimum infrastructure provision was established.

[5] https://assets.gov.ie/200358/a36dd274-736c-4d04-8879-b158e8b95029.pdf

A summary of the major road infrastructure schemes included in the Do Minimum scenario in and around Cork City are set out in Table 4.1, with the complete list of infrastructure and service changes listed in Annex 1.

Table 4.1 Do Minimum Road Infrastructure

Scheme ID	Description
SW22	Dunkettle Interchange
SW23	M28 Cork to Ringaskiddy
SW26	M20 Cork to Limerick Motorway
SW28	Docklands and Tivoli Road Network and Bridges
SW34	N22 Ballyvourney to Macroom
SW36	Skehard Road Realignment and Renewal Project (Cork, City)
SW37	N40 Supplementary Works 2018 (Sarsfield Road) (Cork, City)
SW38	Cork Northern Distributor Road (Eastern section only, between N20 and North Ring Road)
SW42	Eastern Gateway Bridge Western Approach: Monahan's Road Extension Scheme
SW110	Cork North Environs: Ballyhooly Road (NE-U-05)
SW125	Little Island: N25 Junction Upgrade

4.3.2 Do Minimum Public Transport Service Provision

Forecast year public transport service provision was informed by the NTA’s Reference Case scenario for the year 2028, and these assumptions are listed in Annex 1.

The Do Minimum scenario also includes the committed BusConnects Cork network redesign services. The emerging bus services that will serve the STC’s were taken from the BusConnects Cork proposals from the Public Transport Services team within the NTA. These data sources provided the service routes and operating frequency of the bus provision that will be represented in both the Do Minimum and Do Something scenarios.

4.4 Do Something Scenario Assumptions

4.4.1 Do Something Model Development

The Do Something scenario builds on the previously described Do Minimum by including the traffic restrictions and lane re-configuration proposed as part of the proposed STCs. The full extent of these changes is described in Annex 2.

4.5 SWRM Software and Parameters

RMS version 3.1.1 was used to test the Do Minimum and Do Something models. This version of the RMS uses Citilabs Cube 6.5.0 for the main model and public transport assignment model, and SATURN 11.4.07H for the road assignment model.

4.5.1 Modelled Time Periods

The SWRM represents the following five time periods:

- AM Peak (0800 – 0900);
- Lunch Time Peak (1200 – 1300);
- School Peak (1500 – 1600);
- PM Peak (1700 – 1800); and
- Off Peak (2000 – 2100).

4.5.2 Assignment Model Segmentation

Travel demand within the SWRM is segmented into a number of user classes, based on vehicle type, journey purpose and mode of travel. These are presented in for the road model in Table 4.2, and Table 4.3 for the public transport model.

Table 4.2 SWRM Road User Classes

User Class	Journey Purpose	Vehicle Type
Car In-work	Business	Car
Car Commute	Commute	Car
Car Other	Other	Car
Car Education	Other	Car
Car Retired	Other	Car
Taxi	Other	Car
LGV	All	LGV
OGV1	All	Goods Vehicle
OGV2 Permit Holder	All	Goods Vehicle
OGV2 Non-permit Holder	All	Goods Vehicle

Table 4.3 SWRM Public Transport User Classes

User Class	Journey Purpose
In-work	Business
Commute	Commute
Other	Other
Education	Other
Retired	Other

4.5.3 SWRM Road Input Parameters

The SATURN application SATNET was used to build the various data files into an assignable road network (UFN) file.

Matrices were then assigned to the network using the SATALL application, where it iterates through assignment and simulation loops until the user defined levels of convergence are reached (RSTOP and STPGAP), or the model reaches the user defined maximum number of assignment and simulation loops (MASL). SATALL uses a converged equilibrium assignment method to assign the traffic to the road network over successive iterations, until user defined convergence criteria are achieved. The key convergence criteria are presented in Table 4.4 and represent a very tight level of convergence.

Table 4.4 SWRM SATURN Convergence Criteria

VARIABLE	DESCRIPTION	VALUE
MASL	Maximum number of assignment / simulation loops.	150
PCNEAR	Percentage change in flows judged to be "near" in successive assignments	1%
RSTOP	The assignment / simulation loops stop if RSTOP % of link flows change by less than PCNEAR % in successive assignments	98%
NISTOP	Number of successive loops which must satisfy the RSTOP criteria for convergence	4
STPGAP	Critical gap value (%) used to terminate assignment / simulation loops	0.05

5. Proposed STC Preliminary Modelling Output

In line with the modelling methodology set out in Section 2, the Do Minimum and Do Something (with proposed STC) forecast models were used to assess the impacts of the Preferred Route Options (PROs) for the proposed STCs in terms of road network capacity and available route choice by comparing road flow differences between the two models i.e., Traffic Redistribution.

It must be noted that the results presented below are based on initial preliminary transport modelling undertaken in the SWRM and are subject to change with further design development and modelling refinement. The traffic flow redistribution will be continuously monitored throughout the design development and environmental impact assessment process to mitigate any potential impacts that may arise.

Preliminary assumptions have been made regarding traffic signal plans and timings which will be refined and optimised using the Tier 2-4 models that are under development as outlined in Section 2.

5.1 Road Flow Comparison

Assigned "Actual"[6] road model flows were compared for the AM and PM peak periods across the full extent of the proposed BCC STC network.

As described previously, whilst all eleven proposed STCs will be modelled throughout the design development process, at this stage in the project (Preferred Route Options at Public Consultation 3 - November 2023), there is a need to balance the complex interactions between neighbouring STCs and their cumulative impacts. It has been considered most efficient to group proposed STCs when presenting the modelling results in order to present a balanced view of their impacts in combination. As such, the following combinations have been modelled and presented separately in the appendices. An overview of the extent of each map is provided in Appendix C:

- Northern Sector proposed STCs (A, B, C, and D) – Appendix D;
- South West Sector proposed STCs (E, F, and G) – Appendix E.; and
- South East Sector proposed STCs (H, I, J, and K) – Appendix F.

The proposed STCs and their sector definition is illustrated in Diagram 5-1.

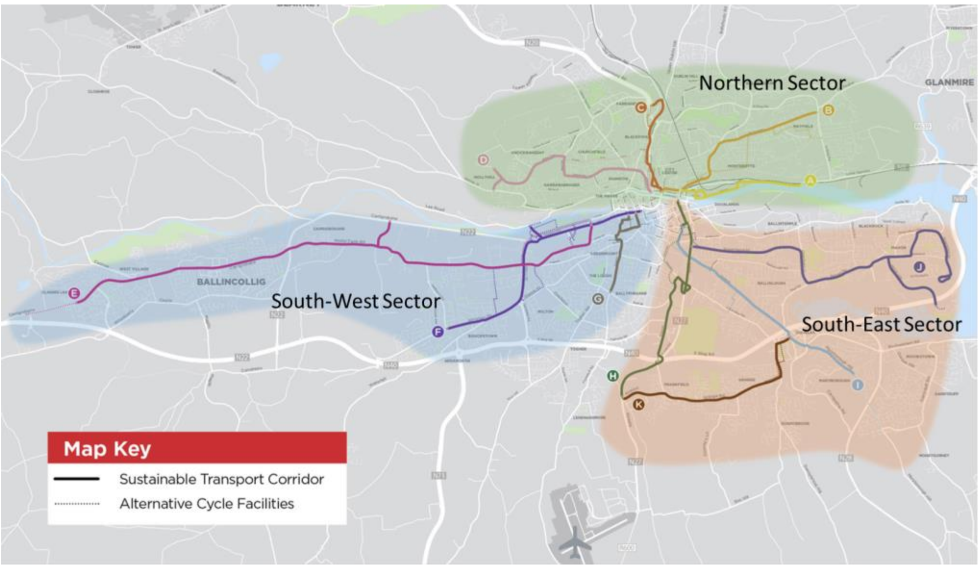


Diagram 5-1 Proposed Sustainable Transport Corridors and Sector Definition

[6] 'Actual Flow' is the terminology used in the SATURN Road assignment modelling software for road traffic flows in Passenger Car Units (PCUs)

6. Conclusion

This document has been prepared to provide an overview of the suite of forecast transport modelling tools that have been and continue to be developed to support the design development and assessment of the proposed STCs. It also presents the results of preliminary transport modelling which has been undertaken at this early stage of the design and planning process.

A description of the transport modelling methodology has been provided, covering the various modeling tools which will be developed over the EIA and illustrating how they will interact with each other and what the primary purpose of each will be.

A key focus at this stage of the design development is on the SWRM as the only modelling tool currently available for use. For that reason, Section 3 discussed the performance of the base year model. The model has been shown to be well calibrated in the area of interest, and validation results including road and public transport assignment model journey times as well as traffic flow comparisons against independent observed data also provide evidence that the model effectively replicates base year conditions.

Further comparisons of a 2019 forecast model were made with observed data from that year, and provided clear indication that the model was capable of producing intuitive forecasts which reflected changes in travel behaviour.

For the EIA there are two particular forecast years which need to be considered, an Opening Year of 2030 and a Design Year of 2045. Producing forecast model results requires a number of assumptions which reflect changes in:

- Network design, including new road infrastructure and updated bus services;
- Population and employment growth, which will influence where people travel form and to; and
- Behavioural change including values of time, propensity to pay, fare assumptions.

Finally, comparisons have been made between the Do Minimum scenario and a series of Do Something scenarios which consider three sectors of proposed STCs (Northern Sector STCs, South West Sector STCs, and South East Sector STCs) and the changes in traffic flow have been plotted to provide an indication of the predicted traffic routing responses to the implementation of the proposed measures. These comparisons typically show reduced traffic on the proposed STCs with some level of reallocation of traffic throughout the wider strategic network.

Appendix A. Do Minimum Schemes

This appendix provides further details on the full list of schemes that have been included in the Do Minimum scenario for 2030.

Table 6.1 Active Travel Infrastructure and Service Schemes

SCHEME ID	DESCRIPTION
SW17	Primary Cycle Network
SW18	Secondary Cycle Network
SW19	Feeder Cycle Network
SW20	Interurban Cycle Network
SW21	Greenway Cycle Network
SW165	Cork City Centre Pedestrianisation Plans

Table 6.2 Public Transport Infrastructure and Service Schemes

SCHEME ID	DESCRIPTION
SW01	Through Running at Kent Station
SW06	New Rail Stations
SW08	Increase in Service Frequency to 6TPH from Midleton and Cobh
SW167	MacCurtain Street Public Transport Improvement Scheme
SW169	Contraflow Bus Lane on Anglesea Street (south)

Table 6.3 Multi-Modal Infrastructure and Service Schemes

SCHEME ID	DESCRIPTION
SW14	Cork BusConnects Network Implementation
SW168	Park and Ride Sites

Table 6.4 Road Infrastructure Schemes

SCHEME ID	DESCRIPTION	SWRM AREA
SW22	Dunkettle Interchange	Cork County
SW23	M28 Cork to Ringaskiddy	Cork City
SW26	M20 Cork to Limerick Motorway	Cork County
SW28	Docklands Tivoli Road Network	Cork City
SW34	N22 Ballyvourney to Macroom	Cork City
SW36	Skehard Road Realignment and Renewal Project	Cork City
SW38	Cork Northern Distributor Road (Eastern section only, between N20 and North Ring Road)	Cork City
SW42	Eastern Gateway Bridge and Monahan's Road Extension Scheme	Cork City
SW44	Cork Docklands to City Centre Road Network Improvement Scheme	Cork City
SW45	Tralee: Northern Relief Road	Kerry

SCHEME ID	DESCRIPTION	SWRM AREA
SW47	Tralee: Ballymullen to Clash Inner Relief Road	Kerry
SW49	Listowel Bypass Extension	Kerry
SW50	Sneem to Blackwater Upgrade	Kerry
SW51	Dingle Relief Road	Kerry
SW53	N86 Upgrade	Kerry
SW60	Ballincollig: Eastern and Western Link Roads	Ballincollig
SW62	Ballincollig: Maglin Bypass	Ballincollig
SW64	Carrigaline: Inner Western Relief Road	Carrigaline
SW65	Carrigaline: Outer Western Relief Road	Carrigaline
SW67	Carrigaline: Southern Inner Relief Road	Carrigaline
SW75	Bandon: Southern Relief Road	Bandon
SW76	Bandon: Northern Relief Road	Bandon
SW79	Kinsale: Northern Relief Road plus Farm Lane Improvements	Kinsale
SW81	Blarney: Stoneview Interchange	Blarney
SW85	Blarney: Stoneview Access Roads	Blarney
SW92	Blarney: Station Road	Blarney
SW95	Blarney: R617 Realignment	Blarney
SW96	Cobh – Local Road Improvements	Cobh
SW102	Glanmire – Local Road Improvements	Glanmire
SW110	Cork North Environs: Ballyhooley Road Upgrade	Cork City
SW117	Carrigtwohill – Local Road improvements	Carrigtwohill
SW125	Little Island: N25 Junction Upgrade	Little Island
SW129	Midleton – Local Road Improvements	Midelton
SW137	Fermoy Slip road to Bypass	Fermoy
SW139	Charleville Town Bypass	Charleville
SW143	Mallow Northern Relief Road	Mallow
SW144	Kanturk River Crossing	Kanturk
SW146	Millstreet Relief Road	Milstreet
SW147	Bantry Relief Road	Bantry
SW151	Dunmanway Northern Relief Road	Dunmanway
SW155	Castletownbere Northern Relief Road	Castle-townbere
SW160	Schull Northern Relief Road	Schull
SW163	Killarney – Local Road Improvements	Killarney
SW164	Clonakilty – Local Road Improvements	Clonakilty
SW171	N40 - Westbound Mahon Slip Road Diverge extension	Cork City

Appendix B. Proposed Traffic Restrictions by STC

Table 6.5 Proposed Traffic Restrictions by STC

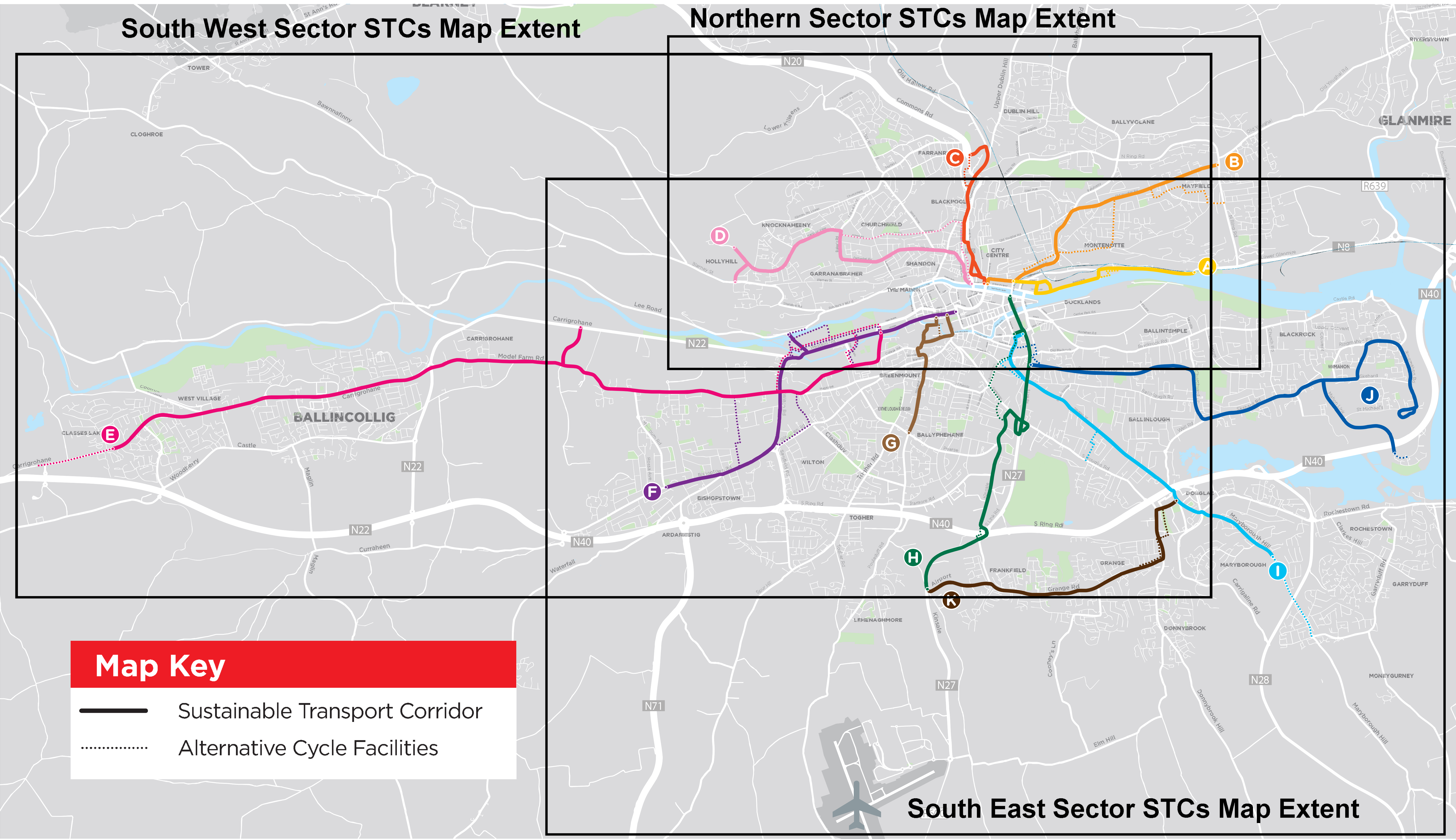
STC	Junction	From Arm	Change
B	Old Youghal Road /North Ring Road	Old Youghal Road	Closed to general traffic in the AM peak
	Old Youghal Road /Iona Park	Old Youghal Road East	Ahead closed to general traffic in PM peak
	Ballyhooly Road /Gordon's Hill	Ballyhooly Road East	Left turn closed in the AM peak
	Old Youghal Road /Gordon's Hill	Old Youghal Road West	Left turn closed in the PM peak
	Ballyhooly Road /Glen Avenue	Ballyhooly Road Northeast	Ahead closed to general traffic in AM peak
		Ballyhooly Road Southwest	Ahead closed to general traffic in PM peak
	MacCurtain Street / Brian Boru Street /Summerhill North	Summerhill North	Right turn closed to general traffic
C	Dublin Hill Lower / Ballyvolane New Road / Ballyhooley Road	Ballyhooley Road	Change priority to give-way from this arm
	Upper Dublin Hill / Lower Dublin Hill	Upper Dublin Hill (Southern Arm)	Change priority to give-way from this arm
	John Street Upper /Cathedral Walk /Watercourse Road	Watercourse Road	Traffic permitted to turn left or right from Watercourse Road Traffic not permitted to turn right from Cathedral Walk onto N20 (except buses)
	North City Link Road /Cathedral Walk	North City Link Road South	Left turn closed to general traffic
D	Cathedral Road /Shandon Street	Cathedral Road East	Right turn banned for general traffic in AM peak
			Ahead closed to general traffic in AM Peak
	Roman Street /Upper John Street	Roman Street	Ahead closed to general traffic in the PM peak
E	Main Street (Ballincollig) / High Street	Main Street (East)	Right turn banned for general traffic
	College Road /Perrott Avenue	College Road West	Ahead closed to general traffic
		Perrott Avenue	Left turn onto College Road closed
	College Road /College View	College Road East	Ahead closed to general traffic
		College View	Right turn onto College Road closed
	College Road /Goal Walk /Highfield Avenue	College Road West	Left turn closed
		Goal Walk	Right turn closed
	Model Farm Road between Scotch Lane and Inchigaggin Lane	Model Farm Road Eastbound	Closed to general traffic in AM peak
		Model Farm Road Westbound	Closed to general traffic in PM peak
		Scotch Lane	Right turn onto Model Farm Road closed in AM peak

STC	Junction	From Arm	Change
F	Curraheen Road / Melbourn Road	Melbourn Road	Left turn banned for general traffic in PM peak
	Wilton Road / Liam Lynch Park	Liam Lynch Park	Arm closed for general traffic
	Washington Street / South Main Street	Washington Street West	Right turn closed
		South Main Street North	Left turn closed
	Sheares Street /Anne Street	Anne Street	Right turn closed
	Sheares Street / Coach Street	Sheares Street	No Right Turn
	Sheares Street / Grattan Street	Sheares Street	Right and Left turn closed
		Grattan Street	No Straight ahead restriction
	Courthouse Street	Courthouse Street	Northbound traffic only
	Cross Street	Cross Street	Southbound traffic only
	Liberty Street / Cross Street	Liberty Street	Eastbound traffic only
	Washington Street /Wandesford Quay /Lancaster Quay	Washington Street	Left turn closed
	Washington Street / Hanover Street	Hanover Street	Right turn closed
	Western Road / River Lee Hotel Bridge	River Lee Hotel Bridge	Left and Right movements permitted
	Lancaster Quay /Marydyke Street /Western Road	Western Road	Ahead closed to general traffic
		Mardyke Street	Left turn closed
	Wood Street / Dyke Parade	Wood Street	Arm Closed to general traffic
	Western Road /Donovan Road Western Road / Ferry Walk	Western Road (West)	Ahead closed to general traffic
		Western Road (East)	Ahead closed to general traffic
		Ferry Walk	Right turn closed
	Western Road /Donovan Road	Donovan Road	Left turn closed to general traffic
G	Pouladuff Road /Árd Na Rí Avenue	Pouladuff Road North	Ahead closed to general traffic in AM peak
	Noonan Road /Gregg Road	Gregg Road	Left turn closed to general traffic
	Gregg Road / Gillabbey Street	Gregg Road	No general traffic Northbound
	Noonan Road / Barrack Street	Noonan Road	No general traffic Southbound
	Bishop Street	Full Link	Bus Gate in both directions - No general traffic
	Hanover Place / Washington Street	Hanover Place	Right turn closed to general traffic
	Hanover Street / Wandesworth Street / Clarke's Bridge	Wandesford Street	Left turn banned for general traffic
H	Kinsale Road Roundabout on South Link Road	Kinsale Road northwest	Northbound closed to general traffic in AM peak
			Southbound closed to general traffic (24hr)
	Lower Oliver Plunkett Street /Clontarf Street	Clontarf Street North	Right turn closed
			Ahead closed to general traffic
	Clontarf Street /Lapp's Quay	Lapp's Quay West	Left turn closed

STC	Junction	From Arm	Change
	Clontarf Street / Eglington Street / Terrance McSweeney Quay	Clontraft Bridge	Ahead closed to general traffic
		Eglington Street	Ahead closed to general traffic
I	Ballinlough Road		Eastbound one-way section conversion to one-way westbound
	Douglas Road / Capwell Road / High Street / Southern Road	High Street	No access to / from High Street
	Douglas Road / Rosebank	Douglas Road (west of Rosebank)	Westbound closed to general traffic in AM peak
	Douglas Road between Bellair Estate and Ballinlough Road (St. Finbarrs)	Douglas Road	Eastbound closed to general traffic in PM peak
	Douglas Road /Douglas Link Road	Douglas Link Road	Right turn closed to general traffic
	East Douglas Street /Church Street	East Douglas Street North	Right turn closed to general traffic
		Church Street	Left turn closed to general traffic
	The Fingerpost Roundabout	East Douglas Street	Both directions closed to general traffic (24hr)
J	Avenue de Rennes /Mahon Drive /Lakeland Crescent	Avenue de Rennes North	Ahead closed to general traffic (AM and PM)
		Lakeland Crescent	Right turn closed to general traffic(AM and PM)
		Avenue de Rennes South	Ahead closed to general traffic (AM and PM)
		Mahon Drive	Right turn closed to general traffic (AM and PM)

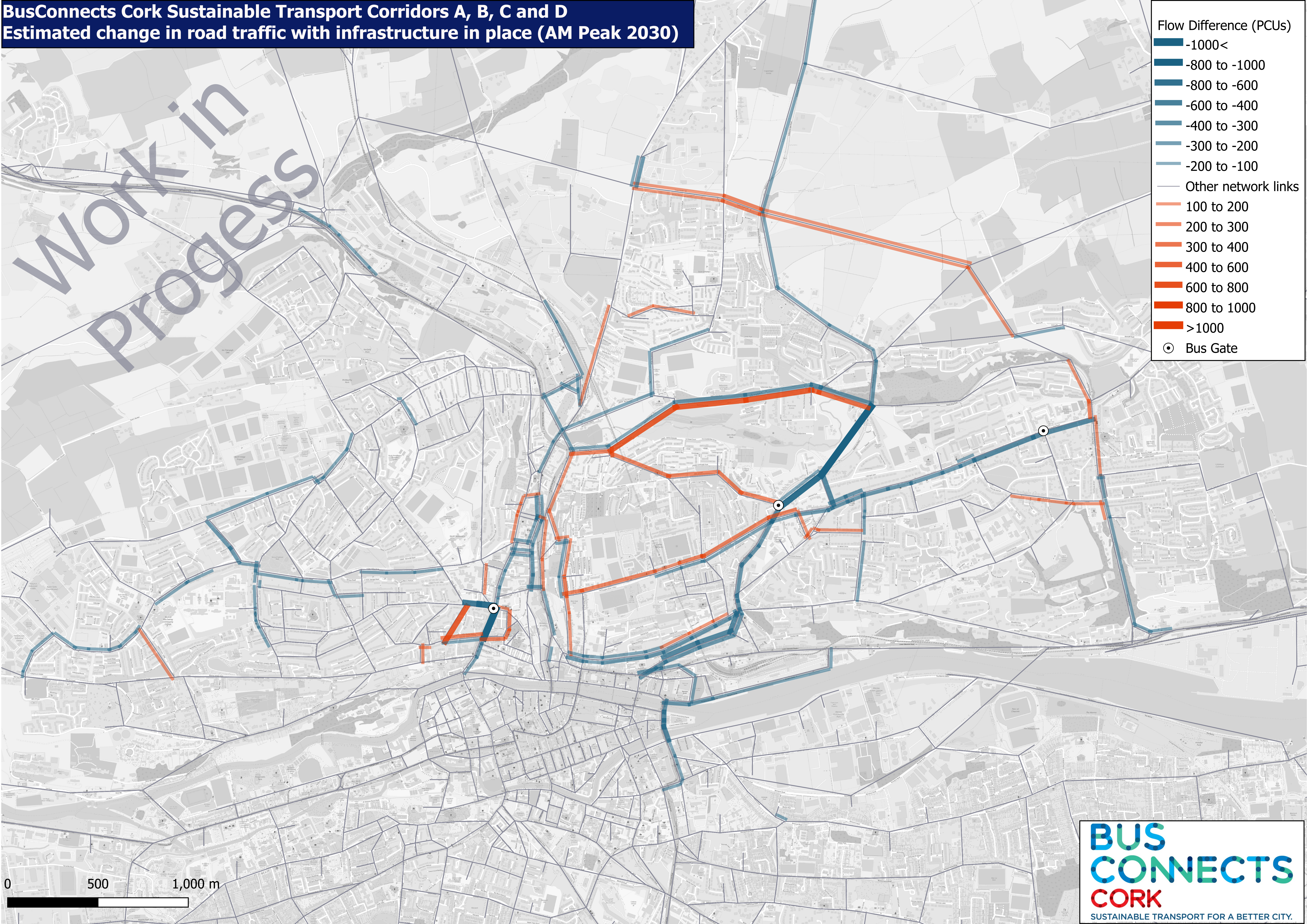
Appendix C. Proposed STC Sectors Overview Map

A Dunkettle to City
B Mayfield to City
C Blackpool to City
D Hollyhill to City
E Ballincollig to City
F Bishopstown to City
G Togher to City
H Airport Road to City
I Maryborough Hill to City
J Mahon to City
K Kinsale Road to Douglas

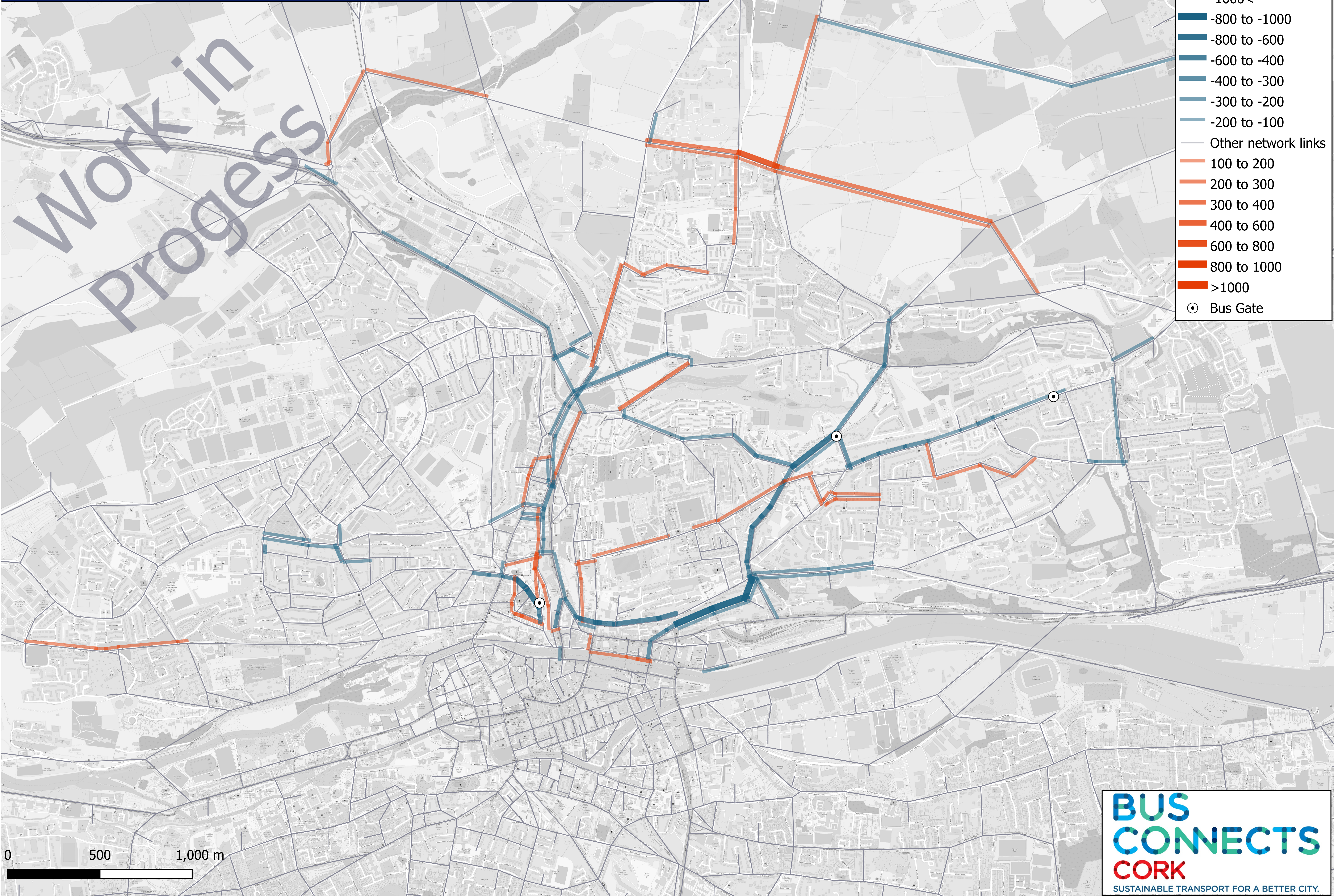


Appendix D. Northern Sector Proposed STC Flow Comparisons

BusConnects Cork Sustainable Transport Corridors A, B, C and D
Estimated change in road traffic with infrastructure in place (AM Peak 2030)

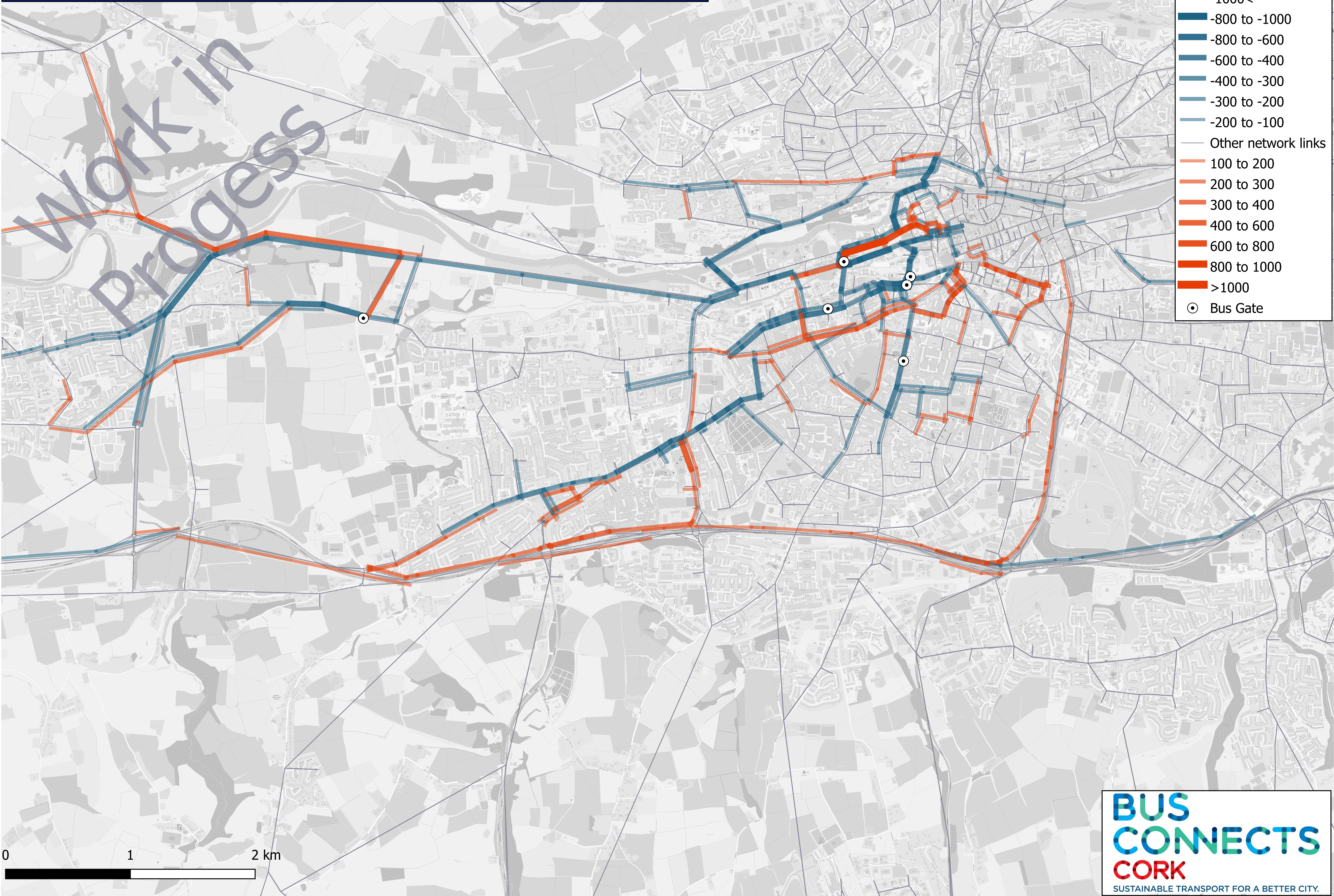


BusConnects Cork Sustainable Transport Corridors A, B, C and D
Estimated change in road traffic with infrastructure in place (PM Peak 2030)

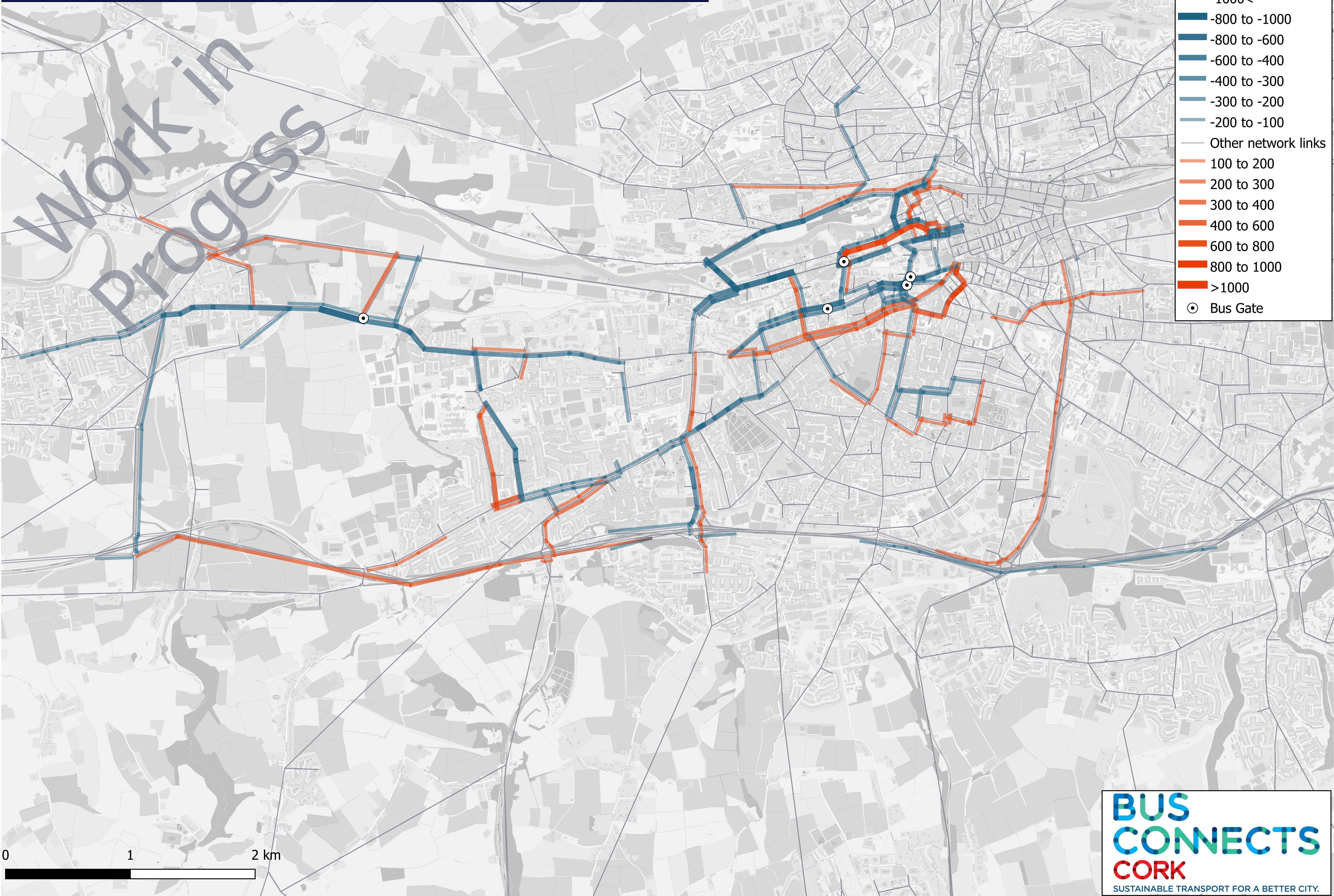


Appendix E. South West Sector Proposed STC Flow Comparisons

BusConnects Cork Sustainable Transport Corridors E, F, and G
Estimated change in road traffic with infrastructure in place (AM Peak 2030)



BusConnects Cork Sustainable Transport Corridors E, F, and G
Estimated change in road traffic with infrastructure in place (PM Peak 2030)



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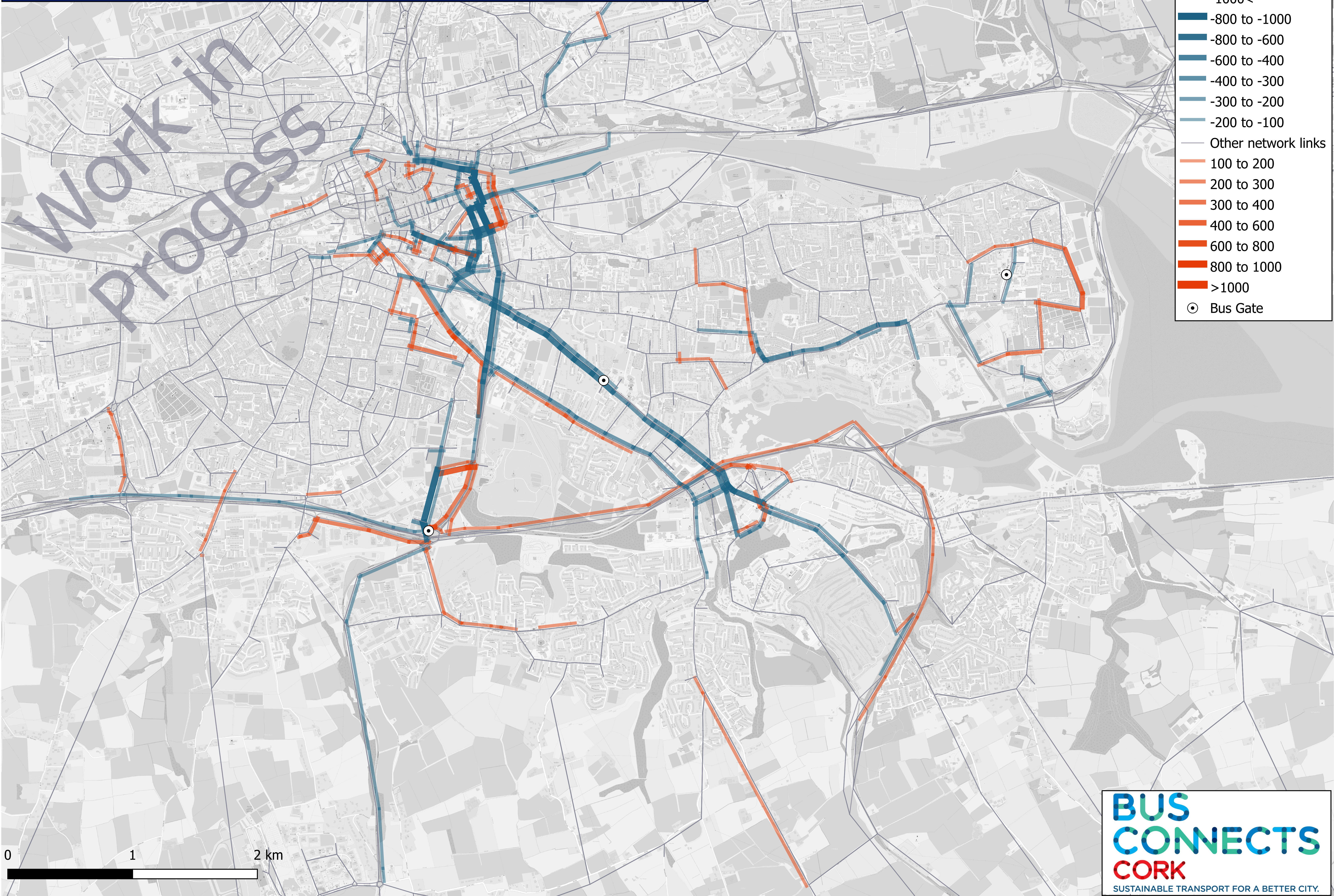
Appendix F. South East Sector Proposed STC Flow Comparisons

BusConnects Cork Sustainable Transport Corridors H, I, J, and K
Estimated change in road traffic with infrastructure in place (AM Peak 2030)



BusConnects Cork Sustainable Transport Corridors H, I, J, and K
Estimated change in road traffic with infrastructure in place (PM Peak 2030)

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