SOUTH FINGAL TRANSPORT STUDY

Comhairle Contae Fhine Gall
Fingal County Council

SYSTRA

FINGAL SOUTH FRINGE AND DUBLIN AIRPORT LAP

SOUTH FINGAL TRANSPORT STUDY MODELLING REPORT

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1. OVERVIEW

1.1 Introduction

1.1.1 Fingal County Council commissioned SYSTRA Ltd. in September 2017 to undertake the South Fingal Transport Study (SFTS). The need for the SFTS was identified in the Fingal County Development Plan 2017-2023 (FCDP) in objective MT07, which states:

"Objective MT07: Carry out a comprehensive feasibility study of the South Fingal area to produce a strategic 'vision' and overall strategy for the proper planning and sustainable development of the study area, based on a sustainable transport and smarter travel approach, planning for all transport modes and needs, whilst also being reflective of road network capacity and modal split assumptions. This will be carried out within two years of adoption of the Development Plan and will be used to inform the preparation of statutory Local Area Plans and Masterplans in the area. The preparation of the study will include implementation recommendations and will involve: Consultation with key statutory stakeholders including TII and the NTA, public consultation and engagement with relevant statutory bodies."

1.1.2 The methodology for the development of the South Fingal Transport Study included the following main tasks:

- Review of the existing policy and transport baseline conditions;
- Detailed future demand analysis;
- Development of proposed transport options and assess in the National Transport Authority's (NTA's) Eastern Regional Model (ERM);
- Optimisation of land use to align with sustainable transport provision; and
- Finalisation of the study and its proposals through consultation with Fingal County Council (FCC) and key stakeholders such as the NTA, TII, and DCC.

1.2 SFTS Overall Approach

Overview

1.2.1 The SFTS is a strategic transport and land use study of Fingal. Its recommendations have been assessed with future population and employment growth and the expected future transport network, including road and public transport networks. Most of the SFTS recommendations are based on previous proposals outlined in the Fingal County Development Plan, (FCDP) various Local Area Plans (LAPs) and the NTA's Greater Dublin Area Transport Strategy 2016-2035. The SFTS uses recent data and updated transport models informed by latest policies, guidelines, development plans and information on growth trends and problem areas within the transport network.

1.2.2 It was decided at the project outset to focus on a shorter term horizon to 2027. This was intended to identify the critical infrastructure required to meet the demands of Fingal's rapidly growing population, as evidenced by the recent Census. Thus, providing FCC with an immediate implementation plan to address the transport needs of the area in the short to medium term.

1.2.3 This horizon year also coincides with the expected delivery of MetroLink in 2027. Planning for new, complimentary infrastructure to enable sustainable population growth will be critical to the success of MetroLink and other future schemes outlined in the GDA Transport Strategy.

Application of Transport Modelling to the Study

1.2.4 Transport models are useful tools in transport plans and studies. They allow for the comparison of different scenarios and aid the understanding of the impacts of changes to the transport network and study area demographics and land use. Transport models are particularly useful in indicating where problem areas could emerge given the assumed future conditions.

1.2.5 For the SFTS, transport modelling analysis was key component of the study approach combined with additional analysis of existing and future data. This provided a strong basis for the resultant recommendations drawing a clear link between recommendations and policy as well as existing and/or forecast network issues. The transport modelling also allows for the testing of combined recommendations which helps consolidate the proposals into a coherent strategy.

1.2.6 The analyses which comprised the SFTS approach are described below, and include:

- Existing Travel Behaviour and Transport Review
- Future Land Use Review
- Network Analysis and Transport Recommendations

Existing Travel Behaviour and Transport Review

1.2.7 The SFTS makes use of observed data as far as possible including data from the 2011 and 2016 census, the National Household Travel Survey and traffic counts. Observed data is invaluable in establishing local trip making trends and patterns and ensuring that study recommendations respond to observed existing issues as well as modelled future issues.

1.2.8 The observed data extracted from the 2016 Place of Work or School – Census of Anonymised Records (POWSCAR) was particularly useful. POWSCAR provides data on daily commuting trips and records can be extracted at a local level. This enabled the examination of travel patterns and behaviours local to the study area. This was particularly useful for identifying movements where cycle infrastructure is likely to succeed reducing car use, e.g. where high numbers of people are making short direct journeys but are doing so by motorised transport.

Future Land Use Review

1.2.9 An initial forecast of population and employment in the county was available from the NTA for the year 2035. This set of forecasts was used by the NTA in the development of the GDA Strategy, in consultation with Fingal County Council. Through engagement with Fingal County planners, SYSTRA refined the demographic planning data to reflect more recent information on housing activity. This included development that is currently underway, in planning, and/or expected within the timeframe of the FCDP as part of approved LAPs. The FCDP and recent data such as the Fingal housing inventory undertaken by Fingal County Planning Department was used to estimate a possible future scenario of population and employment growth, and their locations. For the Airport, this stage of analysis focused on future passenger and Airport related employment.

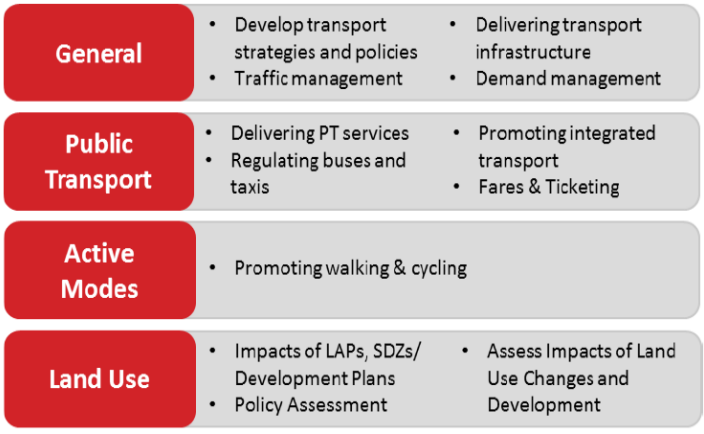
Network Analysis and Transport Recommendations

1.2.10 This stage involved preparing the inputs and data extraction processes to run and interpret the NTA's National Demand Forecasting Model (NDFM) and the East Regional Model (ERM). The key tasks included preparation of planning data inputs to the NDFM and network coding within the ERM model networks (road and PT). The ERM allows for examination for numerous transport trends, such as:

- Demand walking and cycling within an area;
- Public Transport patronage on individual modes and stops e.g. MetroLink, and key bus existing or proposed services;
- Trips generated by residential and employment zones, their travel patterns and choice of transport modes.

1.2.11 The NDFM and the ERM are describe in more detail in Chapter 2.

1.2.12 The NTA regional models are intended to support the NTA across a wide variety of transport planning and appraisal requirements supporting both the public and private sector needs. The models have applications at a local, regional and national level and can be used to predict the changes in travel patterns and network performance based on changes to traffic conditions, demand increases, transport provision and policy or land use changes.



1.2.13 In addition the models are accompanied by a suite of appraisal tools which assess the impacts of proposed changes in terms of Economy, Health, Environment, Safety and Accessibility.

Study area

1.2.14 The geographic scope of the SFTS broadly follows the main areas of anticipated growth in the southern part of the county. These are in Swords, in Fingal/Dublin Fringe (e.g. the area stretching from Baldoyle to Clonshaugh including adjacent Dublin City Council areas such as Clongriffin and Belmayne), and the Airport and its environs. Each of these three broad areas, discussed individually below, has their own particular transport requirements and constraints. As such, each has been examined in detail separately in addition to at a combined strategic level.

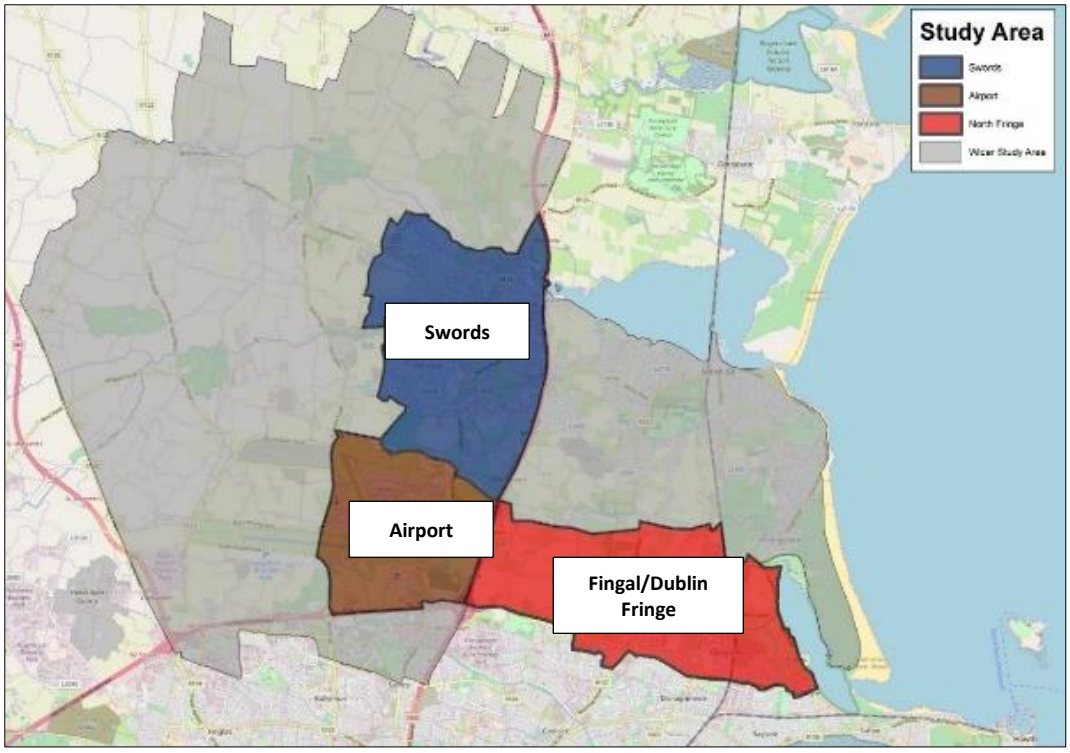


Figure 1.1 South Fingal Study Area

1.2.15 The SFTS includes a detailed report for each of these areas, i.e.:

- **Swords:** Identified as a Metropolitan Consolidation town in the Regional Planning Guidelines (RPGs), Swords has an important role as both a developing town in the Dublin City region, and as the main county town in Fingal;
- **Fingal/Dublin Fringe:** One of the largest undeveloped land-banks in the country located along the Fingal border with Dublin City. It includes Baldoyle, Balgriffin, Clonshaugh and Dardistown in Fingal, and Belmayne and Clongriffin in DCC. Portmarnock South lies to the north and east.
- **Dublin Airport:** The Airport Masterplan forecasts Dublin Airport to grow to 55 million passengers per annum by 2040. Capacity enhancements are at various stages of planning, including construction of the 2nd runway and the possibility of additional passenger processing facilities. Commercial development within the Airport campus, which is currently zoned for office land uses, has the potential to increase vehicular demand on an already constrained network.

1.3 Structure of this Report

1.3.1 This report describes the transport modelling used to inform the development of the SFTS recommendations. It includes details on the models used, i.e. the NTA's National Demand Forecasting Model (NDFM) and the East Regional Model (ERM) and associated Local Area Model (LAM) with respect to their functionality, structure, and key outputs. Each of the report chapters are listed below:

- Chapter 2 NTA Regional Modelling System;
- Chapter 3 Regional Model Inputs;
- Chapter 4 SFTS Modelling Approach
- Chapter 5 Summary and Conclusion

2. NTA REGIONAL MODELLING SYSTEM

2.1 Introduction

2.1.1 This section describes the NTA Regional Modelling System (RMS), outlining its scope, extent, components, functionality and its suitability for use in developing the SFTS.

2.2 Regional Modelling System Structure

2.2.1 The national remit of the NTA requires a system of regional models to help it deliver on its planning and appraisal needs. The NTA Regional Modelling System comprises the National Demand Forecasting Model (NDFM), and five regional transport models covering the Republic of Ireland and centred on the five main cities of Dublin, Cork, Galway, Limerick, and Waterford. The ERM is focused on Dublin City and the Greater Dublin Area and was developed to appraise major transport schemes such as MetroLink.

2.2.2 The Regional Modelling System structure is shown in the figure below.

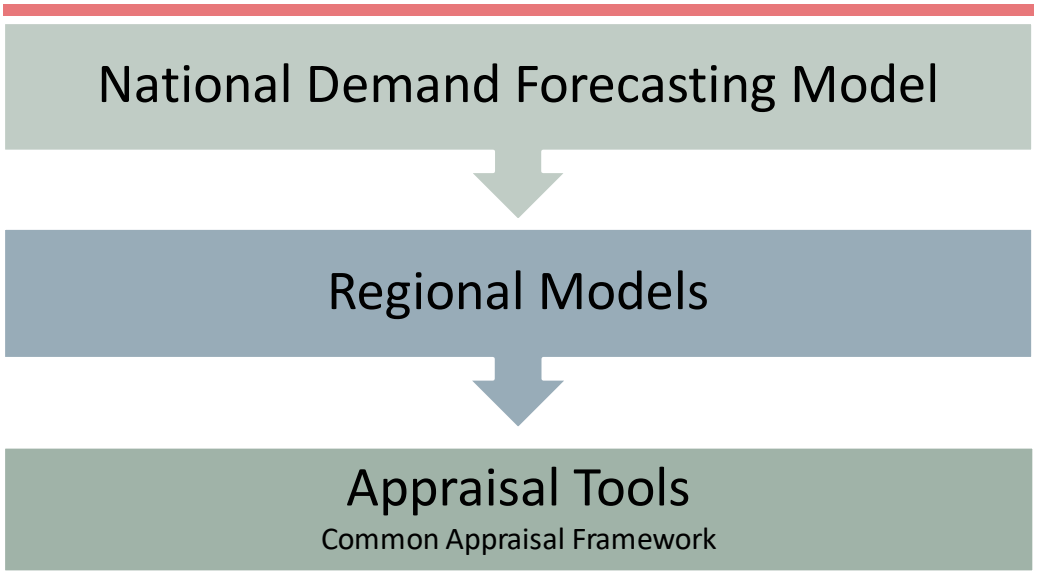


Figure 2.1 General Regional Modelling System Structure

National Demand and Forecasting Model (NDFM)

2.2.3 The ***NDFM*** is a separate modelling system that estimates the total quantity of daily travel demand generated by and attracted to every Census Small Area (CSA), as a function of characteristics such as population, number of employees and land-use data. Its outputs are provided to the regional model (in this case the East Regional Model), in terms of the level of demand from, and to, each zone (referred to as trip-ends).

2.2.4 The key components of the NDFM are as follows:

- The **Planning Data Adjustment Tool** (PDAT) controls the planning data inputs to the core NDFM system. It is used to amend planning data to represent the combination of general changes over time and the relevant land-use planning scenarios;
- The **Car Ownership/Car Competition Models** estimate the level of car ownership in a CSA, (sub-dividing the number of households in each CSA between 'No Car', 'Cars < Adults' and 'Cars >= Adults' households) i.e. the car competition bands;
- The **Car Availability Model** classifies the set of individual person trips as either 'Car Available' or 'Car-not-available' using calibrated relationships between the three car competition bands and the trip purpose;
- The **National Trip-End Model (NTEM)** converts the planning data into person trips, using calibrated trip rates; and
- The **Regional Modelling System Integration Tool (RMSIT)** estimates the level of trip-making by main mode (car, bus, rail and goods vehicles) between 38 of the main urban settlements in Ireland.

Regional Modelling System Components

2.2.5 The RMS comprises five regional transport models covering the Republic of Ireland and centred on the five main cities of Dublin, Cork, Galway, Limerick, and Waterford and are summarised in Table 2.1 Regional Modelling System below.

Table 2.1 Regional Modelling System

Regional Modelling System	Abbreviation	Counties Covered
Eastern 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
Western Regional Model	WRM	Galway, Mayo, Roscommon, Sligo, Donegal & Leitrim

2.2.6 Figure 2.2 below outlines the geographical extent of each of the Regional Models.

Figure 2.2 Regional Model Areas

2.3 The East Regional Model (ERM)

2.3.1 This section describes the NTA's East Regional Model (ERM), outlining its scope, extent, components, functionality and its suitability for use in the modelling of NMN route alignment options.

2.3.2 The ERM and the other regional models have the following key attributes:

- Full geographic coverage of the relevant region;

- A detailed representation of the road network, particularly the impact of congestion on on-street public transport services and including modelling of residents' car trips by time period from origin to destination;

- A detailed representation of the public transport network & services, and an ability to predict demand on the different public transport services within the regions;
- A representation of all major transport modes including active modes (walking and cycling) and including accurate mode-choice modelling of residents;
- 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 four time periods (AM: 07:00-10:00, LT (Lunchtime): 10:00-13:00, SR (School Run):13:00-16:00 and PM:16:00-19:00); and
- A prediction of changes in trip destination in response to changing traffic conditions, transport provision and/or policy.

2.3.3 ERM is the model used to support the development of the SFTS. All the regional models, including the ERM, include 3 core modelling processes (i.e. Demand Model, Road Assignment Model and Public Transport Assignment Model) which receive inputs from the National Demand Forecast Model (NDFM) and provide outputs for transport appraisal and secondary analysis. This process is shown in Figure 2.3 below.

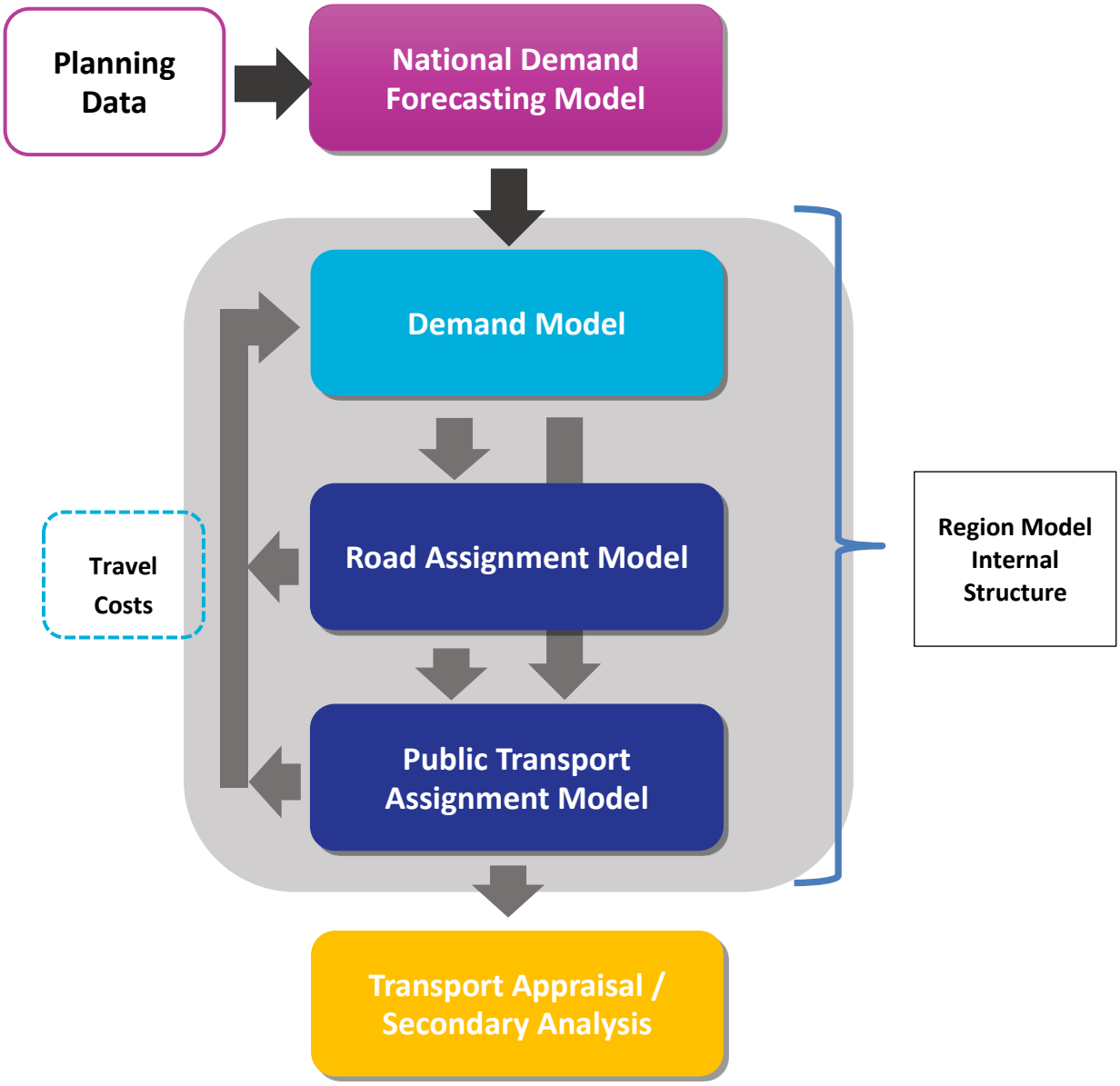


Figure 2.3 NDFM/ERM Model Structure

Zone System

2.3.4 The zone system definitions for each of the regional models were based on Census Small Area (CSA) boundaries and Electoral Districts (EDs). The 2011 CSAs are the core base layer for each zoning system. 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)).

2.3.5 CSAs are subsets of EDs. ED boundaries are commonly used as the unit of geographic information in Ireland and as such it was desirable to maintain a transparent relationship

between EDs and the model zone system. Regional Model zones can be smaller or larger than either of these units where required.

2.3.6 The criteria used for developing zone boundaries for the ERM and other regional models included:

- Population, Employment and Education – maximum values were specified for zone population, number of jobs and persons in education;
- Activity Levels – limits were applied to zone activity levels ensuring that zones with either very low, or very high, levels of trips were not created;
- Intra-zonal Trips – threshold values were 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 were created with homogeneous land use and socio-economic characteristics where possible;
- Zone Size/Shape – thresholds were applied to zone size, and irregularity of shape, to avoid issues with inaccurate representation of route choice;
- Political Geography – as mentioned above, it is possible to aggregate all zones to ED level i.e. zone boundaries do not intersect ED boundaries;
- Special Generators/Attractors – large generators/attractors of traffic such as Airports, Hospitals, shopping centres etc. were allocated to separate zones.

2.3.7 Figure 2.4 shows the ERM Zone System. The ERM zone system includes:

- Total zones: 1854
- Dublin City zones: 485
- Fingal County zones: 252
- External zones: 7

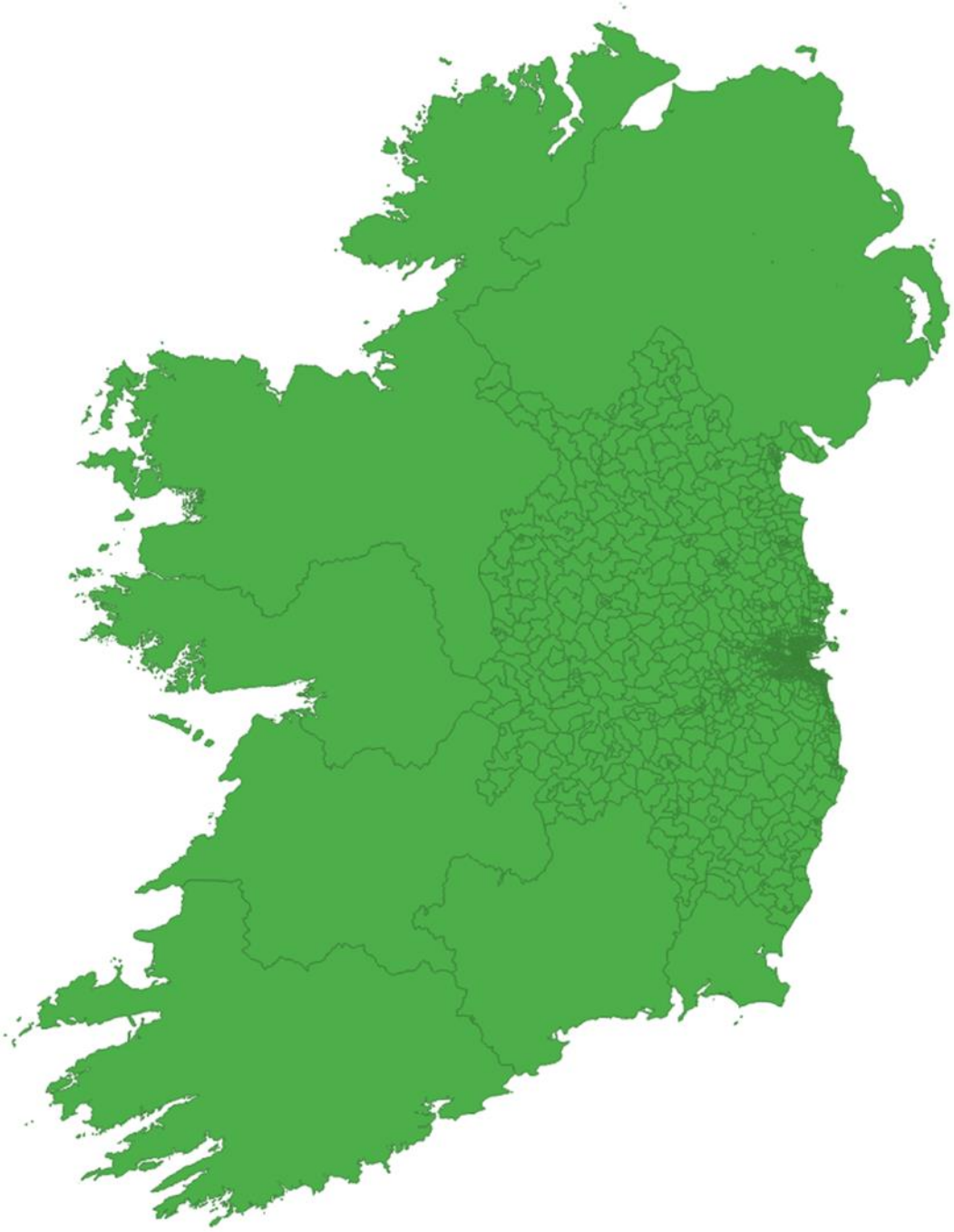


Figure 2.4 ERM Zone Structure

Modes of Travel

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

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

Base Year

2.3.9 The base year of each model is 2012. This is largely driven by the date of the Census (POWSCAR) and the National Household Travel Survey (NHTS). It should be noted that the POWSCAR dates to 2011 but the travel patterns are assumed to be broadly the same in 2012. The NTA is in the process of updating its models to a base year of 2016. The 2012 model remains valid for the purposes of strategic forecasting assessments such as the SFTS.

Time Periods

2.3.10 The model represents an average weekday. The day is split into five time periods considered within each of the regional models, 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 in ERM

Period	DEMAND MODEL FULL PERIOD	ASSIGNMENT PERIOD
AM Peak	07:00-10:00	Peak hour – based on a Peak Hour factor of 0.393 for cars, 0.393 for active modes and 0.47 for public transport
Morning Inter Peak (IP1)	10:00-13:00	Average hour from full period - based on a Peak Hour factor of 0.33 for cars, 0.33 for active modes and 0.33 for public transport
Afternoon Inter Peak (IP2)	13:00-16:00	Average hour from full period (not assigned)
PM Peak	16:00-19:00	Peak hour - based on a Peak Hour factor of 0.358 for cars, 0.358 for active modes and 0.4 for public transport
Off Peak	19:00-07:00	Free flow assignment

Planning Data

2.3.11 The Planning Data referred to above is a national database of 99 demographic and spatial variables for each of the 18,488 CSAs in the state. The main categories of planning data are:

- References and spatial definitions;
- Origin-based person types; e.g. age bands, gender, principal economic status (PES), employment type, and various combinations of categories;
- Destination-based person types; e.g. employment type or education type; and
- Households.

Demand Segments

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

2.3.13 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 segmenting into 33 distinct classifications as noted below in Table 2.3.

Table 2.3 NDFM Classifications

No.	Purpose	Car Availability	Third Level of Segmentation
1	Commute	Available	Blue collar
2	Commute	Available	White collar
3	Commute	Not available	Blue collar
4	Commute	Not available	White collar
5	Education	Available	Primary
6	Education	Available	Secondary
7	Education	Available	Tertiary
8	Education	Not available	Primary
9	Education	Not available	Secondary
10	Education	Not available	Tertiary
11	Escort to education	Available	Primary
12	Escort to education	Available	Secondary
13	Escort to education	Available	Tertiary
14	Escort to education	Not available	Primary
15	Escort to education	Not available	Secondary

No.	Purpose	Car Availability	Third Level of Segmentation
16	Escort to education	Not available	Tertiary
17	Other	Available	Employed
18	Other	Available	Non-working
19	Other	Not available	Employed
20	Other	Not available	Non-working
21	Shopping - food	Available	Employed
22	Shopping - food	Available	Non-working
23	Shopping - food	Not available	All
24	Visit friends / relatives	Available	Employed
25	Visit friends / relatives	Available	Non-working
26	Visit friends / relatives	Not available	All
27	Employers Business	All	All
28	All	Available	Retired
29	All	Not Available	Retired
30	One-way business	Available	All
31	One-way business	Not available	All
32	One-way other	Available	All
33	One-way other	Not available	All

Tours

2.3.14 Tours are an important aspect of how Trip Ends are modelled. The main concept is that every person is expected to make a distinct series of trips beginning from their house and ultimately returning home (signalling the end of a tour). The five distinct trip types which may comprise a tour are shown graphically below in Figure 2.5 and include:

- Simple from Home;
- Simple to Home;
- One-way from Home;
- One-way to Home; and
- Non-Home-Based (NHB) trips.

2.3.15 All tours are defined relative to a home or a destination. This corresponds to the concept of productions and attractions where productions are associated with homes and attractions are associated with destinations. The terms productions and attractions are not used when discussing one-way or NHB trips. These are dependent on direction, are not defined to return to a home or a particular attraction, and therefore in these cases the labels origin and destination are used referring to the start and finish location of such

trips. It is worth noting that trip chains (a tour comprising more than two trips) are modelled as multiple single trips. These consist of an outbound (one way From Home) and an inbound (one-way To Home) as well as any number of intermediate NHB trips. An example of this is shown in the figure.

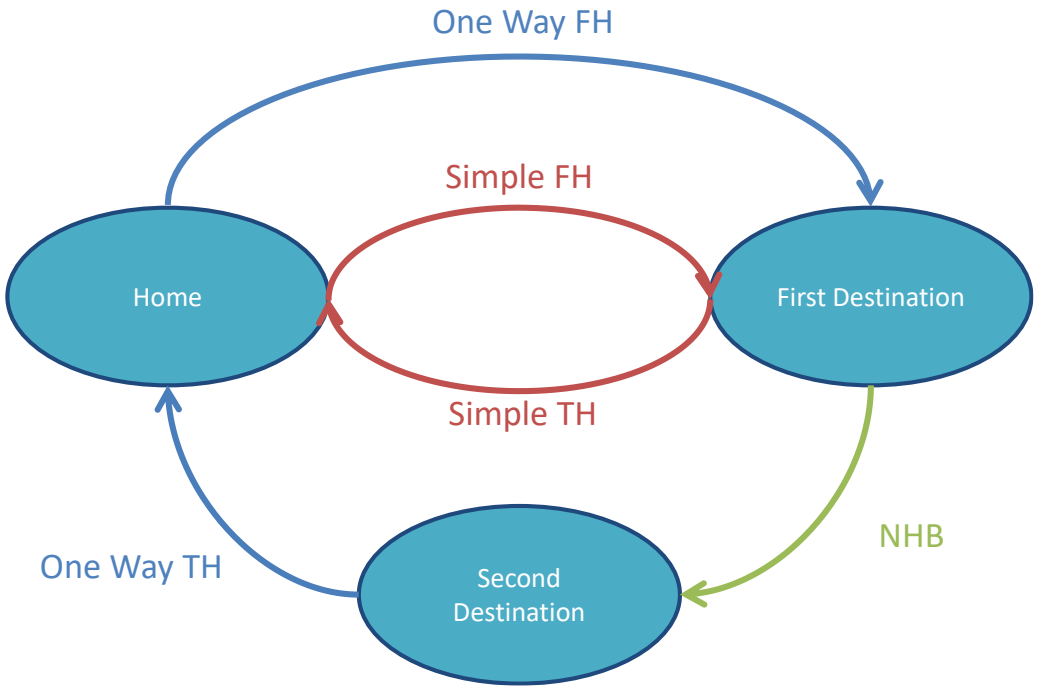


Figure 2.5 Trip Chains

2.3.16 Figure 2.6 shows the most basic relation of origins and destinations with respect to directional trips, comparable to simple tours.

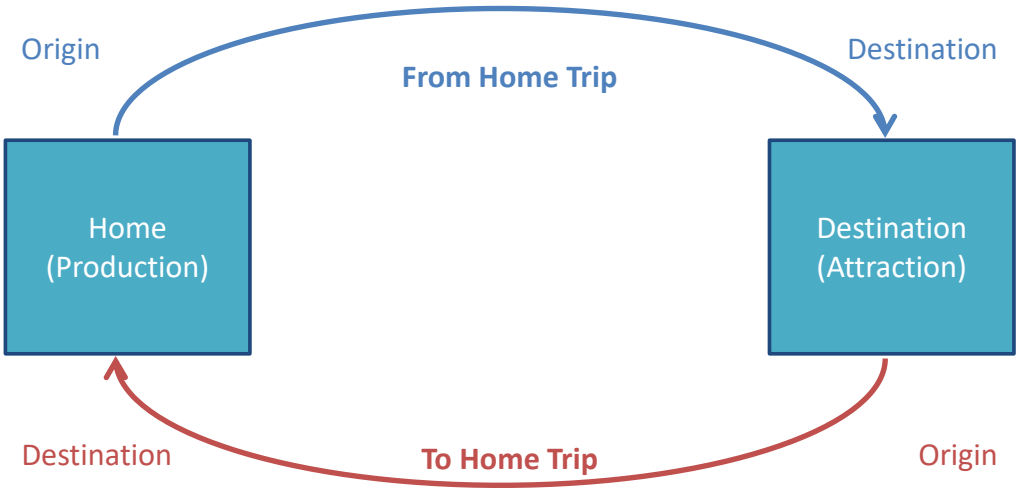


Figure 2.6 PA vs OD for Simple Tours

2.3.17 Figure 2.7 below shows the same relationship for trip chains, where it is particularly noted that both ends of a non-home-based tour correspond to attractions.

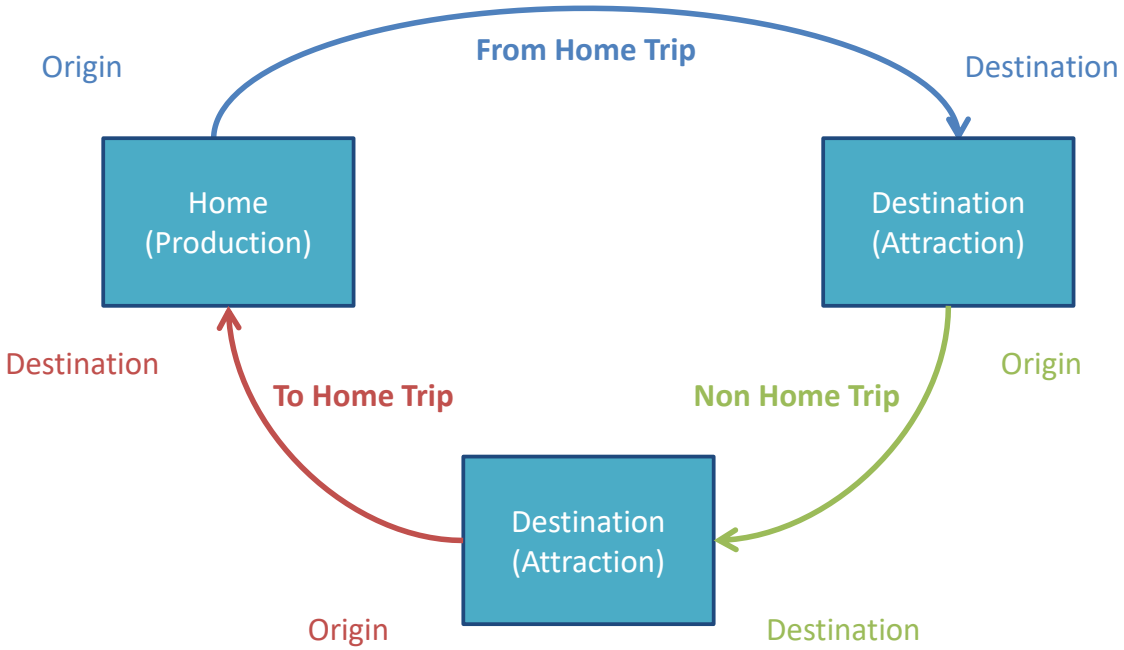


Figure 2.7 PA vs OD for Extended Tours

2.3.18 Tours are considered as movements within or from time period to time period as shown in the Tour Grid below in Table 2.4. The tours under the diagonal for the IP1, IP2 and PM time periods (marked in green) are those which are not considered in any calculations while the off-peak tours (marked in red) are considered only in commute demand segments. Time period demand is derived either by summing the rows (From Home) or the columns (To Home).

Table 2.4 Tour Grid

TP Out\ TP In	AM	IP1	IP2	PM	OP
AM	1	2	3	4	5
IP1	6	7	8	9	10
IP2	11	12	13	14	15
PM	16	17	18	19	20
OP	21	22	23	24	25

ERM Demand Model

2.3.19 The **Demand Model** models travel behaviour and is implemented in Cube Voyager. The travel behaviour data is derived from the 2012 National Household Travel Survey and the 2011 Census. 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 to the Road and Public Transport models to determine the route-choice and generalised costs.

2.3.20 The demand model consists of several components that interact in a sequential manner between the trip end model and the assignment models. It includes the following distinct components:

- Macro Time of Day;
- Mode Choice;
- Destination Choice;
- Parking; and
- Tours and One-Way.

2.3.21 A simple representation of the model structure is shown in Figure 2.8 below

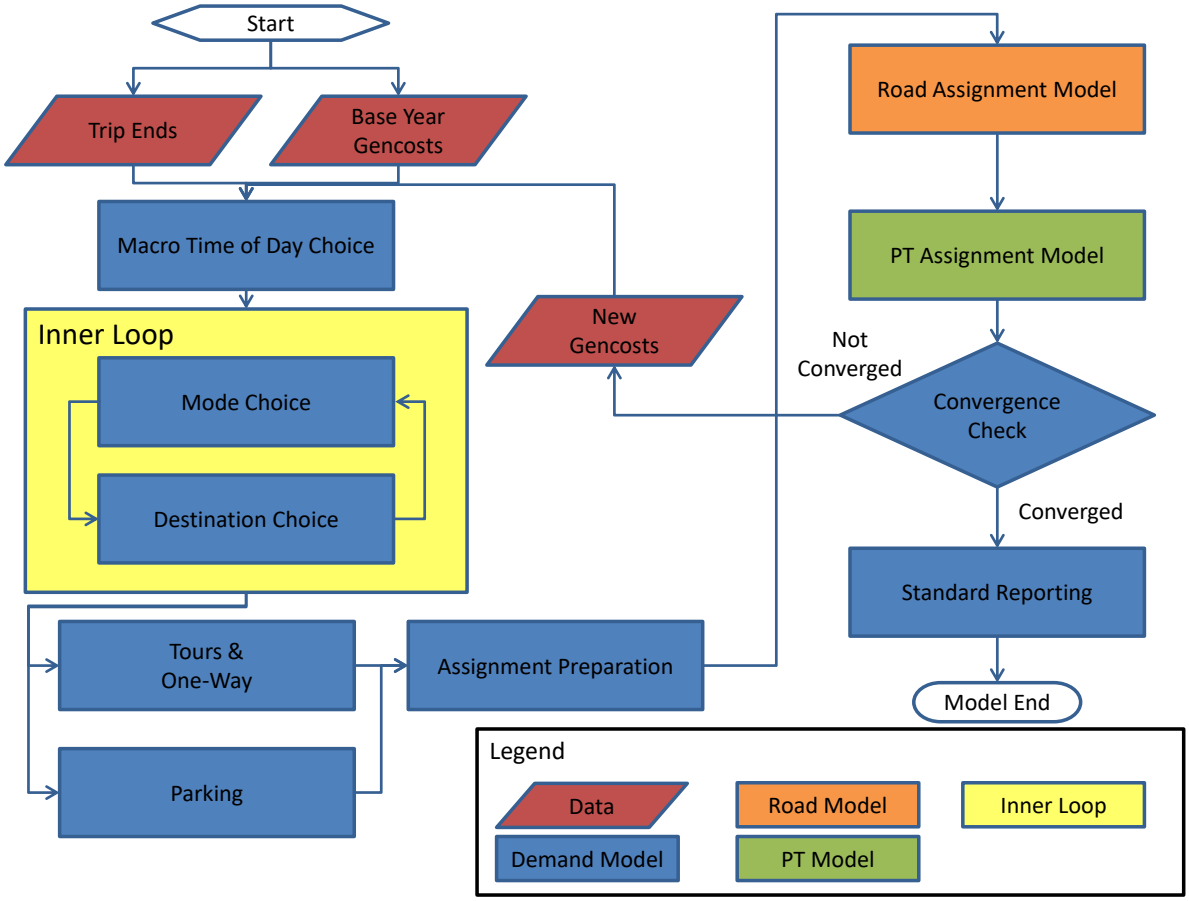


Figure 2.8 Demand Model Structure

ERM Road Assignment Model

2.3.22 The **Road Assignment Model** (RDAM) is implemented in SATURN and includes capacity restraint whereby travel times are recalculated in response to changes in assigned flows. The main purpose of the RDAM is to assign road users to routes between their origin and destination zones. The cost of travel is then calculated by the RDAM for input to the demand model and economic appraisal.

2.3.23 The inputs to the Road Assignment model from the demand model are the road assignment matrices from the assignment preparation stage.

2.3.24 The outputs from the Road Assignment model 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.

2.3.25 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.

ERM Public Transport Assignment Model

2.3.26 To generate costs to update the choice model processes, a PT assignment must be undertaken to establish new generalised costs. The **Public Transport Assignment Model** (PTAM) is implemented in Voyager and 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. The model includes:

- Rail;
- DART;
- Luas;
- Metro.
- Urban Bus;
- Inter-Urban Bus; and
- Bus Rapid Transit (BRT).

2.3.27 The outputs of the PT assignment model fall into two categories, those required by the demand model, and those produced for reporting and analysis purposes.

2.3.28 The outputs from the Public Transport Assignment model for the demand model processes consist of the assigned networks which are passed on to active mode assignment as the starting point for their network build procedure, 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 PT model process is shown below in Figure 2.9 below.

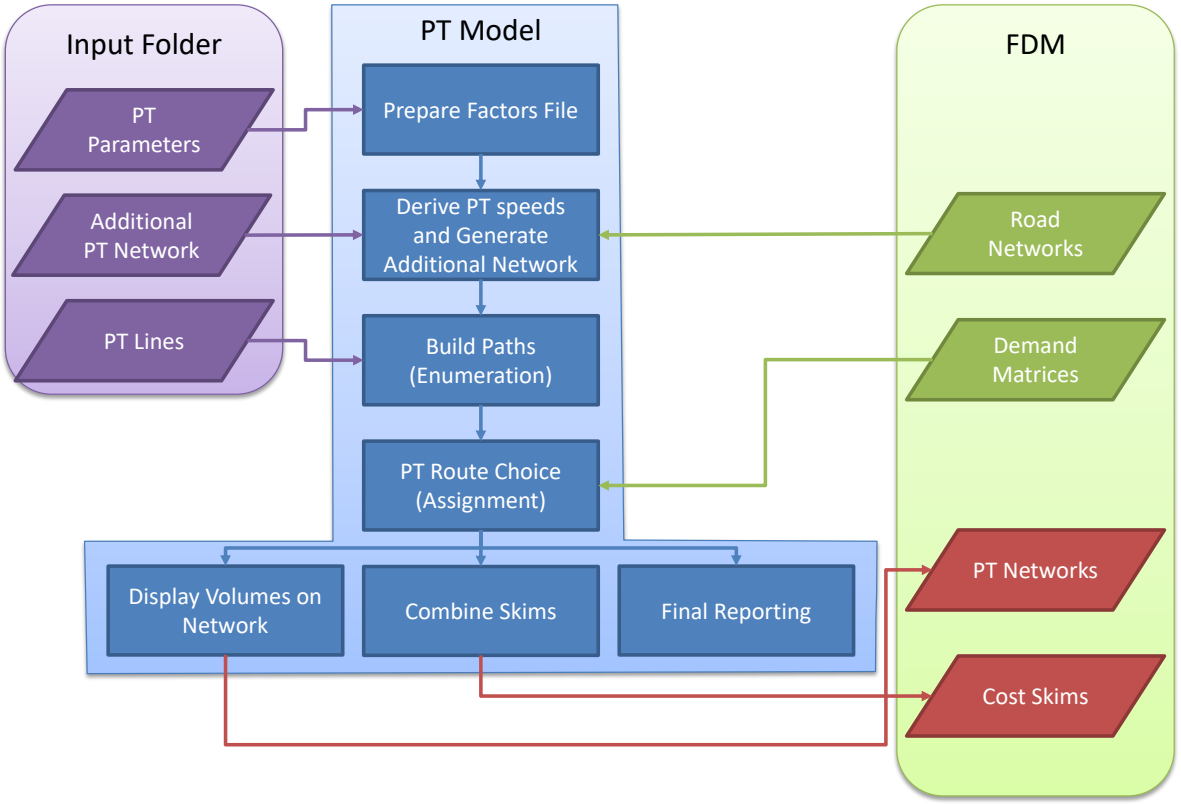


Figure 2.9 PT Model Process

ERM Active Modes Model

2.3.29 The Regional Modelling System represents active modes (i.e. walking and cycling) within the demand model to improve the realism of travel choices. To generate costs to update the choice model processes, an **active modes assignment** must take place to establish new generalised costs. This active mode assignment assumes no crowding or delays.

2.3.30 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. The active assignment is a CUBE-based lowest cost path assignment model with no junction modelling based purely on distance and a constant speed by mode.

2.3.31 Walk speeds are taken as 4.8 kph for all user classes while cycle speeds are set to 12 kph as default except in specified cases as indicated by the cycle data network input. Improvements to cycling mode provision are included through associating improvements to cycling Quality of Service to increases in service user speeds.

2.4 ERM Calibration

2.4.1 It is important that a strategic transport model is appropriately calibrated and validated in line with best practice guidelines. The ERM has been subject to a comprehensive calibration and validation process whereby a substantial amount of observed data has been incorporated into both the demand model and the assignment models as presented in Table 2.5.

Table 2.5 Demand and Assignment Model calibration and validation data

Data used to calibrate the ERM Demand Model	Data used to Calibrate and Validate ERM 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

2.4.2 The calibration and validation process ensures that the ERM accurately reflects existing conditions and 'costs' associated with travel. This allows changes in the forecasting of transport demand and strategic transport infrastructure schemes and appropriate transport policies to be modelled and tested using the ERM.

2.4.3 Comprehensive documentation on the calibration of the ERM's various components can be found on the NTA's website.

Use of ERM for Strategic Transport Planning

2.4.4 The model has many strengths and features that make 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.

2.4.5 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.

2.4.6 The model utilises a tour-based approach which allows for more accurate mode choice modelling and consideration of travel costs, particularly with respect to the inclusion of parking charges.

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

2.4.8 The use of SATURN software in the road model allows for explicit junction modelling to be included in the model which improves typical network representation in congested areas over a link-based approach. Link speeds and delays are transferred to the public transport model which allows journey times of on-street modes (Bus, BRT) to reflect perceived traffic conditions rather than a strict timetable.

2.4.9 The model covers the Fingal Region plus surrounding counties, and takes full account of travel within, into and out of the Fingal area.

2.4.10 As the model is also used as the basis for scheme evaluation, the transport networks represented contain a level of detail beyond that which would be normally required for its use as a strategic transport planning tool.

2.4.11 To account for the availability of parking facilities in Fingal and Dublin, both a free workplace parking model and a parking constraint model have been implemented to re-evaluate mode choice based on whether parking was available at the travellers' ultimate destination.

Demand Forecasting Using NTA RMS

2.4.12 As part of the development of a South Fingal Transport Study, land use forecasts were required for future years (2027 and 2035) for the study area.

2.4.13 These forecast years were chosen as they are the standard reference case years provided by the National Transport Authority. The 2027 reference case is significant for Fingal as it is close to the year of opening for MetroLink. The 2035 is significant in that it is the target year for completion of the NTA Transport Strategy for the Greater Dublin Area 2016-2035.

2.4.14 For the SFTS, is was necessary to review the forecasts provided by the NTA, since the Census 2016 provided a new starting point from which to forecast. As the NTA developed their forecasts in 2015, they did not include the latest information as a baseline. Further, the NTA's forecasts were developed for the GDA strategy, and as such are generally representative of the anticipated growth, whilst not necessarily being in line with later or more detailed information such as county development plans.

2.4.15 Therefore, an important step in the SFTS was to look at the NTA forecasts, their methodology, and highlight where the forecasts may differ from what is expected to occur in the Fingal study area, between now and 2035. A revised forecast was thus developed for the SFTS, which is overall equivalent to the NTA forecast in terms of the total population and employment, but with some differences in terms of locations and

densities of development. For 2027, some or all of the forecasted growth to 2035 may be delivered in advance of MetroLink.

2.4.16 Section 3.1 below therefore presents detailed information as background to make clear what the NTA's approach has been to deriving land use forecasts. It then sets out the general approach that was followed by SYSTRA and Fingal County Council to develop an agreed set of 2027 and 2035 forecasts.

2.4.17 This is an important step as the assumptions on the distribution and intensity of growth that is assumed to occur in population and employment have a significant bearing on the study recommendations.

Fingal Area in the ERM

2.4.18 Figure 2.10, below, illustrates the base ERM zone system within the South Fingal study area. Areas with high levels of employment and population such as Swords are represented in quite a high level of detail within the ERM. As such, distinct housing areas/estates and key employers such as Swords Business Park and Pavilions Shopping Centre have been given their own zones. Dublin Airport has also been given its own zone as it is a key generator/attractor of trips within the South Fingal area. This allows an accurate representation of traffic accessing/egressing these key areas within the ERM. Outside of the main urban centres, the ERM zones become larger and more aggregate in nature primarily due to the low levels of activity (population and employment) in these areas.

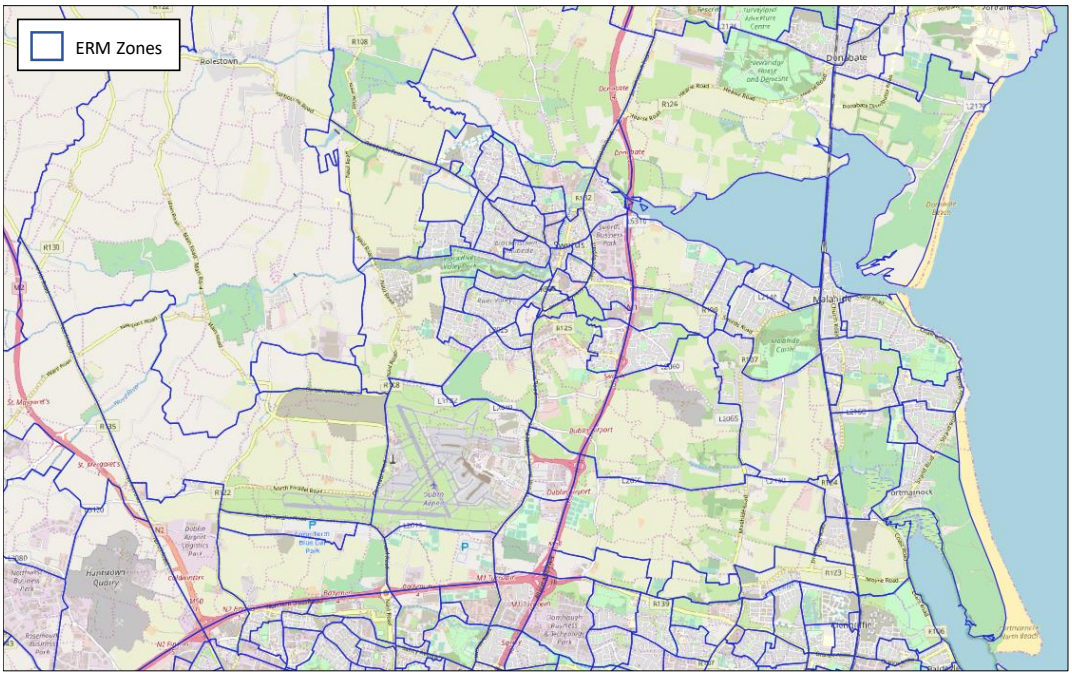


Figure 2.10 South Fingal Study Area ERM Zones

South Fingal Road Network

2.4.19 The ERM road network in the South Fingal study area, illustrated in Figure 2.11 overleaf, was extracted from the HERE[1] mapping layer which provides a detailed representation of all National Primary, Secondary, Regional and local roads in Ireland. 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. As illustrated in Figure 2.11, the ERM 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 represent "spigots" used to load traffic from the zones accurately onto the road network.

[1] HERE Maps (http://maps.here.com), originally Navigation Technologies Corporation (NavTeq) provides mapping, location businesses, satellite navigation and other services under one brand.

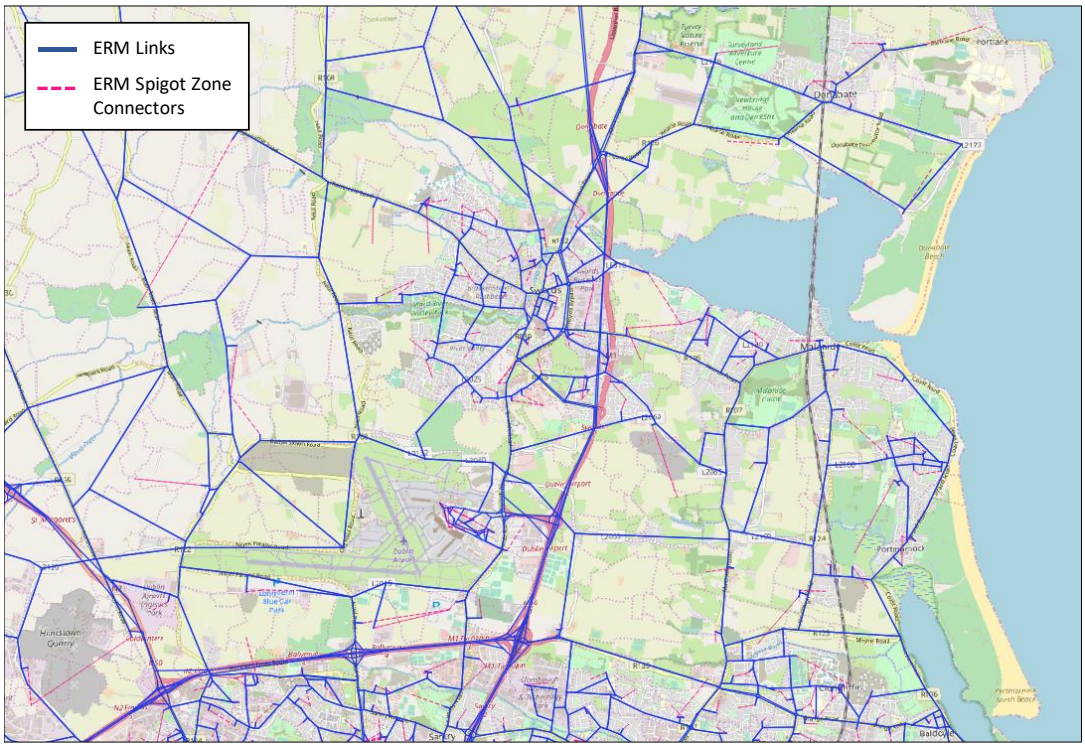


Figure 2.11 South Fingal Study Area ERM Road Network

South Fingal Public Transport Network

2.4.20 The General Transit Feed Specification (GTFS) database provides information on all public transport services operating in Ireland including data on routing, timetables, headways etc. This database is used to generate an accurate representation of the public transport services in operation in the ERM. Figure 2.12 provides an overview of the ERM public transport network in South Fingal.

2.4.21 A detailed representation of public transport stop locations is also included to ensure that demand can access services at accurate locations. The Public Transport assignment module takes into consideration all elements of travel including aspects such as fare paid, walk time to stops, wait time and travel time. Within the ERM, attributes such as congested vehicular speeds are passed from the road network assignment to ensure that the impact of traffic delay on bus speeds is accurately represented.

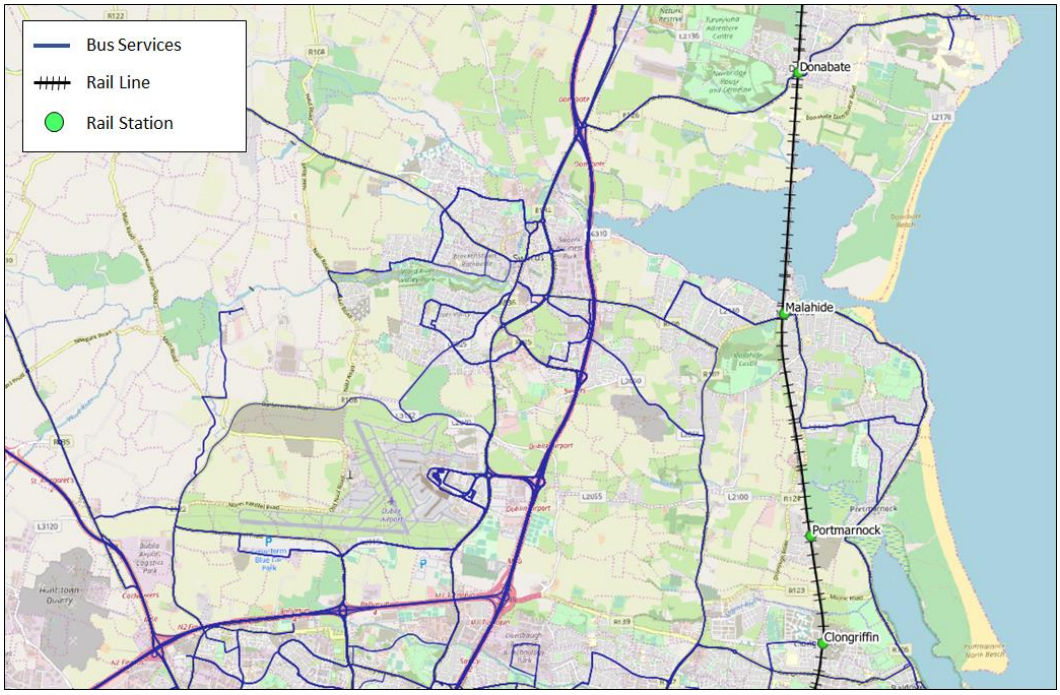


Figure 2.12 South Fingal Study Area ERM Public Transport Network

Airport Model

2.4.22 An Airport model has been developed for the ERM to estimate the mode share and trip distribution pattern for air passengers travelling to Dublin Airport. The model has been developed through analysis of a major passenger survey undertaken in late 2016, along with planning datasets containing demographic and other information for each small area from the NDFM.

2.4.23 The model uses forecast planning data and passenger volumes to generate future demand, and then undertakes destination and mode choice. It can be used to assess surface access to the airport, splitting demand by those who:

- Use public transport;
- Take a taxi;
- Drive and park; or
- Get dropped off.

2.4.24 Within the model, the user can also adjust the availability of parking which will impact on passengers' mode choice travelling to/from the airport. The main output is a set of matrices, separated for business and leisure trips, which can be fed into the ERM. This can then be used to assess the wider strategic impact of demand generate by the airport.

Scenarios

2.4.25 The ERM generally considers two main types of inputs for testing, namely:

- **Demand:** This represents changes to demographic information such as population, employment, education etc.; and
- **Supply:** This represents changes to the assignment networks e.g. new road infrastructure, new public transport services, new walk and cycle infrastructure etc.

2.4.26 Forecast demographic inputs have been developed in consultation with FCC using a review of Local Area Plans, developments with planning permission and identified areas with potential for infill development. This information on future population, employment and education was fed into the NDFM to generate forecast demand to be assigned in the ERM.

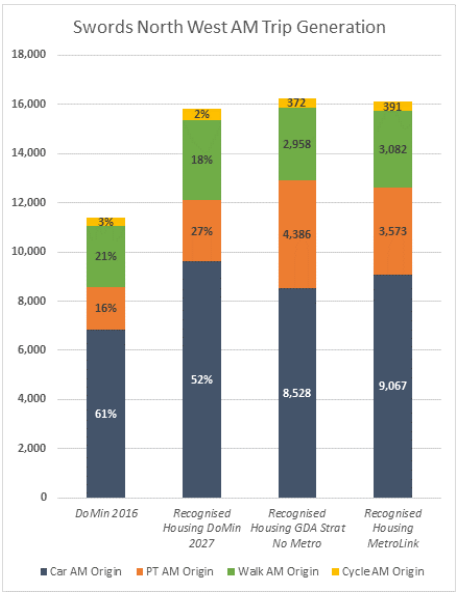
2.4.27 On the supply side, the generation of new scenarios for testing can include aspects such as the introduction of new road infrastructure, improvements to public transport services or upgrades to walking and cycling networks etc. Each of these elements are coded within the road, public transport and active mode assignment models within the ERM for testing. Further details on the various network and demand scenarios tested within the ERM as part of the SFTS are provided in Chapters 4, 5 and 6 of this report.

Outputs and Analysis

2.4.28 The ERM produces a wide range of outputs which can be used to assess the impacts of proposed test scenarios. In general, the SFTS focuses on the following:

- Trip Generation by Mode;
- Trip Distribution by Mode; and
- Network Analysis

Trip Generation by Mode

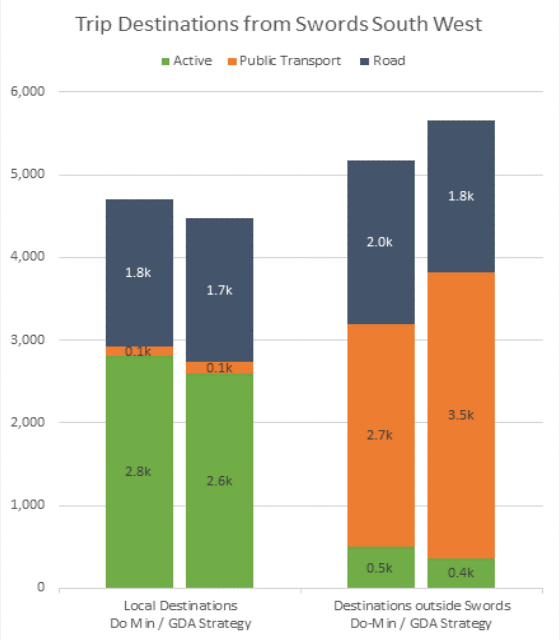


2.4.29 As discussed above, the NDFM uses demographic forecasts to generate trip demand which can be input into the ERM demand model. The demand model then undertakes detailed mode and destination choice based on the cost of travel to the user. These choice model components have been calibrated to Census POWSCAR and National Household Survey data, and as such, provide a robust estimation of forecast demand choices. Therefore, the RMS can be utilised to identified the level of travel demand on each of the main modes of transport for a forecast scenario, and understand the impact of introducing various levels of public transport and/or other schemes. In terms of the SFTS, the trip generation and mode share elements of the RMS can provide useful information to answer questions such as:

- What level of traffic is being generated by specific zoned lands;
- What mode of transport are people using? - a reduction in car mode share may have a positive impact on the road network performance in the area;
- What is the impact of introducing new public transport services such as MetroLink or Bus Connects? What is the estimated patronage levels? Etc.

Trip Distribution by Mode

2.4.30 Trip distribution analysis focuses on the key forecast origins and destinations of travel estimated by the RMS. This can have a significant impact on the rationale behind a person's choice of mode and route, and can be very useful in identifying potential mitigation measures for issues on the road network. For example, if the model estimates a number of relatively short distance car trips, perhaps these could be converted to walking/cycling with an introduction of infrastructure upgrades at strategic locations. Likewise, trip distribution analysis can give an indication as to potential demand that could be captured by new public transport services or road network upgrades.



Network Analysis

2.4.31 Network analysis identifies the impact on the road and public transport networks of forecast growth in population, employment and education, and the infrastructure measures introduced as part of the test scenario. The SFTS focuses on the following network attributes:

- Traffic Flows and Delay;
- Journey Times;
- Junction Volume over Capacity (V/C); and
- Public Transport Line Flows.

Traffic Flows and Delay

2.4.32 Analysis of the road traffic assignment within the ERM using SATURN can be used to identify the change in traffic volumes and travel delay on the network from one scenario to another. These differences can then be analysed to provide information on:

- Roads experiencing significant increases in traffic volumes;
- Utilisation of new proposed road infrastructure; and

- Key areas on the network that are likely to experience traffic congestions and delay.

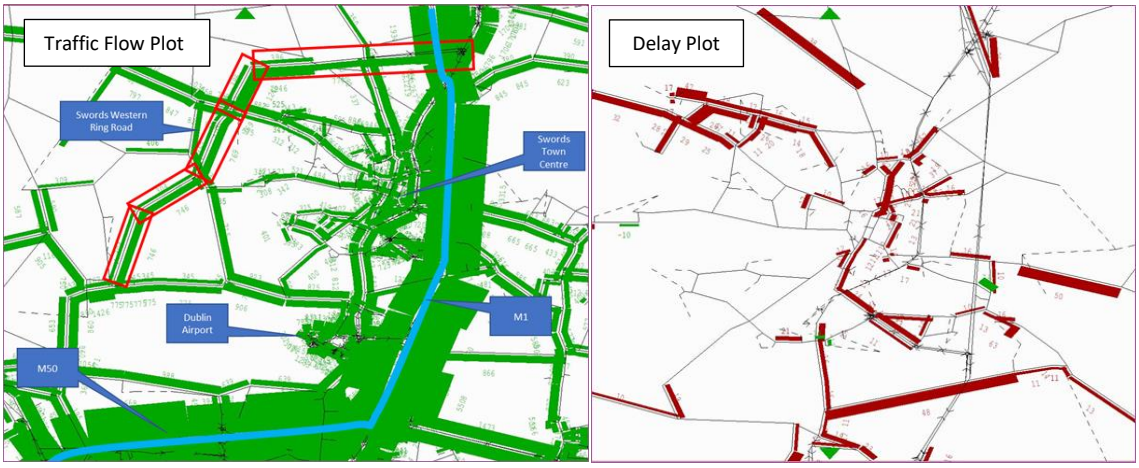


Figure 2.13 Traffic Volumes & Travel Delay Plots taken from the ERM Road Model

Journey Times

2.4.33 The Joyride functionality within SATURN facilitates analysis of the change in journey times along routes on the road network between two scenarios. This is used to identify the potential journey time savings that can be achieved due to proposed infrastructure /mitigation measures e.g. junction upgrades, new roads such as the Swords Western Relief Road, upgrades to public transport services etc.

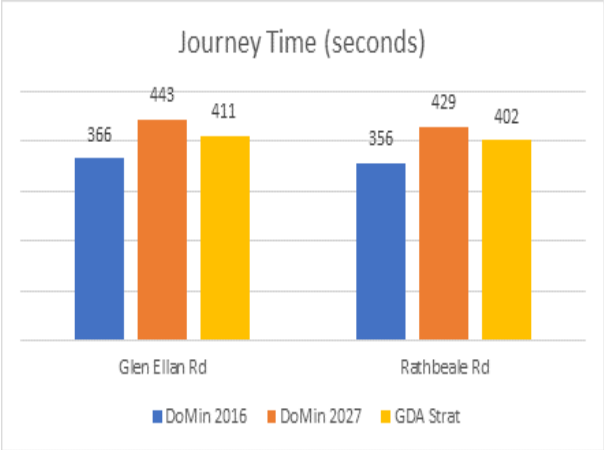


Figure 2.14 Journey Times by Scenario along Key Roads

Junction Volume over Capacity (V/C)

2.4.34 Volume over capacity (V/C) is a commonly used index to assess the performance of junctions. In general, a V/C of greater than 100% means that demand through the junction exceeds capacity leading to significant congestion and delay. Typically, junctions with V/C in excess of 85% are regarded as suffering from traffic congestion. Through plotting junction V/C and comparing between scenarios, areas that are likely to experience congestion and delay can be identified. Analysis of V/C can also highlight how specific junction performance can improve/deteriorate under varying test scenarios.

Figure 2.15 Junction Volume/Capacity Ratio

Public Transport Line Flows

2.4.35 The public transport assignment within the ERM identifies the routes passengers take on the network and their mode of travel i.e. bus, rail, Luas etc. Through extracting results from this assignment, the boarding and alighting profiles for various public transport services can be examined. This can be useful in identifying where services are under-utilised or over-crowded. It can also assist in determining the impact of new proposed public transport offerings, or where there may be capacity for additional services.

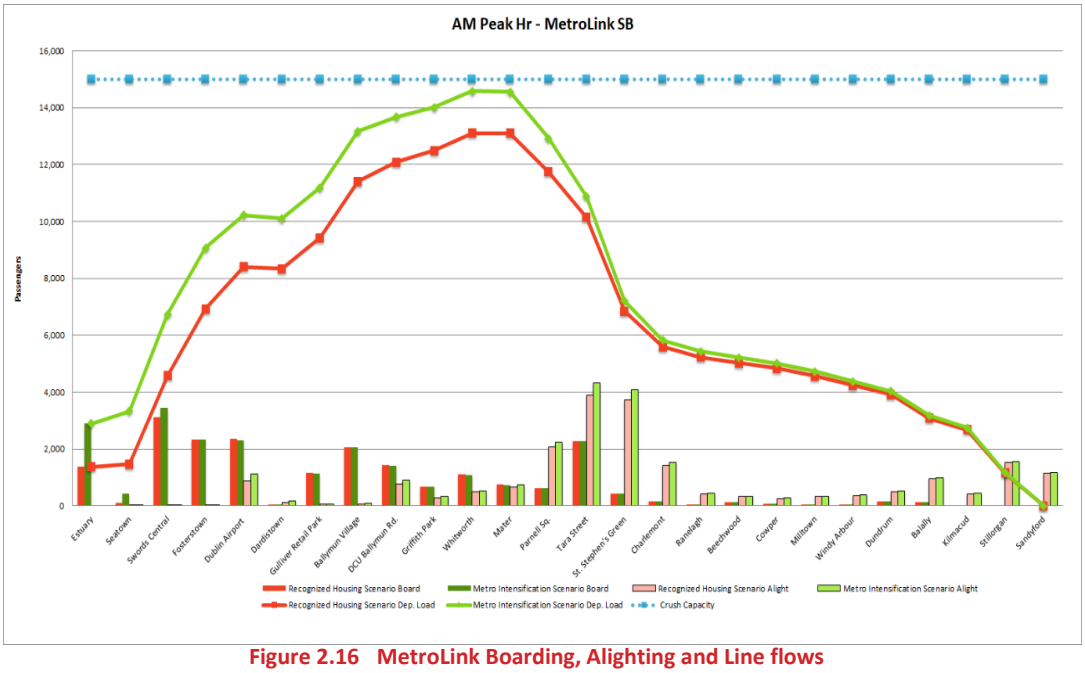


Figure 2.16 MetroLink Boarding, Alighting and Line flows

Summary

2.4.36 The East Regional Model provides a comprehensive representation of travel patterns, behaviour, and network conditions across the Greater Dublin Area and Fingal and is suitable tool for the testing of the range of transport schemes being considered in the Study Area.

3. REGIONAL MODEL INPUTS

3.1 Land Use Forecasts

3.1.1 This section outlines the methodology by which population, employment, education places and retail activity have been distributed within the GDA for the purposes of creating the travel demand inputs into the transport modelling process. This involves the disaggregation of the regional figures for 2035, down to the ERM zone level to provide a picture of the GDA for the strategy horizon year. The primary drivers for transport demand are population and employment, from which education and retail are also derived.

3.1.2 The overall process developed by the NTA for developing demographic forecasts at local GDA zone level is as follows:

- National forecasts for the GDA have been developed based on the Central Statistics Office's (CSO) M2F2 'Traditional' Scenario[1];
- Data from the Regional Planning Guidelines for the Greater Dublin Area 2010 – 2022 was then used to distribute population and employment into the counties within the GDA;
- The distribution within each county was undertaken through a process of defining settlements and distributing growth locally within these settlements. This was undertaken by the NTA and the local authorities of the GDA.
- The final step, undertaken by the NTA and local authorities, was to breakdown the forecasts within each settlement to GDA zone level, based on planning data and advice from local authorities.

3.1.3 All future growth was constrained to CSO forecasts, in order to provide a forecast scenario that is consistent with established national projections.

Population

3.1.4 The GDA consists of seven local authority areas: Dublin City, South Dublin, Fingal, Dun Laoghaire-Rathdown, Kildare, Meath and Wicklow. The Regional Planning Guidelines for the Greater Dublin Area 2010 - 2022 (RPG) provides guidance on the future growth of population within each of the areas covered by the local authorities. The local authorities, working with these guidelines, have developed "core strategies" which provides strategic direction as to where future housing will be provided within each county. Working with the Local Authorities for the purposes of the transport model, the 2035 GDA population has been distributed in accordance with the RPG.

3.1.5 Table 3.1 below shows that the proportions of population within each county are planned to remain broadly similar in 2035 when compared to 2011.

Table 3.1 GDA Population within Each Local Authority for 2011 and 2035

Population	Population 2011	% of GDA 2011	Population 2035	% of GDA 2035	Growth 2011 to 2035	% Growth 2011 to 2035
Fingal	273,991	15%	350,036	15%	76,045	28%
Dublin City	527,612	29%	637,246	28%	109,634	21%
South	265,205	15%	332,722	15%	67,517	25%
Dún Laoghaire-	206,261	11%	257,073	11%	50,812	25%
Kildare	210,312	12%	282,408	12%	72,096	34%
Meath	184,135	10%	235,707	10%	51,572	28%
Wicklow	136,640	8%	191,666	8%	55,026	40%
GDA	**1,804,156**	**100%**	**2,286,858**	**100%**	**482,702**	**27%**

3.1.6 Based on the table above, the NTA have assumed that the population for the whole of Fingal will grow to 350,000 by 2035. This growth is then allocated to Census Small Areas (CSAs) by the NTA.

3.1.7 As a means of distributing each demographic variable below the Local Authority level, the NTA defined a number of settlements in the region. Any Hinterland town with a population of over 2,000 people was defined as a settlement, while the Metropolitan Area was split on a more informal geographical basis.

3.1.8 The next and final step involved allocating the settlement totals to the Census Small Areas within the settlement, and as such represent the highest level of disaggregation available (although CSAs may be broken further into model zones where they are large).

Employment

3.1.9 The chosen distribution of the future 2035 population has been developed based on the RPGs, which provide guidance on the consolidation of development into a planned settlement hierarchy. The future growth in employment thus follows the RPG settlement hierarchy and keeps a similar proportion of employment in 2035 that existed in 2011 from Local Authority areas, in addition to planned settlements within the Local Authority areas.

3.1.10 The rate of unemployment amongst working age adults is a variable within the modelling and must be specified. In 2011 it was set at 11% and in future it is assumed to revert to the long term average of 4% to 5%.

3.1.11 Table 3.2 shows the employment distribution for 2035 by Local Authority area, which have been further disaggregated to model zone level.

Table 3.2 GDA Employment within Each Local Authority for 2011 and 2035

Employment	Jobs 2011	% of GDA 2011	Jobs 2035	% of GDA 2035	Growth 2011 to 2035	% Growth 2011 to 2035
Fingal	79,452	13%	109,860	13%	30,408	38%
Dublin City	287,788	46%	397,930	46%	110,142	38%
South Dublin	77,699	12%	107,436	12%	29,737	38%
Dún Laoghaire-	68,626	11%	94,891	11%	26,265	38%
Kildare	52,260	8%	72,261	8%	20,001	38%
Meath	34,478	5%	47,673	5%	13,195	38%
Wicklow	27,574	4%	38,127	4%	10,553	38%
GDA	627,877	100%	868,178	100%	240,301	38%

Education and Retail

3.1.12 For education and retail, the total figures were derived by relating the numbers in education, and the numbers employed in retail to the total population and jobs figures, according to the evidence from the CSO, e.g. 7% of the National Population were of Secondary School going age. Numbers employed in retail is used as an indicator of retail activity rather than floor space, as the various retail formats mean floor space is less useful as an indicator of travel demand than retail employment.

Allocation to Census Small Areas / NTA Model Zones

3.1.13 Figure 3.1 & 3.2 show the initial allocation of future population, employment, and education in CSAs for the purpose of the SFTS. It is important to note that these numbers can be varied during the study to determine impacts of different land use assumptions on the transport network. Therefore the numbers shown in these figures may differ from later more detailed assessments undertaken as part of the SFTS.

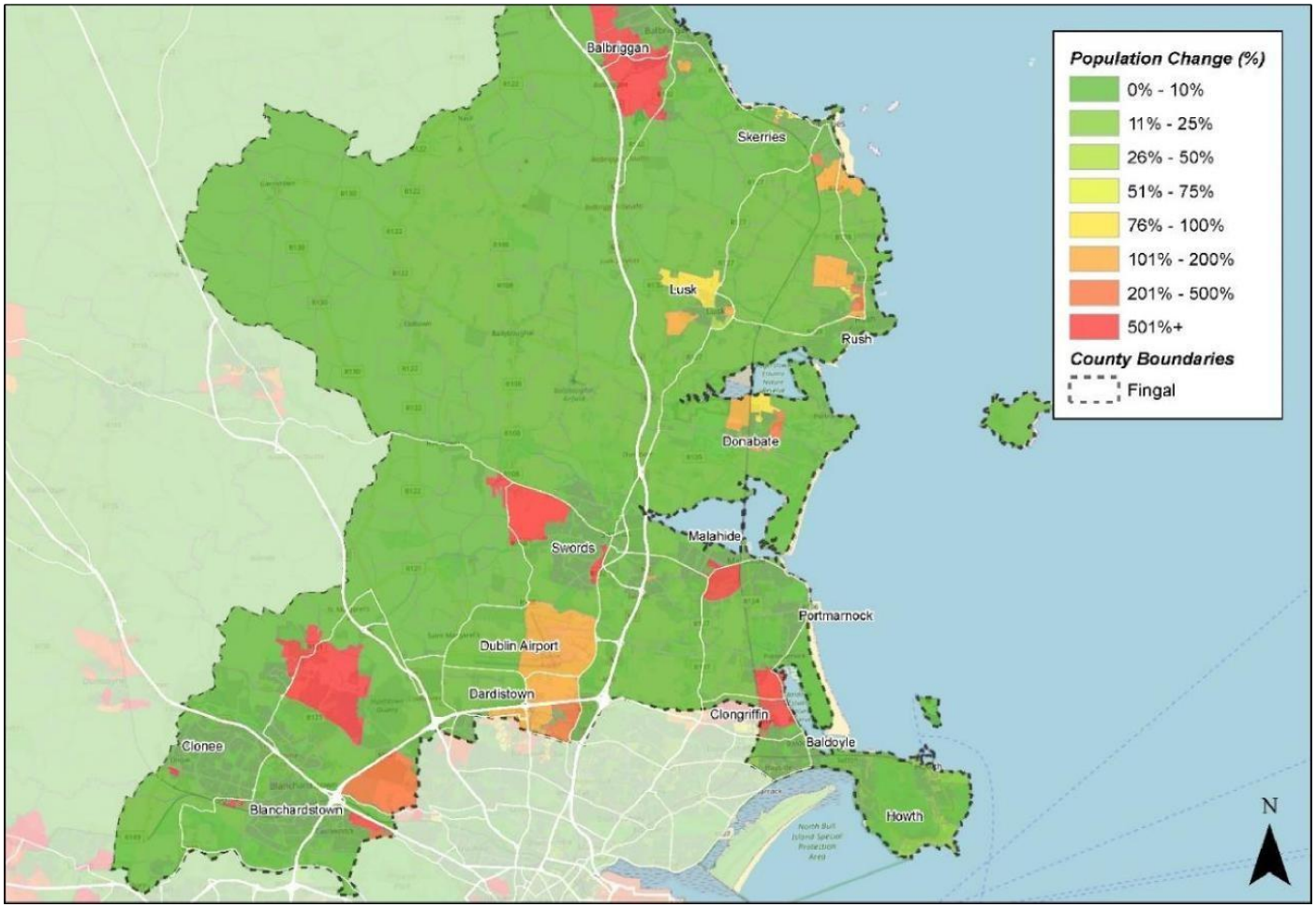


Figure 3.1 Population Percentage Change

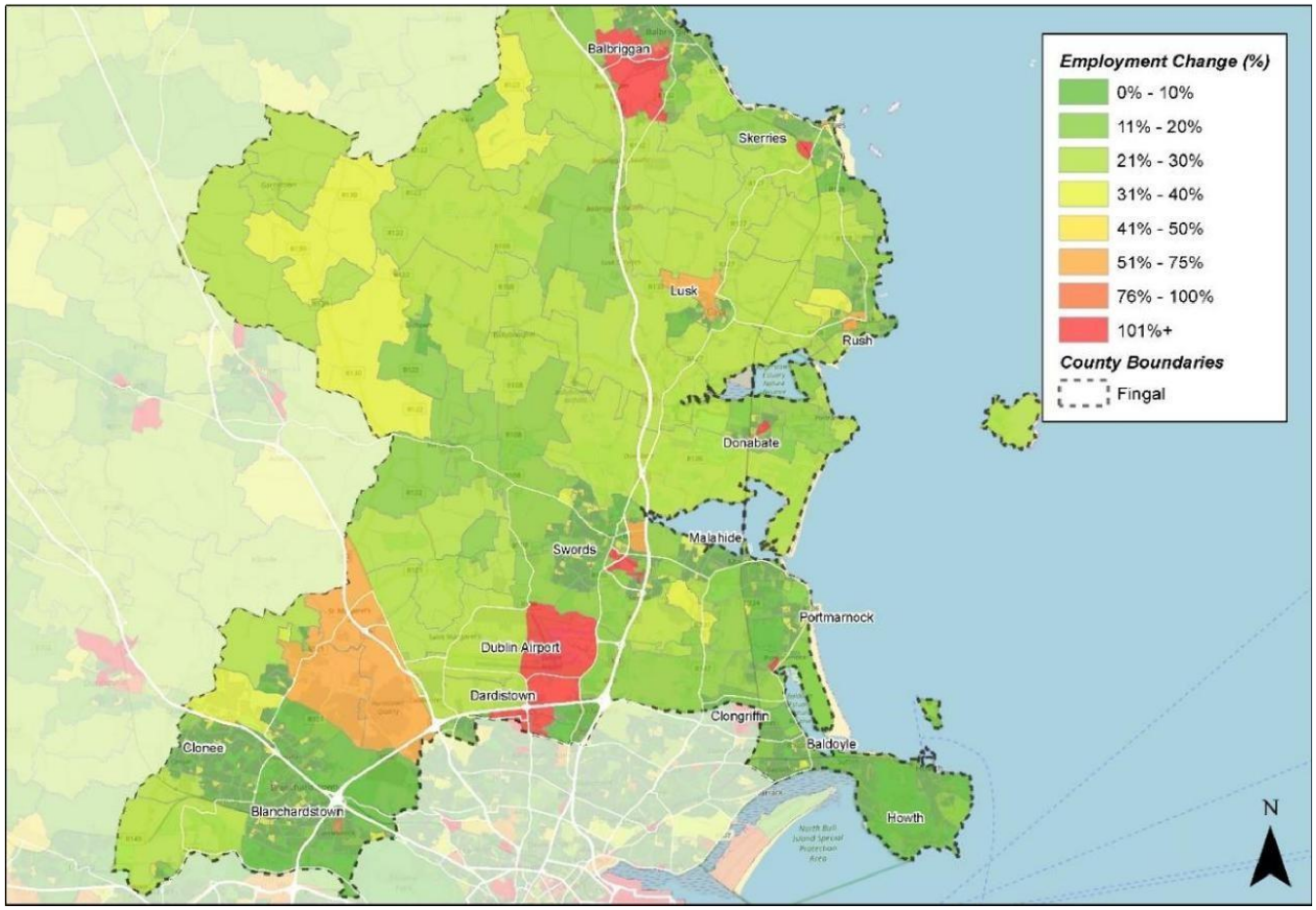


Figure 3.2 Employment Percentage Change

Summary

3.1.14 This section has presented an overview of the NTA forecasts for 2035. The 2027 forecasts are in line with the 2035 distribution, as they have been interpolated in all locations based on straight line growth between 2011 and 2035.

3.1.15 The 2035 forecasts are the basis for the NTA GDA Strategy but may not fully align with the Fingal County Development Plan or the latest information on development, as the NTA prepared the forecasts while the development plan was still being drafted. As noted above, the NTA assumed no growth in many zones / CSAs by 2035 but Census 2016 shows growth in nearly all locations in the study area between 2011 and 2016.

3.1.16 The next section presents 2035 revised SFTS forecasts. It is anticipated that new 2027 forecasts will be used in the study. It is possible to use a straight-line interpolation between the 2016 and 2035 forecasts to produce a new 2027 forecast. However, this would not represent any differentials in growth due to some sites being developed earlier than others, or those areas which depend on Metro North or the delivery of other transport infrastructure.

3.2 SFTS Forecasts

Population

3.2.1 As has been noted above, the NTA models assume that Fingal grows to 350,000 by 2035. This is in line with the Regional Planning Guidelines. This growth equates to an additional 54,000 above the current Census 2016 levels to the county.

3.2.2 The allocation of this 54,000 uses the same proportions that were assumed by the NTA (2011 – 2035 proportions). However, any zones which have grown between Census 2011 and Census 2016 have been set to the higher number.

3.2.3 To further refine the growth allocations in the county, various LAPs were examined with growth then allocated to the LAP areas. The NTA's assumed growth proportions from 2011 – 2035, didn't exactly match up to proposed development areas, so manual adjustments were made to match the zoning provided in the Fingal Development Plan. The

3.2.4 The study area also includes some zones that belong to Dublin City Council (DCC) i.e. zones in Belcamp, Belmayne, Clongriffin, Clonshaugh and Donaghmede. To take into account the new starting point of 2016 for population for these DCC zones, the existing NTA forecasts for 2035 were used as long as they are greater than the 2016 numbers. From these the 2027 forecasts were derived by assuming a straight line growth between 2016 and 2035 to get 2027 numbers.

3.2.5 Figure 3.3 shows the resulting 2035 Population Growth Assumptions at an ERM zone level.

Employment

3.2.6 The latest employment figures for 2016 can only be obtained through access a specialised micro-data file directly through the CSO. This is not currently available. As we currently don't

have access to the latest employment figures for 2016, the existing 2035 NTA forecasts have been used.

3.2.7 Figure 3.4 below shows the main employment growth areas within the study area at an ERM zone level. As shown in the map, the main growth areas, are Swords and the airport.

Summary

3.2.8 This section has provided background to the derivation of population and employment growth forecasts used in the South Fingal Transport Study. More detailed information can be found in the relevant sections of the sub reports for Swords, Fingal/Dublin Fringe, and the Airport. It should be noted that the modelling approach described in this report represents the starting point for the overall transport modelling. This forecasting approach remains consistent but will have been further refined for each area as described in each area-specific sub report.

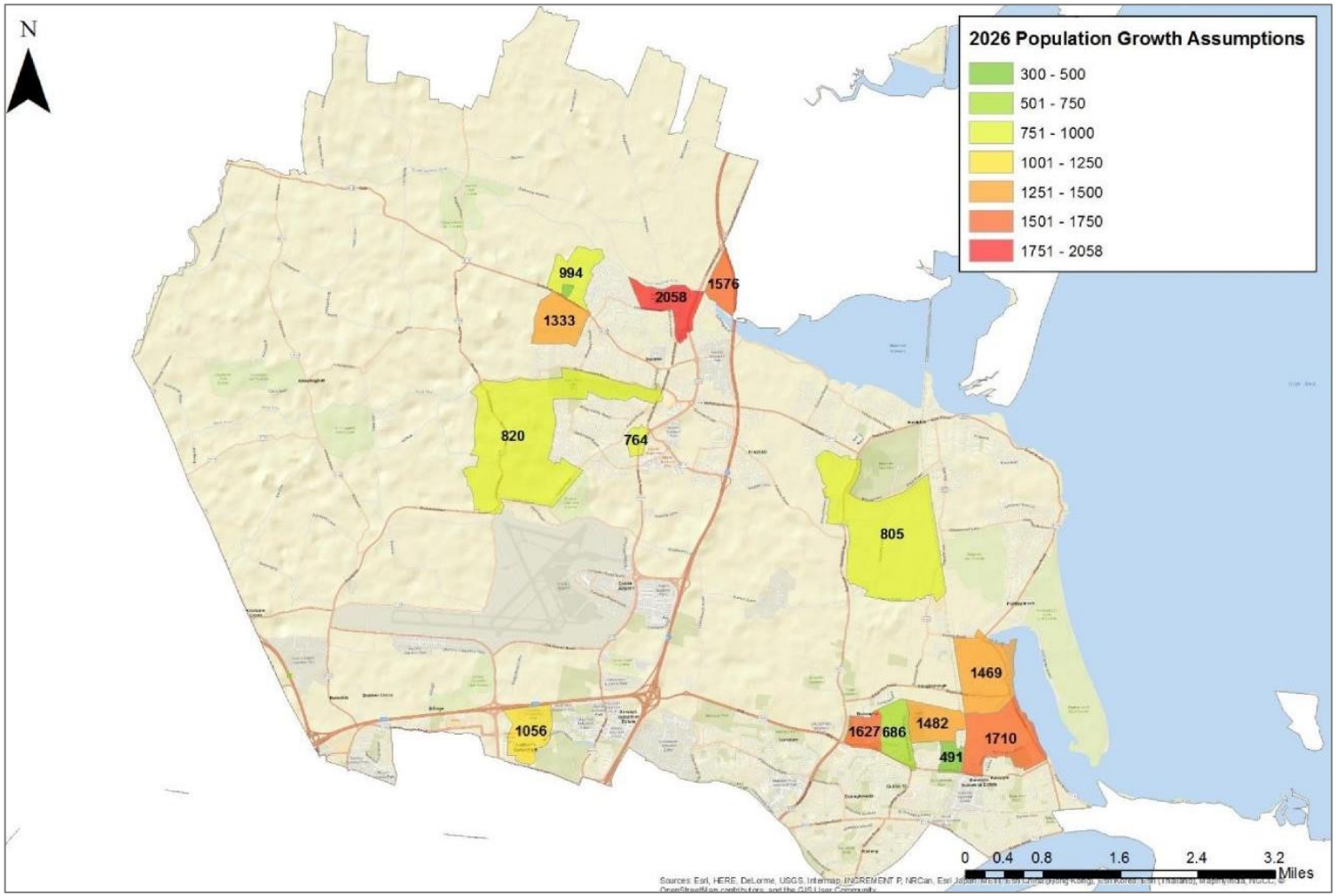


Figure 3.3 2027 Population Growth Assumptions

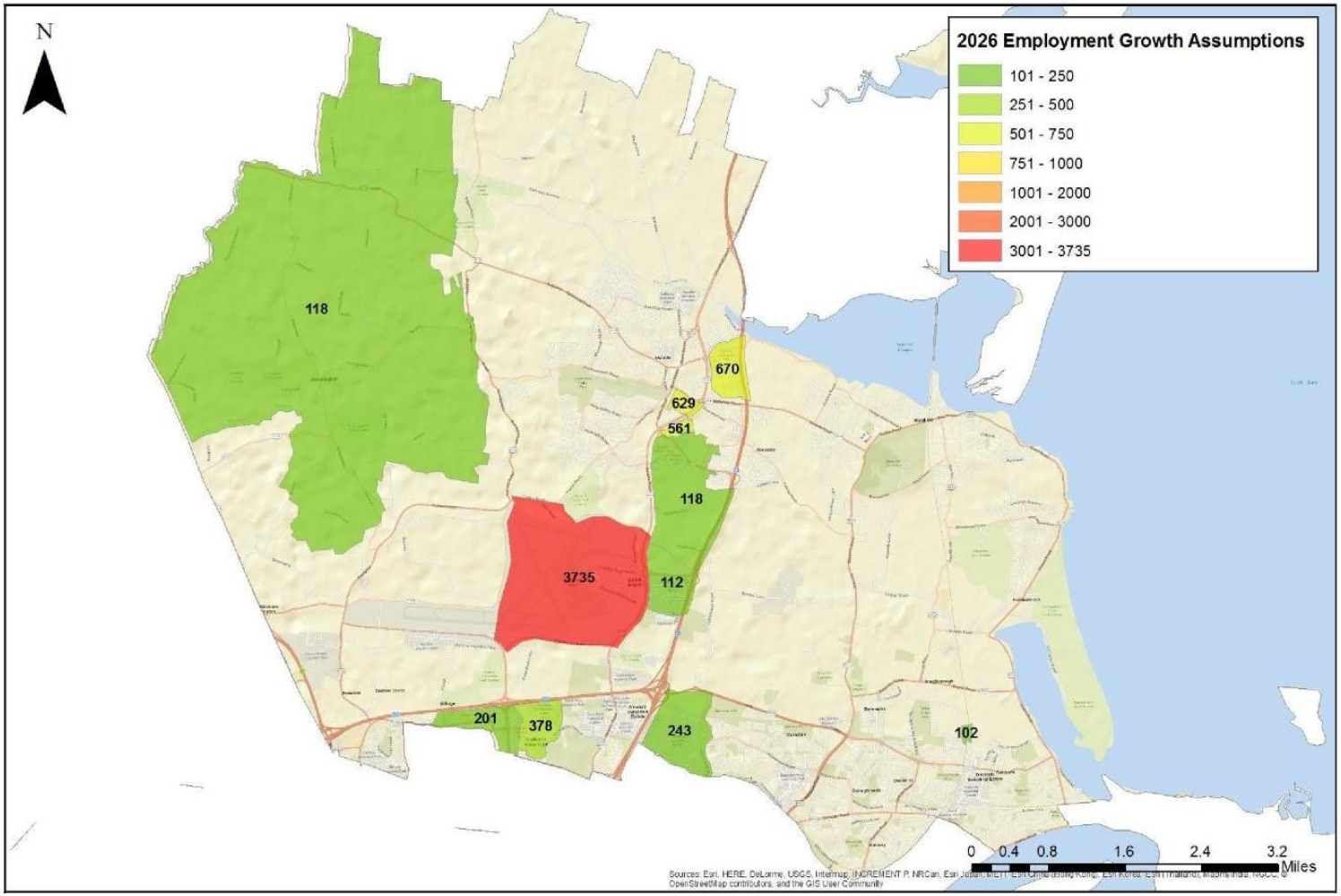


Figure 3.4 2027 Employment Growth Assumptions

3.3 Networks for SFTS Study

3.3.1 The SFTS is planned to be phased in to correspond with the opening of MetroLink in 2027 and with the partial implementation of the GDA Strategy in 2027. As such the appraisal year for the SFTS is 2027.

Base Year Network

3.3.2 A base year network was developed to examine the model's detail and performance in reflection the existing transport network with particular focus on Fingal. A 2018 network was developed from the 2012 base model to incorporated schemes that have since come on line.

3.3.3 The base year demand scenario was developed using the 2016 census data to provide trip rate figures for the 2018 base network.

Do Nothing Network

3.3.4 A Do Nothing model was developed for 2027 to examine the impacts of growth to 2027 on the existing infrastructure. The 2027 and 2018 networks are the same but the demand set used is different, including 2027 growth.

Table 3.3 2027 Do-Nothing Network

Scheme included (in addition to 2012 Base)	Mode
Luas Cross City	PT

Do Minimum Network

3.3.5 The Do Minimum network includes forecast transport demand and additional transport schemes that are either under construction or committed to be implemented post-2018. A Do Minimum network is defined for 2027. The 2027 Do Minimum scenario is coded on top of the 2018 Base scenario.

3.3.6 In effect, the Do Minimum represents the anticipated future year situation without the SFTS recommendations. The Do Minimum scenario includes the following set of road and public transport schemes and are explained in further detail below.

Table 3.4 2027 Do-Minimum Network

Schemes included (in addition to Do Nothing)	Mode
MetroLink	PT
Core Bus Corridor Network	PT
GDA Strategy 2027 Road Network	Road
GDA Strategy 2027 Bus Network	PT

GDA Strategy 2027 Cycle Network	Active
Bus Rapid Transit	PT

3.3.7 The 2027 CBC and BRT network are shown in Figure 3.5 below while the MetroLink is shown in Figure 3.6.

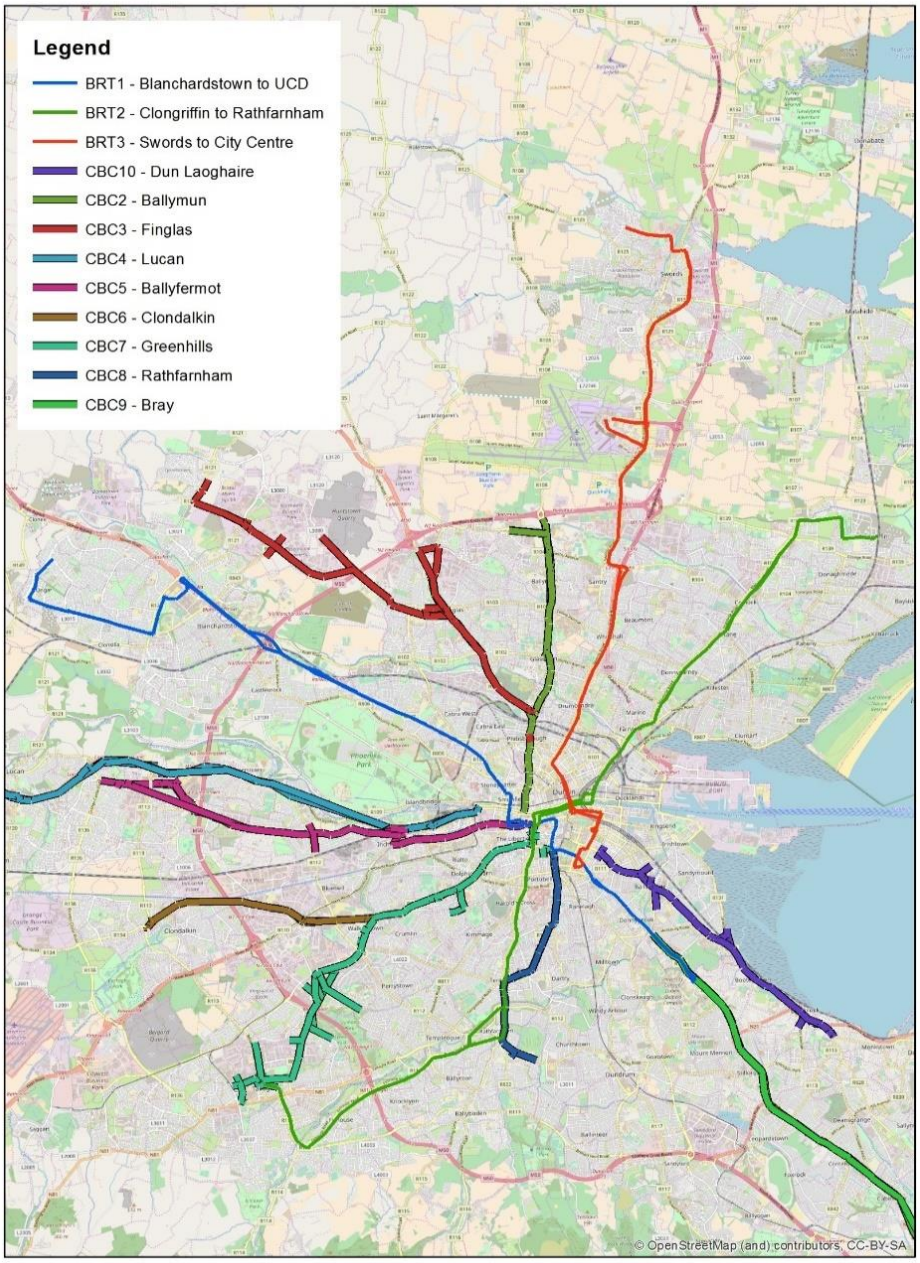


Figure 3.5 Map of CBC and BRT Routes

Figure 3.6 Map of Proposed MetroLink Route

Do Something Networks

3.3.8 The Do Something network is comprised of the Do Minimum network with the SFTS included. In effect, they are the same as the Do Minimum network with the addition of the SFTS scenarios. The SFTS options are coded on top of the Do Minimum 2027 scenario, to facilitate their assessment and comparison against each other.

Table 3.5 2027 Do-Something Network

Scheme include (in addition to Do Minimum)	Mode
Fingal Transport Strategy	Road

4. SFTS MODELLING APPROACH

4.1 Introduction

4.1.1 The SFTS was modelled in two stages, the first was testing various scenarios in the ERM to provide full multi-modal results, including public transport, road, and active modes. The ERM provided the geographic scope to look at Fingal's interactions with Dublin City and the wider region. In particular it allowed this analysis on a multi-modal level providing data on public transport which has a strong north-south connection between Dublin and Fingal which is vital for testing various bus services and MetroLink.

4.1.2 Due to long run times (approx. 3 days) the ERM is not suitable for a high number of tests which are required when examining specific network operation issues. As such a Local Area Model was developed. A Local Area Model is essentially a cut-out part of the main ERM which can be run in a much shorter time, and thus enables detailed testing of road proposals. The process of modelling is shown in Figure 4.1 below.

4.1.3 The Local Area Modelling approach is explained in more detail in the next section.

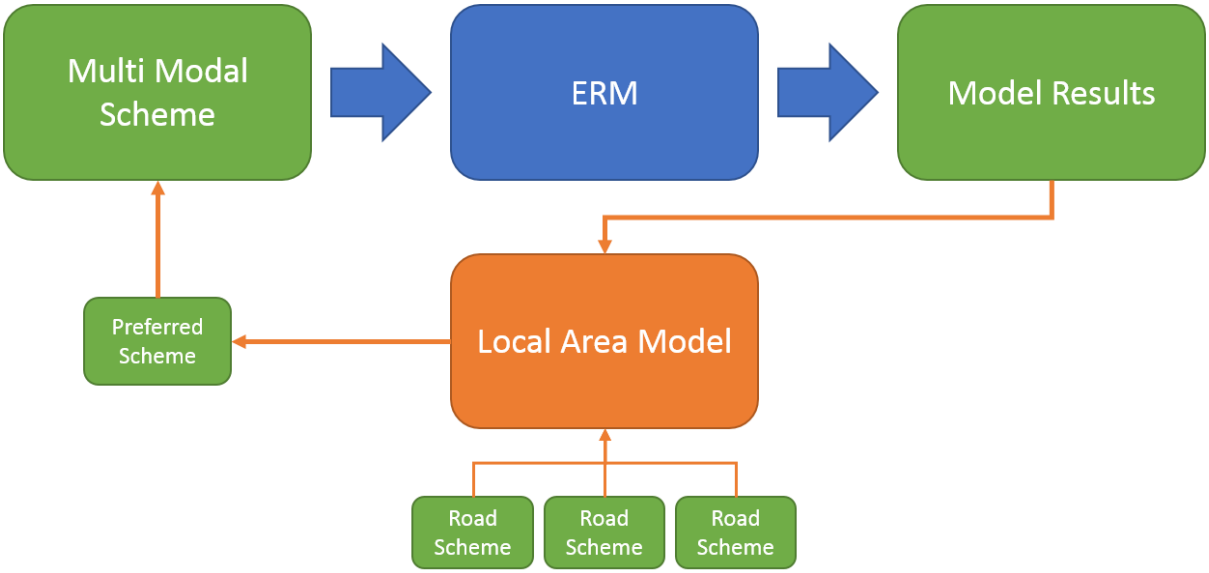


Figure 4.1 ERM / Local Area Modelling Approach

4.2 Local Area Model

4.2.1 Local Area modelling provides the opportunity to quickly and easily test multiple scenarios on an iterative basis using a fixed demand. The best outcomes from these LAM results can be fed back into the ERM to carry out a full multi-modal analysis.

4.2.2 The local area model was developed by cordoning an area of the road model out of the ERM along with demand. The area of the LAM is shown in Figure 4.2 below.

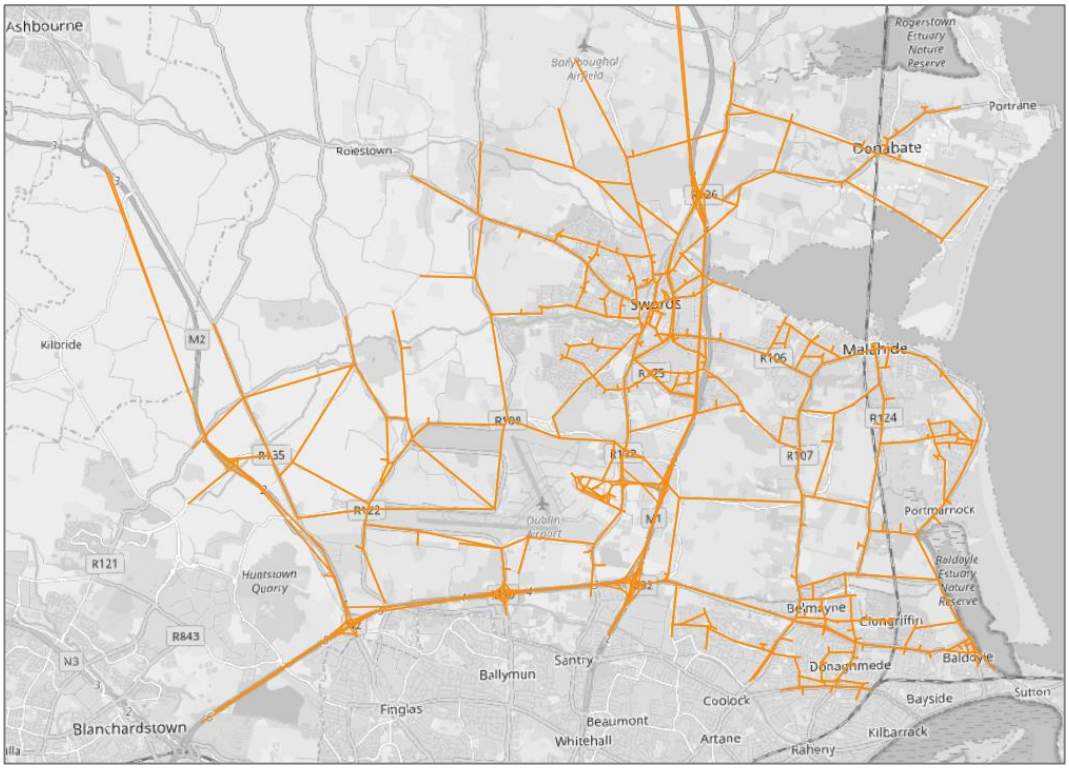


Figure 4.2 LAM Network

4.2.3 The LAM area covers all three of the key locations to be tested in Fingal; the airport, the North Fringe and Swords. Often when producing an LAM the Regional Model zones will be disaggregated into small zones, in the case of the Fingal Study this was not deemed to be necessary due to the already high level of details available for the study area. As such demand for the LAM comes directly from the ERM but destination and modal choice remain fixed for runs with only route choice changing.

4.3 Scenario Descriptions

4.3.1 The scenarios tested divide into two categories; land use and infrastructure.

Land Use

4.3.2 As discussed previously the land use assumptions for Fingal were derived from the Regional Planning Guidelines which provide a background growth onto which specific information around proposed development can be added. Straight line growth between 2016 and 2035 has then been used to determine the baseline 2027 land use forecasts.

4.3.3 Within the SFTS different levels of development were tested for the land use scenarios starting at 0% proposed development, or simply the background growth only. This was then increased to cover 25%, 50%, 75% and 100% of proposed development. This was undertaken to examine potential upper limits on employment levels in Swords specifically, and so excluded other parts of the study area. Table 4.1 below outlines the jobs by area included in each scenario. Population for each scenario remained consistent.

Table 4.1 Employment Level Scenarios

	Employment			
	100%	75%	50%	25%
Barrysparks	6500	4875	3250	1625
Crowcastle	6500	4875	3250	1625
Fosterstown	1000	750	500	250
Estuary West	2000	1500	1000	500
Lissenhall	5000	3750	2500	1250
Lissenhall East	5000	3750	2500	1250

Infrastructure

4.3.4 Various infrastructure scenarios were tested using a combination of the ERM and the LAM. Road infrastructure was initially tested in the LAM using the Do Something demand scenario. This provided a base level of demand to experiment with various road options. These road options are listed in Table 4.2 and the Swords relevant schemes are shown in Figure 4.3. Public Transport schemes were tested in the ERM only, as detailed in the scenarios listed in Table 4.5. For cycling, POWSCAR and GIS analysis was used to inform cycling recommendations, and as such was outside the scope of the modelling approach described in this report.

Table 4.2 Road Schemes tested in the LAM

Scheme	Description
Western Distributor Link Road	Distributor Road for the proposed developments areas (Oldtown – Mooretown) West of Swords
Western Bypass to Swords	Bypass to the West of Swords from M1/R132 to the Airport Box
Swords Relief Road at Lord Mayors	Additional relief Road to cross the Ward River
Fosterstown Link	Link between the R132 and Forest Road
East West Link Road (Clonshaugh section)	Additional Link between Malahide Road and Stockhole Lane parallel to the R139 in prolongation of the R123
East West Link Road (Airport section)	Additional Link between Stockhole Lane and the R132
Clarehall Junction Relief Road	Relief Road to the West of Clarehall Junction
R107 Kinsealy Bypass	Bypass from south of Clarehall Junction to the North of Kinsealy
N2 - Airport West Link	Direct Link between the N2 and the Airport

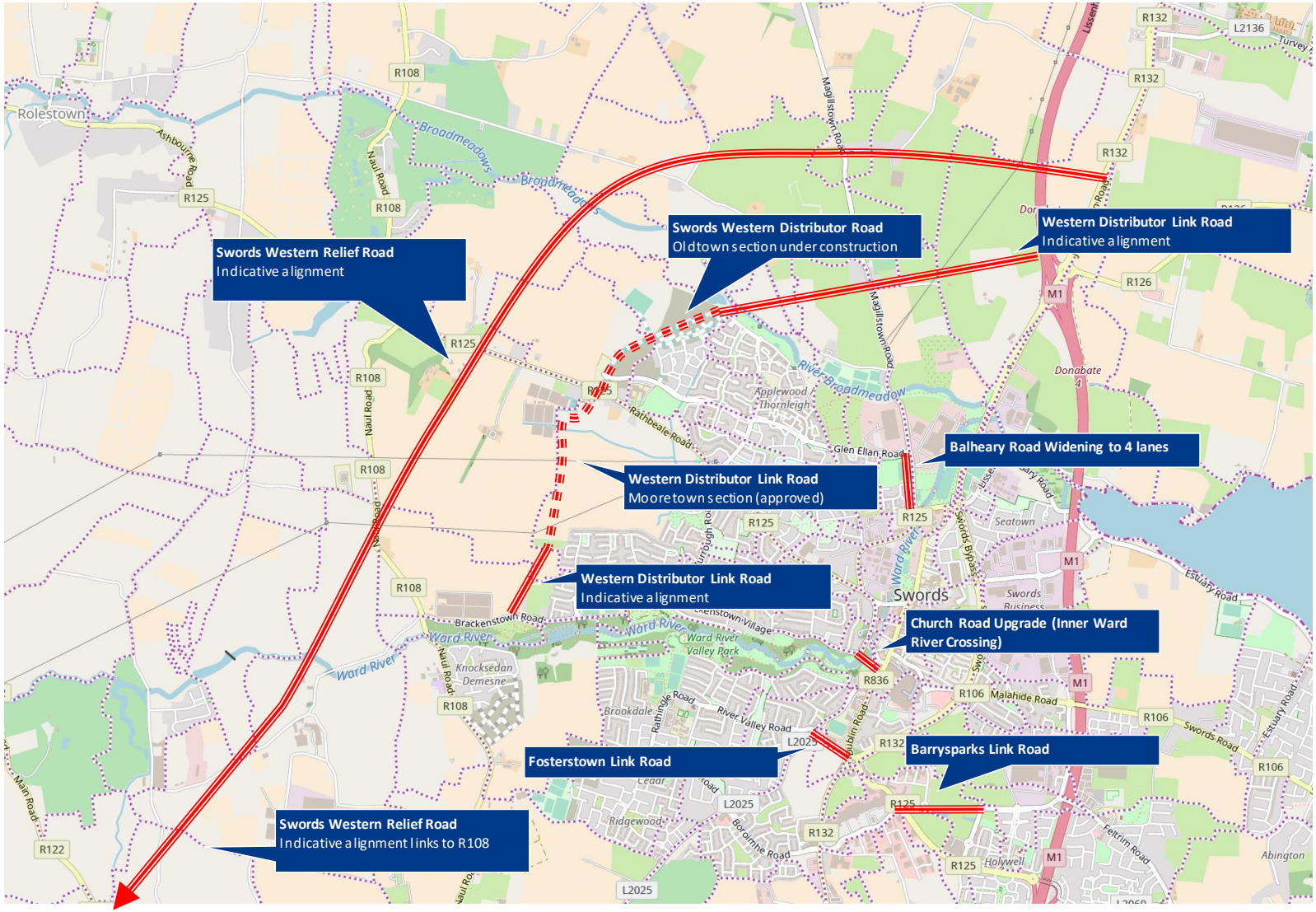


Figure 4.3 **Fingal Development Plan Road Schemes**

4.3.5 Road networks tests were refined being fed back into the model as shown in Figure 4.4. This process therefore attempts to find optimal solutions to identified congestion issues, within the constaints set out by the overall study (transport policy, FDP objectives, etc.).

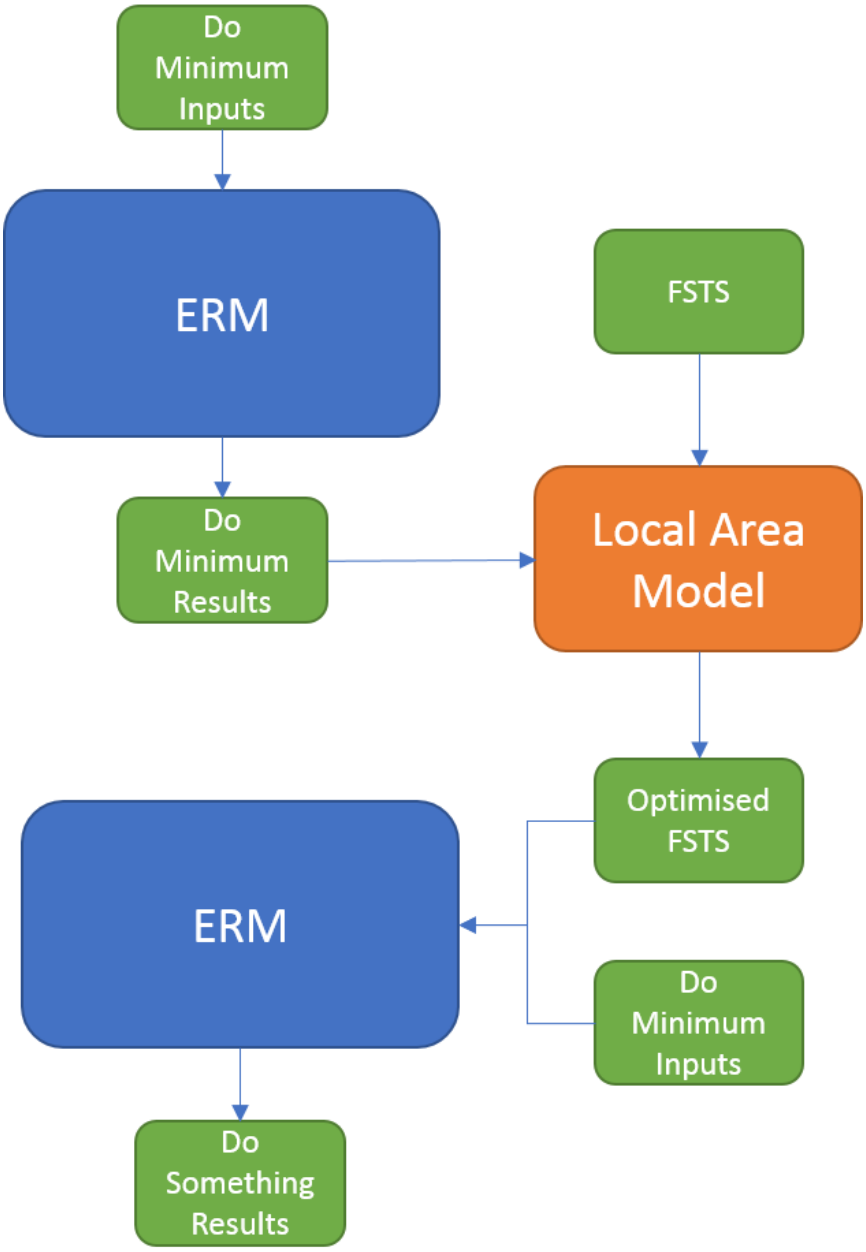


Figure 4.4 LAM Role in Scenario Development

Do Something ERM Tests

4.3.6 The main ERM modelling process involved four infrastructure variations to be tested on a multi-modal basis, these are shown in Table 4.3.

Table 4.3 Infrastructure Scenarios

Scenario	Infrastructure
Do Nothing	2018 Infrastructure only
GDA Strategy (no metro)	2027 GDA Strategy PT, Active and road network. Metro not included
GDA Strategy (no metro) with Fingal Transport Strategy	2027 GDA Strategy PT, Active and road network. Fingal Transport strategy road and active networks. Metro not included.
GDA Strategy (Metro) with Fingal Transport Strategy	2027 GDA Strategy PT, Active and road network. Fingal Transport strategy road and active networks. Metro included.

4.3.7 In addition to the four infrastructure variations tested in the ERM, three variations of parking constraint were also applied.

4.3.8 Parking constraint limits parking availability in a zone in the model. It uses a mechanism to ensure vehicles use zones with available parking if the destination is full (unavailable), incurring the costs associated with this additional searching and distance. In some cases this can result in road user's changing mode to PT, walking or cycling.

4.3.9 Parking constraint for the SFTS was defined by the number of spaces per square meter of employment area. This allows the number of spaces to be scalable for the different employment scenarios. Table 4.4 below shows the parking constraint scenarios applied.

Table 4.4 Parking Constraint Scenarios

Parking Constraint Scenario (per m2)	Parking Constraint Scenario (No. Employees per space)
None	1
1 per 30m^2	2.5
1 per 60m^2	5

4.3.10 A summary of all scenarios tested in the ERM and used for assessment is shown in Table 4.5.

Table 4.5 Scenarios tested in ERM and used for Assessment

	Scenario Name	Type	Year	Employment Level	Parking Constraint	Metro
Ref Scenarios	**AAK**	Do Nothing	2018 Network 2016 Demand	0%	None	No
	ABZ	GDA Strat + Recognised Housing	2027	0%	None	No
	ABY	GDA Strat	2027	25%	None	No
	ABH	GDA Strat + Recognised Housing + Fingal Strategy	2027	0%	None	No
Test Scenarios	**ACG**	GDA Strat + Fingal Strategy	2027	25%	1 per 30m^2	No
	ACA	GDA Strat + Fingal Strategy	2027	50%	1 per 60m^2	No
	ACB	GDA Strat + Fingal Strategy	2027	50%	1 per 60m^2	Yes
	ACC	GDA Strat + Fingal Strategy	2027	75%	1 per 60m^2	No
	ACD	GDA Strat + Fingal Strategy	2027	75%	1 per 60m^2	Yes
	ACE	GDA Strat + Fingal Strategy	2027	100%	1 per 60m^2	No
	ACF	GDA Strat + Fingal Strategy	2027	100%	1 per 60m^2	Yes

5. SUMMARY AND CONCLUSION

5.1 South Fingal Transport Study

5.1.1 The SFTS is a strategic study of current and future transport conditions primarily focused on Swords, the Airport, and the Fingal/Dublin Fringe. The SFTS made use of existing data sources such as the 2016 Census (POWSCAR) to develop many of its recommendations. It also made use of the NTA Regional Modelling system.

5.2 NTA Regional Modelling System (RMS)

5.2.1 The NTA RMS is a set of modelling tools designed to enable detailed analysis of future conditions on the transport network. The NTA RMS includes five regional models. The East Regional Model is the largest, covering all of the Greater Dublin Area and adjacent counties. The National Demand Forecasting Model provides trip end data to all five of the regional models for any forecast year based on assumptions around population and employment growth.

5.3 Use of the RMS in the SFTS

5.3.1 The RMS, including both the NDFM and the ERM were extensively checked and adjusted to match up to date information on Fingal's transport networks and its 2016 population and employment distributions. The process improved the models robustness in the study area. Following these, the forecasting was developed.

5.3.2 The ERM was used to test conditions on the 2027 by providing it with NDFM trip end outputs for the same year and with updated transport networks. The NDFM inputs were based on a review of housing inventories, the Fingal Development Plan, the NTA's assumptions on growth, and other sources.

5.3.3 The ERM's transport networks were updated to include any known road or public transport upgrades. For example, its public transport network was updated to line up with the NTA's Transport Strategy for the Greater Dublin Area.

5.3.4 The ERM, with the above preparation steps completed, could then be used to test different scenarios on the road and public transport networks. Scenario development was driven by an assessment of forecast conditions on the networks and consultation with Fingal, NTA, and TII. This process led to mitigation options being identified, and where relevant these were tested in the ERM to assess the impacts.

5.4 Conclusion

5.4.1 This report provides a general background to the main modelling resources and approaches undertaken for the South Fingal Transport Study. Further detail on model results is available within the individual reporting for each sub area as referenced above in Section 1.12.