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Bonneagar Iompair Éireann
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Údarás Náisiúnta Iompair
National Transport Authority

Luas Finglas

Environmental Impact Assessment Report

2024

Appendix A18.1: Transport Modelling Report

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Building Ireland's Future

Appendix 18.1: Transport Modelling Report

Luas Finglas

Transport Modelling Report

January 2024

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1. INTRODUCTION

This Transport Modelling Report is an appendix to the Environmental Impact Assessment Report (EIAR) Chapter 18 (Material Assets: Traffic and Transport), which has considered the projected transport impacts associated with the Luas Finglas scheme. It supplements the headline modelling results presented within the main EIAR.

Luas Finglas is a 3.9km extension of the Luas Green Line from Broombridge to Charlestown via Finglas, with a 350-space Park & Ride facility located just off the M50 at St Margaret's Road. The alignment is primarily off-road and segregated from traffic providing a high quality public transport service. The scheme includes improvements to the walking and cycling network to enable access to Luas and deliver local connectivity benefits.

SYSTRA has been commissioned to undertake transport modelling using a variety of tools to inform the preliminary design and statutory process of the Luas Finglas project. This report summarises the methodology and results of the modelling exercise undertaken.

1.1 Modelling Methodology

The modelling methodology can be summarised as follows:

- The foundation of the modelling work undertaken is the National Transport Authority's (NTA) Regional Modelling System (RMS), specifically the East Regional Model (ERM). Chapter 2 provides an overview of the RMS and its components.
- Modelling was undertaken for the baseline year (2020) and two forecast years (2035 and 2050). Chapter 3 outlines the land use assumptions used to generate future transport supply and demand forecasts.
- Modelling was done for two main scenarios (Do-Minimum and Do-Something). The Do Minimum and Do Something transport supply scenarios were modelled for a number of future years (demand forecasts), in accordance with the assumptions outlined in Chapter 4. Chapter 4 describes the modelled scenarios and Chapter 5 provides an overview of the modelling results.
- A highway Local Area Model (LAM) was developed, calibrated and validated for the base year and used to test the impact of Luas Finglas in the forecast years of 2035 and 2050. Chapter 6 details the calibration and validation process, and summarises the key results from future year testing.

1.2 Report Structure

The following outlines each Chapter of this Modelling Report:

- Chapter 2 provides an overview of the NTA's Regional Modelling System;
- Chapter 3 describes the forecast land use assumptions used in the modelling;
- Chapter 4 describes the individual modelled scenarios;
- Chapter 5 outlines the main ERM results;
- Chapter 6 focuses on the Local Area Model and its results.

2. NTA REGIONAL MODELLING SYSTEM

2.1 Introduction

This section provides an overview of the NTA RMS which comprises five regional transport models covering the Republic of Ireland centred on the five main cities of Dublin, Cork, Galway, Limerick, and Waterford (as summarised in Table 2-1 below).

Table 2-1: Regional Modelling System

Regional Modelling	Abbreviation	Counties Covered
East Regional Model	ERM	Louth, Monaghan, Cavan, Longford, Westmeath, Meath, Offaly, Laois, Kildare, Dublin, Wicklow, Carlow & Northern Wexford
South East Regional Model	SERM	Wexford, Kilkenny, Waterford & Tipperary South
South West Regional Model	SWRM	Cork & Kerry
Mid-West Regional Model	MWRM	Limerick, Clare & North Tipperary
West Regional Model	WRM	Galway, Mayo, Roscommon, Sligo, Donegal & Leitrim

Each regional model has the following key attributes:

- Full geographic coverage of the relevant region;
- A detailed representation of the road network;
- A detailed representation of the public transport network & services;
- A representation of all major transport modes including active modes (walking and cycling);
- A detailed representation of travel demand, e.g. by journey purpose, car ownership/availability, mode of travel, person types, user classes & socio-economic classes, and representation of five time periods (AM, Lunch Time, School Ride, PM and Off-Peak);
- A prediction of changes in trip destination in response to changing traffic conditions, transport provision and/or policy; and
- A prediction of mode-choice in response to changing traffic conditions.

Figure 2-1 below illustrates the geographical extent of each of the Regional Models.

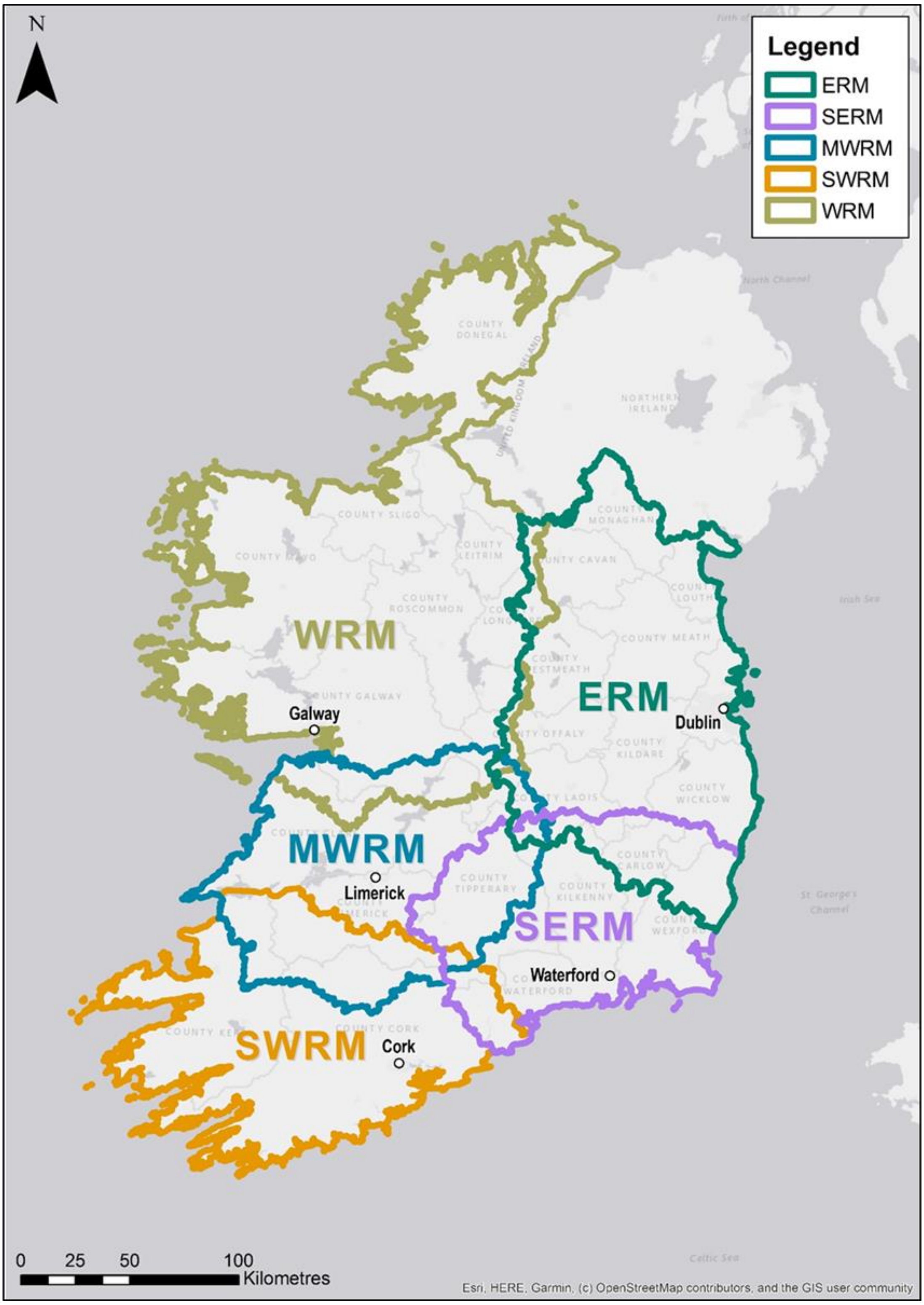

Figure 2-1: Regional Models – Areas of Coverage

The East Regional Model (ERM), which is centred around Dublin City and the Greater Dublin Area, has been used for modelling the Luas Finglas scheme.

2.2 RMS Overarching Structure

The regional models, including the ERM, combine three core modelling processes (i.e. Demand Model, Road Assignment Model, Public Transport Assignment Model) which receive inputs from the National Demand Forecasting Model (NDFM) and provide outputs for transport appraisal and secondary analysis. This process is shown in Figure 2-2.

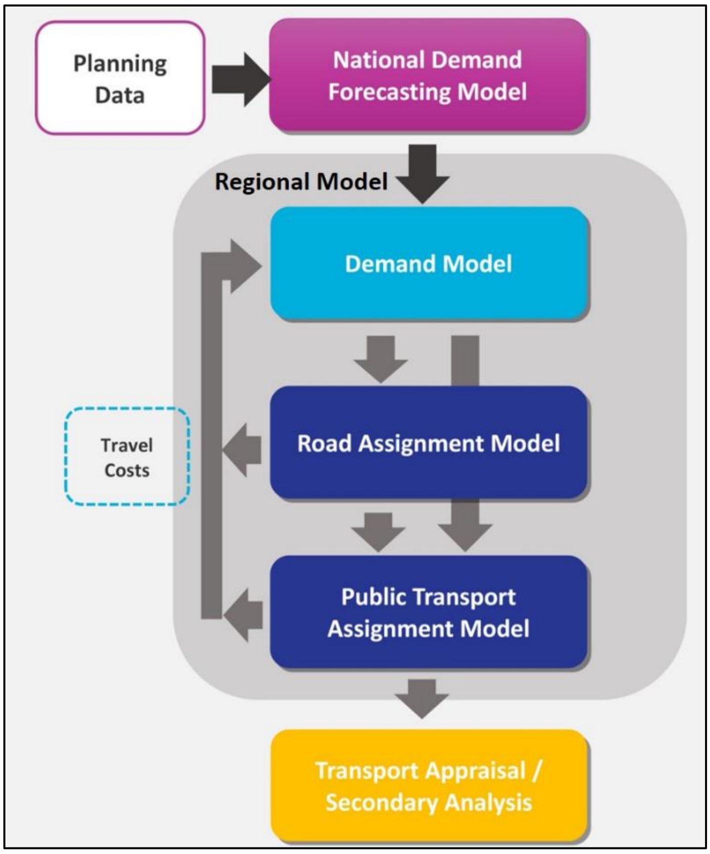

Figure 2-2: Regional Modelling System Structure

The two main RMS components (NDFM and Regional Model) are discussed in more detail in Sections 2.3 and 2.4.

2.3 National Demand Forecasting Model (NDFM)

The NDFM is a separate modelling system that estimates the total quantity of travel demand generated by and attracted to every Census Small Area (CSA) daily. The level of demand to and from each CSA (referred to as trip ends) is related to characteristics such as population, number of employees and land-use data. These trip ends are then used by the Regional Models to create travel demand matrices for the internal area of each of the Regional Models.

Additionally, the NDFM also estimates the inter-regional demand (demand crossing the boundary of each of the Regional Models), which then forms the external demand for each of the Regional Models.

The Planning Data represents a key input into the NDFM. It is a national database of 114 demographic and spatial variables for each of the 18,641 CSAs in the state. The main categories of planning data are:

- Spatial definitions (CSA/DED/NUTS names, area types etc.);
- Production related variables – demographic data about residents living in each CSA (e.g. total population living in each CSA, age bands, gender, employment status etc.);
- Attraction related variables – data related to employment and education in each CSA (e.g. number of jobs within each CSA, number of education places etc.).

Further details about the NDFM structure, its components and calibration can be requested from the NTA via the NTA's website[1].

2.4 East Regional Model (ERM)

2.4.1 Model Dimensions

As outlined previously, the ERM covers most of the eastern side of the country centred on Dublin City, and its dimensions are defined in terms of:

- Zone system;
- Modes of travel represented;
- Base year;
- Time-periods; and
- Demand segmentation.

The following sections provide a description of each of these dimensions.

2.4.1.1 Zone System

The zone system definitions for each of the regional models are based on Census Small Area (CSA) boundaries. CSAs are the smallest geographic unit of data available with which to define the model zone system. Each CSA is a defined geographic area associated with demographic data (e.g. population, age distribution, employment status), and the work / school travel characteristics of the population (via Place of Work, School or College - Census of Anonymised Records (POWSCAR)). Regional Model zones can be smaller or larger than CSAs where required.

The East Regional model includes 1,953 zones, of which 1,907 are internal zones, 39 are external road route zones and 7 are external rail route zones. Figure 2-3 shows the ERM Zone System, and Figure 2-4 highlights the zones covering the Dublin City area.

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1 https://www.nationaltransport.ie/planning-and-investment/transport-modelling/regional-modelling-system/ndfm-overview-rtm/

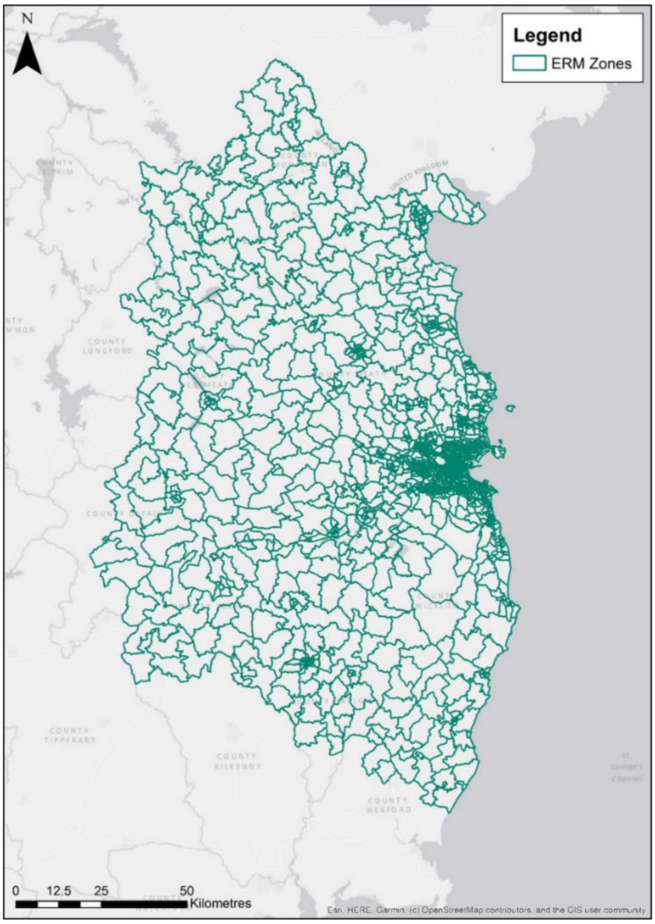


Figure 2-3: ERM Zone System

Figure 2-4: Dublin City zones

2.4.1.2 Modes of Travel

The regional model covers all surface access modes for personal travel and goods vehicles including:

- Private vehicles – cars;
- Public transport – bus, rail, Luas, Metro;
- Park and Ride;
- Taxis;
- Active modes – walking and cycling; and
- Goods vehicles – light goods vehicles and heavy goods vehicles.

2.4.1.3 Base Year

The base year of each regional model is 2016. This is largely driven by the date of the Census (POWSCAR) and the National Household Travel Survey (NHTS).

2.4.1.4 Time Periods

The regional model represents an average weekday. The day is split into five time periods detailed in Table 2-2 below. The periods allow the relative difference in travel cost between time periods to be represented. Representative peak hours are used in the assignment models, which are based on period to peak hour factors derived from survey data for each time period and mode.

Table 2-2: Time Periods

Period Name	Demand Model Period	Assignment Period
AM Peak	07:00-10:00	08:00-09:00
Morning Inter Peak – Lunch Time (LT)	10:00-13:00	12:00-13:00
Afternoon Inter Peak – School Run (SR)	13:00-16:00	15:00-16:00
PM Peak	16:00-19:00	17:00-18:00
Off Peak	19:00-07:00	20:00-21:00

2.4.1.5 Demand segmentation

Groups of people with similar travel behaviours (for example, commuters who own a car) are represented by distinct demand segments in the RMS. This allows those groups to be treated differently in the regional demand model according to their behaviour.

The NDFM demand segments were derived from the National Household Travel Survey (NHTS) data and Place of Work, School or College - Census of Anonymised Records (POWSCAR) data sets. They have been divided into 33 distinct classifications covering commute, education, shopping, visiting friends, business, escort to education and other.

2.4.2 Core Modelling Processes

The ERM includes the following core modelling processes:

- Demand Model;
- Road Assignment Model;
- Public Transport Assignment Model; and
- Active Modes Model

2.4.2.1 Demand Model

The Demand Model processes all-day travel demand from the NDFM through a series of choice models to represent combined mode, time of day, destination and parking decision making. The outputs of the demand model are a set of trip matrices which are assigned using the Road Assignment Model and Public Transport Assignment Model to determine the route-choice and generalised costs.

2.4.2.2 Road Assignment Model

The main purpose of the Road Assignment Model (RDAM) is to assign road users to routes between their origin and destination zones. It is implemented in the SATURN road assignment software and includes capacity restraint whereby travel times are recalculated in response to changes in assigned flows.

The inputs to the RDAM from the Demand Model are the road assignment matrices. The outputs from the RDAM for the demand model processes consist of generalised costs skims by time period and assigned road networks in CUBE Voyager format which are passed on to the PT model.

In addition to these requirements for demand model processes, there are a series of standard SATURN outputs that are produced for use in the specific interrogation of the road networks for scheme and/or scenario assessment e.g. network statistics, journey times, delay, volume/capacity, traffic volumes etc.

2.4.2.3 Public Transport Assignment Model

The Public Transport Assignment Model (PTAM) is used to allocate PT users to services between their origin and destination zones. The model includes a representation of the public transport network and services for existing and planned modes within the modelled area. In addition, the PTAM network includes walk links to provide for improved permeability and access.

The base model includes:

- Heavy Rail;
- Light Rail;
- Urban Bus; and
- Inter-Urban Bus.

The outputs from the Public Transport Assignment Model for the Demand Model processes consist of the assigned networks which are passed on to the Active Modes Model and generalised cost skim matrices by user class for each of the assigned time periods that feed back into the main Mode and Destination choice demand model loop. An overview of the PTAM process is shown in Figure 2-5.

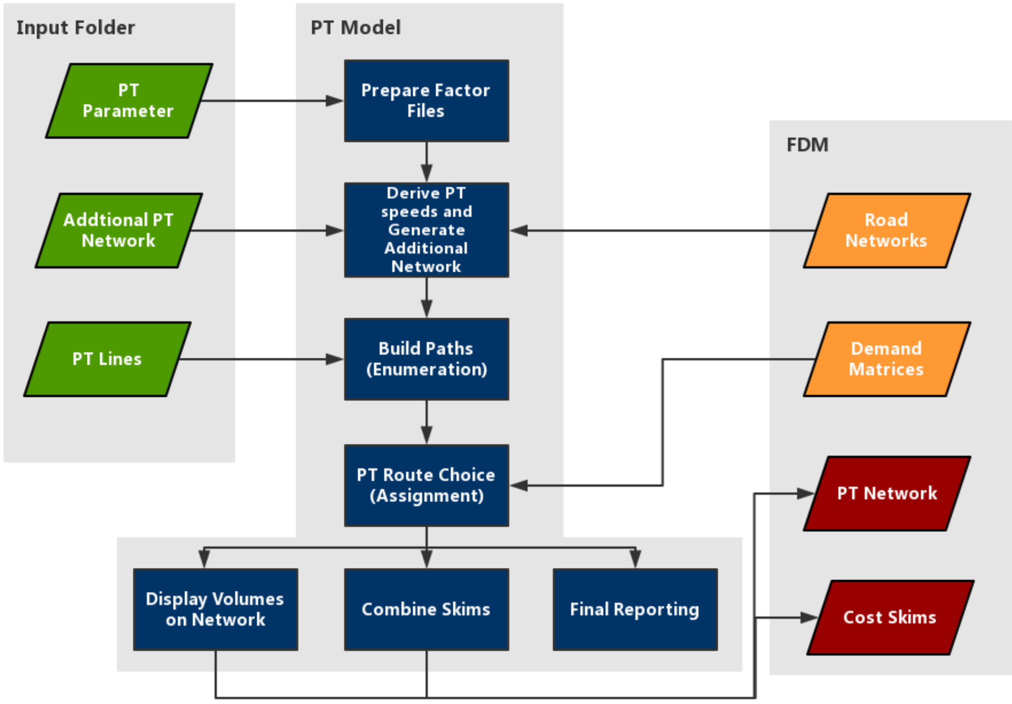


Figure 2-5: PT Model Process

2.4.2.4 Active Modes Model

The active modes assignment is run after the PTAM using the PT network with rail and motorway links removed. The active mode assignment is a shortest path assignment and does not include delays or crowding.

The inputs for the active assignment model are the output CUBE format PT networks, the demand model produced assignment matrices and separate input pedestrian only links and cycle lanes. The outputs of this process include an assigned network with walk and cycle flows by user class, and a set of generalised cost skims.

2.5 Suitability of East Regional Model

2.5.1 Model Calibration and Validation

The ERM has been subject to a comprehensive calibration and validation process in line with best practice guidelines. A substantial amount of observed data has been incorporated into both the demand model and the assignment models as presented in Table 2-3.

Table 2-3: Observed data used for Model Calibration and Validation

Demand Model	Assignment Models
Tour proportions	Road traffic volumes
Generalised cost distributions	Road journey times
Travel distance distributions	Road trip length distribution
Modal share	Public transport in-vehicle time factors
Journey time distribution	Public transport fares and ticket types
	Public transport passenger flows
	Public transport boardings and alightings
	Public transport journey times
	Public transport interchange/transfers

The calibration and validation process ensures that the ERM accurately reflects existing conditions and 'costs' associated with travel. This allows changes in the transport demand and impacts of strategic transport infrastructure schemes and transport policies to be modelled and tested using the ERM. Further details on the ERM calibration can be found in the Model Development and Calibration Reports available on the NTA's website[2].

2.5.2 Use of ERM for Strategic Transport Planning

The model has many strengths and features that makes it the ideal tool to aid the strategic planning process. The ERM has been developed from first principles making best use of the most recently available data (POWSCAR and NHTS) to replicate travel choices and transport network conditions as accurately as possible.

Several distinct journey purposes and characteristics including car availability, employment status, and education level are considered within the model to evaluate travel choices more accurately. This carries through to forecasting whereby specific person type demand can be forecast to derive appropriate trip distributions and future year travel conditions.

The model utilises a tour-based approach which allows for more accurate mode choice modelling and consideration of travel costs.

Four main modes of travel are included in the model: private car, public transport, walking, and cycling. Each mode has been calibrated individually, for each journey purpose, to replicate observed trip cost distributions.

[2] https://www.nationaltransport.ie/planning-and-investment/transport-modelling/regional-modelling-system/regional-multi-modal-models/east-regional-model/

The use of SATURN software in the road model allows for junction modelling to be included which improves network representation in congested areas. Link speeds and delays are transferred to the public transport model which allows journey times of on-street modes (Bus) to reflect real traffic conditions rather than being based strictly on timetables.

2.5.3 Summary

The East Regional Model provides a comprehensive representation of travel patterns across the Study Area and it is a suitable tool for assessing the effects of the proposed scheme.

3. FORECAST LAND-USE ASSUMPTIONS

3.1 Introduction

ERM Future year travel demand is based on forecasts of population, employment and education data as defined by the NTA at the Census Small Area (CSA) level. This data is collated into a planning sheet. The National Demand Forecasting Model converts this forecast planning sheet to travel demand (in total productions and attractions per zone) for input to the ERM, as described in section 2.3.

Two forecast years have been used for the Luas Finglas EIAR assessment:

- Opening Year: 2035
- Design Year: 2050 (opening year +15)

2035 and 2050 reference case planning sheets have been obtained from the NTA, which are aligned with National Planning Framework (NPF) forecasts as well as the latest planning policy for the Greater Dublin Area. These planning sheets are the basis for the forecast land use included in the 2035 and 2050 Core modelling scenarios.

To ensure the land use forecasting was as accurate as possible, a desktop review was undertaken of major planning applications within the study area around the Luas Finglas alignment. This was then compared to the values in the NTA reference planning sheet to ensure a robust representation of proposed developments in the area was included in the forecast ERM runs.

The following sections provide an overview of the growth in population, employment and education as outlined in the NTA 2035 reference planning sheets, along with alterations made to reflect local planning applications. For the 2050 forecast, minimal adjustment have been applied to the standard NTA 2050 planning sheets and the few alterations are mentioned in this section.

3.2 Population

Figure 3-1 highlights the key areas of population growth included in the NTA reference planning sheet between 2016 (ERM Base Year) and 2035.

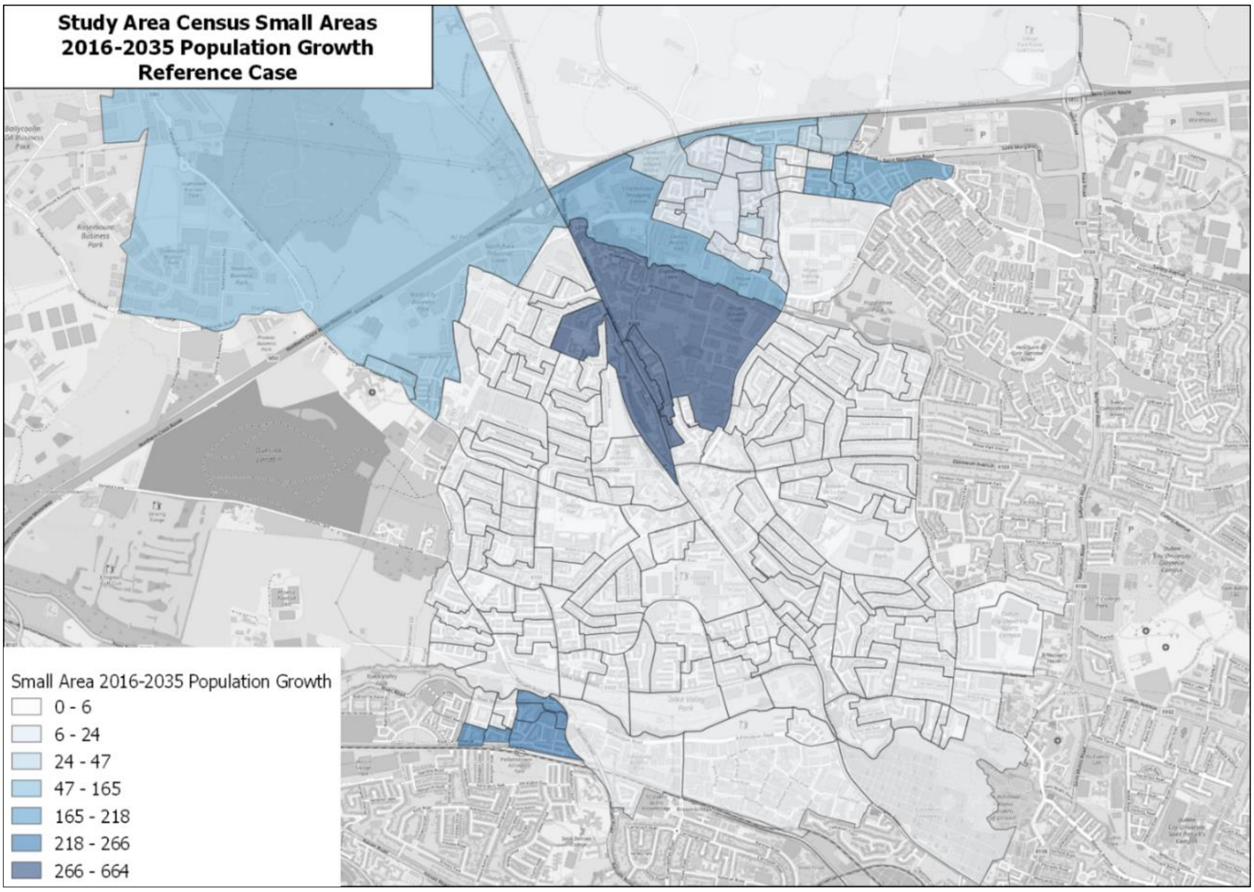


Figure 3-1: Reference Case Planning Sheet 2016-2035 Population Growth

This growth was then compared to major planning proposals within the study area outlined in Figure 3-2 and Table 3-1, to ensure they are fully captured in the future year test demand.

Table 3-1: Large Development Proposals within Study Area

Census Small Area	Development	Planning Ref	Residential Units
267066019	Charlestown Shopping Centre Phase 2	F19A/0146	377
267066019	Charlestown SHD (Car Park)	TA06F.310350	590
268012004	Merville Place	TA29N.310722	191
268015005/268015014	Hampton wood	TA29N.305538	129
268069004	Scribblestown	DCC Report No. 393/2017	70

Census Small Area	Development	Planning Ref	Residential Units
268027002	Royal Oak	PL29N.248996	69
268065013	Jamestown Road SDRA	City Development Plan 2016-2022, Variation No. 33: Jamestown Road SDRA[3]	2,200

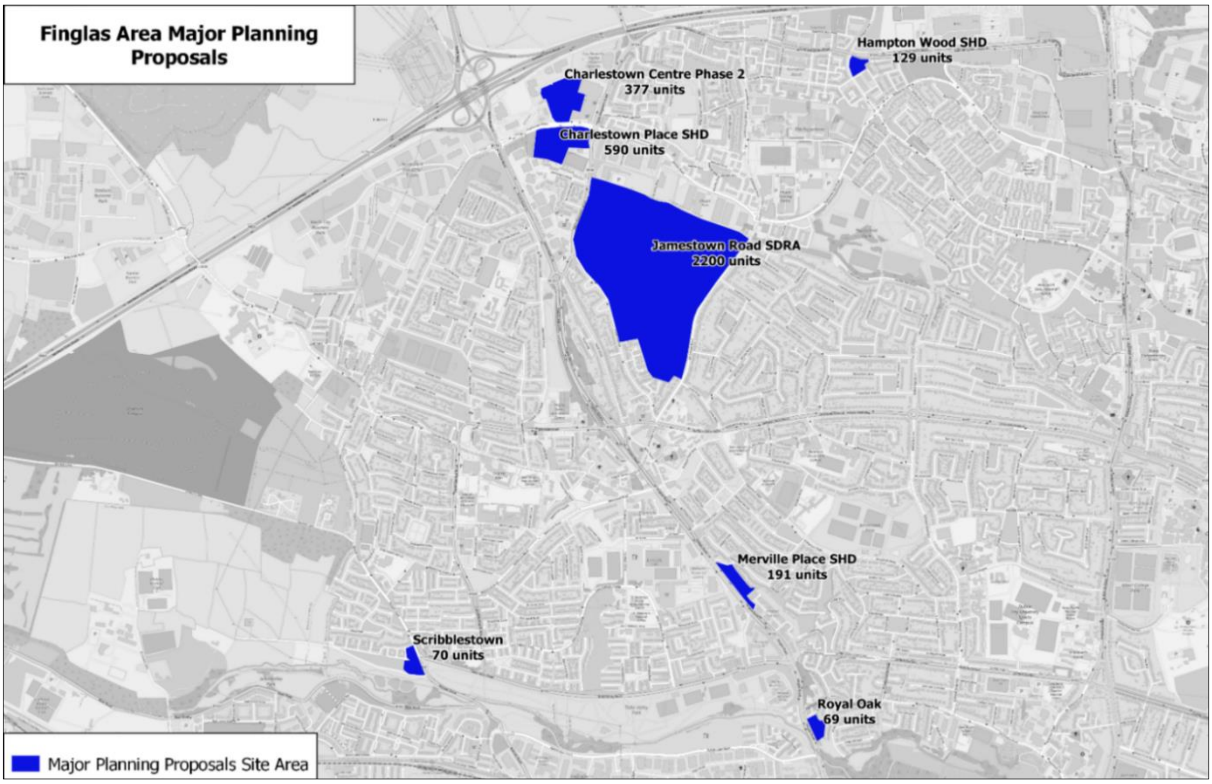


Figure 3-2: Finglas Area Major Planning Proposals

The above projects have progressed through the planning process and it is assumed that they will be complete by 2035, with the exception of the Jamestown Road SDRA which will take longer to complete.

The estimated development population was derived using 2016 Census data for Dublin City. The census classifies households based on the number of occupied rooms (kitchen, living room and bedrooms) and provides the number of households within each class and the total persons living in these households. This allows the approximate average population for different unit sizes to be estimated and the results are outlined in Table 3-2.

[3] NOTE: The Jamestown Road SDRA was the latest planning document available for the Jamestown Road industrial estate at the time modelling was undertaken

Table 3-2: DCC Household Size by number of occupied rooms (2016 Census – Statbank Table E1035)

Household Type (no. of rooms)	No. Households	No. of Person	Estimated Household Size
All households	211,591	52,4687	2.48
1 room	11,337	17,353	1.53
2 rooms	26,105	51,726	1.98
3 rooms	31,446	72,930	2.32
4 rooms	31,796	73,817	2.32
5 rooms	39,358	107,892	2.74
6 rooms	28,889	80,990	2.80
7 rooms	13,698	42,238	3.08
8 rooms	7,867	26,153	3.32
9 rooms	2,046	7,072	3.46
10 or more rooms	1,457	5,395	3.70
Not stated	17,592	39,121	2.22

To estimate the development population, the household sizes were applied to the number of studio, 1 bed, 2 bed and 3 bed units in each development per approved planning permission. For the Jamestown Road SDRA, it was assumed that the unit profile would be in line with the other developments within the study area. Therefore, the average household size per unit across the other developments was applied to Dublin City Council's estimated yield of 2,200 units for the SDRA to calculate overall population totals. Table 3-3 outlines the calculated projected population totals for each of the planning proposals in Figure 3-2. These values are then compared to the population total for the relevant CSAs in the NTA's 2035 reference planning sheet.

Table 3-3: Study Area Development Proposals – Estimated Population

Census Small Area	Development	Planning Ref	Residential Units	Estimated Development Population	Planning Sheet CSA Population Total in 2035
267066019	Charlestown Shopping Centre Phase 2	F19A/0146	377	772	996
267066019	Charlestown SHD (Car Park)	TA06F.310350	590	1,306	
268012004	Merville Place	TA29N.310722	191	402	338

Census Small Area	Development	Planning Ref	Residential Units	Estimated Development Population	Planning Sheet CSA Population Total in 2035
268015005 /268015014	Hampton wood	TA29N.305538	129	284	688
268069004	Scribblestown	DCC Report No. 393/2017	70	161	203
268027002	Royal Oak	PL29N.248996	69	153	232
268065013	Jamestown Road SDRA	City Development Plan 2016-2022, Variation No. 33: Jamestown Road SDRA	2,200	4,796	995

To ensure that the 2035 planning sheet used in the forecast ERM runs is as robust as possible, the relevant CSAs from Table 3-3 have been updated to reflect the calculated estimated development population. For the Jamestown Road SDRA, there was limited information available on development phasing and likely unit levels by 2035 at the time of undertaking the modelling analysis. Therefore, for the Core development scenario, it has been assumed that 50% of the residential units (1,100) will be complete by 2035. The other 50% is assumed to be completed by 2050 and included in the 2050 forecast. Table 3-4 outlines the final 2035 population values for each of the CSAs with identified planning proposals.

Table 3-4: Planning Sheet Population Alterations by Small Area

Census Small Area	Planning Sheet CSA Population 2016	Original Planning Sheet CSA Population 2035	Estimated Development Population	New Planning Sheet CSA Population 2035
267066019	792	996	2,078	2,870
268012004	338	338	402	740
268015005/268015014	471	688	284	755
268069004	203	203	161	364
268027002*	232	232	153	385
268065013**	331	995	2,398	2,729
Total	***2,367***	***3,452***	***5,476***	***7,843***

3.2.1 2050 Population Levels

A similar exercise was undertaken for the 2050 population planning forecasts. Values from the NTA's 2050 reference planning sheet were compared to the major applications noted above:

- If growth was sufficient to account for planned development, it was assumed that this development is included in the NTA's reference case Planning Sheet (i.e. no change needed).
- If growth was insufficient, the values in the NTA Planning Sheet were adjusted to included planned levels of development.

For the Jamestown SDRA it was assumed that the full 2,200 units would be delivered by 2050.

3.3 Employment

The growth in employment within the study area between 2016 and the reference case 2035 planning sheet is illustrated in Figure 3-3, overleaf. A review of major planning applications did not identify any significant industrial or employment developments planned for the Finglas area not already accounted for in the NTA reference case planning sheet with the exception of the Jamestown Road SDRA.

The Jamestown Road industrial lands have only recently been rezoned and are planned to transition from 100% employment to 30% employment under the SDRA scheme. As the area is predominantly low-density industrial development at present, it is assumed that any employment lost will be replaced by higher density employment development within the SDRA, but with no overall employment growth when compared to 2016 levels.

Therefore, for the Jamestown Road development, employment figures have been retained at 2016 levels in the 2035 and 2050 planning sheet. With no additional information readily available, employment levels for all other CSAs within the study area have been retained as per the NTA's 2035 reference planning sheet.

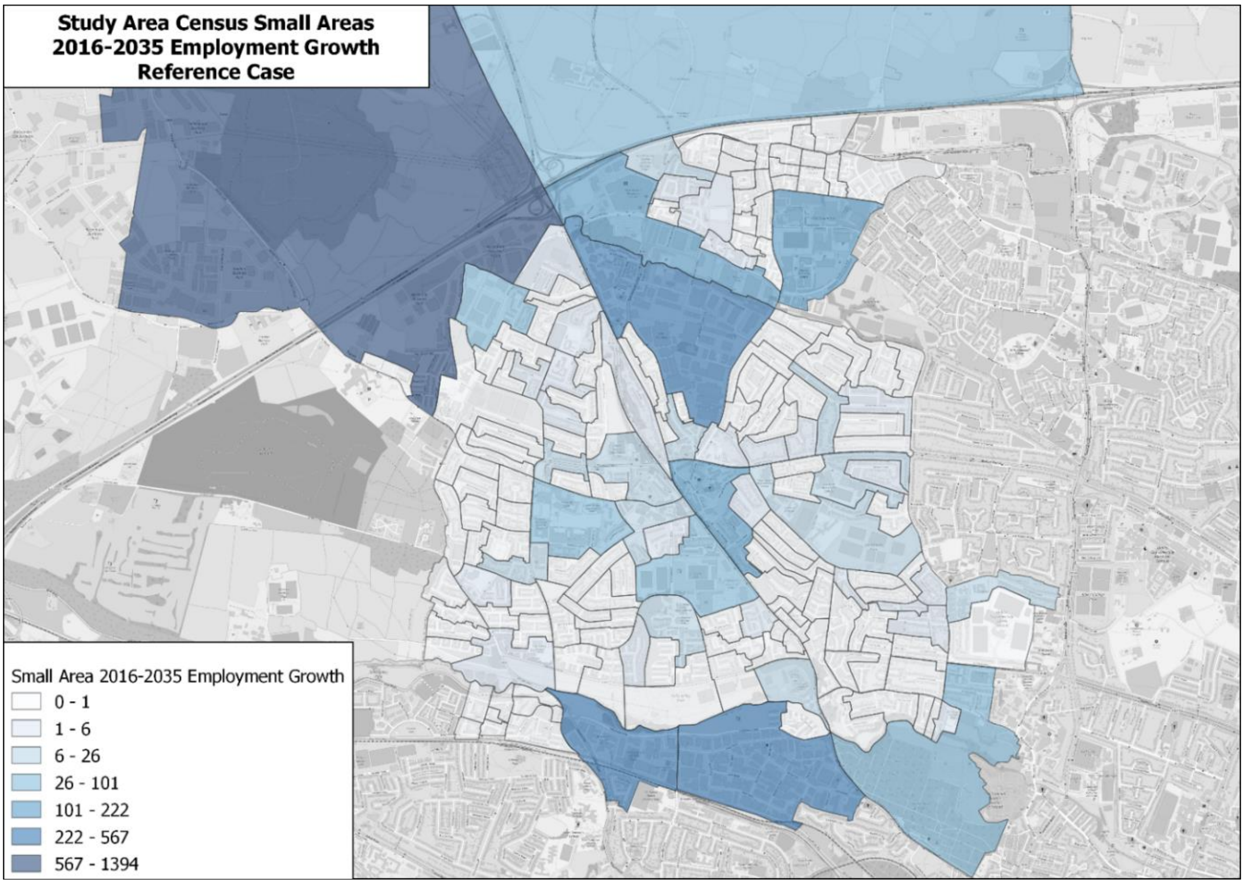


Figure 3-3: Reference Case Planning Sheet 2016-2035 Employment Growth

Table 3-5: Planning Sheet Employment Alterations by Small Area (Jamestown Rd SDRA)

Census Small Area	Planning Sheet CSA Employment 2016	Planning Sheet CSA Employment 2035	Estimated 2016-2035 Growth due to Development	New Planning Sheet CSA Employment 2035
268065013	**1,414**	**1,827**	**0**	**1,414**

3.4 Education

The growth in education within the study area between 2016 and the reference case 2035 planning sheet is illustrated in Figure 3-4. As per the employment data, a review of major planning applications did not identify any significant education developments planned for the Finglas area not already accounted for in the NTA reference case planning sheet with the exception of the Jamestown Road SDRA.

The Jamestown Road SDRA stipulates that 10% of the lands be for "Community/Educational uses". As outlined previously, at the time of modelling there was limited information available on development phasing for the Jamestown Road development, however, it is assumed that it will not be fully built out by the test year 2035.

For the purpose of this modelling assessment, it has been assumed that the 10% education facilities will be built post 2035. Therefore, education growth values from the NTA's reference planning sheet have been used for the 2035 Core land use scenario.

In the 2050 forecast, 268 education places have been added in the Jamestown Road Small Area to account for the new school. This is based on a review of average school sizes within the study area.

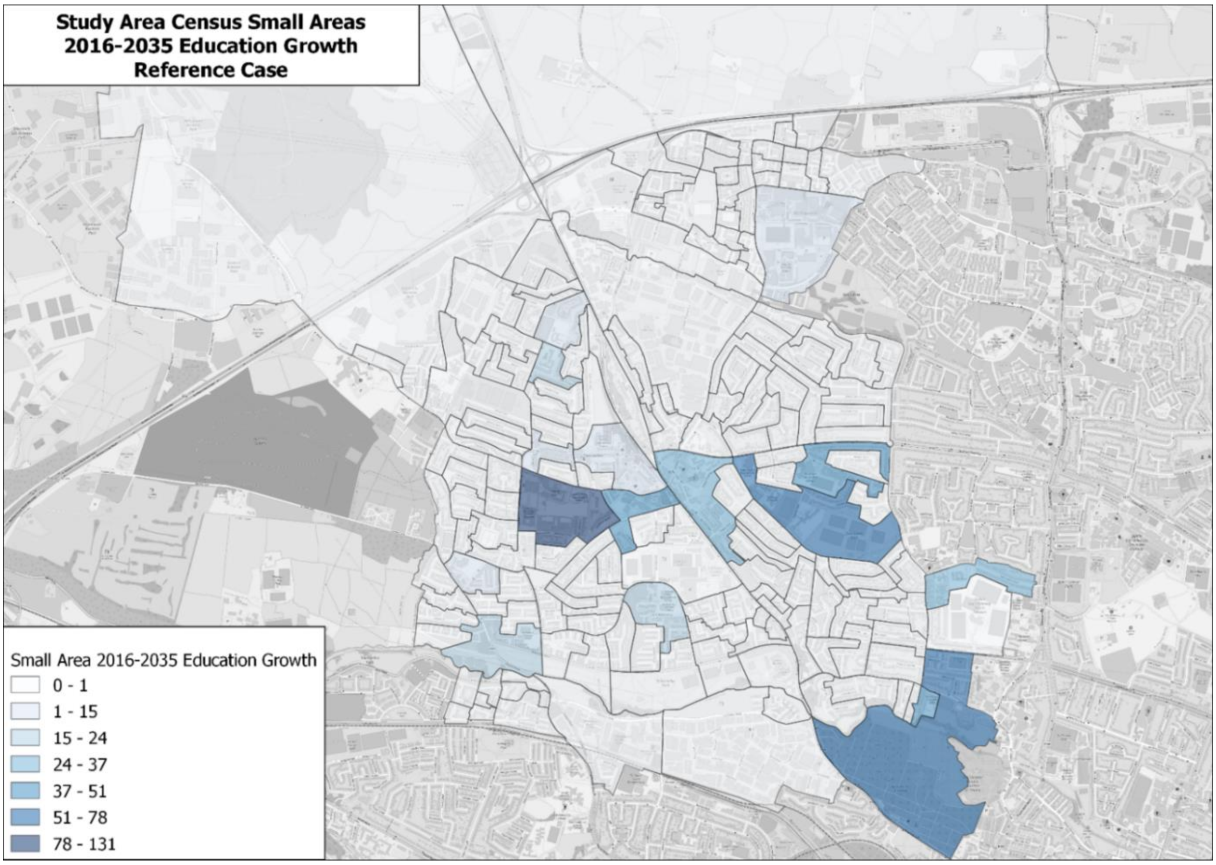


Figure 3-4: Reference Case Planning Sheet 2016-2035 Education Growth

4. MODELLED SCENARIOS

4.1 Overview

The following sections provide an overview of the scenarios modelled in the ERM for the 2035 and 2050 forecast years. It includes information on schemes included in the 'Do Minimum' Core scenario, along with details of how Luas Finglas has been coded in the ERM and key modelling parameters.

4.2 Do Minimum

In order to accurately model future year transport conditions, assumptions have been made around the delivery of committed and planned transport proposals by 2035. A detailed review was undertaken of road, public transport and active travel (walking and cycle) schemes included in the latest draft Transport Strategy for the Greater Dublin Area 2022-2042[4].

For active travel and public transport schemes, cognisance has been taken of their current delivery status, their proposed phasing within the draft GDA Transport Strategy, along with their inclusion in the National Development Plan (NDP) which sets out the investment priorities that will underpin the implementation of the National Planning Framework.

The following schemes are likely to significantly impact on the appraisal of the Luas Finglas, namely:

- **BusConnects**: delivery of high frequency bus services from Finglas to the city centre with improved public transport priority due to the creation of a Core Bus Corridor along the R135;
- **DART+ West**: electrification of the Maynooth Rail line with improved frequencies facilitating interchange with the Luas Finglas extension at Broombridge; and
- **Greater Dublin Area Cycle Network Plan**: Delivery of a high-quality cycle network providing improved accessibility to the Luas Finglas stations and supporting Cycle + Ride.

It is proposed that these schemes be included in the Core 2035 Do-Minimum scenario as they have progressed significantly through the planning process, they are name checked as Strategic Investment Priorities within the NDP and are outlined for implementation by 2030 in the draft 2042 GDA Transport Strategy Phasing. The inclusion of the BusConnects Core Bus Corridor scheme also allows for a more robust appraisal of Luas Finglas. The provision of an improved bus service running parallel to the Luas route along the Finglas Road is likely to have some impact on patronage. As such, the exclusion of the Core Bus Corridor scheme in the 'Core' scenario would potentially lead to an over-inflation of Luas Finglas benefits.

Since undertaken the Luas Finglas modelling, these schemes have progressed further through planning:

[4] It should be noted that the strategic modelling for Luas Finglas was undertaken in Summer 2022. The GDA Strategy 2022-2042 was still draft at this stage. Although the strategy has since been approved, it is still referenced here as draft as that was the source information available to inform the modelling assumptions.

BusConnects Core Bus Corridor Infrastructure:

- The Preliminary Business Case for the BusConnects programme has been approved by Government.
- Currently a number of the corridors, including the Ballymun/Finglas to city centre scheme have been submitted to ABP for approval.

DART+ West:

- The Preliminary Business Case for the DART+ programme has been approved by Government.
- The Government granted Approval in Principle to the NTA to enable the submission by CIÉ / Iarnród Éireann of a Railway Order application to An Bord Pleanála for the DART+ West element of the programme (Decision Gate 1).
- A Railway Order application for DART+ West was submitted to An Bord Pleanála on the 29th July 2022 (https://www.dartplus.ie/en-ie/projects/dart-west).
- Broombridge Station is on the DART+ West alignment and there will be a significant enhancement in the level of rail service provided.

In the following sections, each of the schemes highlighted within the draft GDA Transport Strategy have been outlined with information on their status[5] at the time the modelling was undertaken and whether they should be included within the 2035 Core Do-Minimum scenario.

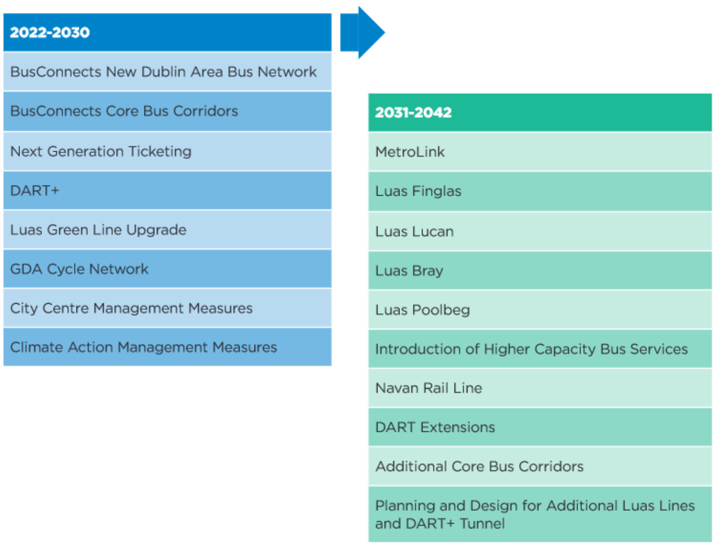


Figure 4-1: Draft Transport Strategy for the Greater Dublin Area 2022-2042 Phasing

[5] As referenced previously, this represent the status of projects when the Luas Finglas strategic modelling was undertaken in the Summer 2022. It is acknowledged that schemes will have progressed since then, however, this was the latest information available at the time to inform the modelling assumptions.

4.2.1 Planned Road Schemes Overview

Table 4-1: ERM Future Road Schemes

ID	Mode	Scheme Name	Description	In Do Minimum	Delivery Stage
R1	Road	Southern Port Access Route	Development of a road link connecting from the southern end of the Dublin Port Tunnel to the South Port area, which will serve the South Port and adjoining development areas	**X**	In pre-planning stage with ABP application anticipated Q1 2023. Aligned with GDA strategy and funded through Dublin Port Company. Forms key part of Port's Masterplan 2040. www.dublinport3fm.ie
R2	Road	M/N11 Additional Capacity	Capacity enhancement and reconfiguration of the M11/N11 from Junction 4 (M50) to Junction 14 (Ashford) inclusive of ancillary and associated road schemes, to provide additional lanes and upgraded junctions, plus service roads and linkages to cater for local traffic movements	**X**	Has completed Phase 2: Options Selection of the TII Project Management Guidelines. Is name checked in the National Development Plan 2021-2030 and the draft GDA Transport Strategy
R3	Road	N3-N4 Link (Leixlip-Blanchardstown)	N3–N4: Barnhill to Leixlip Interchange	**X**	Included in Draft GDA Transport Strategy Stage, feasibility report not yet published.
R4	Road	N4-N7-N81 Link	North-South Road – west of Adamstown SDZ linking N7 to N4 and on to Fingal	**X**	N4-N7 corridor study published in 2017 and recommends "Western Dublin Orbital Route", GDA Strategy mentions enhancing capacity between N3-N4-N7 but nothing specific – no detail of project advancement beyond this. https://www.tii.ie/tii-library/strategic-planning/strategic-reports/N4_N7-Corridor-Study_Feb17.pdf

ID	Mode	Scheme Name	Description	In Do Minimum	Delivery Stage
R5	Road	N2 Slane Bypass	Enhancements of the N2/M2 national route inclusive of a bypass of Slane, to provide for additional capacity on the non-motorway sections of this route, and to address safety issues in Slane village associated with, in particular, heavy goods vehicles	**X**	Mentioned in GDA Strategy and National Development Plan. Is currently at Phase 3: Design and Environmental Evaluation of the TII Project Management Guidelines. http://www.n2slanebypass.ie/
R6	Road	N2 Upgrade	N2 Upgrade from the M2 Rath Roundabout to Kilmoon Cross to address safety issues	**X**	Mentioned in GDA Strategy and National Development Plan. Is currently at Phase 2: Options Selection of the TII Project Management Guidelines https://www.n2rath2kilmoon.ie/
R7	Road	N3 Junctions and Bus Priority	Junction enhancements and lane layout changes, including bus lane provision, to enhance safety, legibility and bus priority along the N3 between Junction 1 and Junction 4	**X**	Mentioned in GDA Strategy and National Development Plan. Is currently at Phase 2: Options Selection of the TII Project Management Guidelines https://consult.fingal.ie/en/consultation/n3-m50-clonee-non-statutory-public-consultation-scheme-update-emerging-preferred-option
R8	Road	M4 Junctions and Bus Priority	Improvements to junctions 5, 6 and 7 on the M4 in order to address queuing onto the mainline and associated traffic safety issues plus the provision of bus priority between Junctions 5 and 7	**X**	Mentioned in GDA Strategy and National Development Plan Is currently at Phase 2: Options Selection of the TII Project Management Guidelines https://maynoothleixlip.ie/phase-2/
R9	Road	N7 Removal of Uncontrolled Accesses	The removal of all direct uncontrolled accesses onto the N7 between the M50 and Naas, in accordance with the EU Guidelines for the Development of the Trans-European Transport network and	**X**	Mentioned only in GDA Strategy, not in Development plan

ID	Mode	Scheme Name	Description	In Do Minimum	Delivery Stage
			the implementation of measures to facilitate efficient bus operations		
R10	Road	N81 Enhancements and Bus Priority	Safety, alignment and bus priority enhancements to the N81	**X**	Mentioned only in GDA Strategy, not in Development plan
R11	Road	South Fingal Transport Study Roads	Roads as recommended in South Fingal Transport Study	**X**	Outlined in South Fingal Transport Study, no further publications and not mentioned in GDA Strategy or National Development Plan.
R12	Road	Level Crossing removal DART+ West	Closure of 5 level crossing on the Connolly-Maynooth rail line (Ashtown, Coolmine, Porterstown, Clonsilla and Barberstown)	✓	See PT1 DART+ West section below.

4.2.2 Planned Public Transport Schemes Overview

Table 4-2: ERM Future PT Schemes

ID	Mode	Scheme Name	Description	In Do Minimum	Delivery Stage
PT1	Heavy Rail	DART+ West	DART expansion to Maynooth Line, Connolly enhancements, elimination of level crossings, new Docklands Station	✓	Government has approved Preliminary Business Case for the DART+ Programme as a whole. DART+ West has completed a second round of Public Consultation and published the Preferred Route.

ID	Mode	Scheme Name	Description	In Do Minimum	Delivery Stage
					Government has issued Decision Gate 1 approval for DART+ West in line with the requirements of the Public Spending Code. The project therefore has approval to apply to An Bord Pleanála for a Railway Order application once all necessary planning and environmental documentation has been finalised, expected in 2022.
PT2	Heavy Rail	DART+ South West	DART expansion to Hazelhatch, four-tracking between Park West and Heuston, Phoenix Park Tunnel Enhancements	X	Government has approved Preliminary Business Case for the DART+ Programme as a whole. DART+ South West has completed a second round of Public Consultation and published the Preferred Route.
PT3	Heavy Rail	DART+ Coastal North	DART expansion to Drogheda, capacity enhancements through station modifications	X	Government has approved Preliminary Business Case for the DART+ Programme as a whole. DART+ Coastal North at Options Selection Stage, Emerging Preferred Option being developed.
PT4	Heavy Rail	DART+ Coastal South	Elimination of level crossings, possible capacity enhancements at Bray and Greystones	X	Government has approved Preliminary Business Case for the DART+ Programme as a whole. DART+ Coastal South at Options Selection Stage, Emerging Preferred Option being developed.
PT5	Heavy Rail	DART+ Tunnel	Heavy Rail Tunnel linking Docklands (Northern Line) and Heuston Station (Kildare Line)	X	DART+ Tunnel has been deferred in the Draft GDA Strategy until post 2042.

ID	Mode	Scheme Name	Description	In Do Minimum	Delivery Stage
PT6	Heavy Rail	DART Further Expansion	DART expansion to Sallins, Kilcock and Wicklow	X	DART extensions scheduled for the latter period of the Draft GDA Strategy.
PT7	Heavy Rail	Navan Rail Line	The existing rail network in the GDA will be extended by the provision of a new rail line from the M3 Parkway terminus station (just west of Dunboyne) to Navan town, serving Dunshaughlin and Kilmessan along its route	X	Navan Rail Line scheduled for the latter period of the Draft GDA Strategy.
PT8	Light Rail	Metrolink (Swords-Charlemont)	Mostly underground Metro Line from north of Swords to Charlemont via northern suburbs and Dublin Airport including interchange stations with DART network at Glasnevin and Tara Street	X	Preliminary Business Case Submitted to Government in February 2021. Awaiting Decision Gate 1 approval. "TII is targeting the completion of all relevant planning material for MetroLink to allow a Railway Order Application to be made in the first half of 2022." https://www.metrolink.ie/#/news
PT9	Light Rail	Luas Extension to Finglas	Extension of Luas Green Line to Finglas and Charlestown	X	Luas Finglas will be excluded from the Do Minimum scenario and included in the Do Something scenario.
PT10	Light Rail	Luas Extension to Bray	Extension of the Luas Green Line southwards in order to serve the Bray and Environs area	X	Luas Bray scheduled for the latter period of the Draft GDA Strategy.
PT11	Light Rail	Luas Extension to Poolbeg	Extension of the Luas Red Line to Poolbeg	X	Luas Poolbeg scheduled for the latter period of the Draft GDA Strategy.
PT12	Light Rail	Luas to Lucan	Light rail line from Lucan to the City Centre	X	Luas Lucan scheduled for the latter period of the Draft GDA Strategy.

ID	Mode	Scheme Name	Description	In Do Minimum	Delivery Stage
PT13	Light Rail	Luas Green Line Upgrade	Upgrade of Luas Green Line southern section to provide higher frequency	✓	Luas Green Line Upgrade scheduled for the first half of the Draft GDA Strategy.
PT14	Light Rail	Luas lines post 2042	Post 2042 delivery of Luas lines: 1. City Centre to Clongriffin; 2. City Centre to Beaumont and Balgriffin; 3. Green Line Extension to Tyrrelstown; 4. City Centre to Blanchardstown; 5. Red Line Reconfiguration to provide the following lines: a. Clondalkin-City Centre; and b. Tallaght-Kimmage-City Centre. 6. Tallaght to City Centre via Knocklyon; and 7. Green Line Reconfiguration to provide the following lines: a. City Centre to Bray via UCD and Sandyford; and b. Sandyford to City Centre	X	Scheduled for post-2042 in the Draft GDA Strategy.
PT15	Bus	BusConnects Dublin (Core Bus Corridors, New Network, Fare Structure)	BusConnects Dublin programme as per National Development Plan including the 12 Core Bus Corridors	✓	The Preliminary Business Case for the BusConnects programme has been submitted to Government for approval. Network rollout to be completed by 2024. Fare structure largely implemented November 2021. Three very large public consultations held on Core Bus Corridors, planned to be submitted for planning upon Decision Gate 1 approval by government.

ID	Mode	Scheme Name	Description	In Do Minimum	Delivery Stage
					BusConnects Core Bus Corridors scheduled for the first half of the Draft GDA Strategy. https://busconnects.ie/ https://www.kildarestreet.com/wrans/?id=2021-12-16a.98
PT16	Bus	High Capacity Vehicles on CBCS	Introduction of Higher Capacity Vehicles on some BusConnects corridors to increase capacity	X	Higher Capacity Vehicles on CBCs scheduled for the latter period of the Draft GDA Strategy
PT17	Bus	Additional Corridors (Orbital, Regional, Additional Radial)	Additional Bus Priority Radial routes within Dublin, development of Orbital Core Bus Corridors within Dublin, and Regional Core Bus Corridors on National Roads Approaching Dublin	X	Additional CBCs scheduled for the latter period of the Draft GDA Strategy
PT18	Bus	Connecting Ireland: New Rural Bus Services	Connecting Ireland is the NTA's programme to address the gaps in connections to local and regional centres in rural Ireland, to allow for the access to local services without the need for a car and to provide the option of more sustainable transport across the region	✓	"Rollout of new and improved services will happen on a phased basis from 2022 to 2025." https://www.nationaltransport.ie/connecting-ireland/timeline-and-what-were-doing-next/
DM1	Demand Management	GDA Demand Management Measures	Demand Management Measures include restrictions on Workplace and on-street parking, congestion charging, additional tolls on radial motorways and along the M50	X	No specific information on Demand Management measures to implemented by 2035. Demand Management measures likely to improve performance of Luas Finglas against scheme objectives, therefore exclusion a prudent approach.

4.2.3 Planned Active Travel Schemes Overview

Table 4-3: ERM Future Active Travel Schemes

ID	Mode	Scheme Name	Description	In Do Minimum	Delivery Stage
AT1	Active Travel	Greater Dublin Area Cycle Network Plan (including Radial Core Bus Corridor elements)	The cycle network has been based on the Greater Dublin Area (GDA) Cycle Network plan and includes the Radial Core Bus Corridor elements.	✓	Cycle Network scheduled for the first half of the Draft GDA Strategy. Large increase of funding to €360m/year allocated to 2025.

4.3 Do Something Scenario

The Do-Something future year modelling scenario includes all the Do-Minimum schemes outlined in the previous section, plus the proposed LUAS Finglas extension. The following sections provide an overview of how Luas Finglas has been represented in the ERM, including information on:

- **Characteristics**: capacities, headways, scheduling etc.
- **Alignment**: Route coding, distances and travel times
- **Road Network Coding**: details of how the interaction between the Luas and road network has been represented within the model coding; and
- **ERM Assignment Parameters**: overview of the key parameters used to represent the Luas Finglas in the Public Transport Assignment model.

4.3.1 Characteristics

Table 4-4 outlines some of the key characteristics which have been used to model the Luas Finglas extension. For tram capacity, it has been assumed that the longer trams introduced as part of the Luas Green Line Capacity Enhancement Project will operate on the extension to Finglas. These are 55m trams with a seat capacity of 96 and overall passenger capacity of 408[6].

It has been assumed that the service pattern for the Finglas Extension will include trams operating between Charlestown and Brides Glen with an average headway of 7.5 minutes in all modelled time periods for the Core Scenario in 2035. This headway has been reduced to 5 minutes in the design year 2050.

Table 4-4: Luas Finglas ERM Parameters in GDA Strategy Run

Parameter (Luas Finglas)	Value
Tram Seat Capacity	96
Overall Tram Passenger Capacity	408
Headway	7.5 mins (2035) / 5 mins (2050)

4.3.2 Alignment

Figure 4-2, outlines the Preferred Route for Luas Finglas which has been coded within the ERM Public Transport Model. It also illustrates the ERM zones in proximity to the Luas alignment, along with their connectors to the walk network facilitating access to the Luas stations.

[6] Details available at: https://www.nationaltransport.ie/planning-and-investment/transport-investment/projects/luas-green-line-capacity-enhancement/

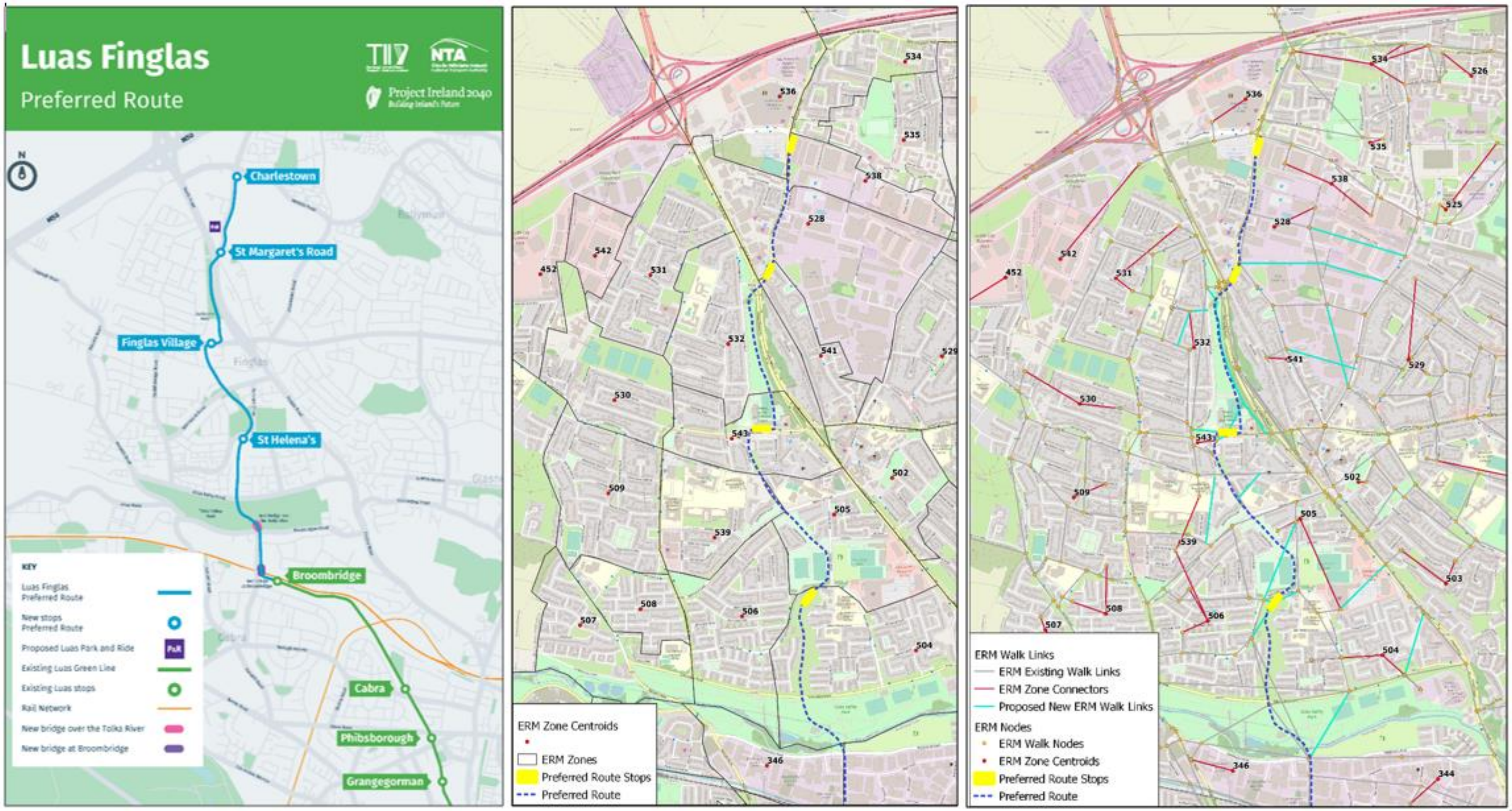


Figure 4-2: Preferred Luas Finglas Route Alignment and ERM Zone System

4.3.2.1 Walk Network and Links to Stations

Walk links have been generated in the ERM connecting the Luas stations to their nearest road network node, representing the station access points as accurately as possible. The ERM zone centroids have been calculated using GeoDirectory weightings to ensure their loading points are reflective of the average access to the network for each zone.

SYSTRA has undertaken a detailed review of the walk network along the Luas alignment to ensure that access is represented as accurately as possible. These new links, highlighted in Figure 4-2, represent walk access through housing estates, green areas, local streets etc. which may not have been included in the overall ERM road network. This ensures that walk access times to the Luas are represented as accurately as possible and that residents are loading on at the correct stations.

4.3.3 Run Times

Table 4-5 outlines the proposed distances between stations and overall travel time (including dwell time at stations) along the route. The proposed travel time has been taken from assumptions within the Initial Operation Plan for the Luas Finglas extension. In total, it is estimated that a journey from Charlestown to Broombridge will take 12.7 minutes.

Table 4-5: Luas Finglas ERM Parameters in GDA Strategy Run

Origin Station	Destination Station	Distance (km)	Total Time (sec)	Tot Time (min)
Charlestown	St. Margaret's Road	0.682	100	1.67
St. Margaret's Road	Finglas Village	0.846	165	2.75
Finglas Village	St. Helena's	1.025	237	3.95
St. Helena's	Broombridge	1.433	260	4.33
Total		***3.986***	***762***	***12.70***

4.3.4 Road Network Coding

The preferred route for the Luas Finglas Extension (Figure 4-2) will interact with the surrounding road network at a number of locations – new signalised junctions are proposed at Ballyboggan Rd, Tolka Valley Rd, St. Helena’s Rd, Wellmount Rd, Cappagh Rd, Mellowes Rd, North Rd (R135) and along St. Margaret’s Rd to the terminus at Charlestown.

It is important that these road network changes are included in the Do-Something ERM assignment to reflect the impact of the Luas Finglas on strategic re-routing of traffic, journey times for vehicular traffic, congestion and mode choice. The latest available junction design drawings have been used to represent the network changes due to Luas Finglas in the ERM road assignment. A simplified version of the signalised junction coding, including signal phasing has been included. At some junctions, the Luas can cross in conjunction with a non-conflicting traffic phase. Where this is not possible, it is assumed the Luas will cross the junction during an elongated pedestrian crossing phase. This longer pedestrian phase will slightly decrease vehicular capacity at these junctions. The individual signal timings have been optimised within SATURN in an attempt reflect the use of SCATS once operational.

One of the main junctions impacted along the Luas alignment is the R135/St. Margaret's Rd roundabout. The following section provides further details on how the proposed junction changes at this location have been included in the ERM SATURN road assignment including signal phasing and assumed Luas crossing times. Similar analysis has been undertaken for all other junctions along the Luas route, and they have been updated accordingly within SATURN.

4.3.4.1 R135 / St. Margaret's Road Junction

Figure 4-3 outlines of one of the design proposals[7] for the North Rd/St. Margaret's Rd junction along with its representation within SATURN. Figure 4-4 provides an overview of the proposed simplified signal phasing used in the initial ERM SATURN assignment.

Figure 4-3: R135/St. Margaret's Road Do-Something SATURN Coding

[7] Design proposals correct at the time of modelling (Summer 2022)

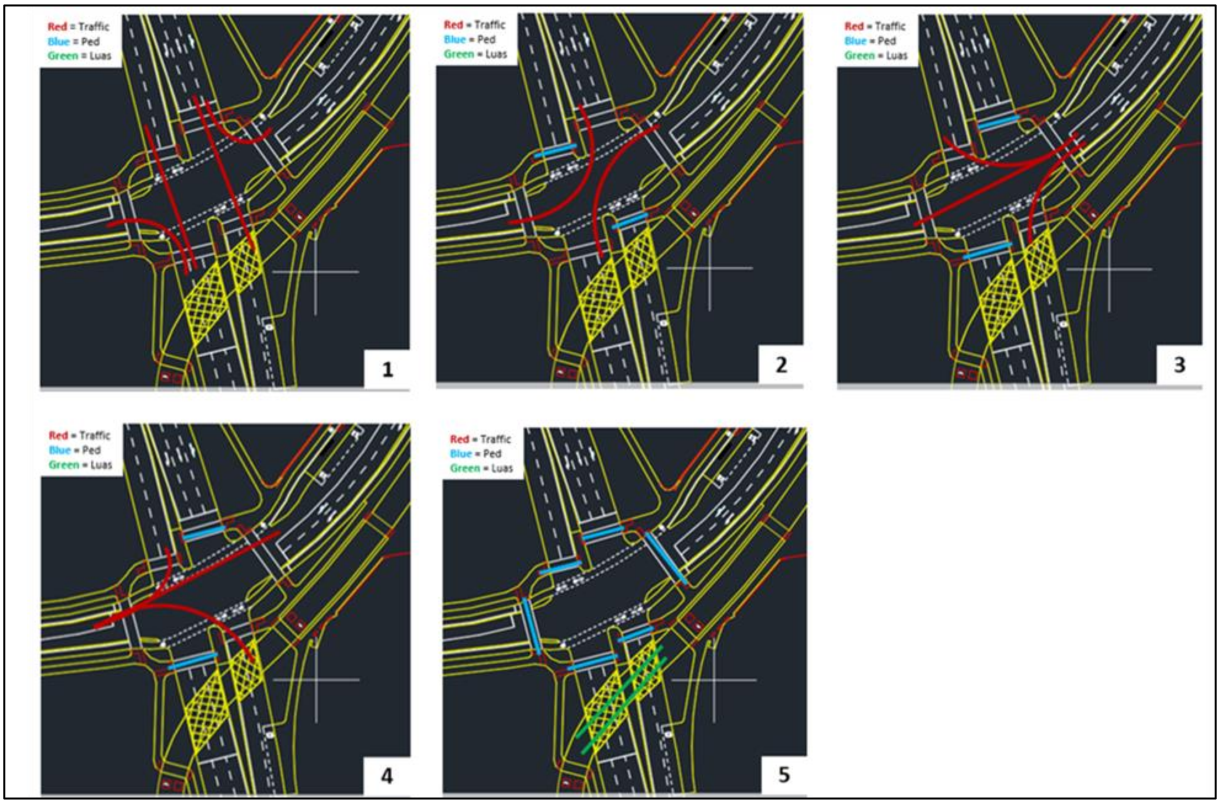


Figure 4-4: R135/St. Margaret's Road Do Something Indicative Traffic and Pedestrian Phasing

in SATURN it has been assumed that all traffic stops while the Luas is crossing the junction and all pedestrian crossings are green. Based on this assumption, traffic phasing was devised that prioritised North-South movements along the R135 and any possible pedestrian crossing phases.

To calculate the intergreen/all-pedestrian phase, it has been assumed that a Luas crossing occurs every 3.75 minutes, given the 7.5-minute headway in each direction proposed for 2035. A standard 120 second cycle time is being used for the junction. Using the 20kph Luas max speed approaching a station (given the proximity of the St. Margaret's Road station) in the Initial Operation Plan, the junction width and a 54.6m tram length, it has been calculated that it will take 16 seconds for a Luas to cross the junction. In addition to a 5 second intergreen time before and after, the Luas crossing phase will last 26 seconds.

Given the 120s cycle time and a 3.75-minute Luas headway, a Luas crossing will not occur every cycle. When a Luas is not crossing, an all-pedestrian phase will still occur but won't require the full 26 seconds. As illustrated in Figure 4-4, the pedestrian crossing at the east (Casement Road) and west (St. Margaret's Road) arms of the junction can't go until the all-pedestrian phase, and as such, these crossings are prioritised. Using *QuickGreen Intergreen Calculator software*, a 15 second intergreen time for the longer St. Margaret's Road crossing was derived.

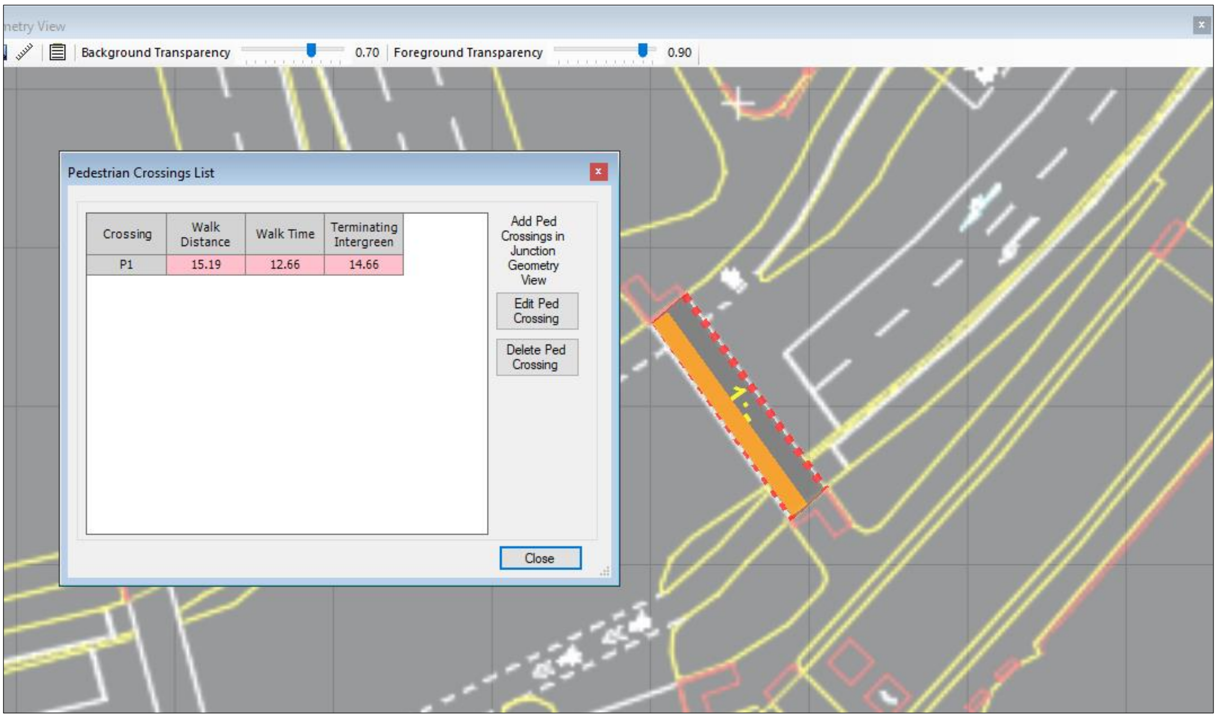


Figure 4-5: St. Margaret's Road Do Something Pedestrian Crossing Time in QuickGreen Intergreen Calculator

SATURN requires signal phase times for an average cycle throughout the peak hour. Therefore, a representative average time for the all-pedestrian/Luas crossing phase was needed:

- **With Luas:** 26 second all-red phase required
- **Without Luas:** 15 second all-red phase required
- **3.75 min Luas Headway:** Extra 11 seconds required every 3.75 mins (3 seconds extra per minute)
- **120 second cycle:** Average 6 additional seconds required for Luas on top of pedestrian crossings
- **Total All-Red phase:** 15 seconds (Pedestrian) + 6 seconds (Luas) = 21 seconds every cycle on average

It should be noted that this junction, and all others impacted by the Luas alignment, will be assessed in further detail through the design process using microsimulation modelling to reflect expected phasing as accurately as possible. The design of the junctions will be an iterative process between design and modelling to determine the preferred solution.

4.4 ERM Assignment Parameters

The following sections provide an overview of the key parameters used within the ERM Public Transport Assignment model. These parameters have been calibrated as part of the 2016 NTA Regional Model System calibration, and as such, it is recommended that they are retained for the Luas Finglas modelling.

4.4.1 Public Transport Generalised Cost

A person's choice of mode of travel is linked to the generalised costs associated each option available to them. In terms of public transport, the equation used to calculate the generalised cost for users is as follows:

Generalised cost = (A X Walk Time) + (B X Wait Time) + Boarding Penalty + Transfer Penalty + (C X In-Vehicle Time) + (Fare)

Where:

- Walk Time = time spent walking to access a public transport service
- Wait Time = time spent waiting at the station/stop for a service to arrive
- Boarding Penalty = penalty applied to represent the time associated with boarding a public transport service
- Transfer Penalty = penalty applied to represent the time and inconvenience associated with transferring between public transport services
- In-vehicle Time = time spent while travelling on a public transport service which may be factored to represent crowding impacts
- Fare = fare paid to undertake travel on public transport
- A = weighting applied to convert actual walk time into a perceived walk time for calculation of overall generalised cost. A value of 1.6 is included in the 2016 calibrated ERM
- B = weighting applied to convert actual wait time into perceived values for calculation of overall generalised cost. A value of 2 is included in the 2016 calibrated ERM; and
- C = Mode specific weight applied to the in-vehicle travel time to represent the perceived preference of one mode versus another. Values for these weightings have been derived for the ERM from stated preference research.

4.4.2 Calibrated Parameters

Table 4-6 outlines the ERM calibrated values for walk time factor, wait time factor, in-vehicle time factor and the boarding penalty. It is recommended that these values are retained as part of the Luas Finglas ERM modelling.

Table 4-6: Luas Finglas ERM Parameters in GDA Strategy Run

Parameter	Value	Source
Walk Time Factor (A)	1.6	TAG[8] suggests values between 1.5 and 2.0. A walk time factor of 1.6 was calibrated in the ERM model, following stated preference study recommendations.
Wait Time Factor (B)	2.0	TAG suggests values between 1.5 and 2.5. A mid-range value of 2.0 was used for the ERM calibration.
In-Vehicle Time Factor (C)	Rail = 1.3 Bus = 1.5 LUAS = 1.0 Metro = 1.0	ERM calibration process started with initial values from BRT stated preference research, which were then refined to improve sub-mode share during model calibration.
Boarding Penalty	5 minutes	Derived during model calibration based on observed boarding data.

4.4.3 Transfer Penalty

The Transfer Penalty reflects the cost of interchanging from one mode to another and the quality of the waiting facilities (information, security etc.). Table 4-7 outlines the values for Transfer Penalty calibrated in the 2016 ERM to match observed data on levels of interchange between public transport modes within Dublin City. It is recommended that these values are retained as part of the Luas Finglas ERM modelling.

Table 4-7: Luas Finglas ERM Parameters in GDA Strategy Run

Transfer	Time Penalty (mins)
All Modes to/from DART/Rail	15
Dublin City Bus to/from Dublin City Bus	15
Other Transfer	5

4.4.4 Fares

The BusConnects 90-minute fare structure has been applied for the Luas Finglas ERM runs. The public transport assignment within the ERM includes a simplified representation of fare structure by operator, with an average fare applied which is representative of all ticket types available.

A key element of the BusConnects fare structure is the facility to accommodate 90 minutes of travel across Dublin City Bus, Luas and Irish Rail without penalising the passenger for making an interchange. The best methodology to implement this within the ERM is to specify a single fare structure that covers all travel across these modes.

The single 'Short Distance Fare' has been set at a Leap value of €1.60 and the 'Longer Distance Fare' at €2.50. Analysis was undertaken to determine the weighted average fare paid across all ticket types using available ticket sales data. This analysis was used to calculate the percentage discount applied to the Leap single fare to estimate the average fare across all ticket types to be applied in the ERM.

[8] UK Department for Transport (DfT) Transport Analysis Guidance (TAG) provides information and guidelines for transport modelling and appraisal.

5. LUAS FINGLAS MODELLING RESULTS

5.1 Introduction

The following chapter presents the modelling results for Luas Finglas for the years 2035 and 2050, focusing on:

- Luas Finglas Catchment Analysis
- Passenger Boardings and Public Transport Flows
- Public Transport Journey Times
- Travel Demand and Mode Share;
- Transport Capacity

5.2 Luas Finglas Catchment Analysis

5.2.1 ERM vs Walk Catchment

The Openroute Service (ORS) plugin for QGIS[9] was used to identify the walk catchment to Luas Finglas stations. It uses the latest Open Street Map network which contains a detailed representation of the road network including residential streets and walking paths. As such, the walk distance to stations is reflective of the available network including elements such as impermeable housing estate links, cul de sac roads etc.

The GIS walking catchment was then compared to the boarding catchment from the ERM for the 2035 AM peak hour and the results are illustrated in Figure 5-1. The blue dotted line represents the areas within a 20-minute walk (based on an average walk speed of 4.8km/hr) of the proposed Luas Finglas stations. Whilst the red shaded areas represent ERM boarders of Luas Finglas by ERM zone, with the darker areas representing higher levels of boarding.

Overall, the results indicate that the modelled ERM boarding catchments for Luas Finglas are sensible. The pattern of modelled boardings in the AM Peak Hour in 2035 at a zone level shows that few boardings come from zones more than a 20-minute walk from a Luas Finglas station. Most boardings come from zones close to a station with a visible correlation between proximity to a station and boardings.

[9] © openrouteservice.org by HeiGIT | Map data © OpenStreetMap contributors

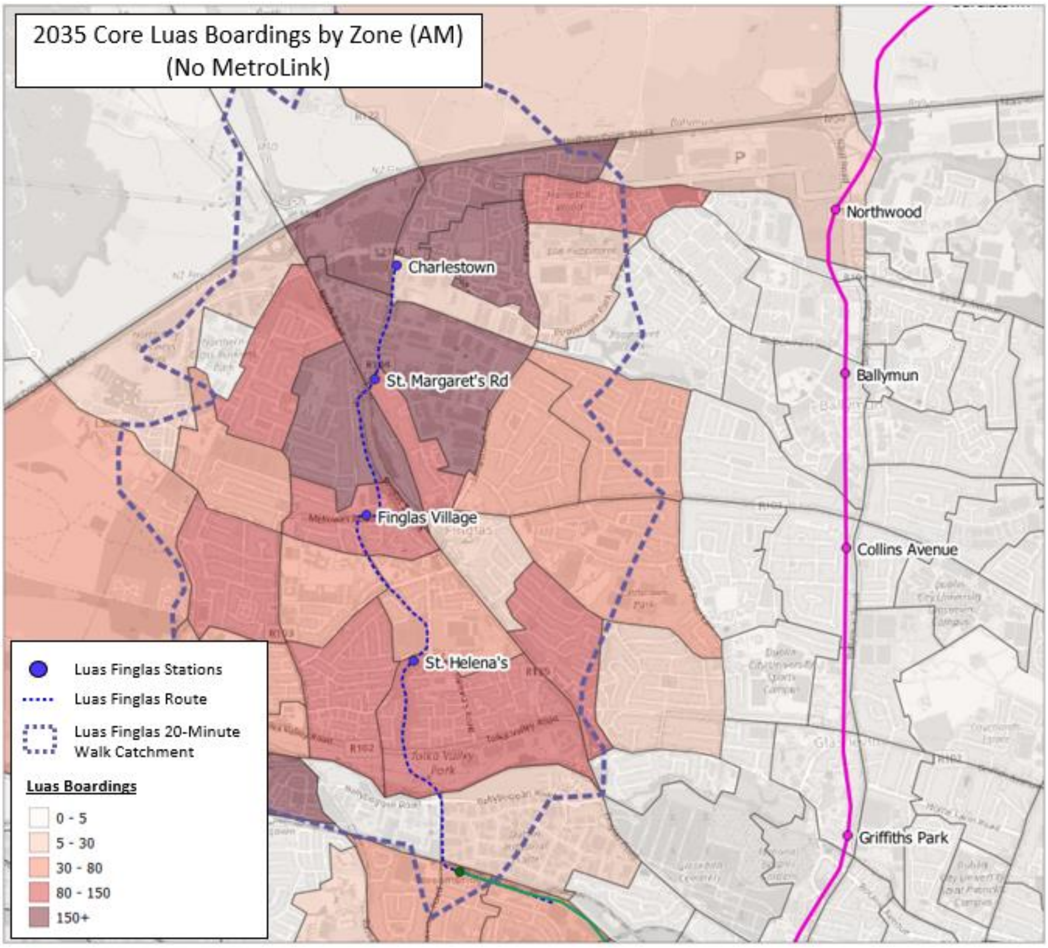


Figure 5-1: Luas Finglas Boarding Catchment (2035 AM)

5.2.2 Population Growth

As outlined in Section 3, detailed analysis was undertaken to estimate future population levels for the ERM using reference case planning sheets. The analysis suggests that within the catchment area around Luas Finglas, the population is forecasted to grow by over 10,500 people (23%) by 2035.

Luas Finglas will pass close to a number of significant development areas, including:

- The Charlestown Centre Phase 2 and Charlestown Place SHD with planning permission granted for 967 residential units;

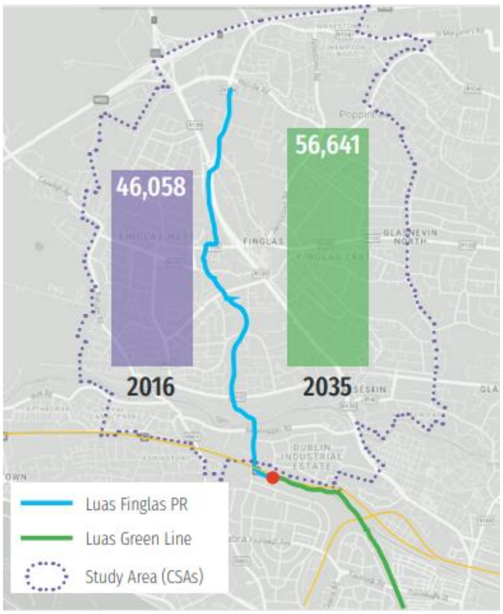


Figure 5-2: 2016-2035 Population Growth Estimate

- The Jamestown Strategic Development and Regeneration Area (SDRA) with the draft Masterplan indicating delivery of 3,500 – 3,800[10] new homes; and
- The proposed regeneration of the Dublin Industrial Estate lands. At the time of writing this report, Dublin City Council (DCC) are preparing a Local Area Plan for these lands. Similar to the Jamestown SDRA, it is envisaged that the Dublin Industrial Estate lands will be redeveloped with more of a focus on residential use.

It is expected that 73% of the forecasted population growth in Finglas will be within a 10-minute walk of a Luas stop. 55% will be within a short 5-minute walk. This shows the success of the scheme in serving these areas of planned major development, contributing to the high level of boardings presented in Section 5.3.

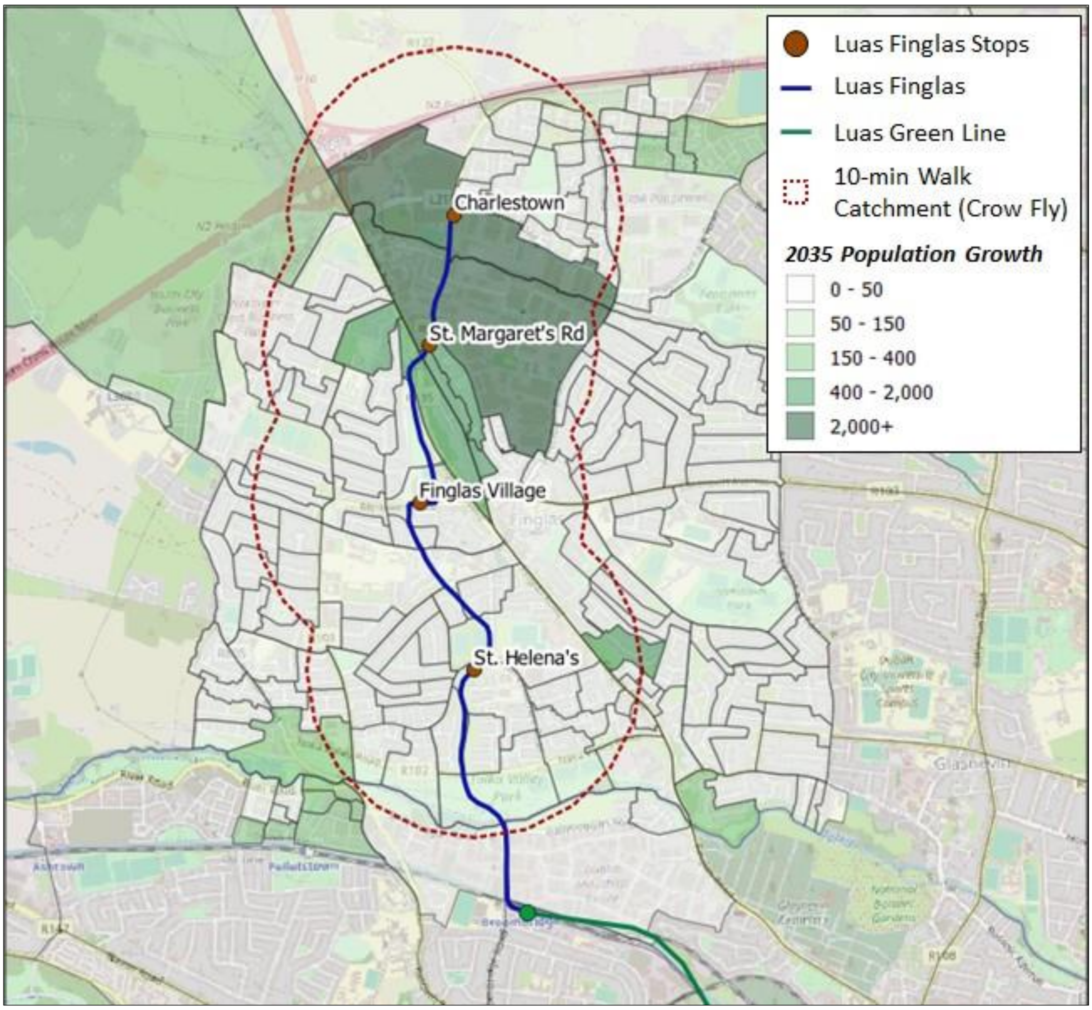


Figure 5-3: Population Growth by CSA in the Study Area (2016 – 2035)

10 https://consultation.dublincity.ie/planning/draft-jamestown/supporting_documents/Draft Jamestown Masterplan 2023.pdf

5.2.3 Accessibility & Social Inclusion

Figure 5-6 illustrates the 2016 POBAL Deprivation Index along with the Luas Finglas 10-minute crow-fly walk catchment. In total, 10,212 people who are identified as 'disadvantaged' will live within a 10-minute straight-line catchment of a Luas Finglas station.

Developing and constructing Luas Finglas will support improvement through increased accessibility to work, education, health and community facilities. It will provide direct connectivity to TU Dublin and Trinity College, and in general bring education, jobs, and leisure activities to within greater reach of a significant number of currently disadvantaged residents.

Through an integrated public transport network, Luas Finglas will support accessibility to major destinations beyond the direct catchment of the extension. For example, St James' Hospital and the new National Children's Hospital will be accessible via Luas Finglas and a single transfer to the Red Luas Line. St Vincent's Hospital can be accessed via interchange with the future DART at Broombridge or bus connections via transfer in the city centre.

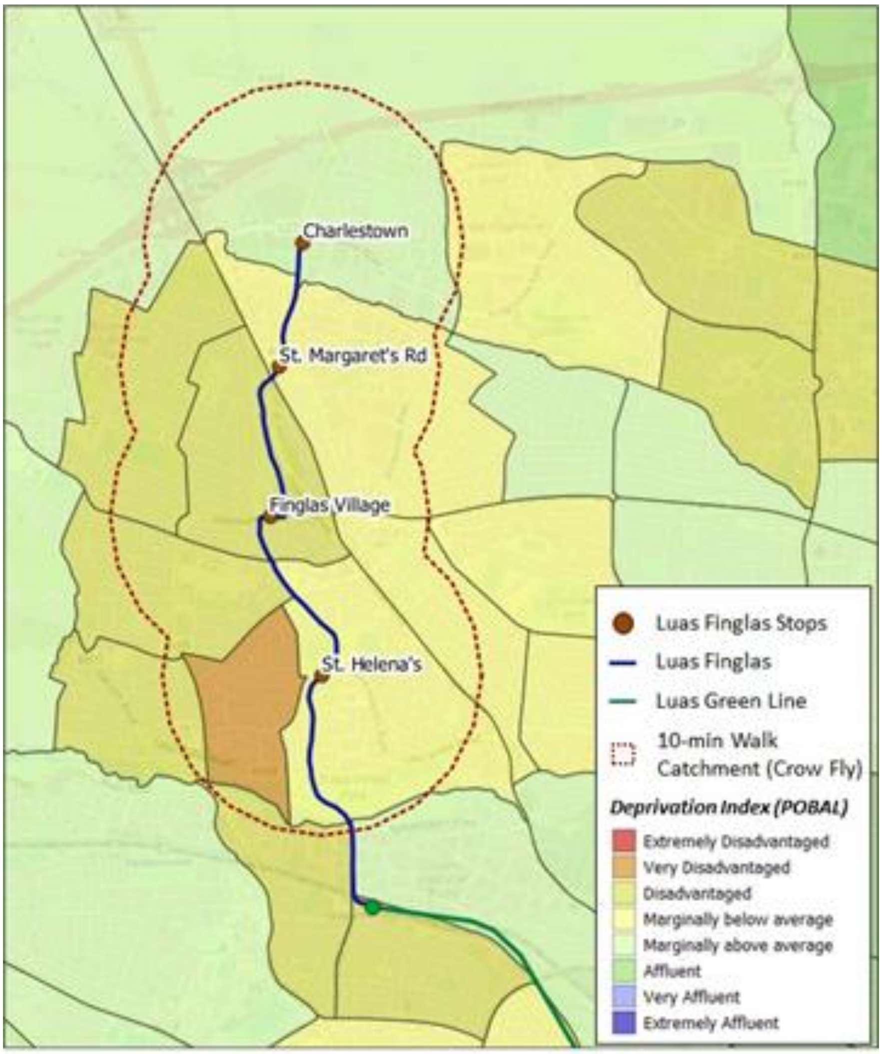


Figure 5-4: Deprivation Index and Luas Finglas Walk Catchment (Crow Fly)

5.3 Passenger Boardings

Luas Finglas will provide a high capacity, frequent and reliable public transport services shortening journey times from Finglas to Dublin city centre and other destinations through direct services or interchange with other services. Luas Finglas will benefit those living or working in walking distance to a stop, in addition to those travelling from further afield and accessing the line via bike, bus or by car through the proposed Park & Ride site at St Margaret's Road.

Table 5-1 outlines the total boardings in both directions at the Luas Finglas stations across the representative modelled peak hours in 2035. The ERM results indicate that Luas Finglas will be well used, with over 3,600 boardings across the four stations in the AM peak. The largest number of boardings are at the Charlestown Place and St Margaret's Road stations which serve the very large quantum of new and proposed development in the study area. As outlined in Section 3.2 previously, Charlestown has planning for 967 residential units whilst the Jamestown SDRA was initially proposed for 2,200 additional residential units (this has since been revised upwards as part a Masterplan for the area).

Table 5-1: 2035 Peak Hour Boardings, Luas Finglas Stations (both directions)

Station/Peak Hour	AM	LT	SR	PM	OP
Charlestown	1,291	243	168	341	138
St. Margaret's Road	955	184	117	139	93
Finglas Village	782	199	190	326	130
St. Helena's	670	174	124	165	88
Total	***3,697***	***799***	***599***	***970***	***449***

Table 5-2 outlines the total alightings in the 2035 modelled peak hours. The relatively tidal nature of usage on the Luas Finglas line can be seen through the concentration of boardings in the AM peak hour and alightings during the SR and PM periods. Compared to the boarding profile, the alighting profile is more evenly spread between the stations.

Table 5-2: 2035 Peak Hour Alightings, Luas Finglas Stations

Station/Peak Hour	AM	LT	SR	PM	OP
Charlestown	257	162	620	783	144
St. Margaret's Road	113	110	350	751	126
Finglas Village	319	143	278	503	115
St. Helena's	160	132	297	500	124
Total	***848***	***548***	***1,545***	***2,537***	***509***

As would be expected given the projected population growth with the study area in both the short and medium term (see section 5.2.2), modelled boardings are substantially higher in 2050 than 2035. AM peak hour boardings grow to over 5,067 representing a 37% increase. This is reflective of the growth in population around the Luas Finglas stops and also the proposed increase in frequency of service.

The pattern of very large numbers boarding at Charlestown Place and St. Margaret's Road is magnified in 2050 as all the projected development around these stops come to fruition. Growth is more modest, although still significant, at the other two stations.

Table 5-3: 2050 Peak Hour Boardings, Luas Finglas Stations

Station/Peak Hour	AM	LT	SR	PM	OP
Charlestown	1,700	287	201	506	152
St. Margaret's Road	1,549	253	155	199	123
Finglas Village	953	220	208	423	144
St. Helena's	865	189	136	225	97
Total	***5,067***	***949***	***699***	***1,352***	***515***

Similarly when looking at alightings, there is a large increase evident between 2035 and 2050, most notably during the School Run and PM peak hours. Growth is relatively evenly split across all four stops during the school run, while the pattern of higher usage at St Margaret's Road and Charlestown Place is evident in the PM. Luas Finglas is a key enabler of the planned development around St Margaret's Road and Charlestown.

Table 5-4: 2050 Peak Hour Alightings, Luas Finglas Stations

Station/Peak Hour	AM	LT	SR	PM	OP
Charlestown	324	184	765	1,015	161
St. Margaret's Road	151	150	505	1,223	179
Finglas Village	412	159	325	638	126
St. Helena's	231	152	355	639	136
Total	**1,117**	**645**	**1,950**	**3,516**	**602**

5.3.1 Luas Line Profile

The line flows for the AM peak hour in 2035 along the Luas Green Line are presented in Figure 5-5 below, showing the patterns of boarding and alighting along the line. The grey line shows the total passenger load along the line at each station.

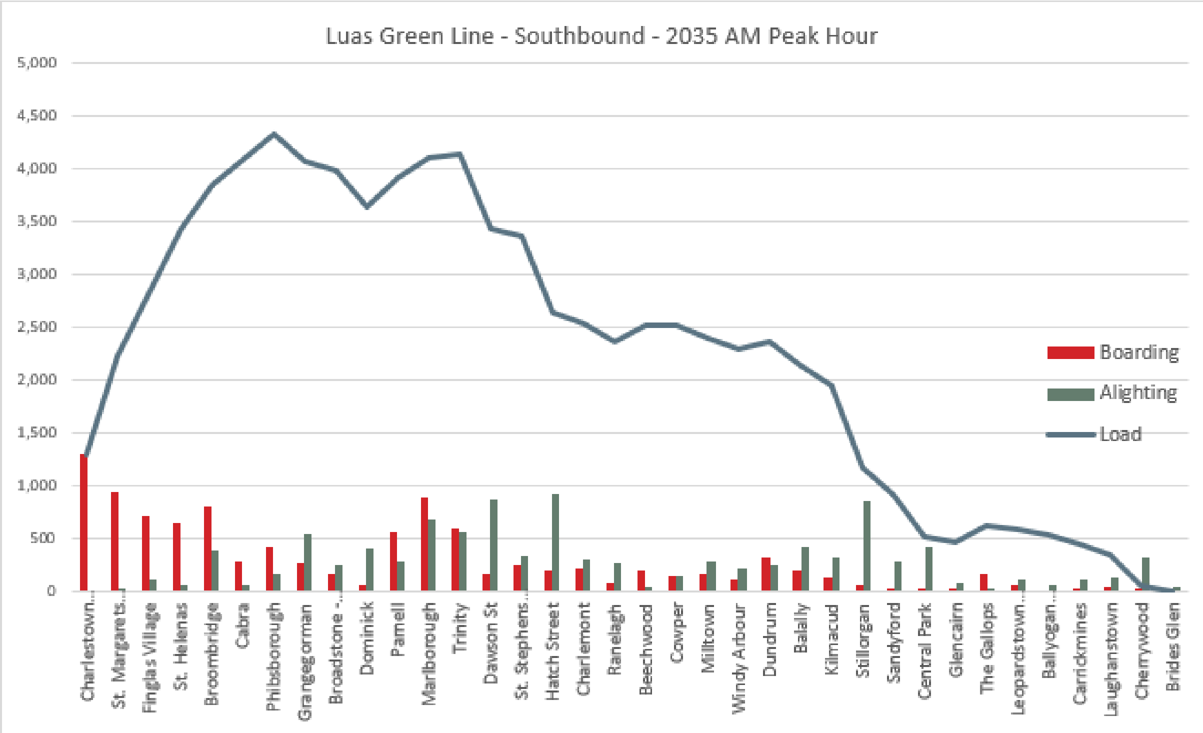


Figure 5-5: Line Flow for Luas Green Line Southbound for the AM Peak Hour in 2035

The line flows indicate that the Luas Finglas stations will be four of the best used stations along the line. Alightings are mainly concentrated at city centre stations as expected.

Similarly during the PM peak hour in a Northbound direction the Luas Finglas stops are among the four the best used in terms of alightings, the two most northern stops in particular. Broombridge is another station north of the city centre with a large number of alightings due to surrounding population levels and potential interchange with DART+ services.

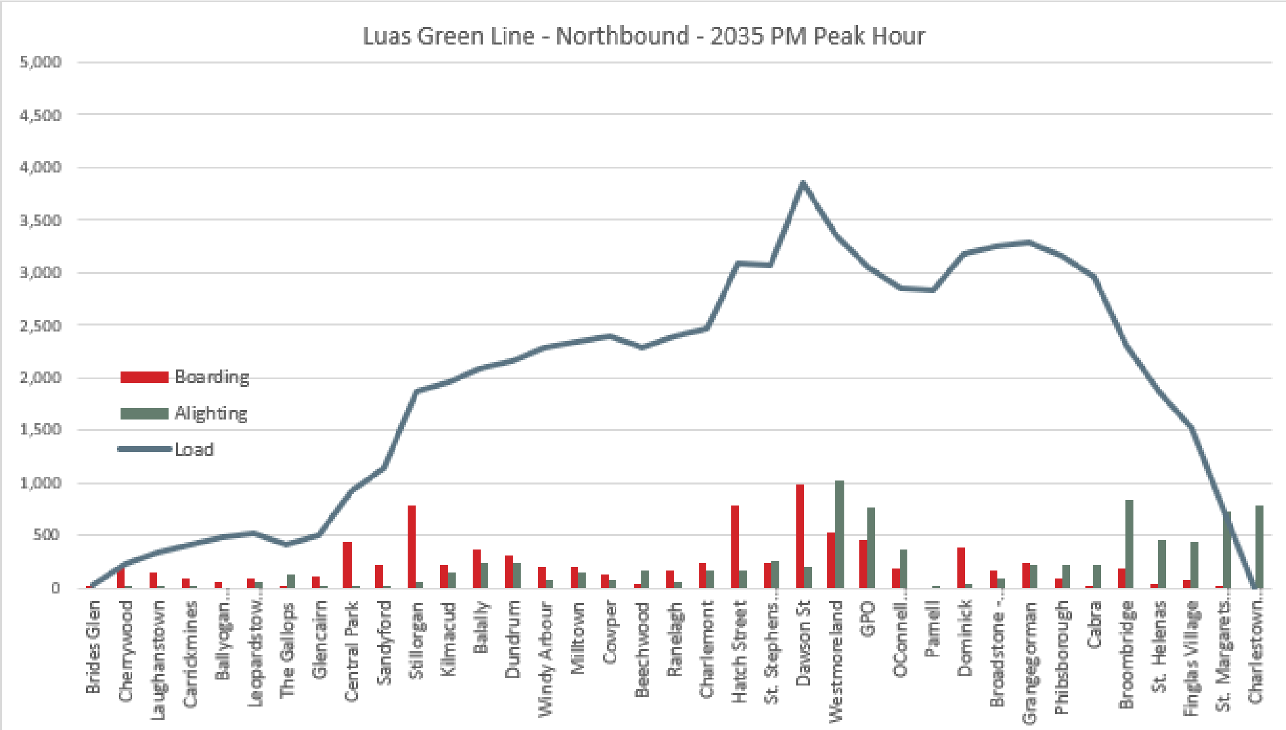


Figure 5-6: Line Flow for Luas Green Line Northbound for the PM Peak Hour

Line profile results for all time periods for the 2035 and 2050 modelled years are provided in Appendix A.

5.3.2 Interchanges

ERM outputs were extracted for the number interchanges between public transport services in the catchment area around Luas Finglas stations, and the results for the 2035 AM peak Do-Minimum and Do-Something scenarios are illustrated in Figure 5-7.

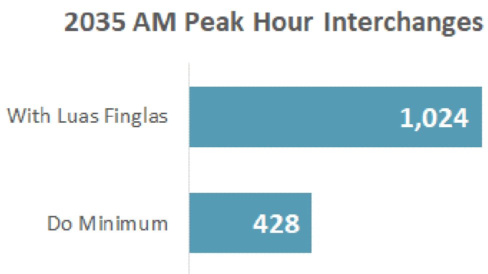


Figure 5-7: Public Transport Interchange by Scenario (2035 AM Peak Hour)

Modelling analysis indicates there will be 1,024 public transport interchanges in the AM peak hour within the north-west of the city during the opening year of Luas Finglas (2035), over twice as many that would occur without the delivery of the scheme. This high number of public transport interchanges illustrates the integration of Luas Finglas with the wider network.

These arise mainly from interchange between Luas and bus and Luas and DART+ services. Bus interchanges occur at Charlestown and Finglas Village stations with the new BusConnects Network E Spine, F Spine and N Orbital bus routes (see Figure 5-8). Luas and DART+ interchanges occur at Broombridge station, which is a high quality interchange location due to a redesign as part of the Luas Cross City project that will have a high level of heavy rail service arising from the DART+ West project. The level of integration with other high quality public transport services further increases the utility of Luas Finglas to the surrounding population.

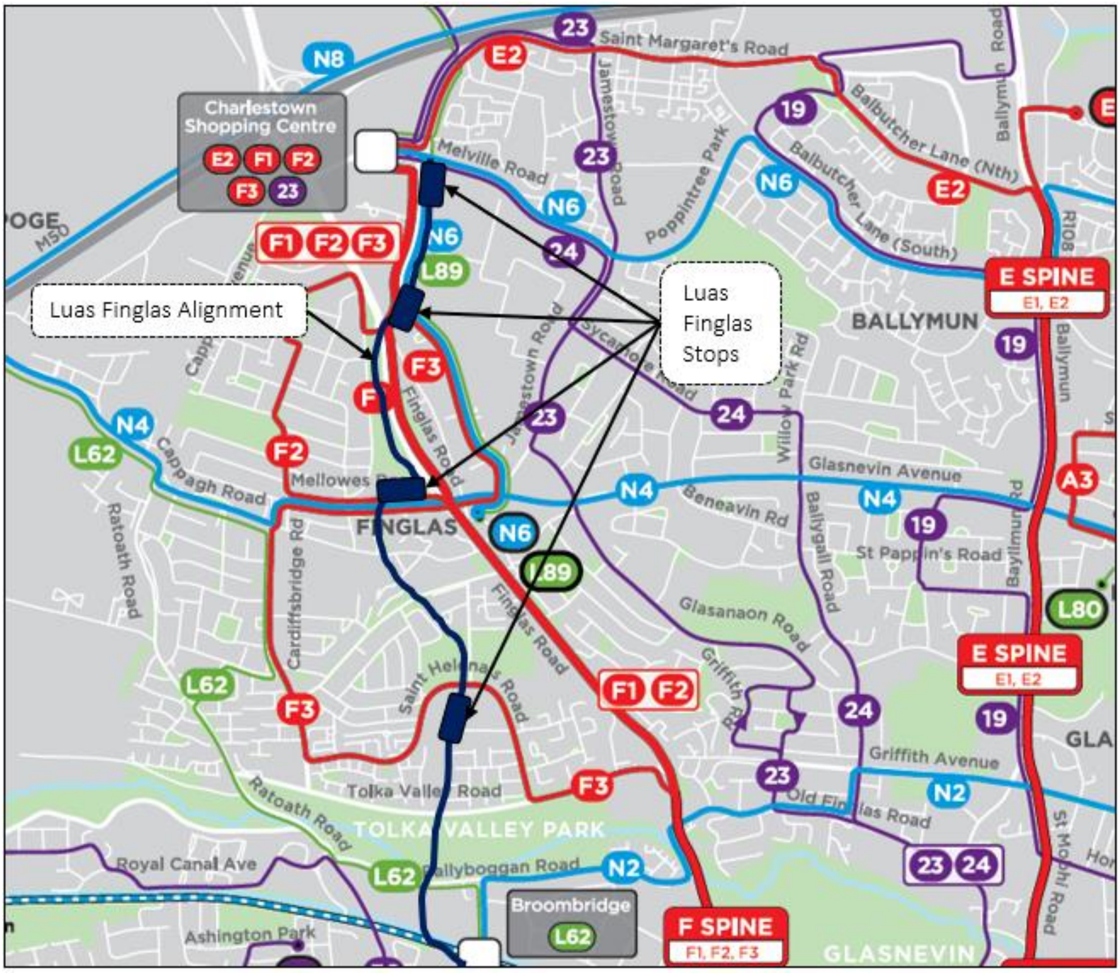


Figure 5-8: Luas Finglas and BusConnects Network

5.4 Public Transport Journey Times

As an extension to the Luas network, Luas Finglas services will, to a significant extent, utilise existing infrastructure. Together with the current Luas infrastructure between Broombridge and the City Centre, Luas Finglas will operate within a 7.5km corridor between Charlestown and the City Centre that is largely segregated from traffic. Luas Finglas will deliver a reliable public transport service offering journey times of 30-minutes from Charlestown to Trinity College.

Analysis was undertaken of the demand weighted average journey time from zones within the Luas Finglas ERM catchment to the city centre[11] by public transport and car in the Do-Something scenario (2035 AM peak). The results of this analysis are illustrated in Figure 5-9 and indicate that the delivery of Luas Finglas

[11] Taken to be Trinity College for the purpose of this analysis

will lead to an average reduction in journey times to the city centre of 15 minutes (over 30%) during the congested peak periods when compared to travel via private car.

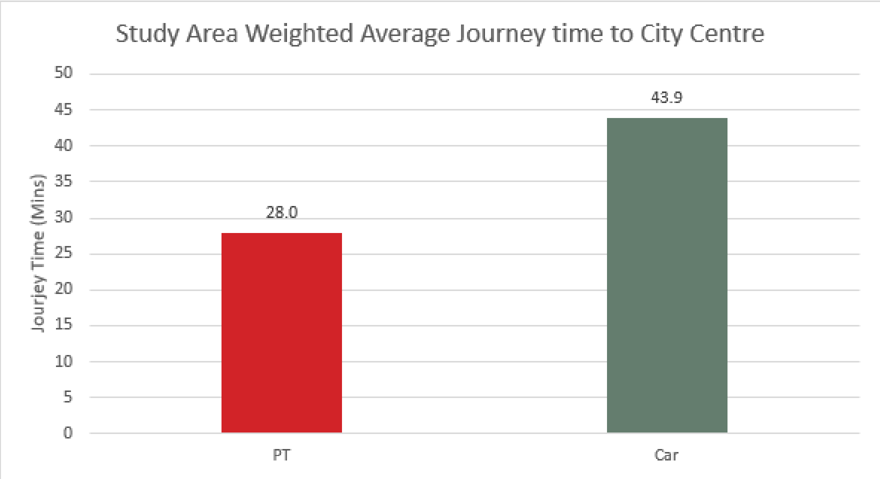


Figure 5-9: AM Peak Hour Average Car and PT Journey Time from Study Area to the City Centre

Taking the journey from Charlestown to Trinity College as an indicative example, journey time by Luas Finglas is expected to be around 30 minutes in the AM peak, whilst the equivalent trip by car in 2035 is estimated to take approx. 47 minutes.

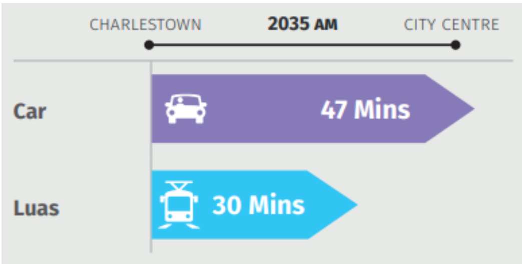


Figure 5-10: 2035 AM Journey Time Comparison

Similar analysis was undertaken for public transport journey times from the Luas Finglas catchment to the city centre in the Do-Minimum vs Do-Something scenario. The results are illustrated in Figure 5-11 for the 2035 AM peak hour, and indicate that Luas Finglas will significantly reduce public transport journey times between the Finglas area and the city centre by an average of 12% (just under 4 minutes) during the AM peak hour.

Luas Finglas provides an off-road light rail link almost completely separated from vehicular traffic. Even with the introduction of the BusConnects Core Bus Corridors, buses will have to contend with traffic on some links at pinch points and delays at busy junctions, particularly closer to the city centre. The segregation provided by the Luas Finglas results in shorter public transport journey times. This reduction in journey time increases the attractiveness of public transport compared to other modes. It also results in quality of life and economic benefits for public transport passengers resulting from travel time savings.

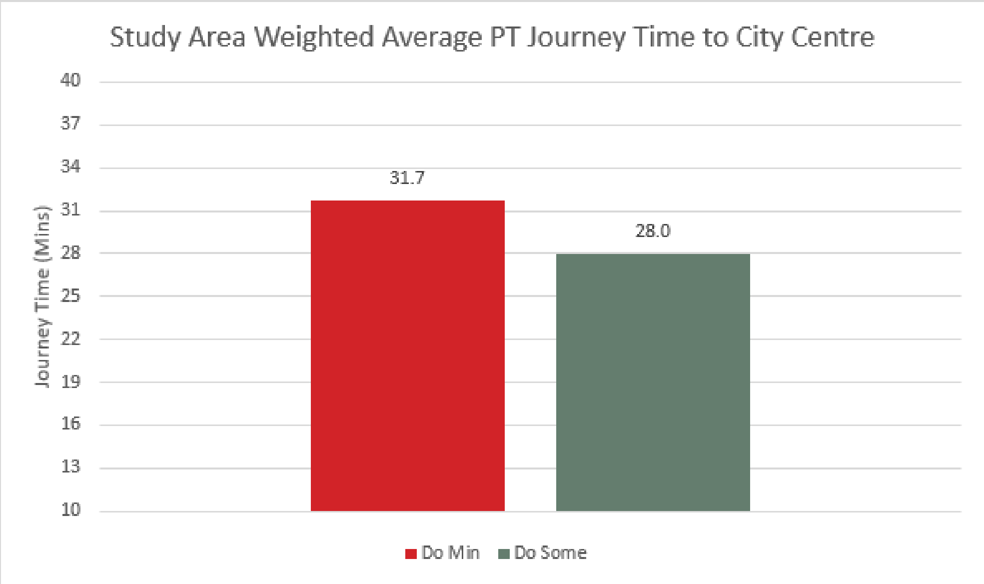


Figure 5-11: AM Peak Hour Change in average PT Journey Time from Study Area to the City Centre

5.5 Travel Demand and Mode Share

As outlined above, Luas Finglas will lead to a significant reduction in journey times for residents in the area and support an increase in public transport usage.

Figure 5-12 outlines the mode share for the Luas Finglas Catchment area for the 2035 and 2050 AM peaks. The results indicate that Luas Finglas will lead to an overall decrease in car mode share of around 1% for the north-west of the city.

In percentage terms this might seem modest. In actual trip numbers it represents a significant increase in sustainable travel. In the opening year 2035, Luas Finglas will deliver an increase of 1.3 million low carbon public transport trips per annum. This represents an 11% increase in public transport trips due to the delivery of Luas Finglas.

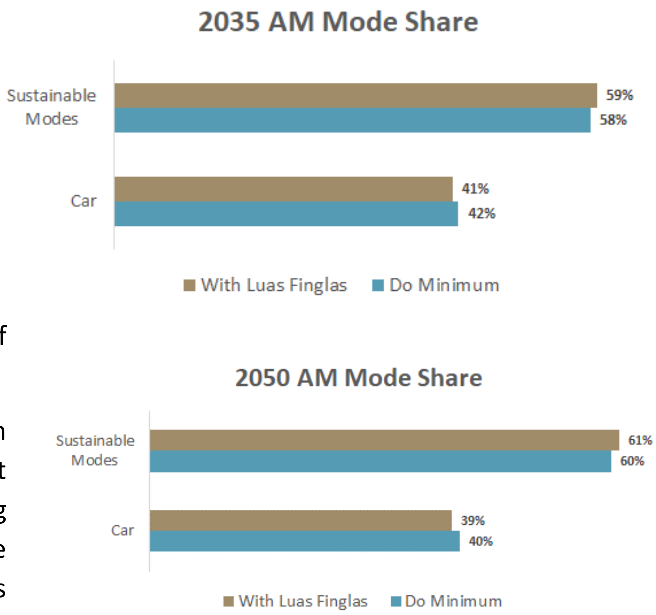


Figure 5-12: AM Peak Mode Share (2035 and 2050)

In 2050, this increases to an additional 1.8 million public transport trips which represents a 13% increase due to the delivery of Luas Finglas.

Figure 5-13 illustrates the impact of Luas Finglas on 2035 AM peak public transport demand. It shows the growth in public transport demand for each of the ERM model zones between the Do Minimum and Do Something Scenario.

The biggest increase in public transport usage is at the northern end of the alignment where significant new developments are proposed. As would be expected, model zones that are further from proposed stations show a lower level of increase and there is less of an impact towards the southern end of the line where the residential areas are much closer to the existing Luas station in Broombridge.

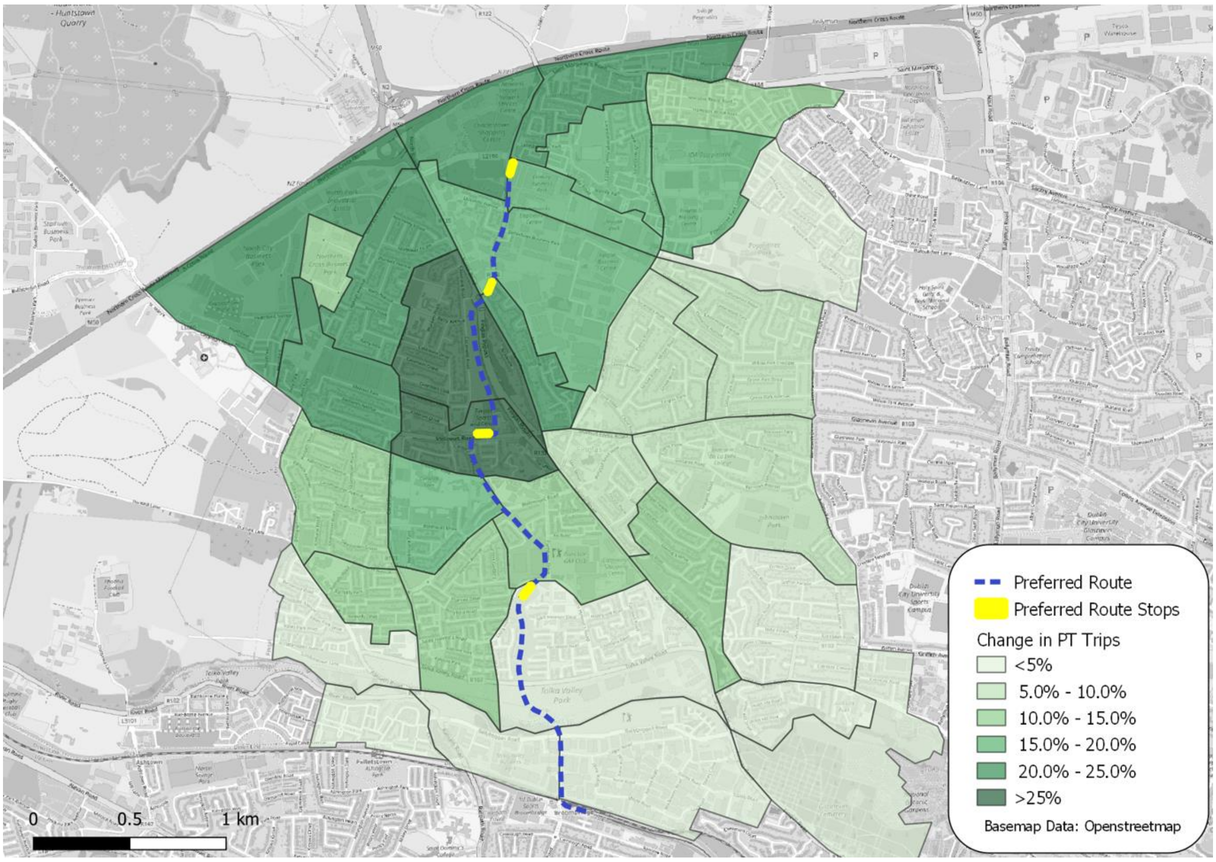


Figure 5-13: 2035 Change in AM peak PT demand with Luas Finglas

5.6 Transport Capacity

5.6.1 Do Minimum Transport Network Constraints

Access to Dublin city centre from the north-west corridor is constrained to a small number of bridge crossings over the Royal Canal at Phibsborough, Broombridge and Ratoath Road. These areas are currently over capacity during peak periods. If current rates of car use continue, traffic congestion is likely to increase in the future due to increased demand for transport arising from general population growth and proposed developments in the Finglas area and wider region.

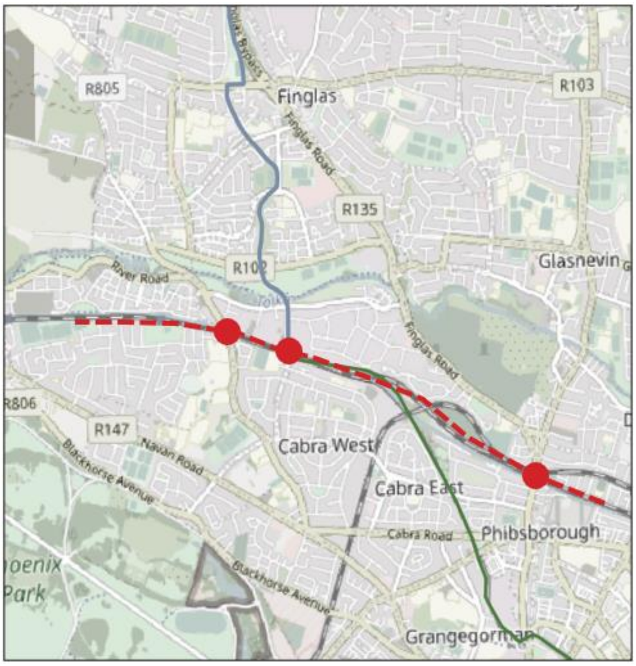


Figure 5-14: Royal Canal Screenline Points

Given the constraints, there is little scope for the capacity of the existing road based transport network to grow to meet future needs. Analysis was undertaken in the ERM to investigate total person trips crossing the Royal Canal Screenline illustrated in Figure 5-14.

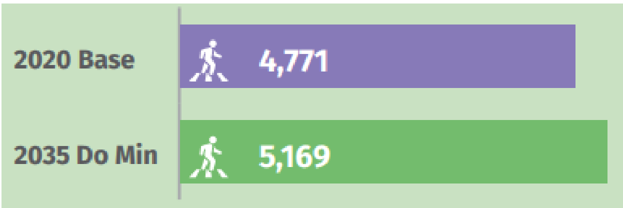


Figure 5-15: AM peak hour persons crossing the Royal Canal

The ERM results forecast an additional 400 person trips crossing the Royal Canal from the north-west in the 2035 Do Minimum scenario AM peak hour (i.e., without the delivery of Luas Finglas) compared to a 2020 base scenario. This is including the proposed upgrades to the bus network and infrastructure to be delivered by BusConnects. An additional 400 trips represents a relatively low growth in trips to the city centre given the estimated population increase of around 10,500 persons within the same time period reflecting the transport capacity constraints.

5.6.2 Increased Transport Capacity from Luas Finglas

Similar analysis was undertaken to compare person trips crossing the screenline in the 2035 AM peak with (Do Something) and without (Do Minimum) Luas Finglas. Figure 5-16 illustrates the person trips by mode crossing each of the cordon points. Note that in the Do Something scenario Luas Finglas is separated as its own crossing.

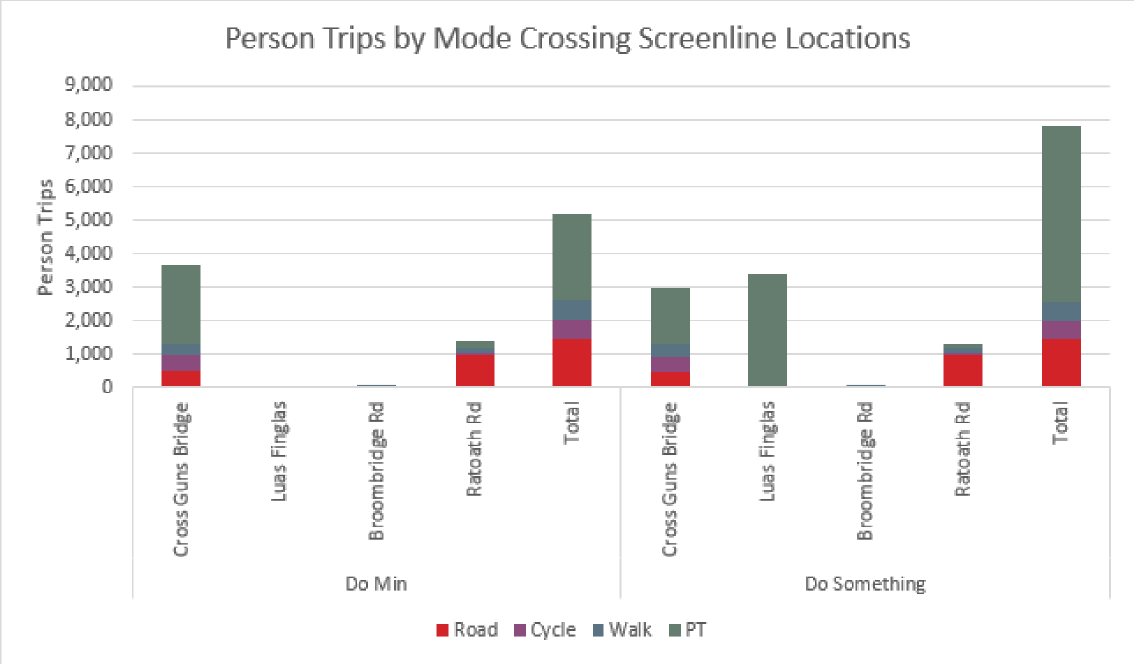


Figure 5-16: Results of Royal Canal Screenline Analysis (2035 AM Peak Hour)

As illustrated in Figure 5-16, the introduction of transport capacity brought by Luas Finglas enables a step change in public transport trips towards the city centre area (highlighted in green in the chart) – resulting in a doubling of public transport trips across the screenline.

The delivery of Luas Finglas will help unlock potential capacity for people movements to and from the north-west corridor. Modelling analysis indicates that in the opening year 2035, the delivery of Luas Finglas will lead to a 50% increase in transport capacity utilisation for trips travelling south towards the city centre in the AM peak. Without Luas Finglas, travel from the north-west corridor is constrained by pinch points on the road network for both cars and bus-based public transport crossing the Royal Canal at Phibsborough, Broombridge and Ratoath Rd.

Figure 5-17: Modelled Person Trips Crossing the Royal Canal (2035 AM Peak)

5.7 Summary

The previous sections have outlined the results of modelling undertaken in the ERM to support the Luas Finglas EIAR. In summary:

- Luas Finglas directly serves a number of large sites marked for high-density development. It is estimated that 73% of the new population expected in the Finglas area by 2035 will be within a 10-minute walk of one of the new Luas Finglas stops.
- Luas Finglas will attract high levels of boardings at all four of the stations along the proposed extension. In total, Luas Finglas will lead to an increase of 1.3 million low carbon public transport trips in 2035, increasing to 1.8 million in 2050.
- Luas Finglas delivers an improved public transport service directly to the city centre, but also to a range of other destinations along the network through integration with other high quality public transport services. Interchange points are provided with DART+ at Broombridge station as well as a number of BusConnects Network spines and orbital routes at Charlestown and Finglas Village.
- The large level of population growth planned for the study area strains the transport system in the Do Minimum scenario, resulting in a bottleneck for travel towards the city centre. Luas Finglas relieves this bottleneck and increases the overall carrying capacity of the transport network over the Royal Canal in this area by 50%.
- Luas Finglas will significantly reduce public transport journey times between the Finglas area and the city centre by an average of 12% during the AM peak hour. When compared to travel via private car, the delivery of Luas Finglas will lead to an average reduction in journey times to the city centre of 15 minutes (over 30%) during the congested peak periods.

6. FINGLAS LOCAL AREA MODEL

6.1 Introduction

The analysis undertaken within the ERM regional model provided a valuable measure of the impact that the proposed scheme has on transport in the Finglas area to feed into Chapter 18 (Material Assets: Traffic and Transport) of the EIAR.

In order to further inform the junction designs and the Environmental Impact Assessment (EIA) for the scheme, a more detailed Local Area Model (LAM) was developed. This Chapter describes the steps undertaken to develop, calibrate and validate a Base Year LAM. It then explains how the future year LAM scenarios have been produced and finally, the main results of the local area modelling are reported. This Chapter is structured as follows:

- **Methodology**: Section 6.2 provides an overview of the methodology used to develop, calibrate and validate the Base Year LAM.
- **Model Specification:** Section 6.3 presents information on the LAM specification including the defined model area, demand segmentation, time periods modelled, model software and key assignment parameters.
- **Traffic Data:** Section 6.4 outlines the traffic data used to facilitate the calibration and validation of the LAM.
- **Road Network and Zone System Development:** Section 6.5 describes the development of the LAM road network and zone system to ensure that it provides an accurate representation of existing conditions.
- **Model Calibration Process and Results:** Section 6.6 outlines the calibration process adopted and the results achieved to ensure that the LAM is meeting relevant Transport Infrastructure Ireland (TII) and NTA guidelines.
- **Model Validation:** Section 6.7 presents the validation process and results, which demonstrate that the model is a suitable and robust tool to be used to assess the impact of the Luas Finglas within the boundary area.
- **Future Year Scenarios:** Section 6.8 outlines the steps undertaken for developing the future year scenarios.
- **Results:** Section 6.9 presents the main results obtained from the future year LAM scenarios.

6.2 Methodology

The methodology for developing the LAM from the RMS is illustrated in Figure 6-1.

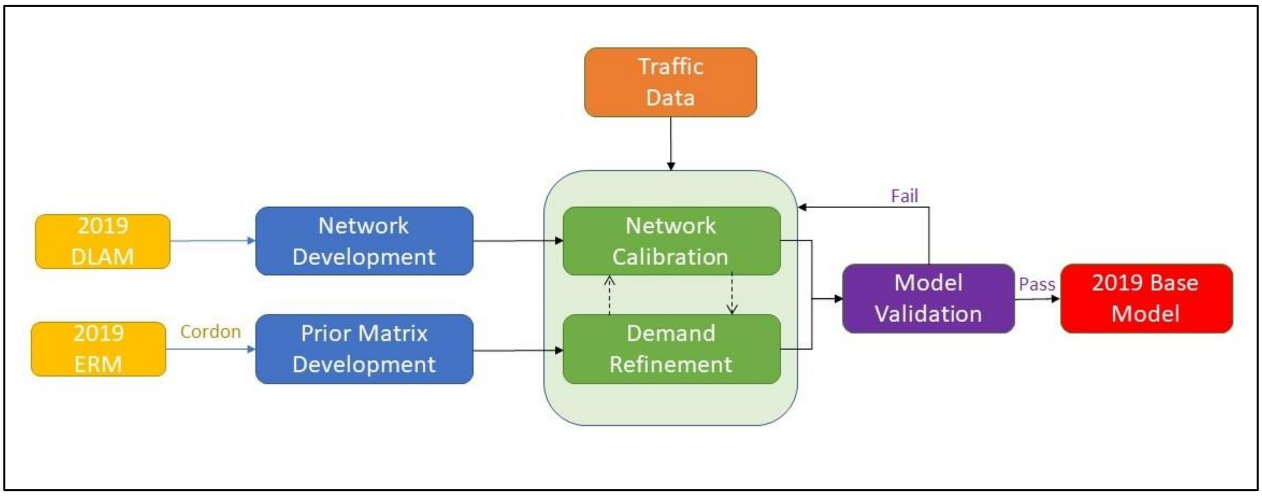


Figure 6-1: LAM Development Methodology

In Summary:

- **2020 ERM Run:** the ERM has been run with 2020 NTA planning data using inputs from the 2016 model and the addition of recent infrastructure developments.
- **ERM Cordon:** the 2020 ERM road assignment was cordoned to extract the initial traffic demand matrix covering the LAM extent. The network was derived from an existing LAM produced for a previous project (the Dublin Local Area Model).
- **Network and Prior Matrix Development:** the initial ERM cordoned road network was reviewed in greater detail for the study area for items including junction layouts, network speeds, missing links etc. The zone system from the ERM was disaggregated where necessary to provide a more accurate representation of traffic loading onto the road network. Further details on the network and zone system development are provided in section 6.5.
- **Traffic Data:** traffic count data was available from the NTA for late 2019/early 2020 (pre-COVID). However, these counts did not cover large sections of the LAM impacted by the new Luas scheme and therefore in November 2021 a new data collection campaign was carried out to enable a robust calibration and validation of the Finglas LAM (refer to section 6.4 for further information).
- **Calibration:** calibration is the process of adjusting the model to better represent observed data. This is normally undertaken in two steps:
  - **Network Calibration:** adjustments to the road network based on observations extracted from traffic survey data e.g. altering turning capacities at junctions, updating link speeds etc.; and
  - **Demand Refinement:** adjustments to the prior matrix to better represent observed travel movements from count data.

Further information on the calibration prosses is provided in section 6.6.

- **Validation:** validation is the assessment of the validity of the calibrated model and its robustness in representing observed traffic conditions. Calibration and validation is an iterative process. If the results of the validation checks are unsatisfactory, then adjustments will be made as required in order to achieve a better representation of reality. Further information on the validation process is provided in section 6.7 of this report.

6.3 Model Specification

This section provides an overview of the key parameters that define the LAM, with specific reference to the following aspects:

- Model Area;
- Model Time Periods;
- Demand Segmentation;
- Model Software; and
- Assignment Parameters.

6.3.1 Model Area

The area to be analysed in detail in the LAM is illustrated in Figure 6-2. The LAM boundary was reviewed and agreed with TII, and was developed to capture the proposed Luas Finglas catchment and likely traffic impacts due to the delivery of the scheme. Traffic entering and exiting this area was also modelled, so traffic passing through the study area has been considered.

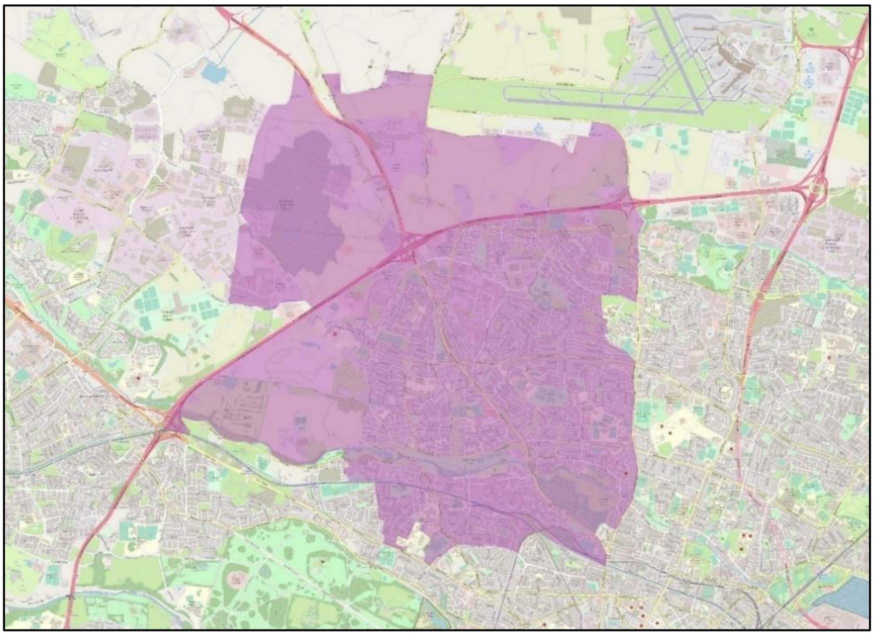


Figure 6-2: LAM Area

6.3.2 Model Time Periods

The analysis of existing traffic data allowed the identification of the typical profile of traffic demand within the study area throughout an average weekday. The results follow a typical trend with peaks in traffic volumes in the morning and evening. The ATC data suggests that the hours experiencing the highest levels of traffic are from 08:00-09:00 in the AM, and 17:00-18:00 in the PM.

Therefore, the LAM was developed, calibrated and validated to represent the following time periods:

- AM Morning peak : 08:00 to 09:00
- PM Evening peak: 17:00 to 18:00

6.3.3 Demand Segmentation

The prior travel demand for the LAM was derived from the NTA's ERM. The ERM assignment matrices contain the following ten user classes:

- Car Employer's Business (in work time)
- Car Commute (travel to/from work);
- Car Other (other non-work purposes such as shopping, visiting friends, etc);
- Car Education (travel to/from school);
- Car Retired;
- Taxi;
- Light Goods Vehicles (LGV);
- Other Goods Vehicles (OGV) 1;
- OGV2 Permit Holder (5 or more axles and allowed drive in Dublin city centre); and
- OGV2 (5 or more axles and not allowed drive in Dublin city centre).

Each user class has its own defined set of generalised cost parameters based on a price per kilometre and a price per minute. To ensure consistency with the larger strategic ERM, the ten user classes and their associated generalised cost parameters were retained for the LAM.
The ten assigned user classes were then grouped in to three broader vehicle classes, based on the availability of disaggregated survey data. The three vehicle classes represented are:

- Car;
- LGV; and
- All other Goods Vehicles.

6.3.4 Model Software

The model software used to develop the LAM is the SATURN (Simulation Assignment of Traffic to Urban Road Networks) suite of transportation modelling programs.

SATURN has 6 basic functions:

1. As a combined traffic simulation and assignment model for the analysis of road-investment schemes ranging from traffic management schemes over relatively localised networks (typically of the order of 100 to 200 nodes) through to major infrastructure improvements where models with over 1,000 junctions are not infrequent;
2. As a “conventional” traffic assignment model for the analysis of much larger networks (e.g., up to 6,000 links in the standard PC version, 37,500 in the largest);
3. As a simulation model of individual junctions;
4. As a network editor, database and analysis system;
5. As a matrix manipulation package for the production of, for example, trip matrices; and
6. As a trip matrix demand model covering the basic elements of trip distribution, modal split, etc.

6.3.5 Assignment Parameters

The LAM was developed in SATURN and the model was calibrated and validated using release version 11.4.07H MC of the software. The SATURN application SATNET was used to build the various data files in to 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 6-1.

Table 6-1: 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

6.4 Traffic Data

This section provides an overview of the traffic count and journey time data used to facilitate calibration and validation of the LAM. Existing data sources were reviewed to identify available counts and locate gaps in observed information across the model area. This review was used to define a specification for additional counts which were commissioned for the area. The combination of new commissioned counts, and existing available information, provided a comprehensive dataset for calibration and validation.

6.4.1 Existing Data Review (Gap Analysis)

A review of existing traffic survey data available for the model area was undertaken from the following sources:

- NTA count database: A mixture of Automatic Traffic Counts (ATC) and Junction Turning Counts (JTC) from previous studies covering a range of years; and
- TII Counters: Permanent TII ATCs located on national strategic roads across the network with data publicly available online.

Figure 6-3 illustrates the location and spread of the most recent (2019/2020) available data across the model area from the NTA count database. Other datasets were too old to be considered for this project. The data review indicated that additional information was required to robustly calibrate and validate a LAM for the area as limited observations are available within the Finglas urban area along the proposed Luas route.

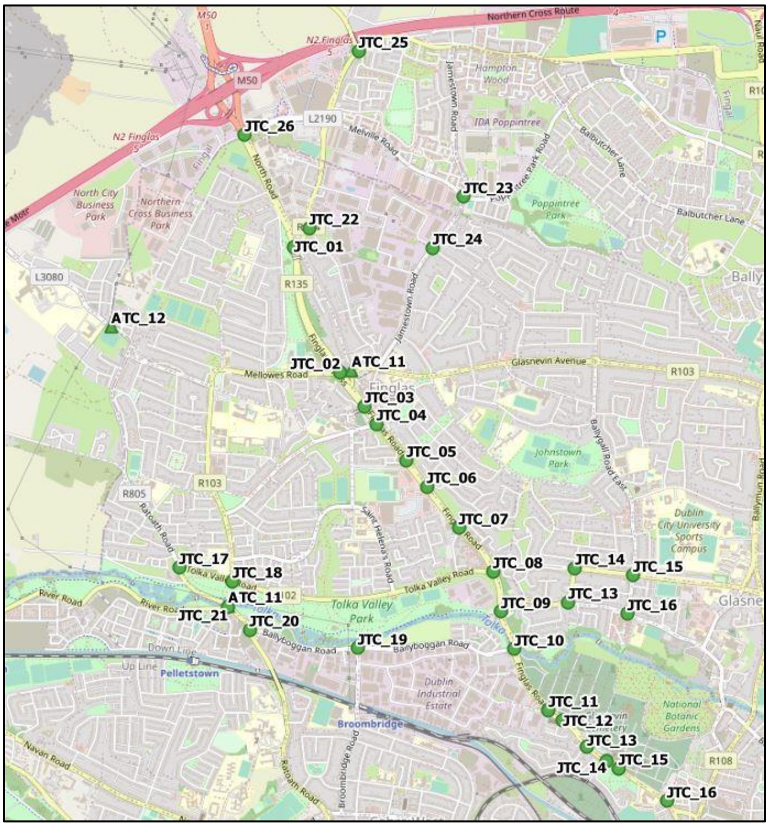


Figure 6-3: Location of existing traffic count sites

On foot of the above review, a data collection exercise was commissioned to supplement existing traffic counts and provide sufficient information to robustly calibrate and validate a LAM for the area.

6.4.2 Commissioned Traffic Survey Data

TRACSIS were commissioned to undertake a programme of traffic surveys to bridge the identified gaps. In particular, the following surveys were required:

- ATCs at key locations to complement the ATC data available from the 2019/2020 survey campaign;
- JTCs at all the main junctions within the model area to capture movement of vehicles during the peak periods.

6.4.2.1 Automatic Traffic Counts (ATCs)

ATC's were undertaken at 6 locations across the network, as illustrated in Figure 6-4, over a one week period during the last week in November 2021. The ATC data provides information on:

- The daily and weekly profile of traffic within the study area;
- Busiest time periods and locations of highest traffic demand on the network;
- Any issues on the network during the survey period e.g. accidents, road closures etc.; and
- Typical speed of traffic on the network.

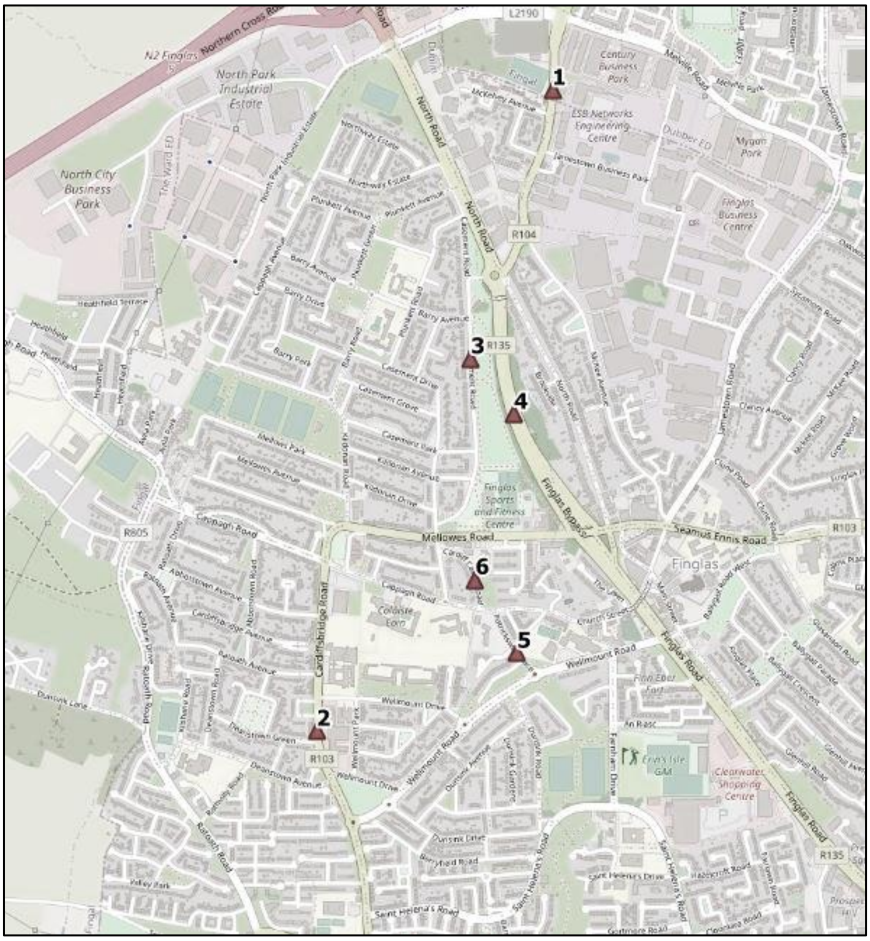


Figure 6-4: Location of the ATC counts

6.4.2.2 Junction Turning Counts (JTCs)

JTC's were undertaken at 14 locations across the network, illustrated in Figure 6-5, during the AM and PM peak periods (07:00 – 10:00 and 16:00 – 19:00) on Tuesday 30th November 2021.

Combined with the existing 2019/2020 traffic data, all the main junctions within the study area have been included and provide information on the volume, and types of vehicles, making turning movements at each location. This data is utilised within the LAM calibration to ensure that the flow of vehicles through the main junctions on the network is being represented accurately.

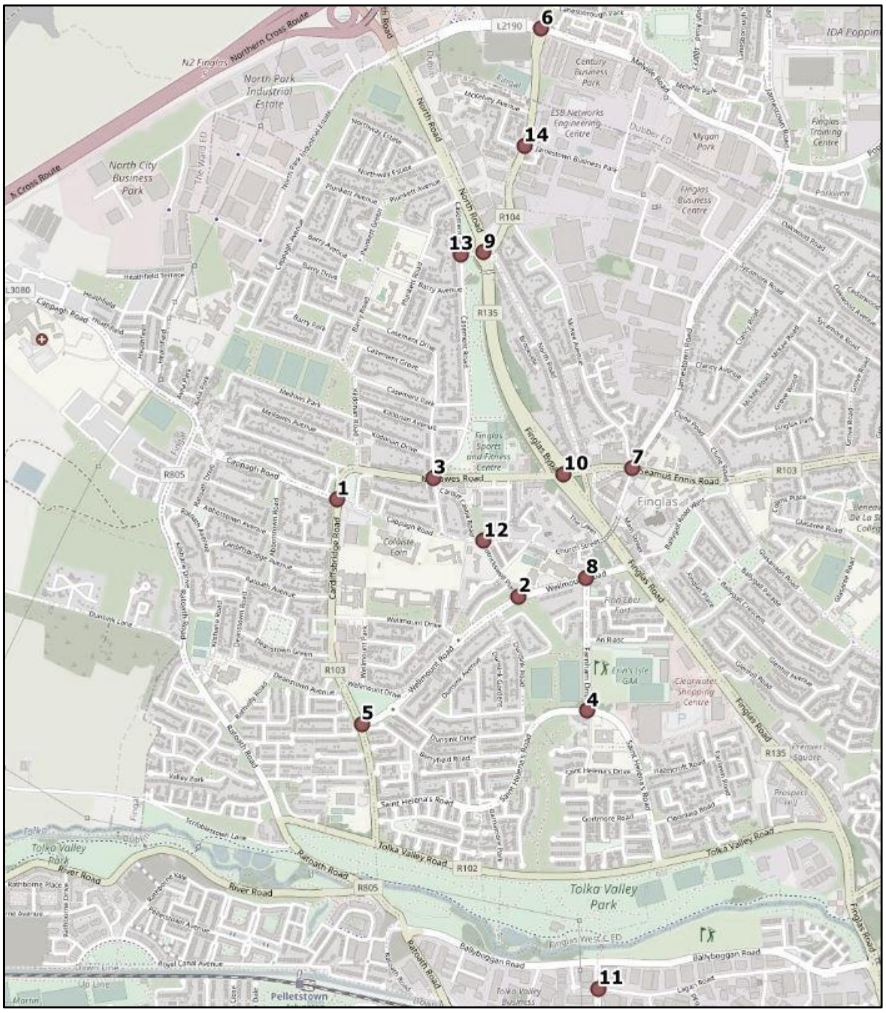


Figure 6-5: Location of the commissioned JTC counts

6.4.3 TomTom Road Journey Time Data

Road journey time data for the proposed scheme models has been sourced from TomTom, who calculate journey times using vehicle position data from GPS-enabled devices and provide this on a commercial basis to a number of different users. The NTA purchased a license to access the anonymised Custom Area Analysis dataset through the TomTom TrafficStats portal. The NTA has an agreement with TomTom to provide travel time information covering six areas of Ireland and for certain categories of road.

The data is provided in the form of a GIS shapefile and accompanying travel time database file. The shapefile contains topographical details for each road segment, which is linked to the travel time database via a unique link ID. The database file then contains average and median travel time, average and median speed, the standard deviation for speed, the number of observations and percentile speeds ranging from 5 to 95 for each link. Figure 6-6 shows the routes for which Journey Times have been analysed.

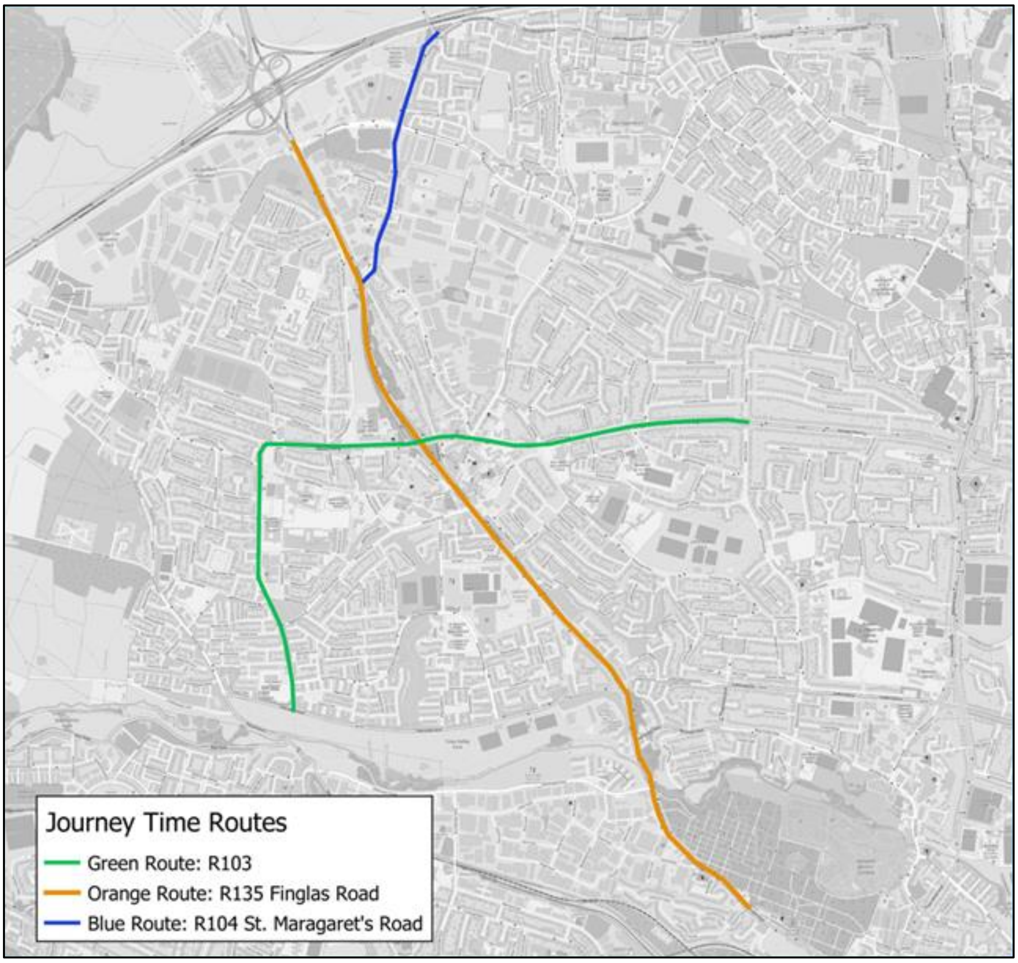


Figure 6-6: Routes for the journey time used for validation

This journey time data was used to validate the LAM to ensure that it is providing a robust representation of current levels of delay on the network at the correct locations (see section 6.7 for further details).

6.5 Road Network and Zone System Development

6.5.1 Network Development

The Dublin Local Area Model (DLAM)[12] was used as a starting point in developing the Finglas LAM network. DLAM itself is an extraction from the ERM road model, but with the addition of extra road network and zoning details. The original base ERM network was developed from the HERE mapping layer which provides a detailed representation of all National Primary, Secondary, Regional and local roads in Ireland.

[12] https://clongriffinscheme.ie/wp-content/uploads/sites/2/2022/03/06.-A6.2_Transport-Modelling-Report.pdf

The Saturn highway network for the Finglas area was extracted from the DLAM using a cordoning process and then additional detail was added to this network to ensure that all necessary junctions and links are included in the Finglas LAM and that the network is representative of the base year conditions.

The LAM road network is illustrated in Figure 6-7. A detailed review was undertaken of all model coding in the study area using digital mapping systems such as Google Earth to ensure it represented, as accurately as possible, the existing road network. This included aspects such as network speed limits, availability of bus lanes, junction layouts, pedestrian crossing points etc.

Junction capacities and saturation flows were adopted from the Network Coding Guidelines developed for the NTA as part of the RMS development, and were further reviewed during the calibration process. Where required, additional detail was added to ensure that traffic was loading onto the road network at the correct locations.

As illustrated in Figure 6-7, the LAM provides a detailed representation of all significant roads within the study area. To ensure full network coverage and route choice, all roads have been considered, from the national primary routes to minor residential streets. The short dead-end links in Figure 6-7 are “spigots” used to load traffic from the zones accurately onto the network, and reflect the further developed zone system that is outlined in section 6.5.2 below.

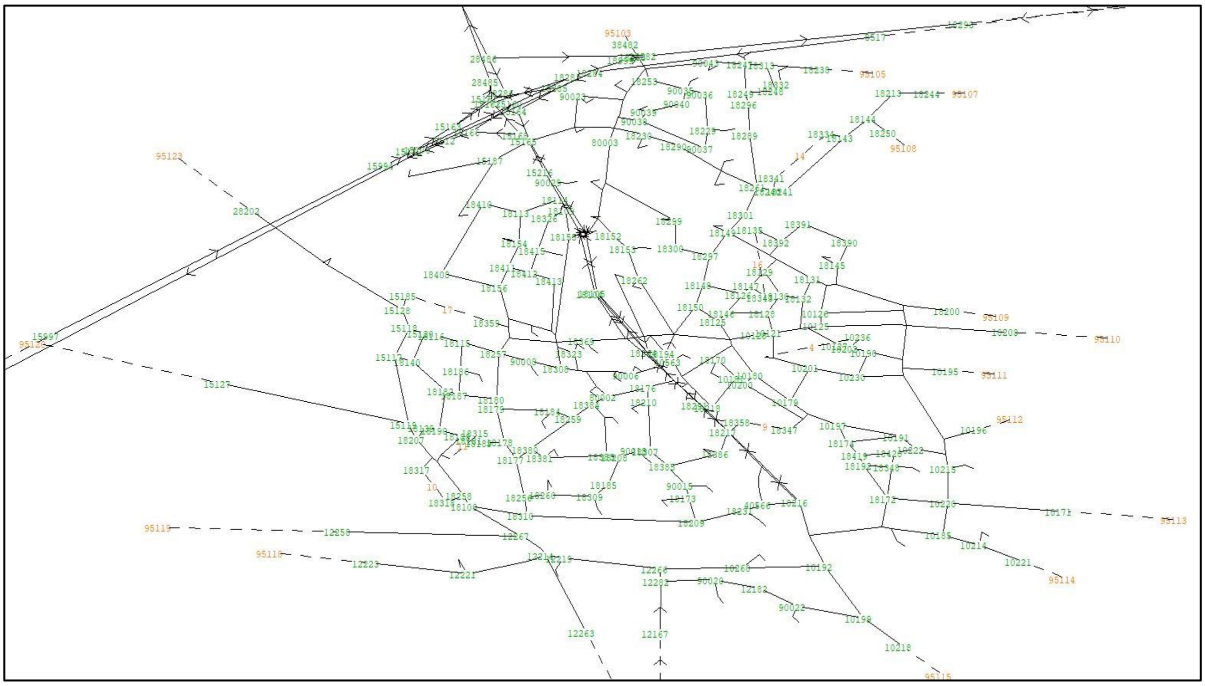


Figure 6-7: Finglas LAM highway network

6.5.2 Zone System Development

The base LAM zone system was adopted from the ERM, which was developed using the Census Small Area Population Statistics (SAPS) and Place of Work, School or College Census of Anonymised Records

(POWSCAR) to get detailed information on population, employment and education centres across the model area. Other data sources such as MyPlan and Geo Directory were also used to obtain information on specified land-use zoning and location of commercial development. The following rules were then applied to generate the zone system:

- **Population, Employment and Education** – the number of zones with values of population, number of jobs and persons in education above a certain threshold should be minimised;
- **Activity Levels** – the number of zones with activity levels that have very low or very high levels of trips should be minimised;
- **Intra-zonal Trips** – threshold values should be applied to the proportion of intra-zonal trips within each zone, to avoid an underestimation of flow, congestion and delay on the network;
- **Land Use** – zones should be created with homogeneous land use and socio-economic characteristics where possible;
- **Zone Size/Shape** – zone size and the regularity of zone shape should be considered in order to avoid issues with inaccurate representation of route choice;
- **Political Geography** – it should be possible to aggregate all zones to ED level i.e. zone boundaries do not intersect ED boundaries; and
- **Special Generators/Attractors** – large generators/attractors of traffic such as Airports, Hospitals, shopping centres etc. should be allocated to separate zones.

Figure 6-8 illustrates the base ERM zone system within the study area. As the area of interest is relatively close to Dublin City Centre, the zones are represented in quite a high level of detail. The ERM zones become larger and more aggregate in nature away from the city centre primarily due to the lower levels of activity (population and employment) in these areas.

A detailed review was undertaken of all ERM zoning and centroid connectors in the study area. On foot of this review a number of edits, illustrated in red in Figure 6-8, were applied to the ERM zone system in order to provide a more accurate representation of traffic loading onto the road network. These mainly involved splitting ERM zones into smaller LAM zones with each LAM zone having a separate “spigot” onto the network.

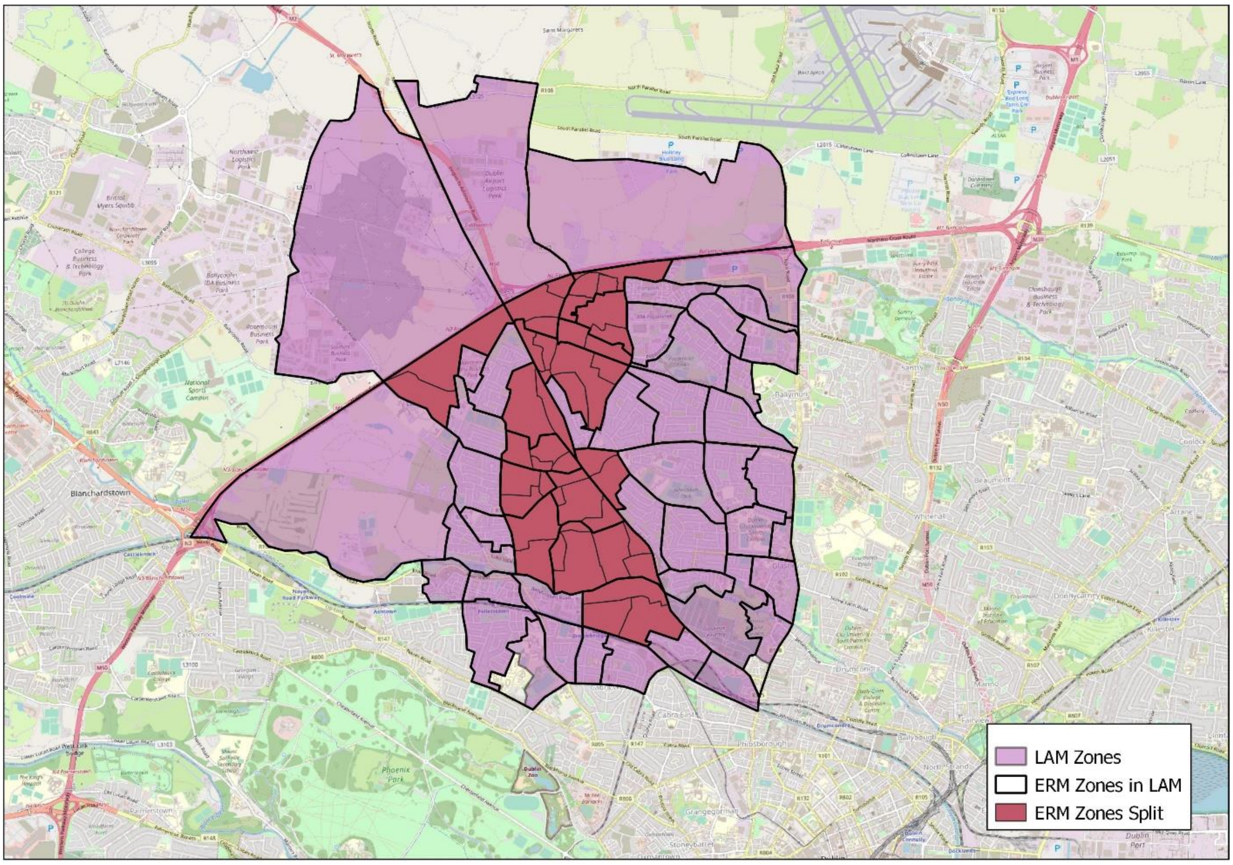


Figure 6-8: LAM zones derived from the ERM

6.6 Model Calibration Process and Results

6.6.1 Introduction

Calibration is the process of adjusting the LAM network and demand to ensure that it provides a robust estimate of assignment when compared to observed traffic characteristics. Generally, the components of the model that may be adjusted on the demand side are trip distribution and trip production/generation levels, and this usually involves trip 'Matrix Estimation'.

On the supply side (network), modelled junction and link characteristics may be altered if sufficient new information is available to justify changes to the existing network.

The Finglas LAM was calibrated and validated in accordance with Transport Infrastructure Ireland's (TII) *Project Appraisal Guidelines (PAG) for National Roads Unit 5.1 – Construction of Transport Models (October 2016)*. This is a widely accepted standard in Ireland that provides robust calibration and validation criteria to which certain types of highway models should adhere.

The method for the calibration of the LAM is illustrated in Figure 6-9 overleaf, and comprises of the following key elements:

- **Network and Zone System Development:** As outlined in section 6.5, the initial LAM network and zone system is derived from the ERM with further detail added where necessary to provide an accurate representation of existing conditions;
- **Network Adjustments:** A detailed review is undertaken of the road network coding taking cognisance of surveyed traffic volumes and network speeds with adjustments made where necessary;
- **Prior Matrix:** The initial prior matrix is extracted from a cordon of the ERM;
- **Calibration Criteria Check:** The LAM is then assessed against guideline calibration criteria in terms of modelled versus observed traffic volumes;
- **Matrix Estimation:** If the model is not passing the initial calibration check, a process known as 'Matrix Estimation' is undertaken to adjust the trip demand in order to provide an improved correlation between counts and modelled flows;
- **Post-Estimation Calibration Check:** The model is then re-tested against the calibration criteria with a focus on correlation between modelled and observed flows, along with an analysis of the demand changes introduced by 'Matrix Estimation'; and
- **Validation:** Once all the calibration criteria have been achieved, the model is passed forward to validation.

The following sections of this Chapter provide an overview of the steps outlined above along with the calibration guidelines for LAM development.

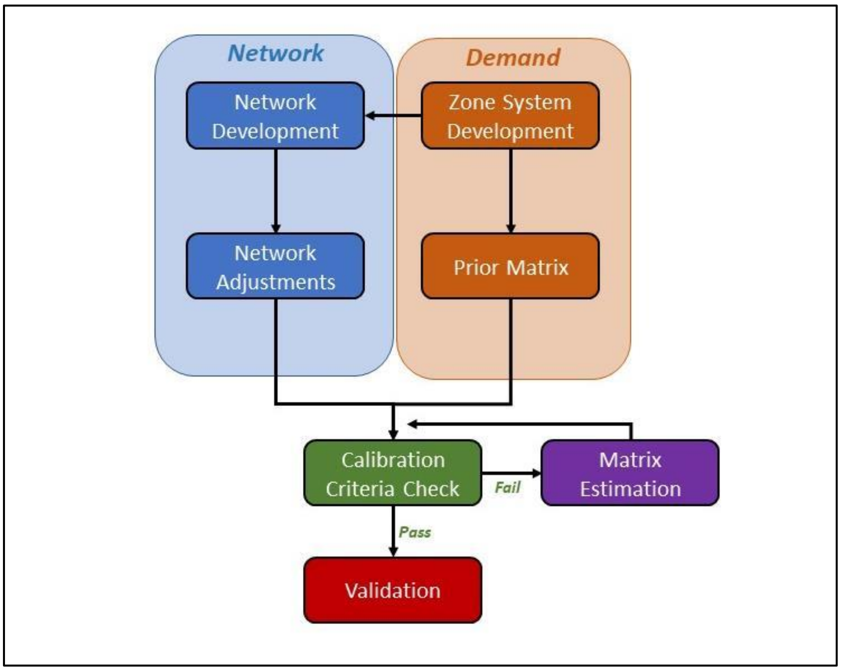


Figure 6-9: LAM calibration process

6.6.2 Calibration Criteria

The guidelines for the calibration of a LAM are contained in the following documents:

- Transport Infrastructure Ireland's (TII) Project Appraisal Guidelines (PAG) for National Roads Unit 5.1 - Construction of Transport Models;
- UK Department for Transport (DfT) TAG Unit M3.1 Highway Assignment Modelling; and
- NTA guidance on LAM development from Regional Models.

The TII guidelines are a widely accepted standard in Ireland and have been developed in cognisance with the UK DfT TAG guidance. They focus on correlations between modelled and observed traffic flows at an individual count level along with monitoring of demand changes introduced by 'Matrix Estimation'.

6.6.2.1 Traffic Flow Calibration

The TII PAG criteria for permissible differences between observed and modelled traffic flows makes use of the Geoffrey E. Havers (GEH) statistic.

The GEH statistic is a measure that considers both absolute and proportional differences in flows. Thus, for high levels of traffic volumes a low GEH may only be achieved if the percentage difference in flow is small. For lower flows, a low GEH may be achieved even if the percentage difference is relatively large. GEH is formulated as:

$$GEH = \sqrt{\frac{(Observed - Modelled)^2}{0.5\ X\ (Observed + Modelled)}}$$

The reason for introducing such a statistic is the inability of either the absolute difference or the relative difference to cope over a wide range of flows. For example, an absolute difference of 100 passenger car units per hour (pcu/h) may be considered a big difference if the flows are of the order of 100 pcu/h, but would be unimportant for flows in the order of several thousand pcu /h. Equally a 10% error in 100 pcu/h would not be important, whereas a 10% error in, say, 3000 pcu/h might mean the difference between adding capacity to a road or not.

As a rule of thumb in comparing assigned volumes with observed flows, a GEH parameter of 5 or less would be an acceptable fit, while GEH parameters greater than 10 would require closer attention. TII guidelines stipulate that at least 85% of count sites must have a GEH of less than 5.

6.6.2.2 Analysis of Trip Matrix Changes

Trip Length Distribution Analysis

A further calibration step recommended by TII guidance is to compare trip length distributions for the prior and post calibrated matrices to ensure they have not been overly distorted by the 'Matrix Estimation' process.

‘Matrix Estimation’ can sometimes generate increased short distance trips to match count information, thus distorting the profile of trip making on the network. PAG suggests that the coincidence ratio[13] should be used to compare trip length distributions before and after estimation, with a desirable range between 0.7 and 1.0

A coincidence ratio can be used to compare two distributions by examining the ratio of the total area of those distributions that coincide. The coincidence ratio is defined as:

$$CR = \frac{\sum\{\text{Min}\ (\text{TLDs}, \text{TLDf})\}}{\sum\{\text{Max}\ (\text{TLDs}, \text{TLDf})\}}$$

Where TLDs is the source trip length frequency and TLDf is the final trip length frequency. A desirable range for the coincidence ratio is between 0.7 and 1.0 where a ratio of 1.0 suggests an identical distribution.

Figure 6-10: Coincidence Ratio Calculation – TII PAG Page 20

6.6.3 Network Adjustments

The Finglas LAM was coded based on best practice approaches developed during the NTA Regional Model Scoping Process, and as such, the model provided an accurate and up-to date representation of the existing road network.

When the traffic survey data was processed and analysed, the network coding was re-checked with the following edits undertaken where there was a clear justification for doing so:

- **Junction Capacity:** The SATURN software flags an error where a junction has insufficient modelled capacity to achieve the observed traffic flow. All these instances were reviewed in detail and remedial action was taken where required. This included:
  - Adjusting Signal Timings (mostly synthesised within the model area);
  - Adding/removing flared lanes;
  - Adding/removing approach lanes; and
  - Adjusting saturation flows through junctions.
- **Network Speeds:** The capacity and speeds of modelled links were checked to ensure they were broadly in line with survey information;
- **Zone Connectors:** A review was undertaken on the location of zone connectors in close proximity to count sites to ensure they were providing an accurate representation of traffic loading onto the road network.

6.6.4 Prior Matrix Development

As noted previously in Chapter 2, the Full Demand Model carries out mode and trip destination choice for all zones within the ERM. The FDM has been calibrated using Census data, and hence, provides a robust

13 The coincidence ratio is a calculation used to examine the how the total area under different distributions coincide, with a value of 1 representing an identical distribution.

and accurate representation of trip distributions across the model network. In order to generate prior matrices for the LAM, a cordon was extracted from a run of the ERM, which has been updated to include 2020 planning data. The cordon function within SATURN, facilitates the extraction of trip matrices for a subset area of the ERM whilst still maintaining route and destination choice from the full model.

A bespoke Excel spreadsheet tool was created to disaggregate the cordoned ERM matrices to each of the Finglas LAM zones. This tool used available data on population, employment, and education places by Census small area, to split trips to/from each ERM zone between the more detailed LAM zoning system. This allowed for a consistent split of demand within the study area, whilst maintaining consistency with the ERM matrix.

Figure 6-11 provides an indicative example of how the disaggregation process is undertaken in the Excel Spreadsheet tool for the Commute user class in the AM peak.

The overall commute trips between Zone 1 and Zone 2 is extracted from a cordon of the ERM. Zone 1 is disaggregated into two LAM zones, namely Zone A and Zone B. Whilst Zone 2 is also disaggregated into two LAM zones, Zone C and Zone D.

Commute trips in the AM are assumed to be travelling from home to work. As such, the origin trips for ERM Zone 1 are split between the LAM zones based on the population numbers in each zone. Likewise, the destination trips to ERM Zone 2 are split between their LAM zones based on the level of employment in each zone. As mentioned previously, Census 2016 data was used to identify the level of population and employment in each LAM zone.

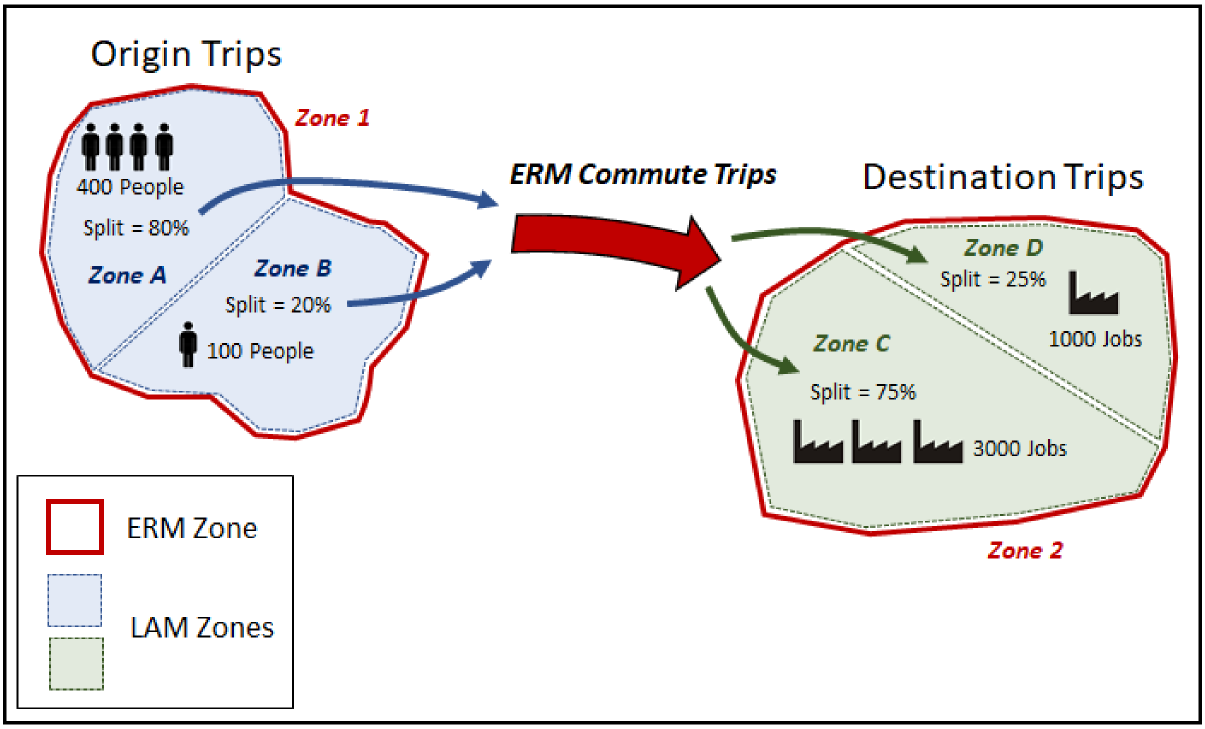


Figure 6-11 LAM Disaggregation Example – AM Peak Commute Trips

Detailed checks were undertaken at various stages to ensure that no demand from the ERM was lost throughout the disaggregation process. Table 6-2 and Table 6-3 below outline the matrix totals by user class before and after the disaggregation process, and indicate that all ERM cordoned demand is represented in the LAM matrices for the AM and PM peaks.

Table 6-2 AM Matrix Total Comparison

USER CLASS	ERM CORDON	LAM MATRIX	% DIFFERENCE
Employers Business	5,183	5,183	0%
Commute	8,314	8,314	0%
Other	4,774	4,774	0%
Education	59	59	0%
Retire	215	215	0%
Taxi	595	595	0%
LGV	2,347	2,347	0%
OGV1	3,116	3,116	0%
OGV2	0	0	0%
OGV2_NP	106	106	0%

Table 6-3 PM Matrix Total Comparison

USER CLASS	ERM CORDON	LAM MATRIX	% DIFFERENCE
Employers Business	5,523	5,523	0%
Commute	7,506	7,506	0%
Other	5,650	5,650	0%
Education	95	95	0%
Retire	450	450	0%
Taxi	591	591	0%
LGV	1,958	1,958	0%
OGV1	1,827	1,827	0%
OGV2	1	1	0%
OGV2_NP	60	60	0%

6.6.5 Matrix Estimation

'Matrix Estimation' is a process used to adjust trip demand so that there is an improved correlation between counts and modelled flows. The base prior matrix is fed into a SATURN programme called SATME2. SATME2 then adjusts origin-destination patterns to produce a trip demand matrix that better replicates traffic counts when assigned to the network.

The prior matrix is adjusted only after all options for improving the network are exhausted. Any matrix adjustment must significantly improve the match between observed and modelled flows, and not introduce more trips into a zone than could realistically be expected. Controls are placed on zones to ensure that the trip demand generated is sensible and in line with census population and employment statistics.

The algorithm driving the SATME2 estimation process tends to reduce long trips in place of chains of short trips, especially when counts are spread over the entire area, which may not fully reflect reality. Constraints are therefore placed on the adjustment process to protect the number of movements and distribution of the through trips contained within the original car trip matrix. By restricting such long through trips, the matrix adjustment algorithm is forced to create or re-distribute short trips.

6.6.6 Post-Estimation Calibration

The post 'Matrix Estimation' model was then re-tested against the TII and TAG calibration criteria to assess performance. This was undertaken in an iterative process, with adjustments made to the road network where necessary to facilitate a better correspondence between model and observed flows e.g. altering junction capacity to facilitate count demand, fixing routing issues and rat-running etc.

A calibration and validation dashboard was created to identify areas of the network requiring adjustment/improvement and not meeting the calibration guidelines. Once all options for network improvement were exhausted, 'Matrix Estimation' was re-run to try and achieve a better match between modelled and observed flows. The iteration between network alterations and 'Matrix Estimation' was carried out until the calibration criteria had been achieved.

6.6.6.1 GEH Calibration Results

Table 6-4 summarises the GEH calibration results for the Finglas LAM after the matrix estimation process, for each of the modelled time periods.

Table 6-4: Finglas LAM – Model Calibration Summary

GEH	AM Counts	AM % Counts	PM Counts	PM % Counts
<5	260	86%	265	87%
5-10	38	13%	36	12%
>10	6	2%	3	1%
Total	304	100%	304	100%

The results in Table 6-4 demonstrate that a satisfactory calibration has been achieved in the model for the AM and PM peak periods, with GEH values falling within TII standards (more than 85% of counts to be modelled with GEH less than 5).

The full list of flow calibration results for each traffic count location are presented in Appendix B.

6.6.6.2 Analysis of Trip Matrix Changes – Trip Length Distribution

TII guidance recommends comparing trip length distributions for the prior and post calibrated matrices to ensure they have not been overly distorted by the 'Matrix Estimation' process.

The 'Matrix Estimation' programme SATME2 can sometimes generate increased short distance trips to match count information, thus distorting the profile of trip making on the network. PAG suggests that the coincidence ratio should be used to compare trip length distributions before and after estimation, with a desirable range between 0.7 and 1.0.

Table 6-5 below outlines the coincidence ratios for each of the calibrated LAM time periods. The coincidence ratios suggest that there has been some minor distortion of trip lengths but that it is within acceptable bounds.

Table 6-5: Trip Length Analysis - Coincidence Ratios

MEASURE	SIGNIFICANCE CRITERIA	AM	PM
Coincidence Ratio	Between 0.7 and 1.0	0.88	0.87

The trip length distributions illustrated in Figure 6-12 and Figure 6-13 below display the proportion of trips travelling various distances for both the pre and post estimation matrices. The results indicate that there have been some changes, however, the general shape of the distributions are similar. The changes overall are not large, and therefore, it is considered that 'Matrix Estimation' has not overly distorted the overall trip length distribution inherited from the ERM.

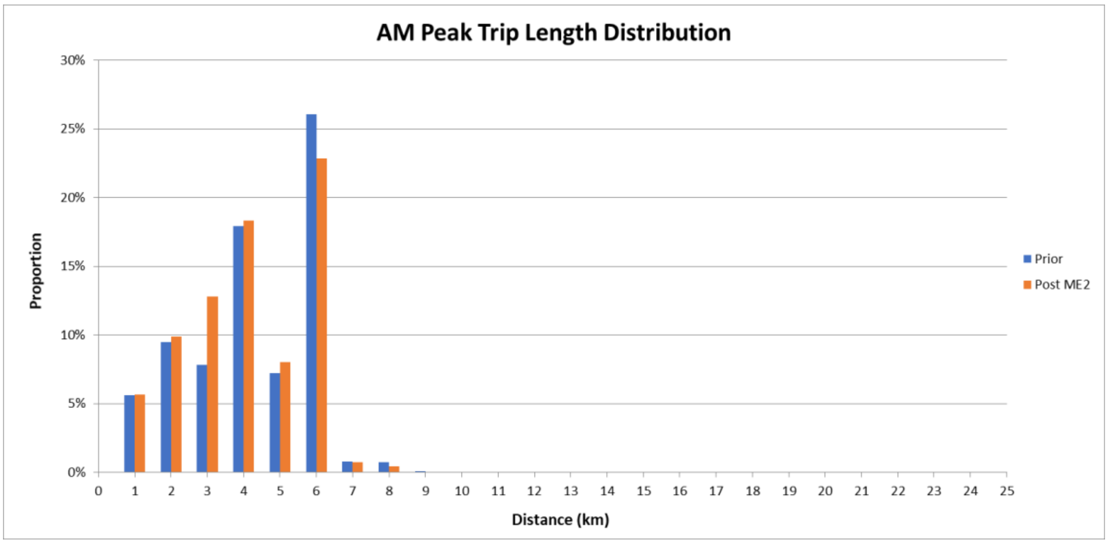


Figure 6-12: AM Peak Trip Length Distribution

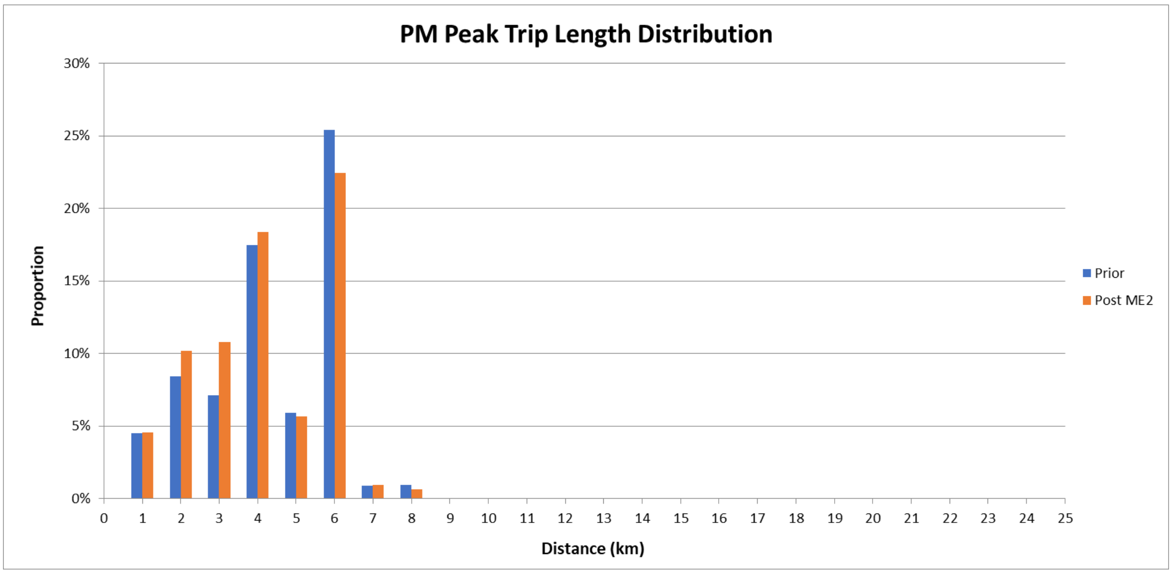


Figure 6-13: PM Peak Trip Length Distribution

6.6.7 Calibration Summary

The previous sections of this Chapter have outlined the methodology used to calibrate the Finglas LAM to better reflect observed traffic survey data. In summary:

- A combination of network edits and 'Matrix Estimation' have been used to provide a better correlation between modelled and observed traffic flows;
- The model meets a satisfactory level of calibration following the GEH criteria; and
- The coincidence ratio is well within TII guidelines and, as such, it is considered that 'Matrix Estimation' has not overly distorted the overall trip length distribution inherited from the ERM.

6.7 Model Validation

The validation of the model uses additional comparative measures against which the robustness of the calibrated model may be judged. Calibration and validation are separate concepts, however, in reality these two elements are part of an iterative process. If the results of the validation checks are not satisfactory, then the modeller will review the inputs and coding within the model and adjust as required in order to achieve a better representation of reality. The guidelines for model validation are outlined in Table 6-6.

Table 6-6: Validation Criteria

CRITERIA	ACCEPTABILITY GUIDELINE
Modelled journey times compared with observed times	
Times within 15% or 1 minute if higher	>85% of cases

As outlined in Table 6-6, TII guidelines recommend that modelled journey times should be within +/- 15% of the observed time, or 1 minute if higher, in more than 85% of cases. Journey Times have been validated comparing Joy Ride Journey Times extracted from Saturn with TomTom data on three different routes (in both directions):

1) R103 Glasnevin Avenue - Cardiffsbridge Road
2) Saint Margaret's Road
3) R135 Finglas Road - North Road

The routes are displayed in Figure 6-14 while Table 6-7 and Table 6-8 report the validation results.

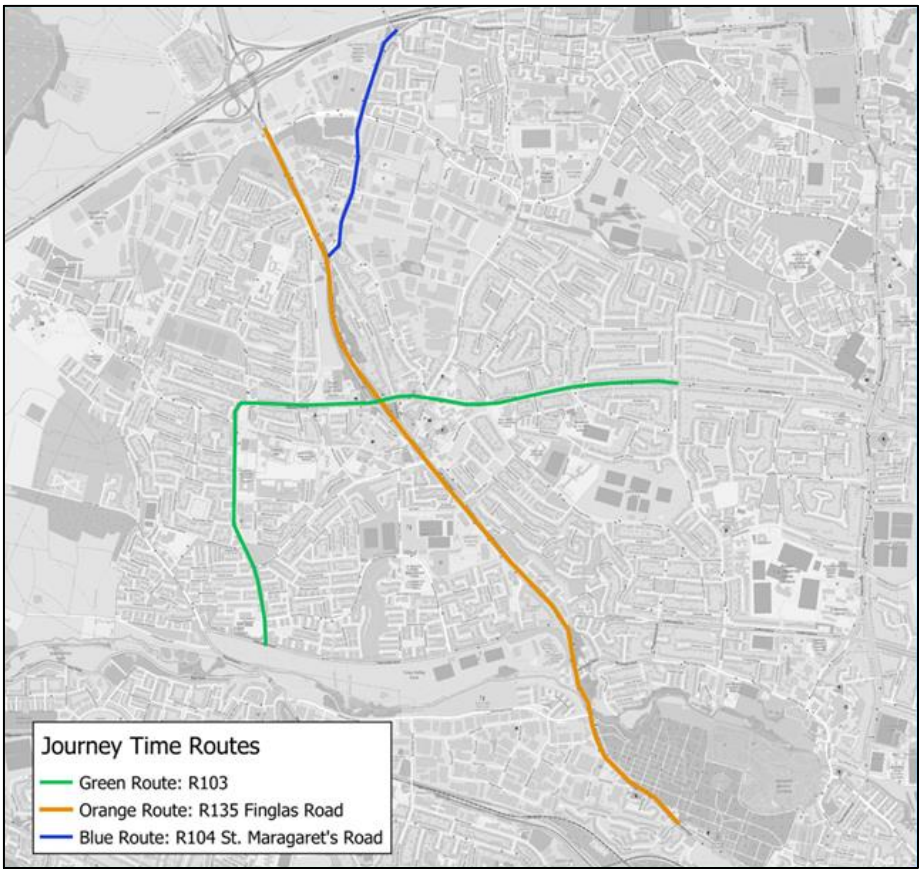


Figure 6-14: Routes used for Journey Time Validation

Table 6-7: validation results for the three routes in the AM peak

Route	Route Name	Direction	Obs.	Mod	Diff.	% Diff	Pass/Fail
1	R103 Glasnevin Avenue - Cardiffsbridge Road	NB	619	545	-74	-12%	Pass
		SB	526	533	7	1%	Pass
2	Saint Margaret's Road	NB	156	156	0	0%	Pass
		SB	190	202	12	6%	Pass
3	R135 Finglas Road - North Road	IB	363	345	-18	-5%	Pass
		OB	315	342	28	9%	Pass

Table 6-8: validation results for the three routes in the PM peak

Route	Route Name	Direction	Obs.	Mod.	Diff.	% Diff	Pass/Fail
1	R103 Glasnevin Avenue - Cardiffsbridge Road	NB	573	539	-34	-6%	Pass
		SB	558	533	-24	-4%	Pass
2	Saint Margaret's Road	NB	182	182	0	0%	Pass
		SB	219	192	-27	-12%	Pass
3	R135 Finglas Road - North Road	IB	283	326	43	15%	Pass
		OB	524	532	8	1%	Pass

The model meets the criteria for journey time validation (more than 85% of routes to be modelled within 15% or within 1 minute of the observed journey times). More details about validation results are shown in Appendix C.

In summary the Finglas LAM meets the required calibration and validation criteria and it is suitable for testing.

6.8 Future Year Scenarios

The previous sections outlined the calibration and validation of the LAM. This was then used to assess the local impact of Luas Finglas on traffic in the area. In order to test future scenarios two inputs are required:

- Future year demand; and
- Future year networks.

6.8.1 Future Year Demand – Furness Method

The Furness Method (also known as *Doubly Constrained Growth Factor Method* – or as *Fratar* in the US) is an iterative process typically used when the future number of trips originating and terminating in each zone is known. The method calculates "*a set of intermediate correction factors which are then applied to cell entries in each row or column as appropriate. After applying these corrections to say, each row, the totals for each column are calculated and compared with the target values. If the differences are significant, new correction coefficients are calculated and applied as necessary*" *(Modelling Transport, Ortuzar, Willumsen, 2011)*.

Figure 6-15 provides an overview of the furness method applied to produce the future year LAM demand. The steps on the left side of the diagram represent the process of calibrating the base year LAM as reported in section 6.6. The first two rectangles on the right side of the diagram refer to the cordoning of the ERM forecast scenarios which results in a cordoned forecast demand matrix (forecast year LAM prior).

The procedure involves the calculation of growth factors at origin and destination level between the base and the forecast year prior. These factors are then applied to the calibrated base year LAM in an iterative process that "pivots" the base demand to match the growth trends observed between the two prior matrices. This results in a final pivoted forecast year matrix that can then be assigned to the LAM network.

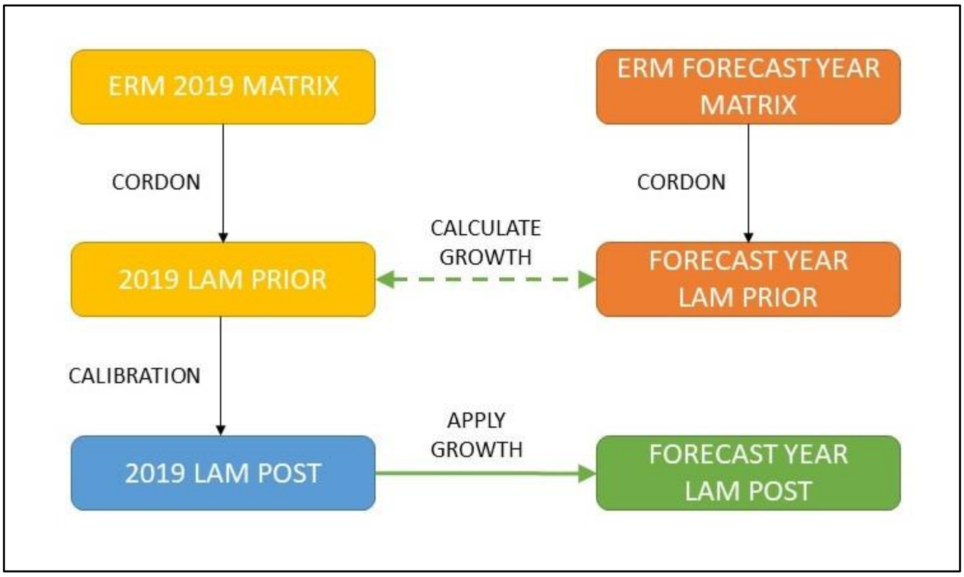


Figure 6-15: Overview of the Furnessing method for the Finglas LAM

Before assigning the forecast demand to the LAM network, a detailed analysis of the total Trip Ends was performed to ensure the growth trends of the demand remained consistent across all zones. Care was taken to ensure results were robust and outliers dealt with appropriately. For example where very large growth was to occur, e.g. at greenfield sites, the gross increase in demand was added to the base year rather than using a multiplication factor. This process was carried out for both 2035 and 2050.

6.8.2 Future Year Networks

The future Do Minimum network is based off the calibrated and validated base SATURN Network. This was then updated with schemes included in the 'Core' scenario (see Section 4.2). This mainly included updating the network along the Finglas Road (R135) to include proposed changes as a result of the BusConnects Core Bus Corridor.

The Do Something network was then built off the Do Minimum. As outlined previously, Luas Finglas will interact with the surrounding road network at a number of locations – new signalised junctions are proposed at Ballyboggan Rd, Tolka Valley Rd, St. Helena's Rd, Wellmount Rd, Cappagh Rd, Mellowes Rd, North Rd (R135) and along St. Margaret's Rd to the terminus at Charlestown.

The two most significant impacts will be at:

- **R135 / St Margaret's Road Junction:** It is proposed that this junction will be altered from the existing roundabout to a signalised junction to facilitate through movements of Luas Finglas, along with improved safety for pedestrians and cyclists; and
- **St Margaret's Road / Melville Road Junction:** It is proposed that this junction will be reconfigured to reduce crossing distances and improve safety for pedestrians and cyclists which includes the removal of existing left-turn filter lanes.

Figure 6-16: R135 / St Margaret's Road Junction Upgrade Proposals

The coding for these junction upgrades has been included in the Do Something networks based on the latest designs available at the time of modelling.

6.9 Results

The future year LAMs were run for 2035 and 2050 and the following sections outline the road network results focusing on:

- **Network Performance Indicators**: looking at queuing, journey times and speeds in the LAM; and
- **General Traffic Assessment:** Assessing the overall impact that any redistributed general traffic will have on the performance of the network within the study area.

This section presents the results from traffic modelling undertaken in the LAM. Full assessment of sensitivity, magnitude of impact, significance of effect, and any required mitigation as a result of these traffic impacts is presented in the EIAR Chapter 18 (Material Assets: Traffic and Transport).

6.9.1 Network Performance Indicators

Network performance indicators for the LAM were extracted for all modelled scenarios in the AM and PM peak hours and are presented in Table 6-9. For each scenario, the following network statistics are presented:

- Queues: this is expressed in total pcu hours which is the volume of vehicles on the network multiplied by the time spent queueing at junctions i.e. waiting for green time, a gap in traffic or behind other stopped vehicles. Queueing is comprised of transient and over-capacity queues:
  - Transient Queues: expressed in total pcu hours, it represents time spent in queues at junctions which are not over capacity (e.g. at a signalised junction where the queue is able to clear during a single cycle).
  - Over-capacity queues: expressed in total pcu hours, this occurs where the volume of turning movements exceeds junction capacity, such that a permanent queue builds (e.g. at a signalised junction where a queue is unable to clear in a single cycle).
- Average Speed: represents the average speed of all vehicles travelling on the network within the modelled time period measured in km/h.
- Total Travel Distance: represents the total distance travelled by vehicles on the road network in the modelled period measured in pcu km.
- Total Travel Time: represents the total time travelled by vehicles on the road network in the modelled period measured in pcu hours.

Table 6-9: LAM network performance indicators

	Time Period	Queues [pcu-hrs]	Average Speed [km/h]	Total Travel Distance [pcu-km]	Total Travel Time [pcu-hrs]
2035 DO-MIN	**AM**	1,100	36	124,588	3,483
	PM	1,009	37	127,986	3,442
2035 DO-SOM	**AM**	1,122	36	124,415	3,506
	PM	1,189	35	127,191	3,593
2050 DO-MIN	**AM**	1,333	34	127,798	3,817
	PM	1,374	34	131,972	3,932
2050 DO SOM	**AM**	1,488	32	127,655	3,969
	PM	1,475	33	131,663	4,012

The results in Table 6-9 indicate that whilst the proposed changes to the junctions at the northern end of the alignment have an impact on road network capacity, the overall impact on the network is relatively minor.

Average speed decreases by only 0-2km/hr in all scenarios for both 2035 and 2050. This represents an approximately 0-5% decrease in average speed with the introduction of Luas Finglas. The minor overall impact is further shown by the impact on total travel time. Total travel time in the model area increases by between 1-4% in 2035 and between 2-4% in 2050.

Slight increases in queuing are evident across all do something scenarios, with average increases of approximately 10% in all scenarios. This is true in both 2035 and 2050. While Luas Finglas results in some increased queuing, there is a very minor impact on travel times and speeds throughout the modelled area.

6.9.2 General Traffic Assessment

6.9.2.1 Overview

The proposed Luas Finglas scheme aims to provide an attractive alternative to the private car and promote a modal shift to public transport, walking and cycling. It is, however, recognised that there will be an overall reduction in operational capacity for general traffic along the study area given the proposed changes to the road layout and the rebalancing of priority to walking, cycling and light rail. This reduction in operational capacity for general traffic along the proposed Scheme will likely create some level of trip redistribution onto the surrounding road network.

It should be noted that the Do Minimum and Do Something scenarios are based on the assumption that travel behaviour will remain broadly consistent over time and that car demand, used for this assessment, represents a reasonable worst-case scenario. It is possible that societal trends in the medium to long term may reduce car demand further due to the ongoing changes to travel behaviours and further shifts towards sustainable travel, flexibility in working arrangements brought on following COVID-19, and delayed car ownership trends that are emerging. The assessment also assumes that goods vehicles (HGVs and LGVs) continue to grow in line with forecasted population growth and economic activity with patterns of travel remaining the same.

The purpose of this section is to assess the overall impact that any redistributed general traffic will have on the performance of the network within the study area.

6.9.2.2 Assessment of Traffic Flow Changes

To determine the impact that the proposed Scheme has in terms of general traffic redistribution on the study area, the LAM Opening Year 2035 model results have been used to identify the difference in general traffic flows between the Do Minimum and Do Something scenarios as a result of the proposed Scheme. The assessment has been considered with reference to both the reductions and increases in general traffic flows along road links.

The majority of instances where a reduction in general traffic flow occurs are located along or adjacent to the proposed Scheme, and where there are proposed measures to improve priority for Luas, cycle and walking facilities.

To determine the impact that the proposed Scheme has in terms of an increase in general traffic flows on the study area, a robust assessment has been undertaken, with reference to TII's Traffic and Transport Assessment Guidelines (May 2014).

This document is considered best practice guidance for the assessment of transport impacts related to changes in traffic flows due to proposed developments and is an appropriate means of assessing the impact of general traffic trip redistribution on the surrounding road network.

Figure 6-17 is an extract from the guidance which outlines '*Advisory Thresholds for Traffic and Transport Assessment Where National Roads are Affected'.*

Where applications affect national roads a Transport Assessment should be requested if the thresholds in Table 2.2, below, are exceeded.

Table 2.2 Advisory Thresholds for Traffic and Transport Assessment Where National Roads are Affected

Vehicle Movements	*100 trips in / out combined in the peak hours for the proposed development*
	Development traffic exceeds 10% of turning movements at junctions with and on National Roads.
	Development traffic exceeds 5% of turning movements at junctions with National Roads if location has potential to become congested or sensitive.

Traffic and Transport Assessment Guidelines PE-PDV-02045 May 2014, TII Publications

Figure 6-17: Extract from the Traffic and Transport Assessment Guidelines (PE-PDV-02045, May 2014)

The basis of the guidance is to assess the impacts of additional trips that have been generated as part of a new development (for example, a new housing estate etc.). Noting that the guidance relates to National Roads only, for the purpose of this assessment, the principles of the guidance have been adapted for the assessment of the proposed Scheme. This has been achieved by extending the threshold to cover all road types in the vicinity of the proposed Scheme, not only National Roads. This ensures a robust and rigorous assessment is undertaken and that potential impacts on more localised or residential streets have been captured as part of the assessment.

The impact assessment of increases to the general traffic flows has used the following thresholds based on the above guidelines:

- **Local / Regional Roads:** Traffic redistribution results in an increase above 100 combined flows (i.e. in a two-way direction) along residential, local and regional roads in the vicinity of the proposed Scheme in the AM and PM peak hours;
  - The threshold aligns with an approximate 1 vehicle per minute increase per direction on any given road. This is a very low level of traffic increase on any road type and ensures that a robust assessment of the impacts of redistributed traffic has been undertaken.
- **National Roads:** Traffic exceeds 5% of the combined turning flows at major junctions on or with National Roads in the AM and PM peak hours as a result of traffic redistribution comparing the Do Minimum to the Do Something scenario with the proposed Scheme in place.
  - The guidelines indicate that a 10% threshold may be used; however, to ensure a rigorous assessment in this instance the lower 5% threshold for turning movements has been utilised.

Where road links have been identified as experiencing additional general traffic flow increases which exceed the above thresholds, a further assessment has been undertaken by way of a traffic capacity analysis on the associated junctions along the affected links.

6.9.2.3 General Traffic Flow Difference – 2035 AM Peak Hour

Figure 6-18 illustrates the difference in traffic flows on the road links in the AM Peak Hour for the 2035 Opening Year.

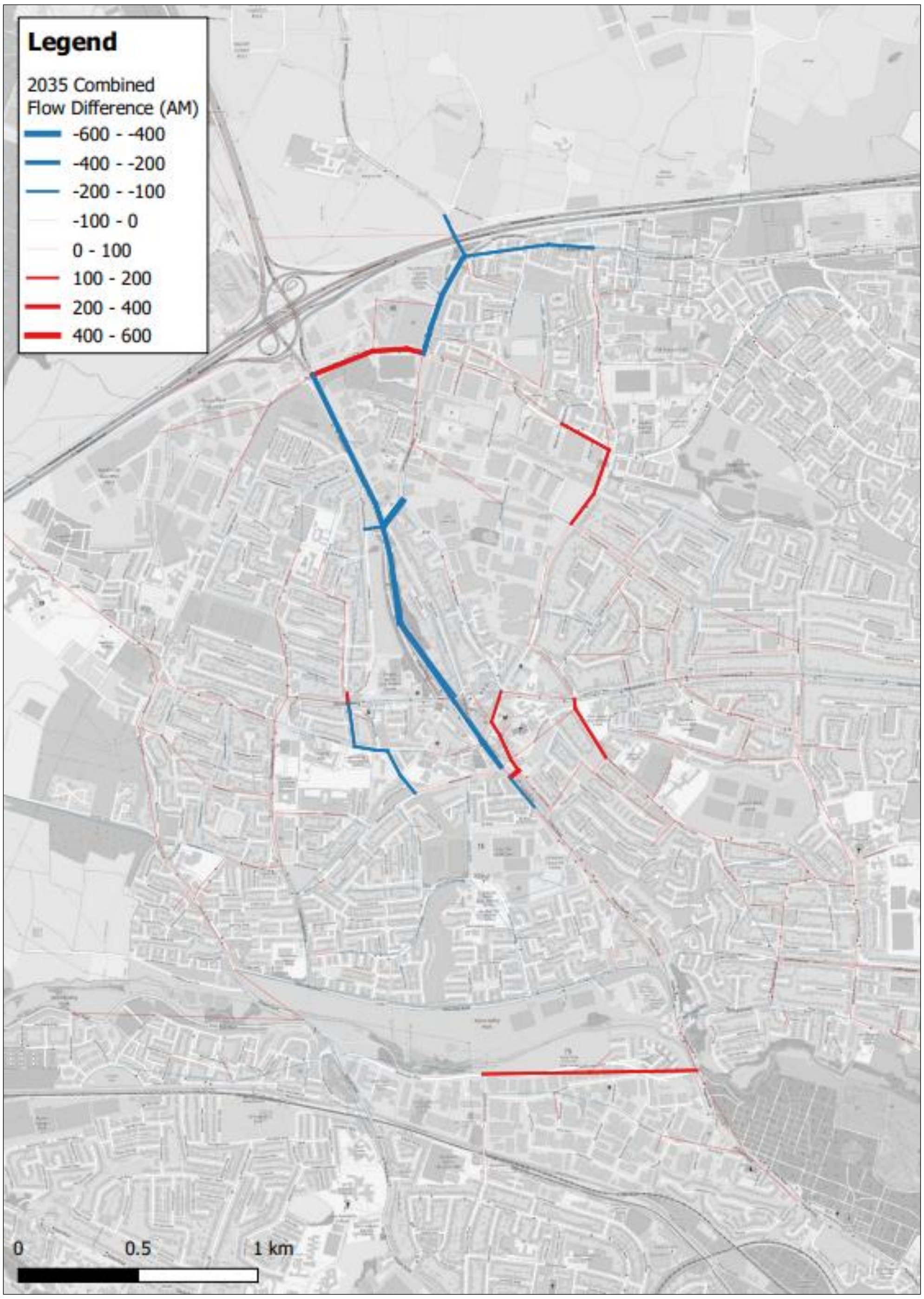


Figure 6-18: Flow Difference on Road Links (Do Minimum vs. Do Something), AM Peak Hour, 2035 Opening Year

Reductions in General Traffic: The LAM indicates that, during the 2035 Opening Year scenario, there are reductions in general traffic noted along the proposed Scheme during the AM Peak Hour, as illustrated by the blue lines in Figure 6-18, which indicates where a reduction of at least -100 combined traffic flows occurs.

The key reductions in traffic flows during the AM Peak Hour are outlined in Table 6-10.

Table 6-10: Road Links that Experience a Reduction of ≥100 Combined Flows (AM Peak Hour, 2035)

Road Name	Do Minimum Flows (PCU)	Do Something Flows (PCU)	Flow Difference
Cappagh Road	517	350	-167
Patrickswell Place	638	497	-141
R103 Finglaswood Road	557	362	-195
Casement Road	756	579	-176
R135 North Road	2,896	2,557	-339
R135 Finglas Road (from St Margaret's Road to Wellmount Road)	2,843	2,445	-397
R104 St Margaret's Road (from McKee Avenue to R135)	1,335	838	-497
R104 St Margaret's Road (from Charlestown Pl to R122)	1,520	1,250	-271
R104 St Margaret's Road (from R122 to Jamestown Road)	1,282	1,153	-129
R122	1,415	1,270	-145

Table 6-10 demonstrates that there is a reduction of between -129 and -497 in general traffic flows on road links that experience a reduction of at least 100 combined flows during the AM Peak Hour. This is attributed to the proposed Scheme including the associated modal shift as a result of its implementation along with signalisation of the R135 / St Margaret's Road junction leading to some localised traffic redistribution. The most significant effect occurs on the R135 Finglas Road and R104 St Margaret's Road.

Increases in General Traffic: The road links which experience additional traffic volumes of over 100 combined flows are illustrated by the red lines in Figure 6-18. These road links have been identified as experiencing traffic volumes above the additional traffic threshold and therefore require further analysis. These road links and associated flow difference between the Do Minimum and Do Something scenarios during the AM Peak Hour are outlined in Table 6-11.

Table 6-11: Road Links where the 100 Flow Additional Threshold is Exceed (2035, AM Peak Hour)

Road Name	Do Minimum Flows (PCU)	Do Something Flows (PCU)	Flow Difference
Ballyboggan Road	994	1,144	150
Glasanaon Road	720	900	180
Charlestown Place	2,030	2,353	323
Finglaswood Road (North of Mellowes Road)	454	620	166
Jamestown Road	1,599	1,699	101
Melville Road	1,226	1,342	117
Finglas Main Street	343	494	151
Jamestown Road (South of Seamus Ennis Road)	50	169	119

Table 6-11 outlines that the additional traffic on road links that experience an increase of at least 100 combined flows varies between 101 and 323 combined flows during the AM Peak Hour. Further junction capacity assessment has been undertaken along these road links to determine whether they have the capacity to cater for the additional traffic volumes as a result of the proposed Scheme.

Operational capacity outputs have been extracted from the LAM at the associated junctions along the subject road links to determine whether there is reserve capacity to facilitate the uplift in traffic. It should be noted that the **worst performing arm** of the junction has been used for the purpose of the assessment to ensure a conservative impact assessment is undertaken.

National Roads – 5% Threshold Impact Assessment (2035 AM Peak Hour)

TII's assessment methodology indicates that National Roads require further assessment where traffic increases exceeding 5% of the combined turning flows at junctions on or with National Roads as a result of traffic redistribution associated with the proposed Scheme. The only National Road junction within the Study Area is the M50 Junction 5 and flow difference between the Do Minimum and Do Something scenarios during the AM Peak Hour are outlined in Table 6-12.

Table 6-12: National Roads Analysis (2035, AM Peak Hour)

Road Name	Do Minimum Turning Flows (PCU)	Do Something Turning Flows (PCU)	Flow Difference (PCU)	% Difference
M50 Junction 5	8,591	8,593	2	0%

Table 6-12 demonstrates that redistributed traffic from the proposed Scheme will have a less than 5% impact on turning flows at junctions with National Roads. Therefore, this is below the threshold required for further assessment.

6.9.2.4 General Traffic Flow Difference – 2035 PM Peak Hour

Figure 6-19 illustrates the difference in traffic flows on the road links in the PM Peak Hour for the 2035 Opening Year.

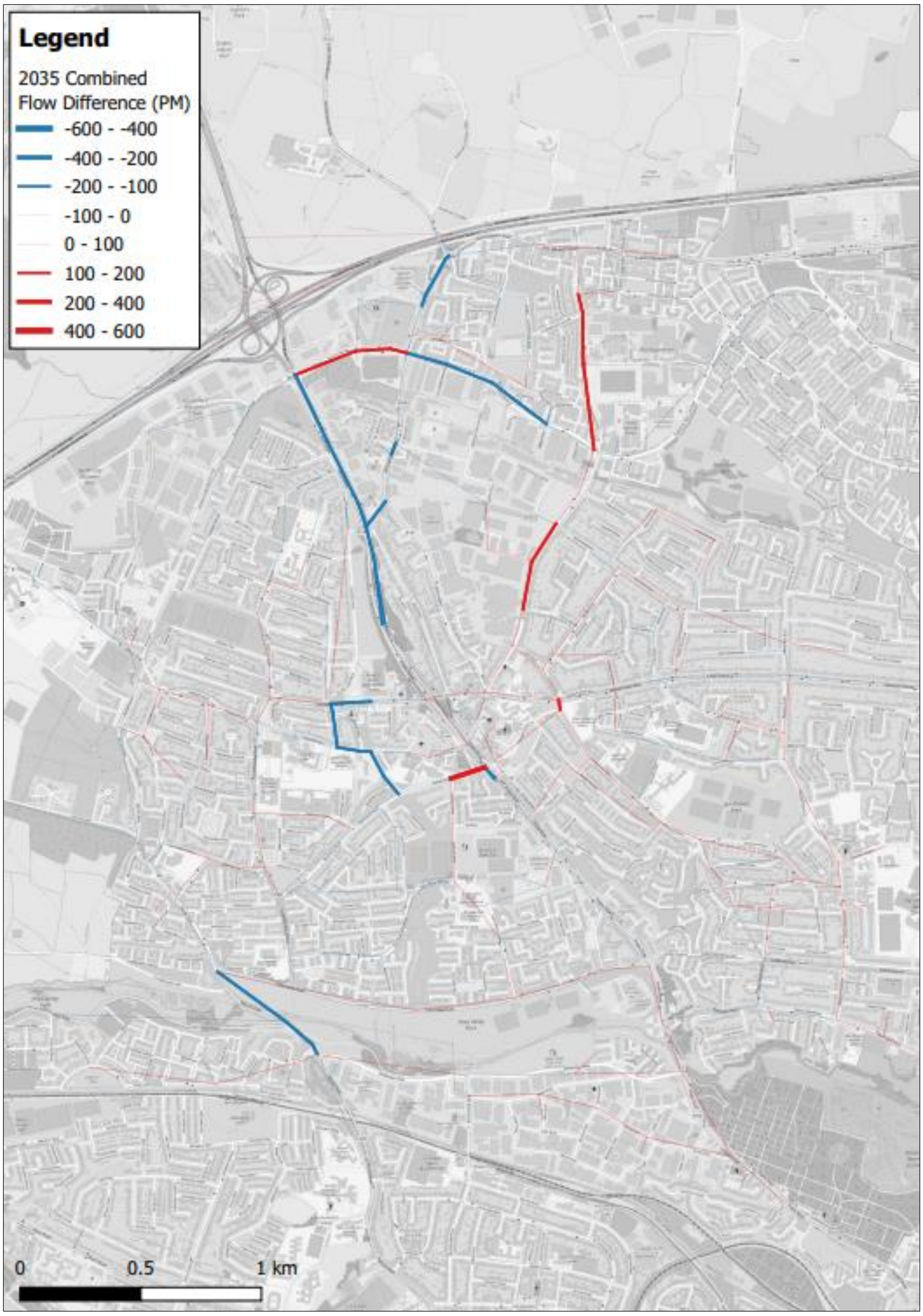


Figure 6-19: Flow Difference on Road Links (Do Minimum vs. Do Something), PM Peak Hour, 2035 Opening Year

Reductions in General Traffic: The LAM indicates that, during the 2035 Opening Year scenario, there are reductions in general traffic noted along the proposed Scheme during the PM Peak Hour, as illustrated by the blue lines in Figure 6-19, which indicates where a reduction of at least -100 combined traffic flows occurs. The key reductions in traffic flows during the 2035 PM Peak Hour are outlined in Table 6-13.

Table 6-13: Road Links that Experience a Reduction of ≥100 Combined Flows (PM Peak Hour, 2035)

Road Name	Do Minimum Flows (PCU)	Do Something Flows (PCU)	Flow Difference
Cappagh Road	668	526	-143
Patrickswell Place	695	556	-138
R103 Finglaswood Road	560	421	-138
Mellowes Road	1,564	1,459	-105
R135 North Road	3,342	3,190	-152
R135 Finglas Road (from St Margaret's Road to Finglas on/off slip roads)	2,850	2,745	-106
R104 St Margaret's Road	1,245	1,049	-196
Melville Road	1,518	1,375	-144
R104 St Margaret's Road (from Charlestown Pl to R122)	1,301	1,166	-136
Ratoath Road	2,279	2,142	-137

Table 6-13 demonstrates that there is a reduction of between -105 and -196 in general traffic flows on road links that experience a reduction of at least 100 combined flows during the PM Peak Hour, which is attributed to the proposed Scheme.

Increases in General Traffic: The road links which experience additional traffic volumes of over 100 combined flows are illustrated by the red lines in Figure 6-19. These road links have been identified as experiencing traffic volumes above the additional traffic threshold and therefore require further analysis. These road links and associated flow difference between the Do Minimum and Do Something scenarios during the PM Peak Hour are outlined in Table 6-14.

Table 6-14: Road Links where the 100 Flow Additional Threshold is Exceed (2035, PM Peak Hour)

Road Name	Do Minimum Flows (PCU)	Do Something Flows (PCU)	Flow Difference
Glasanaon Road	876	993	117
Charlestown Place	1,350	1,478	128
Jamestown Road (from Melville Road to R104)	541	666	126
Jamestown Road (from Melville Road to Clancy Avenue)	1,017	1,138	120
Wellmount Road	769	971	202

Table 6-14 outlines additional traffic on the road links that experience an increase of at least 100 combined flows varies between 117 and 202 combined flows during the PM Peak Hour. As described earlier, these road links have been identified as experiencing additional traffic volumes over the threshold for further assessment.

National Roads – 5% Threshold Impact Assessment (2035 PM Peak Hour)

TII's assessment methodology indicates that National Roads require further assessment where traffic increases exceed 5% of the combined turning flows at junctions on or with National Roads as a result of traffic redistribution associated with the proposed Scheme. The only National Road junction within the Study Area is the M50 Junction 5 and flow difference between the Do Minimum and Do Something scenarios during the 2035 PM Peak Hour are outlined in Table 6-15.

Table 6-15: National Roads Analysis (2035, PM Peak Hour)

Road Name	Do Minimum Turning Flows (PCU)	Do Something Turning Flows (PCU)	Flow Difference (PCU)	% Difference
M50 Junction 5	8,709	8,609	-100	-1%

Table 6-15 demonstrates that redistributed traffic from the proposed Scheme will have a less than 5% impact on turning flows at junctions with National Roads. Therefore, this is below the threshold required for further assessment.

6.9.3 General Traffic Impact Assessment

Following the above threshold assessment, the following junction analysis has been undertaken to determine the impact as a result of the redistributed general traffic associated with the proposed Scheme.

Junction Analysis: To understand the magnitude impact of the redistributed traffic, operational capacities have been extracted from the LAM.

The capacity of junctions within the LAM are expressed in terms of Volume to Capacity ratios (V / C ratios). The V / C ratios represent the operational efficiency for each arm of a junction. For the purpose of this EIAR, operational capacity outputs of a junction have been identified with reference to the busiest arm which experiences the maximum V / C ratio.

A V / C ratio of below 85% indicates that a junction is operating well, with spare capacity, with traffic not experiencing queuing or delays throughout the hour. A value of 85% to 100% indicates that the junction is approaching its theoretical capacity with traffic possibly experiencing occasional queues and delays within the hour. A value of over 100% indicates that a junction is operating above its theoretical capacity and traffic experiences queues and delays regularly within the hour. The junctions have been described in the ranges outlined in Table 6-16.

Table 6-16: Junction Volume / Capacity Ranges

V / C Ratio	Traffic Condition
≤85%	A junction is operating well within theoretical capacity.
85% - 100%	A junction is approaching theoretical capacity and may experience occasional queues and delays within the hour.
≥100%	A junction is operating above its theoretical capacity and experiences queues and delays quite regularly within the hour.

The above analysis was carried out on the following scenarios:

- 2035 Opening Year – Do Minimum vs Do Something – AM Peak Hour;

- 2050 Design Year (Opening Year + 15 Years) – Do Minimum vs Do Something – AM Peak Hour;
- 2035 Opening Year – Do Minimum vs Do Something – PM Peak Hour; and
- 2050 Design Year (Opening Year + 15 Years) – Do Minimum vs Do Something – PM Peak Hour.

The AM and PM Peak Hour flows are modelled as occurring between 08:00 to 09:00 and 17:00 to 18:00 respectively, which present an overall worst-case scenario.

6.9.3.1 General Traffic Impact Assessment (2035, AM Peak Period)

Table 6-17 outlines the V / C ratios at the local / regional road junctions identified as requiring further assessment in the AM Peak Hour for the 2035 Opening Year. The location of these junctions along links experiencing an increase in traffic flows of greater than 100 PCUs due to the proposed Scheme are illustrated in Figure 6-20.

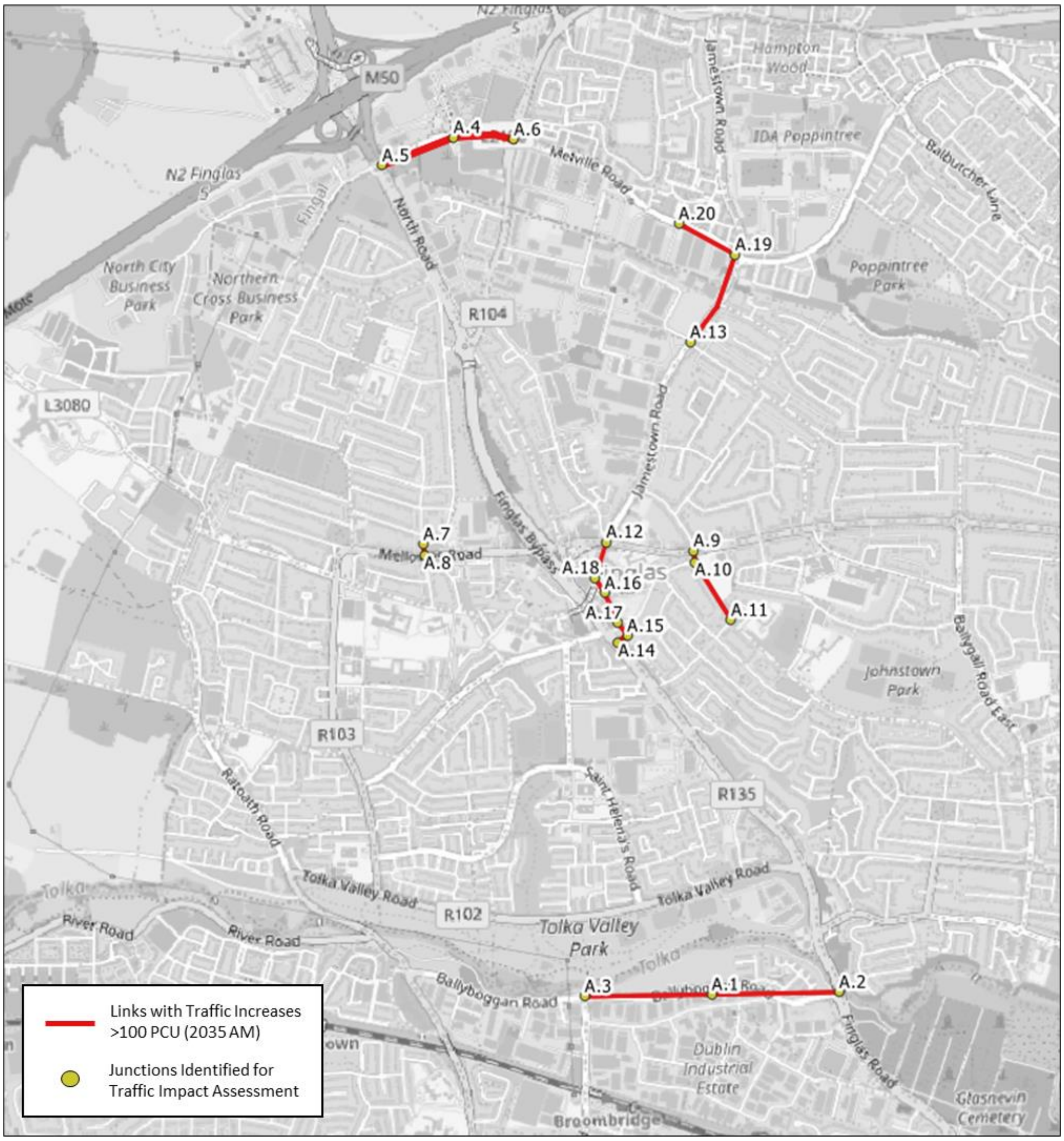


Figure 6-20: Key Junctions for V/C Assessment, AM Peak Hour, 2035 Opening Year

Table 6-17: Volume over Capacity at Key Junctions (Do Minimum vs Do Something), AM Peak, 2035

Road Name	Junction Name (Map ID)	Max V/C		DM Max V/C Range			DS Max V/C Range		
		Do Min	Do Some	≤85%	85% - 100%	≥100%	≤85%	85% - 100%	≥100%
Ballyboggan Road	BALLYBOGGAN ROAD / GLASNEVIN WOODS (A.1)	37	43	✓			✓		
Ballyboggan Road	BALLYBOGGAN ROAD / FINGLAS ROAD (A.2)	80	84	✓			✓		
Ballyboggan Road	BROOMBRIDGE ROAD / BALLYBOGGAN ROAD (A.3)	103	101			✓			✓
Charlestown Place	CHARLESTOWN ROAD / CHARLESTOWN SC (A.4)	76	71	✓			✓		
Charlestown Place	R135 / NORTH ROAD (A.5)	85	94		✓			✓	
Charlestown Place	ST MARGARETS ROAD / CHARLESTOWN PLACE (A.6)	92	96		✓			✓	
Finglaswood Road	FINGLASWOOD ROAD / CARDIFF CASTLE ROAD (A.7)	51	61	✓			✓		
Finglaswood Road	FINGLASWOOD ROAD / MELLOWES ROAD (A.8)	89	88		✓			✓	
Glasanaon Road	BALLYGALL ROAD WEST / CLUNE ROAD / SEAMUS ENNIS ROAD (A.9)	76	75	✓			✓		
Glasanaon Road	BALLYGALL ROAD WEST / GLASANAON ROAD (A.10)	22	28	✓			✓		
Glasanaon Road	BALLYGALL PLACE / GLASANAON ROAD (A.11)	16	24	✓			✓		
Jamestown Road	SEAMUS ENNIS ROAD / JAMESTOWN ROAD (A.12)	101	101			✓			✓
Jamestown Road	SYCAMORE ROAD / JAMESTOWN ROAD (A.13)	90	99		✓			✓	
Finglas Main Street	FINGLAS ROAD / MAIN STREET (A.14)	82	81	✓			✓		

Road Name	Junction Name (Map ID)	Max V/C		DM Max V/C Range			DS Max V/C Range		
		Do Min	Do Some	≤85%	85% - 100%	≥100%	≤85%	85% - 100%	≥100%
Finglas Main Street	FINGLAS ROAD / MAIN STREET (A.15)	36	45	✓			✓		
Finglas Main Street	MAIN STREET / ST CANICE'S CHURCH (A.16)	16	16	✓			✓		
Finglas Main Street	MAIN STREET / BALLYGALL ROAD WEST (A.17)	22	27	✓			✓		
Finglas Main Street	MAIN STREET / CHURCH STREET (A.18)	32	35	✓			✓		
Melville Road	JAMESTOWN ROAD / MELLVILLE ROAD / POPPINTREE PARK LANE (A.19)	104	97			✓		✓	
Melville Road	MELVILLE WAY / MYGAN PARK (A.20)	36	33	✓			✓		

The results of the junction analysis illustrated in Table 6-17 demonstrate that the majority of junctions are operating with a maximum V / C ratio of below 85% during the AM Peak Hour in the 2035 Opening Year, and that the proposed Scheme will have a negligible impact on the majority of the road junctions identified as requiring further assessment.

Capacity issues are noted at the following junctions:

- **Broombridge Road / Ballyboggan Road** – operates above 100% during both the Do Minimum and Do Something scenarios; and
- **Seamus Ennis Road / Jamestown Road** – operates above 100% during both the Do Minimum and Do Something scenarios

Each of these junctions operate with a maximum V / C ratio of above 100% in both the Do Minimum and Do Something scenarios, with very little difference in the ratio between the scenarios, therefore the impact of the Scheme on these junctions is considered to be minimal.

6.9.3.2 General Traffic Impact Assessment (2035, PM Peak Period)

Table 6-18 outlines the V / C ratios at the local / regional road junctions identified as requiring further assessment in the PM Peak Hour for the 2035 Opening Year. The location of these junctions along links experiencing an increase in traffic flows of greater than 100 PCUs due to the proposed Scheme are illustrated in Figure 6-21.

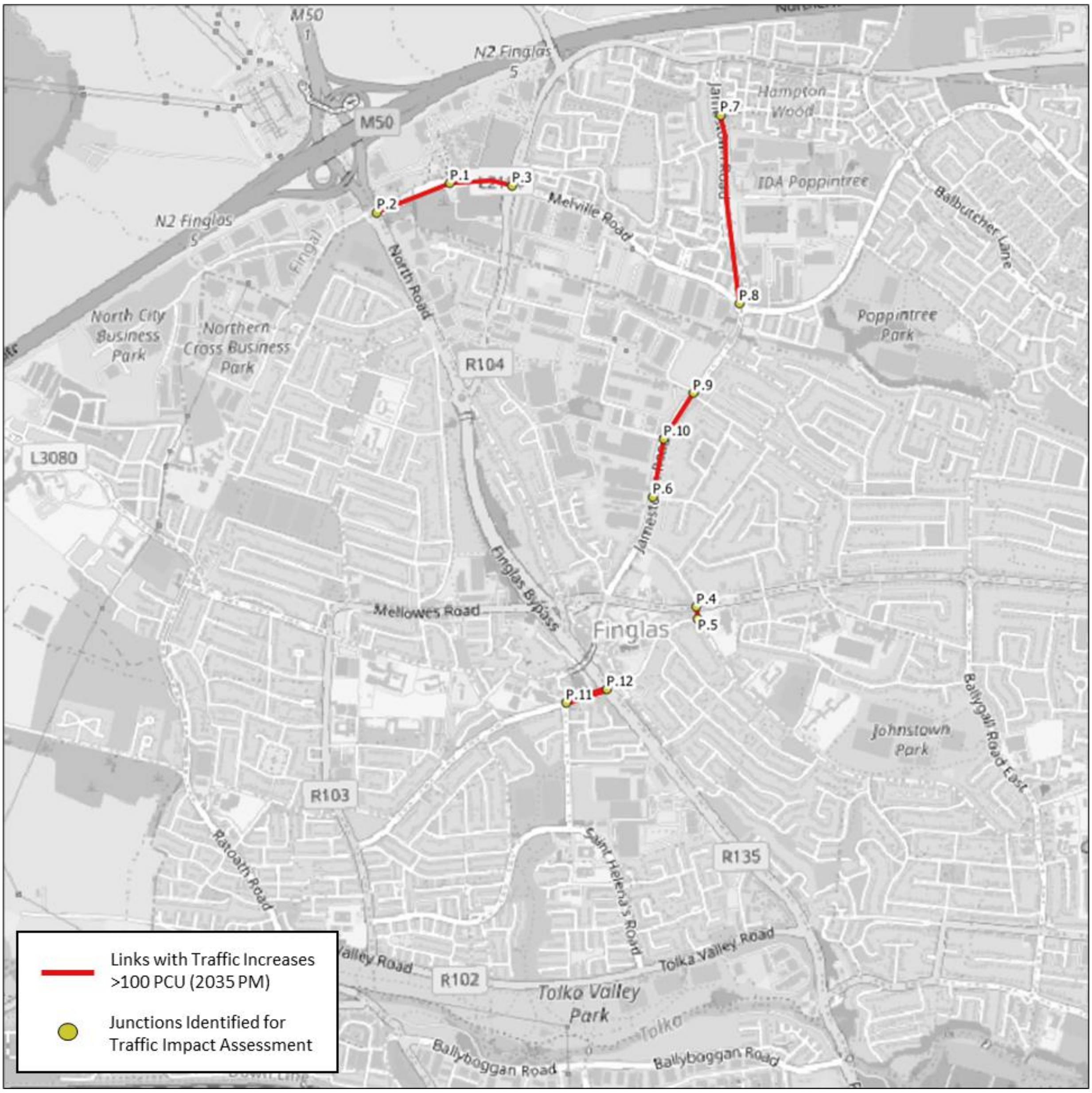


Figure 6-21: Key Junctions for V/C Assessment, PM Peak Hour, 2035 Opening Year

Table 6-18: Volume over Capacity at Key Junctions (Do Minimum vs Do Something), PM Peak, 2035

Road Name	Junction Name (Map ID)	Max V/C		DM Max V/C Range			DS Max V/C Range		
		Do Min	Do Min	≤85%	85% - 100%	≥100%	≤85%	85% - 100%	≥100%
Charlestown Place	CHARLESTOWN ROAD / CHARLESTOWN SC (P.1)	53	59	✓			✓		
Charlestown Place	CHARLESTOWN PLACE / R135 NORTH ROAD (P.2)	102	102			✓			✓
Charlestown Place	ST MARGARETS ROAD / CHARLESTOWN PLACE (P.3)	100	101			✓			✓
Glasanaon Road	BALLYGALL ROAD WEST / CLUNE ROAD / SEAMUS ENNIS ROAD (P.4)	91	93		✓			✓	
Glasanaon Road	BALLYGALL ROAD WEST / GLASANAON ROAD (P.5)	24	27	✓			✓		
Jamestown Road	CLANCY AVENUE / JAMESTOWN ROAD (P.6)	32	34	✓			✓		
Jamestown Road	JAMESTOWN ROAD / HAMPTON WOOD ROAD (P.7)	22	25	✓			✓		
Jamestown Road	JAMESTOWN ROAD / MELVILLE ROAD / POPPINTREE PARK LANE (P.8)	103	103			✓			✓
Jamestown Road	SYCAMORE ROAD / JAMESTOWN ROAD (P.9)	88	89		✓			✓	
Jamestown Road	JAMESTOWN ROAD / JAMESTOWN BUSINESS PARK (P.10)	33	36	✓			✓		
Wellmount Road	WELLMOUNT ROAD / FARNHAM DRIVE (P.11)	36	71	✓			✓		
Wellmount Road	R135 FINGLAS ROAD / WELLMOUNT ROAD (P.12)	101	101			✓			✓

The results of the junction analysis illustrated in Table 6-18 demonstrate that the proposed Scheme will have a negligible impact on the local / regional road junctions identified as requiring further assessment within the study area in the 2035 PM Peak Hour.

Capacity issues are noted at the following junctions:

- **Charlestown Place / R135 North Road** – operates above 100% during both the Do Minimum and Do Something scenarios;
- **Charlestown Place / St Margaret's Road** – operates above 100% during both the Do Minimum and Do Something scenarios;
- **Jamestown Road / Melville Road** – operates above 100% during both the Do Minimum and Do Something scenarios; and
- **R135 Finglas Road / Wellmount Road -** operates above 100% during both the Do Minimum and Do Something scenarios.

Each of these junctions operate with a maximum V / C ratio of above 100% in both the Do Minimum and Do Something scenarios, therefore the impact of the proposed Scheme on these junctions is considered to be minimal.

6.9.3.3 General Traffic Impact Assessment (2050, AM Peak Period)

The same approach used for Opening Year traffic impact assessment was applied to the 2050 Design Year. In-line with TII Traffic and Transport Assessment Guidelines, links were identified where vehicle movements increase by more than 100 PCUs in both directions as a result of the proposed Scheme. The junctions along these road links were then assessed to determine the impact of the traffic changes on overall capacity.

Table 6-19 outlines the V / C ratios at the local / regional road junctions identified as requiring further assessment in the AM Peak Hour for the 2050 Design Year. The location of these junctions along links experiencing an increase in traffic flows of greater than 100 PCUs due to the proposed Scheme are illustrated in Figure 6-22.

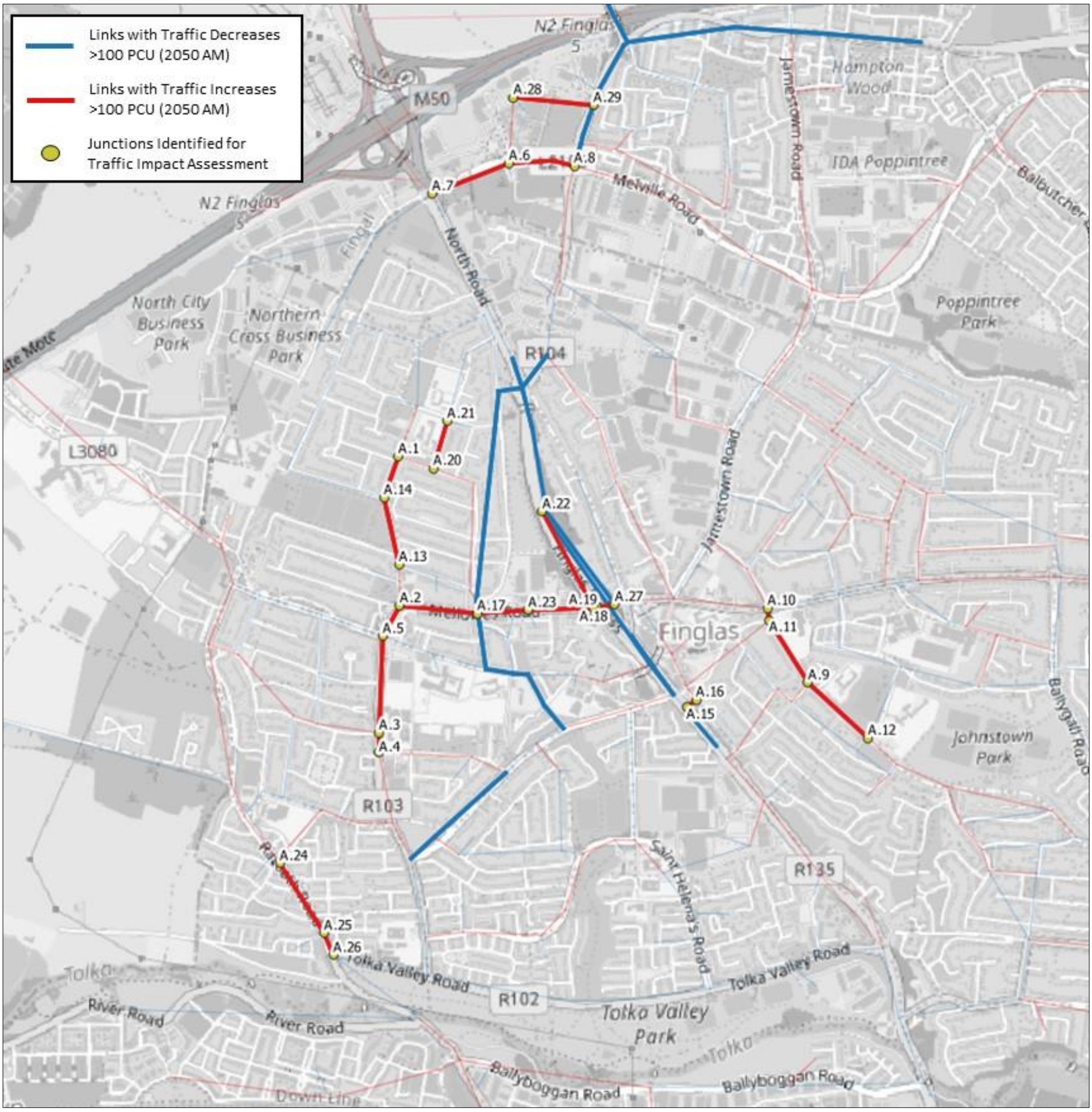


Figure 6-22: Key Junctions for V / C Assessment, AM Peak Hour, 2050 Design Year

Table 6-19: Volume over Capacity at Key Junctions (Do Minimum vs Do Something), AM Peak, 2050

Road Name	Junction Name (Map ID)	Max V/C		DM Max V/C Range			DS Max V/C Range		
		Do Min	Do Min	≤85%	85% - 100%	≥100%	≤85%	85% - 100%	≥100%
Barry Road	BARRY ROAD / CASEMENT DRIVE (A.1)	4	15	✓			✓		
Cardiffsbridge Road	MELLOWES ROAD / KILDONAN ROAD (A.2)	43	46	✓			✓		
Cardiffsbridge Road	RATOATH AVENUE / CARDIFFSBRIDGE ROAD (A.3)	25	28	✓			✓		
Cardiffsbridge Road	WELLMOUNT AVENUE / CARDIFFSBRIDGE ROAD (A.4)	22	23	✓			✓		
Cardiffsbridge Road	CARDIFFSBRIDGE ROAD / CAPPAGH ROAD (A.5)	99	99		✓			✓	
Charlestown Place	CHARLESTOWN ROAD / CHARLESTOWN SC (A.6)	80	72	✓			✓		
Charlestown Place	R135 / NORTH ROAD (A.7)	87	87		✓			✓	
Charlestown Place	ST MARGARETS ROAD / CHARLESTOWN PLACE (A.8)	93	96		✓			✓	
Glasanaon Road	BALLYGALL PLACE / GLASANAON ROAD (A.9)	25	30	✓			✓		
Glasanaon Road	BALLYGALL ROAD WEST / CLUNE ROAD / SEAMUS ENNIS ROAD (A.10)	77	83	✓			✓		
Glasanaon Road	BALLYGALL ROAD WEST / GLASANAON ROAD (A.11)	25	31	✓			✓		
Glasanaon Road	FERNDALE AVENUE / GLASANAON ROAD (A.12)	9	14	✓			✓		
Kildonan Road	KILDONAN ROAD / KILDONAN DRIVE (A.13)	7	11	✓			✓		
Kildonan Road	KILDONAN ROAD / BARRY ROAD (A.14)	14	29	✓			✓		

Road Name	Junction Name (Map ID)	Max V/C		DM Max V/C Range			DS Max V/C Range		
		Do Min	Do Min	≤85%	85% - 100%	≥100%	≤85%	85% - 100%	≥100%
Finglas Main Street	FINGLAS ROAD / MAIN STREET (A.15)	78	75	✓			✓		
Finglas Main Street	FINGLAS ROAD / MAIN STREET (A.16)	52	60	✓			✓		
Mellowes Road	FINGLASWOOD ROAD / MELLOWES ROAD (A.17)	100	100			✓			✓
Mellowes Road	MELLOWES ROAD / R103 (A.18)	64	53	✓			✓		
Mellowes Road	R103 / MELLOWES ROAD (A.19)	36	43	✓			✓		
Plunkett Road	CASEMENT DRIVE / PLUNKETT ROAD (A.20)	4	18	✓			✓		
Plunkett Road	PLUNKETT ROAD / BARRY AVENUE (A.21)	23	21	✓			✓		
R135 Finglas Road	FINGLAS OFF-SLIP (A.22)	49	51	✓			✓		
R103	MELLOWES ROAD / MELLOWES CRESCENT (A.23)	48	58	✓			✓		
Ratoath Road	RATOATH ROAD / RATHVILLY ROAD (A.24)	25	29	✓			✓		
Ratoath Road	RATOATH ROAD / SCRIBBLESTOWN ROAD (A.25)	26	28	✓			✓		
Ratoath Road	RATOATH ROAD / TOLKA VALLEY ROAD (A.26)	85	74	✓			✓		
Seamus Ennis Road	SEAMUS ENNIS ROAD / R103 (A.27)	80	77	✓			✓		
St Margaret's Road	CHARLESTOWN SHOPPING CENTRE MINOR ROAD (A.28)	32	32	✓			✓		
St Margaret's Road	ST MARGARETS ROAD / MINOR ROAD (A.29)	63	67	✓			✓		

The results of the junction analysis illustrated in Table 6-19 demonstrate that the majority of junctions assessed continue to operate with a maximum V / C ratio of below 85% during the AM Peak Hour in the 2050 Design Year. The Finglaswood Road / Mellowes Road junction operates with a V / C ratio of above 100% in both the Do Minimum and Do Something scenarios with little change between the two scenarios.

Overall, redistributed traffic associated with the proposed Scheme is expected to result in a minimal impact at all junctions on road links experiencing an increase of more than 100 PCUs in the 2050 AM Peak hour.

6.9.3.4 General Traffic Impact Assessment (2050, PM Peak Period)

Table 6-20 outlines the V / C ratios at the local / regional road junctions identified as requiring further assessment in the PM Peak Hour for the 2050 Design Year. The location of these junctions along links experiencing an increase in traffic flows of greater than 100 PCUs due to the proposed Scheme are illustrated in Figure 6-23.

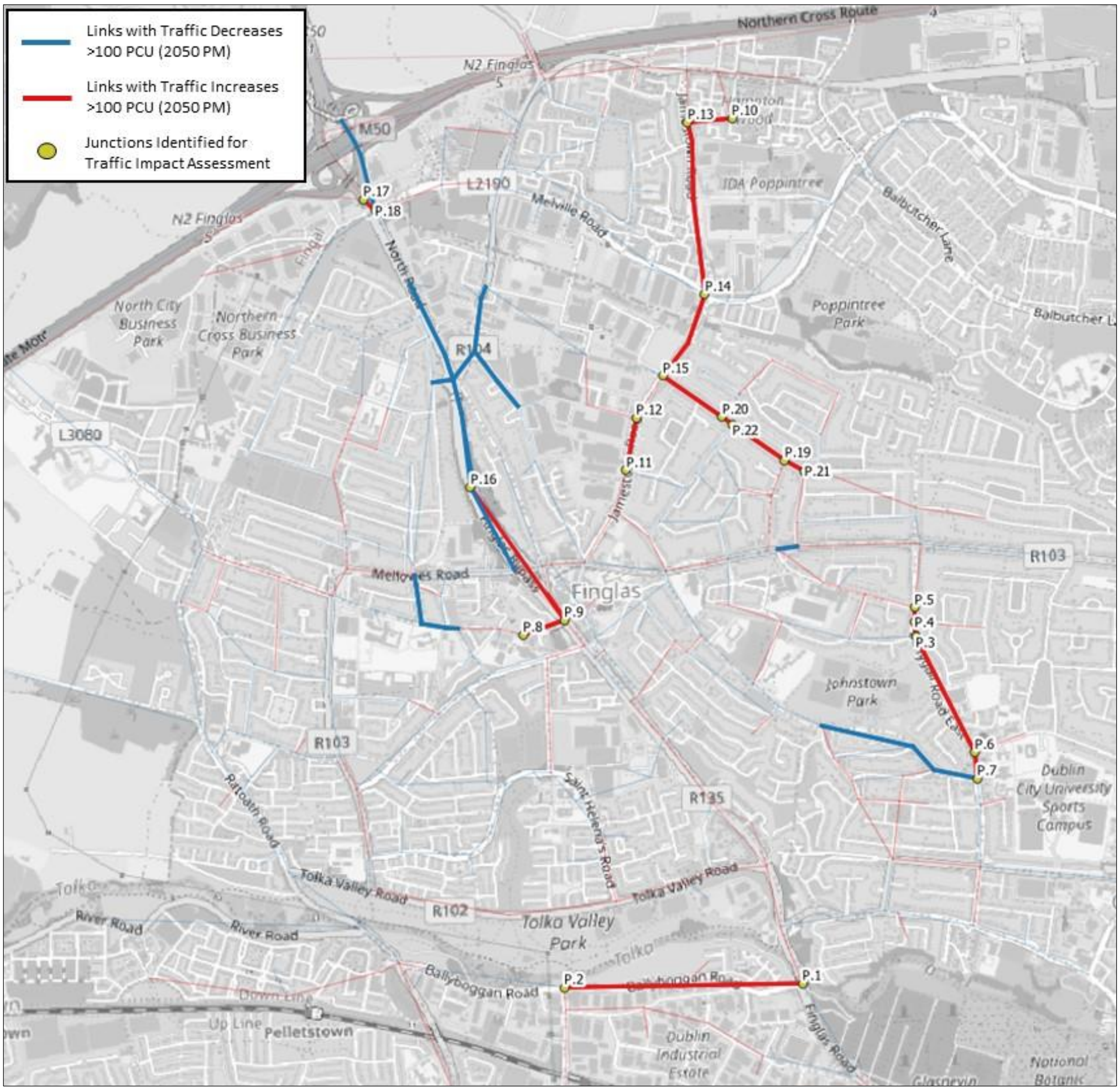


Figure 6-23: Key Junctions for V / C Assessment, PM Peak Hour, 2050 Design Year

Table 6-20: Volume over Capacity at Key Junctions (Do Minimum vs Do Something), PM Peak, 2050

Road Name	Junction Name (Map ID)	Max V/C		DM Max V/C			DS Max V/C		
		Do Min	Do Min	≤85%	85% - 100%	≥100%	≤85%	85% - 100%	≥100%
Ballyboggan Road	BALLYBOGGAN ROAD / FINGLAS ROAD (P.1)	95	94		✓			✓	
Ballyboggan Road	BROOMBRIDGE ROAD / BALLYBOGGAN ROAD (P.2)	101	103			✓			✓
Ballygall Road East	BALLYGALL ROAD EAST / FERNDALE AVENUE (P.3)	21	27	✓			✓		
Ballygall Road East	BALLYGALL ROAD EAST / HILLCREST PARK (P.4)	21	27	✓			✓		
Ballygall Road East	BENEAVIN ROAD / BALLYGALL ROAD EAST / BENEAVIN DRIVE (P.5)	21	22	✓			✓		
Ballygall Road East	CREMORE HEIGHTS / BALLYGALL ROAD EAST (P.6)	31	33	✓			✓		
Ballygall Road East	FITZMAURICE ROAD / BALLYGALL ROAD EAST (P.7)	31	35	✓			✓		
Church Street	CHURCH STREET / CHURCH TERRACE (P.8)	4	10	✓			✓		
Church Street	FINGLAS ROAD / CHURCH STREET (P.9)	95	90		✓			✓	
Hampton Wood Road	HAMPTON WOOD ROAD / HAMPTON WOOD GREEN (P.10)	20	16	✓			✓		
Jamestown Road	CLANCY AVENUE / JAMESTOWN ROAD (P.11)	34	37	✓			✓		
Jamestown Road	JAMESTOWN ROAD / JAMESTOWN BUSINESS PARK (P.12)	34	37	✓			✓		
Jamestown Road	JAMESTOWN ROAD / HAMPTON WOOD ROAD (P.13)	28	39	✓			✓		
Jamestown Road	JAMESTOWN ROAD / MELLVILLE ROAD / POPPINTREE PARK LANE (P.14)	103	102			✓			✓
Jamestown Road	SYCAMORE ROAD / JAMESTOWN ROAD (P.15)	86	94		✓			✓	

Road Name	Junction Name (Map ID)	Max V/C		DM Max V/C			DS Max V/C		
		Do Min	Do Min	≤85%	85% - 100%	≥100%	≤85%	85% - 100%	≥100%
R135 Finglas Road	FINGLAS OFF-SLIP / R135 FINGLAS ROAD (P.16)	98	102		✓				✓
R135 North Road	R135 / N2 SOUTH OF M50 INTERCHANGE (P.17)	83	85	✓			✓		
R135 North Road	R135 / NORTH ROAD (P.18)	98	99		✓			✓	
Sycamore Road	GROVE ROAD / SYCAMORE ROAD (P.19)	8	11	✓			✓		
Sycamore Road	SYCAMORE PARK / SYCAMORE ROAD (P.20)	10	12	✓			✓		
Sycamore Road	SYCAMORE ROAD / GROVE PARK ROAD / WILLOW PARK CRESCENT (P.21)	10	14	✓			✓		
Sycamore Road	SYCAMORE ROAD / MCKEE ROAD (P.22)	8	11	✓			✓		

The results of the junction analysis illustrated in Table 6-20 demonstrate that the majority of junctions continue to operate with a maximum V / C ratio of below 85% during the PM Peak Hour in the 2050 Design Year with the proposed Scheme in place.

It is noted that capacity issues arise at the following junctions:

- **Broombridge Road / Ballyboggan Road** – operates above 100% during both the Do Minimum and Do Something scenarios;
- **Jamestown Road / Melville Road** – operates above 100% during both the Do Minimum and Do Something scenarios; and
- **R135 Finglas Road / Finglas Off-Slip** – operates between 85% – 100% during the Do Minimum and above 100% during the Do Something scenario.

At two of the junctions above, the impact is considered to be minimal as performance is similar in the Do Minimum and Do Something scenarios (above 100% V / C with little change between the two scenarios). A greater impact is predicted at the Finglas Off-Slip entering the R135 in a northbound direction, however it should be noted that this junction is approaching capacity in the Do Minimum scenario, with a small increase in V / C ratio rising from 98 to 102 as a result of the proposed Scheme.

6.9.4 General Traffic Assessment Summary

Luas Finglas will operate in a mainly off-road corridor, however, it will interact with the road network at a number of locations including St Margaret's Road and the R135 North Road, along with crossings of Mellowes Road, Cappagh Road, Wellmount Road, St Helena's Road, Tolka Valley Road and Ballyboggan Road. There will be an overall reduction in operational capacity for general traffic at some of these locations, in particular along St Margaret's Road, and at the junction with the R135 which will be converted to a signalised junction to facilitate Luas crossings as well improved safety for pedestrians and cyclists.

This reduction in operational capacity for general traffic will result in some traffic redistribution from the proposed Scheme area onto the surrounding road network. The LAM Opening Year (2035) and Design Year (2050) model results were used to identify the change in traffic flows between the Do Minimum and Do Something scenarios. Reference has been made to TII's Traffic and Transport Assessment Guidelines as an indicator for best practice, to determine the key road links that require further traffic analysis due to the increase in traffic. Operational capacities were extracted from the LAM at the associated junctions of the road links identified as requiring further assessment, to identify the impact that the proposed Scheme will have on the V / C ratios of these junction.

The results of the assessment demonstrate that the surrounding road network largely has the capacity to accommodate the redistributed general traffic as a result of the proposed Scheme. The vast majority of assessed junctions that required further traffic analysis have V / C ratios that are broadly similar before and after the proposed Scheme implementation. The analysis demonstrates that there will be a level of redistribution of traffic with some increases and some decreases in volumes on surrounding roads.

7. SUMMARY

This report provides an overview of the modelling undertaken to support the Luas Finglas EIAR. A detailed description is provided of the NTA's ERM, along with rationale as to why it is a suitable tool for assessing the effects of the proposed scheme.

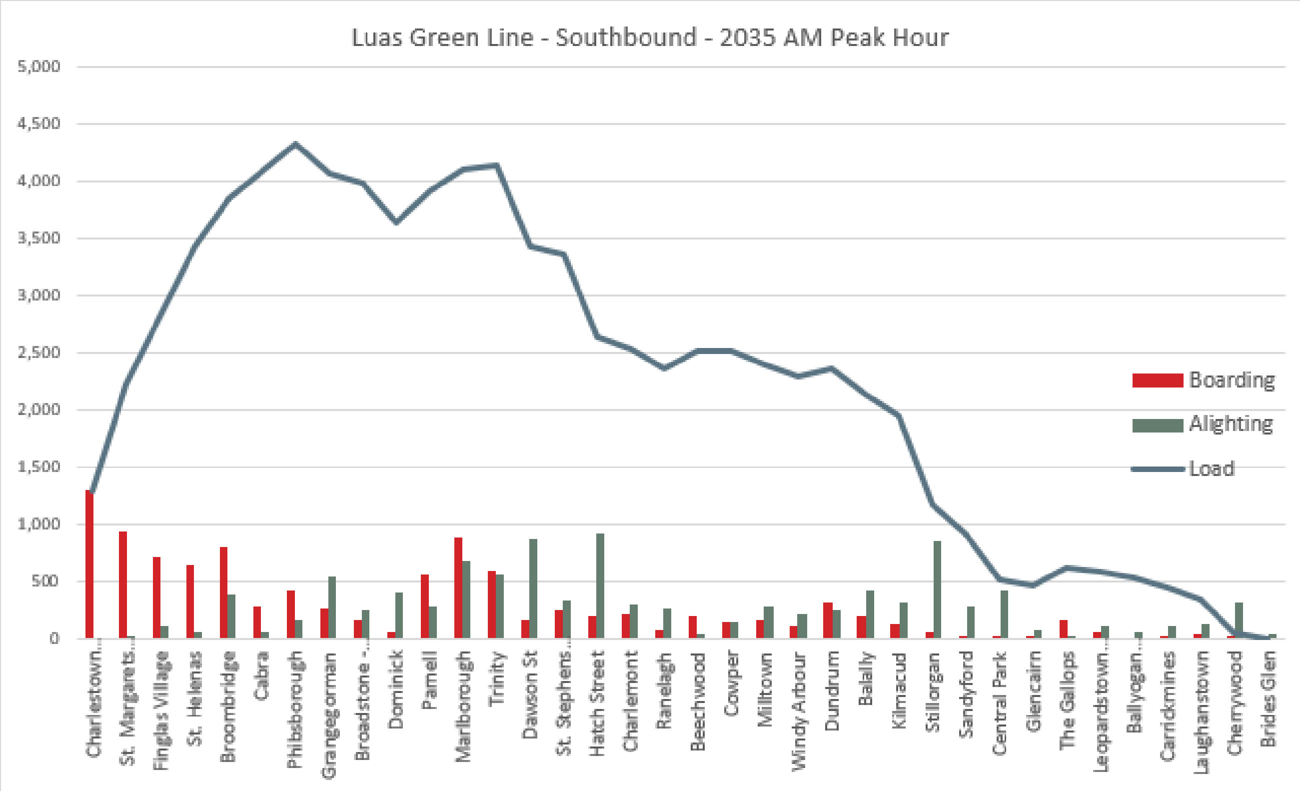
The report outlines the assumptions used to develop future year model scenarios to feed into the appraisal of Luas Finglas, including how they have been represented in the ERM. The results of modelling undertaken in the ERM to support the Luas Finglas EIAR have been presented. In summary:

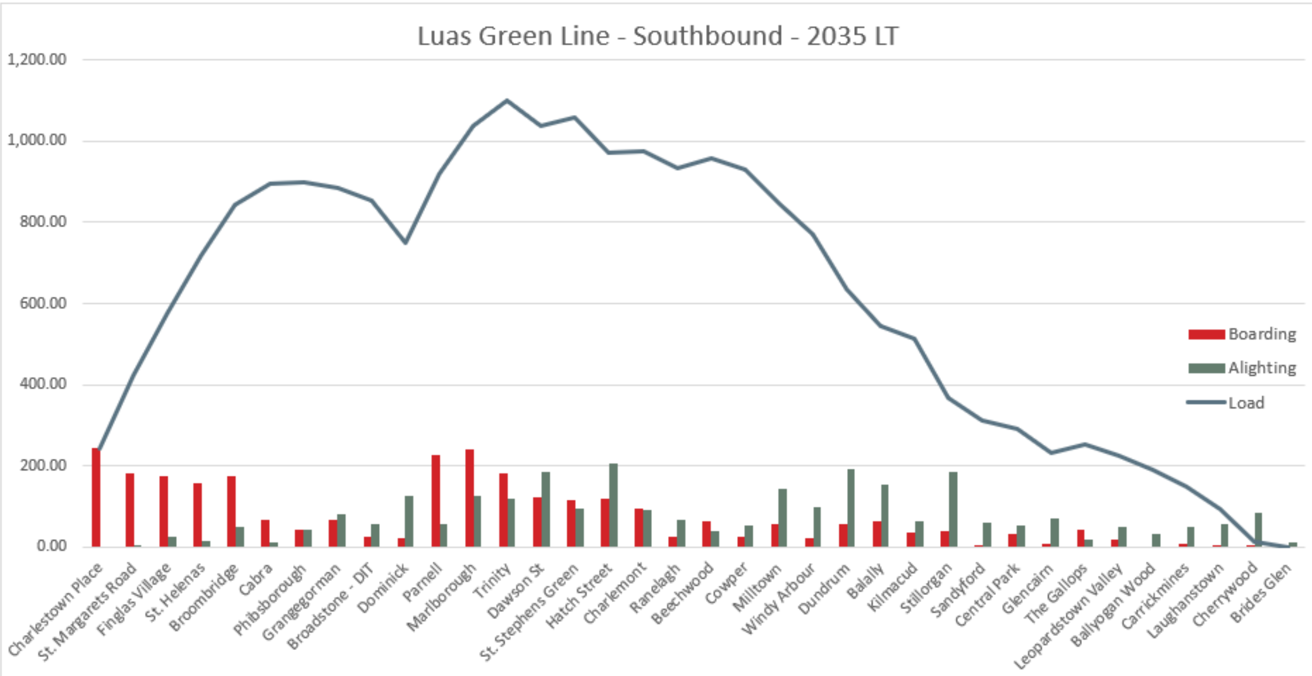
- Luas Finglas directly serves a number of large sites marked for high-density development. It is estimated that 73% of the new population expected in the Finglas area by 2035 will be within a 10-minute walk of one of the new Luas Finglas stops.
- Luas Finglas will attract high levels of boardings at all four of the stations along the proposed extension. In total, Luas Finglas will lead to an increase of 1.3 million low carbon public transport trips in 2035, increasing to 1.8 million in 2050.
- Luas Finglas delivers an improved public transport service directly to the city centre, but also to a range of other destinations along the network through integration with other high quality public transport services. Interchange points are provided with DART+ at Broombridge station as well as a number of BusConnects Network spines and orbital routes at Charlestown and Finglas Village.
- The large level of population growth planned for the study area strains the transport system in the Do Minimum scenario, resulting in a bottleneck for travel towards the city centre. Luas Finglas relieves this bottleneck and increases the overall carrying capacity of the transport network over the Royal Canal in this area by 50%.
- Luas Finglas will significantly reduce public transport journey times between the Finglas area and the city centre by an average of 12% during the AM peak hour. When compared to travel via private car, the delivery of Luas Finglas will lead to an average reduction in journey times to the city centre of 15 minutes (over 30%) during the congested peak periods.

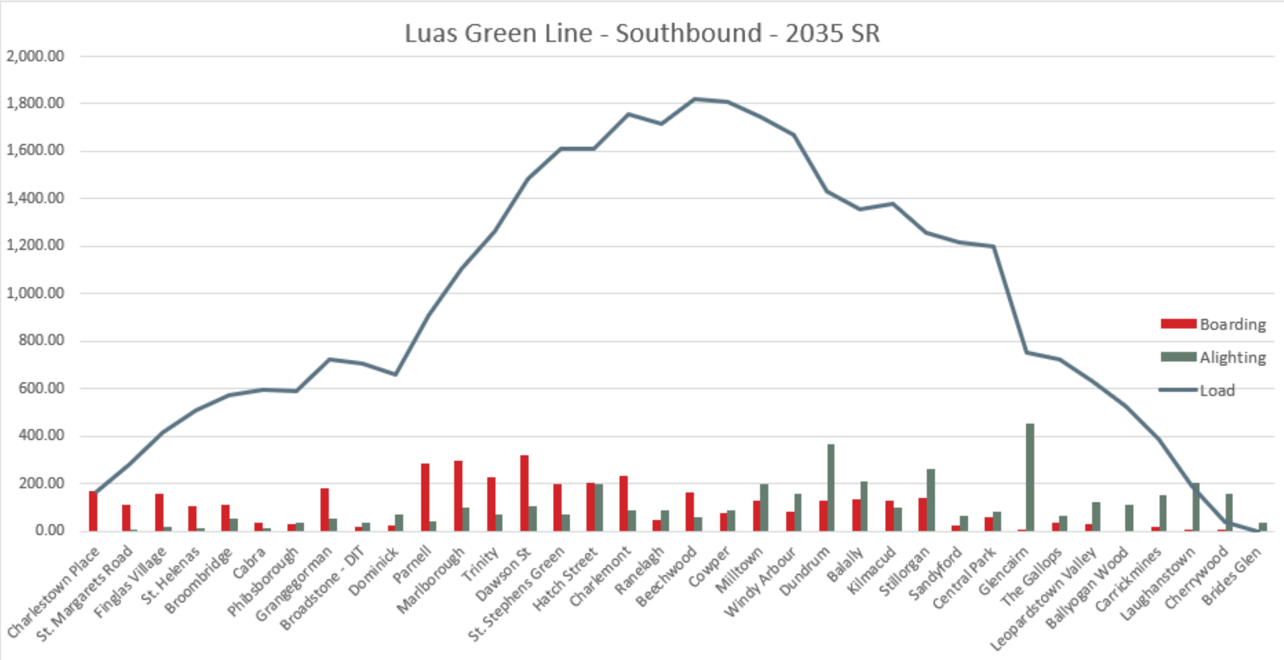
A highway Local Area Model was developed, calibrated and validated for the base year and used to test the impact of Luas Finglas on the surrounding road network in the forecast years of 2035 and 2050. In summary:

- Overall, the impact of junction changes as a result of Luas Finglas leads to a relatively minor increase in travel time and delay on the road network. This is a localised impact, focused around the proposed changes along St. Margaret's Road and the junction with the R135.
- Junction analysis for the AM and PM peak hours for both the 2035 opening year and 2050 design year was undertaken on junctions along the links experiencing an increase in traffic flows of greater than the identified threshold of 100 combined flows (i.e. in a two-way direction). The results of the assessment demonstrate that the surrounding road network has the capacity to accommodate the redistributed general traffic as a result of the proposed Scheme. The vast majority of assessed junctions that required further traffic analysis have V / C ratios that are broadly similar before and after the proposed Scheme implementation.

Appendix A Luas Line Flows Core Scenario



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0.00
Boarding
Alighting
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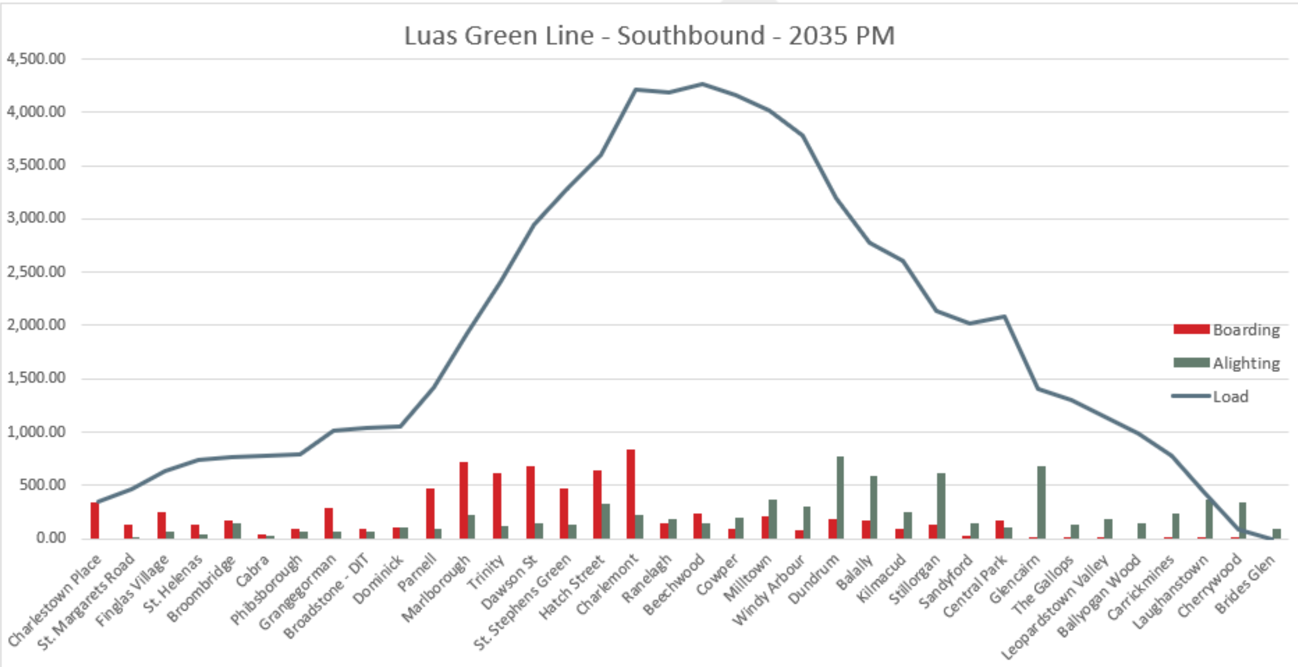
St. Margarets Road
Finglas Village
St. Helenas
Broombridge
Cabra
Phibsborough
Grangegorman
Broadstone - DIT
Dominick
Parnell
Marlborough
Trinity
Dawson St
St. Stephens Green
Hatch Street
Charlemont
Ranelagh
Beechwood
Cowper
Milltown
Windy Arbour
Dundrum
Balally
Kilmacud
Stillorgan
Sandyford
Central Park
Glencairn
The Gallops
Leopardstown Valley
Ballyogan Wood
Carrickmines
Laughanstown
Cherrywood
Brides Glen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St. Helenas
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Grangegorman
Broadstone - DIT
Dominick
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Marlborough
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Dawson St
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Balally
Kilmacud
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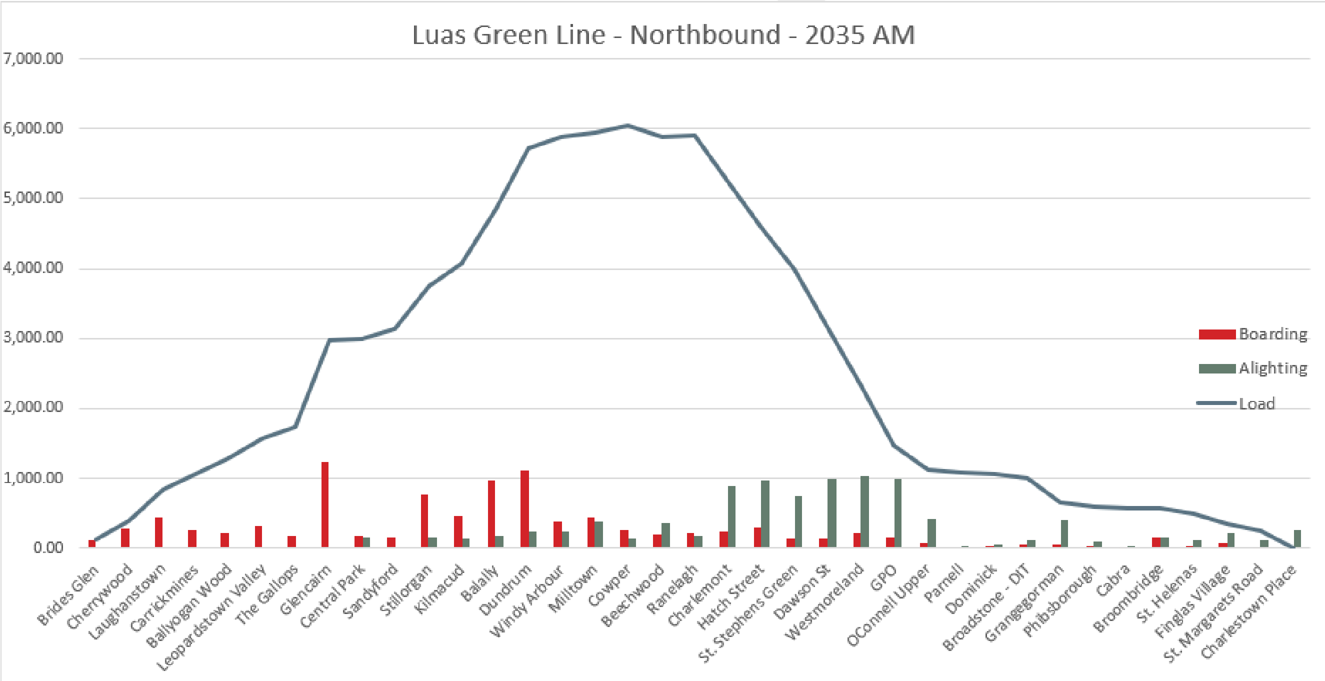
Laughanstown
Cherrywood
Brides Glen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Cherrywood
Laughanstown
Carrickmines
Ballyogan Wood
Leopardstown Valley
The Gallops
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Kilmacud
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Windy Arbour
Milltown
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Beechwood
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Charlemont
Hatch Street
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Dawson St
Westmoreland
GPO
OConnell Upper
Parnell
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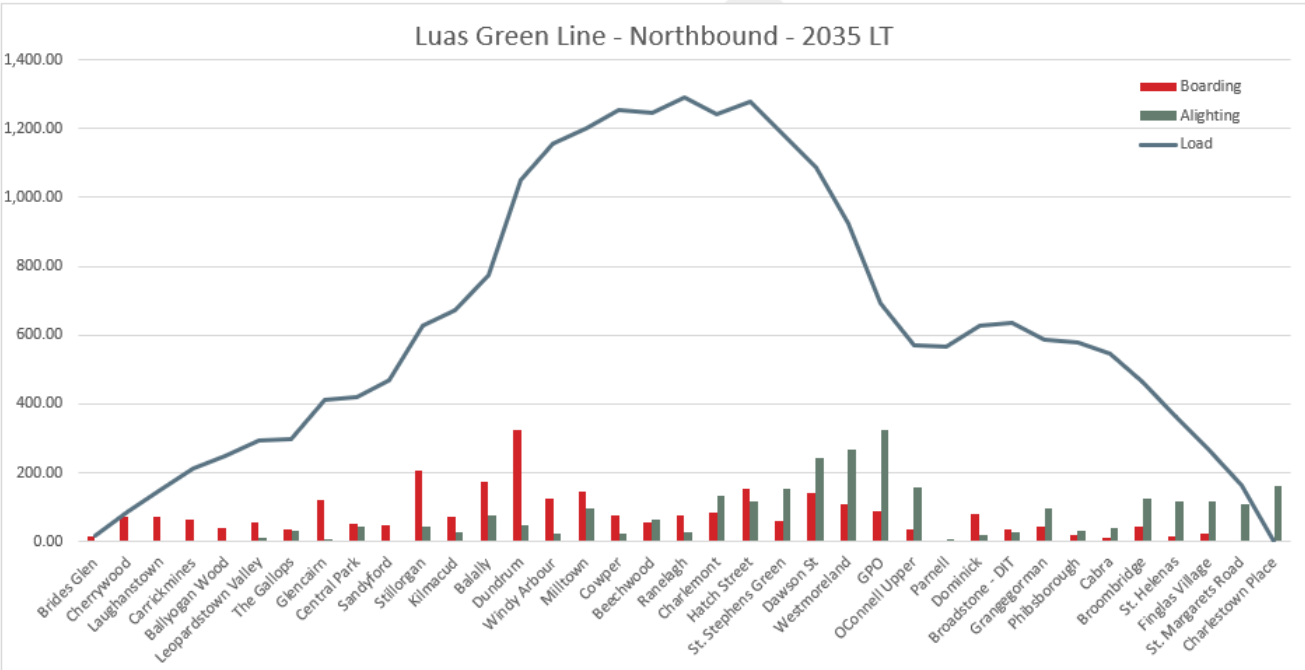
St. Helenas
Finglas Village
St. Margarets Road
Charlestown Place


Luas Green Line - Northbound - 2035 LT
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Boarding
Alighting
Load
Brides Glen
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Carrickmines
Ballyogan Wood
Leopardstown Valley
The Gallops
Glencairn
Central Park
Sandyford
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Kilmacud
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Windy Arbour
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OConnell Upper
Parnell
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Broadstone - DIT
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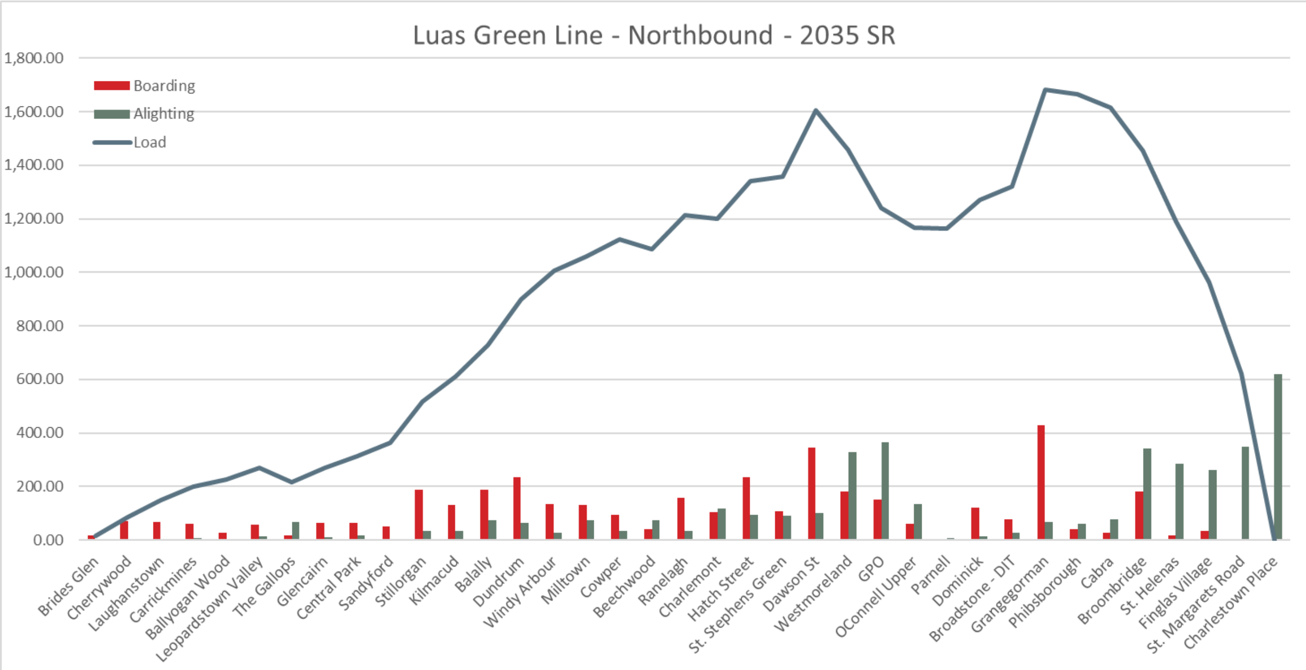
St. Helenas
Finglas Village
St. Margarets Road
Charlestown Place


Luas Green Line - Northbound - 2035 SR
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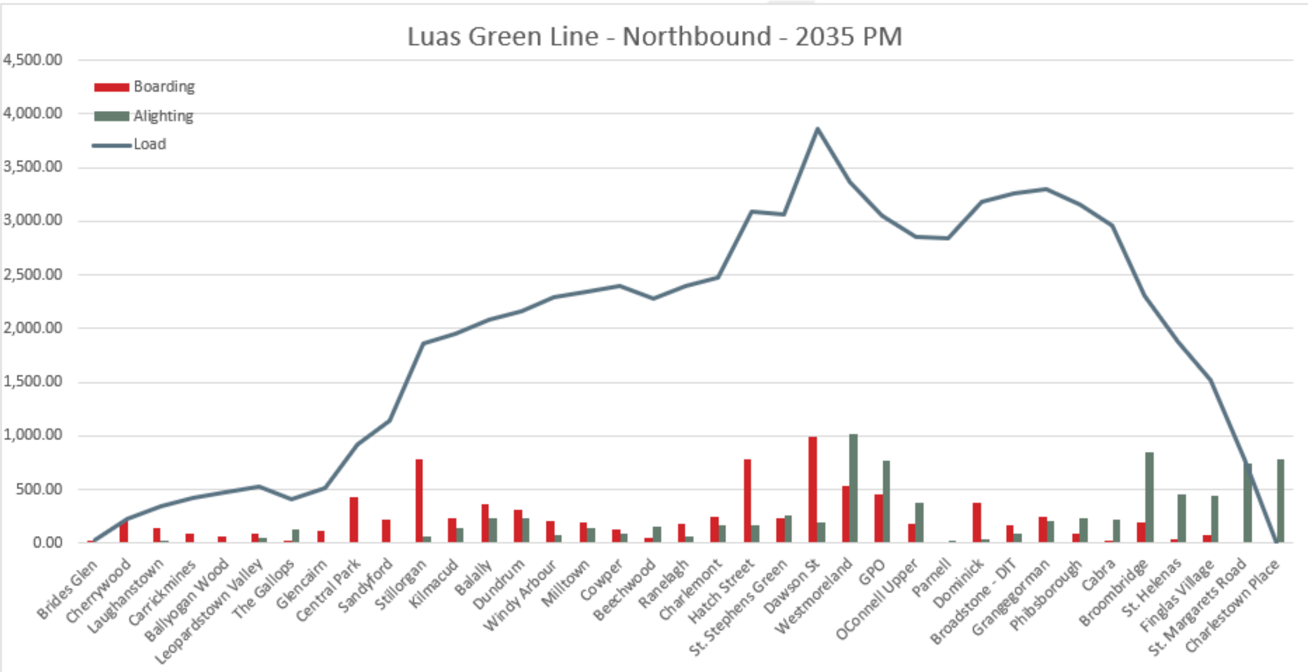
Finglas Village
St. Margarets Road
Charlestown Place


Luas Green Line - Northbound - 2035 PM
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Leopardstown Valley
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St. Margarets Road
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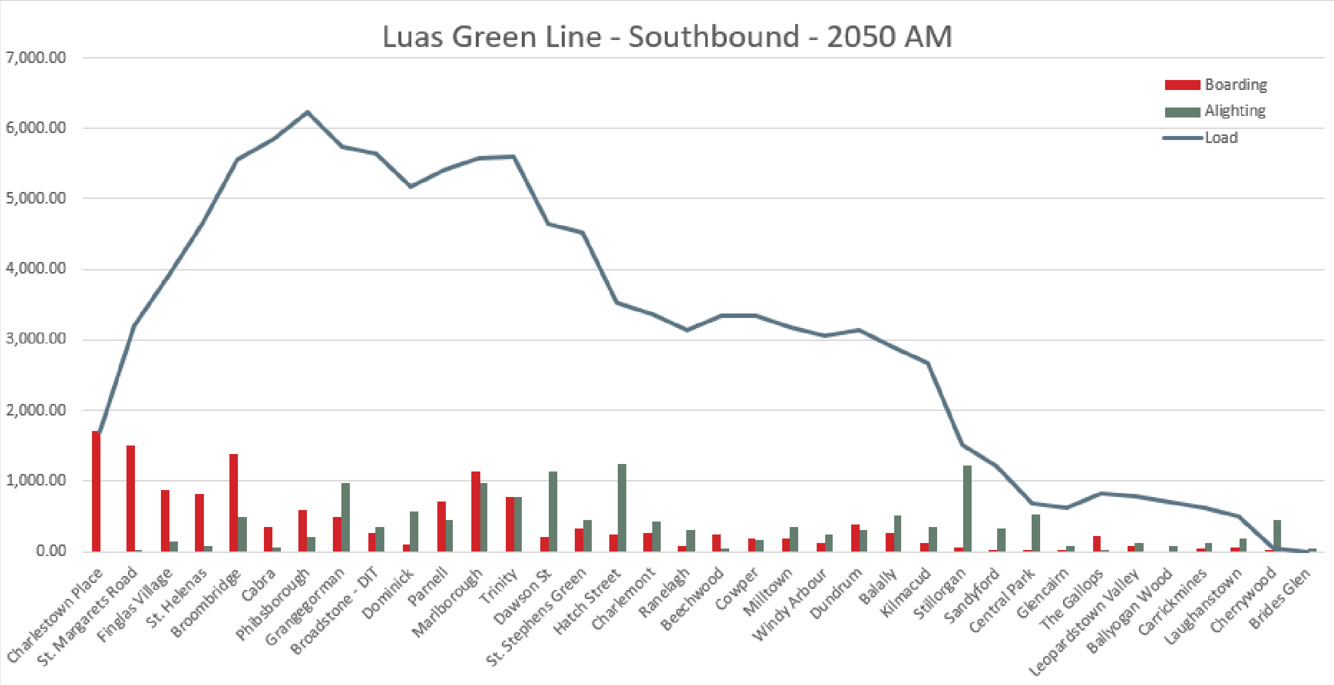

Luas Green Line - Southbound - 2050 AM
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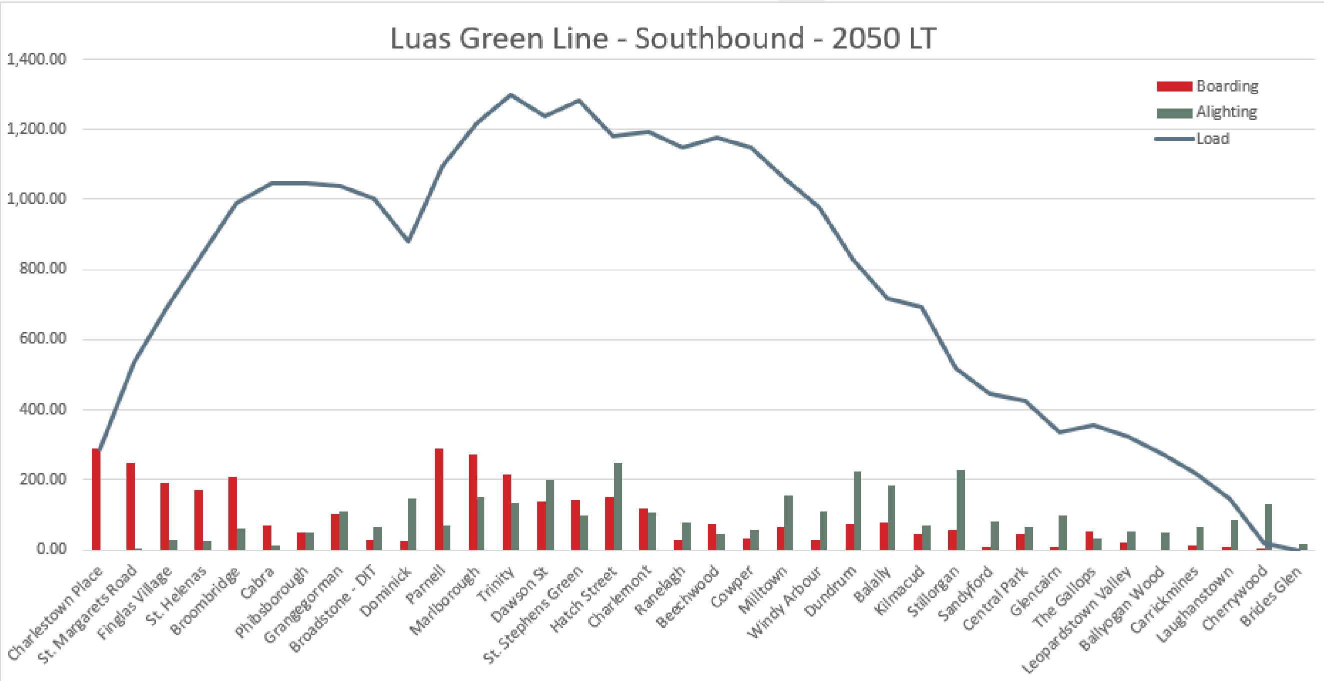
Brides Glen



Luas Green Line - Southbound - 2050 LT
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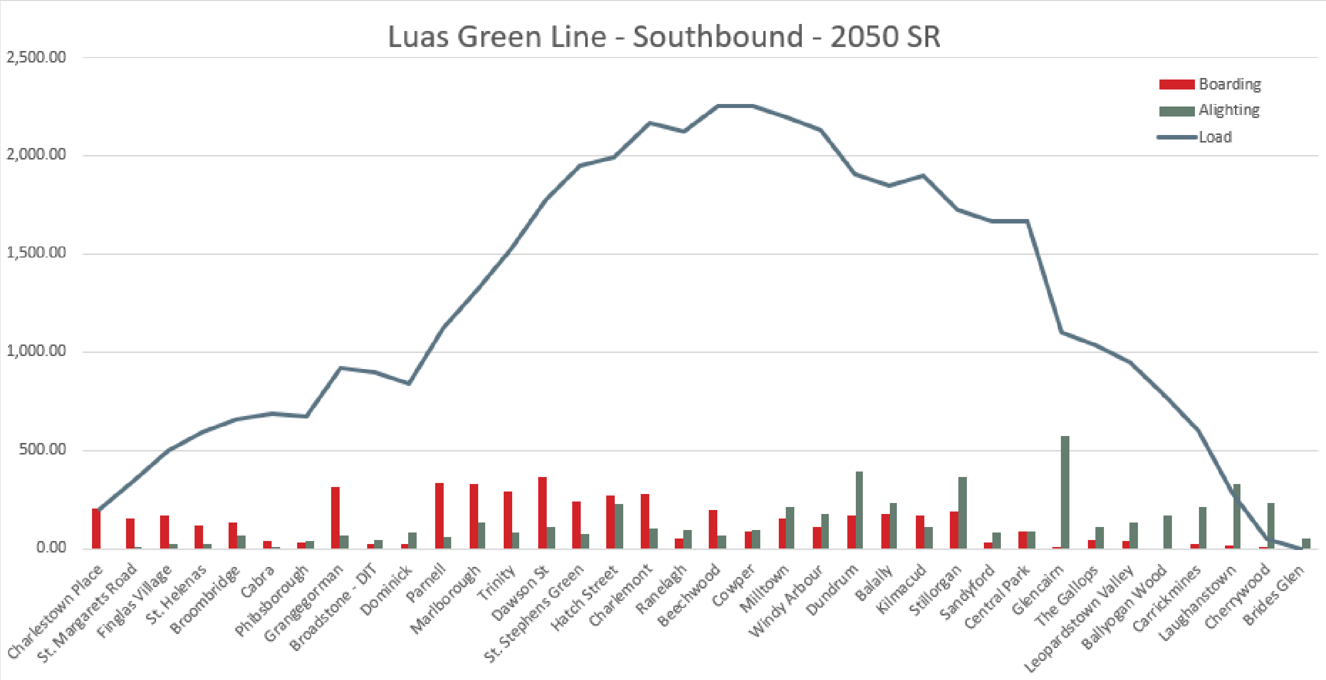
Luas Green Line - Southbound - 2050 SR
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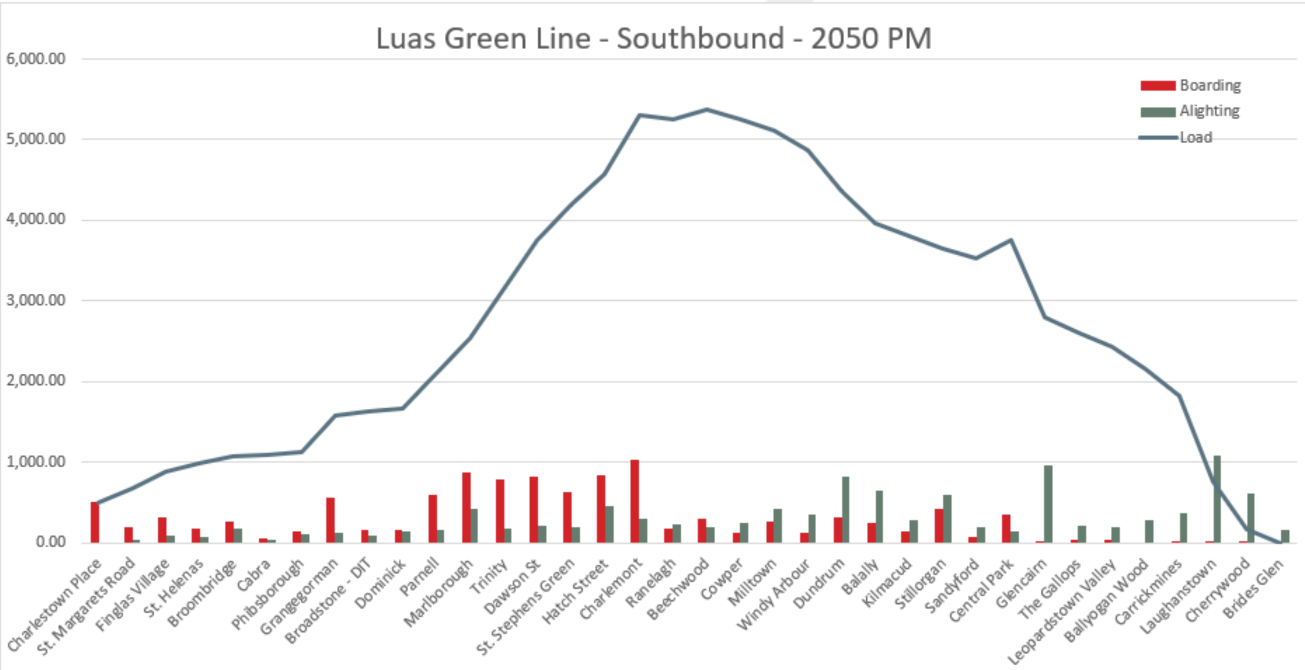
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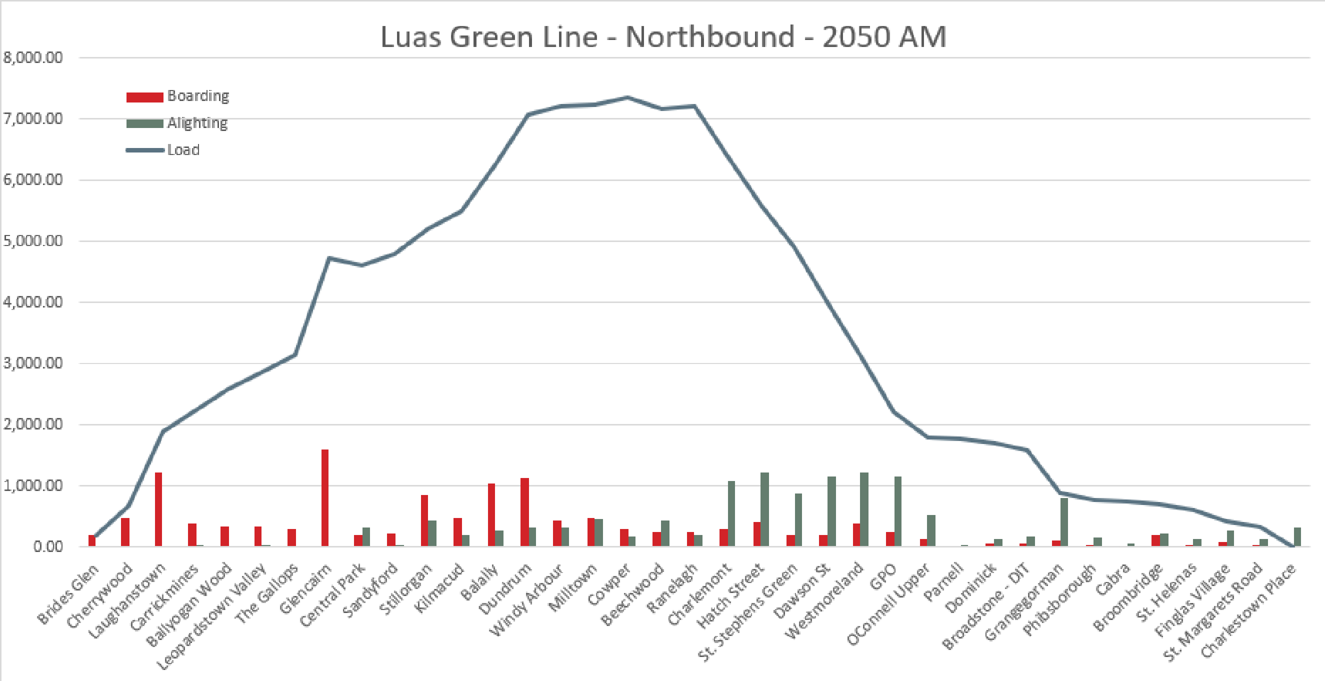
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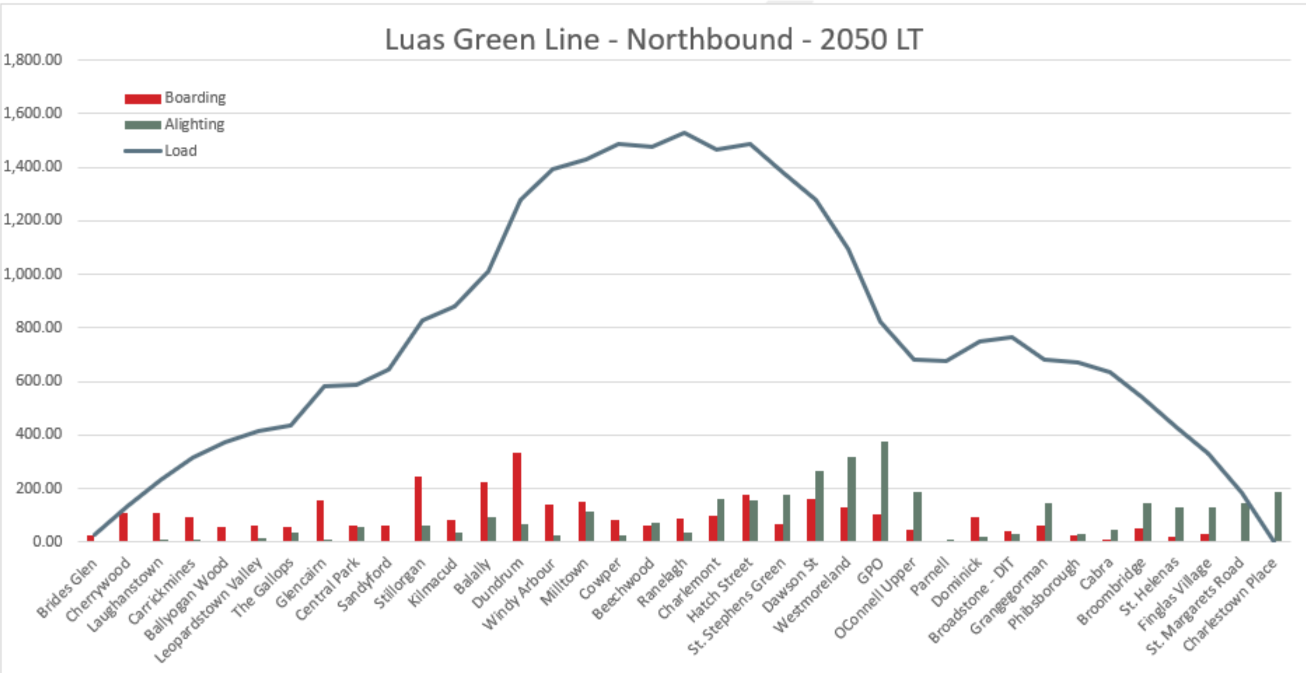
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St. Margarets Road
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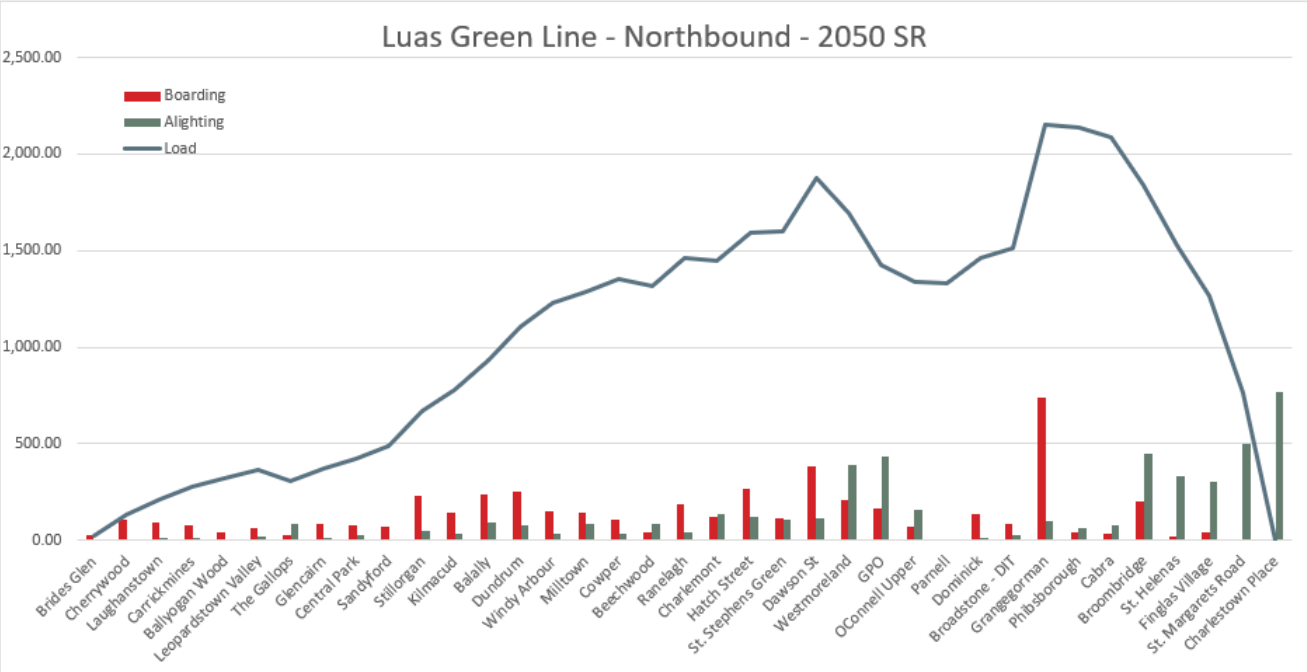
Luas Green Line - Northbound - 2050 SR
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Boarding
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Brides Glen
Cherrywood
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Leopardstown Valley
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Parnell
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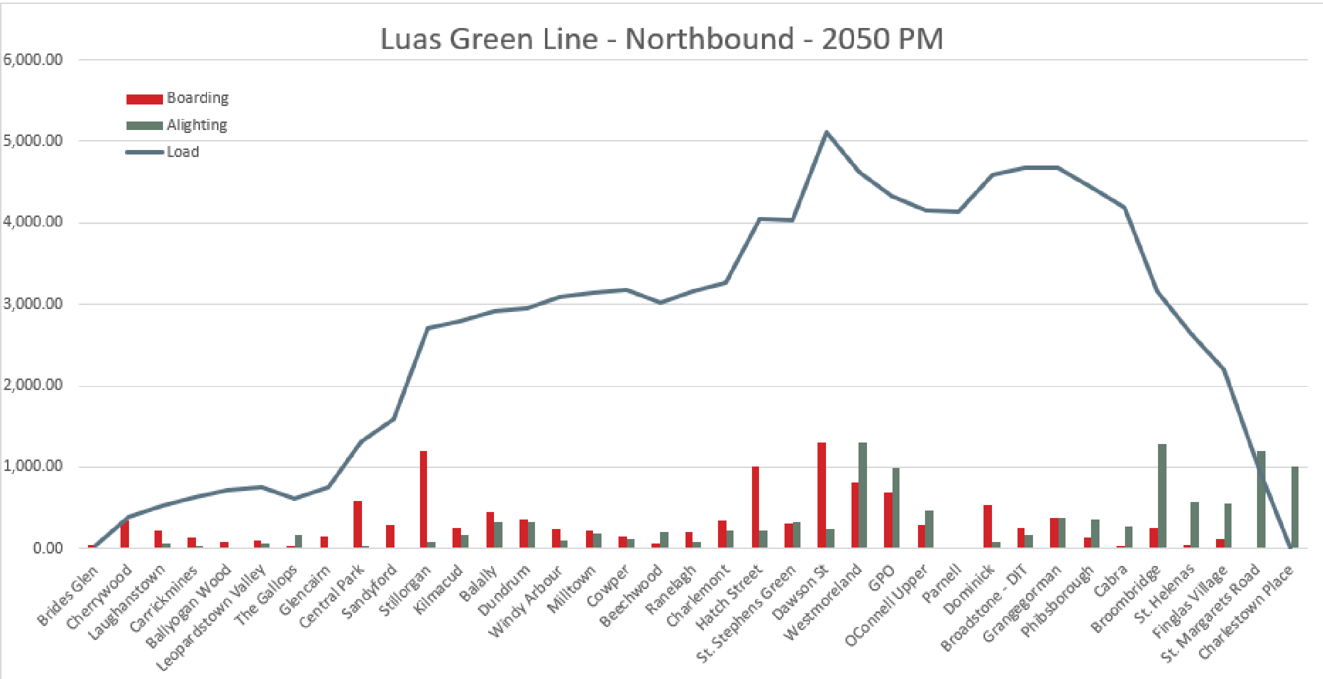
Charlestown Place


Luas Green Line - Northbound - 2050 PM
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Boarding
Alighting
Load
Brides Glen
Cherrywood
Laughanstown
Carrickmines
Ballyogan Wood
Leopardstown Valley
The Gallops
Glencairn
Central Park
Sandyford
Stillorgan
Kilmacud
Balally
Dundrum
Windy Arbour
Milltown
Cowper
Beechwood
Ranelagh
Charlemont
Hatch Street
St. Stephens Green
Dawson St
Westmoreland
GPO
OConnell Upper
Parnell
Dominick
Broadstone - DIT
Grangegorman
Phibsborough
Cabra
Broombridge
St. Helenas
Finglas Village
St. Margarets Road
Charlestown Place

Appendix B Finglas LAM – Flow Calibration Results

Flow Calibration – AM and PM

Site	Movement (ABC nodes)	AM Obs.	AM Mod.	AM GEH	PM Obs.	PM Mod.	PM GEH
02	18105_18151_18102	189	187	0.1	106	95	1.1
02	18101_18102_18264	18	32	2.7	54	48	0.8
02	18102_18151_18103	292	369	4.3	336	455	6.0
02	18169_18103_18265	26	23	0.7	31	18	2.7
02	18169_18103_18151	40	33	1.1	26	55	4.5
03	18264_18219	887	895	0.3	936	953	0.5
03	18219_18195_90006	43	40	0.4	52	40	1.8
03	18219_18195_18169	774	771	0.1	923	888	1.2
03	90006_18195_18169	75	67	1.0	26	15	2.4
04	18264_18219_18191	735	719	0.6	661	662	0.1
04	18264_18219_18176	149	177	2.2	273	290	1.0
04	18292_18219_18176	203	140	4.8	170	124	3.8
04	18292_18219_18195	657	590	2.7	867	817	1.7
04	18176_18219_18195	158	221	4.6	121	111	0.9
04	18176_18219_18191	451	288	8.5	233	162	5.1
05	18191_18175_18218	289	305	0.9	87	90	0.3
05	18191_18175_18217	630	603	1.1	635	633	0.1
05	18218_18175_18217	169	160	0.7	159	117	3.6
05	18218_18175_18304	76	77	0.1	48	23	4.2
05	18217_18304_18291	640	638	0.1	823	826	0.1
05	18217_18304_18175	200	111	7.1	169	135	2.8
06	18175_18217_18358	25	25	0.0	50	98	5.5
06	18175_18217_18234	690	630	2.3	557	604	2.0
06	18358_18217_18234	18	99	10.6	18	26	1.6
06	18358_18217_18304	69	68	0.1	39	39	0.1
06	18280_18217_18304	645	633	0.5	786	810	0.8
06	18280_18217_18358	3	13	3.6	12	40	5.4
07	18217_18234_18216	753	741	0.5	635	637	0.1
07	18216_18280_18217	710	647	2.4	859	842	0.6
08	18234_18216_10118	771	664	4.0	608	601	0.3
08	18234_18216_40566	37	77	5.3	40	37	0.5
08	10118_18216_40566	178	170	0.6	269	269	0.0
08	10118_18216_18280	607	597	0.4	854	820	1.2
08	40566_18216_18280	49	50	0.1	35	21	2.5
08	40566_18216_10118	416	388	1.4	161	167	0.4
09	18216_10118_10198	391	346	2.3	342	323	1.0
09	18216_10118_10192	823	706	4.2	435	444	0.5
09	10198_10118_10192	265	261	0.2	187	191	0.3
09	10198_10118_18216	217	192	1.8	196	180	1.1
09	10192_10118_18216	588	576	0.5	919	909	0.3
09	10192_10118_10198	179	177	0.1	400	365	1.8
10	10118_10192_10199	549	523	1.1	410	405	0.3
10	10118_10192_10260	549	427	5.5	237	231	0.4

Site	Movement (ABC nodes)	AM Obs.	AM Mod.	AM GEH	PM Obs.	PM Mod.	PM GEH
10	10199_10192_10260	122	119	0.3	146	125	1.8
10	10199_10192_10118	482	471	0.5	940	936	0.1
10	10260_10192_10118	260	281	1.3	397	338	3.1
10	10260_10192_10199	19	21	0.5	63	56	0.9
11	10192_10199_10218	377	392	0.8	398	395	0.1
11	10192_10199_90022	158	152	0.5	74	65	1.0
11	10218_10199_90022	88	82	0.7	79	79	0.0
11	10218_10199_10192	568	553	0.6	881	877	0.1
11	90022_10199_10192	51	37	2.1	220	183	2.6
11	90022_10199_10218	43	19	4.4	80	79	0.1
12	10199_10218	403	411	0.4	479	475	0.2
12	10218_10199	638	635	0.1	963	956	0.2
59	18172_10209_10186	10	22	2.9	10	8	0.6
59	18172_10209_10198	131	143	1.0	131	131	0.0
59	10186_10209_18172	23	21	0.4	23	18	1.1
59	10186_10209_10198	339	310	1.6	339	240	5.8
59	10198_10209_18172	410	319	4.8	410	384	1.3
59	10198_10209_10186	296	196	6.4	296	304	0.5
60	18348_18172_10220	20	150	14.1	20	20	0.1
60	18348_18172_10209	61	56	0.7	61	56	0.6
60	18348_18172_18192	20	0	6.3	20	0	6.3
60	10220_18172_18348	34	55	3.1	34	56	3.3
60	10220_18172_10209	73	109	3.7	73	83	1.1
60	10220_18172_18192	11	0	4.7	11	0	4.7
60	10209_18172_18348	134	69	6.5	134	117	1.6
60	10209_18172_10220	265	272	0.4	265	285	1.2
60	10209_18172_18192	26	0	7.2	26	0	7.2
60	18192_18172_18348	11	0	4.7	11	0	4.7
60	18192_18172_10220	8	0	4.0	8	0	4.0
60	18192_18172_10209	7	0	3.7	7	0	3.7
61	10215_10220_10171	267	147	8.4	73	30	6.0
61	10215_10220_10185	321	290	1.8	197	169	2.1
61	10215_10220_18172	14	40	4.9	12	11	0.2
61	10171_10220_10215	95	42	6.4	132	101	2.9
61	10171_10220_10185	51	48	0.4	101	88	1.3
61	10171_10220_18172	186	120	5.4	99	102	0.3
61	10185_10220_10215	224	127	7.3	299	256	2.6
61	10185_10220_10171	47	43	0.6	38	34	0.7
61	10185_10220_18172	4	4	0.1	12	26	3.2
61	18172_10220_10215	32	19	2.5	44	38	0.9
61	18172_10220_10171	351	367	0.8	247	251	0.2
61	18172_10220_10185	28	36	1.3	16	16	0.1
62	10220_10185_10214	276	308	1.8	128	128	0.0
62	10220_10185_10186	93	66	3.1	163	146	1.4
62	10214_10185_10220	180	174	0.5	257	252	0.3
62	10214_10185_10186	138	128	0.9	192	182	0.8

Site	Movement (ABC nodes)	AM Obs.	AM Mod.	AM GEH	PM Obs.	PM Mod.	PM GEH
62	10186_10185_10220	38	0	8.7	90	63	3.0
62	10186_10185_10214	407	321	4.5	193	193	0.0
36	18258_18100_18310	156	155	0.1	150	151	0.1
36	18258_18100_12267	262	256	0.4	382	379	0.2
36	18310_18100_18258	86	61	2.9	78	69	1.0
36	18310_18100_12267	237	287	3.1	335	332	0.2
36	12267_18100_18258	425	429	0.2	621	616	0.2
36	12267_18100_18310	307	308	0.1	418	429	0.5
37	18256_18310_18209	143	142	0.1	27	26	0.1
37	18256_18310_18100	171	184	0.9	228	223	0.3
37	18209_18310_18256	62	62	0.0	70	66	0.5
37	18209_18310_18100	128	165	3.0	198	178	1.4
37	18100_18310_18256	244	245	0.1	340	350	0.6
37	18100_18310_18209	234	217	1.1	231	230	0.1
46	10260_12266_12282	128	103	2.3	20	19	0.2
46	10260_12266_12219	542	488	2.4	375	345	1.6
46	12282_12266_10260	159	159	0.0	226	177	3.5
46	12282_12266_12219	158	128	2.5	461	342	6.0
46	12219_12266_10260	151	157	0.5	192	188	0.3
46	12219_12266_12282	158	136	1.8	48	46	0.3
35	12213_12214_12219	119	133	1.3	119	119	0.0
35	12213_12214_12263	331	363	1.7	416	435	0.9
35	12213_12214_12217	19	17	0.5	88	85	0.3
35	12219_12214_12213	287	273	0.9	433	371	3.1
35	12219_12214_12263	298	262	2.2	233	217	1.0
35	12219_12214_12217	50	53	0.4	188	190	0.1
35	12263_12214_12213	336	333	0.1	510	508	0.1
35	12263_12214_12219	41	33	1.3	41	8	6.6
35	12263_12214_12217	27	27	0.0	77	77	0.0
35	12217_12214_12213	86	87	0.1	276	201	4.9
35	12217_12214_12219	150	164	1.1	38	62	3.4
35	12217_12214_12263	148	147	0.1	70	70	0.0
29	18100_12267_12212	357	409	2.7	594	590	0.1
29	18100_12267_12258	135	134	0.1	114	120	0.6
29	12212_12267_18100	568	579	0.5	917	949	1.0
29	12212_12267_12258	129	114	1.4	315	127	12.6
29	12258_12267_18100	154	159	0.4	98	96	0.2
29	12258_12267_12212	110	104	0.6	48	48	0.0
1	90032_18123_18152	140	70	6.8	102	76	2.7
1	90032_18123_18118	579	503	3.3	500	465	1.6
1	90032_18123_90028	23	14	2.1	38	38	0.0
1	18152_18123_90032	53	53	0.0	96	99	0.3
1	18152_18123_18118	65	68	0.4	101	153	4.7
1	18152_18123_90028	14	0	5.1	19	21	0.4
1	18118_18123_90032	339	348	0.5	419	436	0.8
1	18118_18123_18152	87	100	1.4	92	97	0.5

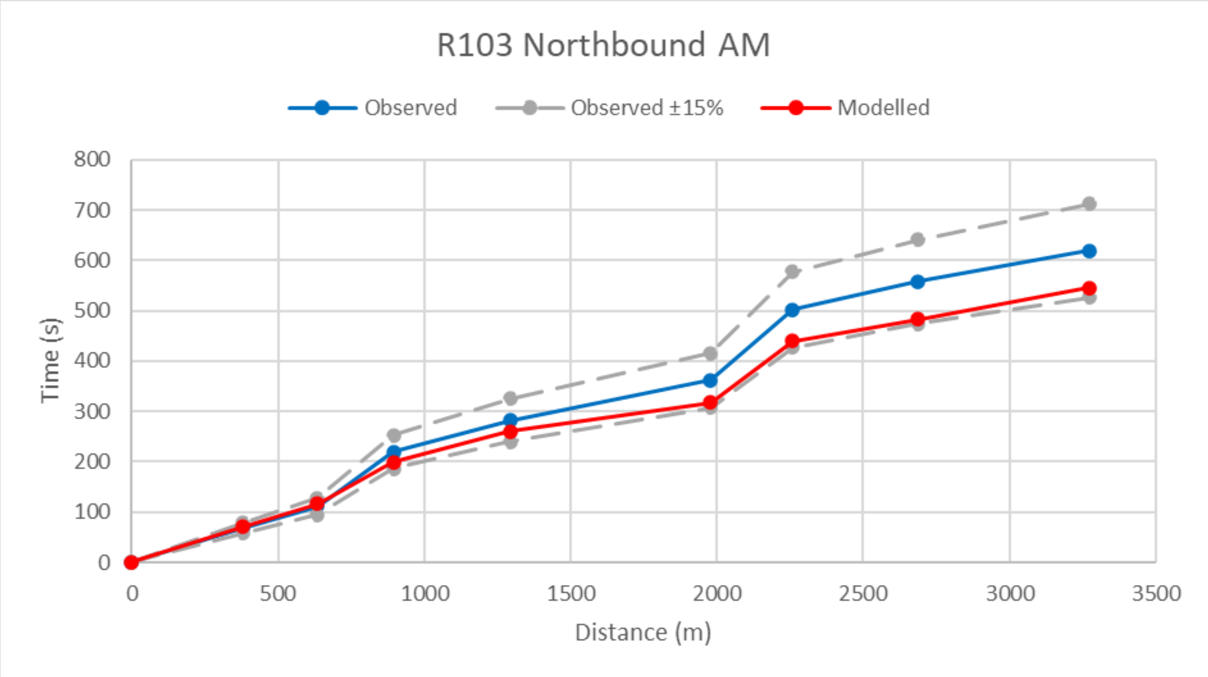
Site	Movement (ABC nodes)	AM Obs.	AM Mod.	AM GEH	PM Obs.	PM Mod.	PM GEH
1	18118_18123_90028	40	41	0.2	79	82	0.4
1	90028_18123_90032	27	28	0.2	45	45	0.0
1	90028_18123_18152	13	2	4.2	18	5	4.0
1	90028_18123_18118	29	40	1.9	63	70	0.9
2	18289_18261_18240	25	25	0.0	20	20	0.0
2	18289_18261_18301	178	178	0.0	87	69	2.1
2	18289_18261_18375	13	13	0.0	29	29	0.0
2	18240_18261_18289	21	21	0.0	38	35	0.5
2	18240_18261_18301	137	133	0.3	147	140	0.6
2	18240_18261_18375	210	207	0.2	241	159	5.8
2	18301_18261_18289	150	154	0.3	280	266	0.8
2	18301_18261_18240	183	185	0.1	185	185	0.0
2	18301_18261_18375	135	137	0.2	188	190	0.1
2	18375_18261_18289	36	36	0.0	57	57	0.0
2	18375_18261_18240	257	255	0.1	206	208	0.1
2	18375_18261_18301	269	248	1.3	227	220	0.5
3	18301_18149_18133	299	312	0.8	247	246	0.1
3	18301_18149_18297	210	201	0.6	196	156	3.0
3	18301_18149_90034	44	46	0.3	26	26	0.1
3	18133_18149_18301	205	203	0.1	219	169	3.6
3	18133_18149_18297	21	0	6.5	14	0	5.3
3	18133_18149_90034	9	9	0.0	5	3	1.0
3	18297_18149_18301	253	262	0.6	379	407	1.4
3	18297_18149_18133	18	1	5.4	23	9	3.5
3	18297_18149_90034	36	33	0.5	15	10	1.4
3	90034_18149_18301	11	11	0.0	54	65	1.4
3	90034_18149_18133	5	5	0.0	16	16	0.0
3	90034_18149_18297	9	4	2.0	30	19	2.2
371	18283_18214_90043	114	122	0.7	127	127	0.0
371	18283_18214_18253	6	6	0.0	22	22	0.0
371	18283_18214_18226	356	349	0.4	219	220	0.0
371	90043_18214_18283	137	137	0.0	196	196	0.0
371	90043_18214_18253	48	35	2.1	89	89	0.0
371	90043_18214_18226	399	403	0.2	187	205	1.3
371	18253_18214_18283	41	41	0.0	28	28	0.0
371	18253_18214_90043	88	88	0.0	36	36	0.0
371	18253_18214_18226	73	24	7.1	29	2	6.7
371	18226_18214_18283	151	151	0.0	310	311	0.1
371	18226_18214_90043	126	119	0.7	247	247	0.0
371	18226_18214_18253	31	31	0.0	95	95	0.0
361	15164_15165_18417	554	558	0.2	489	491	0.1
361	15164_15165_90029	1,057	1,140	2.5	927	946	0.6
361	15164_15165_15187	388	223	9.4	72	50	2.9
361	18417_15165_15168	287	298	0.6	290	315	1.4
361	18417_15165_15187	39	39	0.0	9	9	0.0
361	15216_15165_15168	920	890	1.0	1,514	1,368	3.9

Site	Movement (ABC nodes)	AM Obs.	AM Mod.	AM GEH	PM Obs.	PM Mod.	PM GEH
361	15216_15165_18417	66	64	0.3	103	69	3.6
361	15216_15165_15187	156	231	5.4	47	34	2.1
361	15187_15165_15168	132	94	3.5	337	286	2.9
361	15187_15165_18417	32	10	4.8	44	24	3.5
361	15187_15165_90029	54	52	0.3	114	114	0.0
Site 31	15196_15128	865	835	1.0	796	773	0.8
Site 31	15128_15196	674	665	0.3	824	871	1.6
1	18117_18257_90008	11	6	1.6	9	0	4.2
1	18117_18257_18180	259	229	1.9	253	225	1.8
1	18117_18257_18115	188	192	0.3	199	197	0.2
1	90008_18257_18117	8	0	4.0	8	3	2.3
1	90008_18257_18180	67	5	10.4	55	14	7.0
1	90008_18257_18115	114	114	0.0	131	64	6.7
1	18180_18257_18117	186	176	0.7	260	246	0.9
1	18180_18257_90008	42	25	3.0	32	3	6.9
1	18180_18257_18115	12	0	4.9	31	0	7.9
1	18115_18257_18117	218	215	0.2	265	265	0.0
1	18115_18257_90008	129	119	0.9	99	58	4.6
1	18115_18257_18180	20	0	6.2	21	0	6.5
2	90009_80002_18176	255	146	7.7	122	60	6.5
2	90009_80002_18384	110	98	1.2	68	68	0.0
2	18176_80002_90009	105	112	0.7	113	115	0.2
2	18176_80002_18384	175	199	1.8	285	260	1.5
2	18384_80002_90009	93	93	0.0	96	96	0.0
2	18384_80002_18176	348	333	0.8	241	220	1.4
3	18110_18211_18369	66	68	0.2	35	24	2.0
3	18110_18211_18183	194	214	1.4	69	69	0.1
3	18110_18211_18373	97	100	0.3	80	101	2.2
3	18369_18211_18110	28	2	6.8	50	46	0.6
3	18369_18211_18183	108	41	7.7	74	24	7.1
3	18369_18211_18373	293	272	1.3	332	266	3.8
3	18183_18211_18110	33	6	6.0	98	130	3.0
3	18183_18211_18369	57	67	1.3	64	62	0.3
3	18183_18211_18373	19	18	0.2	32	31	0.1
3	18373_18211_18110	33	0	8.1	50	60	1.4
3	18373_18211_18369	371	396	1.3	399	400	0.1
3	18373_18211_18183	35	31	0.7	37	37	0.0
4	18210_18307_18385	144	122	1.9	132	132	0.0
4	18210_18307_90018	39	40	0.1	63	51	1.6
4	18385_18307_18210	120	98	2.1	153	151	0.2
4	18385_18307_90018	83	86	0.3	99	99	0.0
4	90018_18307_18210	63	22	6.3	58	41	2.4
4	90018_18307_18385	125	50	8.0	81	32	6.5
5	18178_18177_18380	100	46	6.3	100	92	0.9
5	18178_18177_18256	266	58	16.3	162	45	11.5

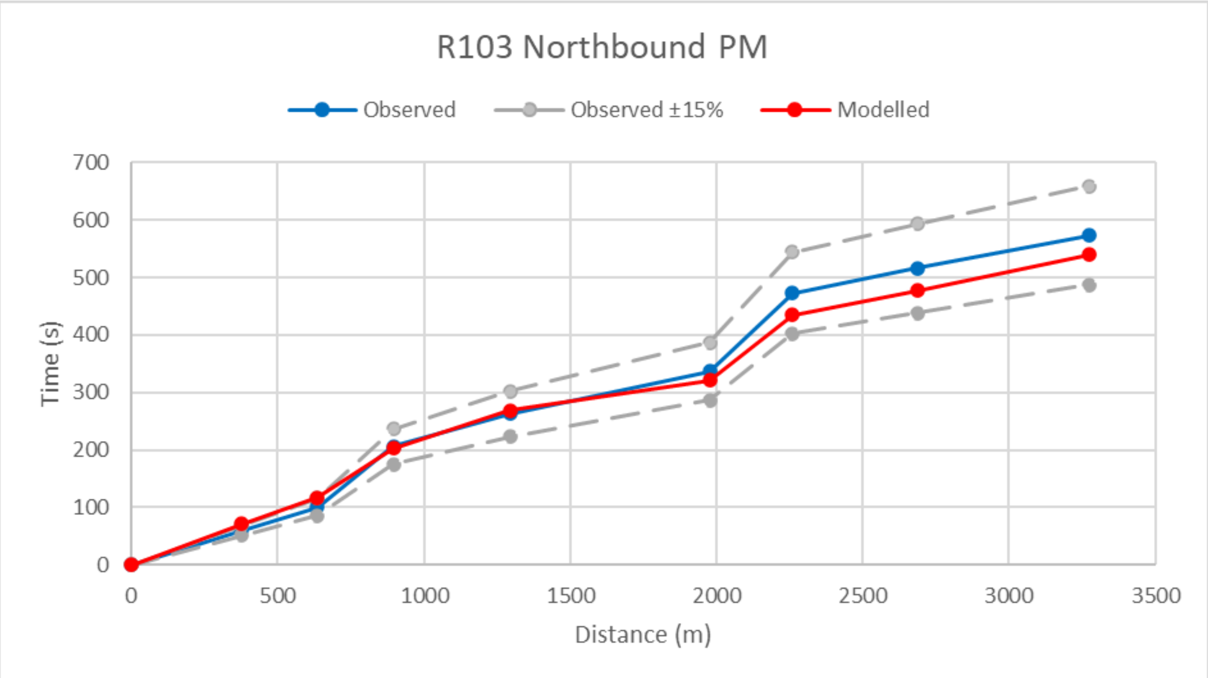
Site	Movement (ABC nodes)	AM Obs.	AM Mod.	AM GEH	PM Obs.	PM Mod.	PM GEH
5	18380_18177_18178	69	65	0.5	160	115	3.8
5	18380_18177_18256	119	164	3.8	100	172	6.2
5	18256_18177_18178	181	185	0.3	234	217	1.1
5	18256_18177_18380	145	137	0.7	178	177	0.1
6	18303_18228_18230	167	173	0.5	139	120	1.7
6	18303_18228_80003	484	475	0.4	344	344	0.0
6	18303_18228_18287	155	156	0.1	142	78	6.1
6	18230_18228_18303	37	37	0.0	82	82	0.0
6	18230_18228_80003	96	101	0.5	112	139	2.4
6	18230_18228_18287	184	186	0.2	260	216	2.9
6	80003_18228_18303	224	217	0.5	387	398	0.6
6	80003_18228_18230	77	76	0.1	115	117	0.2
6	80003_18228_18287	59	57	0.3	104	36	8.1
6	18287_18228_18303	46	83	4.6	89	119	2.9
6	18287_18228_18230	206	276	4.5	248	248	0.0
6	18287_18228_80003	80	0	12.6	53	0	10.3
7	18263_18124_10223	13	0	5.1	12	0	4.9
7	18263_18124_18101	90	110	2.0	118	104	1.3
7	18263_18124_18262	33	10	5.0	38	6	6.9
7	10223_18124_18263	6	0	3.4	6	0	3.4
7	10223_18124_18101	232	226	0.4	215	131	6.4
7	10223_18124_18262	25	25	0.0	45	87	5.1
7	18194_18124_18263	65	74	1.1	51	55	0.6
7	18194_18124_10223	90	1	13.2	79	60	2.2
7	18194_18124_18101	11	0	4.7	39	0	8.8
7	18194_18124_18262	25	10	3.6	59	77	2.2
7	18101_18124_18263	63	145	8.1	135	206	5.5
7	18101_18124_10223	204	341	8.3	164	222	4.2
7	18101_18124_18262	18	17	0.2	47	47	0.0
7	18262_18124_18263	23	8	3.9	40	36	0.6
7	18262_18124_10223	138	72	6.5	103	41	7.3
7	18262_18124_18101	47	44	0.5	52	20	5.4
8	18219_18176_18210	68	70	0.2	169	158	0.9
8	18219_18176_80002	223	244	1.4	293	256	2.2
8	18210_18176_18219	140	140	0.0	119	73	4.7
8	18210_18176_80002	67	67	0.0	102	119	1.6
8	80002_18176_18219	453	370	4.1	290	200	5.8
8	80002_18176_18210	115	109	0.6	80	81	0.1
11	12266_12282_90020	204	239	2.4	69	65	0.5
11	90020_12282_12266	80	74	0.7	221	117	8.0
11	12167_12282_12266	235	213	1.5	325	409	4.4
11	12167_12282_90020	55	47	1.1	33	66	4.7
12	90013_80001_90009	22	22	0.0	29	30	0.1
12	90013_80001_80000	42	37	0.8	57	57	0.0
12	90009_80001_90013	38	38	0.0	27	27	0.1
12	90009_80001_80000	168	170	0.2	182	184	0.2

Site	Movement (ABC nodes)	AM Obs.	AM Mod.	AM GEH	PM Obs.	PM Mod.	PM GEH
12	80000_80001_90013	48	65	2.2	43	43	0.0
12	80000_80001_90009	348	192	9.5	158	125	2.8
13	18109_18155_18108	98	118	1.9	135	135	0.0
13	18109_18155_18110	9	0	4.2	2	0	2.0
13	18108_18155_18109	69	64	0.7	130	130	0.0
13	18108_18155_18110	341	361	1.1	264	175	6.0
13	18110_18155_18109	2	0	2.0	5	0	3.2
13	18110_18155_18108	123	101	2.1	203	229	1.7
14	80003_18298_18299	101	35	8.1	31	3	6.7
14	80003_18298_90032	546	541	0.2	467	479	0.6
14	18299_18298_80003	12	13	0.2	32	28	0.7
14	18299_18298_90032	36	19	3.3	84	68	1.8
14	90032_18298_80003	347	337	0.6	576	523	2.3
14	90032_18298_18299	65	72	0.9	42	43	0.1
9	18118_18121_18122	554	606	2.2	607	686	3.1
9	18119_18120_18118	508	489	0.9	638	615	0.9
9	18104_18266_18108	1,025	1,026	0.0	1,238	1,094	4.2
9	18121_18122_18105	1,126	1,106	0.6	1,010	943	2.2
9	18155_18108_18215	220	219	0.1	337	363	1.4
9	18266_18108_18155	407	425	0.9	395	305	4.8
9	90029_18119_18120	1,299	1,354	1.5	1,246	1,253	0.2
9	18108_18215_15216	1,057	1,184	3.8	1,385	1,470	2.3
10	18105_18151	454	304	7.7	207	107	7.9
10	18265_18104	255	245	0.7	284	263	1.3
10	90002_18102	55	50	0.7	50	45	0.7
10	18102_90002	37	27	1.8	76	70	0.7
10	18101_18102	381	370	0.6	444	467	1.1
10	18102_18101	632	584	2.0	472	486	0.6
10	18169_18103	49	56	1.0	100	72	3.0
10	18102_18264	29	93	8.2	70	117	4.9
10	18103_18151	471	466	0.2	540	522	0.8
10	18151_18103	457	486	1.4	439	468	1.4

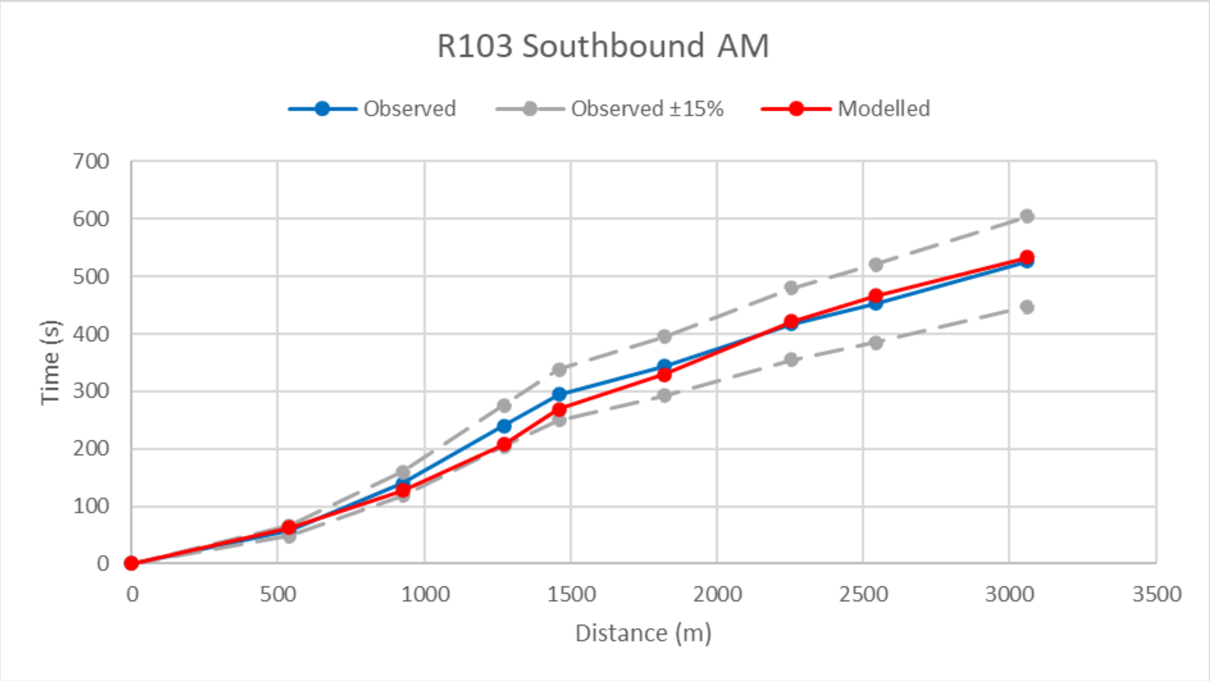
Appendix C Finglas LAM – Journey Time Validation Results



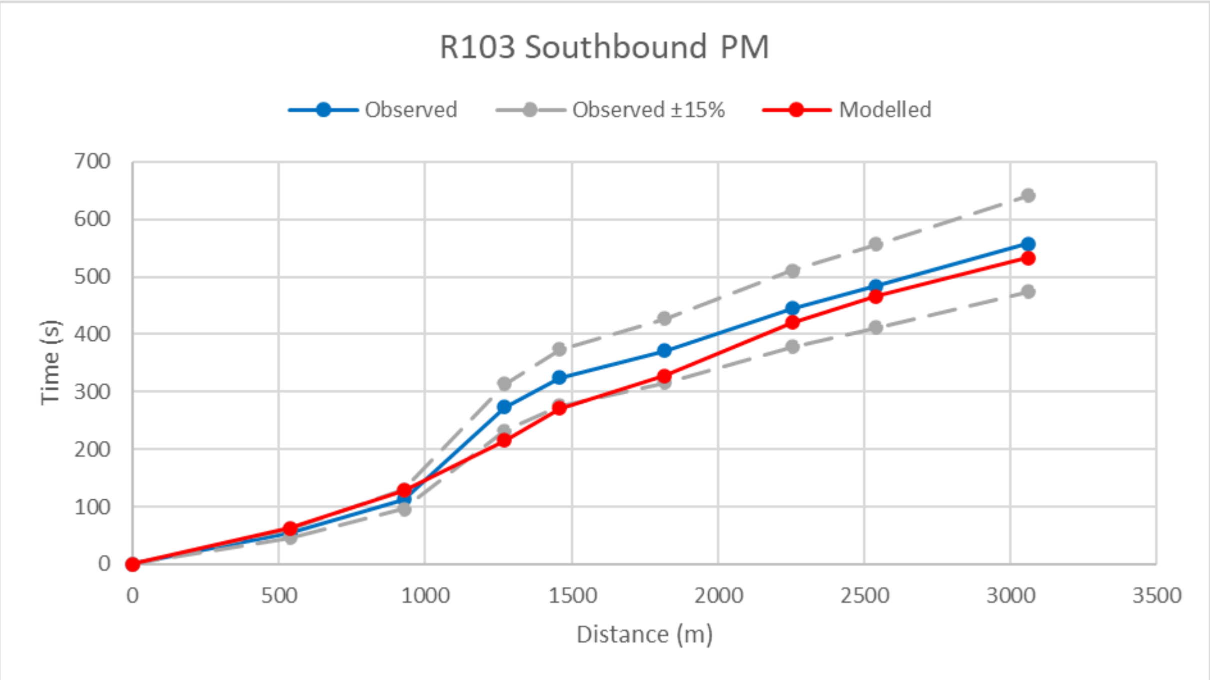
Journey Time Validation – R103 Northbound AM



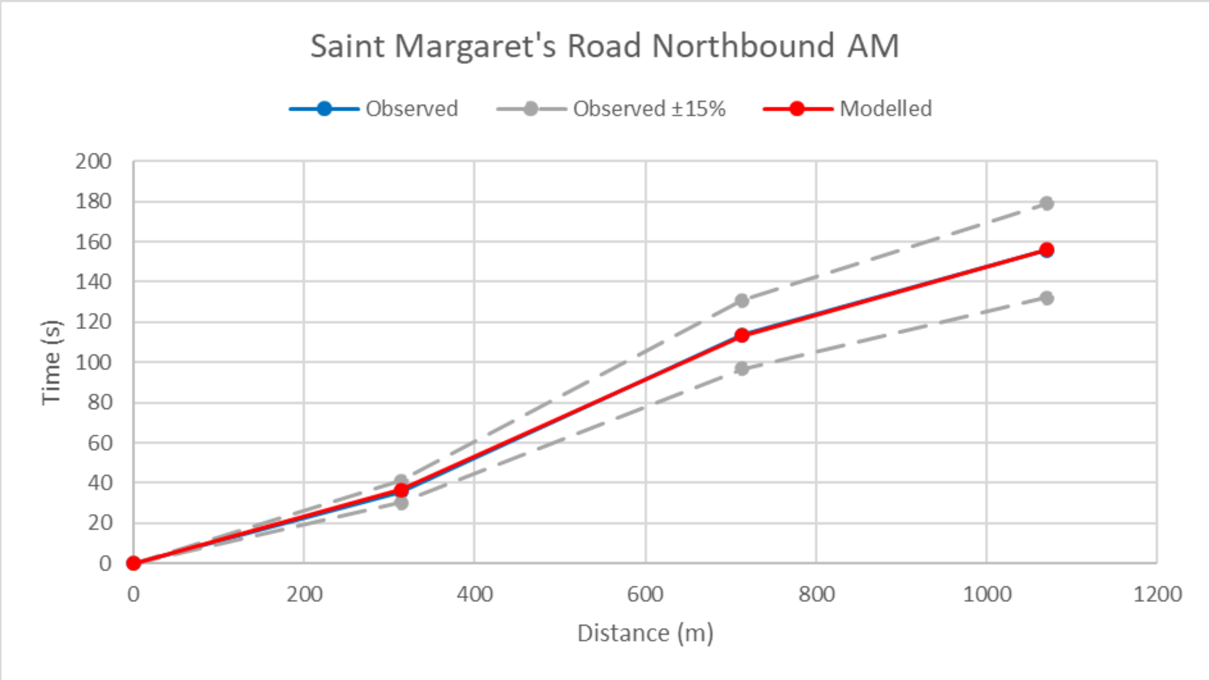
Journey Time Validation – R103 Northbound PM



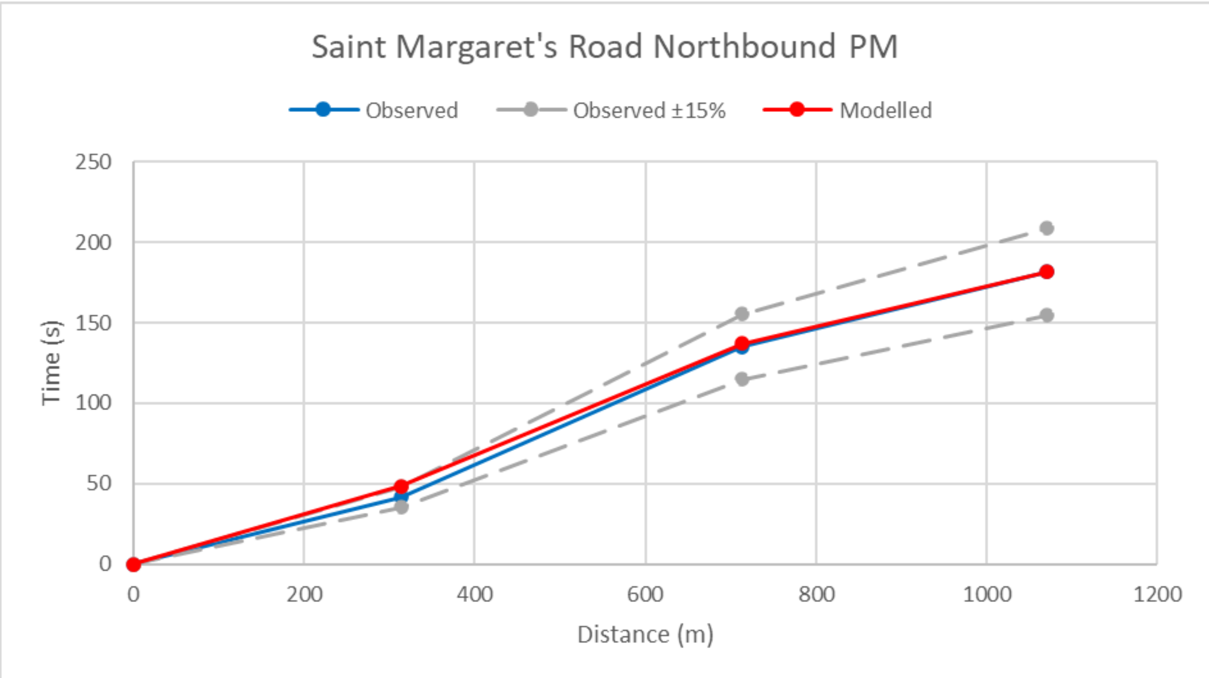
Journey Time Validation – R103 Southbound AM



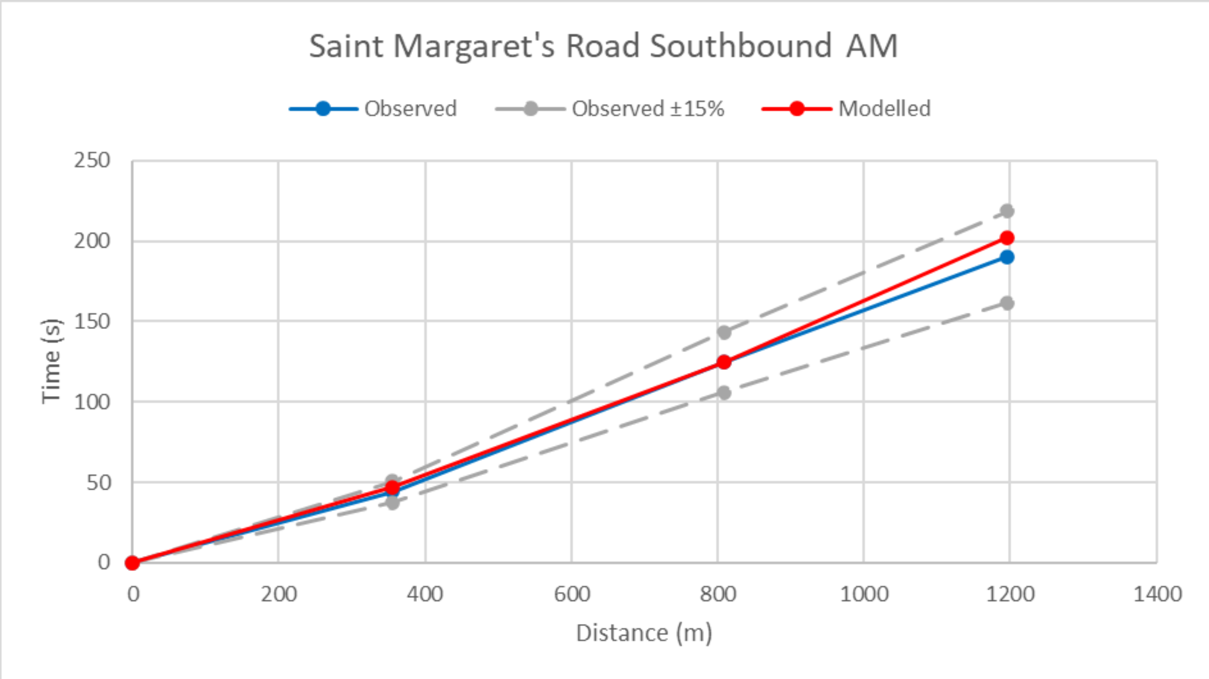
Journey Time Validation – R103 Southbound PM



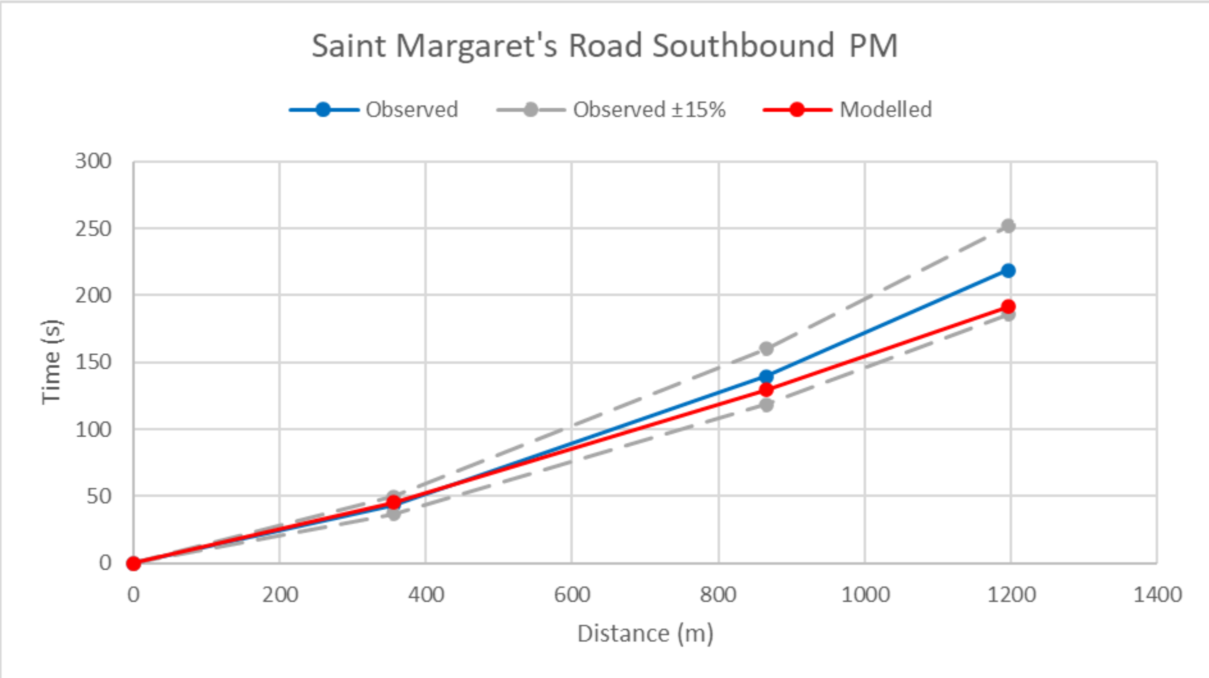
Journey Time Validation – Saint Margaret's Road Northbound AM



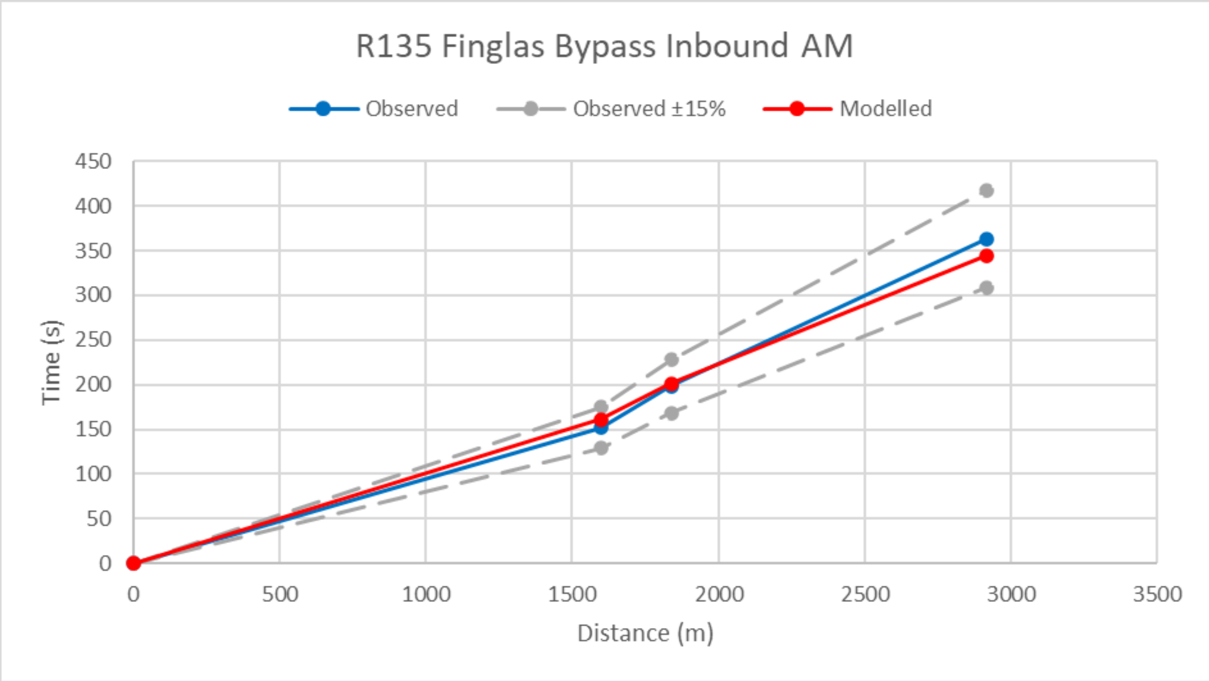
Journey Time Validation – Saint Margaret's Road Northbound PM



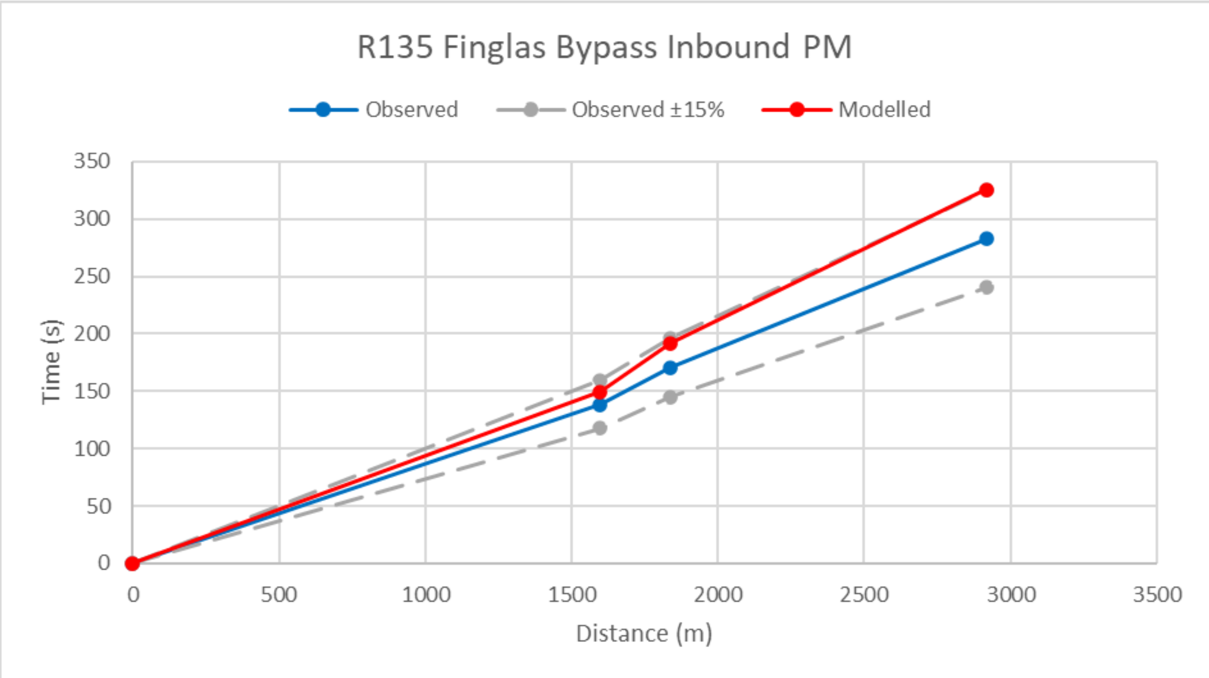
Journey Time Validation – Saint Margaret's Road Southbound AM



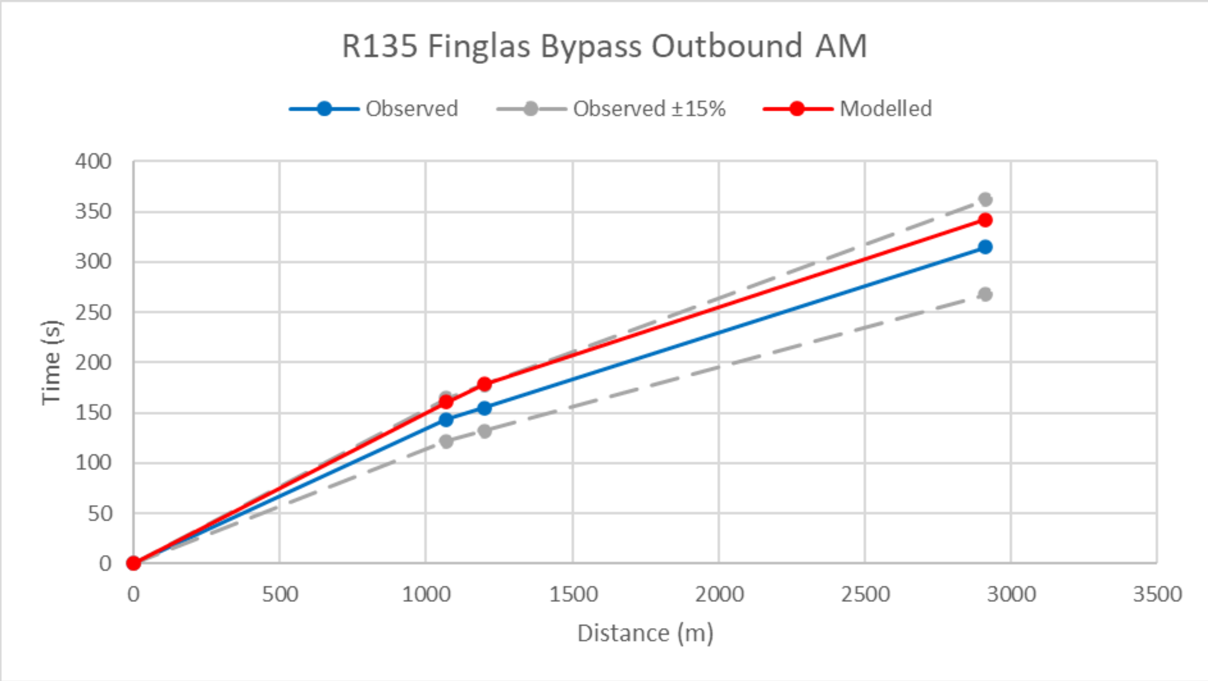
Journey Time Validation – Saint Margaret's Road Southbound PM



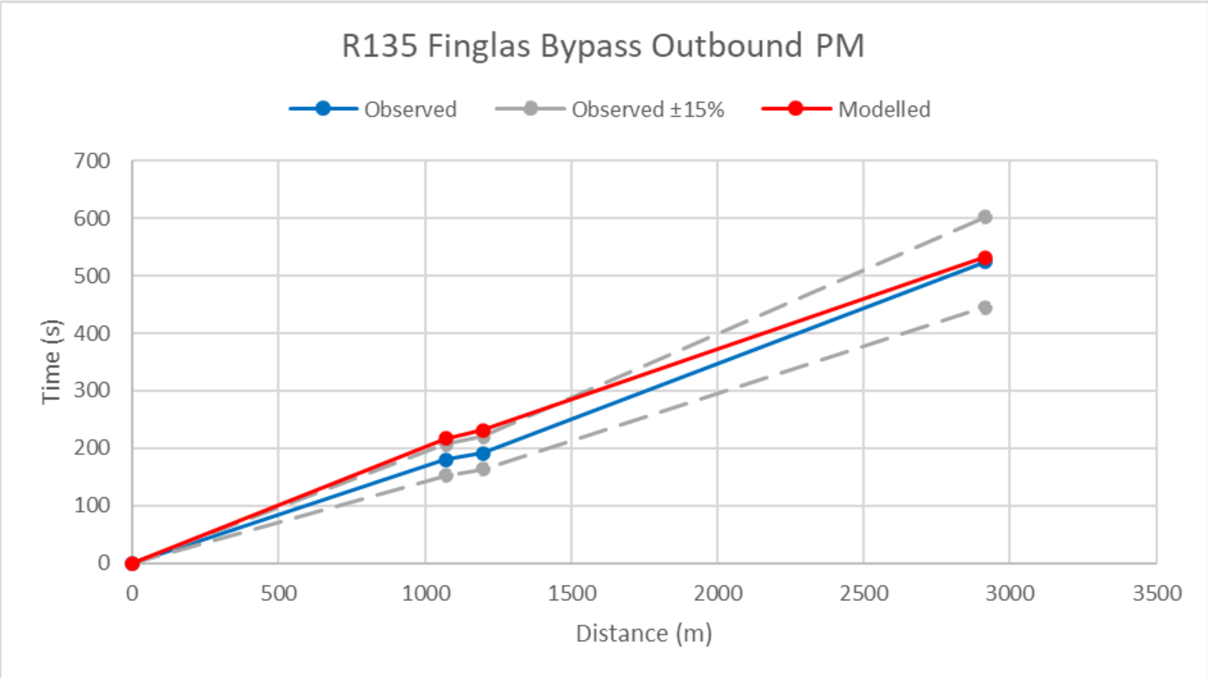
Journey Time Validation – R135 Finglas Bypass Inbound AM



Journey Time Validation – R135 Finglas Bypass Inbound PM



Journey Time Validation – R135 Finglas Bypass Outbound AM



Journey Time Validation – R135 Finglas Bypass Outbound PM

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Transport Infrastructure Ireland

NTA
Údarás Náisiúnta Iompair
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