

# REGIONAL MODELLING SYSTEM

## Modelling Services Framework

### South West Regional Model

Zone System Development Report – Tender Issue



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# CONTENTS

<b>Foreword</b> .....	<b>1</b>
<b>1 Introduction</b> .....	<b>2</b>
1.1 Regional Modelling System .....	2
1.2 Regional Modelling System Structure .....	3
1.3 Approach .....	7
1.4 Report Structure .....	7
<b>2 SWRM Zone System Development</b> .....	<b>8</b>
2.1 Introduction .....	8
2.2 SWRM Regional Zoning System Overview .....	8
2.3 Preparation Work .....	9
2.4 Zone Delineation .....	14
2.5 External Zones Refinement .....	22
2.6 First Pass Zone System .....	23
<b>3 SWRM Zone Development Review Process</b> .....	<b>24</b>
3.1 Overview .....	24
3.2 Road Network Development Team Review .....	24
3.3 NTA and Local Authority Final Review .....	24
3.4 Second Pass Zoning System .....	25
<b>4 SWRM Zone Area Review</b> .....	<b>27</b>
4.1 Introduction .....	27
4.2 Zone Disaggregation Criteria .....	28
4.3 Application of Disaggregation Criteria .....	29
4.4 Zone Area Analysis .....	29
4.5 Network Changes .....	30
<b>5 SWRM Sectoring and Numbering System</b> .....	<b>31</b>
5.1 ERM Guidance .....	31
5.2 Sectoring System .....	31
5.3 Hierarchical Zone and Node Numbering .....	34

5.4	Special zones .....	35
<b>6</b>	<b>SWRM Final Zone System .....</b>	<b>36</b>
6.1	Overall Figures .....	36
6.2	Zoning Analysis .....	37

## TABLES

Table 1.1	List of Regional Models.....	2
Table 2.1	CSAs disaggregated due to Physical Boundaries.....	15
Table 2.2	CSAs disaggregated based on incompatible land-uses.....	17
Table 3.1	Local Authority Changes to Zone System.....	25
Table 5.1	SWRM Sectors .....	31
Table 5.2	Sector, Zone and Node Numbering .....	34

## FIGURES

Figure 1.1	Regional Model Areas .....	3
Figure 1.2	National and Regional Model Structure .....	6
Figure 2.1	Overview of Zone Delineation Process.....	9
Figure 2.2	Map of Small Areas .....	11
Figure 2.3	SWRM zone location area .....	13
Figure 2.4	Example CSA Disaggregation .....	16
Figure 2.5	CSA Aggregation.....	18
Figure 2.6	Initial Zoning System .....	19
Figure 2.7	SWRM Zoning 1.0 – Number of Criteria Not Met.....	20
Figure 2.8	Cork City – Number of Criteria Not Met .....	21
Figure 2.9	Revised External Zones.....	23
Figure 3.1	Second Pass Zone System.....	26
Figure 4.1	SWRM Zoning v1.6 Zone Area .....	28
Figure 4.2	Example Zone Disaggregation.....	29
Figure 4.3	Zone Area Analysis.....	30
Figure 5.1	SWRM Sector System .....	33
Figure 6.1	Final SWRM Zone System.....	36
Figure 6.2	Final SWRM Zone system & My Plan data – Cork City .....	37

Figure 6.3 Final SWRM Zoning – Population distribution.....38

Figure 6.4 Final SWRM Zoning – Activity distribution .....39

Figure 6.5 Final SWRM Zoning – Different Land Use categories .....40

Figure 6.6 Final SWRM Zoning – Intrazonal trip ratio distribution.....41

Figure 6.7 Final SWRM Zoning – Number of indicators exceeded .....42

# Foreword

The NTA has developed a Regional Modelling System (RMS) for Ireland that allows for the appraisal of a wide range of potential future transport and land use alternatives. The RMS was developed as part of the Modelling Services Framework (MSF) by the National Transport Authority (NTA), SYSTRA and Jacobs Engineering Ireland.

The National Transport Authority's (NTA) Regional Modelling System comprises the National Demand Forecasting Model, five large-scale, technically complex, detailed and multi-modal regional transport models and a suite of Appraisal Modules covering the entire national transport network of Ireland. The five regional models are focussed on the travel-to-work areas of the major population centres in Ireland, i.e. Dublin, Cork, Galway, Limerick, and Waterford.

The development of the RMS followed a detailed scoping phase informed by NTA and wider stakeholder requirements. The rigorous consultation phase ensured a comprehensive understanding of available data sources and international best practice in regional transport model development.

The five discrete models within the RMS have been developed using a common framework, tied together with the National Demand Forecasting Model. This approach used repeatable methods; ensuring substantial efficiency gains; and, for the first time, delivering consistent model outputs across the five regions.

The RMS captures all day travel demand, thus enabling more accurate modelling of mode choice behaviour and increasingly complex travel patterns, especially in urban areas where traditional nine-to-five working is decreasing. Best practice, innovative approaches were applied to the RMS demand modelling modules including car ownership; parking constraint; demand pricing; and mode and destination choice. The RMS is therefore significantly more responsive to future changes in demographics, economic activity and planning interventions than traditional models.

The models are designed to be used in the assessment of transport policies and schemes that have a local, regional and national impact and they facilitate the assessment of proposed transport schemes at both macro and micro level and are a pre-requisite to creating effective transport strategies.

# 1 Introduction

## 1.1 Regional Modelling System

The NTA has developed a Regional Modelling System for the Republic of Ireland to assist in the appraisal of a wide range of potential future transport and land use options. The Regional Models (RM) are focused on the travel-to-work areas of the major population centres of Dublin, Cork, Galway, Limerick, and Waterford. The models were developed as part of the Modelling Services Framework by NTA, SYSTRA and Jacobs Engineering Ireland.

An overview of the 5 regional models is presented below in both Table 1.1 and Figure 1.1.

Table 1.1 List of Regional Models

Model Name	Standard Abbreviation	Counties
<b>West Regional Model</b>	WRM	Galway, Mayo, Roscommon, Sligo, Leitrim, Donegal
<b>East Regional Model</b>	ERM	Dublin, Wicklow, Kildare, Meath, Louth, Wexford, Carlow, Laois, Offaly, Westmeath, Longford, Cavan, Monaghan
<b>Mid-West Regional Model</b>	MWRM	Limerick, Clare, Tipperary North
<b>South East Regional Model</b>	SERM	Waterford, Wexford, Carlow, Tipperary South
<b>South West Regional Model</b>	SWRM	Cork and Kerry



Figure 1.1 Regional Model Areas

## 1.2 Regional Modelling System Structure

The Regional Modelling System is comprised of three main components, namely:

- The National Demand Forecasting Model (NDFM)
- 5 regional models; and
- A suite of Appraisal Modules

The modelling approach is consistent across each of the regional models. The general structure of the SWRM (and the other regional models) is shown below in Figure 1.2. The main stages of the regional modelling system are described below.

### 1.2.1 National Demand Forecasting Model (NDFM)

The NDFM is a single, national system that provides estimates of the total quantity of daily travel demand produced by and attracted to each of the 18,488 Census Small Areas. Trip generations and attractions are related to zonal attributes such as population, number of employees and other land-use data. See the NDFM Development Report for further information.

### 1.2.2 Regional Models (RM)

A regional model is comprised of the following key elements:

## Trip End Integration

The Trip End Integration module converts the 24 hour trip ends output by the NDFM into the appropriate zone system and time period disaggregation for use in the Full Demand Model (FDM)

## The Full Demand Model (FDM)

The FDM processes travel demand and outputs origin-destination travel matrices by mode and time period to the assignment models. The FDM and assignment models run iteratively until an equilibrium between travel demand and the cost of travel is achieved.

See the RMS Spec Full Demand Model Specification Report, RM Full Demand Model Development Report and SWRM Full Demand Model Calibration Report for further information.

## Assignment Models

The Road, Public Transport, and Active Modes assignment models receive the trip matrices produced by the FDM and assign them in their respective transport networks to determine route choice and the generalised cost for origin and destination pair.

The Road Model assigns FDM outputs (passenger cars) to the road network and includes capacity constraint, traffic signal delay and the impact of congestion. See the RM Spec Road Model Specification Report for further information.

The Public Transport Model assigns FDM outputs (person trips) to the PT network and includes the impact of capacity restraint, such as crowding on PT vehicles, on people's perceived cost of travel. The model includes public transport networks and services for all PT sub-modes that operate within the modelled area. See the RM Spec Public Transport Model Specification Report for further information.

## Secondary Analysis

The secondary analysis application can be used to extract and summarise model results from each of the regional models.

### 1.2.3 Appraisal Modules

The Appraisal Modules can be used on any of the regional models to assess the impacts of transport plans and schemes. The following impacts can be informed by model outputs (travel costs, demands and flows):

- Economy;
- Safety;
- Environmental;
- Health; and
- Accessibility and Social Inclusion.

Further information on each of the Appraisal Modules can be found in the following reports:

- Economic Module Specification Report;
- Safety Module Specification Report;
- Environmental Module Specification Report;
- Health Module Specification Report; and
- Accessibility and Social Inclusion Module Specification Report.

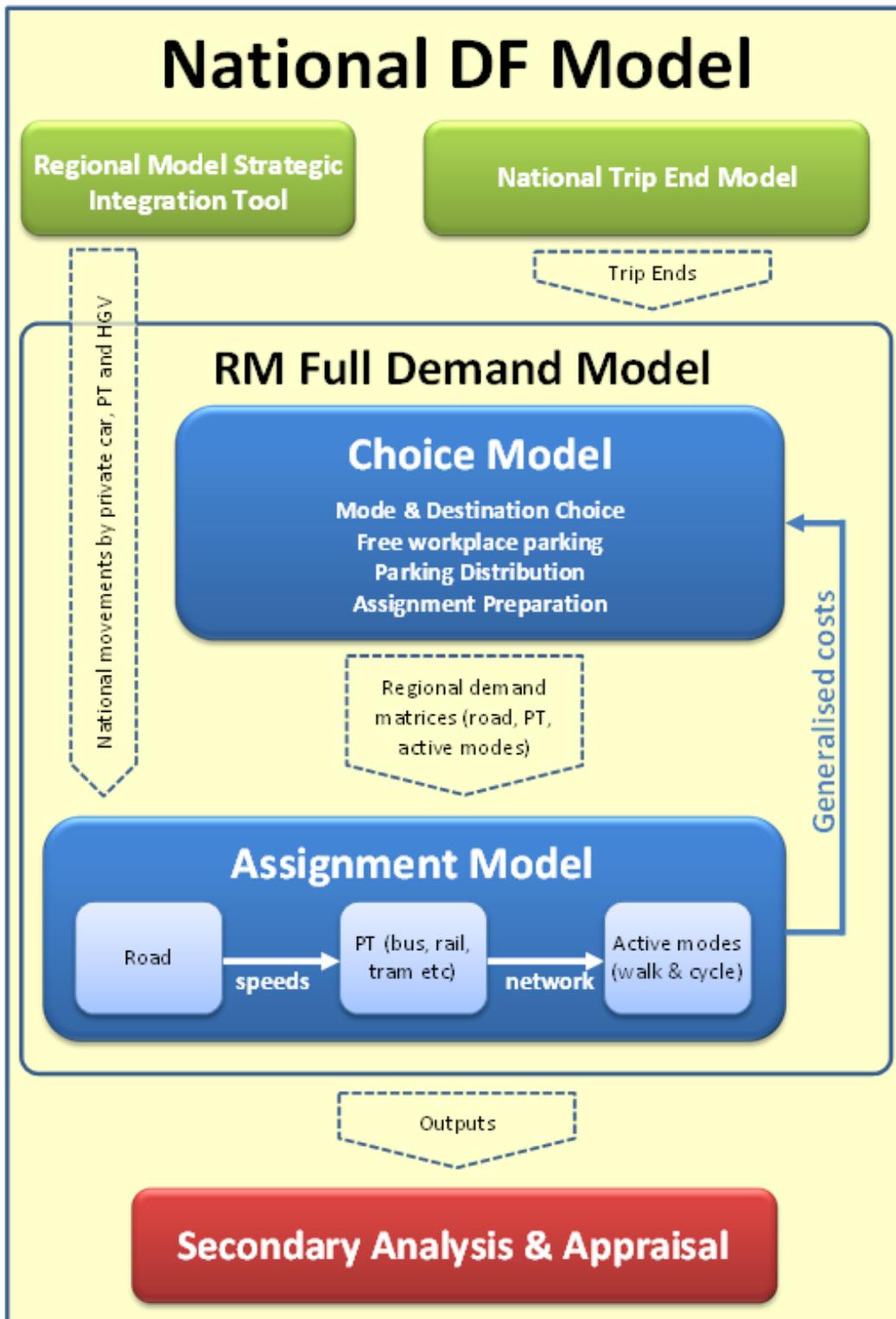


Figure 1.2 National and Regional Model Structure

## 1.3 Approach

The development of the SWRM has followed a 'Repeatable Methods' approach (developed for the ERM), which provides the methodology, guidance and techniques to develop the Regional Modelling System. The methods used for both road network and zone system development are based on earlier development work and emerging guidance undertaken for the ERM. The first pass of the SWRM zoning system was made without the finalised repeatable methods, however a final review was undertaken following completion of the repeatable method process.

For the majority of aspects to date, the zoning development has adopted the methodology as outlined in "ZN TN05 Guidance for Zoning Delineation Process". The document has been reviewed as part of the SWRM development programme with updates provided where gaps were identified or further detail was required.

## 1.4 Report Structure

This report focuses on the development of an appropriate Zone System for the South West Regional Model (SWRM) and includes the following chapters:

- **Chapter 2: SWRM Zone System Development:** This chapter provides information on the specification of the SWRM Zone System and an overview of its development;
- **Chapter 3: SWRM Zone Development Review Process:** This chapter details the review process carried out on the SWRM Zone System;
- **Chapter 4: SWRM Zone Area Review:** This chapter describes the specific review of zone areas;
- **Chapter 5: SWRM Sectoring and Numbering System:** Outlines the sectoring and hierarchical zone numbering system for the SWRM; and
- **Chapter 6: Error! Reference source not found.:** This chapter presents the final zoning system.

## 2 SWRM Zone System Development

### 2.1 Introduction

The zone system is used to segregate the modelled area into a number of disaggregate areas, enabling travel patterns to be separated and described in detail for each relevant origin-destination (OD) movement. The resultant travel demand associated with each zone is loaded onto or assigned to the modelled network using a series of zone centroid connectors.

The regional model zone delineation process aims to create a zone system which allows accurate modelling in the area concerned. The process, which has been established for all regional models, involves taking Census Small Areas, (the smallest spatial level at which data for building demand is available) and manipulating zone boundaries to create zones that take account of physical boundaries (motorways, rivers, etc.), and representative homogenous land use types and activity. This chapter outlines the process undertaken to develop the initial SWRM zone system.

### 2.2 SWRM Regional Zoning System Overview

The SWRM zoning process followed the steps described in the “ZN TN05 Guidance for Zoning Delineation Process”, with some updates being applied where appropriate. The methodology used for the SWRM was outlined in the Zone System Development Specification Report.

This process has been split into two main steps: Preparation Work and Zone Delineation. Within these steps the process is broken down into further sequences of sub-tasks. Figure 2.1 sets out the zone delineation process with arrows representing the chronological order of tasks. The process is iterative in order to achieve an acceptable balance between the various zone delineation conditions.

#### **Preparation Work**

Preparation Work comprises the following sub-tasks:

- Data Review;
- Collation and review of existing data sources;
- Model Area Definition;
- Review of the zonal detail included within previous regional models, the proposed level of model network detail and the potential applications of the completed model;
- Define Zones Criteria; and
- Definition of criteria used to aggregate/ disaggregate zones.

## Zone Delineation

Zone Delineation comprises the following sub-tasks:

- Small Area Disaggregation;
- Applying the disaggregation criteria to further disaggregate Small Areas if necessary;
- Aggregation in Zones;
- Applying the aggregation criteria to combine Small Areas into zones;
- Review Against Criteria; and
- Review of proposed zone system against criteria to check it meets the requirements.

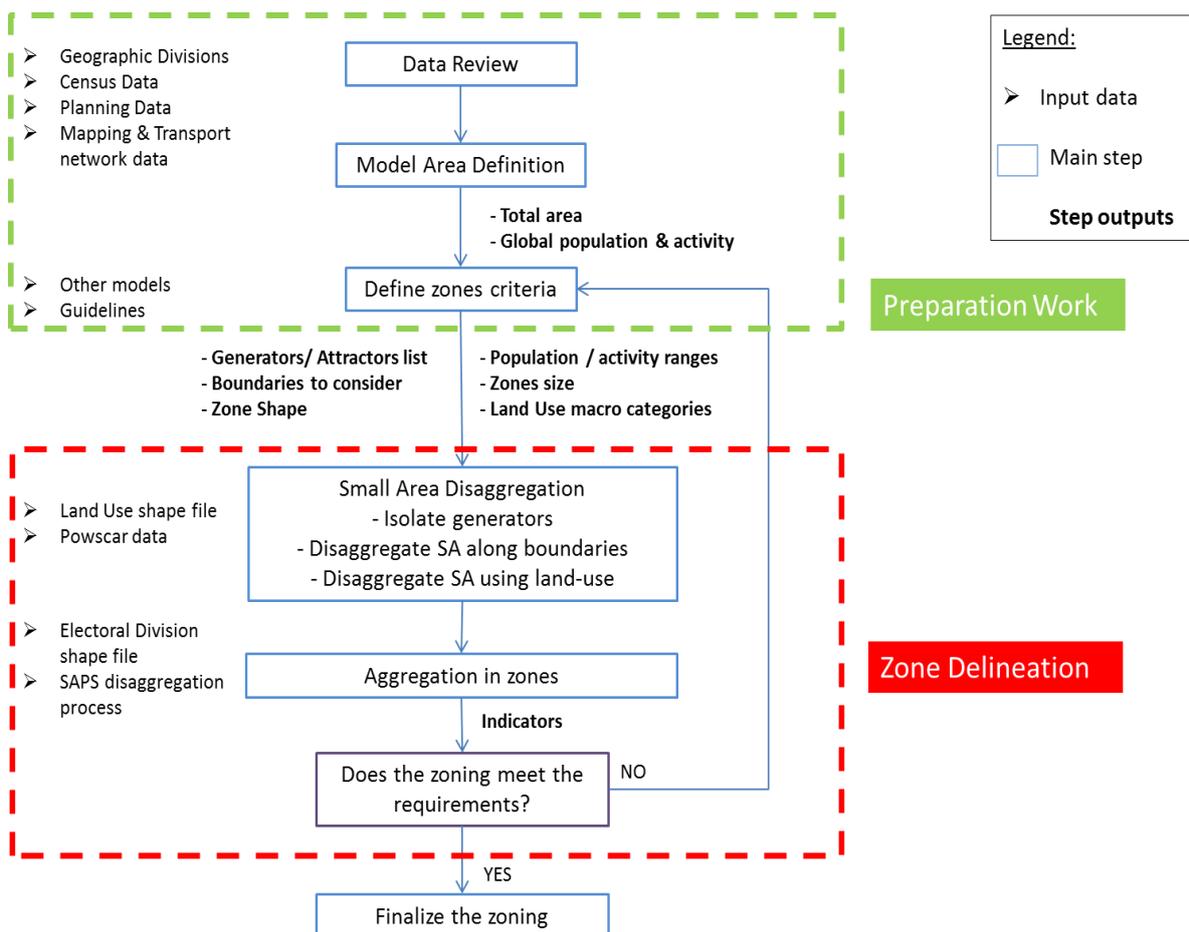


Figure 2.1 Overview of Zone Delineation Process

## 2.3 Preparation Work

### 2.3.1 Data Review

The Zone Delineation Guide identifies a number of zone characteristics, such as population and employment, which are correlated with travel activity levels. To understand the level of travel activity across the modelled area, the Small Area

Population Statistics (SAPS) database, that contains the population and administration data from the 2011 Census, was interrogated. This GIS shapefile was cross-referenced with the Place of Work, School or College Census of Anonymised Records (POWSCAR) travel data (both data sets based on the 2011 Census). This level of geocoded detail allows for each CSA to be assigned the following data:

- total population;
- number of trips (Work and Education) from the Small Area in the AM peak; and
- number of trips (Work and Education) to the Small Area in the AM peak.

This data was used to build a database of population and trip generation across the modelled area to compare activity levels. A map of the Small Areas is shown below in Figure 2.2.

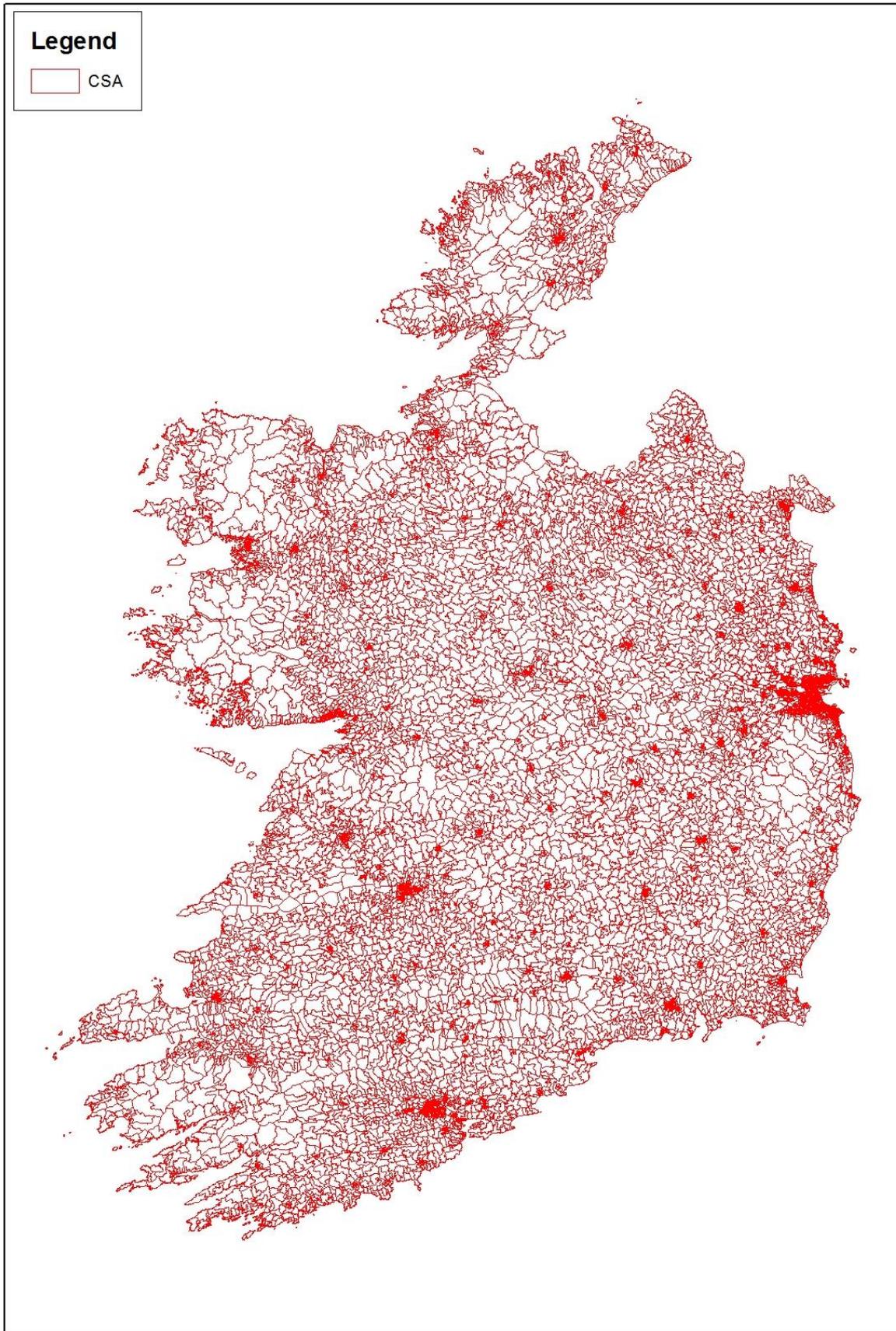


Figure 2.2 Map of Small Areas

In addition, in accordance with the Zone Delineation Guide, data from a number of other sources was extracted. This included:

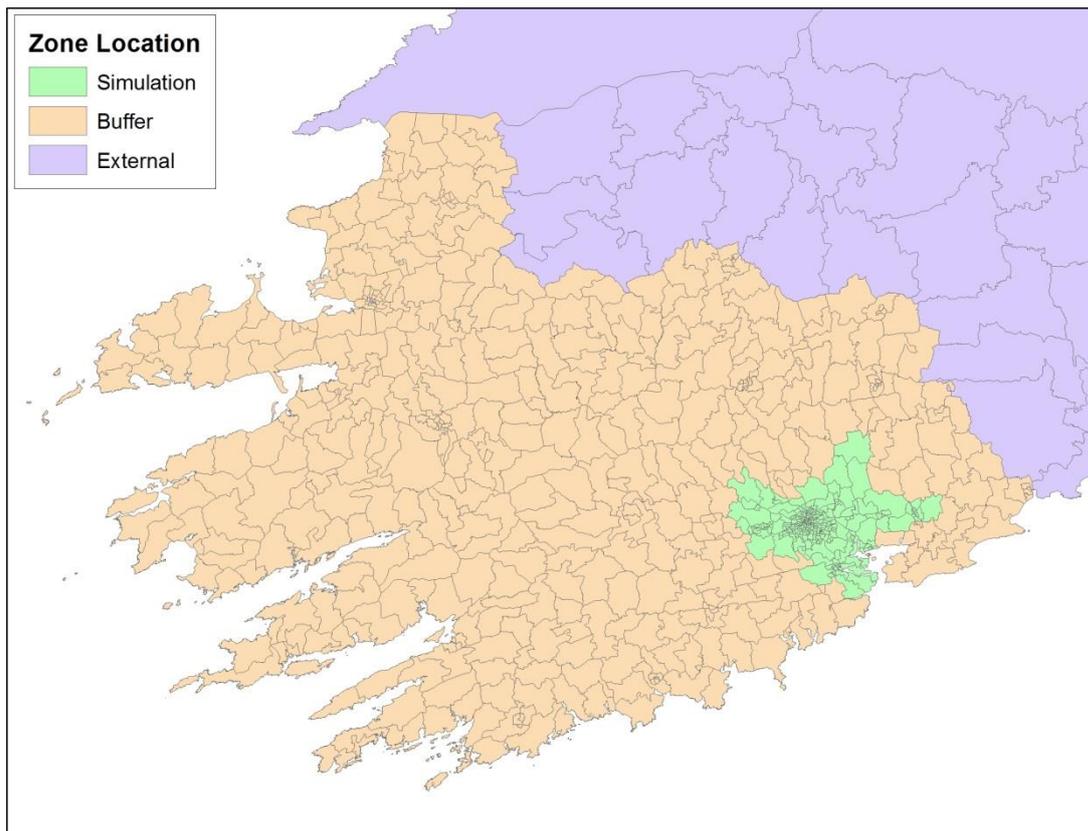
- **MyPlan data:** MyPlan is a database containing data relating to existing land use types in urban areas;
- **Geo Directory data:** Geo Directory is a database of addresses with geographic coordinates, each of which is categorised as either residential or commercial, with different addresses in the same building included;
- **Electoral Divisions;** and
- **Road and rail networks.**

### 2.3.2 Model Area Definition

The model boundary was defined as part of the Modelling Services Framework Model Scoping Task, shown below in Figure 2.3. Following on from the Data Review, the next step in developing the zone system was Model Area Definition.

The SWRM will be used to forecast changes in traffic levels and congestion on existing routes, appraise the benefits of proposed transport interventions and policies and predict the impact associated with land use development plans. These types of model application require a relatively detailed zone system and network to capture evidence relating to a wide range of potential impacts.

The SWRM model network is composed of a simulation area, which includes modelling of individual junction layouts, and a buffer network which contains less detailed junction coding. As the zones tend to be of similar level of activity, the zoning is more detailed in city/town centres than in rural areas. Figure 2.3 illustrates the simulation and buffer areas of the SWRM.



**Figure 2.3 SWRM zone location area**

Additionally, a review of existing models, planning information and spatial strategies was carried out to understand potential model applications. This included a review of the existing Cork Area Strategic Plan (CASP) Model and planning information provided by Cork City Council, Cork County Council and Kerry County Council.

### 2.3.3 Zone Criteria

The Zone Delineation Guide describes the range of conditions and thresholds to be taken into account when compiling a regional model zone system. This involves combining or segregating the individual CSAs into relevant zones. These conditions include:

- Trip Generators / Attractors:
  - Areas with an identified purpose and associated with a considerable level of travel activity/ trip movement (for example airports, universities, hospitals and shopping centres) should be isolated into separate zones representing specific travel patterns.
- Geographical Boundaries:
  - CSAs which intersected physical boundaries such as motorways, rivers and railways should be identified and disaggregated.
- Land use:

- Areas with similar land use characteristics should be consolidated where appropriate to aggregate similar travel purposes.
- Level of travel activity:
  - Zones should lie within and not intersect a District Electoral Division (DED)
  - Zone activity should be in the 500-2,000 range (total trip generation/ attractions during the morning period)
  - A zone should not contain more than two incompatible land-use categories (only categories over 15% of the zone area are considered for this)
  - Zone population should be below 2,000 people.

## 2.4 Zone Delineation

### 2.4.1 Small Area Disaggregation

Three criteria were used to identify CSAs to be disaggregated:

- Significant trip attractors;
- Geographical boundaries; and
- Incompatible land-uses.

#### ***Significant Trip Attractors***

Areas with an identified purpose and associated with a considerable level of travel activity / trip movement (for example airports, universities, hospitals, shopping centres) were isolated into separate zones representing specific travel patterns. Places considered as a generator / attractor were identified using POWSCAR to select CSAs which attracted more than 1,000 trips over a three hour morning period. A list of major hospitals, education places, shopping centres, employers and transport hubs (airports, railway stations) was also generated independently based on local knowledge.

A list of the generators / attractors that were isolated is given below:

- Transport
  - Cork Airport
- Third-level Education Institutions
  - Cork Institute of Technology
  - University College Cork
- Hospitals
  - Cork University Hospital
  - South Infirmary – Victoria Hospital, Cork
- Shopping Centres
  - Ballyvolane Shopping Centre
  - Blackpool Shopping Centre
  - Lough Shopping Centre
  - Mahon Point Shopping Centre
  - Wilton Shopping Centre
- Tourist Attractions
  - Elizabeth Fort
- Industrial Estates
  - Blackash Industrial Estate
  - Churchfield Industrial Estate
  - Hollymount Industrial Estate
  - South Cork Industrial Estate
  - Tivoli Industrial Estate
- Business Parks
  - IDA Cork Business and Technology Park
  - Mayfield Business Park
  - Model Business Park

## ***Geographical Boundaries***

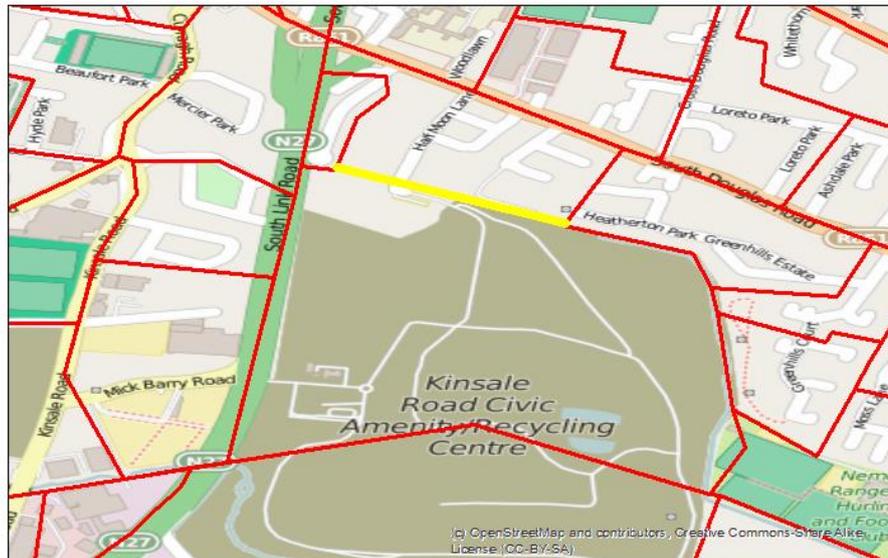
CSAs which intersected physical boundaries such as motorways, rivers and railways were identified and disaggregated. For the SWRM the boundaries considered are detailed in Table 2.1.

**Table 2.1 CSAs disaggregated due to Physical Boundaries**

<b>CSA</b>	<b>LOCATION</b>	<b>DISAGGREGATION</b>
<b>047064022</b>	Little Island	Split along railway line
<b>047235026</b>	Togher and Grange Industrial Estates	Split along South Ring Road (N40)
<b>047235027</b>	Blackash Industrial Estate	Split along N27
<b>048012009</b>	Granary Court, Blackpool	Split along N20

## Land Use

Areas with similar land use characteristics were consolidated where appropriate to aggregate similar travel purposes. Using the MyPlan land-use database, macro-categories of land-use were defined, with incompatible categories identified (e.g. industry and residential) and isolated into separate zones. For example, CSA 048070009 was divided into two to separate the residential area out from the Kinsale Road Civic Amenity / Recycling Centre, see Figure 2.4.



### Legend

- New SA Boundary
- Small Area

## Figure 2.4 Example CSA Disaggregation

The Geodirectory database (which provides locational data for residential & commercial buildings) was used to determine the appropriate split within zones where CSAs were required to be disaggregated.

The CSAs listed in Table 2.2 were disaggregated based on incompatible land-uses located in the same CSA.

Table 2.2 CSAs disaggregated based on incompatible land-uses

CSA	LOCATION	DISAGGREGATION
048018003	Cork City Centre	Separated industrial and residential
048018006	Cork City Centre	Separated residential and industrial
048037006	Shandon	Separated commercial and residential
048037007	Shandon	Separated commercial and residential
048043005	Blackrock	Separated commercial and residential
048054002	Cork City Centre	Separated residential and retail
048054007	Cork City Centre	Separated light industry and commercial
048070009	Turners Cross	Separated industry and residential

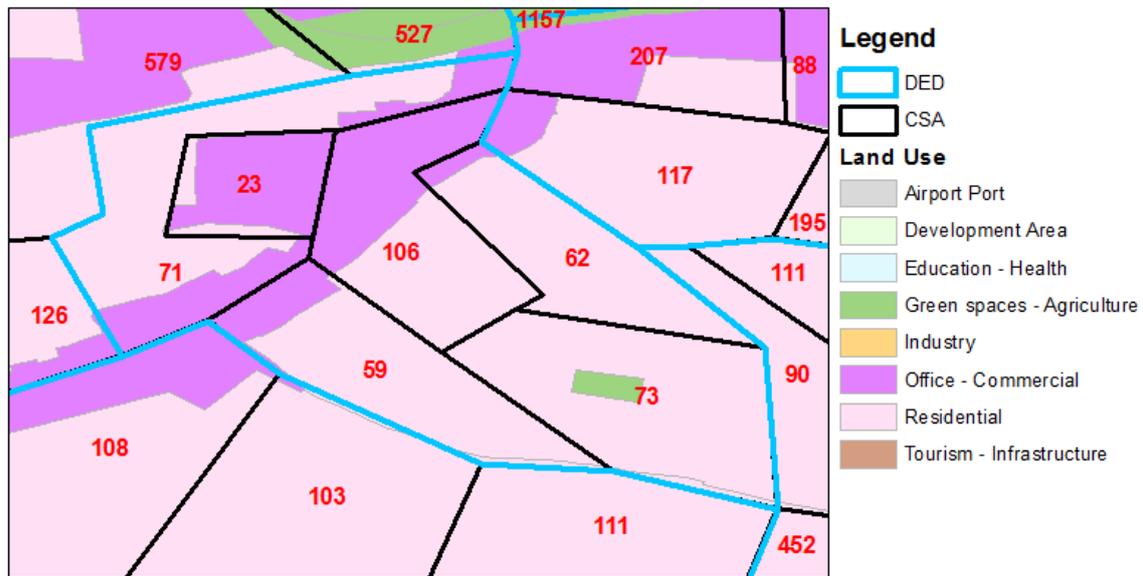
## 2.4.2 Zone Aggregation

Following the disaggregation of the CSAs, the remaining CSAs were aggregated based on the criteria outlined previously to a logical and detailed zoning system, with an optimal level of travel activity within each zone. This process followed the approach and criteria developed for the ERM, which included:

- Zones should lie within and not intersect a District Electoral Division;
- Zone activity should be in the 500-2,000 range (total trip generation / attractions during the morning period (0630-0930, Time of Departure, source POWSCAR);
- A zone shouldn't contain more than two incompatible land-use categories. Only categories over 15% of the zone area are considered for this; and
- Zone population should be below 2,000 people.

The application of the criteria was treated hierarchically on occasions when not all conditions could be met. On occasions when conditions were not met, specific zones have been highlighted for potential review during the travel demand modelling development phase. The uncertainty surrounding these zones mostly relates to the potential level of travel activity, which will be confirmed during matrix development phase, at which point there may be an opportunity to further aggregate or disaggregate zones.

An example of zone aggregation is illustrated in Figure 2.5. The total activity in this DED is 394, which is outside of the activity range of 500 – 2,000 identified in the criteria above for each zone (Criteria 2). However, these CSAs make up an entire DED, and zones should lie within a DED (Criteria 1). Applying the criteria hierarchically, these CSAs are combined into a single zone (with the same boundary as the DED). However, as this zone does not meet all of the criteria it is also flagged for further review.



## Figure 2.5 CSA Aggregation

The aggregation process resulted in an initial SWRM zone system (Version 1.0) with 531 zones, as shown in Figure 2.6 and outlined as follows:

- Cork City zones: 135;
- County Cork zones: 277;
- County Kerry zones: 88; and
- External zones (one per local authority outside of Cork and Kerry Counties): 31.

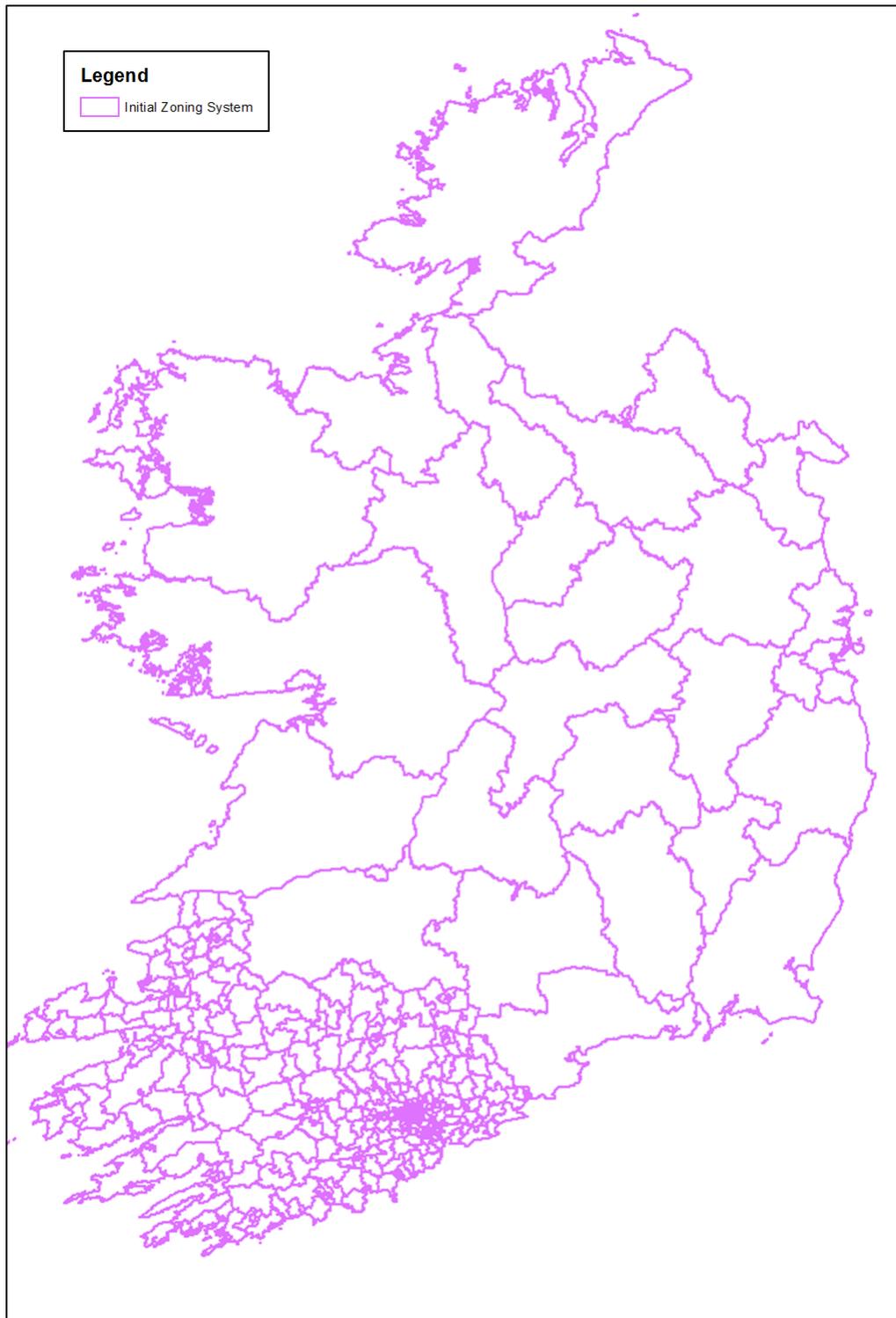


Figure 2.6 Initial Zoning System

### 2.4.3 Review against Criteria

After the development of the initial zone system, an internal review was carried out in line with the Zone Delineation Guide. This review was instigated by the

finalisation of the guide, using the ERM zoning experience to define the criteria. Five criteria were used to identify zones to be reviewed:

- Intrazonal trip ratio <5%;
- Number of key land use categories >2;
- Zone area smaller than 1 km<sup>2</sup>;
- Total POWSCAR trips production (all time periods) < 2,000; and
- Total POWSCAR trips attraction (all time periods) < 2,000.

The number of criteria not met was mapped (Figure 2.7 and Figure 2.8 below) and if at least two criteria were not met the zone was reviewed.

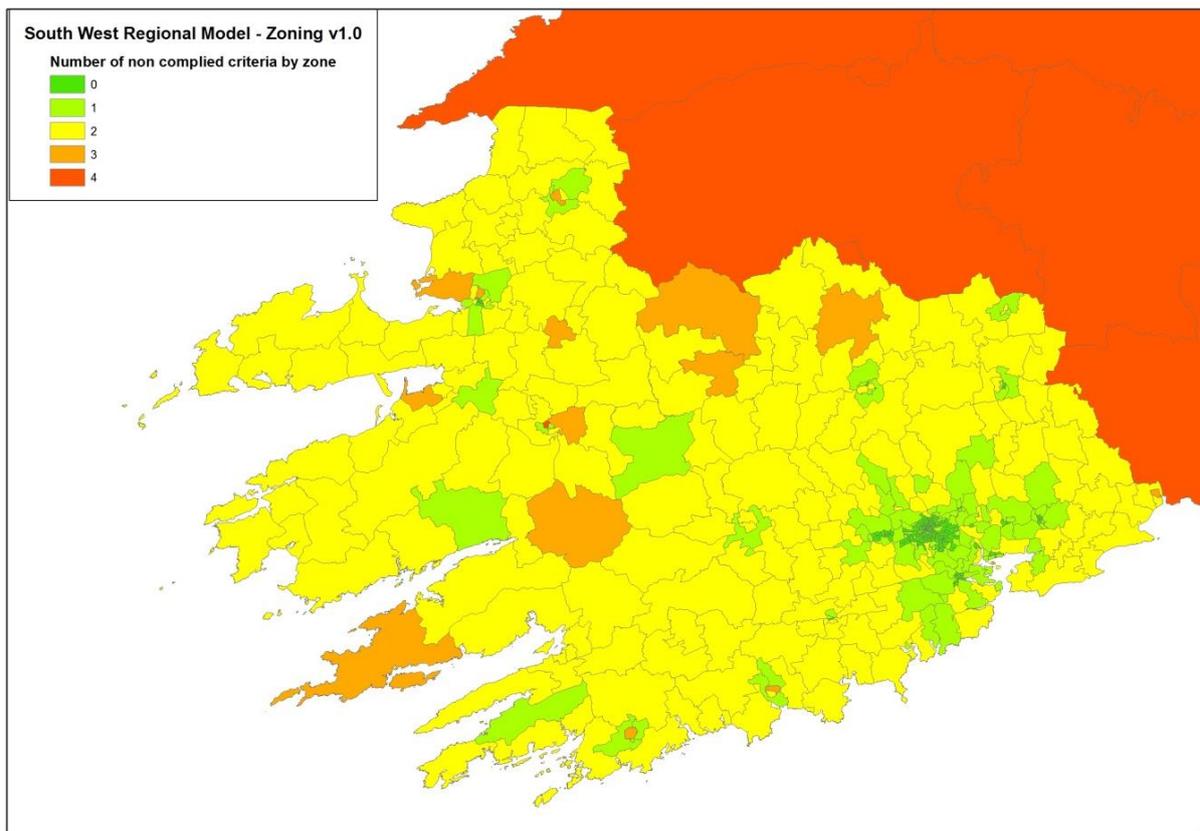
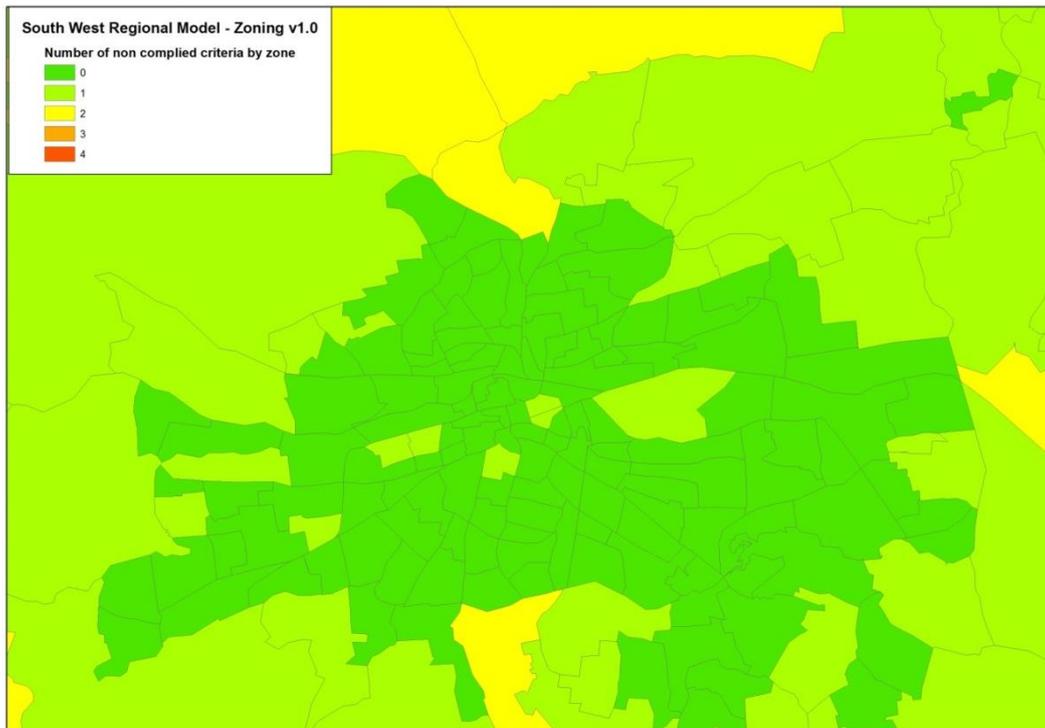


Figure 2.7 SWRM Zoning 1.0 – Number of Criteria Not Met



**Figure 2.8 Cork City – Number of Criteria Not Met**

In addition, a number of other checks were made, including reviewing the following town centres: Carrigaline, Cobh, Midleton, Mallow, Youghal, Bandon and Fermoy (Cork County); Tralee and Killarney (Kerry County). If a CSA has more than 1,500 POWSCAR work attractions or 1,000 POWSCAR school attractions it was also reviewed. CSAs along rail lines were also reviewed and split if necessary. Based on these reviews changes were made to a number of zones:

- Number of criteria not met:
  - new zones were created for Kanturk and Newmarket
- Town Centres:
  - the zone boundaries in Carrigaline, Cobh, Midleton, Bandon and Fermoy were revised; and
  - the zones in Mallow, Youghal, Tralee and Killarney were further disaggregated.
- POWSCAR work attractions:
  - the zone boundaries in Ballycurreen, Frankfield and Grange; Little Island were revised;
  - the Cork Airport zone was further disaggregated (separating out Cork Airport Business Park); and
  - the Cordal, Tralee (South West), Tralee Business Park, Little Island Industrial Estate and Blackpool Shopping Centre zones were further disaggregated.
- POWSCAR School Attractions
  - the zone boundaries in Skibbereen and Bantry and for the Cork Institute of Technology were revised

- Railway Lines
  - the zone boundaries in Little Island were revised to align them with the railway line; and
  - the IDA Industrial Estate zone has been disaggregated into two zones along the rail line.

## 2.5 External Zones Refinement

Based on emerging guidance from the ERM, the external zones were also revised at this time, as it was considered that having 31 external zones (one for every local authority outside of Cork and Kerry) was too disaggregate. A skeletal representation of the main corridors was created, with external demand loaded onto this network using centroid connectors with representative distances and speeds, connected to an appropriate motorway or national road corridor node at the edge of the model road network.

The initial external zones within the SWRM have been refined at the edge of the buffer area within Limerick, Waterford and Tipperary to more accurately reflect demand loading points. Beyond this, the zones for the rest of Ireland have been aggregated to create three large external zones (External West, External North East and External South East). These zones have then been connected to the most appropriate strategic road network corridor, i.e. the M7/M8, N20 or N25. This is shown in Figure 2.9 below.

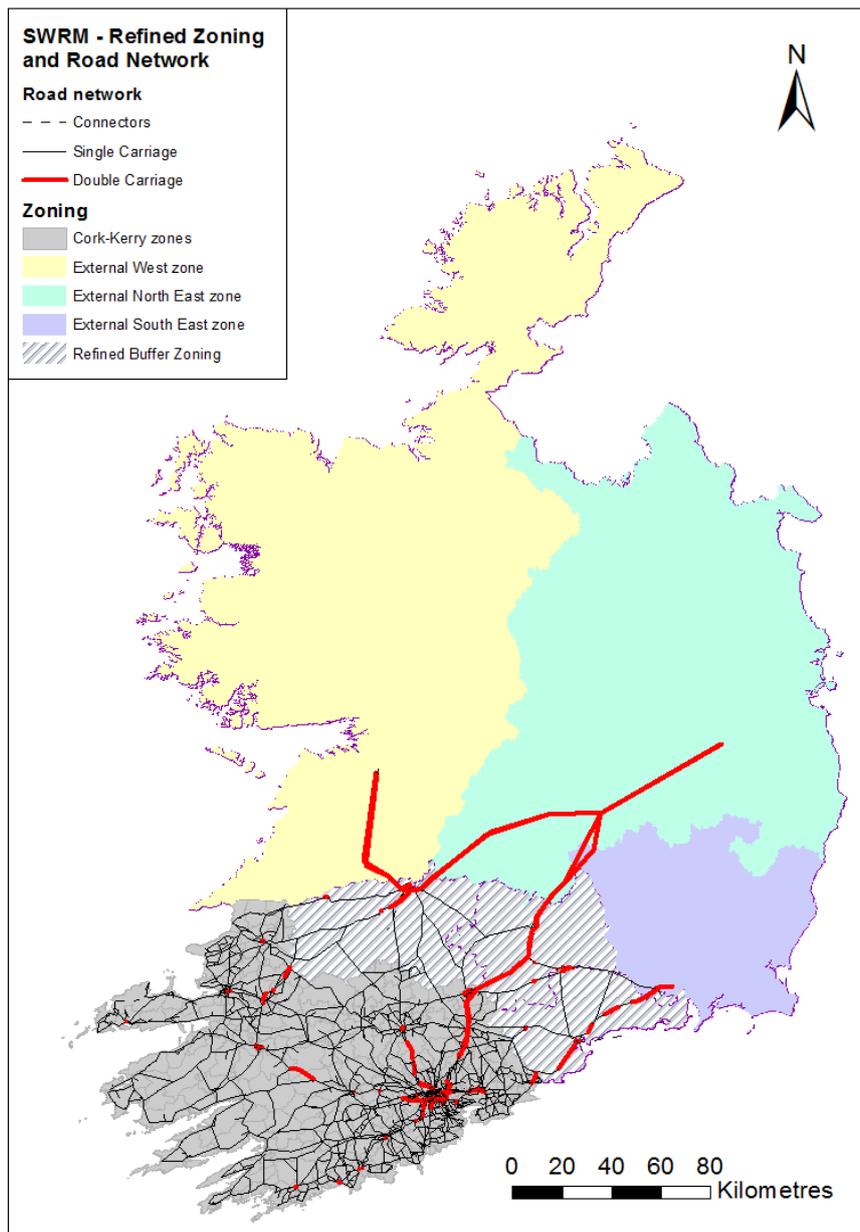


Figure 2.9 Revised External Zones

## 2.6 First Pass Zone System

The application of all of the process outlined above resulted in the 'First Pass' SWRM zone system (Version 1.4). This zone system had 648 zones in total:

- Cork City zones: 133;
- County Cork zones: 351;
- County Kerry zones: 134; and
- External zones: 30.

This zone system was then passed to the NTA and the Local Authorities in the SWRM area for review.

## 3 SWRM Zone Development Review Process

### 3.1 Overview

A first version of the zoning, following the aggregation process, was sent to the Road Network Development team, the NTA and the relevant Local Authorities for review. The purpose of this step is to improve the initial zone system with respect to network and land use configuration whilst taking into account each of the previously discussed zone criteria.

### 3.2 Road Network Development Team Review

The SWRM road network, which was developed separately and in parallel with the zoning system, is linked to the zone system via zone centroids and their connectors. Zone centroids can be defined in the road network, once a first version of the zoning is available. Centroids can be defined as geographical centres of a zone boundary. Zone centroid access (e.g. connectors) was defined using the road development method, which is detailed in Road Model Specification Report. That task (and preliminary assignment tests) raised issues that indicated some changes were required in the initial zoning system. Below are examples of the type of issues that were identified and how they were addressed:

Issue	Solution
<b>Several actual accesses to a large zone</b>	Zone disaggregated further to represent each main access point
<b>Network locally overloaded due to link capacity limitation where a zone is connected</b>	Zone disaggregated further if activity level allows it, modification to the access point if not
<b>No road network coded within the zone (externals)</b>	External zones have been redefined to represent “corridor access” to the simulation area

### 3.3 NTA and Local Authority Final Review

The NTA, Cork and Kerry Local Authorities were provided with the updated zone system as a GIS shapefile with an associated spreadsheet, as per the ERM zone system review format, and asked to review the zoning based on their local knowledge of the area and any future planning requirements. An information note SWRM Zone System Development Report was also supplied. A number of

suggestions and amendments were made, which were incorporated into the final zone system as detailed in Table 3.1.

**Table 3.1 Local Authority Changes to Zone System**

<b>ZONE NUMBER (v1.4 ZONE SYSTEM)</b>	<b>LOCATION</b>	<b>CHANGE</b>
<b>3</b>	Cork City Centre	Boundary re-drawn to include entrance to Kyrl's Quay Car Park
<b>13</b>	Cork City Centre	Zone disaggregated into two zones to avoid an excessive amount of traffic loading onto Monerea Terrace
<b>34</b>	South Docklands (Cork)	Zone disaggregated into four zones to accommodate potential future development
<b>100</b>	Mahon	Zone disaggregated into two zones to accommodate potential future residential development outlines in Mahon Local Area Plan
<b>153</b>	Killard	Split into four zones to accommodate potential future social housing development
<b>470, 495, 779</b>	Castleisland Town	Zone boundaries re-drawn to create a separate zone for the town (but still retaining three zones overall)
<b>475</b>	Tralee	Zone disaggregated into two zones to accommodate proposed expansion of Institute of Technology Tralee and racecourse
<b>882</b>	Killarney	Zone disaggregated into two zones to accommodate possible development at Liebherr Plant

## 3.4 Second Pass Zoning System

Following the review process outlined above, the Second pass zoning system (v1.6) was produced. This system is shown in Figure 3.1 and has 675 zones, broken down as follows:

- Cork City zones: 148;
- County Cork zones: 362;
- County Kerry zones: 134;
- County Limerick zones: 11;
- Waterford zones: 8;
- South Tipperary zones: 7; and
- External zones: 5.

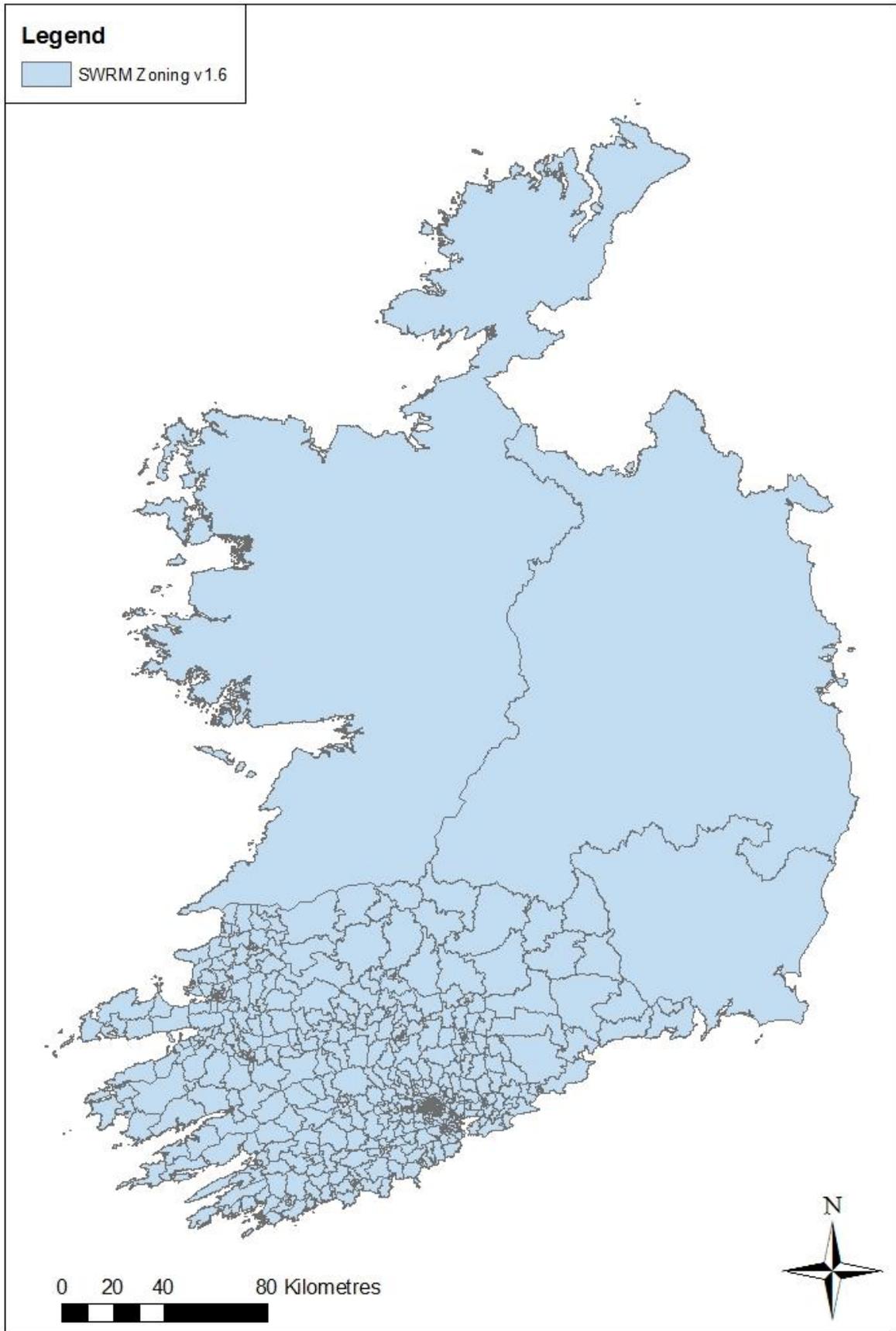


Figure 3.1 Second Pass Zone System

## 4 SWRM Zone Area Review

### 4.1 Introduction

Emerging guidance from the development of ERM and tests carried out on the SWRM using the Second Pass Zoning System identified an issue relating to the area of some of the zones and the representation of active modes in the Regional Models. Application of the aggregation criteria outlined in Section 2.4 resulted in some large zones in rural areas (where there were low levels of activity). This can be seen in Figure 4.1 where significant parts of rural County Cork and County Kerry have zone areas greater than 75 square km.

In the initial PT assignment, the length of the public transport walk connector was taken to be proportional to the area of the zone (it was taken to be  $\frac{2}{3}$  of the radius of the zone, with the assumption that each zone was a perfect circle). This resulted in long walk connectors, and hence a high PT access cost, for some zones, which impacted on the calibration of the FDM. It also led to the over estimation of intra-zonal walking and cycling trips, with the error in the proportion of these trips proportional to the length of the centroid connector.

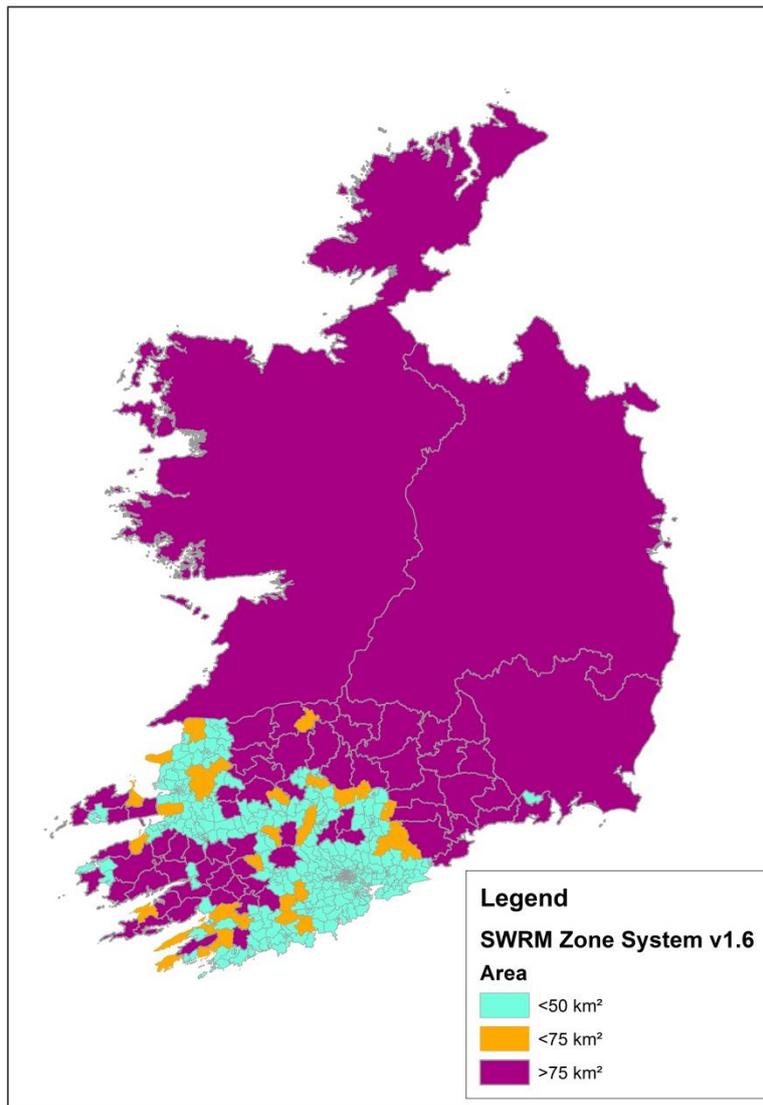


Figure 4.1 SWRM Zoning v1.6 Zone Area

## 4.2 Zone Disaggregation Criteria

If a zone had a walk connector longer than 3km then it was flagged for review, with zones being disaggregated to create a system with the majority of zones aiming for the following target attributes where possible:

- Zone activity target of 2,000.
- Zone population max target of 5,000
- Zone size below 70km<sup>2</sup>

The application of the targets was on a case-by-case basis, so that some zones' attributes remain above the thresholds, but the overall system is much more disaggregate.

## 4.3 Application of Disaggregation Criteria

For each zone that was flagged for review the population density of each of the CSAs making up the zone was displayed on a map. If there was an area that was more densely populated (usually a small town or village) this was separated into a new zone, and the surrounding more rural area left as a separate zone. For example, the map below shows the original zone boundaries in black. The blue shading shows the population density in each of the CSAs making up the zone; the darker the blue the higher the population density. The area to the north east of the zone is more densely populated than the rest of the zone, so this was separated into a new zone (highlighted by the red line) keeping the boundaries of the CSAs intact.

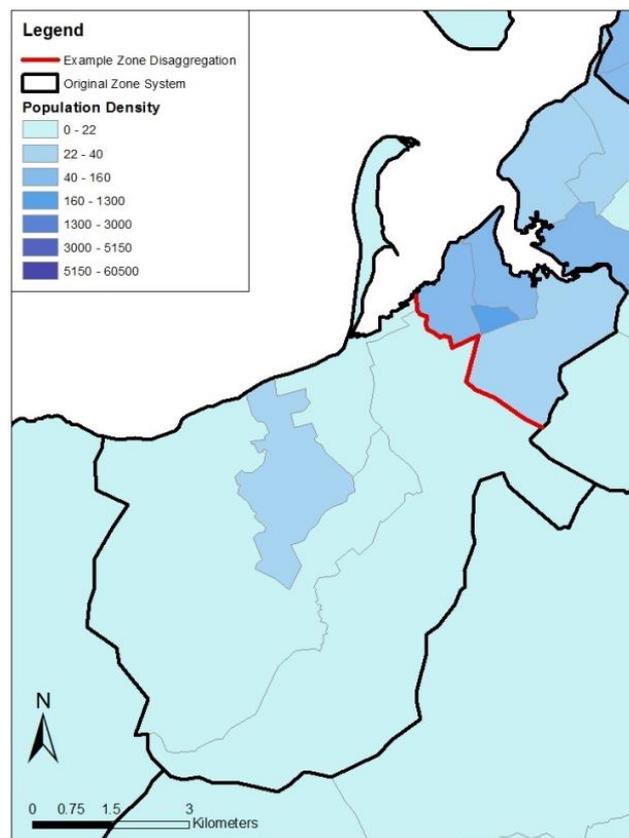


Figure 4.2 Example Zone Disaggregation

This had a small impact on public transport costs (as described in Section 3.4.1 of SWRM Public Transport Model Development Report) but improved the representation of intra-zonal trips, with the proportion of these decreasing from 16% to 12%.

## 4.4 Zone Area Analysis

Figure 4.3 shows a comparison of the zone areas before and after disaggregation. (Note that this does not show zones with an area less than 1km<sup>2</sup> as this that

represents approximately 30% of zones and skews the plot area. As these small zones are within urban areas where the activity levels are sufficiently high to warrant them they were largely unaffected by the disaggregation.) There is a significant reduction in proportion of zones with areas between 50 and 200km<sup>2</sup>, with an associated increase in zones between 15 and 50km<sup>2</sup>. Zones larger than 200 km<sup>2</sup> are all external zones and hence were unaffected by the disaggregation.

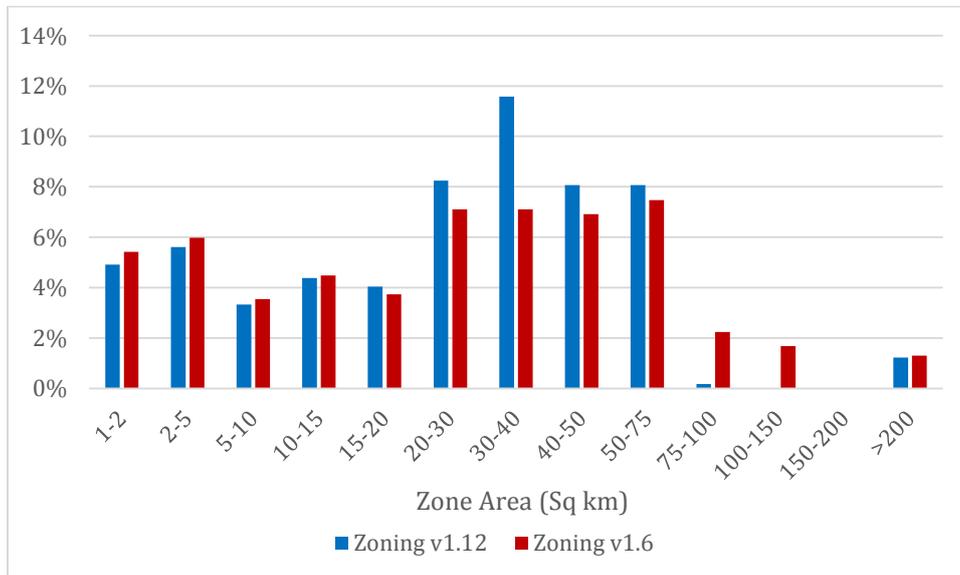


Figure 4.3 Zone Area Analysis

## 4.5 Network Changes

In addition to the zone disaggregation, weighted zone centroids were also introduced based on the highest concentration of population and jobs in a zone. This more accurately reflects the generalised cost of trips to/ from zones where there was a small town or village in a large rural zone. More detail on the methodology employed for this and the impact is given in SWRM Public Transport Model Development Report. The length of centroid connectors was also capped at 500m. Both of these measures further improved the representation of PT and active modes trips.

# 5 SWRM Sectoring and Numbering System

## 5.1 ERM Guidance

As set out in the ERM Guidance “ZN TN07 GDA Sectoring System Information Note”, a sector system has been developed for the SWRM. This sector system is presented below, and is used to define a hierarchical zone and node numbering system. It also facilitates the analysis of the demand and travel patterns at a more aggregated level.

## 5.2 Sectoring System

A number of resources have been used in the development of the sectoring system, including:

- the finalised zone boundaries of the SWRM;
- key geographical features, notably motorways, rail lines and the River Lee;
- county boundaries; and
- a 19-settlement type classification system provided by the NTA.

In total, sixteen sectors have been developed for the SWRM. These are listed in the table below and are also shown on the following map.

Table 5.1 SWRM Sectors

SECTOR	NAME
1	Cork City Centre
2	Cork City - North West
3	Cork City - North East
4	Cork City - South East and Mahon
5	Cork City - South
6	Cork City - University and South West
7	Cork City - West and Ballincollig
8	Blarney and Tower
9	Cork City Outer North and Glanmire
10	Little Island
11	Douglas and Rochestown
12	Cork City South Outer and Airport
13	Commuter Satellite Towns
14	Regional Towns
15	Regional Cities



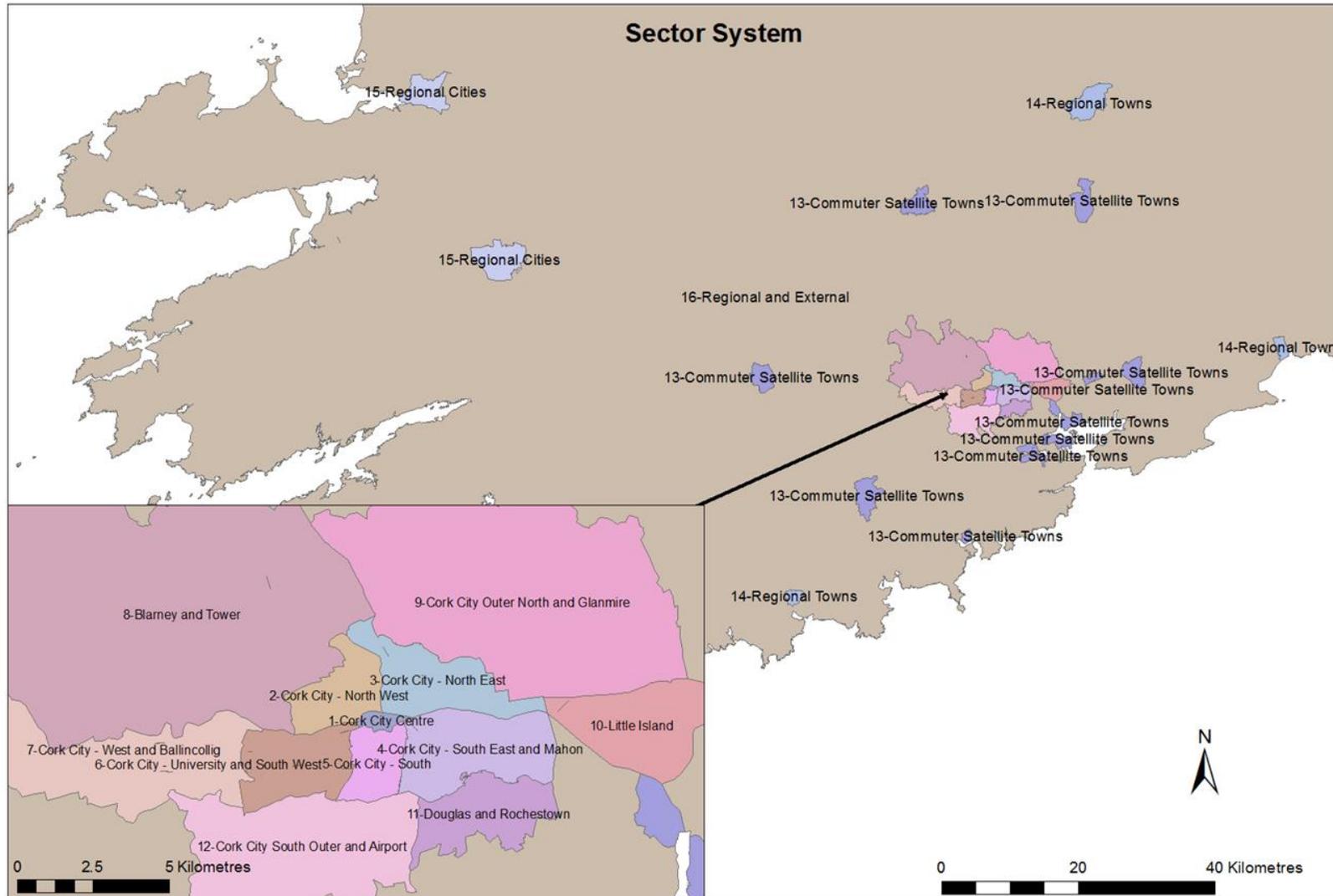


Figure 5.1 SWRM Sector System

## 5.3 Hierarchical Zone and Node Numbering

The “ZN TN07 GDA Sectoring System Information Note” also contains guidance on zone numbering for the regional models. A hierarchical system was adopted, with zones in the SWRM renumbered based on the sector in which they are contained. This numbering system will be consistent across the suite of regional models, ensuring that independent sector, zone and node numbers are available for each of the models whilst remaining within the 5-digit (99,999) number limit within the SATURN software.

SWRM has been given an allocation of 500 zone and node numbers per sector, with the exception of Sector 13 (Commuter Satellite Towns), which has been allocated 1000 zone and node numbers. The first 50 numbers of each sector (100 in the case of Sector 13) have been reserved for zone numbering, and the remaining numbers reserved for node numbering.

Table 5.2 below details the zone and node numbering for the SWRM. The zone and node number ranges correspond to the sector name, i.e. the sector name will match the first three digits of the first zone number in the range. For example, zone and node numbers for Sector 410 will range from 41000 to 41499.

Each model will have a sector for undefined areas (like sector 1000 in ERM). For SWRM this will be sector 2000 which will be given an allocation of 4000 zone and node numbers.

Table 5.2 Sector, Zone and Node Numbering

SECTOR	RANGE	ZONES	NODES
410	500	41000-41049	41050-41499
415	500	41500-41549	41550-41999
420	500	42000-42049	42050-42499
425	500	42500-42549	42550-42999
430	500	43000-43049	43050-43499
435	500	43500-43549	43550-43999
440	500	44000-44049	44050-44499
445	500	44500-44549	44550-44999
450	500	45000-45049	45050-45499
455	500	45500-45549	45550-45999
460	500	46000-46049	46050-46499
465	500	46500-46549	46550-46999
470	1000	47000-47099	47100-47999
480	500	48000-48049	48050-48099
485	500	48500-48549	48550-48599

<b>2000</b>	4000	49000-49099	49100-52999
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## 5.4 Special zones

Transport infrastructures where passengers travel from/to foreign destinations (such as airports or ports) can generate and attract a large number of trips. People that are working at these places are considered in the “regular” demand model as both origins and destinations are within the model area. Trips made by the travellers have a part of their journey outside the model area and a part made within the model area. These trips have then to be considered separately in the model and transport demand for these hubs is modelled differently from the rest of the zones.

In the SWRM, four special zones are considered:

- Cork airport;
- Port of Cork – City Quays;
- Port of Cork – Ringaskiddy; and
- Port of Cork – Tivoli.

## 6 SWRM Final Zone System

### 6.1 Overall Figures

The final SWRM zone system (v2.0) is shown in Figure 6.1. It has 792 zones as follows:

- Cork City zones: 148;
- County Cork zones: 421;
- County Kerry zones: 188;
- County Limerick zones: 11;
- Waterford zones: 8;
- South Tipperary zones: 7;
- External zones: 5; and
- Special zones: 4.

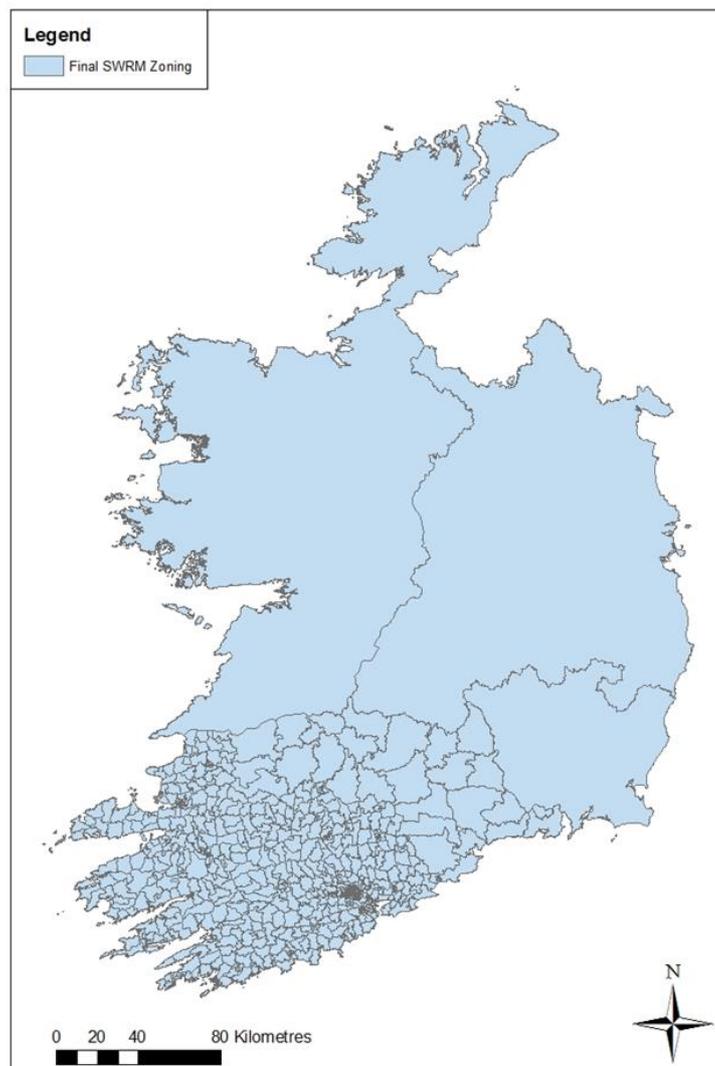


Figure 6.1 Final SWRM Zone System

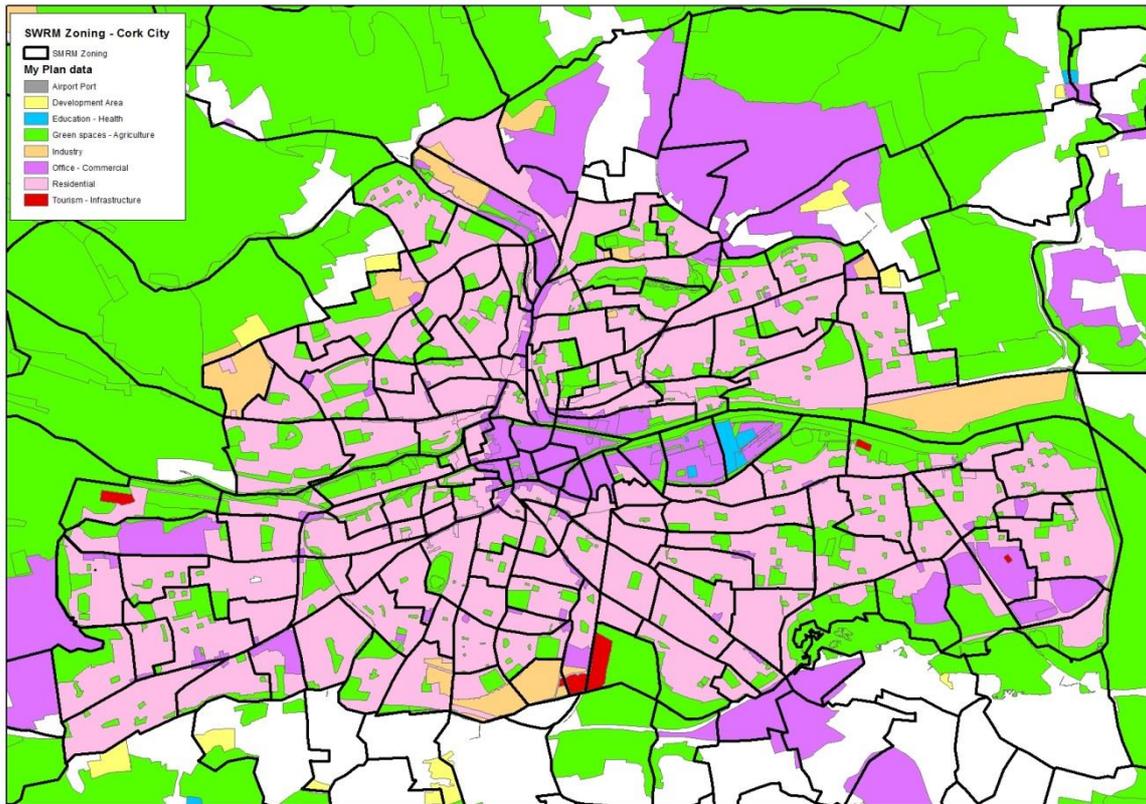


Figure 6.2 Final SWRM Zone system & My Plan data – Cork City

## 6.2 Zoning Analysis

Along with the GIS shapefiles of the zone system, an analysis spreadsheet is produced to check that the zoning is acceptable and meets the criteria defined in the repeatable method process.

The following criteria have been applied across the final zone system to appraise its quality, and to compare it with the other Regional Model zone systems:

- **Population** below 3,000;
- **Activity** between 500 and 2,000 trips;
- Less than 2 different **land use categories**; and
- **Intrazonal trip ratio** below 5%.

## 6.2.1 Population

The population distribution for the SWRM zone system is illustrated in Figure 6.3, and is calculated using the Census Small Area data. In the SWRM, there are no zones (except externals) which have a population that exceeded the 3,000 threshold criteria.

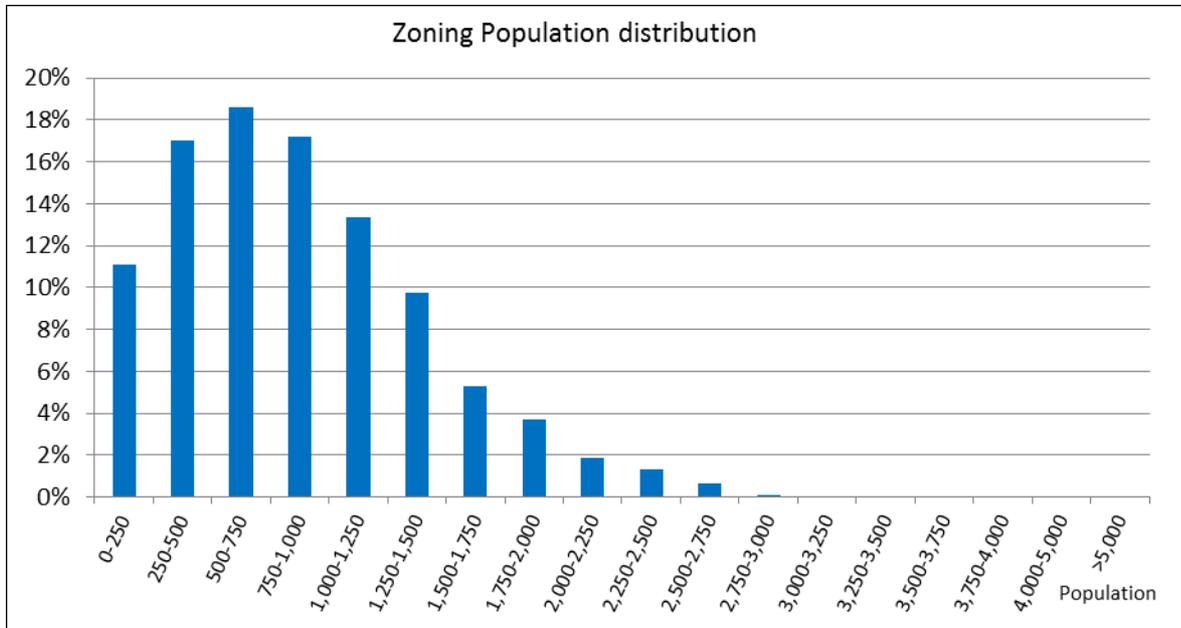


Figure 6.3 Final SWRM Zoning – Population distribution

## 6.2.2 Activity

Activity is defined at the zonal level as the sum of trip productions and attractions. It is calculated at the zoning development stage and is derived from the POWSCAR 2011 database, for all modes and all time periods. This indicator provides a useful mechanism to compare zones of different types, i.e. residential zones (which are mostly trip producers in the POWSCAR database) and employment zones (which are mostly trip attractors).

The target activity range, defined by the repeatable method process, is 500 to 2,000 trips. The activity distribution for the final SWRM zone system is shown in Figure 6.4, overleaf. Approximately 25% of the zones within the SWRM have an activity level below the specified minimum threshold of 500 trips. This is acceptable due to the fact that these zones are mostly located in rural areas, and aggregating them to meet this criterion would have led to very large zones.

6% of the SWRM zones have an activity level above the maximum threshold of 2,000 trips, and these represent large attractors (e.g. industrial estates, education and commercial areas).

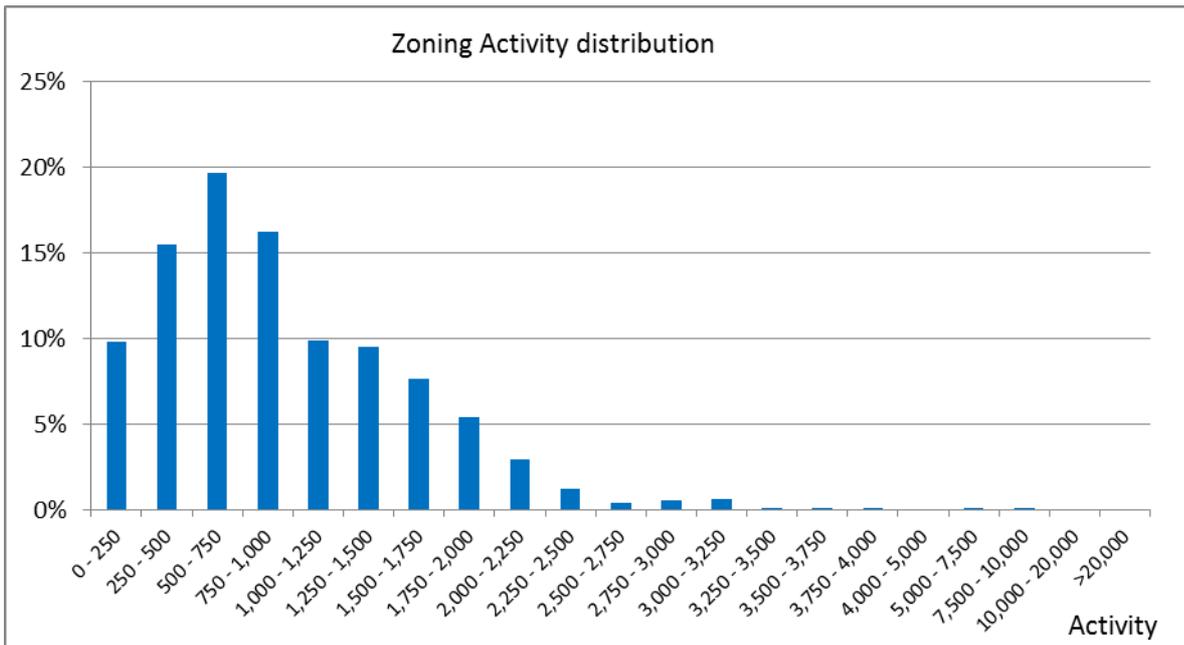


Figure 6.4 Final SWRM Zoning – Activity distribution

### 6.2.3 Land Use Categories

Having homogeneous zones from a land use point of view is important as these areas will then exhibit similar travel purposes. As detailed earlier in this report, MyPlan data has been used to separate (where possible) areas with different land use. Figure 6.5, overleaf, provides an overview of the number of different land use categories within zones in the SWRM. It should be noted that MyPlan data was unavailable for approximately 50% of the zones within the SWRM. The results in Figure 6.5 indicate that only 9% of SWRM zones contain more than a single land use category.

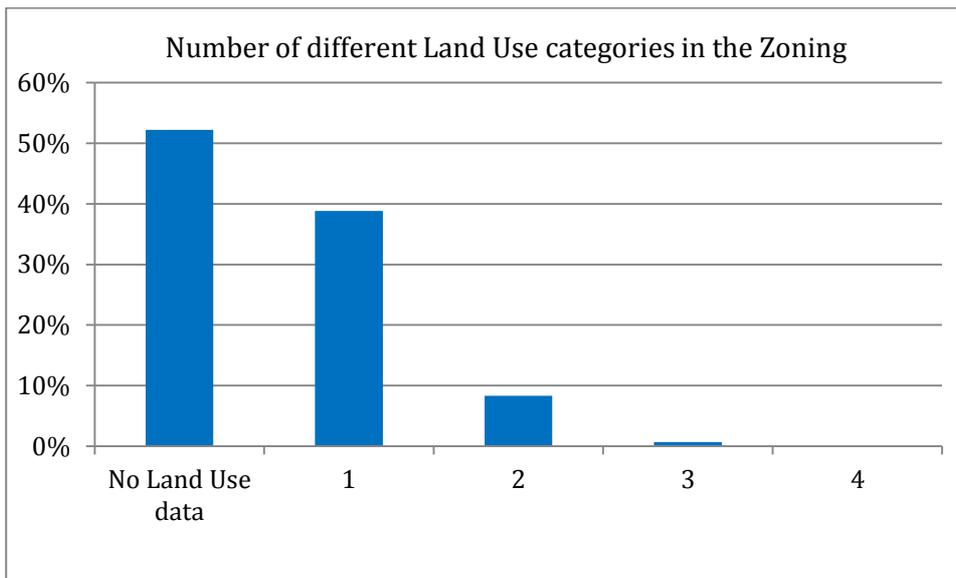


Figure 6.5 Final SWRM Zoning – Different Land Use categories

#### 6.2.4 Intrazonal Trip Ratio

The Intrazonal Trip Ratio is calculated as the ratio of trips that remain within a zone (intrazonal trips) over the sum of trips arriving and leaving the zone. This has been calculated for all zones within the SWRM and measures the level of detail of the zone system. A high intrazonal trip ratio means that a large number of trips are not loaded on to the modelled network as they are made within the zone.

In the SWRM zone system, 58% of zones have an intrazonal trip ratio below the threshold criteria of 5%, and no zone has a ratio of above 30%. Zones with higher intrazonal trip ratios are mostly large in size with low activity levels. Further disaggregation of these zones to meet the intrazonal trip ratio criteria would have a negative impact on the minimum activity threshold of 500 trips outlined previously.

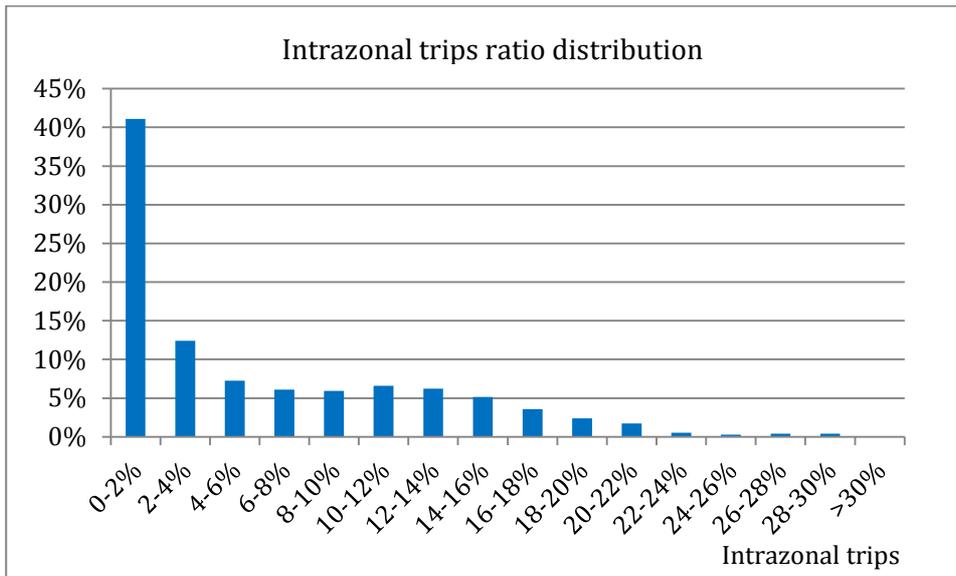


Figure 6.6 Final SWRM Zoning – Intrazonal trip ratio distribution

## 6.2.5 Summary

The previous sections of this chapter outline the criteria utilised to appraise the quality of the SWRM zone system. Figure 6.7, overleaf, illustrates the proportion of SWRM zones which meet each of these criteria thresholds. The analysis indicates that:

- 38% of zones meet all the criteria;
- 49% of the zones fail one criterion;
- 13% fail two criteria; and
- No zone fails more than two criteria.

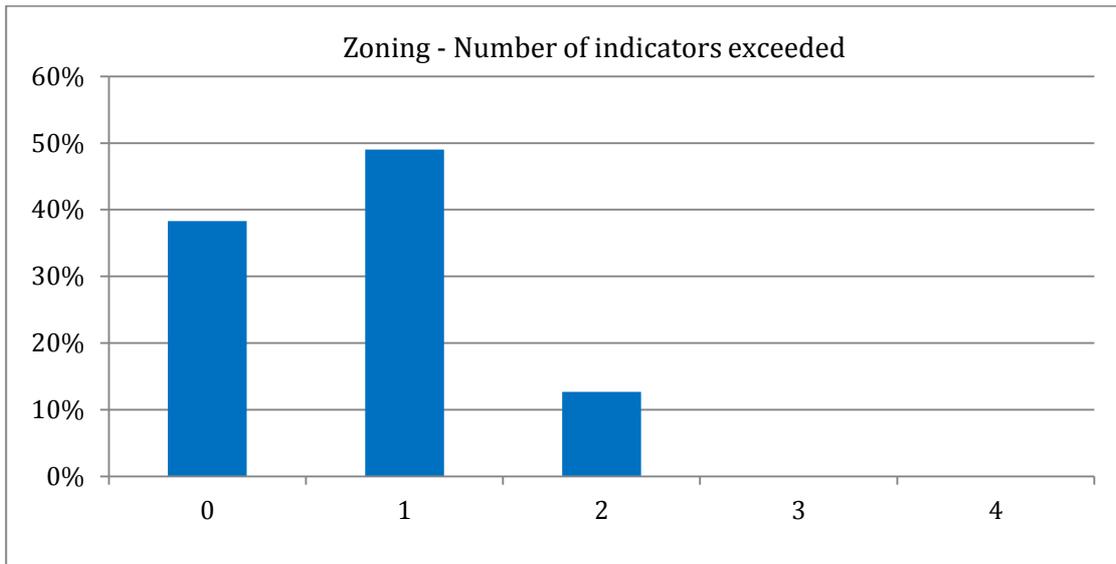


Figure 6.7 Final SWRM Zoning – Number of indicators exceeded



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